Perspectives on Development in the Middle East and North Africa (MENA) Region

Manfred Hafner
Pier Paolo Raimondi
Benedetta Bonometti

The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad

Towards a Great Transformation?

Springer

Perspectives on Development in the Middle East and North Africa (MENA) Region

Series Editor

Almas Heshmati, Jönköping University, Jönköping, Sweden

This Scopus indexed book series publishes monographs and edited volumes devoted to studies on the political, economic and social developments of the Middle East and North Africa (MENA). Volumes cover in-depth analyses of individual countries, regions, cases and comparative studies, and they include both a specific and a general focus on the latest advances of the various aspects of development. It provides a platform for researchers globally to carry out rigorous economic, social and political analyses, to promote, share, and discuss current quantitative and analytical work on issues, findings and perspectives in various areas of economics and development of the MENA region. Perspectives on Development in the Middle East and North Africa (MENA) Region allows for a deeper appreciation of the various past, present, and future issues around MENA's development with high quality, peer reviewed contributions. The topics may include, but not limited to: economics and business, natural resources, governance, politics, security and international relations, gender, culture, religion and society, economics and social development, reconstruction, and Jewish, Islamic, Arab, Iranian, Israeli, Kurdish and Turkish studies. Volumes published in the series will be important reading offering an original approach along theoretical lines supported empirically for researchers and students, as well as consultants and policy makers, interested in the development of the MENA region.

Manfred Hafner · Pier Paolo Raimondi ·
Benedetta Bonometti

The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad

Towards a Great Transformation?

Springer

Manfred Hafner
The Johns Hopkins University,
SAIS-Europe
Bologna, Italy

Paris School of International Affairs (PSIA)
Sciences Po University
Paris, France

Pier Paolo Raimondi
Istituto Affari Internazionali
Rome, Italy

Catholic University
Milan, Italy

Benedetta Bonometti
Eni
Milan, Italy

ISSN 2520-1239 ISSN 2520-1247 (electronic)
Perspectives on Development in the Middle East and North Africa (MENA) Region
ISBN 978-3-031-30704-1 ISBN 978-3-031-30705-8 (eBook)
https://doi.org/10.1007/978-3-031-30705-8

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

The perspective of rapidly decreasing demand for fossil fuels obviously constitutes a strategic challenge for all countries and economies in which hydrocarbon exports are a large component of GDP. This epochal shift is bound to affect all regions and continents, but it is an especially acute problem for the Middle East and North Africa (MENA), a region that not only includes some of the key global oil and gas exporters but also has limited alternative opportunities for economic diversification.

This timely volume proposes an in-depth, detailed, and very well-informed analysis of the situation of the region, as well as of individual countries in it—which is necessary because conditions are far from uniform in the region and not all countries face the same problems. It is a blessing that this volume is available in open access, because much of the information contained in it, while in the public domain, is nevertheless found behind paywalls and not freely accessible to scholars and commentators.

It has always been known that fossil fuels, being a finite resource, would someday run out and be exhausted. In this sense, oil and gas-producing countries have always been aware of the reality that, at some point in time, they might need to transform their economies and find new opportunities for creating value added. Nevertheless, in many, indeed most cases, this simple consideration has not led to the adoption of long-term strategies to achieve the required economic transformation. Well-known exceptions, such as Norway, can be easily compared to the careless behavior of, say, the UK.

Some of the major oil and gas producers in MENA have pursued economic transformation at least since the 1970s (some, like the UAE or Qatar, only became fully independent at that time). They have obtained some significant success, but the task remains far from being fulfilled. Furthermore, they are the exception: most countries in the region are victims of international or civil wars or of authoritarian governments lacking popular support. These prioritize maintaining power over guaranteeing the economic future of their people. In most cases, there simply is no appetite for a great transformation, not even at the rhetorical level.

It is now almost thirty years since the United Nations Framework Convention on Climate Change (UNFCC) entered into force (1994). For the best part of the first twenty years, the major oil exporters of the region—notably Saudi Arabia—directed their diplomatic activity to slowing down progress and hindering the adoption of any decision to phase out the use of oil and oil products. More recently, the United Arab Emirates has taken the leadership in proposing a new narrative that emphasizes investment in clean energy sources—such as wind, solar, and, in their case, also nuclear—while at the same time asserting that continued reliance on fossil fuels is inevitable at least for several decades, and priority should be given to reducing emissions while continuing their use. At COP27 in Sharm el Sheikh, Saudi Arabia and the UAE aligned with large coal-producing and exporting countries in asserting that the problem is not the use of fossil fuels, but the emissions that are released in the atmosphere. By this, it is meant that, to the extent that emissions can be eliminated or prevented from entering the atmosphere, the use of fossil fuels may continue.

Saudi Arabia has been theorizing the circular carbon economy, i.e., a transformation whereby carbon molecules are recycled, reused, or sequestered back into the ground. Saudi Aramco has pledged to become carbon neutral by 2060 with respect to scope 1 and 2 emissions—but the company rejects responsibility for scope 3 emissions, generated by final users when they burn the hydrocarbon molecules, which are the largest component. How is this ambitious, albeit limited, objective to be achieved?

To begin with, both the UAE and Saudi Arabia claim that their oil is one of the lowest emission already now, because extraction methods are less energy-intensive than elsewhere in the world. In addition, they believe that emissions can be further reduced by substituting some of the use of fossil fuels in extraction, treatment, and refining, with electricity from clean sources. For the rest, they aim at capturing and using the CO_2 as Enhanced Oil Recovery (EOR) method or simply sequestering it in the same geological formations that have contained oil and gas for millennia.

It may also be possible to transform hydrocarbons into products that are not primarily meant for burning—i.e., in the production of petrochemicals or other energy-intensive processes, accompanied again by carbon capture and sequestration.

The Saudi approach to the circular carbon economy has been acknowledged and incorporated in the final document of the G20 meeting that took place in Riyadh in 2020, in this way acquiring a degree of legitimacy. But the proof of the pudding must be in the eating: in other words, the purported strategy must be translated into actual project implementation, and this is not happening in any significant way, as this volume documents in detail.

The next Conference of the Parties (COP 28) will be hosted by the UAE. The CEO of the national oil company of Abu Dhabi (ADNOC), Sultan al Jaber, has been appointed to chair the conference. Al Jaber is the same person that has led Masdar, the Abu Dhabi company that is investing widely in renewable energy projects in the UAE as well as internationally. He insists that investment in renewable sources must be massively increased worldwide, but even if this happens, fossil fuels will not be eliminated overnight. There is a transition period during which they are still needed and must be provided for.

Can an acceleration of decarbonization of oil and gas be envisaged? For exporting countries, the exit from the COVID pandemic and the Russian invasion of Ukraine has brought about a significant improvement in export prices and increase in revenue: financial resources are therefore certainly available to allow for greatly increased investment to reduce emissions and convince the rest of the world that there is merit in the circular carbon economy. However, there are also competing destinations for the available financial resources, some in the direction of sensible economic diversification, but many also in the direction of supporting prestige projects that stand no chance of ever becoming cash-flow positive; or in the acquisition of assets of dubious intrinsic value, such as football clubs or the equity of e-gaming companies; not to speak of military expenditure, which remains at record level in the region, and absorbs a large share of government budgets.

It is also a fact that investment in decarbonizing existing oil and gas exports promises to increase production costs rather than the available rent. It may legitimately be argued that in the absence of such investment, the value of the oil and gas countries' resources will be undermined, but there is little direct connection between emissions abatement and the prevailing price for oil and gas on international markets. Rather, the drive toward decarbonization in the OECD countries has been accompanied by the stigmatization of further investment in fossil fuel. This is limiting available supply and enhancing the bargaining position of the major producers, which can obtain higher prices independently of whether they invest in decarbonization or not.

One may also argue that high prices will encourage the OECD countries and China to speed up the process of diversifying away from fossil fuels, but it is not clear that this may justify much-increased investment in decarbonization in the eyes of the major exporters. The alternative for them is to continue maximizing the obtainable hydrocarbon rent and use it to pursue politically motivated projects, the accumulation of financial assets, and enhanced military or repression capacity.

The same is also true for some projects that are much talked about, whereby MENA countries might become exporters of clean electricity or even hydrogen. The idea is well-founded inasmuch the region is comparatively very well endowed with solar and wind resources but is not greatly convincing from an economic point of view. The price of a barrel of oil produced in the UAE or Saudi Arabia is commonly at least eight or ten times its production cost, generating a rent that has no equal in any other sector/geography. In contrast, although it is most likely cheaper to produce electricity from renewable sources in MENA, exporting electrons to Europe (the presumed importer) requires expensive transmission capacity: it is not clear that the delivered cost would be competitive with alternatives, and in any case, it will at most allow for a rate of profit which might be acceptable for a utility, but will never generate a significant rent.

Similarly, it has been proposed that the region might export clean or low-carbon hydrogen, and it is indeed likely that producing hydrogen there may be relatively cheaper than in other geographies, but it is highly unlikely that a demand for imported hydrogen might materialize at prices much above the production cost. It is extremely difficult to visualize hydrogen as a source of significant rent for the states of the region.

The implication is that decarbonization will in any case bring about the demise, or at least drastic reduction, of the hydrocarbon rent available to the state, forcing greater reliance on taxation and attention to value-added generation in all economic activities—with predictable consequences on the stability and nature of the regimes in place. Power incumbents may not be ready to face the political consequences of the transformation and opt for a strategy of continuing maximization of the hydrocarbon rent—which may be doomed in the longer run, but still allow them access to large financial resources in an intervening period during which fossil fuels will still be needed. As the intervening period is, even in the most optimistic of "net-zero by 2050" scenarios, at least three decades long, the temptation for any ruler to postpone the required transformation and persist in the well-established rentier policy mode is certainly powerful. The Russian invasion of Ukraine has precipitated a profound transformation in international relations that further encourages continuing rentier behavior.

International energy relations have become intensely politicized. For the past half-century, the dominant narrative has been that closer economic interdependence would consolidate peace and eventually also support democratization and respect of human rights. Facts have validated this narrative until approximately the turn of the century, but in the last 20 years, things have been moving in the opposite direction. Authoritarian regimes have only selectively adopted international norms, while testing the will of liberal democracies to defend their principles—in the belief that short-term economic interest and disunity would allow their infringement of norms to remain unpunished.

In light of Russian behavior, it has become clear that pursuing economic interdependence with countries whose governments are cheating on the rules is not a wise strategy. As many (most) commodity-exporting countries are ruled by authoritarian regimes, the politicization of international trade inevitably impacts relations between industrial countries, which are primarily liberal democracies on the one hand, and commodity exporters, on the other hand. China occupies a special position, as a predominantly industrial country which, however, has come to dominate the production and refining of key metals and is ruled by an increasingly authoritarian regime.

In the immediate, the decision to terminate Europe's imports of Russian oil and gas has forced the USA and Europe to solicit MENA producers to come to help and increase production to contain prices. These requests have been criticized by numerous commentators, who do not consider MENA authoritarian regimes much preferable to Putin's. In any case, the major MENA exporters have ignored them: they have confirmed the OPEC+ alliance with the Russian Federation and reduced exports to sustain prices—the opposite of what had been requested of them. A closer Russia-Gulf-China triangle has emerged, which is clearly antithetic to the OECD democracies and their values.

Undoubtedly, the MENA region will remain central to global energy trade, but a narrative that saw it playing a growing role in global hydrocarbon production, because it supposedly would be irrational to invest in new, as yet untapped oil and gas resources, has lost credibility. Refusing to invest in new resources from other parts of the world would only enhance the geopolitical weight of the region's authoritarian governments. This does not seem acceptable. It is instead to be expected that the OECD countries will accelerate the process of decarbonization and, in parallel, promote investment in fossil fuels production in politically more acceptable countries, meaning countries in the OECD itself and other democratic countries that are willing to abide by international norms of respect of human rights and peaceful resolution of conflicts.

Short of a new, more successful Arab Spring, OECD relations with MENA will remain difficult. This book provides a very useful and timely resource to understanding the details of the energy dimension of the relationship.

Giacomo Luciani
Scientific Advisor
Master in International Energy
Paris School of International Affairs (PSIA)
Sciences Po University
Paris, France

Adjunct Professor
The Graduate Institute of International
and Development Studies
Geneva, Switzerland

Acknowledgements

We are particularly thankful to Fondazione Eni Enrico Mattei (FEEM) for its support in the realization of this book and financing its open access.

We owe special thanks to Barbara Racah for her precious help throughout the editorial process and to CASSINI for creating compelling maps regarding key energy access in Algeria, Libya, and Eastern Mediterranean as well as the one regarding Middle Eastern key energy assets and religious groups. We also express our gratitude to Prof. Simone Tagliapietra for his useful feedback on our first draft of the manuscript.

Finally, we very warmly thank Prof. Giacomo Luciani for his inspiring foreword to our book.

Zug, Switzerland	Manfred Hafner
Milan, Italy	Pier Paolo Raimondi
Milan, Italy	Benedetta Bonometti
January, 2023	

Introduction

Over the past century, oil has significantly affected every aspect of our daily life, substantially shaping the world's economy and society, and enabling economic growth and socioeconomic development. In no other part of the world is this fact more visible than in the Middle East and North Africa (MENA) region, which is endowed with around half of the world's proven reserves of oil and gas and is home to some of the world's major oil- and gas-exporting countries. The hydrocarbon resources within the region, however, are not equally distributed geographically, creating a first cleavage between hydrocarbon-rich and hydrocarbon-poor countries. The MENA region therefore includes both net energy-exporting and net energy-importing countries.

Hydrocarbon wealth (or the lack thereof) has shaped the socioeconomic, political, and energy evolution of all MENA countries. National governments of hydrocarbon-rich countries have collected revenues from hydrocarbon exports—commonly known as oil rents, which have steadily become the main source of revenue for these countries' economies, eroding the need for a relevant fiscal regime and consolidating the ruling elite. Hydrocarbon revenues (i.e., oil rents) have thus become a key component of the economy, and the allocation of wealth is a key feature of the social contract. The allocation/distribution of wealth consists of several instruments, such as employment in the public sector and massive fossil fuel subsidies among others. This rentier mentality has developed not only in the MENA-exporting countries but also in the importing countries, especially in the aftermath of the 1973 oil crisis when the Gulf monarchies distributed wealth across the region. This approach has also been fueled by the exporting countries' reliance on a foreign and cheap workforce.

The vast hydrocarbon reserves of MENA countries have contributed to their increasing relevance in the international arena, placing them at the center of the geopolitical energy map and enhancing their geopolitical role. Consuming countries have established relations with oil-producing countries since post-World War II in order to secure stable and affordable supplies, which are vital for running their economies. The meeting on the USS Quincy between US President Franklin Delano Roosevelt and Saudi King Abdul Aziz Ibn Saud on Valentine's Day of 1945 marked the beginning of the pivotal role of the Saudis (and the MENA region) in the energy landscape.

The domestic socioeconomic model and geopolitical relevance of the MENA area may become unsustainable in the long term as the world is trying to reduce its thirst for hydrocarbons. Climate change and global warming have become pressing issues, and climate policies are climbing the global political agenda. To fight climate change, governments all over the world aim at transforming the energy system through decarbonization. Countries have set climate targets, and there has been a steep acceleration in global climate ambitions since 2019, as several countries have introduced (or are considering to introduce) net-zero targets by and around mid-century. According to the International Energy Agency's (IEA) Net-Zero Scenario by 2050, the share of fossil fuels in the world's energy supply will need to decline from 80% in 2020 to 20% in 2050. In short, the global energy transition is expected to drastically transform both energy supply and demand over the next 30 years by removing energy sources (i.e., fossil fuels) for the first time in the history of energy evolution. Even if the goal of carbon neutrality by mid-century is not achieved, strong policy intervention will deeply modify the future energy landscape.

Such a fundamental overhaul of energy systems will have a major impact on several aspects, in particular on the economy, industry, international relations, and social cohesion. While the consequences are expected to be global, they will differ in intensity and magnitude across different regions and people. The MENA region is set to be one of the most exposed regions in the world as it is a cornerstone of the current global energy architecture—today, the MENA region is responsible for about 40% of the world's oil exports and 15% of the world's gas exports. Climate policies and technological developments (e.g., electric vehicles) are expected to reduce the world's demand for hydrocarbons even though the world population is rising, and large parts of it aspire to enter the middle class, thus potentially increasing consumption levels. A global deep decarbonization scenario, characterized by a looming decline of oil and gas demand, poses pressing challenges to MENA-exporting countries.

Besides the international pressure to adapt and adjust their domestic energy and economic systems to a low-carbon future, MENA countries also face increasing pressure for some sort of domestic transformation. Despite the different levels of their available hydrocarbon reserves, all MENA countries have developed a heavy reliance on fossil fuels for their domestic energy markets. Over the course of the past decades, MENA countries have become not only major producing countries, but also major consuming countries. Growing populations, energy subsidies, industrialization, and availability of vast, cheap hydrocarbon resources have stimulated domestic energy consumption and limited energy efficiency measures.

Indeed, the energy systems of MENA countries rely heavily on oil and gas with a limited role of other energy sources, and they have been characterized by a high per capita growth rate from 0.02 Exajoule (EJ) (equivalent to 0.5 Mtoe, million ton of oil equivalent) in 1965 to 0.11 EJ (2.7 Mtoe) in 2019, corresponding to a 2.8% average growth rate per annum (some Gulf Cooperation Countries experienced an average growth rate per annum of around 4%). Environmentally, the lack of energy efficiency and high consumption per capita results in high CO_2 emissions passing from 169.6 million tons (Mt) of CO_2 in 1965 to 2,626.7 Mt of CO_2, corresponding to an average growth rate per annum of 5.2% (with some GCC countries, such as Qatar and the UAE, recording rates above 10%). Furthermore, the MENA region is one of the world's areas most affected by the negative consequences of climate change and global warming. Extreme heatwaves, water scarcity, sandstorms, and rising sea levels have become common features of the region, and their intensity and frequency are expected to increase in the future.

By becoming large energy consumers, MENA countries also face macroeconomic challenges. Hydrocarbon-poor countries need to allocate larger financial resources to energy import bills as they need to meet growing domestic demand, whereas hydrocarbon-exporting countries see their main revenue source being eroded as the domestic energy sector is supplied with oil and gas. In this context of growing international and domestic pressure, MENA countries have started considering the development of low-carbon alternatives to transform their energy sector. Regional countries have announced renewable targets to harness their vast potential, and they have increased their participation in the international climate debate. The energy transformation could also be the opportunity to address non-energy related issues, such as job creation, diversification of the economy, and development of new business models. Such a transformation would respond to multiple needs: (i) tackling and reversing the negative consequences of climate change in the region; (ii) meeting the growing energy consumption; (iii) freeing additional oil and gas volumes for export markets; (iv) providing jobs for the young, growing population; and (v) attracting new investments and technologies.

As the global energy transition unfolds, the role of MENA countries in the geopolitical map will become a pressing issue. While the world attempts to reduce its oil and gas demand, oil- and gas-exporting countries need to prepare their hydrocarbon industry for a more demand-constrained world and more stringent environmental measures (e.g., carbon pricing, methane emissions), enhancing the industry's resilience through investment and innovation. At the same time, renewable sources can create new business models, also for hydrocarbon-importing MENA countries, and whole MENA region could become a provider of clean energy and low-carbon products to the world given the region's vast renewable potential.

The current energy scenario is characterized by major transformations, to which MENA countries will not be immune. This book provides a multidisciplinary analysis of the region's energy and geopolitics to better understand how the countries in this area are preparing themselves for this great challenge. The countries of the region share some common features, but they are also characterized by different socioeconomic, energy, and political features. We therefore analyze how each country deals with this transformative time and discusses the consequent challenges and opportunities according to national peculiarities.

We have divided the analysis in each chapter (excluding Chap. 6) into three clusters:

– the Arabian-Persian **Gulf**[1] region, composed of the six Gulf Cooperation Council (GCC)[2] countries plus Iran;
– the **Mashreq** region, composed of Egypt, Iraq, Israel, Jordan, Lebanon, Palestine, Syria;
– the **Maghreb** region, composed of Algeria, Libya, Morocco, Tunisia.

Given the complexity of the expected transformation and its consequences not only on energy patterns, but also on socioeconomic development, the social contract, and geopolitics just to mention a few, this book attempts to address these different transformations of the MENA countries across six different chapters which are regrouped into four parts:

- **Part I** (Chaps. 1 and 2) provides an overview of the region and the major features that drive and hinder a real transformation. Here, the issue is related to the conformation of the energy and socioeconomic systems. Chapter 1 provides a brief introduction of the region from a demographic, economic, energy, and historical point of view. Chapter 2 identifies the barriers and drivers for a great transformation in these countries.
- **Part II** (Chaps. 3 and 4) tackles the energy field in MENA countries: Chap. 3 analyzes the historical evolution of the energy sector up to today with a main focus on fossil fuels. Chapter 4 provides an analysis of the attempts and efforts to push renewable energy sources in the MENA region.
- **Part III** (Chaps. 5 and 6) addresses the geopolitical dimension of the energy sector in this region, with Chap. 5 focusing on oil and gas geopolitics and Chap. 6 addressing the potential geopolitical consequences of the energy transition and the strategies that MENA countries can pursue to remain relevant on the international stage.
- **Part IV** (Chap. 7) provides overall conclusions and key takeaways on all major aspects addressed by the book. It also includes considerations regarding the most recent energy and geopolitical developments in 2021/22.

Manfred Hafner
Pier Paolo Raimondi
Benedetta Bonometti

[1] Hereafter as "the Gulf."

[2] Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

Contents

About the Authors

Manfred Hafner is Professor of International Energy Studies (Geopolitics and Economics of Energy), teaches as an adjunct professor at The Johns Hopkins University School of Advanced International Studies (SAIS Europe) and at SciencesPo—Paris School of International Affairs (PSIA), and is involved in many executive education programmes worldwide. He has been Programme Director of the "Geopolitics and Energy Transition"and "Future Energy" research programmes at the Fondazione Eni Enrico Mattei (FEEM), a non-profit, policy oriented, international research center, and think tank, where this book has been designed. Previously, he was for many years Scientific Director of the Observatoire Méditerranéen de l'Énergie, a think tank and association of Euro-Mediterranean energy operators. He has over his more than 30-year professional career extensively consulted on international energy issues for governments, international organizations, and industry and has coordinated several major interdisciplinary research projects for the European Commission. He has in particular a longstanding experience working with governments and energy operators in most MENA countries on energy strategies and policies. Dr. Hafner holds master's degrees in Energy Engineering from the Technische Universität München, Germany; in Energy Economics and Business from the IFP-School of IFPEN, France, and the Université Paris2/Panthéon Assas, France; and in Energy Economics, Management, and Policy from the University of Pennsylvania, USA. He also holds a Ph.D. in Energy Studies from Mines Paris PSL (Ecole des Mines de Paris). He has published several books on international energy issues.

Pier Paolo Raimondi is a researcher of the "Energy, Climate and Resources" programme of the Istituto Affari Internazionali (IAI). He is also Ph.D. Candidate at the "Institutions and Politics" Doctoral School of the Università Cattolica del Sacro Cuore, Italy, with a research project on the European Green Deal and its consequences for the MENA region. He was a research fellow at the "Geopolitics and Energy Transition" and "Future Energy" research programmes at the Fondazione Eni Enrico Mattei (FEEM) from 2018 and 2021. His main research activity is related to energy markets, geopolitics, and geoeconomics in different geographical areas, mainly the MENA region, Europe, Africa, and Former Soviet Union area. He holds a master's degree in International Relations and a bachelor's degree in Political Science from Università degli Studi di Milano, Italy.

Benedetta Bonometti currently works for Eni S.p.A in the Commercial Negotiations Department. She was previously (2020) a researcher at the "Geopolitics and Energy Transition" programme of the Fondazione Eni Enrico Mattei (FEEM) where she has contributed to the first drafts of this book. She holds a second level specializing Master in Energy and Environmental Management and Economics from Pavia University and Eni Corporate University, as well as a M.Sc. in Public Policy: Energy, Resources, and Development from Sciences Po Paris. Her research interests focus on energy policy and political economics in the Middle East.

Part I
Context and Drivers for the Regional Energy Transformation

Chapter 1
The MENA Region: An Economic, Energy, and Historical Context

This first chapter focuses on some key socio-economic features of MENA countries and their impact on the energy sector. It discusses the general present context of MENA countries focusing in particular on demography, economy, energy and history and highlighting differences and similarities among MENA countries. As such, this chapter sets the scene for the whole book which concentrates on the need, the capability, the challenges and the opportunities of the energy transformation and its geopolitical consequences.

The Middle East and North Africa (MENA) region is often considered as a whole, but it includes as many as 18 countries[1] with a total of 425.8 million people (UN DESA 2020). It stretches from the Atlantic coast of North Africa in the West to Iran beyond the Hormuz Strait in the East passing through the Mashreq (Map 1.1). Stretching across such a vast territory, MENA countries present some important features, but they are also characterized by major differences from an economic and energy perspective. Tables 1.1 and 1.2 show this heterogeneity.

1.1 Demography

The MENA region has witnessed a remarkable demographic growth over the last decades. The total population of the region has grown from 77 million people in 1950 to 425.8 million people in 2019. The exceptional 'youth bulge' experienced by this region since the 1950s can be ascribed to the combination of declining infant mortality and high fertility rate, which has triggered a booming population growth for over forty years. The MENA region had the highest population growth rate in

[1] The chapter considers the MENA region composed by the following countries: Morocco, Algeria, Libya, Tunisia, Egypt, Israel, Jordan, Lebanon, Iraq, Syria, Bahrain, Iran, Kuwait, Saudi Arabia, United Arab Emirates, Oman, Qatar.

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_1

Map 1.1 The Middle East and North Africa. *Source* Authors' elaboration on CIA

the world until 2011, when it was surpassed by sub-Saharan Africa (Cammett et al. 2015).

The youth bulge peaked in North Africa in the 1970s and in the Middle East in the 1990s (Cammett et al. 2015) as a result of declining fertility. Despite the peak and the fall in population growth, the MENA region has continued to expand its demographic basis. The population is expected to grow significantly over the next 30 years with some differences at the country level.

The high fertility rate and low mortality rate have also given MENA countries one of the youngest populations in the world (Fig. 1.1). Even though the share of young population has declined over the past 70 years, the active population has exacerbated national socioeconomic challenges, such as job creation. Indeed, the young growing population has suffered some major socioeconomic limitations, highlighted by the high youth unemployment rate.

The demographic development (and especially the expected growth) is set to further stress the existing challenges of the region's socioeconomic model as oil exporting countries may distribute oil rents to a larger population, resulting in lower per capita distribution.

1.2 Economy

The region has been significantly shaped by its abundant hydrocarbon endowment and by the surge of oil consumption worldwide following World War II, which has prompted its socioeconomic growth, shaping its political economy, and consolidating

Table 1.1 Key socioeconomic indicators of MENA countries compared to world's major economies

	Population in 2019 (million)	Expected population by 2050 (million)	Population annual average growth rate 2019–2050 (%)	GDP in 2019 (constant 2010 US$) (billion)	GDP per capita in 2019 (constant 2010 US$)	GDP per capita (PPP) in 2019 (constant 2017 international $)
Algeria	42.3	59.7	1.1	202	4701	11,522
Libya	6.5	8.5	0.9	55	8122	21,843
Morocco	36.1	44.9	0.7	126	3407	7547
Tunisia	11.9	14.3	0.6	51	4404	11,421
Egypt	104.7	159.5	1.4	302	3010	11,763
Iraq	41.1	73.9	1.9	221	5624	10,890
Israel	8.5	12.9	1.4	319	35,286	40,626
Jordan	10.6	14.9	1.1	33	3325	10,071
Lebanon	5.8	4.9	− 0.5	39	5792	14,493
State of Palestine	4.8	8.8	2.0	14	3700	6245
Syria	19.7	36.1	2.0	NA	NA	NA
Bahrain	1.5	1.8	0.6	34	20,936	45,312
Iran	86.1	98.9	0.4	491	5922	14,904
Kuwait	4.4	5.1	0.5	137	32,702	49,947
Oman	4.6	6.2	1.0	75	15,081	31,284
Qatar	2.8	3.3	0.5	179	63,281	90,044
Saudi Arabia	35.4	48.2	1.0	703	20,542	47,000
UAE	9.1	11.4	0.7	404	41,420	68,264
MENA TOTAL	435.9	613.3	1.1	3385	8133	16,602
WORLD	7724.9	9687.4	0.7	84,933	11,068	16,974
USA	333.2	375	0.4	18,349	55,886	62,459
EU-28*	513.5	441.2	− 0.5	16,563	37,037	44,395
China	1419.7	1316.9	− 0.2	11,520	8242	15,978

*EU-28 includes the United Kingdom
Source Authors' elaboration on UN, World Bank, IEA data

its governance. Before the 1950s, MENA countries had some of the lowest levels of socioeconomic development in the world. However, these countries experienced unprecedented levels of economic growth and social development from the 1950s to the 1980s. In terms of GDP per capita, the region experienced a growth of 3.7% per year over the 1960–1985 period (Yousef 2004). This figure is lower than East Asia and the Pacific region (4.3% per capita annual growth), but higher than Latin America and the Caribbean (1.6%). The rapid economic growth has also triggered

Table 1.2 Key energy indicators of MENA countries compared to world's major economies

	Total primary production (Mtoe) 2019	TPES per capita (toe/capita) 2019	CO2 intensity to GDP (constant US$) (tCO2/US$15) 2019	Electricity consumption (TWh) 2019
Algeria	65.7	1.5	836.7	70.6
Libya	21.8	3.2	1285.4	18.4
Morocco	23.1	0.6	592	32.7
Tunisia	11.5	1.0	572.8	17.7
Egypt	98.1	1.0	617.6	154.7
Iraq	67.7	1.7	799.8	45.3
Israel	24.2	2.8	183.2	60.4
Jordan	7.8	0.8	563.8	17.9
Lebanon	8.8	1.3	535.8	18.4
Syria	9.2	0.5	1277.6	12.5
Bahrain	16.2	10.1	1054.5	34.1
Iran	271.6	3.3	1514.7	263
Kuwait	35.8	8.5	808.3	54.8
Oman	29.0	5.9	966.3	33.8
Qatar	50.6	18.1	538.4	43.6
Saudi Arabia	214.1	6.3	749.1	310.1
UAE	91.4	9.4	471	125.7
MENA TOTAL	1046.7	2.4	775	1313.7
World	14,482.9	1.9	392.3	23,662
USA	2212.7	6.7	246	3964.5
EU-28*	1573.3	3.5	188.6	2562
China	3389.3	2.4	680.8	6807.4

*EU-28 includes the United Kingdom
Source Authors' elaboration on UN, World Bank, IEA data

major gains in a series of social indicators. By the late 1980s, the Middle East region experienced sharp drops in infant mortality, rising life expectancy, school enrollment levels approaching 100% and higher literacy levels that rose from an average of some 40% of the adult population to almost 60% (Yousef 2004).

Countries in the region have witnessed a strong economic growth over the last decades, underpinned by oil revenues (Chap. 2 will discuss the implications of the rentier state). The economic growth came hand-in-hand with oil price cycles (Fig. 1.2). The first significant economic boom occurred in the 1970s following the two oil price spikes of 1973 and 1979, when oil prices skyrocketed and MENA oil exporting countries earned a sizable windfall. From 1985 to 2000, oil prices remained quite low, reducing MENA oil producers' revenues. Significant revenues were collected during the second oil boom (Table 1.3)—MENA oil revenues grew fourfold during the 2000–08 period—and ended with the 2014 oil price drop.

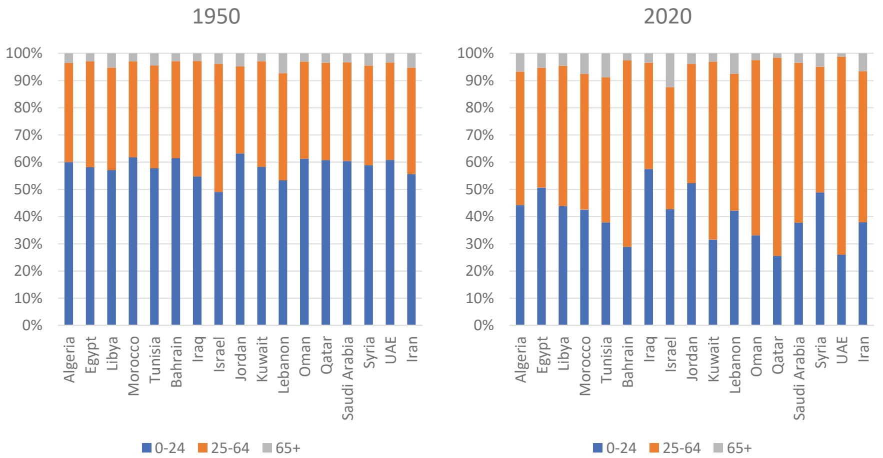


Fig. 1.1 Age groups in MENA countries in 1950 and 2020 (% of total population). *Source* Authors' elaboration on UN DESA

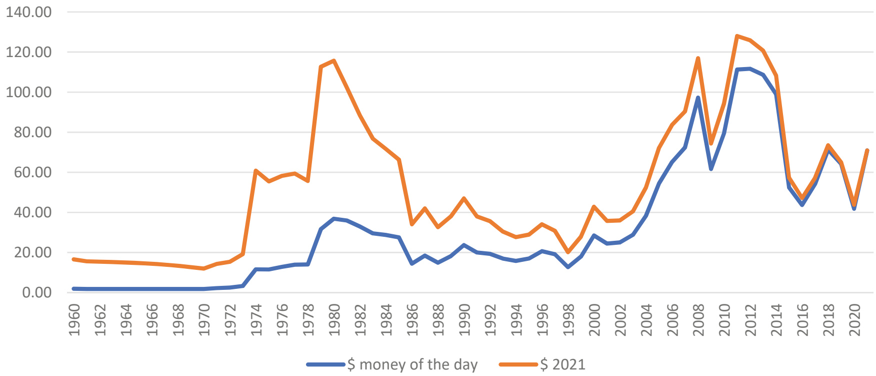


Fig. 1.2 Crude oil prices 1960–2021 (US$/barrel). *Source* Authors' elaboration on BP (2022)

However, there are some major differences regarding the conduct of MENA oil exporting countries in these two periods. In the first oil boom, oil exporting governments bestowed their revenues to their citizens and oil rents to the oil-poor countries in the region that did not have their own rents. By contrast, in the second oil boom, oil-rich countries initially responded prudently to the massive amount of money they were collecting. Higher savings, slower domestic absorption and greater reliance on the markets are only some of the key strategies of that period, during which total MENA debt fell from 55 to 17% of GDP (Malik 2017). Although ever-increasing proportions of current account surpluses were transferred into regional sovereign wealth funds (SWFs), the rentier-dependent model of development was not overcome during this period. The regional distribution of oil rents was left to the private

Table 1.3 Net oil revenue of major MENA oil exporters (2005–2013, US$ billion) and Brent oil price (US$/barrel)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Algeria	35	41	46	60	41	48	63	63	60
Iraq	24	32	37	61	39	49	74	88	86
Kuwait	41	50	55	80	47	57	89	96	92
Libya	28	36	41	57	34	44	14	54	34
Qatar	14	18	21	30	16	27	44	44	42
Saudi Arabia	135	157	167	251	139	190	273	293	274
United Arab Emirates	26	32	35	46	27	34	52	56	53
Brent oil price ($/b)	54.52	65.14	72.39	97.26	61.67	79.50	111.26	111.67	108.66

Source Authors' elaboration on Luciani (2016) and BP (2020)

sector, which looked into opportunities in the neighboring countries, enhancing the economic dependency between the local elites and the rich businessmen from the Gulf (Luciani 2016).

In real terms, GDP per capita has significantly risen across the region, with some of the MENA countries becoming among the richest countries on a GDP per capita basis in today's world. That is particularly true in the major oil producing countries located in the Arabian-Persian Gulf. Today Qatar is the world's richest country in terms of GDP per capita. Other high-income MENA countries are the United Arab Emirates (UAE), Saudi Arabia, Kuwait and Israel. On the other hand, there are countries in the region (e.g. Egypt, Jordan and Morocco) that have a GDP per capita rate in the range of $3000–4000.

At the country level, inequality rates are not higher than those in the rest of the world. However, the lack of data on top income shares in the MENA economies made an in-depth analysis impossible. What is striking is the high degree of intraregional inequality (Alvaredo and Piketty 2014). This, in turn, has had a significant impact on wealth accumulation across the region (*Idem*). Labor migration from other MENA countries to GCC countries has been a remedy for intraregional income disparities. Moreover, the second oil boom contributed to expanding regional inequality, leading to the eruption of the Arab Spring in 2011. People had the perception that different opportunities were distributed both at the regional level (oil-rich vs. oil-poor) and at the domestic level (Luciani 2016).

1.3 Energy

Regional inequality and labor migration reflect also the unequal distribution of hydrocarbon reserves across the region. In fact, some countries within this area are among the major oil and gas producers in the world, as shown in Tables 1.4 and 1.5. At the end of 2019, the MENA region accounted for about 52% of the world's total proven oil reserves and for about 42% of the world's total proven gas reserves (BP 2020). The countries with the largest oil reserves in the MENA region are Saudi Arabia (17.2% of the world's proved total reserves), Iran (9%), Iraq (8.5%), Kuwait (6%) and the United Arab Emirates (5.7%) (BP 2020). Moreover, in 2019, oil production in the MENA region amounts to 35.6% of the world's total oil output, with five countries in the top 10 producers (BP 2020). Among the MENA producing countries, Iran and Libya have a higher oil production potential, but it has been substantially hindered by international sanctions as well as security and governance issues. Saudi Arabia, Iran and Kuwait have the largest share of the region's total proved oil reserves, while Kuwait, the UAE and Qatar have the highest total proved reserves per capita rate, which shows these countries' wealth (Table 1.4).

The MENA region is also endowed with conspicuous gas reserves, amounting to 42% of the world's total proven reserves. Nevertheless, the share of gas produced in the region (21.4% of the world's total production) is considerably smaller than the share of gas reserves (BP 2020). A perfect example is represented by Iran and Qatar. While Iran ranks second worldwide in proven gas reserves with 32 trillion cubic metres (tcm) (16.1% of the world's total), Qatar holds the third largest proven gas reserves with 24.7 tcm (12.4% of the world's total). To put into context, these reserves have a different potential if we consider the countries' populations: Iran is home to 82 million people (390.2 bcm per capita), whereas Qatar to almost 3 million (8.8 tcm per capita). In terms of reserves, they are second only to Russia, which holds 19.1% of global proven gas reserves (BP 2020). However, their shares of gas production are considerably lower compared to Russia, which produces 679 billion cubic metres (bcm) (17% of global gas production): Iran provides 6.1% (244.2 bcm) of global gas output and Qatar's production share amounts to 4.5% (178.1 bcm) of global gas output (BP 2020). The discrepancy becomes relevant also when one considers the exports. Russia is responsible for 19.9% of the world's gas exports (exporting 256.6 bcm in 2019 most by pipeline), Qatar is responsible for about 10% of the world's gas exports (exporting 128.6 bcm mainly via LNG), while Iran is responsible for 1.3% exporting only 16.9 bcm in 2019 via pipeline. However, most countries in the region are attempting to enhance their gas production both for internal consumption and export, given the increasing relevance of gas in the global energy transition as well as the need to transform the countries' energy sectors.

Iran, Qatar and Saudi Arabia have the largest share of the region's total proved gas reserves, while Qatar, Algeria and the UAE have the highest total proved reserves per capita rate, which shows these countries' wealth (Table 1.5).

The unequal distribution of hydrocarbon resources across the region has marked a major dichotomy between oil-rich and oil-poor. Generally, these countries can also be classified in: net-hydrocarbon exporters (in the Arabian-Persian Gulf) and net-hydrocarbon importers (Western Mediterranean countries, excluding Libya and Algeria, and Eastern Mediterranean). Even though some countries are labelled as net-hydrocarbon exporters, they also import some energy (e.g. transportation fuel and natural gas). Throughout the years, some countries have changed their energy status thanks to the evolution of domestic markets and the discovery of sizeable hydrocarbon reserves. This is the case of Egypt and Israel. Egypt has fluctuated from

Table 1.4 Oil proved reserves, production and share of total, by selected MENA countries, 2019

	Total proved reserves (thousand million barrels)	Share of world's total (%)	Share of MENA (%)	Total proved reserves per capita	Production (mb/d)	Share of world's total (%)	Consumption (mb/d)	Share of world's total (%)
Algeria	12.2	0.7	1.4	288	1.48	1.6	0.45	0.5
Egypt	3.1	0.2	0.3	29	0.68	0.7	0.74	0.8
Iran	155.6	9	17.4	1807	3.53	3.7	2.02	2.1
Iraq	145	8.4	16.2	3528	4.77	5	0.72	0.7
Libya	48.4	2.8	5.4	7446	1.22	1.3	0.1	0.1
Kuwait	101.5	5.9	11.3	23,068	2.99	3.1	0.43	0.4
Oman	5.4	0.3	0.6	1173	0.97	1	0.30	0.3
Qatar	25.2	1.5	2.8	9000	1.88	2	0.35	0.4
Saudi Arabia	297.6	17.2	33.2	8406	11.83	12.4	3.79	3.9
Syria	2.5	0.1	0.2	126	0.024	0	n.a	n.a
UAE	97.8	5.6	10.9	10,747	3.99	4.2	1.04	1.1
Total	894.3	51.7		2507	33.41	35.1	9.9	10.0

Table 1.5 Gas proved reserves, production and share of total, by selected MENA countries, 2019

	Total proved reserves (tcm)	Share of world's total (%)	Share of MENA (%)	Total proved reserves per capita	Production (bcm)	Share of world's total (%)	Consumption (bcm)	Share of world's total (%)
Algeria	4.3	2.2	5.2	102,485	86.2	2.2	45.2	1.2
Egypt	2.1	1.1	2.6	20,418	64.9	1.6	58.9	1.5
Iran	32.0	16.1	38.5	371,863	244.2	6.1	223.6	5.7
Iraq	3.5	1.8	4.3	86,202	10.8	0.3	19.9	0.5
Israel	0.5	0.2	0.6	54,547	11.2	0.3	10.8	0.3
Libya	1.4	0.7	1.7	219,947	9.4	0.2	3.7	0.1
Kuwait	1.7	0.9	2.0	385,182	18.4	0.5	23.5	0.6
Oman	0.7	0.3	0.8	144,858	36.3	0.9	25	0.6
Qatar	24.7	12.4	29.7	8,814,631	178.1	4.5	41.1	1
Saudi Arabia	6.0	3	7.2	169,055	113.6	2.8	113.6	2.9
Syria	0.3	0.1	0.3	13,635	3.7	0.1	n.a	n.a
UAE	5.9	3	7.1	652,607	62.5	1.6	76	1.9
Total	83.2	41.8	100	227,712	839.5	21.0	641.4	16.2

Source Authors' elaboration on BP

being a net-hydrocarbon exporter to importer and back again thanks to the discovery of natural gas offshore fields in the Mediterranean, such as the Zohr field. A similar trend is visible in Israel, which has started to export gas to Jordan and Egypt in 2019.

The countries of the MENA region vary considerably in terms of energy features. First, some of them are major hydrocarbon producers (Table 1.6). Most of the Gulf countries (with the exception of Bahrain) are members of this group. Other major producers are some of the North African countries (Libya, Algeria and Egypt) and Iraq. Production has changed throughout the decades, and some countries have emerged as new producers, such as Israel.

Second, MENA countries diverge also regarding the type of fossil fuel that they produce: oil, gas or both. Some countries have historically been associated with oil production, such as Saudi Arabia, Kuwait, Iraq, while others with gas, mainly Qatar. Iran and Algeria have usually stood out as both gas and oil producers in the region. Gas has become increasingly relevant also in key oil-producing countries, for instance Saudi Arabia, where gas is consumed entirely domestically, and Egypt, which has substituted a declining oil production trend with gas production.

Given the vast hydrocarbon resources and relatively small population, MENA countries are among the world's largest oil and gas exporting countries. Regarding oil exports, Saudi Arabia is the world's largest exporter followed by Russia, Canada and Iraq (Fig. 1.3). In the last decade, the US has emerged as one of the three largest oil producers in the world. Despite the remarkable export growth, the US exports

Table 1.6 Oil production by selected MENA countries, 2000, 2010, 2019 (mb/d)

	2000	2010	2019
Saudi Arabia	9.12	9.86	11.83
UAE	2.59	2.93	3.99
Iran	3.85	4.42	3.39
Iraq	2.61	2.46	4.77
Kuwait	2.24	2.56	2.97
Qatar	0.85	1.63	1.86
Libya	1.47	1.79	1.30
Egypt	0.77	0.72	0.65
Algeria	1.54	1.68	1.48

Source Authors' elaboration on BP

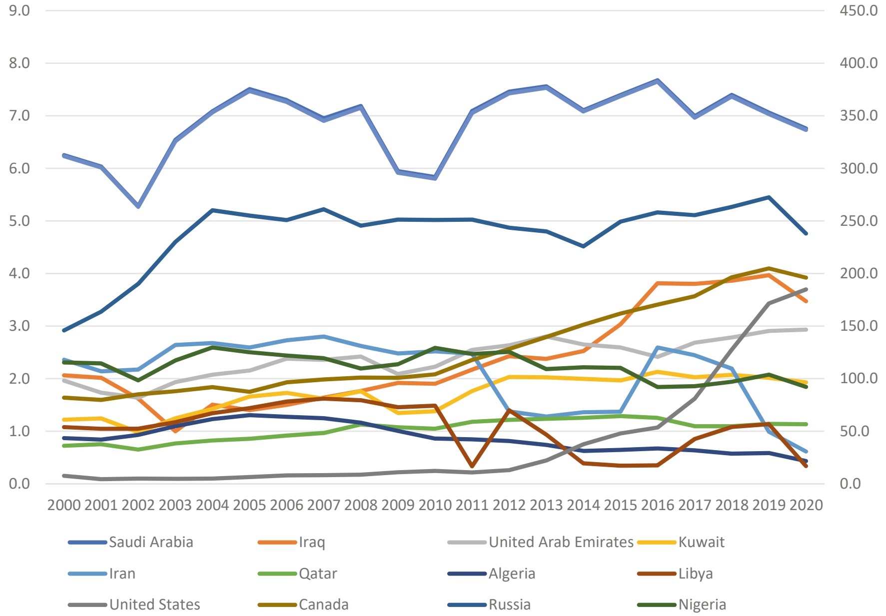


Fig. 1.3 Crude oil and NGL exports by world's largest oil exporting countries, 2000–2020, mb/d (left) Mt (right). *Source* Authors' elaboration on ENERDATA

less oil compared to Saudi Arabia and Russia due to its larger domestic market. Iran's oil exports are deeply hindered by different cycles of international sanctions, while Iraq managed to increase its oil production hence its exports despite its critical sociopolitical situation. Meanwhile, Algeria has witnessed declining oil exports due to higher domestic consumption and higher competition in the global oil markets caused by the advent of the American shale oil with similar characteristics.

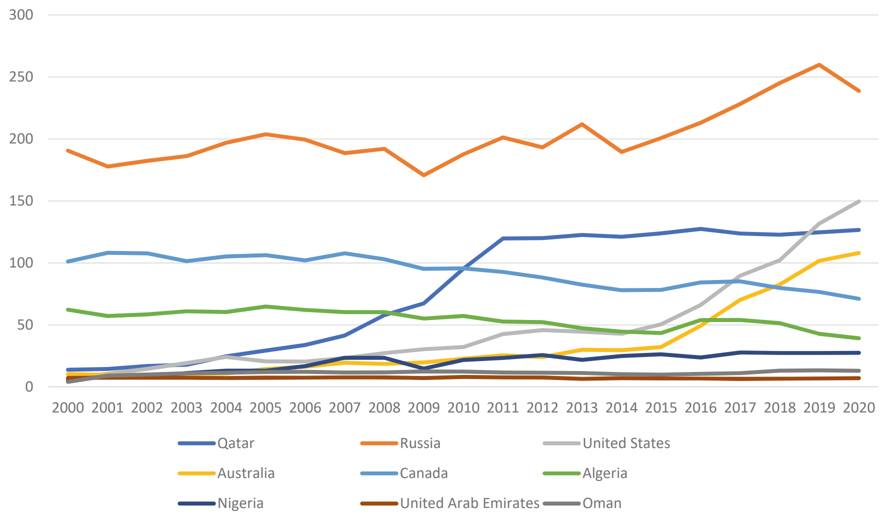


Fig. 1.4 Natural gas export* by world's largest gas exporting country, 2000–2020, bcm.*Both pipeline and LNG export volumes. *Source* Authors' elaboration on ENERDATA

Among MENA countries, there are also major gas exporting countries (Fig. 1.4). Qatar stands out in terms of gas exports, with a dominant role in the global LNG markets. The small country also exports some gas volumes via pipeline through the Dolphin pipeline to the UAE and Oman. Qatar has ramped up its LNG exports in the 2000s, but due to the 2005 self-imposed moratorium its exports have remained stationary. Globally, the largest gas exporter is Russia, with a well-developed infrastructure network linked to Europe. More recently, Russia has launched ambitious plans to diversify both in terms of markets (Asia, in particularly China) and transport mode (LNG). Nonetheless, following Russia's war in Ukraine in 2022 the expansion of Russia's LNG industry may be undermined given the international sanctions that prevent Western technological and financial cooperation.

Other two major LNG exporters are Australia and the US—thanks to its shale gas—intensifying the competition in the market. Algeria is facing declining gas exports akin oil exports, due to higher domestic consumption. Moreover, Algeria exports the vast majority of its gas to Europe via pipeline. Saudi Arabia represents an interesting example not appearing in the chart, despite being a large gas producer. Indeed, the Kingdom consumes its entire gas production for its domestic market.

Hydrocarbon resource-poor countries (e.g. Morocco and Israel) have strived to attain a certain level of energy security by importing coal and, more recently, by developing renewable energy sources (RES). Thanks to the discovery of sizable natural gas fields offshore in the Mediterranean, Israel has steadily replaced its coal consumption with its domestic gas production. The MENA region has experienced a strong energy and electricity demand over the last three decades with, for instance, power consumption increasing by around 6%/y in average between 1990 and 2018

(IEA 2020). Without any significant changes in these factors, MENA countries' electricity demand is expected to triple by 2050 (Ghobadi 2019).

Figure 1.5 shows the strong energy demand in MENA countries over the last decades, which has been driven by several factors. Most MENA countries have experienced a strong demographic growth (2.1% in the last 10 years), which is likely to progress in the coming decade (World Bank 2019a). Energy consumption is further incentivized by low prices due to subsidies. A robust economic growth (3.2% at regional level in the last 10 years) has further encouraged energy demand (World Bank 2019b).

Another major trend in the region is the extraordinary expansion in electricity consumption over the last three decades (Fig. 1.6). Underpinned by low oil prices and demographic growth, regional electricity consumption surged from 282.6 TWh in 1990 to 1332.9 TWh in 2020. For example, in the GCC countries electricity consumption grows at an average rate of 6–7% per year. Residential use is one of the main drivers of this growth with air cooling accounting for about 70% of residential and commercial electricity demand.

A key factor that contributes to a surge in electricity demand is air conditioning, which will be increasingly needed as a result of economic growth and climate change. The IEA forecasted a skyrocketing growth in cooling units in the MENA region, passing from 52 million in 2018 to 210 million units by 2050 (OECD and IEA 2018). Also, water scarcity represents a pivotal driver in the projected rise of energy

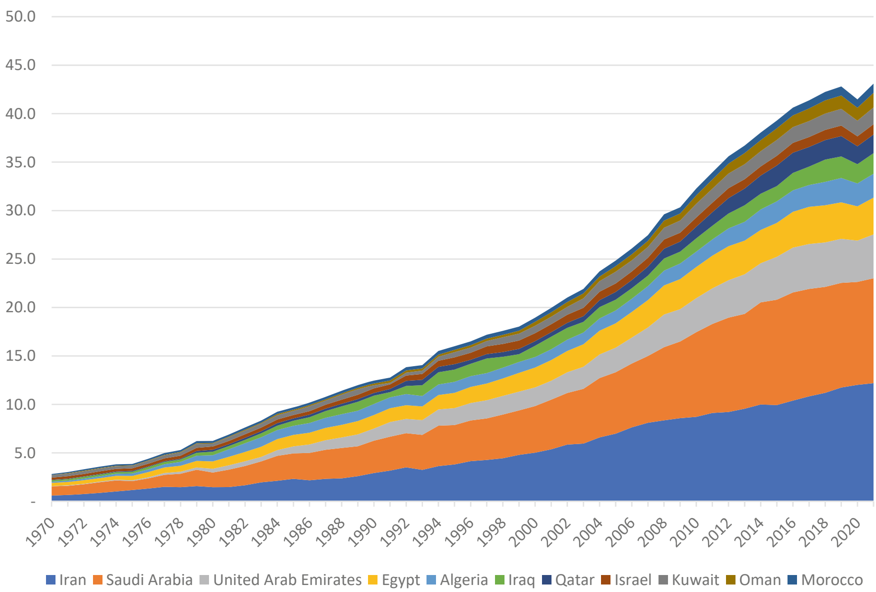


Fig. 1.5 Primary energy consumption in selected MENA countries, 1970–2021 (Exajoule). *Note* Primary energy comprises commercially traded fuels, including modern renewables used to generate electricity. *Source* Authors' elaboration on BP (2020)

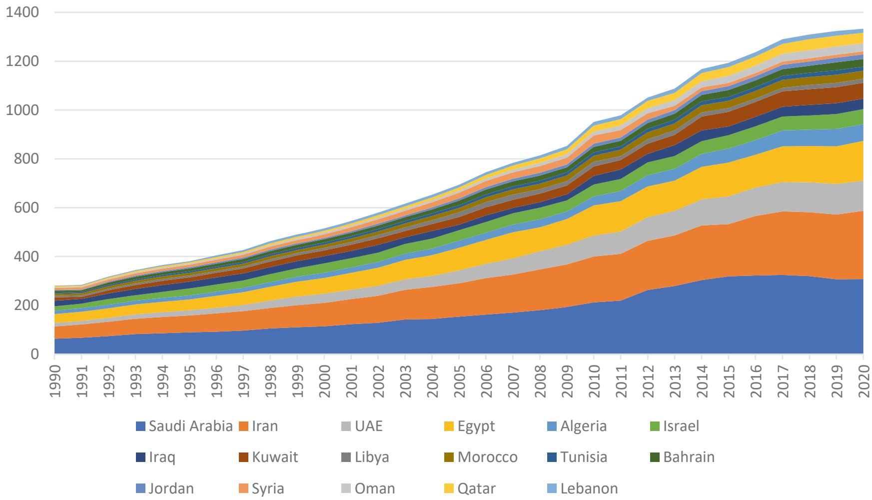


Fig. 1.6 Electricity domestic consumption in MENA countries, TWh, 1990–2020. *Source* Authors' elaboration on ENERDATA

demand across the region. The MENA region is the most water-stressed region in the world, with 12 out of 17 of the most stressed world countries present in this region (Bahrein, Iran, Israel, Jordan, Kuwait, Lebanon, Libya, Oman, Palestine, Qatar, Saudi Arabia, United Arab Emirates, Bahrain and Oman) (WRI 2019). According to the World Bank, MENA countries are likely to witness the largest economic losses due to water scarcity within the framework of climate change, amounting to 6–14% of GDP by 2050 (WRI 2019). Water scarcity is a key driver of electricity demand since more and more countries, especially in the GCC, are increasingly relying on seawater desalination plants—a particularly energy-intensive industry—to meet the domestic water demand for households and industries, while they keep relying on fossil aquifers for agriculture. Nowadays, desalinated water accounts for more than 90% of total water supply for households and industries in Qatar and the UAE and roughly 60% in Saudi Arabia (IRENA 2019). An increasing population, economic growth and the localization of industries within these countries make a rise in water demand inevitable, leading to an increasing reliance and use of seawater desalination plants, further boosting domestic electricity demand.

The region's energy mix relies heavily on oil and natural gas. This is certified by the share of fossil fuel energy consumption of total primary energy supply compared to the other world's regions (Fig. 1.7). As of today, natural gas and oil account for 97.4% of the total primary energy supply in the MENA region.

Oil has been inevitably the dominant energy source in the region; however, its relevance has recently diminished due to the higher use of natural gas. The availability of cheap fossil fuels, low domestic energy prices, demographic growth and better economic conditions as well as ambitious industrialization plans (with a specific preference for energy-intensive industries) have contributed to positioning many MENA

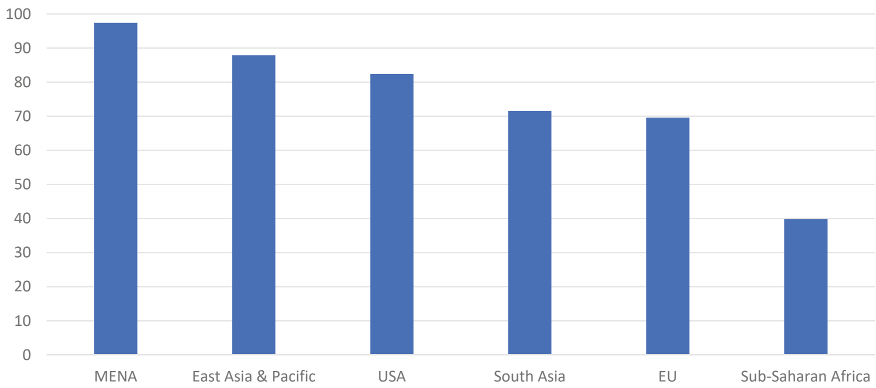


Fig. 1.7 Fossil fuel energy consumption (% of total primary energy supply) by world region in 2015. *Data on South Asia and Sub-Saharan Africa are related to 2014. *Source* Authors' elaboration on World Bank data

countries among the highest energy-intensive countries in the world (Fig. 1.8). Countries such as Iraq and Libya experienced a skyrocketing CO_2 intensity rate due to the negative effects of wars and social instability on their GDP. Most MENA countries' CO_2 intensity rates have been rising, or at least remained stable, over the past decades. This condition is certainly the result of comparative advantage in energy-intensive industrial activities. However, it is also true that current pricing policies encourage wasteful energy consumption, disincentive energy efficiency measures and damage the wider economy along with its environment.

It also must be said that in the past four decades, many developed countries decided to relocate their production outside their borders as they were shifting towards a more service-based economy. This process contributed to increasing carbon intensity in

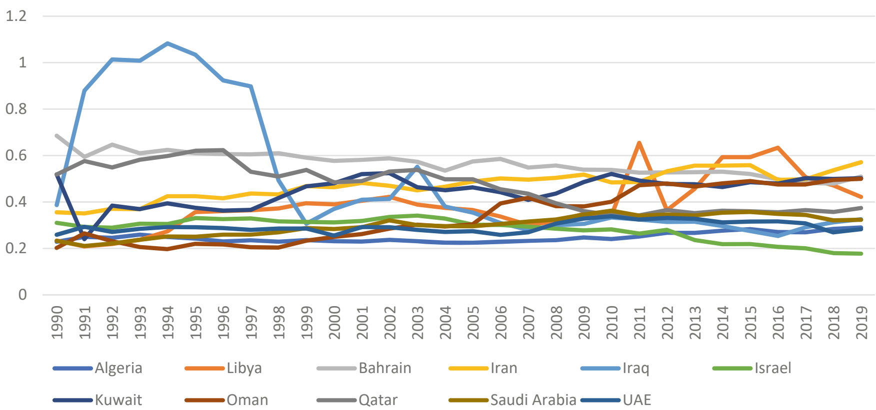


Fig. 1.8 CO_2 intensity to GDP (in constant US$2015, PPP) in selected MENA countries 1990–2019 (kCO_2/$15p). *Source* Authors' elaboration on ENERDATA

other parts of the world, such as the MENA region. Currently, the measurement of carbon emissions is based on a production-based approach, which calculates the CO_2 produced within a country's borders and does not fairly represent the reality of carbon intensity. A consumption-based approach, which calculates the emissions related to the production and supply of the goods and services consumed in the concerned country, would be much preferable.

1.4 History

The region has been the theater of multiple conflicts and tensions among which the unresolved and long-lasting Israeli-Palestinian conflict; the Suez Crisis in 1956; the Iran-Iraq war in 1980–88; the Iraqi invasion of Kuwait in 1990; the US-led invasion of Iraq resulting in the overthrow of Saddam Hussein in 2003; and multiple intra-state and inter-state tensions across the entire region, not least the regional turmoil that spread across the entire area in 2011, known as the Arab Springs. The origins of many of these conflicts pre-date oil, and some have ancient causes, such as the early succession to the Islam leadership after the death of the Prophet Muhammad, and later extra-regional influences due to the colonization process. But it is clear that oil is what made the region important in world affairs. Oil has exacerbated the underlying tensions, it has drawn in the great powers—over and over. Giacomo Luciani (2017) affirmed that oil—and more precisely oil rent—has created a regional dynamic whereby major political developments take place at the regional rather than the single-state level. Under such circumstances, all major political movements in the region have a regional, not country-specific, dimension. The Arab Springs embody this feature.

The significant abundance of hydrocarbon reserves has profoundly shaped the regional political economy and its sociopolitical structure, as illustrated by the Rentier State Theory (Beblawi and Luciani 1987). However, fossil fuels are only the latest chapter of MENA's long history, which has contributed to creating some relevant common features across the region. A first major episode that unified the region was the birth of Islam in 610 A.D. and its impressive expansion after the Prophet's death (632 A.D.). Another unifying factor is the Ottoman Empire, which ruled a great portion of the region until its collapse with the end of World War I. These two experiences inevitably marked common elements at the regional level, although peculiarities remained at the local level.

Foreign powers played a significant role in the area. At the beginning of the XX century, with the slow decline of the Ottoman Empire, two main powers stepped up as major foreign players in the Middle Eastern and North African countries: the United Kingdom and France. Their early involvement in the region was primarily commercial. Nevertheless, they were also motivated by competition between each other and other powers. Britain attempted to control the power vacuum left by the steady decline of the Ottomans, with the specific goal of preventing potential encroachments by Russia and France to its major colony, India. The involvement of Britain alarmed

France, which increased its presence in the entire region and stood up as the protector of the Christians, many of whom were historically concentrated in the Levant.

That growing engagement of some major European countries led to the creation of new borders and mandates, especially with the renowned 'Sykes-Picot Agreement' in 1916. Indeed, at the end of World War I, the Ottoman Empire collapsed and Britain and France split up the region and put in place the mandate system, officially becoming the region's dominant powers. The UK acquired direct control on Palestine and Iraq, while France on Syria and Lebanon. Egypt and the Emirate of Transjordan existed in a state of precarious independence, with Britain remaining the true master of their destinies (Kamrava 2013).

At the beginning of the XX century, oil had a limited relevance in the foreign powers' diplomacy in the region. As World War I approached, oil started to become more and more strategic. The decision taken by Winston Churchill, as First Lord of the Admiralty, to convert the British Royal Navy to oil from coal before World War I posed oil at the top of the strategic agenda of many countries (Yergin 2009). Later, the widespread use of the internal combustion engine in particular in the automotive sector and its large deployment, starting from the US, dramatically increased the demand for oil. This inevitably raised the issue of a stable oil supply, leading to a growing interest for the Middle East.

With the decolonization process (Table 1.7), the dominance of the European powers over most of the MENA countries started to slowly but inexorably decline. In some cases, political independence happened to be a swift process, while in other cases it was achieved after prolonged conflicts, such as Algeria which suffered a 9-year independence war with France in 1954–62.

After World War II, the progressive rise of the American influence has further undermined the European influence over the region. The famous meeting between President Franklin D. Roosevelt and Saudi King Abdul Aziz Ibn Saud on the USS Quincy in the Suez Canal on Valentine's Day 1945 is considered the dawn of the long-lasting relationship between Washington and Riyadh (Yergin 2009). A simple concept was at the heart of this alliance: the US would guarantee security to the Kingdom in return for access to affordable energy supplies. Since then, energy (i.e. oil) has become a major component of the region's geopolitics and a major driver of external engagement with the region. Washington began to position itself in the Gulf, taking the leading role at the expense of the Europeans while ensuring oil flows and consolidating its alliance with the Saudis. The European decline and the opposite rise of the US in the region became remarkably clear with the Suez Canal crisis in 1956.[2]

Although the Suez Canal marked the decline of European influence in the region, European countries did not completely withdraw from this area. An example is the role of the British military, which left the Gulf only in the 1970s. The result was the

---

[2] Britain and France, together with Israel, waged war against Egypt, ruled by Nasser, who declared the nationalization of the Suez Canal. While the UK defended the Suez Canal as a strategic waterway for several years, the US intervened threatening serious damage against Britain. The US did not want to alienate Arab oil producers, which could have embargoed oil shipments from the entire Middle East.

Table 1.7 Independence year of selected MENA countries

Country	Independence year	Former colonial country
Egypt	1922	Britain
Iraq	1932	Britain
Saudi Arabia	1932	Ottoman*
Lebanon	1943	France
Syria	1946	France
Jordan	1946	Britain
Oman	1950	Portugal
Libya	1951	Italy
Morocco	1956	France
Tunisia	1956	France
Kuwait	1961	Britain
Algeria	1962	France
Bahrain	1971	Britain
Qatar	1971	Britain
United Arab Emirates	1971	Britain

*The Ottoman control over the area ultimately ended in 1918. 1932 represents the formation of the Kingdom of Saudi Arabia after the unification of the dual kingdom of the Hejaz and Najd, which had been administered as two separate units since 1927

Note Iran is not included in the table because it was not under formal colonial power.1979 is considered as independence year, commemoration of the Iranian Revolution

Source Authors' elaboration

division of the MENA region into spheres of influences: the US oversaw mainly the Gulf, while the European countries established stronger ties with the North African countries (thanks to their vicinity and historical ties).

Since the end of World War II, energy has become a decisive component of the geopolitics of the region, which would have been very different without its great hydrocarbon endowment. The presence of oil has shaped the policies and alignments of all the countries of the MENA region over the last decades, not only with each other but also with the great global powers. Indeed, although all the countries achieved independence, the influence of external powers has remained a key feature of regional politics. At the beginning, oil was primarily a British interest. The US then expanded their presence, especially in the Gulf, in the post-World War II period. After 1979, the competition between the two main Gulf countries (i.e. Saudi Arabia and Iran) erupted, with the two competing across the region at different intensity throughout the years.

In 2011, with the widespread social revolt movement ('Arab Spring'), the region experienced a major turmoil. The Arab Spring shocked the political structures in many MENA countries with the collapse of several long-lasting rulers (e.g. Hosni Mubarak in Egypt, Zine El Abidine Ben Ali in Tunisia, and Muammar Gaddafi in Libya). Since then, the region has witnessed a growing competition among regional countries, which could be described as civil war (Luciani 2017). Widening regional inequality, historical rivalries on several issues (e.g. Shiites-Sunnis) and geopolitical aspirations have inflamed regional cleavages (Map 3.2 Chap. 3 Sect. 3.1).

The growing competition among MENA countries is further exacerbated by the foreign interference of old (US and European countries) and new (China and Russia) foreign powers. As MENA countries are deeply exposed to global hydrocarbon markets and trends, the political and economic transformations in the region are further influenced by changing global energy dynamics, such as the shale revolution in the US, the rising energy demand of Asian-Pacific countries, notably China, and the global decarbonization process.

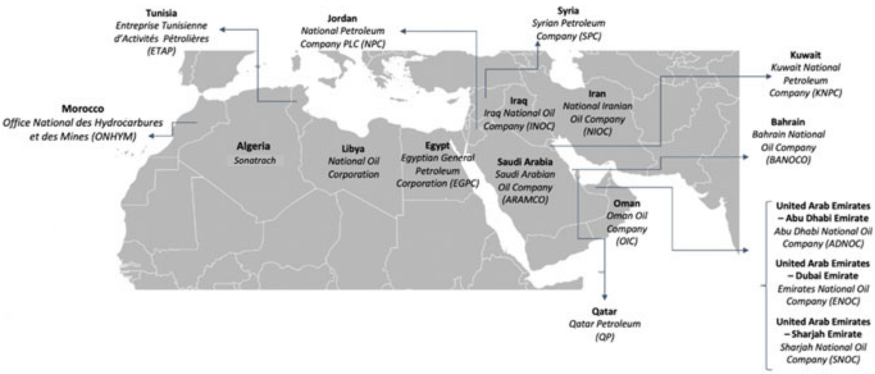
Thanks to its increase of shale oil output (increased by 10 mb/d between 2000 and 2019), the US has become the world's largest oil producer—17 mb/d in 2019 – reducing its dependence on oil imports and its interest in the MENA region. Furthermore, the rapid growth of US shale oil production has caused an abundance in the global oil market, thus depressing prices between 2014 and 2021, with negative economic consequences for the MENA region. On the contrary, the fast-growing economies of the Asia–Pacific region have increasingly expanded their energy consumption, intensifying their energy trades with oil-exporting countries in the area. Lastly, the global energy transition is gaining a worldwide consensus among governments and the private sector. Some major economies have expressed their commitment to become carbon–neutral by mid-century, which would leave only a small room for fossil fuels in their energy mix. That would reduce the world's oil demand (prompting forecasts on a looming oil demand peak) altering the strategic relevance of oil for some consuming countries. On the other side, some major emerging countries (e.g. China) may increase their hydrocarbon imports from the region, and consequently relevance in the energy sector of the MENA countries. These different drivers may yield major shifts in the geopolitics of the region.

The history of the energy sector, especially oil and gas, in the MENA region reflects its broader history in political and geopolitical terms. Between the two world wars and until World War II, most countries used to sign decade-long concession agreements with the different governments in the MENA region to develop oil fields with the major international oil companies (IOCs). These IOCs, known as Seven Sisters, included Anglo Persian Oil (later renamed British Petroleum), Royal Dutch Shell, Standard Oil of New Jersey (later renamed Esso, then Exxon), Mobil, Gulf, SOCAL (Chevron) and Texaco. These concessions provided very limited financial benefits for the host governments, which usually received royalties imposed at a flat rate as a percentage of the oil produced. The IOCs held control over all aspects of the industry leaving the host government with a very limited active role. These IOCs established an oil consortium (oligopoly), excluding competition and a free market. During this period, the Seven Sisters managed to keep oil prices under $2 per barrel from the 1950s until 1970 (Krane 2019). The only exchanges of crude oil were made among these companies with fully integrated upstream and downstream activities.

Thus, these IOCs would balance oil demand and supply to avoid oil price fluctuations. This system was in place only thanks to the concessionary agreements granted by the host states and the political weight of major powers. Thus, governments in the MENA region, but also in other oil producing regions, were dissatisfied with the terms of the oil concessions.

Some oil producing countries had already tried to free themselves from the IOCs' excessive power over production strategy and volumes as well as revenues. Lazaro Cardenas in Mexico and Mohammed Mossadegh in Iran are two of the early episodes of expropriation and nationalization of natural resources at the expense of IOCs. In 1938, the Mexican President ruled the overnight expropriation of all foreign oil assets handing the petroleum industry to a newly created national oil company, PEMEX, referring to Article 27.4 of the 1917 Mexican Constitution, which declared that underground resources belonged not to those who owned the property above (i.e. IOCs), but to the Mexican state. In 1951, Mossadegh, the Iranian Prime Minister, took a similar decision targeting British assets, namely the Anglo-Iranian Oil Company. However, in both occasions, foreign players reacted strongly against these attempts. In 1953, for example, a US-backed coup overthrew Mossadegh and restored a large share of foreign control over Iranian oil reserves.

Even though IOCs managed to resist the first wave of nationalizations, from the beginning of the 1960s the Seven Sisters began to see their power and monopoly crumbling. The first major change was the evolution of the oil market. New actors, companies, began to enter into the international oil industry, resulting in the loss of IOCs' control over oil trade. The advent of Soviet oil in the European markets further contributed to increasing the competition. In the 1950s–1960s, following the movements to achieve full independence from mostly European powers, and the later attempt to diminish external influence, countries in the MENA region also launched a nationalization process of key economic sectors, namely energy, which led to the creation of National Oil Companies (NOCs) (Map 1.2).



Map 1.2 National Oil Companies by country. *Source* Authors' elaboration

In 1960 the Organization of Petroleum Exporting Countries (OPEC) was established in Baghdad to further strengthen the countries' position in the energy sector with respect to international oil companies, and to coordinate the decisions of the different exporting countries. The founding members of OPEC were Saudi Arabia, Iraq, Kuwait, Iran and Venezuela, but the organization was soon enlarged to also comprise Qatar, Indonesia, Libya, Algeria, the Emirate of Abu Dhabi, Ecuador, Gabon and Nigeria. OPEC, however, failed to gain control of the oil prices, which continued to be determined by the IOCs over the following 13 years. OPEC was a response to the IOCs' unilateral cut in the posted price of oil, which was the reference price for tax assessment. IOCs were forced to cut posted oil prices to address a situation of oversupply in the oil market between the mid-1950s and 1960 caused by the entry of new actors and the limits on oil imports imposed by the US government (Nakhle and Petrini 2020). Therefore, IOCs decided to reduce posted prices in order to preserve market share and to relieve the pressure on their profits. This strategy inevitably caused a substantial loss of revenues (15% reduction of revenues) for the host countries (Chalabi 2010). According to the concessionary system, government revenues from a barrel were calculated as 50% of the official posted price, less than half of the production cost per barrel.

However, some major changes occurred in the global oil markets in the early 1970s setting the right conditions for the rise of OPEC as a major player in the oil markets. In that period, a market and price setting power shifted from the IOCs to OPEC, mainly driven by the tight supply–demand conditions that emerged in that period. Between 1970 and 1973, global demand for oil increased at a fast rate with most of the rise in demand met by OPEC countries, strengthening OPEC power vis-à-vis IOCs. That is one of the key components of OPEC success compared to the previous wave of nationalizations (Mexico and Iran), which failed to gain control at the expense of the IOCs. In the 1970s, OPEC governments became increasingly aware of such growing power and started to seek higher stakes on their sales. The rise of oil prices in the 1970s (fourfold increase in the oil price in 1973) terminated IOCs' dominance era. Several factors contributed to the rise of oil prices, which were beneficial also for the IOCs. Indeed, they had the opportunity to start their development and exploration activities in other areas (e.g. North Sea, Alaska, Gulf of Mexico) with higher extraction costs, which were not sustainable under their old oil price regime. The larger this market, the lower the share of market under the Seven Sisters, whose production share dramatically decreased from 85% in 1950 to 72% by 1960 (Cleveland 2009).

Over the years, the role of IOCs in the MENA region decreased, and the different countries established their own NOCs, such as ARAMCO in Saudi Arabia, Sonatrach in Algeria, Qatar Petroleum in Qatar, National Iranian Oil Company in Iran or National Oil Company in Libya and so on. Recently, however, IOCs have again gained positions in this region, due to the internationalization of NOCs, which are willing to expand their activities in other countries and sectors (such as renewable energy) to keep pace with the global transformation of the energy sector. The internationalization of NOCs is also sometimes driven by the need to enhance technical know-how and expertise to be able to fully compete with private companies worldwide.

The nationalization of resources, which led to high levels of oil and gas revenues, also shaped the socio-political structure of both hydrocarbon-rich and hydrocarbon-poor countries in the region. Thanks to the oil rent, governments in the region provide a very generous wealth distribution system (e.g. energy subsidies, cash transfers, and other social benefits) to their citizens without the need to collect taxes from them. That is the root of a social contract between rulers and citizens which guarantees the allocation of wealth to the citizens at the expense of their social and political participation. The term social contract might be defined as "*entirety of explicit or implicit agreements between all relevant societal groups and the sovereign (i.e. the government or any other actor in power), defining their rights and obligations towards each other*" (Loewe et al. 2019). Building on this bargain, Luciani and Beblawi have coined the term "rentier economy" for natural resource-endowed countries that rely on an external rent, in the absence of a domestic productive sector with a very small share of the population involved in the generation of the rent, while all the citizens enjoy its distribution and benefits (Beblawi and Luciani 1987). Another peculiarity identified is that the government, in a "rentier state", is the main recipient of the external rent. Consequently, a rentier economy also needs to have a rentier mentality, in other words the reward is not given by work and productivity but rather by luck and by the situation. Thus, in the MENA region, most countries, even the resource-poor ones, have adopted a rentier mentality, namely wealth sharing policies and citizens' attitudes are at the core of the states themselves. Nationals are entitled to free education (also at the tertiary level), free healthcare, generous subsidy schemes and cash grants, and they overwhelmingly work in the public sector, benefiting from higher wages, earlier pension age, shorter working hours and higher overall security. Patronage and rent sharing are key drivers of the high demand of public sector jobs, even when the sector is saturated (Hertog 2020).

This brief overview aimed at describing the major common features of a complex region such as the Middle East and North Africa. The region is often considered as a whole due to its several similarities in economic, energy and historical terms. Nonetheless, it is also fragmented. What is striking is the regional implications of different phenomena rather than country-level peculiarities. The energy transformation, which is a global development, will deeply affect MENA countries and the region as a whole. However, the different choices of each MENA country will affect other MENA countries as well.

Bibliography

Alvaredo F, Piketty T (2014) Measuring top incomes and inequality in the Middle East: data limitations and illustration with the case of Egypt, Economic Research Forum, Working Paper No. 832, May 2014

Beblawi H (1987) The rentier state in the Arab World. Arab Stud Q 9(4):383–398
Beblawi H, Luciani G (eds) (1987) The rentier state: nation, state and the integration of the Arab World. Croom Helm, London
BP (2020) Statistical review of world energy
Cammett M, Diwan I, Richards A, Waterbury J (2015) A political economy of the Middle East, 4th edn. Westview Press, Boulder
Chalabi FJ (2010) Oil policies, oil myths: observations of an OPEC Insider. Bloomsbury Publishing, London
Cleveland CJ (2009) Concise encyclopedia of the history of energy. Elsevier, Boston
ENERDATA (n.d.) Global energy & CO_2 Data, database
Ghobadi M (2019) Middle East electricity demand will triple by 2050, powered by rapid growth of wind and solar energy. DNV. https://www.dnv.com/news/middle-east-electricity-demand-will-triple-by-2050-powered-by-rapid-growth-of-wind-and-solar-energy-136544. Accessed 28 July 2021
Hertog S (2020) The 'rentier mentality', 30 years on: evidence from survey data. British J Middle Eastern Stud 47(1):6–23
IEA (2020) Middle East. IEA. https://www.iea.org/regions/middle-east. Accessed 25 July 2021
IRENA (2019) Renewable energy market analysis: GCC 2019. IRENA, Abu Dhabi
Kamrava M (2013) The modern middle east. A political history since the First World War, 3 edn. University of California Press
Krane J (2019) Energy kingdoms. Oil and political survival in the Persian Gulf. Columbia University Press, New York
Loewe M, Trautner B, Zintl T (2019) The social contract: an analytical tool for countries in the Middle East and North Africa (MENA) and Beyond. Deutsches Institut für Entwicklungspolitik (DIE), Briefing Paper, 17/2019. https://www.idos-research.de/uploads/media/BP_17.2019.pdf
Luciani G (2016) On the economic causes of the Arab Spring and its possible developments. In: Selvik K, Utvik BO (ed) Oil states in the New Middle East. Uprisings and stability, Routledge, pp 188–204
Luciani G (2017) Oil rent and regional economic development in MENA. In: Luciani G (ed) Combining economic and political development: the experience of MENA. International Development Policy series 7. Graduate Institute Publications, Boston: Brill-Nijhoff, Geneva, pp 211–230
Malik A (2017) 'Rethinking the Rentier Curse'. In: Luciani G (ed) Combining economic and political development: the experience of MENA. International Development Policy series 7. Graduate Institute Publications, Geneva, Brill-Nijhoff, Boston, pp 41–57
Nakhle C, Petrini F (2020) The changing relationship between OPEC countries and international oil companies. The dynamics of bargaining power in an evolving market. In: Harald Claes D, Garavini G (eds) Handbook of OPEC and the global energy order. Past, present and future challenges. Routledge International Handbook
OECD and IEA (2018) The future of cooling. Opportunities for energy-efficient air conditioning. IEA, Paris
UN DESA (2019) World population prospects 2019. UN DESA
World Bank (2019a) Population growth (annual %)-Middle East and North Africa. The World Bank Data. https://data.worldbank.org/indicator/SP.POP.GROW?locations=ZQ. Accessed 7 Nov 2020
World Bank (2019b) GDP Growth (annual %)-Middle East and North Africa. The World Bank Data. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=ZQ. Accessed 7 Nov 2020
WRI (2019) 17 countries, home to one-quarter of the world's population, face extremely high water stress, Insights, August 2019. https://www.wri.org/insights/17-countries-home-one-quarter-worlds-population-face-extremely-high-water-stress
Yergin D (2009) The prize. The epic quest for oil, money & power. Free Press, New York

Yousef TM (2004) Development, growth and policy reform in the Middle East and North Africa since 1950. J Econom Perspectives 18(3):91–116

Chapter 2
Domestic and International Drivers and Challenges for the Energy Transformation in the MENA Region

This Chapter focuses on some key socio-economic features of MENA countries and their impact on the energy sector. Both domestic and international drivers for a transformation in MENA countries are analyzed. While being characterized by a great ***heterogeneity*** *in terms of population, energy and economics, the MENA region presents also some common features that can be considered both drivers and obstacles for the transformation in each country.*

Domestically*, the pervasive role of oil rents has shaped profoundly the sociopolitical and economic structure of the countries, for example the low role of private sector or the labour market, which depends on cheap imported labour force. Governments see the energy transition as a potential driver for the creation of a more diversified economy, more jobs for their young, growing population. Another key obstacle for the transformation is the issue of (universal) energy subsidies, which encourage inefficient, ramping energy demand growth—mainly based on fossil fuels. Furthermore, the extensive use of fossil fuel subsidies is also responsible for economic and environmental issues. By encouraging the consumption of fossil fuels, countries face a growth in emissions with negative impacts on the environment. Moreover, they also affect macroeconomic aspects with oil-importing countries facing high energy import bills and oil-exporting countries experiencing an erosion of hydrocarbon export volumes. Reforming fossil fuel subsidies remains quite challenging as they are a key pillar of the social contract. For these reasons, governments need to pursue a holistic approach in reforming their economies and societies as energy transformation will require a multidimensional reforming process given the deep link between society and oil.*

Additionally, there are ***international factors*** *that incentivize and induce energy transformation in the MENA region. Firstly, the global commitment towards the fight to global warming contributes to encourage the transformation in the region. Growing international pressure has increased and MENA countries have started to announce their own ambitious climate pledges. Since*

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_2

2021, a group of MENA countries, mainly located in the Gulf, have pledged to net-zero targets by and around mid-century. This is driven by international pressure but also the need to adapt and mitigate the existing negative consequences of climate change in the region, which are expected to exacerbate the regional fragile environment (e.g. rising temperatures, sea levels as well as water stress and scarcity). The exposure to such climate developments encourages MENA governments to consider energy transformation through the deployment of renewables in order to reduce their climate footprint and reduce negative climate consequences both regionally and globally. Lastly, MENA countries have considered possible measures to transform their energy and economic model in order to adapt to the upcoming reduction in global oil and gas demand due to the global energy transition in light of the International Energy Agency's scenarios.

The need to transform the oil-based socioeconomic and energy model of MENA countries is the subject of periodic debate. Indeed, oil rents, accruing directly to the states from the rest of the world, have shaped the region's political economy and sociopolitical structure. The evolution of this region, and its socioeconomic development, are deeply interlinked with the evolution of oil revenues, which depend on the volume of exports and on the trends in oil prices. Since 1970, numerous scholars (e.g. Mahdavy 1970; Beblawi and Luciani 1987; Beblawi 1987; Anderson 1987; Gray 2011; Herb 2005; Luciani 2019) have extensively analyzed the effects of (oil) rents on the MENA region and its political economy, under the paradigm of the Rentier State Theory.

Today, MENA countries have to face several challenges, notably weak private sectors, high unemployment rates, low productivity, and autocratic regimes. All of these issues are a result of the region's economic structure, which is based on an overdependence on unearned and external income streams (the so-called "rents").

This domestic aspect is not the only driver for the region's transformation. In recent years, climate change and the fight against global warming have become key issues in the international political debate. Countries have steadily created an international climate change regime to mitigate and adapt to the effects of global warming. To achieve the international climate targets set by both the international community and national governments, the world's economy needs to undergo a drastic change, and to move away from fossil fuels and the resulting peak in oil demand. This poses a dual challenge for MENA countries: the need to reduce their energy dependence on polluting energy sources, while finding alternatives to (unabated) fossil fuels exports for governmental revenues.

This chapter presents the common challenges and features of the rentier state in an energy and economic perspective to better understand what drives and/or hinders the energy transformation of the MENA region. It also addresses the international drivers, namely the international climate change regime and the fight against global warming.

2.1 The Role of Oil Rents: Economic Dependence

In MENA countries the hydrocarbon sector accounts for large shares of their revenues and exports, playing a pervasive role in their economy. In 2019 the hydrocarbon sector accounted for 70% of exports revenues and 50% of GDP in Saudi Arabia, and it covered 92% of exports revenues and 40% of GDP in Kuwait (OPEC 2019).

Table 2.1 highlights the conspicuous oil and gas rents of numerous MENA countries. The rent is here defined as the export revenues minus the production/export cost. The export revenue is the product of export volume and export price. The economic dependence on oil revenues is increasingly visible as oil prices rise. Throughout the last cycle of oil prices (2000–2014), hydrocarbon rents in percentage of GDP increased in all countries. Major Gulf oil-producing countries are the ones with the highest oil rents, with the exception of Iran. International sanctions have drastically hindered Iran's ability to export hydrocarbons and collect their rents, stressing the need to find new solutions to diversify Iran's economy (e.g. agricultural products). In North Africa, Egypt has reduced its dependence on oil rents thanks to two major revenue sources: tourism and the Suez Canal fees.

Due to the high dependence of MENA countries on oil revenues, economic diversification is a major political issue, fueling numerous analyses and debates. However, countries need to deal with the cyclical evolution of oil prices. While low oil prices force countries to diversify, high oil prices make economic diversification more challenging. With high oil prices, every dollar invested in the hydrocarbon sector generates a much higher return than a dollar invested in non-hydrocarbon sectors. At times of growing oil prices, economic diversification may well be taking place, but it is obscured by the inflation of value added in the oil sector. By contrast, when prices decline, diversification becomes more visible (Luciani 2019).

Table 2.1 Oil and gas rents (% of GDP) and Brent oil prices ($/barrel)

	2000	2005	2010	2014	2015	2016	2017	2018
Algeria	24.1	32.9	26.5	24.4	16	12	14.6	18.8
Saudi Arabia	43.1	51.1	38.7	41.1	24.1	19.9	23.6	29.4
UAE	21.9	25.9	22.6	24.2	14	11.3	13.6	17.3
Qatar	42	43.2	33.8	30.6	20	15.3	17.9	21.2
Kuwait	49.5	56.9	49.5	55.2	38	32.5	35.9	43
Egypt	6.8	14	8.9	8.1	3.6	2.6	4.8	6.4
Iraq	N.A	63.9	42.6	45.7	35	30.6	37.3	45.6
Iran	32.6	34.3	22.1	26.1	15.5	12.9	17.4	N.A
Libya	34.7	63	54.2	42	28.2	22.1	38.4	43.3
Bahrain	6	6.5	6	8.6	5.1	3.2	3.4	4.3
Oman	46.7	46.9	39.6	39.2	23.9	19.7	23.4	29.1
Brent oil prices	28.5	54.5	79.5	98.9	52.3	43.7	54.1	71.3

Source Authors' elaboration on World Bank and BP

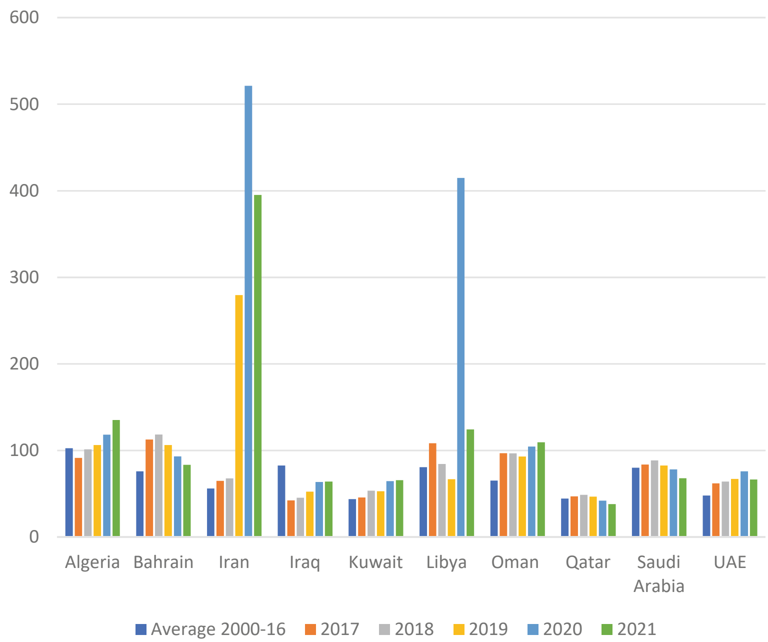


Fig. 2.1 Fiscal breakeven oil prices for selected MENA oil exporting countries (US$/b). *Source* Authors' elaboration on IMF

The relationship between hydrocarbon revenues and national budgets represents a concern if governments do not put in place an adequate response to tackle volatile revenues. Indeed, hydrocarbon revenues fluctuate depending on oil price cycles. In 2018, the IEA's Special Report on Oil Producing Economies (2018) pointed out that MENA countries have too often implemented their spending plans on the basis of current oil prices, meaning that government expenditure rises while prices are high and comes down when they fall. This "pro-cyclical" approach has jeopardized the region's fiscal and financial sustainability. It is difficult to reverse expansionary policies, implemented when oil prices are high, with austerity policies enforced when oil prices are low, given the social contract in place in the region. When the price of oil dropped in 2014, fiscal issues emerged as the oil prices were no longer able to satisfy the countries' fiscal breakeven oil prices,[1] summarized in Fig. 2.1. Fiscal breakeven oil prices, which are driven by budgetary expenditures, have been well above the market oil price in most MENA countries.

A short-term solution to offset the volatility of oil prices and revenues is to draw financial resources from the financial reserves. Some of the oil-exporting countries have managed to enhance their financial reserves when the oil prices were high. Nonetheless, particularly after the 2014 oil price drop, these countries had to use

[1] Fiscal breakeven oil price is the oil price at which the fiscal balance is zero (under the IMF's definition).

their resources to keep their welfare state running, while preventing social unrest. The result is that the financial reserves of countries such as Algeria and Iraq eroded significantly over the course of a few years. For example, in 2013 Algeria had a record of $195 billion of foreign reserves, which started to drop rapidly in 2014. In 2020, Algeria's foreign reserves stood at slightly above $59 billion and at this rate it is expected that they will be gone in 2022. Also Saudi Arabia had to resort to drawing from its financial reserves, which peaked at over $730 billion in 2014 and had fallen by some 30% by 2017 due to low oil prices (IEA 2018). In 2020, Saudi Arabia's reserves stood at $472 billion.

In this context, MENA countries have consistently announced diversification plans and strategies. Call for economic diversification are not new in the region; Saudi Arabia expressed its intention to diversify its economy away from oil revenues in its first National Development Plan back in 1970. As oil prices collapsed in 2014, economic diversification gained a new momentum. Moreover, economic diversification is also dictated by the medium and long-term forecasted decrease in global oil demand, rather than oil reserves depletion, due to the increasing relevance and efforts of decarbonization policies worldwide and international conventions (i.e. UNFCCC, United Nations Framework Convention on Climate Change). Following the publication of the Paris Agreement in 2015, McGlade and Ekins (2015) have estimated that roughly 40% of oil reserves in the MENA region will not be exploited. According to the IEA's Sustainable Development Scenario, where oil demand is forecasted to peak in the 2030s, hydrocarbon exporters are expected to lose between 25 and 40% of their revenues compared to the reference scenario (IEA 2020). Thus, MENA countries have considered enhancing the use of renewable energy sources in order to foster economic diversification. However, the all-pervasive role of oil and gas in the energy and economic structure of several MENA countries represents a significant barrier to the development of renewable energy sources.

2.2 The Prevalence of the Public Sector and Cheap Labor

The public sector is a key pillar of the social contract in line with the rentier mentality present in the region. Indeed, the share of people employed in the public sector in the MENA region is far higher than in most other regions in the world: 14% in Morocco, 17% in Iran, 19% in the UAE, 20% in Qatar, 21% in Syria, 25% in Egypt, 26% in Kuwait, 30% in Iraq, 32% in Algeria, 32% in Palestine, 38% in Saudi Arabia and 40% in Jordan. These percentages are higher if only the nationals are taken into account, especially in GCC (Gulf Cooperation Council) countries, since they are home to a high number of expats with all levels of skills, even outnumbering nationals in some cases. Since the first oil boom, increasing numbers of foreign workers flew into oil-rich countries. Now, migrant workers constitute the majority of the workforces in all Gulf countries, ranging from 53% in Saudi Arabia to 94% in the UAE (Mehlum et al. 2016). However, expats predominantly work in the private sector, in line with the Kafala migration policy.[2] Depending on the country, the public sector jobs were attributed only to nationals (i.e. GCC countries), or to those who had successfully attained a certain level of education (i.e. Tunisia and Egypt) or to those who belonged to tribes deemed essential for political stability (i.e. Jordan).

The lack of a developed private sector, and the reliance on public sector employment for political and stability purposes, has serious and damaging consequences on the economy of MENA countries. The reliance on public sector employment for political purposes and stability undermines the labor productivity of MENA countries since jobs depend neither on performance nor on achievements.

These two elements are the main reason for the low labor productivity expressed as the value added per employed worker in oil-producing MENA countries. The creation of numerous public sector jobs has not added significantly to economically productive activity. A large gap in average wages between the private and public sector contributes to the greater attractiveness of the public sector at the expense of the private sector. For example, across the GCC countries, the gap between average public and private wages is often between 150 and 250% (IEA 2018). The differences in labor productivity are particularly stark when comparing hydrocarbon-producing economies in the Middle East and North Africa with other countries in the region that import oil and gas.

This is because the private sector is motivated by the minimization of the cost of labor, accepting lower skills and qualification for the sake of lower wages. The meaning of declining productivity is that economic growth is achieved exclusively by increasing the number of expatriates. Overall, the structure of labor markets in the MENA region, especially GCC countries, is inadequate to enhance the competitiveness of the private sector, since it relies on the availability of cheap foreign labor rather than up-front technological investments, because of lower production costs. Oil-exporting countries in the MENA region enjoy cheap labor; however, this condition creates little incentive to invest in machinery that may improve labor productivity. Generally, machinery and technology require higher skills awarded with higher wages.

The expansion of the public sector also threats budgetary sustainability. For example, in Iraq the public sector has grown from 1.2 million employees in 2003 to around 3 million in 2018, posing a serious challenge to the state budget. Indeed, in 2016 Iraq spent over $30 billion in salaries, corresponding to 60% of the country's net income from oil and gas that year (IEA 2018). This context worsened due to the changing demography at the beginning of 2000s, when the MENA region experienced the so-called "youth bulge". Having one of the youngest populations in the world, the MENA region has failed to create enough jobs for its ever-growing youth, resulting in a high rate of youth unemployment. Indeed, the region experiences one of the highest youth unemployment rates in the world, totaling an average of 30% in

[2] The Kafala migration policy consists of the sponsorship system used in the GCC countries, Lebanon and Jordan. Under Kafala, a migrant worker's immigration and legal residency status is tied to an individual sponsor throughout his/her contract period in such a way that the migrant worker cannot typically enter the country, resign from a job, transfer employment, nor leave the country without first obtaining explicit permission from his/her employer.

2017 with respect to a world average of 13%, with however large differences across countries. Some of the highest youth unemployment rates (15–24 years old) in the region in 2019 have been registered in Palestine (37%) with Gaza at 61% (World Bank 2020), Jordan (37.2%), Tunisia (35.8%) and Saudi Arabia (30%) (World Bank 2021).

The use of the public sector for job creation has limits. In some cases, the share of public sector jobs declined, with the most prominent decrease in Egypt (from 35% in early 2000 to 21% in 2017). However, with the outbreak of the "Arab Spring", other countries, mainly the UAE, Jordan, Morocco and Tunisia, have substantially increased the share of employment opportunities in the public sector, on top of giving direct transfers to people as lump sum payments (i.e. KSA). Moreover, to counteract the protests, GCC countries also offered generous packages to public sector employees, among which a substantial increase in wages (the UAE and Qatar increased wages by between 50 and 120% in 2011). At the same time, however, the MENA region did not develop a private sector that would absorb the demand of jobseekers, given the reduction of opportunities in the public sector of most MENA countries.

2.3 Energy Subsidies: A Pervasive and Unsustainable Role

Another crucial aspect of MENA countries is low energy prices due to subsidies. Tom Moerenhout (2021) explains the rationale of low energy prices in the GCC countries (also true for other MENA countries) and why it is extremely difficult to pursue an energy pricing reform in this area. There are principally three reasons that undermine any energy pricing reform: (i) the central role that these subsidies play in welfare protection and distribution; (ii) the important role they play in industrial policy and economic development; and (iii) the political dimension and the social contract.

First, pricing policies in the MENA region are a key component of the social contract. The government, which is the main receiver of oil rents, is responsible for allocating and redistributing wealth. Low oil prices are one of the components of such a welfare state. Without any other changes in political representation and other social aspects, an increase of energy prices would represent a unilateral alteration of the social contract. Second, low oil prices can be used as a powerful industrial policy. They can promote and foster economic development and sustain specific industrial sectors and their competitiveness. For example, industrialization in energy-intensive sectors (e.g. petrochemicals, cement, aluminum and steel) has been a key aspect of GCC countries' industrial policy. Third, low energy prices are considered an instrument to preserve power and control through systems of patronage and rentierism. Given the crucial role played by energy subsidies in social and political stability, implementing pricing reforms is often politically costly and can threaten political stability.

Energy subsidy: lack of agreement on common definition and approaches

As of today, energy subsidy does not have a precise definition as international organizations and countries attribute different meanings to this term, albeit with many common elements.

There are fundamentally two approaches. On the one hand there is the **opportunity cost approach** (for instance measuring the subsidy as the difference between the domestic price and the international price (or even a domestic market price) of a commodity, and on the other hand there is the **supply cost approach** (thus comparing the price of a commodity to the cost of supplying it to the customers).

With regard to the opportunity cost approach, a widely used definition proposed by de Moor and Calamai (1997), defines a subsidy as "any measure that keeps prices for consumers below the market level or keeps prices for producers above the market level or that reduces costs for consumers and producers by giving direct or indirect support" (de Moor and Calamai 1997).

The problem with this definition is that it is sometimes difficult to define what the benchmark market (and thus price) is, in particular when a commodity is not (or cannot be) internationally traded as is the case for electricity, but often also for natural gas if it is only used domestically, and the conditions for a functioning domestic market price formation do not exist (for instance due to a monopolistic supply structure). There exists a large literature of energy commodity pricing in the presence of a monopolistic supply structure (Percebois 1999). Fundamentally, in this case, the Government (or Regulator) should set the price to be as low as possible for consumers in order to maximize the socio-economic development of the country, but high enough to incentivize suppliers to invest in a reliable supply. In this case, a subsidy exists if the price of the commodity is below the long run marginal cost of supplying that commodity to the domestic market (the term "long run" implies that future investment needs have to be incorporated in the tariff structure) in the case of increasing cost curves (the case of most production activities) and in any case guaranteeing the profitable operation of all operating companies (example transmission and distribution which have decreasing cost curves).

In the international literature, all too often subsidies for countries are calculated using the opportunity cost approach even though there may be good reasons to price a commodity below opportunity cost but above cost of supply. These reasons may be due to the fact that (a) the aim of a state-owned energy commodity producer is not to maximize its own profit but to foster the socio-economic development of the country, (b) international market prices are very volatile and not significant for the development of the domestic market, (c) there is no connection between the local market and the international markets of a specific commodity.

Whatever approach is used, two types of energy subsidies implementation forms can be identified: explicit and implicit. Explicit subsidies are the transfers written in the state's budget that the government gives to energy producers or consumers. Implicit subsidies, less transparent and more difficult to calculate, usually take place in oil producing countries with vertically integrated utilities, where the tariffs for consumers cover the production costs but are below international benchmark prices. In this way, the utility does not incur in losses and the government does not make explicit transfers to neither consumers nor producers (El Katiri and Fattouh 2015).

Having in mind these three aspects, it is clear how energy subsidies are a key socio-economic pillar of rentier states and more broadly of the so-called "social contracts" of most countries in the region. They are at the center of socio-economic stability and one of the few tools of social welfare systems in most other countries, especially before the 2011 Arab Spring and the decline of oil prices in 2014. For instance, some subsidy system reforms targeted specific energy sources, including petroleum subsidies in the case of the UAE at the federal level, and fossil fuel subsidies in the case of Jordan. On the other hand, few countries have been unable to implement energy subsidy reforms, mostly due to internal political struggles, as in the case of Algeria and Lebanon. Overall, Iran carried out one of the most comprehensive subsidy reforms in the MENA region, especially for an oil-producing country. This reform kicked off in 2010 and its main peculiarity concerned a universal cash transfer system (El Katiri and Fattouh 2015). Also, Egypt reduced the level of energy subsidies after the Arab Spring, and in 2014 it carried out a comprehensive energy subsidy reform, which also included measures to offset the negative impact of the reform on the most vulnerable households (through food subsidies and cash-based transfers) (Breisinger et al. 2019). Thus, contrary to Iran, these measures did not target the whole population. The following Figs. 2.2, 2.3 and 2.4 highlight the extent and economic burden of subsidies and the differences among MENA countries, both in absolute terms and as a share of GDP.

The sharp decline of oil prices in 2014 urged MENA countries to reconsider energy subsidy reforms to curtail the major drawbacks of this subsidy system. First of all, energy subsidies may seriously contribute to worsening macroeconomic conditions, in particular in those importing countries that guarantee to their citizens a lower price of the commodity than its import and distribution cost. This either requires other sectors to cross subsidize this commodity or it requires increasing the country's debt. Also, energy subsidies may hinder the efforts of energy mix diversification within the broader economic diversification framework. Indeed, energy efficiency measures are unlikely to be successful in a high energy subsidy environment and the introduction of renewable energy also becomes more challenging. Moreover, subsidized prices make energy utilities dependent on subsidies given by the government to keep their operations running, otherwise, they are not likely to be able to cover their operating costs. For highly indebted countries, such as Lebanon, the transfer of subsidies to

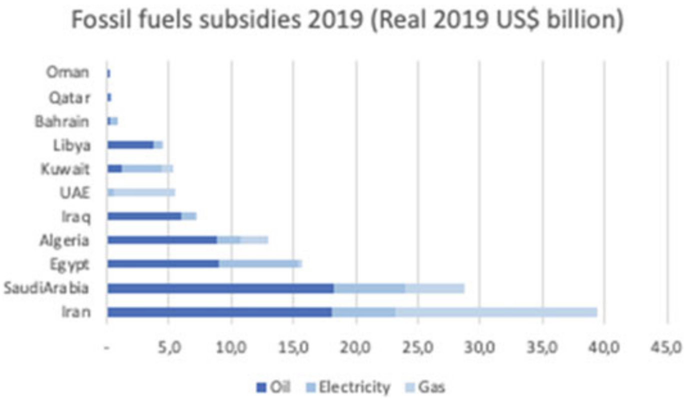


Fig. 2.2 Fossil fuel subsidies in 2019 (real 2019 US$ billion). *Source* Authors' elaboration on IEA data

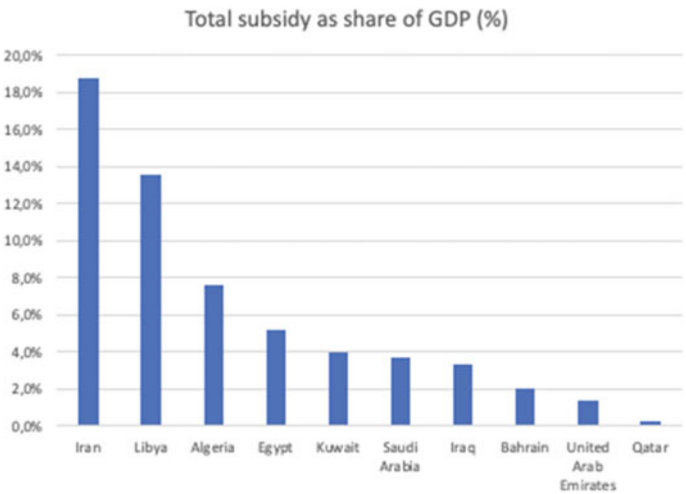


Fig. 2.3 Total subsidies as a share of GDP in 2019 (%). *Source* Authors' elaboration on IEA data

the power company EDL is highly inefficient and costly. Also, contrary to Europe, numerous countries in the region (e.g. Lebanon, Syria and Egypt) have adopted the so-called cross-subsidization, whereby residential energy tariffs are below cost level tariffs while industrial tariffs are above the cost levels in order to offset the difference. Higher tariffs for industries adversely affect the efficiency and the competitiveness of this sector and distort consumption. Lastly, energy subsidies in some cases are also regressive, which is a major disadvantage in a region where 20–40% of the total population is considered multidimensionally poor (Sida 2019). This is because energy subsidies can sometimes represent a major handout to the middle and upper classes and to the wealthy that can easily afford to consume more energy. Therefore,

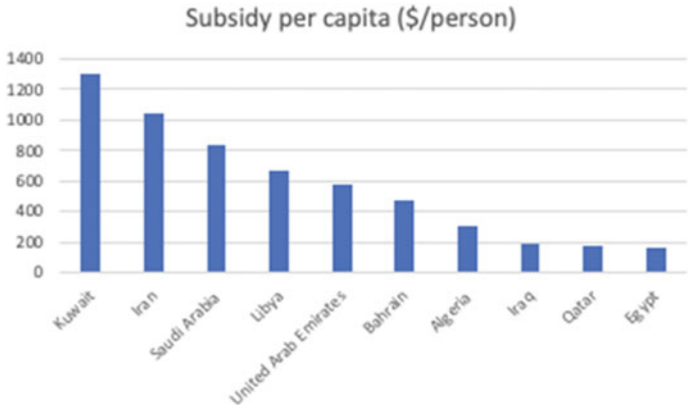


Fig. 2.4 Subsidy per capita in 2019 ($/person). *Source* Authors' elaboration on IEA data

it is crucial to reform energy subsidies in order to shift from universal subsidies and, at the same time, guarantee targeted subsidies to preserve and protect lower-income classes.

Since 2014, some countries have put in place some energy pricing reforms, undertaking different strategies and implementation timelines, as shall be discussed later in the following chapters. Nonetheless, energy subsidies are still widely used in these countries, incentivizing energy demand and representing a barrier for the deployment of renewable energy sources as well as energy efficiency.

From an energy perspective, low energy prices encourage domestic energy demand, including fossil fuels. As some MENA countries are large oil and gas exporters, a growing domestic energy consumption poses a direct threat to the socioeconomic model based on the revenues from oil rents. Indeed, higher domestic consumption erodes potential export volumes, which are vital for the governments' coffers. Indeed, the region's energy mix is highly dependent on fossil fuels with little diversification of sources, with a few exceptions (e.g. Morocco is also reliant on coal while Egypt on hydro). Figure 2.5 highlights the high reliance of numerous countries in the MENA region on fossil fuels and the relatively little diversification of their energy mix.

As occurred with natural gas over the last few decades, MENA countries have now turned to renewable energy sources in order to free additional oil barrels for exports. Thus, diversification of the energy mix from fossil fuels has become a priority for the great majority of countries in the region and the need of economic diversification has increased for the oil-exporting ones. On the other hand, resource-poor countries are striving to diversify their energy mix in order to be less affected by oil price volatility and to ensure a balanced energy trilemma (energy security, affordability and sustainability).

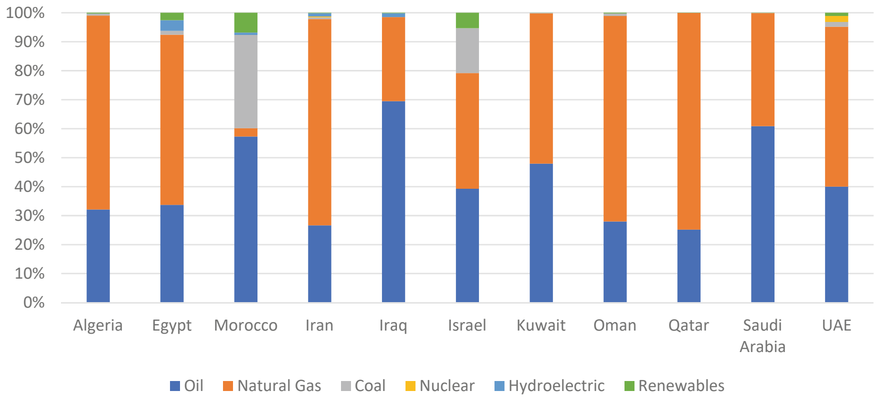


Fig. 2.5 Primary energy consumption by fuel, 2021. *Source* Authors' elaboration on BP (2022)

2.4 Growing Domestic Energy Demand and Water-Energy Nexus

All MENA countries need to satisfy their rising energy demand. Thus, growing domestic energy demand may be seen as a major driver for MENA energy transformation. These countries have experienced strong energy demand growth rate throughout the last decades. The MENA region's primary consumption expanded from 299 Mtoe in 1990 and 1024 Mtoe in 2019, i.e. an average growth rate of 4.3% per year. At the country level, Iran and Saudi Arabia are the two largest consumers in the region accounting for almost half of the region's total primary energy consumption in 2019. This growth is almost entirely satisfied by fossil fuels. More in detail, MENA countries, in particular Gulf countries, consume far more oil per capita compared to developed countries. In 2019, Gulf countries consumed between 37 and 45 barrels per capita, twice the US and even four times the EU (Fig. 2.6). Growing energy demand, and in particular high oil consumption rates, have increasingly forced MENA countries to consider energy transformation since becoming large fossil fuel consumers erodes directly the main income source for governments (i.e. oil export volumes).

Energy demand is expected to continue to increase in the following years mainly driven by population growth, economic expansion and industrialization plans. However, there are also other less human-driven causes that will eventually exacerbate the general trends: climate change and water demand. Water scarcity is a common feature in the MENA region. Out of the 17 most water-stressed countries in the world, eleven[3] are in the MENA region. Economic growth, population growth, the consequent rise in food and energy demand, are contributing to an increase in water demand. Moreover, agriculture plays a major role, accounting for 90% of overall water use—compared to a global average of 70% (UNICEF 2021). Unsustainable

[3] Bahrain, Iran, Jordan, Kuwait, Lebanon, Libya, Oman, Israel/State of Palestine, Qatar, Saudi Arabia, United Arab Emirates.

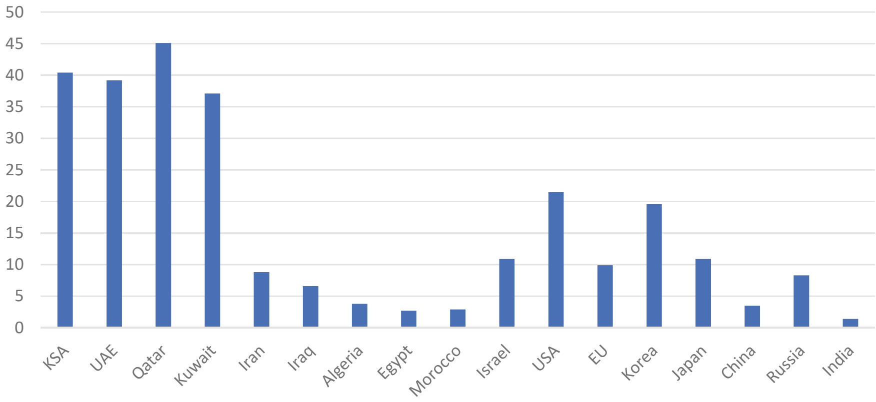


Fig. 2.6 Oil consumption per capita in selected countries in 2019, (barrel per capita in a year). *Source* Authors' elaboration on BP, UN DESA

water abstraction and groundwater development stress cause an irreversible depletion of groundwater resources in the MENA region. Furthermore, MENA water resources are characterized by a high dependence on transboundary waters, often shared by more than one country. 60% of surface water resources in MENA are generated outside the region with the region having three shared river systems (UNICEF 2021). Moreover, all countries in the area share at least one aquifer with a neighboring country. In this context, a strong cooperation policy is crucial to avoid free riders and potential water-related conflicts or tensions. Climate change is expected to further exacerbate the existing weaknesses in the water sectors.

To address all these challenges, MENA countries have increasingly invested in desalination plants. Currently, almost half of the global desalination capacity is located in the MENA region (48%), with three Gulf countries (Saudi Arabia 15.5%; the UAE 10.1%; and Kuwait 3.7%) being major producers in the area and globally. In terms of technology, the Middle East is an exception as it heavily relies on fossil fuel-based thermal desalination—the Middle East, led by the UAE and Saudi Arabia, accounts for roughly 90% of the thermal energy used for desalination worldwide. By contrast, the most common desalination systems installed worldwide are based on membrane technologies that use electricity, such as reverse osmosis. However, the Middle Eastern countries exploit the availability of cheap oil and gas and the prevalence of co-generation facilities for power and water. Thus, two-thirds of the water produced from seawater desalination in the region is from fossil fuel-based thermal desalination, even though the use of membrane technologies is expanding in the region. The rest is from membrane-based desalination that, however, relies on electricity produced using natural gas.

Growing water demand, expansion of desalination capacity and its overdependence on fossil fuels further increase energy—and more precisely fossil fuels—demand in the region. These trends are forcing MENA countries to transform their energy systems in order to satisfy the expansion of the demand side, while preserving a certain amount of fossil fuels for exports, which are currently vital for governmental revenues.

2.5 Rentier State and Governance: The Consolidation of Rulers

The idea that oil (rent) has hindered democratic developments in the region is widespread both in the academic sphere and in the media outlets, even if it may be controversial. It has often been stated that oil prevented democratic development in this region. In a rentier state, citizens are exempted from tax collection as the government enjoys financial independence by accruing revenues from oil rents. This provides a significant autonomy to the state. Citizens are less eager to request political participation as they do not need to pay taxes. As history teaches, democratic requests arise when taxes are imposed—and often increased—as occurred with the French Revolution. What is certainly true is that oil rents have contributed to the consolidation of regimes that would otherwise have faced serious challenges in the following decades. Especially in the Gulf, oil has indeed cemented power in the hands of the existing ruling families. Indeed, very few countries were democracies when oil rents began to flow into the governments' coffers. Furthermore, the great strategic relevance that oil gained after World War II prompted a major extra-regional involvement in the protection of the ruling families, in particular those who were in favor of Western countries.

The absence of income taxes represents a pillar of rentier economies. However, it hampers these countries' sustainability as they are fiscally dependent on oil revenues. Rentier economies in the region have increasingly considered to expand taxation, although it may weaken the existing social contract between citizens and their rulers. Some countries have gradually introduced VAT, such as the UAE and Saudi Arabia in January 2018, and even increased it (Saudi Arabia from 5% up to 15% in July 2020). Setting out taxes and energy subsidy reforms has to be a gradual process and has to be accompanied by the introduction of other benefits and social safety nets in order to maintain social stability and the political status quo.

The need of transforming energy and socioeconomic systems may contribute to modify the current political status quo. In the past years, MENA countries have rolled out some reforms, reducing energy subsidies. Governments' and ruling elites' ability to preserve stability and security, while implementing the transformation, will be of paramount importance. In some cases, retracting unsustainable benefits may result in streamlining and strengthening political structures (Krane 2019).

2.6 External Drivers and Challenges

MENA countries are also forced to change their energy and socioeconomic model due to external factors, namely the fight against climate change and the global rush towards a low-carbon economy. Despite their population sizes, MENA countries are major oil and gas consuming countries, and are responsible for an important share of global GHG emissions. Thus, MENA countries can play a crucial role in achieving international climate targets. In the foreseeable future, growing political pressure on these countries may put under strain their dual nature of large oil and gas producing and consuming countries.

In short, the primary external drivers of MENA energy transformation are climate change and the consequent higher political consensus that entails a tighter acceptability of fossil fuels. Over the last decades, a general consensus on the urgency to address climate change, global warming and its negative consequences has emerged worldwide. Political commitment spans from national to supranational level via sub-national institutions as well as the private sector. Such ever-growing political consensus on decarbonization and the fight against climate change is one of the major drivers for the MENA countries' energy transformation. However, the pathway of climate policies—both at the international and regional level—has been long and not without some speed bumps. This section aims to provide an historical overview of the creation of the international climate change issue, assessing the domestic side of the key external driver (i.e. climate change) for energy transformation in the region.

2.6.1 The International Climate Policy and Regime

Countries and governments across the globe are increasingly considering climate change a top priority in their political, economic and social agenda. An international climate change policy regime has emerged throughout the last decades, becoming one of the key external drivers for MENA countries to pursue energy transformation. Before moving to the formation and evolution of the international climate change regime, which inevitably stimulates the process of energy transformation in MENA countries, it is important to highlight a few general features of such regime.

First, the regime has aimed at the widest possible participation and consensus given the global nature of the climate change and GHG emissions issues (Bodansky and Rajamani 2016). However, in the last two decades, this aim has been undermined by growing international awareness and urgency, leading to higher policy demands. The obstructionism from major oil producing countries or the US decision to not join the Kyoto Protocol and the withdrawal from the Paris Agreement in 2017 are only some examples. Second, the regime exemplifies the 'framework convention/protocol' approach to international environmental law (*Idem*). As we shall see, the UNFCCC established the basic framework for the climate change regime, on the basis of which the Kyoto Protocol specifies obligations and mechanisms for emissions reduction by developed countries. Also the Paris Agreement created a framework based on the UNFCCC but with a different approach compared to that of the Kyoto Protocol, as we shall see. The third general feature of the international climate change regime is the inevitable consequence of the multidimensionality of the issue. Tackling climate change requires an extraordinarily broad scope that encompasses not simply environmental protection but also economic and development policies (*Idem*). Lastly, the international regime is largely neutral regarding policy options, meaning that states have significant flexibility in designing strategies to deal with climate change in terms of both mitigation (Kyoto Protocol) and adaptation (UNFCCC and the Paris Agreement) (*Idem*).

The formation of the international climate regime has undergone several phases over the last six decades. While the initial interest for climate change was purely scientific, in the 1980s and 1990s a shift occurred, making climate change a political issue. Since then, governments have become increasingly involved in the political process to tackle climate change. The shift took place slowly but steadily, also thanks to the development of technological capabilities that allowed the investigation of the consequences of climate change.

In the late 1970s, the World Meteorological Organization (WMO) began to express concerns over the possibility that human activities—in terms of carbon dioxide emissions– might contribute to the serious warming of the lower atmosphere. Political and public concern on global warming grew over the 1980s, and in 1988 the WMO and the United Nations Environment Programme (UNEP) established the International Panel on Climate Change (IPCC) to investigate and report on the scientific evidence of climate change and on possible international responses to climate change.

In the early 1990s governments set the basis for the creation of the international climate regime. This phase resulted in the adoption and entry into force of the UNFCCC, following the 1992 "Earth Summit" in Rio de Janeiro. Moreover, throughout the 1990s and the early 2000s, the international community worked consistently on the 1997 Kyoto Protocol and its implementation. Climate change thus steadily became a major political issue both domestically and internationally. But it was in the 2010s that the international community really focused its political attention on the issues of climate change and the need to reduce GHG emissions, also pushed by public concerns and scientific knowledge.

In 2015, the international community established a key milestone with the Paris Agreement. The 2015 Agreement aims to limit global temperature to well below 2 °C, preferably to 1.5 °C, compared to pre-industrial levels. Moreover, with the Paris Agreement, countries aim to low-carbon development. Three years later, the publication of the Special Report of the IPCC on Global Warming of 1.5 °C was a further call for decarbonization actions, claiming that achieving the 1.5 °C objective will require a significant drop in GHG emissions of about 45% already by 2030 and zero net emissions in 2050. Meanwhile, the UN also adopted Sustainable Development Goals (SDGs), reiterating the need for a sustainable development in order to combat climate change and its impacts while ensuring access to affordable, reliable, sustainable and modern energy for all.

In essence, governments worldwide have steadily participated in a series of meetings with the specific goal to address and tackle climate change collectively. The process, however, which is far from being complete, has been gradual and not without setbacks (e.g. political obstructionism and withdrawals from agreements). Nonetheless, each of these international agreements was the result of prolonged negotiations and discussions, contributing to the formation of the current political consensus over climate change and decarbonization.

The first step was the establishment of the UNFCCC with the 1992 Earth Summit in Rio de Janeiro. It identified “the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” as its ultimate objective. Moreover, the UNFCCC framework also established two specific principles of the international climate regime: the “precautionary principle” and the principle of “common but differentiated responsibilities”. These two principles affirmed that political action should not be postponed by a lack of full scientific certainty and the richer countries (higher emitters) should bear the biggest burden in terms of mitigation, while poorer countries (lower emitters) should be able to increase gradually their emissions to a threshold sufficient to reach economic and social development (Van de Graaf and Sovacool 2020). What is crucial is that the UNFCCC framework is a political consensus among all countries, including traditionally more conservative ones (e.g. OPEC and Russia). Its adoption in 1992 and its entry into force in 1994 were aided by the absence of any legally binding targets to reduce GHG emissions.

With the Kyoto Protocol in 1997, countries worldwide translated into concrete targets, objectives and timelines that they had identified as principles in the UNFCCC framework. According to the Protocol, developed countries had to reduce their emissions by 5.2% below the 1990 baseline by 2012 (Van de Graaf and Sovacool 2020). The Protocol established also some flexible mechanisms, allowing developed countries to reach their reduction targets through alternative ways rather than mitigating emissions domestically. A flexible measure was the Clean Development Mechanism (CDM), which allowed developed countries to invest in clean projects in developing countries obtaining carbon credits in return. The Protocol also set the Joint Implementation (JI) which is similar to CDM with the difference that it applies to projects in other developed countries, such as Central and Eastern European countries. Moreover, it also introduced the possibility of emissions trading. The idea behind these mechanisms was that emissions should be reduced where it is most economical to do so (Van de Graaf and Sovacool 2020).

However, the Kyoto Protocol is generally regarded as a failure for several reasons. Firstly, it took almost eight years before entering into force, illustrating the challenging and difficult evolution of the international climate regime. The Protocol faced some major opposition, particularly from the US. The US did not join because of US Congress’ reluctance for a treaty that put carbon limits on the US economy but not on China. Russia’s ratification in 2004 made it possible for the Protocol to finally enter into force in 2005. Secondly, it focused on developed countries, appeasing flexibility demands of the developing countries for their social and economic development. However, by creating such stark differences between developed and developing countries, the Kyoto Protocol failed to account some of the world's largest emitters (e.g. China), but developing countries in general, which were not willing to stifle their economic development by emissions reduction targets. Moreover, the Kyoto Protocol did not produce the right conditions to incentivize climate policies at the national level; those countries that remained committed to addressing climate change were mainly motivated by domestic considerations rather than international obligations.

The 2015 Paris Agreement was a pivotal moment for global climate and energy policy. As Yergin states in his latest book "The New Map", the relevance of the Paris Agreement in international climate change policies is remarkable. There are two "eras" in climate policy: "before Paris" and "after Paris" (Yergin 2020). After years spent in seeking a post-Kyoto agreement, the world's countries gathered at UN COP21 in Paris achieving an agreement in December 2015, pledging to "hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels". The Agreement entered into force only 11 months after it was signed, highlighting a major political consensus compared to the Kyoto Protocol. The Paris Agreement diverges consistently from the Kyoto Protocol also on the universal application of its targets: *all* countries—not only developed ones—need to participate in climate actions, producing national plans on how to reduce emissions. Each country produces and presents the Nationally Determined Contributions (NDCs), which are thus unilateral, voluntary pledges. This aspect was a remarkable difference compared to the Kyoto Protocol. The voluntary pledges are a domestic product rather than a multilateral negotiation, allowing countries to overcome major barriers to previous international cooperation on climate change. Firstly, it accepted the reluctance of most major emitters to tie themselves into a rigid set of predetermined emissions reductions that are legally binding. This avoided a situation with the US similar to the one following the Kyoto Protocol. Secondly, it did not envisage a fair burden-sharing arrangement as part of a comprehensive international agreement, compared to post-Kyoto climate negotiations. Under the Paris Agreement, each country presents and submits an emissions reduction plan. Nevertheless, the voluntary nature of the NDCs raises the issue of compliance and whether these plans are actually carried out by national governments. Regarding this issue, the Agreement establishes a common transparency and accountability framework and an iterative process in which parties take stock, every five years, of their collective progress and put forward emission reduction contributions for the next five-year period (Bodansky and Rajamani 2016). Bodansky and Rajamani (2016) affirmed the Paris Agreement represents the culmination of three major shifts in the climate change regime in relation to multiple issues, namely (1) the architecture of the regime, (2) differentiation between developed and developing countries, and (3) the legal character of commitments.

The Paris Agreement also envisages a broader climate action going beyond the state level, seeking to embrace explicitly climate action by sub- and non-state actors.

Although climate actions at these levels were already present, the Paris Agreement enhanced them with the result that these non-national climate actions gained prominence (Van de Graaf and Sovacool 2020). In sum, the Paris Agreement set and crystallized an emerging hybrid architecture, in which bottom-up substance to promote participation is combined with a top-down process to promote ambition and accountability (Bodansky and Rajamani 2016). As of today, 189 states have joined the Paris Agreement (the USA rejoined the Agreement in February 2021) (Table 2.2).

2.6.2 The MENA Region, Climate Change and Policy: The Domestic Dimension

Notwithstanding this international context, MENA countries are pursuing, at different paces, the transformation of their energy sector not only as a reaction to the international pressure and climate change policy, but also as a result of domestic considerations. These countries are already experiencing the negative effects of climate change such as growing GHG emissions, rising air and water temperatures, water scarcity, desertification, and so on. However, although MENA countries have been on the front line of climate change, they have also had a challenging relationship with global warming and with the resulting climate policy.

The first and immediate consequence will be the rise of air temperature, which has already repeatedly broken records in recent years. In 2016, the highest recorded temperature in the region was 54 °C in Kuwait, while in the same period, Basra in Iraq recorded 53.9 °C. As air temperatures rise, the countries' energy demand will rise too, particularly in the cooling sector. This will trigger a further increase in energy consumption (also due to subsidized energy prices), threatening oil exports and governments' revenues.

The growing temperature also affects water availability. The MENA region currently faces a general water scarcity, being the world's most water-stressed region. If the MENA region is endowed with 52% and 42% of the world's oil and gas proven reserves, it is endowed with as little as 1% of global renewable freshwater resources. Over 60% of the population of the MENA region lives in areas of high or very high water stress, compared to some 35% for the rest of the world (World Bank 2022). Climate change will inevitably worsen this challenging condition, harming regional growth prospects. It is estimated that the negative impact of water scarcity on GDP growth in the MENA region ranges between 6 and 14% of GDP reduction. Also regarding water scarcity, MENA countries may resort to desalination plants, which are energy-intensive and almost entirely powered by fossil fuels in the region. MENA countries are also on the front line of climate change as several regional cities, located on the coast line, are imperiled by rising sea levels. Moreover, climate change will also affect food production, which could lead to a general increase of food prices. This would further challenge MENA countries economically, since this area is one of the most important food dependent regions.

Table 2.2 Major milestones of the international climate change regime

Year	Milestone	Note
1988	IPCC founded by WMO and UNEP	To investigate and report on scientific evidence on climate change and possible international responses to climate change
1990	IPCC first assessment report	Estimating that global mean temperature likely to increase by about 0.3 °C per decade, under business-as-usual emissions scenario
1992	'Earth Summit' in Rio de Janeiro	Ultimate objective: "the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" Two specific principles of the international climate regime: the "precautionary principle" and the principle of "common but differentiated responsibilities"
1997	Kyoto protocol	Developed countries had to reduce their emissions by 5.2% below the 1990 baseline by 2012
2005	Kyoto protocol into force	Following Russia's ratification in 2004, KP entered into force 8 years after it was signed
2007	COP-13	Adoption of the Bali Action Plan, initiating a new round of negotiations under the FCCC
2009	COP-15	Takes note of the Copenhagen Accord, establishing a new architecture, based on voluntary mitigation pledges and transparency
2010	COP-16	Adoption of the Cancun Agreements, incorporating elements of the Copenhagen Accord into the FCCC process
2011	COP-17	Adoption of the Durban Platform, launching negotiations towards a post-2020 agreement, with a scheduled end in 2015

(continued)

Table 2.2 (continued)

Year	Milestone	Note
2015	Paris agreement (COP21)	Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels Hybrid architecture: top-down (below 2 °C) and bottom-up (NDCs)
2016	Paris agreement into force	The Paris Agreement entered into force 11 months after it was signed
2017	US' withdrawal from Paris agreement	President Trump announced the unilateral withdrawal from the Paris Agreement
2018	Special report IPCC	Achieving the 1.5 °C objective will require a significant drop in GHG emissions of about 45% by 2030 and zero net emissions in 2050
2019–2020	Major net-zero commitment	EU: net-zero in 2050 China: net-zero in 2060 (emissions peak before 2030) Japan: net-zero by 2050 South Korea: net-zero by 2050 UK: net-zero by 2050
2021	US rejoined the Paris agreement	On his first day, newly elected US President Biden signed an Executive Order to rejoin to the Paris Agreement
2021	Glasgow (COP26)	The main political outcome is the Glasgow Climate Pact, which requests governments to revisit and strengthen their NDCs before the end of 2022 to bring these in line with the Paris Agreement's temperature goal

Source Authors' elaboration on Bodansky and Rajamani (2016) and Van de Graaf and Sovacool (2020)

Despite its exposure to climate change, the MENA region has always had a "conflictual" approach to the issue of climate change, with special reference to the major oil and gas producing countries in the Gulf (Luomi 2020). Over the past ten years, climate change has gained an increasing attention in the region, as a result of the increasing focus on this issue worldwide. Nevertheless, it is crucial to reiterate that also regarding climate change the MENA region is far from being a homogeneous group, despite its exposure to global warming and its consequent fragility. The political consideration and commitment to address the issue diverges widely across the region. On one side of the spectrum, there are countries like the UAE and Morocco, which have increasingly invested in building a reputation as climate and clean energy leaders in the area. The decision to locate the new headquarters of the International

Renewable Energy Agency (IRENA) in Abu Dhabi illustrates the Emirates' political commitment to position themselves at the center of the climate policy map. Morocco has enhanced its commitment to climate and low-energy targets due to domestic reasons (e.g. cleaning the country's energy mix, energy security) as well as international ones (export of clean energy such as electricity and hydrogen to Europe). On the other end, there are countries like Oman, Kuwait, Bahrain and Algeria that have been less engaged with international climate policy. In the middle of the spectrum, there is Saudi Arabia which has always had an ambivalent relationship with the issue. It has been accused of obstructing progress and undermining political ambition within the UN international climate change negotiations, while it has stepped up its ambition in terms of renewable energy targets (Luomi 2020).

A shared approach to climate actions has emerged over the past decade within the region and particularly in the Gulf and oil producing countries. While the Gulf countries have tried to intertwine domestic climate actions and economic plans, they have downgraded climate change to an environmental issue to be managed by dedicated departments within environmental ministries or agencies (Luomi 2020). This dual approach illustrates the essence of the challenge for climate change policy. Although big emitters make commitments to fight global warming, it has proven difficult to translate these commitments into actual and collective action. The international sphere collides with domestic politics and constraints, especially in those countries that rely heavily on hydrocarbons for their economy and/or energy sector. In this sense, MENA countries are particularly illustrative. Climate change mitigation requires considerable investment, while climate change adaptation may lead to substantial changes in the current socioeconomic and energy models of MENA countries, posing a serious threat to their domestic political stability.

All MENA countries are parties to the UNFCCC and its legally binding instrument, the Kyoto Protocol, and to the Paris Agreement. At the international level, the climate change policies of MENA countries have been characterized by an absence of strong domestic strategies; this is particularly true for Gulf countries (Luomi 2020). Generally, they have stressed their status as developing countries and their vulnerability to response measures, while prioritizing adaptation over mitigation as a policy option.

Under the Kyoto Protocol, MENA countries have been considered as developing countries with no commitments for GHG emissions reduction. Some Gulf countries have also tried to seize monetization opportunities with Pre-Paris mitigation projects, such as the Kyoto's Protocol's CDM. In this sense, oil producing countries have sponsored carbon capture and storage (CCS) as a viable solution. The six Gulf states collectively have 27 projects (15 in the UAE, six in Saudi Arabia, and two each in Kuwait, Oman, and Qatar), comprising 0.6% of Clean Development Mechanism projects registered worldwide in terms of size (Luomi 2020).

Under the 2015 Agreement, almost all MENA countries have submitted their NDCs. Through their NDCs, MENA countries have expressed their real ambitions on climate change. Of the six Gulf states, only Oman had set a quantitative emission reduction target (2% by 2030), while three Gulf governments had communicated no quantitative targets (Luomi 2020). The UAE are currently the only MENA country that has submitted its updated NDC in December 2020, which aims for a decrease in emissions of 23.5% below business as usual in 2030. Regarding mitigation measures, MENA NDCs refer normally to renewable energy, energy efficiency, and CCS. Some of the Gulf countries have framed mitigation contributions or actions in the context of economic diversification efforts. MENA countries announced mitigation contributions in the form of GHG targets, non-GHG targets, proposed actions or a combination of these elements (Griffiths 2017). The Gulf countries have not made any unconditional GHG emissions reduction commitments (Griffiths 2017). Generally, major oil exporting countries have mentioned their special status as countries highly dependent on fossil fuel export revenues, stressing the need to minimize the negative impacts of response measures (Luomi 2020).

In their NDCs, some Gulf countries, namely the UAE and Kuwait, refer to the fossil fuel subsidies reform. The Eastern Mediterranean countries (e.g. Israel, Jordan, Lebanon) have a different approach, having announced unconditional commitments, with Israel being the most ambitious with a reduction target of 26% by 2030 below the 2005 level (Griffiths 2017). The North African countries, with the exception of Egypt, have made at least some form of unconditional commitment (Griffiths 2017). Syria has submitted its NDC only in 2018 given its critical conditions caused by the 10-year civil war. The other war-torn nation, Libya, has not yet submitted its NDC. The lack of ambitious unconditional commitments within the NDCs of MENA countries shows how these countries call for international support and financing in order to pursue an emissions reduction policy—especially those countries that are highly dependent on hydrocarbon revenues.

The year 2021 was particularly relevant for climate policies in the MENA region as three countries pledged to reach net-zero emissions by and around mid-century: the UAE by 2050, while Saudi Arabia and Bahrain by 2060. As a result, two distinct groups have emerged regarding climate ambitions: on one side, higher ambition, high-emission group of mainly oil and gas exporters, and on the other hand lower ambition, low emission group of mainly developing countries (Elgendy 2022). These two groups reflex a geographical distinction with the former generally located in the GCC countries (plus Morocco) and the latter located in North Africa. The two groups own also different financial capabilities to pursue and implement such plans, with Gulf countries holding massive financial reserves while North African countries facing fiscal tightness. Nonetheless, all MENA countries have submitted their first NDCs, except Libya which is not ratified the Paris Agreement. As of end of 2022, around ten countries have submitted their updated NDCs, while Morocco, Tunisia, Oman and the UAE have submitted their second NDCs (World Bank 2022).

Climate targets and policies have been boosted by the COVID-19 crisis as a part of economic recovery plans. Moreover, there has been a greater political willingness to act on climate. Some major developments are happening also in the MENA region even though it is home to major oil and gas producers. Ahead of COP26, the UAE had launched its plan to achieve net-zero emissions by 2050 in October 2021. Moreover, it would oversee $163 billion in investment in renewables making it the first country in the region to pledge to achieve carbon neutrality. A few weeks later, Saudi Arabia affirmed its plan to become carbon neutral by 2060. During its G20 presidency, Saudi Arabia launched its Circular Carbon Economy in 2020. These two countries seek to develop several low-carbon technologies such as renewables, hydrogen (both green and blue) and CCUS, exploiting their competitive advantages in order to adapt and adjust their economy to a low-carbon future. At the same time, they are still committed to remaining big oil players in the foreseeable future. In the same period, another MENA country has joined the net-zero club: Bahrain, which announced its pledge to reach net-zero emissions by 2060. To achieve its goal, Bahrain will adopt a circular carbon economy, strengthened by various offsetting schemes including CCS technology and afforestation. Since 2021, MENA countries have increased their climate targets following the global steep acceleration in net-zero ambitions, but increased focus and bold action is needed to translate such growing, ambitious commitments into projects and actions.

In conclusion, climate change represents a major external driver for the energy transformation of MENA countries. Climate change has shaped international politics, as governments have increasingly committed to fighting climate change and achieving decarbonization. The ever-growing consensus, combined with a deeper scientific knowledge of the harm caused by climate change, has led to the formation of the international climate change regime, which forces MENA countries to act in collaboration with all the other countries. Moreover, climate change is expected to further exacerbate some of the existing challenging conditions that MENA countries must deal with: rising air and water temperatures, water scarcity, desertification and so on. These conditions have a direct impact also on the energy sector.

In compliance with the international climate change regime and pushed by the domestic dimension of climate change, MENA countries have submitted their climate plans (NDCs). Oil-producing countries have often combined climate change actions with their need to diversify their domestic economy, while others have set more ambitious reduction plans.

2.6.3 Oil and Natural Gas Demand in a Decarbonized World: Peak Demand for Oil and More Pressure for Natural Gas

The ever-growing international political commitment towards decarbonization will have profound consequences for fossil fuels demand in the coming decades. MENA oil and gas exporting countries need to transform their business model or they will face severe economic losses, which could also cause social instability. A net-zero scenario will cause a drastic drop in fossil fuels demand by mid-century despite some uncertainty over fossil fuels demand. To testify the strong political pressure on fossil fuels, the IEA released a roadmap for the global energy sector in May 2021, called 'Net Zero by 2050'. The report analyzes how to transition to a net zero energy system by 2050. In this report, the IEA claims that there are no new oil and gas fields approved for development beyond projects already committed as of 2021. In October

2021, ahead of the COP-26 in Glasgow, the IEA released its World Energy Outlook (IEA 2021a) where it compares four scenarios (IEA 2021a):

> The **Net Zero Emissions by 2050 Scenario (NZE)** shows, according to the IEA, a "narrow but achievable pathway for the global energy sector to achieve net zero CO_2 emissions by 2050", with advanced economies reaching net zero emissions in advance of others. This scenario also meets key energy-related United Nations Sustainable Development Goals (SDGs), in particular achieving universal energy access by 2030. The NZE does not rely on emissions reductions from outside the energy sector to achieve its goals, but assumes that non-energy emissions will be reduced in the same proportion as energy emissions. It is consistent with limiting the global temperature rise to 1.5 °C without a temperature overshoot (with a 50% probability).
> The **Announced Pledges Scenario (APS)** takes account of all of the climate commitments made by governments around the world in advance of the COP-26, including Nationally Determined Contributions as well as longer term net zero targets, and assumes that they will be met in full and on time. The global trends in this scenario represent the cumulative extent of the world's ambition to tackle climate change as of mid-2021. The remaining difference in global emissions between the APS and the goals in the NZE or the Sustainable Development Scenario shows the "ambition gap" that needs to be closed to achieve the goals agreed upon in the Paris Agreement in 2015.
> The **Stated Policies Scenario (STEPS**) does not take for granted that governments will reach all the announced goals. Instead, the STEPS explores where the energy system might go without the implementation of additional policies beyond the ones already implemented (or under development). As with the APS, it is not designed to achieve a particular outcome. It takes a granular, sector-by-sector look at existing policies and measures and those under development. The remaining difference in global emissions between the STEPS and the APS, represents the "implementation gap" that needs to be closed for countries to achieve their announced decarbonization targets.
> The **Sustainable Development Scenario (SDS)** is a "well below 2 °C" pathway, and represents a gateway to achieving the outcomes targeted by the Paris Agreement. The SDS assumes all energy-related SDGs are met, all current net zero pledges are achieved in full, and there are increased efforts to realize near-term emissions reductions; advanced economies reach net zero emissions by 2050, China around 2060, and all other countries by 2070 at the latest. Without assuming extensive net negative emissions, this scenario is consistent with limiting the global temperature rise to 1.65 °C (with a 50% probability). With some level of net negative emissions after 2070, the temperature rise could be reduced to 1.5 °C in 2100.

Fossil fuels are expected to decline drastically in a decarbonized world, even though oil and natural gas will decline at different rates.

As shown in Fig. 2.7, global oil demand, which had reached its record level of 97.6 mb/d in 2019 before falling to 88.5 mb/d in 2020 during the shutdowns of the

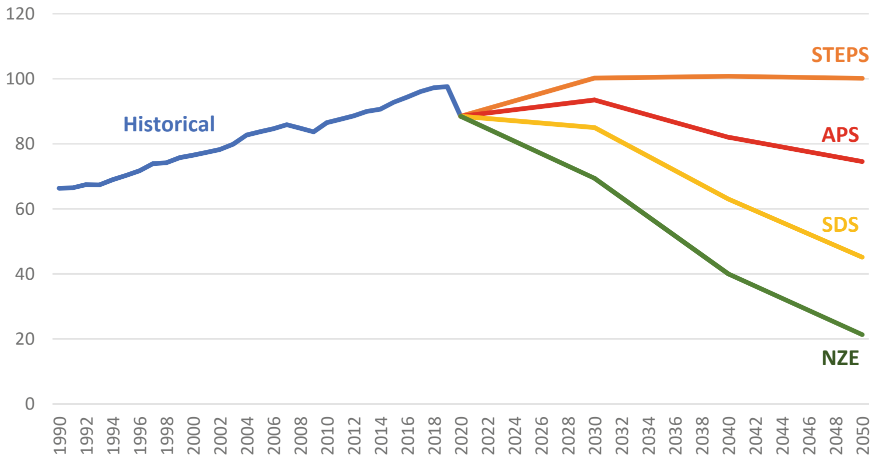


Fig. 2.7 Future oil demand under IEA scenarios (mb/d). *Source* Authors' elaboration on IEA data of the WEO 2021

first Corona year, is expected to reach by 2050 a level of 45 mb/d (– 54% compared to 2019) in the SDS and even down to 21 Mb/d (minus 78.5%, or compared to 2019) in the NZE. The sharp decline will be mainly driven by significant changes in the transport sector as electric vehicles will gain an increasing market share, especially in countries with net zero pledges.

In the STEPS scenario oil demand would remain at around 100 mb/d up to 2050, but this is a counterfactual scenario. Taking account of the pledges proposed for the COP-26 in Glasgow as of mid-2021, oil demand by 2050 would already be 26% lower than in the STEPS. These pledges have already been reinforced as the COP-26 came closer, and will again be reinforced at the COP-27 in Sharm el-Sheikh in 2022, and again later. It is clear that the policy is to move towards some carbon neutrality by mid-century. The planet might indeed not achieve carbon neutrality by mid-century, but this is the clear direction towards which policies are increasingly moving worldwide. In other words, the stated policies' and the announced policies' scenarios will bend a bit downwards year after year towards the SDS and NZE scenarios.

Oil is thus expected to become less and less relevant as a result of growing decarbonization policies and technological developments in oil demand-driving sectors such as transport (i.e. electric vehicles). In recent years, attention has moved from the concept of 'peak oil supply' to 'peak oil demand'. Peak oil demand consists of a decline of global oil demand in the relatively near term. The scale and pace of the declining role of oil is driven by a combination of climate policies (e.g. improvements in energy efficiency, greenhouse gas emissions limits, carbon pricing) and the development of technological solutions (e.g. expansion of EVs). In SDS, Middle East[4] oil production is expected to fall from some 30 mb/d in 2019 to some 18 mb/d

[4] The IEA definition of Middle East excludes North Africa.

by 2050, a reduction of 40%. At the same time, the global market share will increase from some 31% of today to 38% by 2050.

Natural gas demand has a different, yet also challenging, future (Fig. 2.8). The IEA foresees that in decarbonization global natural gas demand remains roughly stable at around 3860 bcm (the 2020 level) up to 2030 as on the one side it will be challenged by increased energy efficiency in all sectors as well as the strong continuation of renewable energy penetration in the power sector, and on the other side it will partly replace coal for power generation and the industry. Indeed, burning coal in power plants emits twice as much CO_2 for every kWh produced compared to burning natural gas. After 2030, the global demand for natural gas (in particular for unabated natural gas) should decline rapidly. By 2050, natural gas demand is expected to reach around 2367 bcm (minus 39% compared to 2020) in the SDS and 1686 bcm (minus 56% compared to 2020) in the NZE. In NZE, natural gas demand falls largely in all regions, except those that are currently heavily reliant on coal, where natural gas largely displaces coal.

For the outlook for natural gas a key driver is the degree of coal-to-gas switching. Its potential varies across sectors and regions. Moreover, it depends on the pace and scale of emissions reductions plans undertaken at the national level. Due to higher economic and demographic growth, natural gas could experience a longer future especially in developing Asia, Africa and the Middle East.

Natural gas has enjoyed the status of 'transition fuel' as it is the least polluting fossil fuel, making the outlook for natural gas more durable than for oil. Natural gas plays and is expected to continue to play a crucial role in supporting fast-growing developing economies as they decarbonize and reduce their reliance on more polluting fuels, notably coal. Natural gas is also expected to enjoy some gains in the short- and medium-term in some developed countries as they are phasing out

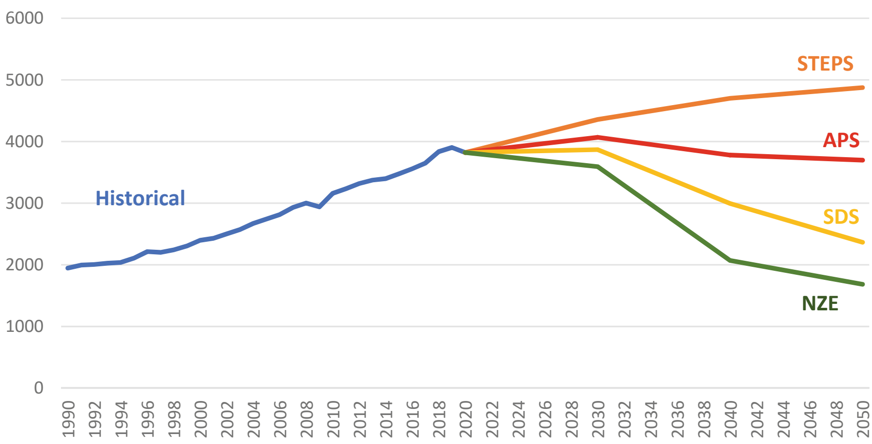


Fig. 2.8 Future natural gas demand under IEA scenarios (bcm). *Source* Authors' elaboration on IEA data

of coal and sometimes also nuclear. Nonetheless, unabated natural gas is expected to be under more and more pressure in a fully decarbonized world.

Despite generating less CO_2 than coal, unabated gas releases methane (CH_4) which is a potent GHG. Methane released directly into the atmosphere is 80 times more potent than CO_2 over a 20-year time period. The sixth IPCCC report notes that to limit global warming to 1.5 °C, a deep reduction in emissions of methane must be achieved over the 2020 decade. As methane's atmospheric lifespan is relatively short, a fall of methane emissions can yield the most immediate reduction in the rate of warming. On November 2, 2021 at the COP-26 in Glasgow, the EU, the US and over 100 countries launched the Global Methane Pledge. Under this initiative, these countries, which represent 70% of the global economy and are responsible for nearly half of anthropogenic methane emissions, commit themselves to a collective goal of reducing global methane emissions by at least 30% by 2030 from 2020 levels.

In decarbonization scenarios, gas use will progressively need to be CO_2 abated, thus either in form of carbon neutral hydrogen, biogas or natural gas with CCUS. Figure 2.9 presents the penetration of CCUS associated to natural gas demand in the different scenarios. As can be seen, deep decarbonization scenarios require high volumes of CCUS. Starting from almost nothing today, CO_2 abated natural gas production with CCUS is expected to reach by 2050 717 bcm in the SDS and 1200 bcm in NZE. Therefore, while in the SDS by 2050, 70% of demand will still be constituted by unabated natural gas and 30% by CCUS abated natural gas, in the NZE—which has a 30% reduced remaining demand for natural gas by 2050 compared to the SDS scenario—the proportion is the other way round: 70% CCUS abated natural gas and 30% unabated natural gas. CCUS thus allows partial offsetting of the needed general decline in natural gas production post 2030. In fact, in the NZE, by 2050 a total of 7.6 Gt CO_2 will be captured, almost 50% of which from fossil fuel combustion, 20% from industrial processes, and around 30% from bioenergy use with CO_2 capture and direct air capture (DAC).

There is some upside for natural gas demand in the NZE as a result of its role in scaling up low-carbon hydrogen production: by 2030, around 250 bcm will be used in steam methane reformers equipped with CCUS. After 2030, natural gas use in the power sector in NZE will decline globally by more than 80%. By 2050 less than 190 bcm of natural gas will be used for power generation in NZE, accounting for around 1% of electricity generation worldwide (compared with almost a quarter today), mostly equipped with CCUS. Energy demand in buildings will also transition quickly away from natural gas. In 2050, more than 50% of global gas production will be used to produce low-carbon hydrogen; a further 15% in the industrial sector, mainly for cement production and in light industries.

In NZE, in 2050, about half the global gas will be produced in the Middle East and Russia. According to this deep decarbonization scenario, the Middle East production of natural gas would fall from around 650 bcm in 2019 to some 400 bcm in 2050, representing a quarter of the global natural gas supply (another quarter is expected to be supplied each by Russia and the US—the balance by Africa and the rest of the world). Therefore, even though overall production in the Middle East would decline, its market share on a worldwide scale would increase from 14% of today to 24% by

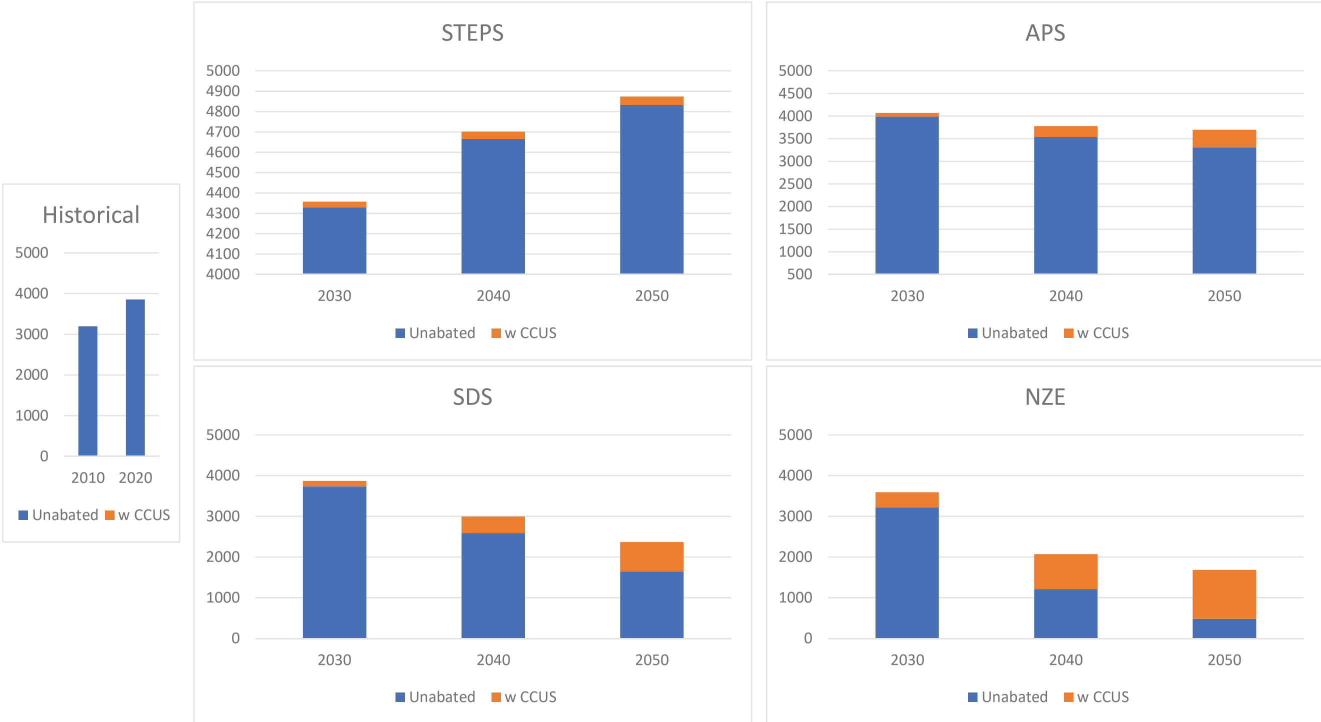


Fig. 2.9 Demand for unabated natural gas and gas with CCUS under IEA scenarios (bcm). *Source* Authors' elaboration on IEA data

2050. Still according to NZE, interregional trade of natural gas will fall to less than 300 bcm, around 40% of current levels.

From today's perspective, NZE seems an extremely ambitious scenario. SDS still seems very ambitious but more likely to be achieved. According to SDS, Middle East[5] gas production is expected to increase from around 650 bcm in 2019 to 740 bcm by 2030, but then to fall to 580 bcm (a quarter of the world total) by 2050.

To conclude, if we assume the world to progressively implement decarbonization scenarios, global oil and gas demand will need to fall over the next decades. Compared to oil, the fall in gas demand will be less rapid and less dramatic. Due to the important reserves and low production cost of the MENA region, the market share of this region is expected to increase, even though their absolute exports will nevertheless fall importantly.

This explains the pressing need to transform and diversify the economies of these countries. The advantage these countries have is that hydrocarbon revenues, if well used, will provide the financial resources necessary for this transition.

Bibliography

Anderson L (1987) The State in the Middle East and North Africa. Comparative Politics 20

Beblawi H (1987) The Rentier State in the Arab World. In: Beblawi H, Giacomo Luciani (eds) The Rentier State. Croom Helm, London

Beblawi H, Luciani G (eds) (1987). Croom Helm, London

Bodansky D, Rajamani L (2016) The Evolution and Governance Architecture of the United Nations Climate Change Regime, in Detlef Sprinz and Urs Luterbacher (eds), International Relations and Global Climate Change: New Perspectives (MIT Press, 2nd edn, 2016 Forthcoming), Available at SSRN: https://ssrn.com/abstract=2168859

BP (2022) Statistical Review of World Energy, bp, June 2022.

Breisinger C, Mukashov A, Raouf M and Wiebelt M (2019) Energy subsidiy reform for growth and equity in Egypt: The approach matters, Energy Policy, Volume 129, June 2019

de Moor A, Calamai P (1997) Subsidizing unsustainable development. Undermining the Earth with public funds. Earth Council and Institute for Research on Public Expenditure. https://www.cbd.int/doc/case-studies/inc/cs-inc-earthcouncil-unsustainable-en.pdf

El Katiri L, Fattouh B (2015) A brief political economy of energy subsidies in the Middle East and North Africa Oxford Institute of Energy Studies. OIES Paper MEP 11:1–21

Elgendy K (2022) Climate change in the Middle East and North Africa: Hosting Negotiations and Catalyzing Action, Arab Gulf States Institute in Washington, Blog Post, 13 May 2022. https://agsiw.org/climate-change-in-the-middle-east-and-north-africa-hosting-negotiations-and-catalyzing-action/

Gray M (2011) A theory of "Late Rentierism" in the Arab States of the Gulf. Center For International and Regional Studies (CIRS) Occasional Paper (7):1–50

Griffiths S (2017) A review and assessment of energy policy in the Middle East and North Africa region, Energy Policy, Volume 102, March 2017.

Herb M (2005) No representation without taxation? Rents, development, and democracy. Comp Polit 37(3):297–316

IEA (2018) Outlook for producer economies, Special Report WEO 2018, IEA, Paris. https://www.iea.org/reports/outlook-for-producer-economies

[5] The IEA definition of Middle East excludes North Africa.

IEA (2020) World energy outlook. IEA, Paris
IEA (2021a) World energy outlook. IEA, Paris
IEA (2021b), Net Zero by 2050. A Roadmap for the Global Energy Sector, IEA, Flagship Report, May 2021b, Paris
Kerr MH, Yassin E-S (1982) Rich and poor states in the Middle East. Westview Press, Boulder, CO, p 1982
Krane J (2019) Energy kingdoms. Oil and political survival in the Persian Gulf. Columbia University Press, New York.
Luciani G (ed) (2017) Combining economic and political development: the experience of MENA. International Development Policy, No. 7, Brill Nijhoff, Leiden
Luciani G (2019) Unsustainable: But why?, In: Oxford Institute for Energy Studies (2019), Economic Diversification in the MENA, OIES Forum, Issue 118, June 2019. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/06/OEF-118.pdf
Luomi M (2020) Gulf States' Climate Change Policies Amid a Global Pandemic, The Arab Gulf States Institute in Washington (AGSIW), Issue Paper 6, 25 September 2020. https://agsiw.org/wpcontent/uploads/2020/09/Luomi_Climate-Change_Online-1.pdf
McGlade C, Ekins P (2015) The geographical distribution of fossil fuels unused when limiting global warming to 2 °C. Nature 517:187–190
Mahdavy H (1970) The patters and problems of economic development in rentier states: the case of Iran. In: Cook MA (ed) Studies in the economic history of The Middle East. Oxford University Press, Oxford
Mehlum H, Moene K, Ostenstad G (2016) Guest workers as a barrier to democratization in oil-rich countries. In: Selvik K, Utvik BO (eds) Oil states in the New Middle East. Uprising and stability, Routledge
Moerenhout T (2021) Fuel and electricity reform for economic sustainability in the gulf. In: Luciani G, Moerenhout T (eds) When can oil economies be deemed sustainable? Palgrave Macmillan
OPEC (2019) Annual statistical bulletin 2019 Kuwait. OPEC. https://www.opec.org/opec_web/en/about_us/165.htm. Accessed 6 March 2020
Percebois J (1999) L'apport de la théorie économique aux debats énergétiques, Cahier n°99.11.15, Centre de Recherche en Economie et Droit de l'Energie, Université de Montpellier I, November 2021
Sida (2019) Multidimensional poverty analysis for the Middle East and North Africa 2019. SIDA
UNICEF (2021) Running dry. The impact of water scarcity on children in the Middle East and North Africa
Van de Graaf T, Sovacool BK (2020) Global Energy Politics, Polity.
World Bank (2020) US$15 Million Investment in Information Technology to Boost High-Skilled Jobs for Palestinian Youth. World Bank. https://www.worldbank.org/en/news/press-release/2020/06/15/us15-million-investment-in-information-technology-to-boost-high-skilled-jobs-for-palestinian-youth. Accessed 28 July 2021
World Bank (2021) Unemployment, youth total (% of total labour force ages 15–24) (modeled ILO estimate)—Saudi Arabia, Jordan, Tunisia. World Bank Data. https://data.worldbank.org/indicator/SL.UEM.1524.ZS?locations=SA-TN-JO. Accessed 28 July 2021
World Bank (2022) Middle East & North Africa Climate Roadmap (2021–2025). Driving transformational climate action and green recovery in MENA, The World Bank, 25 January 2022. https://thedocs.worldbank.org/en/doc/6f868d4a875db3ef23ef1dc747fcf2ca-0280012022/original/MENA-Roadmap-Final-01-20.pdf
Yergin D (2020) The New Map. Energy, Climate, and the Clash of Nations, Penguin Press, 1 edition.

Part II
The Energy Sector in the MENA Region at a Crossroad

Chapter 3
National Energy Sectors: Historical Evolution and Current Situation

This Chapter presents the present energy, economics and politics landscape of the MENA region country by country. Fossil fuels fuels have been at the center of this landscape in the MENA region. Each MENA country has gone through a transformation of their energy systems. Understanding this historical evolution is instrumental to better understand the starting point for future national energy transformations (Chap. 4). While fossil fuels play a key role in all national energy sectors, countries vary regarding energy endowment, population size and economics. A clear regional cleavage can be identified between hydrocarbon-exporting and hydrocarbon-importing countries.

The ***Arabian-Persian Gulf*** *(GCC countries plus Iran) is home of the largest hydrocarbon-producing countries embodying the most prominent example of rentier state. Given high hydrocarbon resources, limited population, they have generally benefit economically from the hydrocarbon industry with high wealth level per capita. Saudi Arabia and the UAE have become major oil producers and exporters. Nonetheless, they all have a very strongly increasing domestic hydrocarbon consumption which could in the future undermine their main income source. Gulf countries are also endowed by large gas reserves but so far only Qatar has been able to become a global powerhouse of gas (LNG) trade, while other countries with large gas reserves (e.g. Iran and Saudi Arabia) have not managed to gain an international or regional gas trade role. Saudi Arabia consumes its entire gas production domestically, while Iran has seen its ability to attract LNG technology hindered by international sanctions. Natural gas has, over the years, gained relevance in the domestic energy mix of Gulf countries in the attempt to decarbonize the power sector and free additional oil export volumes. Since all of them have a strongly rising energy consumption and are among the highest energy consumers per capita in the world, they have*

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_3

started to undertake some energy subsidy reforms albeit at different pace and intensity.

The ***Mashreq cluster*** *(Egypt, Iraq, Israel, Jordan, Lebanon, Palestine and Syria) is home of both hydrocarbon-rich and hydrocarbon-poor countries. Some of them have experienced multiple transformation in terms of energy conditions with countries shifting from being net-importers to net-exporters. Egypt for instance, which is an old oil province, has since mid-1990s strongly expanded the role of gas. However, in the aftermath of the Arab Spring it became a net gas importer in the 2010s. Later, in 2018, thanks to the discovery of the Zohr offshore gas field, Egypt returned to be a net gas exporter. Another major transformation occurred in Israel, which has managed to reduce its dependence on coal (traditionally used for energy security reasons) and increase the role of gas in the energy sector thanks to the discovery of offshore gas fields. While sharing several characteristics, Lebanon and Jordan have undertaken different energy pathways with Jordan undergoing through a transformation of its energy sector while Lebanon remaining very much reliant on oil imports. The most striking difference between the two countries comes from the role of natural gas, which is absent in Lebanon's energy system. Different sociopolitical and economic features in these two countries have heavily influenced their ability to reform and transform the energy sector, with Lebanon experiencing a dramatic economic (and political) crisis. Lastly, the cluster is home of two countries (Iraq and Syria) whose energy sectors have been heavily affected by the long-lasting security and governance issues. Iraq holds large hydrocarbon reserves but its ability of monetizing them (and create socioeconomic development for its citizens) has been impacted by numerous international and regional events.*

Within the ***Maghreb*** *cluster (Algeria, Morocco, Tunisia), Algeria and Libya stand out in terms of hydrocarbon reserves. Algeria is particularly important for Europe's gas security as it is linked with it through three pipelines (two to Spain and one to Italy). Nonetheless, Algeria represents also the perfect example of rentier state—with high dependence on oil rents extremely visible during the periods of low oil prices. Libya has important oil reserves and a gas pipeline to Italy, but the country has long suffered international sanctions and over the last decade a civil war, deeply affecting oil and gas production and exports.*

3.1 The Arabian-Persian Gulf

The Arabian-Persian Gulf cluster is composed of GCC countries plus Iran. These countries represent the most prominent example of rentier states. They share numerous similarities in political and socio-economic terms and a common evolving context, mostly due to the changing role of oil in the global energy system (Table 3.1).

Countries in this cluster greatly vary in population size, ranging from just over 1 million people (Bahrain) to nearly 35 million (Saudi Arabia). The population comprises both nationals as well as expats, which can make up to roughly 80% of the total population in countries such as Qatar and the UAE. Countries with limited oil and/or gas endowments (i.e. Bahrain and Oman) have lower GDP and GDP per capita levels, with the exception of Iran, which for a few decades was under international sanctions that limited its economic growth and well-being. Regarding energy, electricity consumption depends on population size, the amount of energy subsidies and on consumers' lifestyle, as some countries may consume above their needs.

A key common characteristic of these countries is the abundance of hydrocarbon resources, which puts them on the global energy, economic and geopolitical map. With the exception of Algeria, Iraq and Libya, all the main oil producers and the largest oil reserve holders in the MENA region are located in this cluster, with Saudi Arabia and Iran playing the predominant roles, closely followed by Kuwait, as summarized in Table 3.2.

This cluster's wealth, however, is not limited to oil. The Gulf countries are also endowed with natural gas reserves, which are expected to play a key role (at least as a transition fuel) in the energy transition process. Iran and Qatar are the largest gas reserve holders worldwide after Russia. In terms of global production share, the role of Gulf gas producers has been mostly downsized following the surge in US shale gas production. Nevertheless, as of 2019, Iran, Qatar and Saudi Arabia are the third, fifth and eighth largest gas producers in the world (BP 2020). Table 3.2 illustrates the great potential of gas in the region in terms of reserves, production and consumption, although in some countries of the area its full exploitation is hindered by a number of barriers.

Table 3.1 Key socioeconomic and energy indicators by Gulf countries, 2019

	Population (million)	GDP (constant US$2015) (billion)	GDP PPP per capita (constant international $2017)	TPES (Mtoe)	Power Consumption (TWh)
Bahrain	1.6	38.8	45,060.4	16.2	34.1
Iran	82.9	396.7	12,389.2	271.6	263
Kuwait	4.2	114.2	49,853.7	35.8	54.8
Oman	4.9	72.2	27,294.6	29.0	33.8
Qatar	2.8	167.5	90,043.8	50.6	43.6
Saudi Arabia	34.2	678.6	46,962.1	214.1	310.1
UAE	9.7	388.7	67,119.2	91.4	125.7

Source Authors' elaboration on The World Bank Data, IEA

Table 3.2 Key energy indicators by the Gulf countries in 2019

	Oil				Natural gas				Electricity	
	Reserves (Gb)	Production (Mt)	Consumption (Mt)	Balance of trade (Mt)	Reserves (tcm)	Production (bcm)	Consumption (bcm)	Balance of trade (bcm)	Capacity (GW)	Production (TWh)
Bahrain	0.2	10.2	13.4	– 3.2	0.2	16.9	16.9	0	8.8	34.7
Iran	155.2	146.5	92.3	54.2	34.0	231.7	211.7	20	80.2	314.1
Kuwait	101.5	144.5	39.3	105.2	1.7	19.3	24.6	– 5.3	19.8	75.1
Oman	5.4	47.7	16.8	30.9	0.7	40.9	28.5	12.4	8.7	38.1
Qatar	25.2	70.9	22.7	48.2	23.8	167.6	44.5	123.1	12.7	48.6
Saudi Arabia	285	546.8	159.2	387.6	9.4	96.8	96.8	0	85.2	366.7
UAE	97.5	181.7	57.7	124	6.1	67.4	78.3	– 10.9	37.5	138.4

Note Imports (–)
Source Authors' elaboration on ENERDATA

Over the last decades, Gulf countries have seen a growing domestic energy demand, which affects the stability of their macroeconomic structure based on oil, the product that these countries export and that provides their revenues. Gulf countries have a significantly higher oil consumption per capita rate compared with other (developed and developing) countries. In 2019, the per capita consumption in Gulf countries, except for Iran, was two times the per capita level of the US and four times the level of European countries (see Fig. 2.6 in Chap. 2).

Despite the high gas potential, only few countries in this cluster export relevant gas volumes. Figure 3.1 shows the different evolution of their gas balance. Traditionally, some countries have faced high domestic consumption (i.e. Saudi Arabia and Kuwait), which has absorbed their entire gas production. Kuwait has recently had to rely on some gas import volumes from Iran to meet its domestic demand. Iran, though having the second largest gas reserves in the world after Russia, has traditionally been either a very minor net gas exporter or sometimes even a net gas importer. In fact, the country exports gas to Turkey and Iraq, and at the same time imports gas from Turkmenistan. Only recently, gas exports have increased to a record level of above 20 bcm/y, which is very little for a country with such important gas reserves and gas production levels. The reason is that most of Iran's gas production is consumed domestically (including the amount reinjected into aging oil fields to boost their output). Obviously, the geopolitical barriers (i.e. sanctions) did not help Iran to become a major gas exporter. Indeed, the country had important LNG export projects that had to be abandoned due to the sanctions. Thanks to Abu Dhabi's gas production, the UAE has been a net exporter, although it has recently become a net importer, through the Dolphin pipeline, mainly due to the rising demand and lack of reserves in Dubai and in some of the other minor emirates. Although Bahrain and Oman import gas from Saudi Arabia and Qatar, Oman is a net gas exporter, exporting LNG to Asia. Graph 3.s does not include Qatar given the great difference in terms of scale of gas exports. Indeed, it is the largest gas exporting country in the region, reaching a level of 122 bcm of total gas exports in 2019 (both by LNG and pipeline).

Historically, GCC countries, with the exception of Qatar, have made no particular investments in gas exploration and development. This trend is now changing with the National Oil Companies, especially in Saudi Arabia, the UAE and Kuwait, which are planning to invest also in upstream gas projects. The push towards gas investment is dictated by numerous reasons. Firstly, gas can substitute oil in domestic consumption, enhancing oil volumes available for export. Secondly, gas itself may become a precious source of revenues, as global oil demand is expected to peak in the coming decade. Lastly, the decision to invest in gas is vital for these countries, mostly reliant on oil revenues, in order to remain at the forefront of the global energy system in the medium-term, gas being a key component of the global energy transition for European and Asian countries alike.

Key chokepoints, however, are located in this region (Map 3.1), such as the Hormuz Strait, where 21 million barrels of oil pass through every day, corresponding to nearly one-third of the total sea-traded oil. After passing through the Hormuz Strait, the oil export volumes must pass through other major chokepoints: the Bab el-Mandab and the Suez Canal before reaching Europe, and the Malacca Strait before

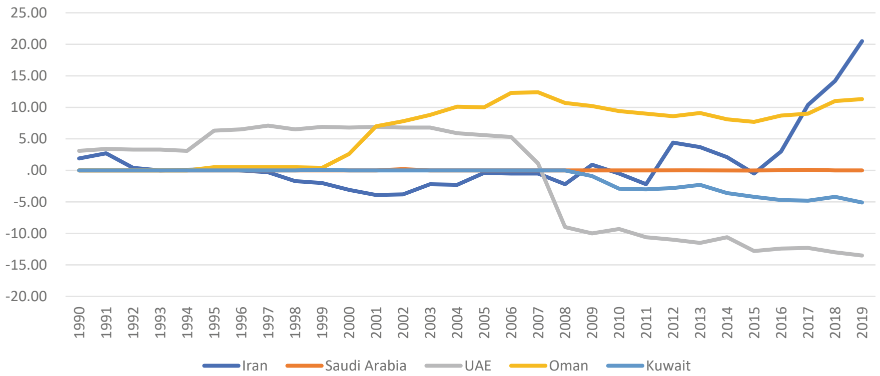


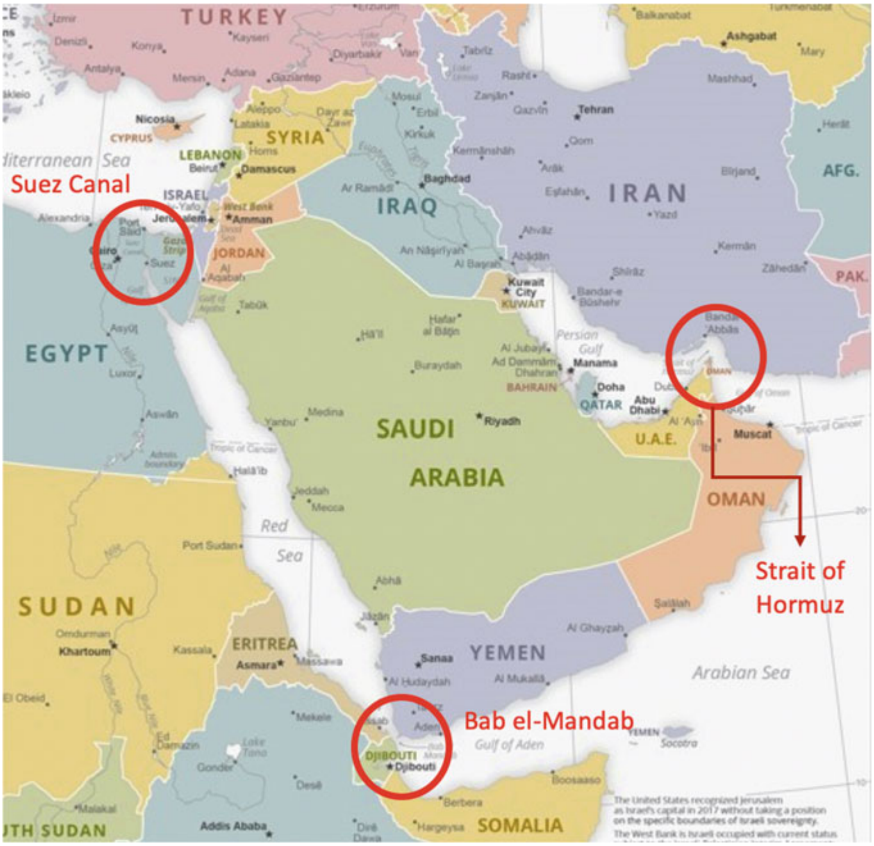
Fig. 3.1 Gas balance* of selected Gulf countries, 2000–2019, bcm. *: Production minus consumption. Exports (+) Imports (−). *Source* Authors' elaboration on BP

arriving to Asia. Map 3.1 highlights the two main oil chokepoints of the Gulf region (Hormuz and Bab el-Mandab). In 2018, 27 million barrels of oil passed through these two chokepoints every day.

Gulf countries have enjoyed massive oil revenues thanks to their vast hydrocarbon resources and relatively small population. Thanks to the distribution of their conspicuous hydrocarbon rent, these countries have been able to put in place solid social contracts.

As already mentioned in Chap. 1 (Sect. 1.3), oil plays a pivotal role in the governance and politics of these countries, even though it is important to understand that this is true only for the most recent part of their history. Krane (2019a) highlights how before oil the main feature of the Arabian Peninsula was isolation. The ascent of Islam in the V century AD, and centuries later (XX century AD) the advent of oil, have put the Arabian Peninsula in the world's political map. Before the rise of the present monarchies in the XX century, people in this area were organized under a system of tribal rule. As Britain expanded its interests in the Gulf, it became mandatory to overcome the ill-defined tribal rule as a way to protect British interests in the region. Britain thus created clear political institutions, providing political and financial backing to sheikhs who were in favor of and followed the terms of the Queen's treaties (Krane 2019a). This allowed the creation of the hereditary sheikhly rule. The Gulf sheikhs extended control over their territories and a consequence was the settlement and loyalty of nomadic tribes. After the end of British control, the monarchies developed strong governing institutions and remained politically stable throughout the following decades, albeit with some differences, as described here below.

Oil has contributed to the integration of this area with the rest of the world, prompting significant socioeconomic development. Benefiting from their vast hydrocarbon resources and small populations, Gulf countries have experienced a generally high wealth level per capita, with a GDP per capita (PPP) ranging between $12,389.2 (Iran) and $90,043.8 (Qatar).

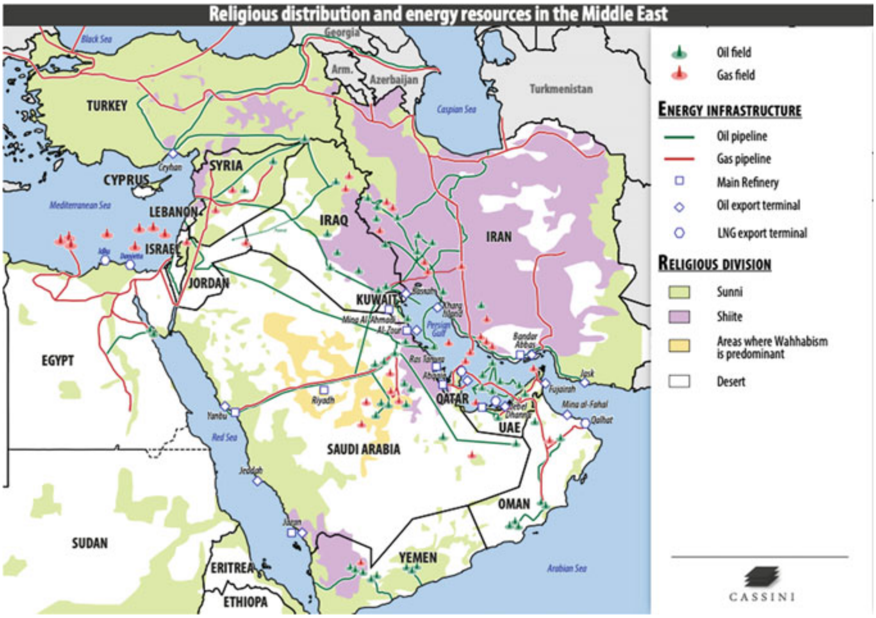


Map 3.1 Oil chokepoints in the Middle East. *Source* Authors' elaboration on CIA

Gulf countries have in general experienced a high degree of political stability over the last decades. In the aftermath of the Arab Spring, GCC countries in the MENA region were the least affected by revolts and social unrest. The only exception was Bahrain, the worst-off among GCC countries, which holds the smallest hydrocarbon reserves and oil revenues to redistribute to the population, which is starkly divided between a ruling Sunni minority and a vast Shiite majority (Map 3.2). Saudi Arabia and Oman also experienced some protests in 2011, but to a lesser extent.

A major driver of the revolts in the region is the unequal redistribution of the oil rent and benefits among the population, as we will analyze in the specific case of Saudi Arabia. Following these protests, governments in most GCC countries sharply increased their direct cash transfers and public sector wages to nationals.

Iran has also experienced numerous protests during the last decade, especially since the 2009 presidential elections. Overall, Iran is a different type of rentier state compared to most GCC countries, mainly due to its large population. Afflicted by international sanctions, Iran has made considerable investments in non-oil related



Map 3.2 Religious distribution and energy resources and infrastructure in the Middle East. *Source* CASSINI

industries, especially manufacturing, in order to satisfy its citizens' requests for a better standard of living. Over the years, the private sector has significantly developed and it has become a lifeline for the country amid sanctions. For instance, in 2019–2020, the exports of the private manufacturing sector (roughly $41.3 million) exceeded oil exports.

All in all, a small or unequal redistribution of oil revenues is one of the main drivers of social instability, threatening the political power in place. Thus, the need of these countries to gradually change in order to keep their political status quo is enhanced by volatile and low oil prices, coupled with the (likely) decreasing role of oil in the global energy system in the future.

3.1.1 Saudi Arabia

Oil might stand as a synonym for Saudi Arabia. The Kingdom of Saudi Arabia holds 17% of the world's proven petroleum reserves and is the world's largest oil exporter. The hydrocarbon sector plays a paramount role in the Saudi economy, accounting for 70% of the Kingdom's exports and 50% of its GDP (OPEC 2019a). Figure 3.2 presents the historical oil production and demand evolution of Saudi Arabia. Between 1980 and 2015, oil demand grew by an average of 6%/y.

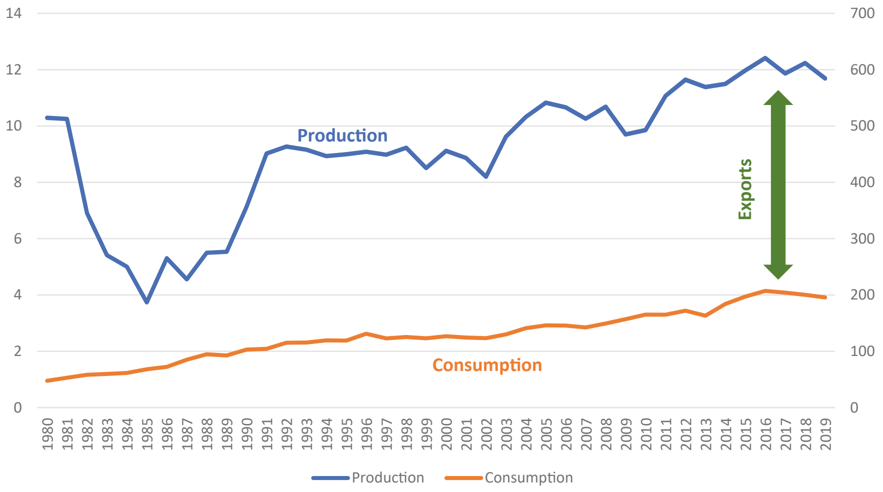


Fig. 3.2 Saudi Arabia's oil production, consumption 1980–2019, Mt (left), mb/d (right). *Source* Authors' elaboration on ENERDATA

In the early 1980s, Saudi oil production declined significantly as Saudi Arabia played the role of swing producer trying to keep up its oil prices, and deciding to leave the administered pricing system in 1985 (Chap. 5, Sect. 5.1.1). However, in the second half of the 1980s, Saudi Arabia's oil production swung progressively back to around 8 mb/d, a level it kept throughout the 1990s. These 15 years were years of low oil prices which therefore pushed up world demand. Indeed, during the 2000 and 2010 decades, when global oil demand increased strongly in particular due to China's strong economic growth rates, Saudi Arabia further increased its oil production, which amounted roughly to 10–11 mb/d during the 2010 decade. Over the same period, crude oil production increased by 18%. This higher production level was needed to satisfy both the increasing domestic and international demands. The difference between production and domestic consumption is what Saudi Arabia can export. With exports of around 7 mb/d, Saudi Arabia is by far the largest oil exporter in the world.

At the same time, Saudi Arabia is one of the largest gas producers worldwide (113.6 bcm in 2019). However, the entire gas production is used to satisfy the country's internal demand, leaving no room for gas exports.

The Saudi National Oil Company, Saudi ARAMCO, owns and operates Ghawar, the largest conventional oil field worldwide (discovered in 1948, it accounts for roughly a third of the cumulative oil production of Saudi Arabia as of 2018), with 48 billion barrels in reserves and a daily production of nearly 4 million barrels, as well as Safaniya, the largest offshore oil field in the world, with 37 billion barrels in reserves and a daily production of up to 1.3 million barrels.

Besides its vast oil resources, Saudi Arabia can also benefit from low production costs. It is often affirmed that Saudi Arabia has the lowest oil production costs in the world, with some estimates below $3 per barrel (Al Jazeera 2020a). That figure may be true for old oil fields, which however face declining production levels. New oil fields will inevitably be developed at higher production costs, albeit remaining competitive compared to other global oil producing areas. Saudi Aramco declared an average upstream cost per barrel of $7 per boe (Saudi Aramco 2021). In any case, Saudi Arabia is traditionally considered the world's oil supplier of last resort due to its vast and cheap reserves, meaning that it is potentially able to produce and supply oil as long as anyone is willing to buy it.

Hydrocarbons play a pervasive role not only in Saudi GDP and export revenues, but also in its energy mix. As in other MENA countries, the availability of vast and cheap fossil fuel resources has shaped the Saudi energy mix. In the total primary energy supply (TPES) (213.6 Mtoe in 2018) the share of oil amounts to 63% while the share of gas represents 37% (IEA 2018a), while other sources, namely solar and biomass, play a very marginal role (Fig. 3.3).

A relevant development in the Saudi energy sector is the evolution of the power sector, which has evolved over the past decade both in terms of growth and fuel mix (Fig. 3.4). Power generation has increased by an annual average of 6.4% since 2005. However, between 2000 and 2015, power generation has grown by 7% per year (which means doubling every ten years!), while since 2015 it has drastically slowed down (1% per year) due to the economic crunch following the fall in international oil prices. In terms of fuel mix, the Kingdom decided to strongly expand its natural gas production and installation of gas-fired generation since 2016. Back then, oil-based liquid fuel covered more than half of the power generation feedstock needs. In 2019, Saudi Arabia had a total capacity of 86 GW, which is almost entirely thermal (53% oil and 46% gas). Saudi electricity generation (357.4 TWh in 2019) was dominated by gas (206 TWh, equivalent to 58% of the total) and oil (147 TWh, i.e. 42% of

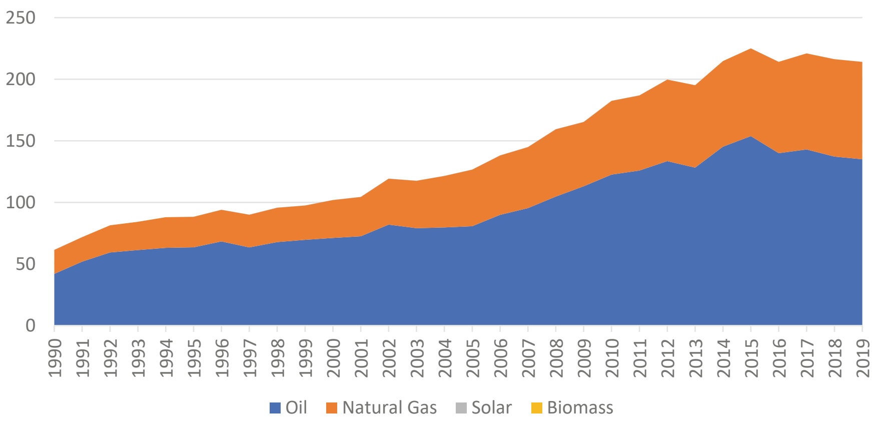


Fig. 3.3 Total primary energy production of Saudi Arabia, 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

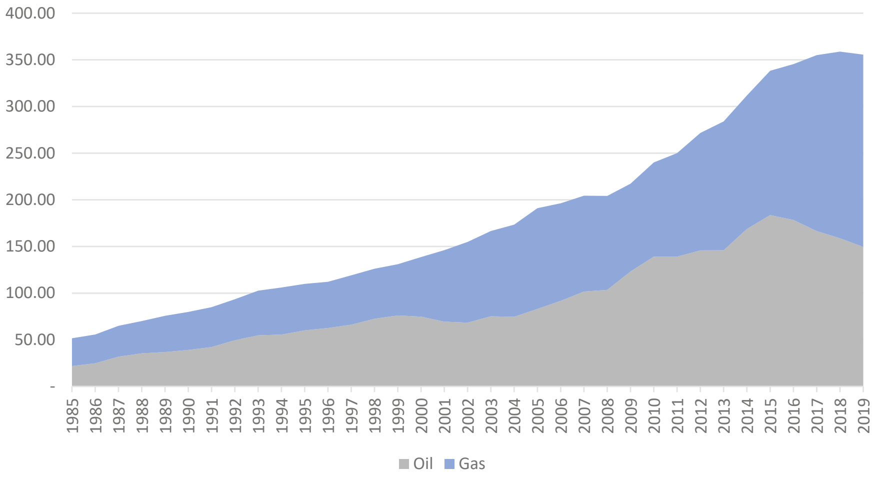


Fig. 3.4 Saudi Arabia's electricity generation by source, 1985–2019, (TWh). *Source* Authors' elaboration on BP

total), while renewable energy sources still play a very modest role (less than 1%) (BP 2020).

Prior to the 1980s, Saudi Arabia had only a limited interest in gas production, resulting in a high flaring rate of its associated gas from crude oil production. This approach drastically changed as the government invested massively in gas infrastructure to utilize its gas output. In the past two decades, gas output has risen significantly from 47.3 bcm in 2000 to 113.9 bcm in 2019 (BP 2020). Natural gas is expected to play an even more important role in Saudi electricity generation as the deployment of renewable energy sources (RES) in the Kingdom faces several limits and barriers despite their great potential (Chap. 4, Sect. 4.2.1).

A peculiarity of Saudi electricity is the large use of crude oil for power generation. Indeed, Saudi Arabia is the biggest user of crude oil for power generation worldwide. Burning unprocessed oil results in significant economic loss since crude oil could be refined into much higher value oil products with a very high valorization on international markets, while for power generation the much lower value of the fuel oil component would be largely sufficient. Over the last years the usage of unprocessed crude oil for power generation has, however, strongly declined and at the same time a strong shift to natural gas has been implemented. But still in 2019, out of 2.6 mb/d of oil used for power generation, Saudi still burned 0.43 mb/d (16.5%) of unprocessed oil. In 2015, its average use of crude oil in power generation peaked at 0.9 mb/d (i.e. 26% of the 3.4 mb/d of the oil used for power generation that year) (Al Ghamdi 2020).

Like other Gulf countries, Saudi Arabia consumes a significant amount of oil (40.4 barrel per capita per year), which leads to a lower economic gain and a higher environmental footprint (Fig. 2.6 in Chap. 2).

Since its growing domestic energy demand may erode its profitable export volumes, Saudi Arabia has also considered developing and harnessing its solar and wind potential to satisfy its domestic needs. Saudi Arabia holds a great potential in renewable energy sources, especially solar, which is however still largely untapped. In 2019, renewable energy sources accounted only for 0.3% of the Saudi energy mix. Saudi Arabia has set several targets throughout the years. In 2013, the King Abdullah City for Atomic and Renewable Energy (K.A. CARE) announced ambitious plans to develop solar power, reaching 41 GW, 17.6 GW of nuclear power thanks to 16 nuclear power plants, and 9 GW of wind power by 2032 (Krane 2019b). During the second half of the 2010 decade, however, these plans were cut down due to low oil prices and political commitment. Saudi Arabia now plans only two nuclear power plants of 1.4 GW each. The renewables target has been reduced to a modest 3.45 GW of renewables capacity by 2020 and 9.5 GW by 2023. In 2020, Saudi Arabia has a total installed renewable capacity of 413 MW. Despite the challenges, natural gas and RES can play a more important role in the foreseeable future, allowing Saudi Arabia to free additional oil volumes for export from the domestic market, resulting in higher revenues.

Most of Saudi oil flows through the Hormuz Strait heading to Asia (69% of its total oil exports in 2019). In 2019, Saudi Arabia exported 415.8 Mt of crude and oil products and its main markets were China (86.8 Mt, i.e. 21% of total exports), Japan (53.9 Mt, 13%) and India (50.7 Mt, 12%), while it exported 56.4 Mt (14% of total exports) to Europe. Due to political hostility, Saudi Arabia fears the closure of the Hormuz Strait by its regional nemesis, Iran. For this reason, Saudi Arabia has tried to enhance alternative export options, in particular through its East–West pipeline. This pipeline has a total capacity of 5 mb/d and brings Saudi oil from the Eastern province to the Red Sea Yanbu port. Yet, Saudi still depends largely on the Hormuz Strait for most of its oil exports, leaving political and security risks as Chap. 5 Sect. 5.1.3 will analyze.

- **Saudi energy companies**

The Saudi energy market is largely dominated by state-owned companies. Saudi Electrical Company (SEC) is the vertically integrated power utility which holds the Kingdom's monopoly of power supply. According to the Electricity Law of 2005 (issued by Royal Decree N. M/56), the Saudi electricity market aims at introducing competition. Unbundling is currently taking place, which should establish one transmission company, one distribution company and four generation companies, all regulated with a SEC holding company (Li et al. 2017).

Concerning oil and gas, Saudi ARAMCO is the well-known National Oil Company of the Kingdom. Its presence in the oil and gas sector dates back in time. Saudi Arabia was completely overlooked by British regional and oil interests, leaving the door open to a new company, Standard Oil of California, known as SOCAL (now Chevron). In 1933, SOCAL signed a 60-year concession agreement with the new Saudi king, Ibn Saud, who was eager to receive money in exchange of concessions. A subsidiary company, called California Arabian Standard Oil Company (CASOC), was created to manage the agreement. SOCAL initially did not have any major discovery success; thus, it decided to share the risks with one of the major American oil companies, Texaco. In 1944, the company changed its name to Arabian American Oil Company (ARAMCO). However, the two companies decided to include other companies in the development of the concession agreement and secure capital. The Saudi king insisted that Aramco remained 100% American. Thus, they identified Standard Oil of New Jersey (then Exxon) and Socony Vacuum (then Mobil) as the two new partners. SOCAL and Texaco held 30% each of Aramco, while Standard Oil of New Jersey purchased 30% and Socony Vacuum 10% of the company. In 1948, the first well was drilled in the supergiant Ghawar field, which is considered the biggest oil field in the world. Several decades and stages of development were required to realize the extent of this reserve, which is really a network of five fields. Already in the 1950s, ARAMCO was able to produce 500,000 barrels per day also thanks to an increasing oil demand. A couple of decades later, in 1973, Saudi Arabia bought 25% interest in ARAMCO, which increased to 60% the following year. Finally, in 1980, the Saudi government acquired full ownership of ARAMCO and in 1988 the name was changed to "Saudi ARAMCO". This company was a precursor of the "Saudization policies" carried out in the 2010s by the Kingdom. In fact, by 1989, all senior executives and 73% of the workforce were Saudi nationals (ARAMCO Museum, Dhahran), but at the same time the Government was clever enough to persuade a large number of American and international expats to keep on working at Saudi Aramco—of all NOCs, Saudi Aramco is often referred to as the best. Since the early 1990s, Saudi ARAMCO has formed joint ventures in Asia, Europe and North America, and in 1993 a Royal Decree merged Saudi Arabia Marketing and Refining Company with Saudi ARAMCO, integrating the Kingdom's petroleum activities. In the 2000s, it considerably increased its gas activities, thanks to, for instance, the Hawiyah Gas Plant which began production, boosting Saudi's gas supplies by more than 30%. Today, Saudi ARAMCO is regarded as one of the world's most profitable companies, generating $88.2 billion in net income in 2019, a 22% decrease compared to the previous year (Gambrella 2020). In 2018, it decided to disclose for the first time the accounts in preparation for the IPO of 1.5% of the company, which took place in December 2019. It was traded only on the Saudi stock exchange, Tadawul. In December 2019, the IPO raised a record $25.6 billion, by selling 3 billion shares at SAR32 ($8.53) per share (Gross 2019). In January, an additional 450 million shares were sold, increasing the size of the IPO to $29.4 billion (Reuters 2020). The goal of the IPO is to raise capital vital for the diversification strategies enacted by Saudi Arabia, since the current socio-economic system may not be sustainable in the long run.

- **The unsustainability of the rentier state: an economic and energy perspective**

Saudi Arabia experiences all the pains and gains of the classic rentier state. The Saudi debt (as a percentage of GDP) changes in relation with the fluctuations of oil prices. In 2014, when oil prices were rather stable and over $100 per barrel, the country's debt reached its lowest level (1.5% of the GDP). Since the fall of oil prices in 2014, Saudi Arabia has seen its debt expanding. This condition reached a new peak with the unprecedented crisis in 2020 caused by the Covid-19 pandemic. In that year, oil prices plummeted below $20 per barrel, reaching an 18-year low for Brent crude. To tackle oil prices volatility, Saudi Arabia used its large foreign reserves to preserve the social welfare for its citizens. In March 2020, oil prices fell at the fastest rate in the last 20 years with a monthly drop of nearly $27 billion, reaching the lowest point in the last 19 years (Barbuscia and Rashad 2020).

In 2020, Saudi Arabia started also a price war with Russia following the fallout in the OPEC + meeting in March 2020. The Kingdom showed its unique capacity to increase oil production on very short notice, as it promised to reach 12.3 million barrels per day in April 2020, thus increasing its ability to export greater oil volumes. This ability, however, may be hindered over time due to the steep rise in domestic energy demand. Indeed, the internal electricity demand grew at a rate of 5% per year between 2010 and 2018 and it is expected to increase by 8–10% yearly to 2032 (Khan and Salam 2018), due to an annual population growth of 2.62% (2010–2018), an annual average GDP growth of 3.81% (2010–2018) (The World Bank 2020a, 2020b) and the expected localization of numerous industries in the country. All these factors contribute to a growing water demand, which relies for 60% on energy-intensive desalination plants, increasing the electricity demand even further (IRENA 2019). Overall, Saudi Arabia is the 13th largest energy consumer in the world, ahead of countries with considerably larger populations and economies (i.e. Canada, Germany). Other key factors also contribute to the Kingdom's high energy consumption.

Saudi Arabia's harsh environment (temperatures reaching 50 °C in summer, resulting in high consumption of air conditioning) and water scarcity also partly explain the elevated use of electricity. Another important factor regards the generous energy subsidies in place in the country, which hinder energy efficient measures. These subsidies also represent a fiscal burden for the government, since they amounted to $80 billion (11% of the country's GDP) in 2012. Thus, Saudi Arabia planned and started to implement their gradual reduction. While the, energy subsidy reform is not yet complete at the time of writing, already in 2018 total energy subsidies had been partly decreased and amounted to less than 6% of Saudi GDP. Indeed, since 2015, Saudi Arabia has significantly increased tariffs for all fossil fuels. Energy-intensive industries, the most developed in the country, were the most affected since they felt threatened in terms of competitiveness. Also, in 2015, households were impacted by a substantial increase in energy tariffs, especially in terms of transport fuel and electricity prices. Though low consuming households (< 4000 kWh) were exempt from the price increase, middle (4000–6000 kWh) and high (> 6000 kWh) consuming households saw a price increase of $0.05/kWh and $0.08/kWh, respectively (APICORP 2018). However, these new retail prices still do not cover production costs, since the Kingdom also raised the prices of the fuels employed for generating electricity. Despite the unpopularity of the subsidy reforms, which led to an inflation spike, the government explicitly set the goal of zero electricity subsidies by 2025. Table 3.3 summarizes the main drivers leading to an astonishingly high and rising energy demand.

Table 3.3 Main drivers of high and increasing energy demand

DRIVERS OF HIGH AND INCREASING ENERGY DEMAND	
Population growth (2.6%*)	Growing water demand (60% of water demand satisfied by water desalination plants)
Annual average GDP growth (3.8%*)	
Localization of industries	
Weather (50° C in summer)	
High energy subsidies	

*This percentage regards the period 2010–2018
Source Authors' elaboration

- **The unsustainability of the rentier state: a socio-political perspective**

Oil is predominant also in the socio-political sphere. A high and fairly equal redistribution of oil revenues within the framework of a rentier economy is key to social stability. Indeed, Steffen Hertog argues that regions with a more coherent regional identity, such as the central ones, receive the highest contributions thanks to their ability to organize around such identity (Haykel et al. 2015). The South, which is very similar to the center, but has developed a less cohesive identity, suffers the most. Concerning the Eastern Province, Hertog states that this region has enjoyed fewer contributions since it was not able to draw on regional identities, but rather on town-based ones (Haykel et al. 2015). Therefore, it was not the Eastern Province that was specifically discriminated against for religious/sectarian divide (inhabited predominantly by Shi'a), since there are other regions in the Kingdom, inhabited by Sunni Saudi nationals, that also suffer from unequal redistribution of resources (Haykel et al. 2015). The town-based identity argument is in line with Alamer research (Al Rasheed 2018), which focuses on the reasons why this region has seen the largest number of protests against the political regime in place, going beyond the dichotomy of the Sunni-Shi'a divide. He argues that the presence of strong town-based identities, dating back before the establishment of the Saudi state, paved the way to the formation of a homogenous and well-organized group, such as in Qassim, which experienced the highest number of protests. The strengthening of the town-based identity in Qassim was facilitated by its location: it is close enough to oil fields so that its inhabitants go to work and come back every day, but far enough so that migrants, as well as Saudis coming from other towns or regions, do not move here, preferring to reside closer to the oil fields.

Building on this argument, political mobilization and oil prices are positively correlated in the Kingdom. In fact, the Gregory Gause III shows that political mobilization occurs mostly during periods of high prices, since in times of low oil prices the government increases the level of subsidies and of general redistribution to the population (Haykel et al. 2015). The author concludes that Saudi Arabia presents a "rentier exceptionalism" because mobilization does not happen when oil prices drop, as is usually the case (Haykel et al. 2015). This policy also contributes to the unsustainability of the rentier economy in the Kingdom, arising especially from the volatility of oil prices due to the oil dependence of the Saudi economy. Until King Salman and his son, the current Crown Prince Mohammed bin Salman, came to power in 2015, periods with very low oil prices were coped with by spending and borrowing. Recently, various methods, such as selling a $17.5 billion bond in 2016, were employed, but new strategies, such as Vision 2030 and the National Transformation Program (NTP), have also envisaged a decrease of subsidies and the introduction of VAT (Al Rasheed 2018).

As the world is expected to decarbonize and consume less oil, Saudi Arabia may experience lower income from oil rents. Therefore, its "rentier exceptionalism" may need to change. A small taste of potential future challenges occurred in 2020, when the Kingdom suffered from low oil prices caused by the effects of the Covid-19 pandemic. In May 2020 the Saudi government decided to raise the VAT from 5 to 15% starting from July and to cut the cost-of-living allowances for public employees by SAR 1000 ($267), in response to record low oil prices and the effects of the corona virus lockdown (Bostock 2020). New austerity measures mean lower revenues for citizens, which could further stress the weaknesses of the current social contract.

- **The example of ARAMCO adaptation to the changing Saudi context**

Saudi ARAMCO, the national oil company, has significantly contributed to Saudi Arabia's economic and social development, and it has ensured stability through the social contract by becoming one of the main actors in the global energy system. It may be described as the "economic star" of Saudi Arabia. Recently, ARAMCO had to outline new strategies in order to adapt to and enhance its resilience in response to the changing energy context.

The following section analyzes the new strategies of ARAMCO in order to remain at the forefront of the global energy system and to strengthen the economic sustainability of the Saudi energy sector in the mid-long term.

ARAMCO horizontal diversification strategy for a flexible adaptation

Regarding horizontal diversification, namely diversification strategies within the energy sector, ARAMCO has made strong investments in activities with a forecasted high growth in the coming years, such as gas and petrochemicals/refineries both in Saudi Arabia and abroad. As a matter of fact, OECD countries are forecasted to externalize petrochemical activities in order to be in line with their decarbonization policies and targets. However, worldwide petrochemical demand is expected to increase in the coming decades and to account for more than a third of oil demand growth in 2030 and roughly 50% in 2050, according to the 2018 IEA report on the future of petrochemicals (IEA 2018b). Thus, ARAMCO is also making large investments in refining activities: in 2019, it set a goal to increase its refining capacity from 4.9 billion barrels per day to 10 billion barrels per day by 2030 (Dipaola 2019). By predominantly investing in Asia, the Kingdom manages to adapt these refineries to the quality of Saudi crude, managing to maintain and enhance its market share. A primary example includes ARAMCO's acquisition of 20% of stakes of the Indian Reliance Industries' refining and petrochemical business, which amounts to one of the largest foreign investments in India (Mukherjee and Ulmer 2019). Moreover, this strategy has had an important development also at home. In March 2019, Saudi Aramco announced the acquisition of a 70% stake in the country's petrochemicals giant, SABIC, from the Saudi sovereign wealth fund (SWF), Public Investment Fund (PIF). The deal is of considerable relevance and scale: the purchase price amounted to $69.1 billion and SABIC is the fourth largest chemical company for sales. It usually employs natural gas to produce its chemicals, while Aramco employs liquids derived from crude oil (Seznec 2020). With this merge, ARAMCO is striving to expand also in the chemical downstream activities, coupled with the natural gas and general downstream (refineries etc.) sector to become a world player in numerous fields. Moreover, by focusing on non-combustion activities of oil and gas, ARAMCO is able to reduce its vulnerability with respect to decarbonization policies as well as to financially contribute to the economic and social diversification strategy through the PIF.

Regarding energy-related fields, ARAMCO, through its subsidiary Saudi Aramco Energy Ventures (SAEV) is aiming to invest in R&D regarding hydrogen fuels, higher efficiency for internal combustion engines, limiting carbon emissions and CCS technology for cleaner mobility in Saudi Arabia. SAEV is expected to launch a $500 million fund for renewable projects and energy efficiency (Pyper 2020). Moreover, SAEV is exploiting venture capital to help minimize CO_2 impact in the oil and gas sector, which is one of the main strategies of ARAMCO nowadays. For instance, by also investing in Zouk, a European equity fund for clean-tech startups, ARAMCO is acquiring expertise in related fields, which might generate an increasingly added value in the coming decades (Pyper 2020).

ARAMCO contributes to the diversification of the Saudi energy mix

ARAMCO is also striving to expand its trade and activities in the gas sector. ARAMCO has always been the only gas provider for domestic consumption in Saudi Arabia, in particular for water desalination and high energy-intensive industries (steel, aluminum etc.). As aforementioned, despite being the 8th largest gas market worldwide, high domestic internal gas consumption hinders gas exports. Therefore, Saudi Arabia has recently embarked on new large development projects in order to have a global outreach also in the gas market, such as Hasbah, Hawiyah and Marjan. Moreover, the Kingdom is also developing megaprojects in new areas, including the Jafurah shale development, which is expected to come online in roughly 2025 (IEA 2020). In May 2019, ARAMCO signed with the US company Sempra Energy a 20-year contract stipulating that it would buy 5 million tons of LNG per year. Moreover, it has also acquired a 20% equity in an LNG facility, currently under construction in Port Arthur, Texas (Bussewitz 2019). Nevertheless, due to the consequences of Covid-19, ARAMCO is reviewing its LNG investment plan in Texas. The stand-by of numerous new projects is in line with ARAMCO's current strategy to cut investments in new projects, while keeping investing in its assets and focusing on upstream oil and gas projects. Indeed, investments were downgraded from a $40 billion target to $25 billion, with possible further decreases (Ratcliffe et al. 2020). Similarly, Saudi Arabia put on hold its plans to enhance its refinery capacities and petrochemical activities worldwide. For instance, in August 2020 ARAMCO suspended a $10 billion petrochemical project in China while in July 2021, it appeared to have put on hold the expansion of its petrochemical activities in Port Arthur, Texas (Faucon and Said 2021).

Saudi ARAMCO has increasingly looked into opportunities in the LNG sector, especially in the Asian markets. However, Saudi Arabia ought to deal with challenging conditions both at the domestic and international level. Domestically, the development of new gas fields comes with higher costs. Moreover, Saudi Arabia has prioritized the use of gas domestically in order to free additional oil export volumes. Internationally, Saudi Arabia would be a late comer, while other LNG exporting countries have better economic conditions to consolidate their power.

To conclude, economic diversification has become a priority for the Kingdom to ensure its socio-political and economic sustainability. In 2016, it published "Vision 2030", a document comprising targets and objectives in numerous fields to reduce reliance upon oil for revenues, envisaging, for instance, quite ambitious targets for renewable energy capacity. Saudi ARAMCO is already adapting to the new global context in order to try to remain at the front of tomorrow's global energy system.

3.1.2 UAE and Qatar

Qatar and the UAE share numerous characteristics in various fields. Both countries extend over relatively small territories, (Qatar area: 11,437 km^2 and UAE area: 83,600km^2), they are aviation (Qatar Airways, Emirates in Dubai and Etihad in Abu Dhabi are some of the most renowned airlines worldwide) and events hubs (Expo 2020 in the UAE and 2022 World Cup in Qatar). Also, in the demographic sphere, non-nationals make up the great majority of the population, representing 87% of the total population in both countries (Gulf Labour Markets and Migration 2019). Similarly, in the energy sector, both the UAE and Qatar are heavily reliant on gas, which represents 88% and 94% of total primary energy supply (91.4 Mtoe for UAE and 50.6 Mtoe for Qatar) and 98% and 100% of power generation, respectively (138.4 TWh for UAE and 49.8 TWh for Qatar) in 2019 (WEO 2021; IEA 2018c, d).

Before diving into the similarities and differences between Qatar and the UAE, it must be remembered that although the UAE is taken as a whole, it consists of a federation of seven semiautonomous sheikhdoms (or emirates): Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Quwain, Ras al-Khaimah, and Fujairah. The federation was initially formed in 1971 when the emirates became independent from the British empire, and achieved the present formation in 1972 following Ras al-Khaimah's reluctant join. Within the federation, Abu Dhabi and Dubai are by far the most important emirates. However, these two emirates present major differences in their economy and political power. While Abu Dhabi is rich in oil and gas (holding 93% of the UAE's oil and gas), Dubai is a post-oil economy. Abu Dhabi is the political and petroleum powerhouse of the UAE. Abu Dhabi and Dubai are the most influent emirates in the federation, holding key cabinet posts and economic relevance (Abu Dhabi with its oil and gas reserves, Dubai with trade and real estate). Power and authority in the UAE are shared between the federal and emirate levels and apportioned among the seven emirates based largely on population size. While nineteen issues (including foreign affairs, defense, finances, education, and health) are under federal government responsibility, the constitution allows each emirate to exercise sovereignty over issues not under federal jurisdiction. In this way, Abu Dhabi managed to retain control over its own oil and gas reserves (Ulrichsen 2020). For such reasons, in several occasions the two emirates had disagreements. They underwent several crises due to a rift over the degree of federal power and oversight; with Dubai in favor of a looser arrangement, whereas Abu Dhabi for a closer integration (*Idem*). Especially in the 2000s, Dubai's policy was strongly characterized by unilateralism, with decisions taken with little coordination with the federal government. The result was a less coherent UAE foreign policy.

The following section will analyze firstly the major differences between Qatar and the UAE in the energy sphere, such as energy security and diversification of energy sources, and then the main characteristics these two countries share in the energy sector.

- **Differences in the energy sector: energy security and diversification of energy sources**

Stark differences between Qatar and the UAE arise when analyzing more in depth the recent energy policies and the "sources" of natural gas, a key element of the energy mix of both countries. These two countries differ in energy security and in diversification of sources for their energy mix and power generation.

The UAE: energy security as a major driver for diversification of energy sources

The UAE holds significant oil and gas reserves (97.8 thousand million barrels and 5.9 tcm in 2019), which are almost entirely located in Abu Dhabi, and it is a major oil and gas producing country. It is member of the Organization of the Petroleum Exporting Countries (OPEC) and the Gas Exporting Countries Forum (GECF). The UAE mainly produces crude oil (around 3.1 mb/d) and a lower share of non-crude oil liquids (about 0.9 mb/d) (Fig. 3.5).

With a relatively small population (9.7 million people in 2019), the UAE is also a major oil-exporting country. Within the OPEC, the UAE is the third-largest oil producer behind Saudi Arabia and Iraq. It is committed to monetizing its vast resources, fueling growing tensions with the OPEC leader, Saudi Arabia. The UAE indeed announced its plans to increase its crude oil production capacity to 5 mb/d in 2030. In 2019, it exported 2.8 mb/d of crude oil, most of which went to Asia (93% of total exports) and primarily to Japan (30% of total exports).

The UAE's total primary energy supply amounted to 91.4 Mtoe in 2019, with natural gas (71% of total TPES) gaining increasing relevance and replacing oil,

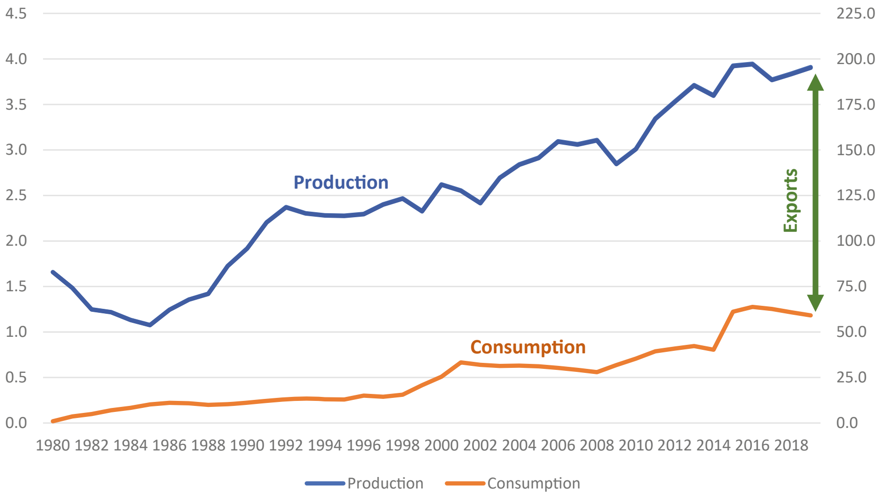


Fig. 3.5 UAE's oil production and consumption, 1980–2019, Mt (left), mb/d (right). *Source* Authors' elaboration on ENERDATA Global Energy & CO_2 DATA

especially in the last years (27%) (Fig. 3.6). Nonetheless, over the past years, the UAE has also increasingly used coal in its energy mix with a 2% share. At the same time the UAE has increased its effort in renewable energy sources, but with modest results.

Its domestic electricity consumption has increased constantly over the last three decades from 14.3 TWh in 1990 to 125.7 TWh in 2019 (+7.8% on average annual growth rate). The power sector is nearly totally reliant on natural gas. That is why the UAE is striving to enhance its energy security. The UAE has increased its gas production from around 20.1 bcm in 1990 to 67 bcm in 2019. However, it has also

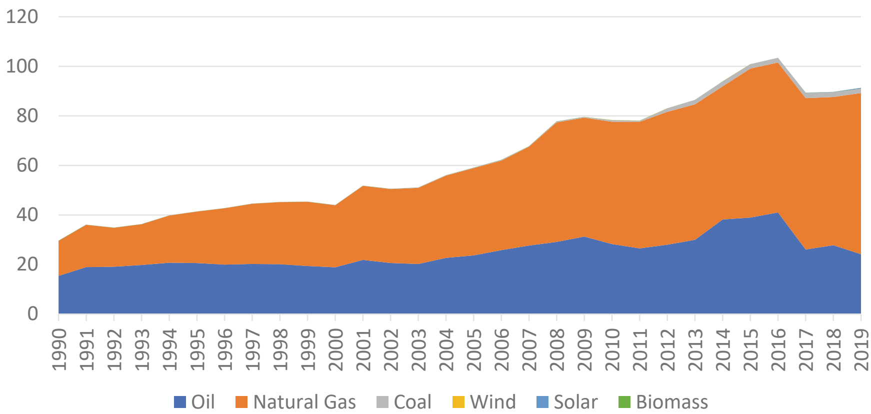


Fig. 3.6 UAE's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

experienced a growing gas consumption that forced the country to increasingly rely on LNG imports as well as gas pipeline imports to meet its domestic needs. The UAE became a net importer of natural gas in 2008 as UAE consumption exceeded production. However, Fig. 3.7 also shows the double nature of the UAE gas patterns. On the one hand, the UAE has exported constant gas volumes via LNG mainly to Asia, thanks to Abu Dhabi's gas production and liquefaction plant. On the other hand, growing gas consumption has contributed to higher gas imports both from Qatar via pipeline and, since 2014, LNG using Dubai's Floating Storage and Regasification Unit (FSRU) as well as a second FSRU-based import terminal in Abu Dhabi since September 2016.

The main route of gas supply to the UAE is through the Dolphin pipeline (Map 3.3), which connects Qatar with the UAE and Oman, providing one-third of the UAE gas supply. In 2010, Qatar and Dubai signed a contract whereby Qatar would sell gas via Dolphin pipeline at $2/MBtu until 2032. However, taking into account the geopolitical tensions between Qatar and the UAE, culminated in June 2017 with the embargo on Qatar by the Quartet (Bahrain, Egypt, Saudi Arabia and the UAE), it is unlikely that Qatar will renew the contract with the same favorable terms and prices. Also, given the high growth of electricity and water demand in the UAE, it might be quite challenging for this country to secure increasingly higher quantities of gas, given the current political stalemate with Qatar.

The Dolphin pipeline currently satisfies more than one-fourth of the UAE's gas supply. Had the UAE chosen to increase its LNG from other countries, it would have had to pay on average 3 times more, assuming 2017 gas prices. As a matter of fact, by importing gas through the Dolphin pipeline, the UAE is able to guarantee affordable prices, even if the electricity subsidies are decreased, as planned in Vision 2021. In

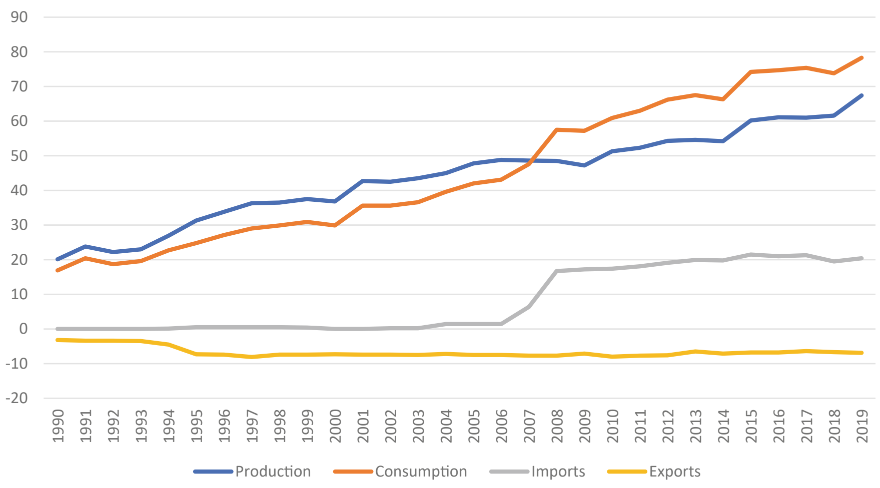


Fig. 3.7 UAE's natural gas production, consumption, imports and exports 1990–2019 (bcm). *Source* Authors' elaboration on ENERDATA

Map 3.3 Dolphin gas pipeline connecting Qatar to the UAE and Oman. *Source* Authors' elaboration

short, the Dolphin pipeline has been a key factor for the Emirates' security of gas supply, especially when taking into account IEA's definition of security of supply as "uninterrupted availability of energy sources at an affordable price" (IEA 2019). Nonetheless, the UAE has increased its LNG imports especially in the aftermath of the crisis within the GCC. Such an increase was driven by the need to improve its security of supply.

Meanwhile, the UAE, through the national oil company Abu Dhabi National Oil Company (ADNOC) and joint ventures, has carried out major exploration activities for gas fields. Natural gas is expected to reach the target of 38% of the energy mix by 2050. However, Emirati gas production used to be rather low, and the newly discovered gas fields are usually rich in sulphur content so that the total costs for gas production and treatment for sulphur are expected to be quite high, standing at around $8/MBtu (IRENA and MASDAR Institute 2015). Nevertheless, in February 2020, ADNOC announced the discovery of 2.2 tcm of gas in Jebel Ali, on the border between the emirates of Dubai and Abu Dhabi, representing the largest gas discovery worldwide since 2005 (Meliksetian 2020). This gas field is shallower than most other gas fields in the UAE, leading to possible lower production costs, even though it is sour. Also, ADNOC, with Wintershall and ENI, is developing the Ghasha ultra-sour gas concession, which is expected to come in operation in 2025 (Saadi 2020).

In order to enhance its energy self-sufficiency, the UAE is striving to diversify its energy mix and power generation sources. To date, the UAE is the country in the cluster with the highest share of renewable sources (excluding hydro) in the energy mix for electricity generation, amounting to 0.4% of total electricity (IEA 2018c). In 2017, the UAE published the so-called "Energy Strategy 2050" with the aim of increasing the percentage of clean energy (intended as renewables plus nuclear) in the energy mix from 25 to 50% by 2050 (UAE Ministry of Energy and Industry 2017). In order to meet this objective, the UAE has made considerable investments in renewable mega-projects, such as the Mohammed bin Rashid Al Maktoum Solar Park, which is expected to become the world's largest independent power producer in terms of capacity (5 GW by 2030) with a conspicuous investment of AED 50 billion ($13.61 billion). The first two phases of the project have been carried out in 2013 and in 2017, and they started operating with a capacity of 13 MW and 200 MW, respectively. In full operation, the Al Maktoum Solar Park is expected to meet 25% of the UAE's internal demand for electricity from clean sources. Also, in 2013, the Emirate of Abu Dhabi, put into operation the largest concentrated solar power (CSP) plant in the world (at that time) named Shams 1, which provides electricity to roughly 20,000 households thanks to a capacity of 100 MW. It was developed and financed by Shams Power Company, a joint venture between the Emirati Masdar (60%) and a consortium composed of Total (20%) and Abengoa Solar (20%) (Masdar 2017).

Moreover, the UAE has not limited its diversification efforts to only solar and wind, but it has also launched the first nuclear energy program in the GCC, becoming the main frontrunner of the diversification of energy sources in the GCC. The UAE has begun the construction of a four-nuclear reactor power plant (5.6 GW), jointly developed by Emirates Nuclear Energy Corporation (ENEC) and Korea Electric Power Corporation (KEPCO). The plant entered commercial operation in 2021. Ahead of the COP26, the UAE reiterated its ambition to achieve leadership in the clean energy sources, announcing its ambition to achieve net-zero emissions by 2050.

Overall, in the medium-long term, the UAE energy security landscape is drastically improving, thanks to the newly discovered gas fields, the full operation of the Barakah nuclear power plant and of solar power mega-projects. Nevertheless, in today's context, the country is still reliant on imports, the majority of which come from Qatar, which is not considered a closed ally anymore. Thus, from the energy security point of view, the UAE is committed to bringing online the new gas, renewable and nuclear projects as soon as possible, especially before the termination of the Dolphin pipeline contract in 2032.

Qatar: the global LNG powerhouse

Qatar stands out among the GCC countries, as it holds a special place in the global gas market rather than in the oil market. The small emirate has focused on LNG exports rather than oil, benefiting from its vast reserves based on the giant field, North Dome—shared with Iran. These reserves and strategy allow Qatar to be the world leading player in the LNG industry. In fact, it holds the third largest gas reserves after Russia and Iran and it has very low production costs.

In 2019, Qatar holds 24.7 tcm of natural gas reserves, accounting for around 12.4% of the world's total gas reserves. The turning point for Qatar's gas production was 1996 (Fig. 3.8). Until then, its entire gas production was consumed domestically. After that year, Qatar's growing gas production has aimed at exporting LNG. Indeed,

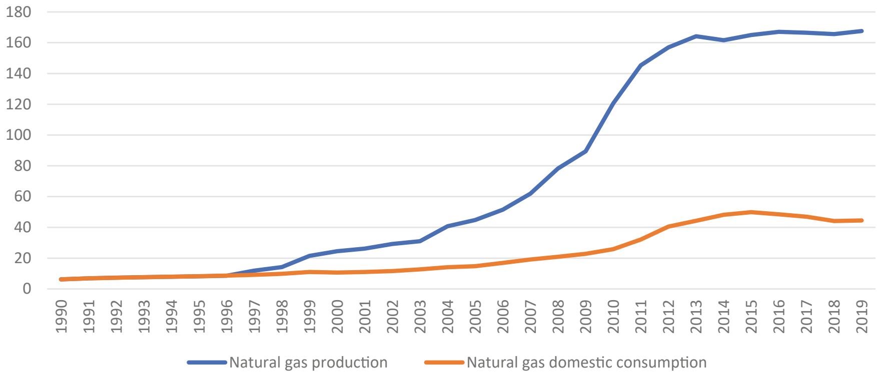


Fig. 3.8 Qatar's gas production and consumption, 1980–2019, bcm. *Source* Authors' elaboration on ENERDATA

the country entered the LNG sector in 1996 when it launched its first LNG train. Since then (4.3 bcm per year), Qatar's LNG capacity has expanded rapidly, reaching a production capacity of 101 bcm per year in 2009–2010.

Qatar has been able to expand its LNG industry thanks to the vital contribution of the IOCs (ExxonMobil, Total, Japanese Marubeni and Mitsui as well as Shell) in terms of both technology and expertise. Growing production volumes combined with a small population has allowed Qatar to consolidate its status as the world's top LNG producer and exporter. In 2019, Qatar accounted for 22% of the world total LNG production—the highest global share by a single country (GIIGNL 2020). The bulk of Qatar's exports are via LNG—with a smaller share via pipeline to UAE and Oman. In 2019, it exported 107.1 bcm via LNG and the main destinations are located in Asia (67% of total exports) and Europe (30% of the total) (BP 2020). The largest buyers are China, India, Japan and South Korea. Meanwhile, Qatar has also exported its gas through the Dolphin pipeline to UAE and Oman.

Prior to 2017, there were two main companies, Qatargas and RasGas, operating in the LNG sector. The state-owned Qatar Petroleum had a majority stake in Qatargas and in other international companies, such as Total and Mitsui &Co, and owned small stockholdings, while RasGas consisted of a 70/30 joint venture between Qatar Petroleum and Exxon Mobil, respectively. At the end of 2016, the chief executive of Qatar Petroleum announced the merger of the two companies into one company, named Qatargas. This merge established the largest LNG producing company in the world, which also produces helium and other derivatives, with a capacity of 77 million tons (Qatargas n.d.). This choice was predominantly dictated by the desire to take advantage of the economies of scale and to better coordinate and counteract the increasing competition from other LNG exporting countries. In fact, in order to remain a leader in the LNG market share, Qatar has to increase its investments in this sector to counteract fierce competition, especially from Australia, Russia and the United States (Fig. 3.9). Therefore, in April 2019, Qatar Petroleum invited bids

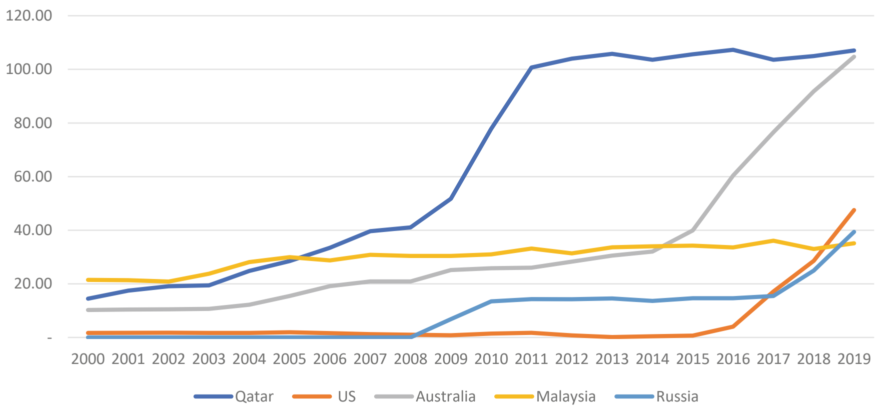


Fig. 3.9 LNG export volume by world's largest LNG exporting country, 2000–2019, bcm. *Source* Authors' elaboration on BP (2020)

from three joint ventures to develop a massive expansion project for the North Field, which is planned to be completed by 2024.

This move marked a sharp change in Qatar's approach to its LNG industry and natural gas resources management. In 2005, it established a self-imposed moratorium on the development of the North Dome in order to preserve its resources for future generations, and to understand the effect of the field's rising output on the reservoir. In 2017, Qatar decided to lift the moratorium in response to the growing international competition in the LNG industry. Qatar expects to boost output in the North Dome in order to increase LNG production by 64%, from 77 million tonnes per annum (Mtpa) in 2019 to 126 Mtpa in 2027.

Qatar's LNG exports increased significantly between 1997 and 2011, when they stabilized at slightly above 100 bcm (77 Mt). Until 2010, Qatar's LNG exports were divided almost equally between Europe and Asia; however, in 2019, the largest share (67%) flew to the energy-hungry Asian markets, with the main markets being South Korea, India and Japan.

Qatar feels pressure also in terms of pricing mechanisms. The US LNG has contributed to foster spot and gas prices. However, Qatar has been one of the strongest supporters—along with Algeria—of long-term contracts based on oil indexation. Oil indexed long-term contracts still represented around 60% of the exports in 2019. It considers them a more predictable and reliable mechanism for those involved in the industry. However, the US LNG has substantially changed the global LNG market, fostering the use of spot prices. Despite buyers' growing renegotiation calls, Qatar has remained extensively committed to oil indexation.

Along with the expanded production of natural gas since 2000, Qatar has also managed to increase its production of liquids, such as condensate LPG and NGLs, which are a significant and valuable byproduct of natural gas. Around 50% of the oil production in Qatar is related to NGL production (Fig. 3.10). However, total oil production (crude oil plus natural gas liquids) underwent an up and down during the

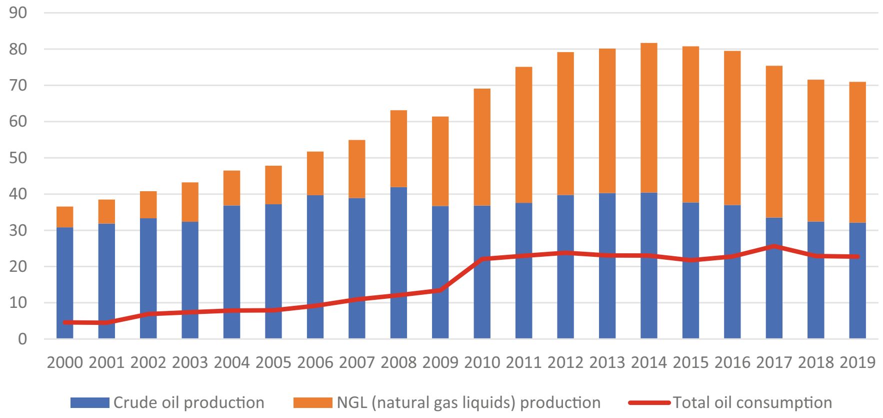


Fig. 3.10 Qatar's production of crude oil and natural gas liquids 2000–2019 (Mt). *Source* Authors' elaboration on ENERDATA Global Energy & CO_2 DATA

last two decades. Until 2013 it increased, reaching 80 Mt in 2013. Since then, total oil output declined to 71 Mt in 2019, and 60% of Qatari oil production is exported.

Qatar produces less oil than its regional peers, especially Saudi Arabia and the UAE, but it is by far the largest MENA gas (mainly LNG) exporter. In December 2018, Doha announced its decision to exit from OPEC. The move could have a political motivation as Qatar intends to distance itself from Saudi Arabia, the de facto leader of OPEC, especially following the 2017 blockade on Qatar. With only 600,000 barrels per day of crude oil output in 2017, Qatar accounted for less than 2% of OPEC's crude oil output. In recent years, small producers held little power in the cartel. This decision will be analyzed in more depth in Chap. 5 (Sect. 5.1.2), but the move was driven by political considerations and it was also based on the strong belief that natural gas will have a rosier future than oil and coal in light of the global energy transition.

Given its vast gas reserves, Qatar's total primary energy supply relies significantly on natural gas (Fig. 3.11), in particular following the massive investment in gas production in the 2000s, which has also allowed Doha to become the world's top LNG exporter. The country's TPES is therefore heavily reliant on natural gas (around 88% of TPES in 2019), with the rest being oil. Qatar's TPES is thus not very diversified, relying exclusively on gas and oil. Like other MENA countries, it has increased significantly from 6,558 Mtoe in 1990 to 43,408 Mtoe in 2019, i.e. an average annual growth rate of 6.7%. The strong growth is also due to its important industrial sector (in particular its LNG, refining, petrochemical, desalination, and gas-to-liquids complexes) which are very energy-intensive.

Natural gas also dominates Qatar's electricity capacity, which is nearly 100% gas-based. The country's total installed power capacity stands at 14.5 GW, after having been increased by 2.5 GW in 2019 with the commissioning of the Umm Al Houl gas

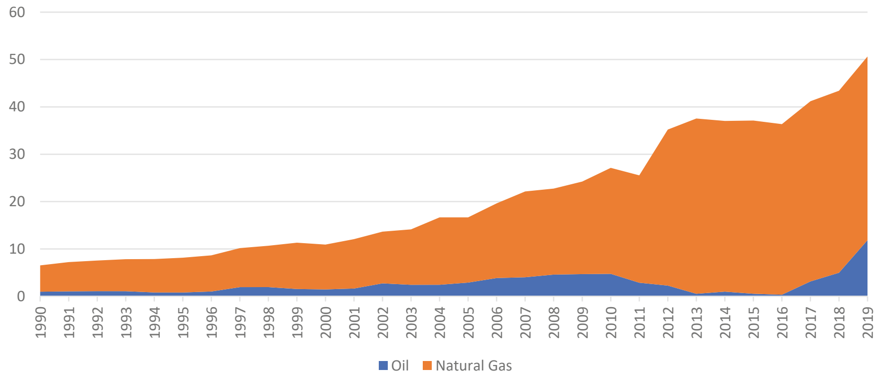


Fig. 3.11 Qatar's TPES, 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

power plant. Electricity production (49 TWh) is all gas-based and has increased by 9.7% per year between 2005 and 2018.

Overall, Qatar has so far had no incentive to diversify its energy mix and power generation sources, since it is endowed with natural gas, which is used to satisfy its domestic energy demand and water desalination plants. Renewables thus play a very minor role in Qatar's energy policy. The only targets set in the renewable energy field (the Qatar National Development Strategy 2018–2022) envisaged the commissioning of 200 MW of renewable energy by the end of 2022. This target has already been outpaced thanks to the commissioning of a 350 MW solar PV plant in 2021. This capacity will be increased to 500 MW at an indefinite and future point in time (The State of Qatar 2018). Nevertheless, in 2021, Qatar Petroleum set a 4 GW renewable target by 2030 in its Sustainability Strategy (Ingram 2021). A detailed analysis on this subject will be conducted in Chap. 4, which is devoted to renewable targets and their possible attainment. However, Qatar's lower economic and strategic need to develop renewable energy, with respect to the UAE, is further demonstrated by the lack of specific renewable targets for the energy sector in Qatar's National Vision 2030 (General Secretariat of Development Planning 2008).

- **Energy subsidy reforms: some similarities**

Qatar and the UAE have carried out thorough energy subsidy reforms, motivated by the fast-growing electricity demand, which has grown by 8% per year between 2006 and 2016, one of the highest rates in the world. In recent years it was slightly below 6%, but it is still very high. Both countries share the need to curb electricity, fossil fuel and domestic water demand due to numerous common peculiarities. In fact, they experience not only high energy consumption growth rates, but also robust population growth, especially of non-nationals, due to the labor-intensive structure of the countries' labor markets and their migration policies. Moreover, the localization of industries within the countries, a key policy for economic diversification from hydrocarbon revenues and export, boosts domestic electricity demand. Decreasing water demand is also crucial since both Qatar and the UAE rely for more than 90% of their household and industry water consumption on energy-intensive seawater desalination plants (IRENA 2019). The roll out of water and energy subsidy reforms played a crucial role in the steep decrease in electricity and water consumption in Qatar and the UAE.

Qatar implemented electricity subsidy reforms between 2015 and 2017, increasing its electricity prices from 2.16 US cent per kWh to 2.43 US cent per kWh only for expats (Krane and Monaldi 2017). Indeed, Qatar is the last GCC country to provide free electricity and water to its nationals (Hussein and Lambert 2020). Regarding energy sources, natural gas subsidies fell from $950 million in 2015 to $493.1 million in 2017 (Krane and Monaldi 2017). Overall, Qatar substantially reformed total energy subsidies, including oil and gas, aiming at decreasing government expense from $3 billion in 2015 to $1.5 billion in 2017, representing 0.9% of the country's GDP, significantly lower than most other GCC countries (Kahramaa 2016). The majority of these reforms resulted in a significant growth in electricity and water tariffs for non-nationals, leading to a remarkable gap in prices paid by residents and nationals. The success of the energy subsidy reform was strengthened by the implementation of the National Programme for Conservation and Energy Efficiency, the so-called Tarsheed program. Under this scheme, the government set the goal to reduce electricity and water consumption per capita by 8% and 20% between 2011 and 2016, respectively. Already in 2016, the country managed to successfully curb electricity consumption per capita by 18% and water consumption per capita by 20%, especially thanks to the wide utilization of smart meters (Oxford Business Group 2019).

Similarly, also the UAE, depending on the emirate, has adopted some of the most successful energy subsidy reforms in the region. Fuel prices are traditionally set at the federal level, but in 2015 they were reformed throughout the country. Fuel prices are not yet deregulated, but they are set by a commission each month, based on international prices. The fuel prices reform was carried out timely in 2015–2016 when oil prices were already low, thus without triggering social discontent or instability. The Dubai Emirate was the forerunner for reforming electricity and water tariffs in 2011, resulting in a 15–20% growth in electricity and tariff prices for non-nationals, industries and government. Nationals witnessed very modest tariff increases and only when their consumption exceeded a cap. Overall, they paid electricity and water 3–4 times less than non-nationals. In 2015, also the Emirate of Abu Dhabi started implementing electricity and water tariff reforms, raising the electricity prices for expats by 40% on average and by 120% for high-consumption households, while nationals were not affected (Krane and Monaldi 2017). Similarly, water tariffs for non-nationals increased by 170% reaching peaks of 374% for particularly high consumption levels. In this case, an increase in tariff was also introduced for nationals, which, however, was roughly three times lower than the tariff paid by expats. Since then, no significant changes have occurred to the 2015 energy subsidies reform in the UAE (Al-Saidi 2020).

In conclusion, although the UAE and Qatar are often considered very similar, they score very differently in terms of energy security and type of source endowment. Thus, these two countries are not only taking diverging paths in the geopolitical landscape of the region, but also their current energy sectors, future energy targets and objectives vary greatly. Indeed, by relying on gas rent, Qatar is less pressed to quickly diversify, as gas is likely to play a key role in the future global energy system for some time. Nevertheless, both Qatar and the UAE are striving to carry out efficient and effective energy subsidy reforms and economic diversification, each country at its own pace, depending on their economic needs and on their natural resource endowment.

3.1.3 Other GCC Countries: Bahrain, Kuwait and Oman

Bahrain and Oman share multiple characteristics both in economic and energy terms, while Kuwait differs substantially from the other two countries. At the same time, Kuwait and Oman play similar roles in the region's geopolitics since they both strive to be perceived as neutral and independent. Thus, grouping Bahrain, Kuwait and Oman together enables a deeper understanding from a multidisciplinary perspective, as these countries share common characteristics as well as striking differences. For example, Kuwait has been one of the richest countries in the MENA region with a GDP per capita[1] of $27,156 in 2019, while Bahrain and Oman have a lower rate, that is $21,199 and $14,516, respectively.

This section will firstly provide an overview of energy peculiarities in Bahrain, Kuwait and Oman, highlighting similarities. It will then assess the role of natural resource abundance and rentier economy in shaping current economic trends and challenges for the three countries, also considering their geopolitical stance. Lastly, it will discuss the roll-out of energy subsidy reforms, common to all these countries, in order to offset high domestic energy consumption levels.

- **Key energy sector peculiarities**

The striking difference among these three Gulf countries is that Kuwait is a hydrocarbon-rich country. And it is responsible for a significant production, Bahrain and Oman own more limited hydrocarbon reserves and their production levels are significantly lower than those of Kuwait (Table 3.4).

Kuwait stands out in terms of oil production, and despite its relatively small geographic size, it ranks seventh worldwide for oil reserves (101.5 thousand million barrels), with oil production slightly above 3 million barrels per day and oil exports above 2 million barrels per day in 2019. On the contrary, Oman's oil reserves amount to 5.4 thousand million barrels (ranking 21st in the world). Its oil production is slightly below 1 million barrels per day, 87% of which is exported. The oil reserves of Bahrain amount to 189 million barrels (ranking 67th worldwide) and its oil production is unable to satisfy internal consumption, obliging the country to import 93% of its domestic oil consumption (BP 2020).

[1] At constant 2015 US$.

Table 3.4 Key energy indicators of Kuwait, Bahrain and Oman in 2019

	Oil			Natural gas		
	Reserves (Gb)	Production (mb/d)	Consumption (mb/d)	Reserves (tcm)	Production (bcm)	Consumption (bcm)
Kuwait	101.5	3.0	0.651	1.7	19.3	24.5
Bahrain	0.189	0.21	0.27	0.1	16.9	16.9
Oman	5.4	0.9	0.295	0.7	40.9	28.5

Source Authors' elaboration on ENERDATA

Gas reserves in Kuwait are also quite large, ranking 20th worldwide. However, Kuwait produces natural gas below its capacity so that it imports almost 20% of its total natural gas demand. Oman ranks 28th in terms of gas reserves worldwide, managing to export 21% of its total natural gas production while Bahrain has more limited gas reserves. In fact, it ranks 52nd in the world, with its natural gas production satisfying its internal consumption (BP 2020). Kuwait's inability to meet its gas demand with its domestic production explains why power generation is mostly provided by oil, which accounts for 57% of total electricity generation and the remainder is provided by natural gas (IEA 2018e).

Kuwait's total oil reserves include roughly half of the 5 billion barrels of the Neutral Area shared with Saudi Arabia. The bulk of Kuwait reserves are located in the Burgan area, which is considered to be the second largest oil field in the world after Ghawar in Saudi Arabia. Kuwait's oil production was severely affected by the war with Iraq in the early 1990s. However, Kuwait managed to rapidly resume, and even expand, its pre-war oil production level. In the past two decades, Kuwait's oil production has surged and then declined driven by OPEC quotas (Fig. 3.12). Between 2000 and 2013, Kuwait increased its oil production by around 50% when it peaked at 158 Mt (3.1 mb/d). The production remained stable until 2016, declined by 7.5% in 2017 and remained stable at around 145 Mt (2.9 mb/d) due to OPEC's production curbs. Most of Kuwait's oil production is exported to the Asia–Pacific region (85%).

Kuwait's gas reserves are also quite large. Since 2010, Kuwait managed to rapidly increase its gas production (by around 6%/y), reaching 18.4 bcm in 2019 (BP 2020). This volume meets almost 80% of Kuwait's gas consumption (23.5 bcm). For this reason, Kuwait decided to import LNG through a FSRU[2] commissioned in 2009 with a capacity of 7.8 bcm/year. In 2019, Kuwait imported 5.2 bcm of LNG. The country is committed to increasing LNG imports with different agreements[3] in order to secure future gas supplies. In addition, Kuwait is also considering importing pipeline gas from Iran and Iraq to help meet rising demand from power plants and industry.

The country's total primary energy supply is strongly reliant on fossil fuels. Compared to Oman and Bahrain, oil is far more important in Kuwait's TPES, accounting for almost 50% (Fig. 3.13). However, natural gas has increasingly gained

[2] The Mina Al-Ahmadi FSRU.

[3] In 2020, Kuwait signed a 15-year agreement with Shell and Mitsui for 8 bcm/year of LNG until 2035 and with Qatar Petroleum and Qatargas for 8 bcm/y from 2022 to 2037.

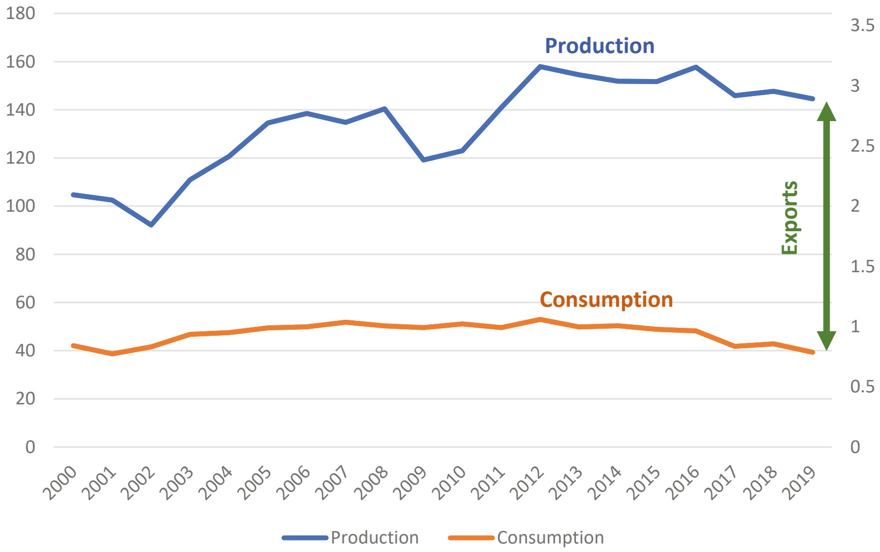


Fig. 3.12 Kuwait's oil production and consumption, 2000–2019, Mt (left) mb/d (right). *Source* Authors' elaboration on ENERDATA

ground in the energy mix. Fossil fuels dominate also Kuwait's total power capacity (19.8 GW in 2019), with natural gas accounting for 11.4 GW and oil for 8.3 GW. Total power capacity has been expanded by more than 25% since 2014. That has gone hand in hand with the expansion of power production, which has increased on average by 3%/year since 2010, reaching 75 TWh in 2019. Natural gas has increasingly gained relevance in the power mix by replacing oil; it increased its share from 40% (22.6 TWh) in 2010 to 61.5% (46.2 TWh) in 2019. The rest is being supplied almost entirely by oil (Fig. 3.14). The power sector is almost totally responsible for total gas consumption since the mid-2000s as Kuwait strives to keep more profitable oil for exports. Total energy consumption increased rapidly between 2000 and 2008 (5.4% per year on average). Since 2014, it has been fluctuating around 36 Mtoe.

Bahrain and Oman have more limited hydrocarbon reserves, in particular Bahrain is the country with the smallest reserves of the three. Since 2013, Bahrain's oil production has remained stable, reaching 10 Mt in 2019 (Fig. 3.15). The lion share of its production (around 75%) comes from the Abu Safah offshore field, where Saudi Aramco is the main producer. Currently, Saudi Aramco produces around 300,000 b/d from this field, half of which is owned by Bahrain. The Awali oil field, owned entirely by Tatweer Petroleum,[4] is Bahrain's other historical oil reserve. However, this field has experienced a steady decline due to a steep drop in drilled wells and facility shutdowns. In 2018, a new tight oil field in the Khalij Al-Bahrain Absin was discovered. The oil field holds great potential since it is estimated to be the largest

[4] Nagoholding owns 100% of Tatweer Petroleum since 2016 following the withdrawal of Occidental Petroleum and Mibadala Development Company.

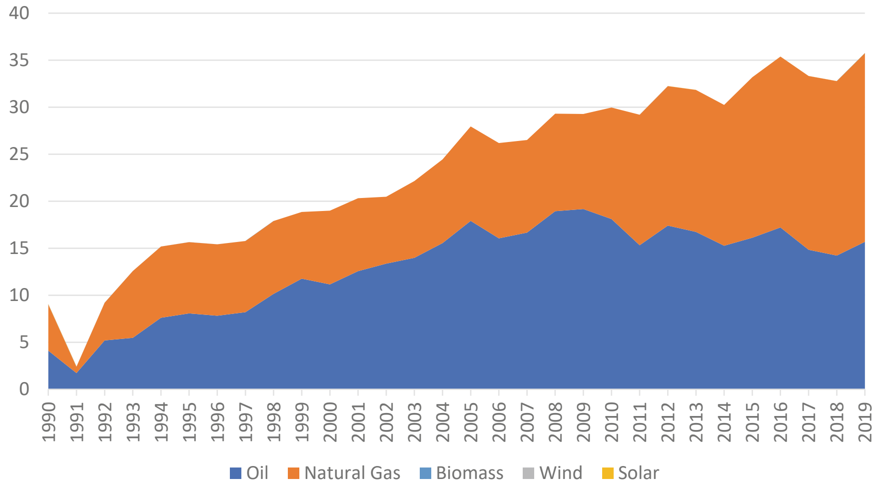


Fig. 3.13 Total primary energy supply in Kuwait, 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

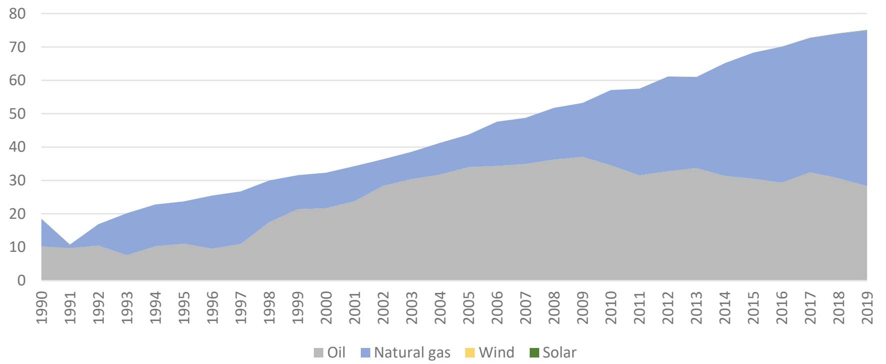


Fig. 3.14 Electricity production in Kuwait, 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

oil reserve ever discovered in the country. It could hold at least 80 billion barrels of tight oil and 282–565 mcm of deep gas.

Bahrain also produces natural gas, although at a modest level (around 15–17 bcm), which accounts for the majority of the national TPES (Fig. 3.16). Therefore, after several delays, in 2020 Bahrain commissioned an LNG import terminal with a capacity of 8.2 bcm/year. Power generation (34.7 TWh in 2019) relies entirely on natural gas (Fig. 3.17). Bahrain's power sector is among the most privatized sectors in the region since 2004. The total capacity stood at 8.8 GW, 4 GW of which is owned by auto-producers, mainly in the aluminum sector.

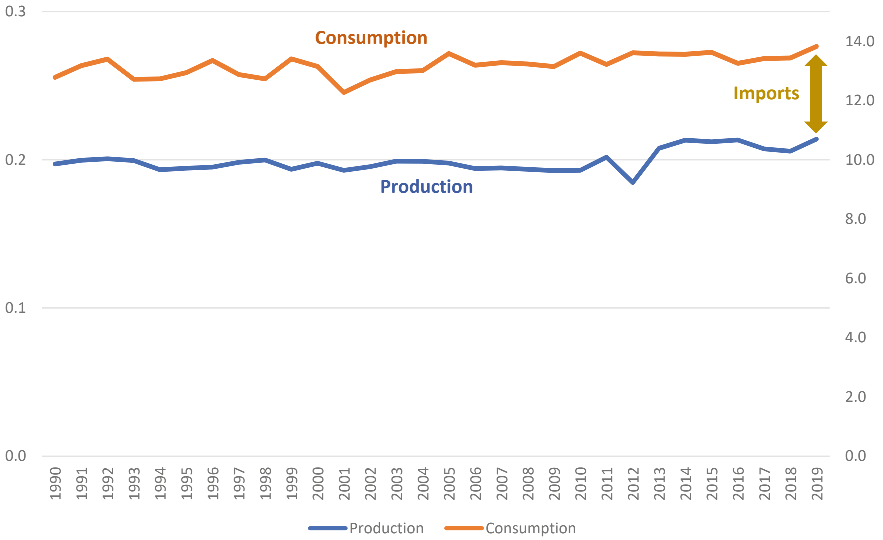


Fig. 3.15 Bahrain's oil production and consumption, 1990–2019, Mt (left), mb/d (right). *Source* Authors' elaboration on ENERDATA

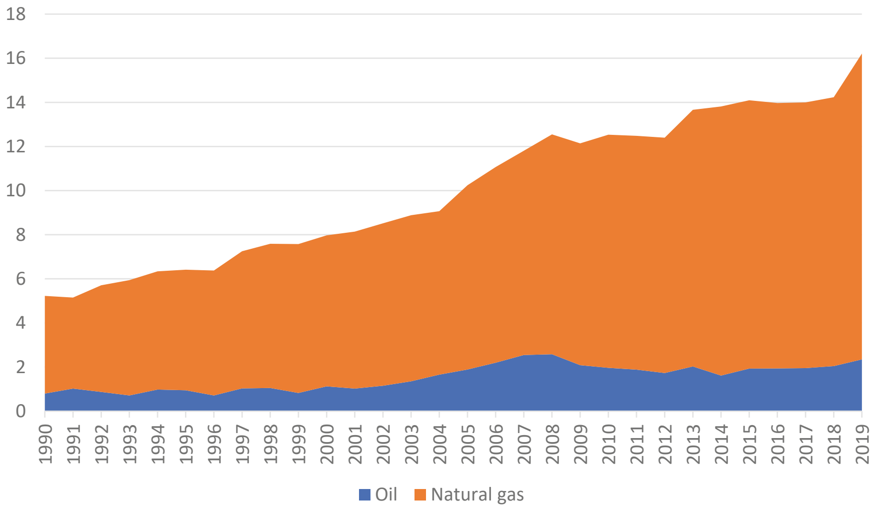


Fig. 3.16 Total primary energy supply in Bahrain, 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

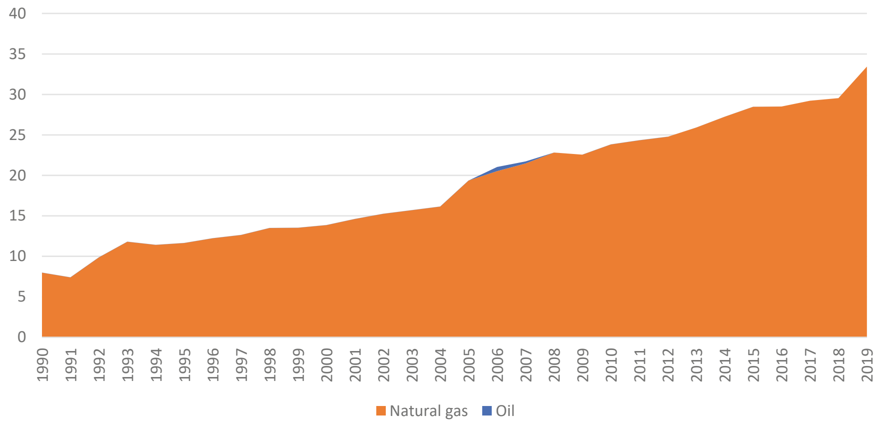


Fig. 3.17 Electricity production in Bahrain, 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

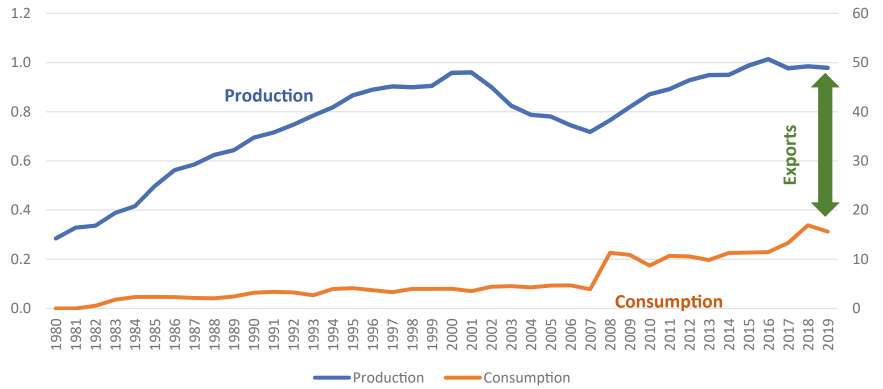


Fig. 3.18 Oman's oil production and consumption 1980–2019, Mt (left) mb/d (right). *Source* Authors' elaboration on ENERDATA

Oman stands in between Kuwait and Bahrain in terms of oil and gas production. Oman has produced stably around 48 Mt/y since 2015. However, the country's oil production experienced a phase of strong decline between 2001 and 2007 (from a peak of 50 Mt in 2001 to 38 Mt) and then a rapid increase between 2009 and 2015 (Fig. 3.18). 90% of Oman's oil production is exported and around 80% of it went to China in 2019. The upstream sector is dominated by Petroleum Development Oman (PDO),[5] which accounts for about 60% of total oil production and holds more than 90% of Oman's oil reserves.

Concerning natural gas, Oman has expanded its efforts to increase gas production in order to free oil volume for exports. Natural gas production in Oman has increased

[5] It is owned by Oman government (60%), Shell (34%), Total (4%) and Partex (2%).

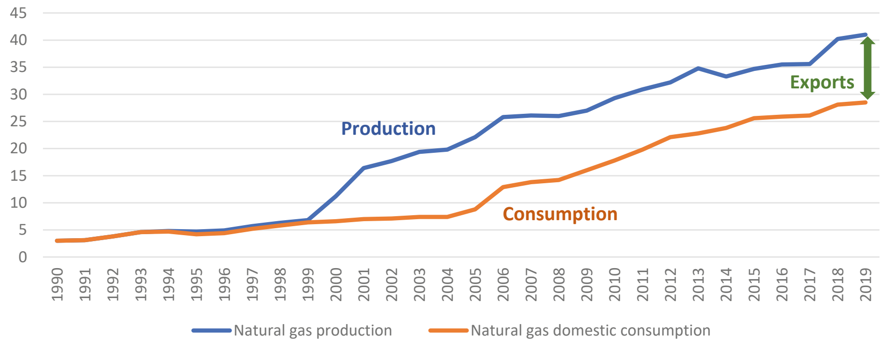


Fig. 3.19 Oman's gas production and consumption 1990–2019, bcm. *Source* Authors' elaboration on ENERDATA

four-fold from the level of 2000, reaching 41 bcm in 2019 (Fig. 3.19). Since 2010, gas output has increased by 3%/year. Oman owns Block 61, which is the largest tight gas reserve in the Middle East. The gas fields, Ghazeer and Khazzan, will be responsible for a combined production of 31 bcm. The Khazzan gas field is already producing 15.5 bcm/year, while the Ghazeer gas field started its production in 2020 (15.5 bcm/year of gas and over 65,000 b/d of condensates). Natural gas exports started much later than oil exports, with the Oman LNG company established in 1994. Oman has one LNG liquefaction plant for exports in Qalhat near Sur, composed of 3 units, with a capacity of 10.4 Mt/year. In 2000, Oman commissioned two gas liquefaction trains, with a third added in 2006. Oman has exported growing LNG volumes, while at the same time it imports Qatari gas through the Dolphin pipeline (Fig. 3.20). LNG has become a major income source for Oman, while reducing its dependence on oil.

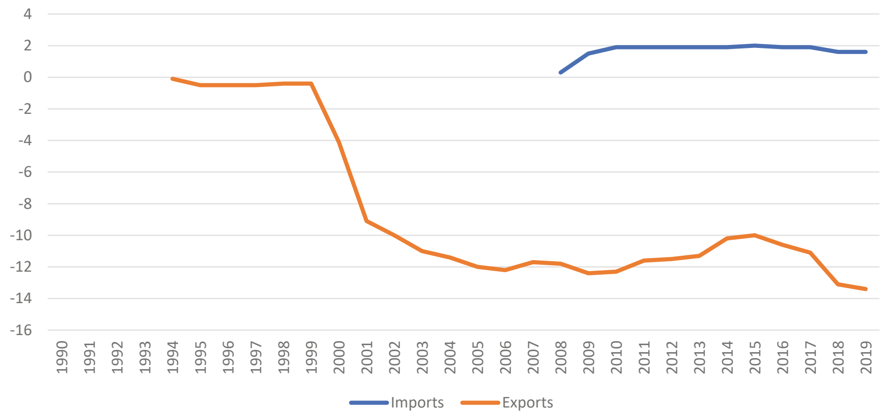


Fig. 3.20 Oman's gas exports and imports, 1990–2019, bcm. *Source* Authors' elaboration on ENERDATA

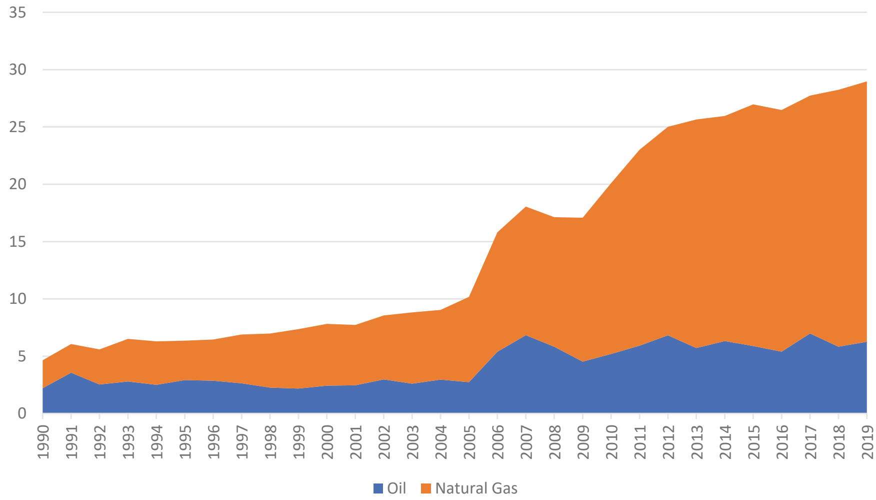


Fig. 3.21 Total primary energy supply in Oman, 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

In 2019, Oman's TPES was 25.5 Mtoe, with natural gas accounting for almost 90%. In terms of TPES, natural gas has become more and more relevant after 2005 in line with Oman's strategy to diversify its economy away from oil (Fig. 3.21). Moreover, the domestic use of gas changed considerably over the period 2000–2011. During that time, the industry's gas use increased from 27% in 2000 to 58%, while the electricity sector's share remained constant at around 19% (IRENA 2014). Moreover, gas use at oil fields, flared gas and other uses accounted for 22% of the total gas use in 2011, significantly less than the 54% share in 2000s.

Natural gas plays a dominant role in Oman's electricity production. Oman has a total power capacity of 14 GW (96% gas and the rest oil). In 2019, Oman's electricity production reached 38.1 TWh, 94% of which from gas and the rest from oil (Fig. 3.22). Power generation from natural gas grew at a remarkable average annual growth rate of 9.9% from 2000 and 2010 and at 6.7% over the period 2010–2019.

- **Unsustainability of the rentier economy: socio-economic consequences**

Kuwait

The energy sector is the pillar of the Kuwaiti economy since it accounts for more than 90% of government revenues and total exports, and 50% of the country's GDP, stimulating the consolidation of a rentier economy and the social contract. However, despite having the second lowest fiscal breakeven price in the GCC region ($61 per barrel) and a positive budget balance (a surplus of roughly 6% in 2019), Kuwait's socio-economic model has become quite unsustainable in the medium term (Statista 2020). Given the predominance of the public sector, key feature of the social contract,

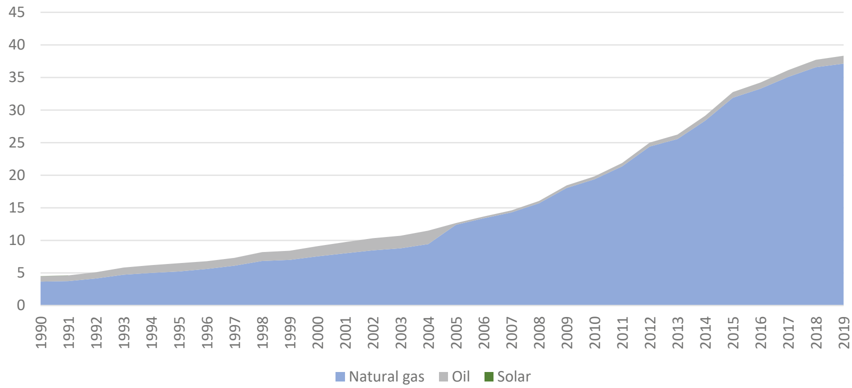


Fig. 3.22 Electricity production in Oman, 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

54% of the government's budget for the fiscal year 2018–2019 was utilized to pay the wages of Kuwaiti nationals. The private sector is scarcely present as the government implements 90% of all development projects, which hinders human capital development and the shift towards a knowledge-based economy (Olver-Ellis 2019). Apart from very high expenditures, the Kuwaiti economy has been stagnating for nearly a decade. This means that it is falling behind, with respect to other GCC economies, in key economic indicators, such as regulatory environment and economic competitiveness, partly due to tensions in its parliamentary politics. Nowadays, Kuwait is striving to horizontally diversify its production and exports from hydrocarbons, shifting towards an integrated energy sector, by diversifying downstream activities, boosting refining capacities and realizing the full potential of natural gas fields (Oxford Business Group 2018). Kuwait, through its national oil company, Kuwait Oil Company, has therefore attracted numerous foreign oil companies, namely Shell, and mostly employed Service Agreements as fiscal arrangements.

Overall, in theoretical terms, Kuwait is one of the best placed countries in the GCC to diversify its revenues, export and energy mix from oil, thanks to a relatively small population (4 million people, contrary to Saudi Arabia), a large oil production and reserves base (contrary to Bahrain and Oman) and an ideal geographical position to develop both wind and solar energy. However, economic diversification and the introduction of renewable energy sources (0.11% of total electricity generation in 2018) (IEA 2018e) have not yet taken place mostly due to political stalemate, a low level of private sector involvement and low synergies among the numerous authorities involved (Butler 2019).

Bahrain and Oman

In Oman and Bahrain too the social contract is built upon the oil rent, which has shaped their socio-economic model, despite the lower abundance of their natural resources. Little diversification from oil revenues, volatile and low oil prices and social unrest in the broader MENA region (e.g. the 2011 Arab Spring) may in part destabilize these countries with lower natural resources. Both countries suffer from budget pressure, with increasing deficits, leading to higher debts to GDP (Bahrain debt amounts to 105% of its GDP and Oman to 60.1% in 2019) (Trading Economics 2019a, b), high fiscal breakeven oil prices ($96 per barrel for Bahrain and $87 per barrel for Oman in 2020) and an increasing unemployment rate, especially among the young people (IMF 2020). Worse financial and economic conditions have already led to some protests and social unrest since the demands of the population (i.e. high level of subsidies, a well-paid job in the public sector etc.) may not always be met. Austerity measures were discussed, and suggested by the IMF, but rarely implemented fearing further social dissatisfaction and unrest, especially in Bahrain, which has witnessed the highest level of social unrest among Gulf countries during the Arab Spring. Social unrest has been generated by a polarized population between Sunni and Shiites, with the Sunni minority holding the power, as well as economic dissatisfaction.

In order to deal with their poor economic outlook, both countries may need to request external economic aid. Nevertheless, both countries may privilege financial aid from neighboring countries rather than international financial institutions such as the IMF, which are often conditioned on the implementation of specific and possibly unpopular policies. However, access to external aid is different for Bahrain and Oman, depending on regional alliances. Bahrain is under the geopolitical influence of Saudi Arabia and the UAE so that these countries, along with Kuwait, may resort to Manama for financial assistance, as in 2018 with a $10 billion stimulus package (Thafer 2020). On the contrary, Oman has always strived to adopt a neutral and balanced stance regarding the region's geopolitics. The new Sultan Haitham bin Tariq has expressed his willingness to follow the steps of his predecessor, Sultan Qaboos bin Said, and remain the neutral arbiter in the region. Thus, for Oman, accepting financial assistance from the UAE and Saudi Arabia may result in losing its geopolitical independence. Relying on Qatar might also lead to regional turbulence, since the Quartet (Saudi Arabia, the UAE, Egypt and Bahrain), which established an embargo over Qatar, may be angered by this request. Oman may request financial stimulus from Kuwait since the latter has always adopted a neutral stance, this would ensure that Oman's neutrality and independence are not threatened. At the same time, as mentioned before, Kuwait's economy is not thriving, especially following the Covid-19 crisis, and it may thus prefer to direct its finances internally rather than to Oman. Overall, while Bahrain may rely on its major allies and protectors to receive financial stimulus, Oman may find itself in a harder position, while trying to conjugate its neutral geopolitical stance with financial assistance. Oman is also likely to find it challenging to seek credit, given its high public debt to GDP ratio (above 80% in 2020) and strained capital reserves (The World Bank 2020c). Moreover, contrary to other GCC countries, net foreign assets are some of the lowest in the region and sovereign wealth fund assets are valued approximately at 50% of the country's GDP (Ismail and Narayanan 2020).

- **A common path: energy subsidy reforms**

Kuwait, Oman and Bahrain have considerably high energy and electricity consumption per capita rates. Of the three, Bahrain has the highest per capita energy consumption (9.7 toe in 2019), which is also three times the Middle East average and five times the global average. Kuwait's energy consumption per capita rate (around 8.5 toe since 2011) represents the world's sixth highest in 2019. Oman has a lower rate (5.1 toe in 2019) even though it is three times higher than the global average, due to its energy-intensive industrial production. Similarly, Bahrain's electricity consumption per capita rate (21 MWh) is higher than that of Kuwait and Oman due to the aluminum sector, which is five times the Middle East average and seven times the global average. Kuwait has a rate of 12–13 MWh/capita since 2008, representing the world's seventh highest in 2019, while Oman's per capita electricity consumption reached 6.7 MWh in 2019.

Kuwait, Oman and Bahrain revised their energy pricing policy in consideration of their high energy and electricity consumption per capita rates, while in all three countries the path to reform of the energy subsidies is hindered by economic constraints and sociopolitical issues.

Kuwait

In Kuwait energy subsidies made up 16% of the government's budget in 2018, a burden for public finances (Moerenhout 2018). Nevertheless, Kuwait was the last GCC country to introduce energy subsidy reforms, because of the robustness of its budget compared to other countries, its rather small population size, and the political struggle between the National Assembly, the legislative authority, and the government. Until 2016, electricity prices were one-twentieth of production costs and water was basically free, making the country the sixth highest energy consumer in the world (World Bank 2017a). However, low oil prices in 2016 led the National Assembly to propose and approve an increase in electricity tariffs for expatriates and for commercial use. Moreover, Kuwait was the last country to reform gasoline prices, which were the lowest worldwide: in 2016, the government, circumventing the National Assembly, raised gasoline prices by 41–83%, depending on octane levels (Shehabi 2017). A political confrontation between the government and the National Assembly took place, with the latter challenging the energy price reform in court. One year later, the Appeals Court ratified the energy reform carried out by the government. Overall, prices for some petroleum products were raised in Kuwait, for instance, gasoline increased from 0.24$/liter in 2015 to 0.34 $/liter in 2018, while prices for other products did not change in this time span (i.e. diesel) (Shehabi 2019).

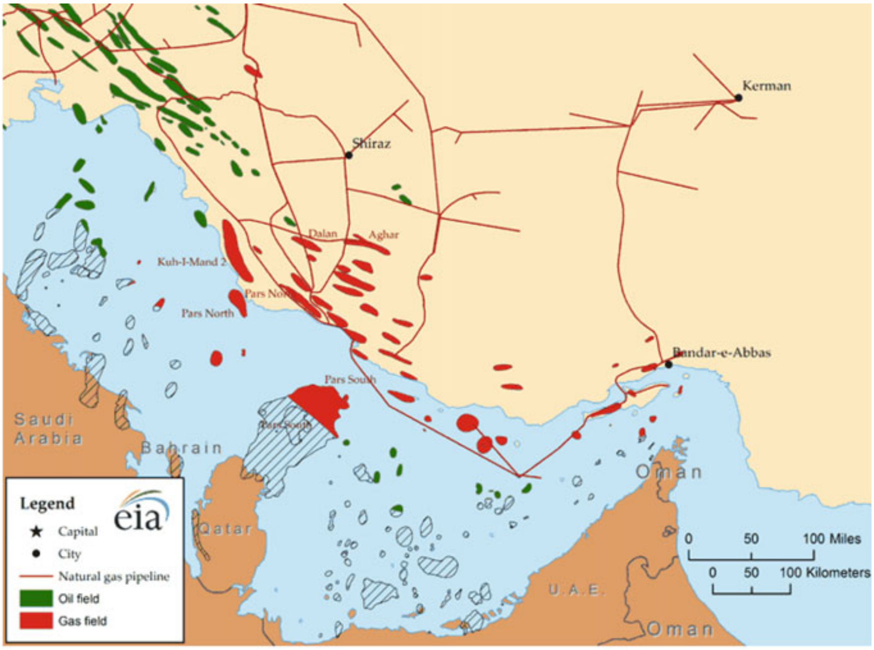
Bahrain and Oman

In Bahrain and Oman the path to energy subsidy reform was rather similar in terms of time and content: both countries decided to raise natural gas prices in 2015 by 11% and 100%, respectively, and to reform diesel and petrol prices in 2016. In the same year, Bahrain increased diesel prices by 14% and petrol prices by 60%, while Oman increased diesel by 10% and petrol by 33% (Lahn 2016). Moreover, both countries are setting energy prices per unit by consumption slab, which might allow cross-subsidization, namely high-consuming customers are discouraged from excessive consumption by paying above the cost, subsidizing for low-consuming customers, who are usually the least well-off. Nevertheless, there are differences in the subsidy reforms of Oman and Bahrain: first, while Oman does not have differentiated prices for expats and nationals, in Bahrain prices were increased for both categories, although nationals are still benefiting from lower prices. Another striking divergence regards Oman's gradual increase of energy prices, which are linked to the international market—a strategy similar to the one adopted in the UAE and Qatar—while Bahrain applied "ad hoc" price adjustments more than once, in line with the policy of Saudi Arabia and, partly, Kuwait (Moerenhout 2020). Therefore, ever since 2016, Oman has increased its energy prices by employing a pricing formula that links Omani prices to international and UAE ones. For instance, in 2016, diesel price with the first adjustment amounted to 0.42 USD/l, while in 2018 it was equal to 0.65 USD/l. To curb opposition to its energy price reforms, Oman first unsuccessfully attempted to put caps for regular gasoline. Then, in 2018, Oman introduced the "National Subsidy Scheme" aimed at ensuring regular gasoline to low-income households at a subsidized price of 0.47 USD/l (in 2018 regular gasoline amounted to 0.59 USD/l with projected yearly increases) (Moerenhout 2020). In Bahrain, since 2016, energy prices were increased in 2018, in particular gasoline 95 went from 0.42 USD/l in 2016 (which was already 58% higher than in 2015) to 0.53 USD/l in 2018, while diesel from 0.32 USD/l in 2016 (which was already 19% higher than in 2015) to 0.42 USD/l in 2018 (Moerenhout 2020).

To conclude, the rentier economy and the social contract have become economically unsustainable for all three countries. Nevertheless, while Bahrain and Oman are already experiencing economic difficulties, for Kuwait economic diversification has become a priority to build an economically sustainable future and to dynamize the economy by involving also the private sector.

3.1.4 Iran

Iran is a major oil and gas producing country with vast oil and gas resources (155.6 thousand million barrels and 32 tcm in 2019). Iran's heavy reliance on oil and gas derives from its conspicuous hydrocarbon reserves: it ranks fourth in the world in terms of oil reserves, representing 9% of total proven oil reserves. It also holds the second largest gas reserves worldwide, preceded by Russia, accounting for 16.1% of total proven gas reserves (BP 2020). Iran shares with Qatar the largest non-associated gas field in terms of reserves worldwide, named South Pars for the Iranian side and North Dome for the Qatari side, as detailed in Map 3.4 (NS Energy n.d.). Discovered in 1990, South Pars accounts for around 40% of proven Iranian gas reserves. It has a 24-phase development plan with 18 phases already operational and it is managed by a subsidiary of the National Iranian Oil Company (NIOC), the Pars Oil & Gas Company (POGC).



Map 3.4 Division of North Dome/ South Pars gas field between Qatar and Iran. *Source* EIA

Despite its great gas and oil potential, several cycles of international sanctions and the limitations on exporting these natural resources have greatly affected the development of the country's oil and gas sector, in terms of production and foreign investments. Iran remains nonetheless the second largest economy in the MENA region, after Saudi Arabia, and a slowdown of GDP growth has not directly affected the unemployment rate, which, on the contrary fell from 13% in 2011 to 11% in 2016, which is consistently lower than in numerous other MENA countries (The World Bank 2020d).

- **Iranian hydrocarbon sector: a turbulent history**

Iran's oil and gas history is a turbulent one, limited by both external and internal forces. The history of its hydrocarbon sector dates back over a century and represents the starting point of oil discoveries in the MENA region. In fact, oil in the Middle East was first discovered in today's Iran in 1908 by the British geologist G.B Reynolds and the following year a subsidiary of the British oil company Burmah Oil was established: the Anglo-Persian Oil Company (APOC). Oil production started in 1913 and its increasing importance was dictated by the willingness of the British navy to shift its fuel source from coal to oil. Already at that time, APOC was widely unpopular in Iran, since the host country was only receiving 16% of net profits (Kent 2015). After World War II, in line with other MENA countries, resource nationalism was on the rise in Iran with a specific animosity towards the British presence, embodied by the Anglo-Iranian Oil Company (AIOC), APOC's new name following 1935. Although the concession agreement was revised to include more favorable clauses for the country, resource nationalism gained consensus under the leadership of Iranian Prime Minister Mossadegh. In 1951, the Iranian Parliament decided to nationalize AIOC leading to the so-called Abadan Crisis. The UK responded strongly, putting pressure on other countries to boycott Iranian oil, leading to a substantial contraction of revenues for the Iranian government. In 1953, a US-backed coup overthrew Mossadegh and secured the power of the pro-Western Shah, Mohammed Reza Pahlavi. The AIOC changed its name to National Iranian Oil Company (NIOC) and Iranian oil was exported once again. Throughout the following two decades, the Iranian oil and gas sector witnessed a period of prosperity: in 1976 peak production reached 6.6 million barrels per day and in 1978 Iran became the second largest OPEC producer.

Iran's hydrocarbon industry, however, has experienced some major turbulent times since 1979. Following the Iranian Revolution in 1979, the National Iranian Oil Company (NIOC) took absolute control over the oil and gas sector, cancelling all international oil agreements. This process took place at the same time as the emergence of national oil companies in the broader MENA region. The war with Iraq in the '80 s considerably hindered oil production so that it was only from the mid- '90 s that NIOC started investing in the hydrocarbon sector with projects either financed by NIOC or in joint ventures with international oil companies. Figure 3.23 depicts the country's oil production and exports, highlighting the main sanctions introduced and changed.

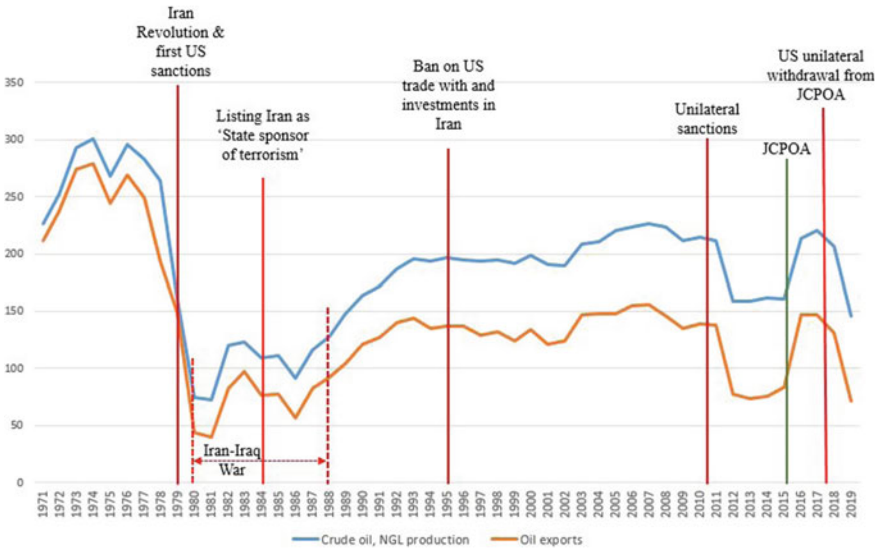


Fig. 3.23 Iran oil production and export (Mt) and key political events. *Source* Authors' elaboration

Sanctions on Iran have been recurrent in the last few decades, heavily affecting oil exports and production, as the table above highlights. The 1979 Iranian Revolution and the imposition of the first US sanctions on Iran in 1980 resulted in a drastic drop in oil production (from 263.7 Mt in 1978 to 74.4 Mt in 1980) and exports (from 193.6 Mt to 43.6 over the same period). The 8-year war with Iraq limited production levels and investments. Nonetheless, Iran showed significant resilience and managed to increase its oil output and export volumes, despite the 1984 listing of Iran as "State sponsor of terrorism" and the 1995 ban on American trade with and investments in Iran, targeting especially the energy sector. NIOC started investing again in hydrocarbon projects from the mid-1990s. In 2006, the new round of American and UN sanctions on Iran harmed oil exports, but it did not greatly impact production, since oil products were mostly employed to satisfy the growing internal demand for power generation.

In 2010, unilateral sanctions were imposed on Iran, which negatively decreased oil output (passing from 214 Mt in 2010 to 158.7 Mt in 2013) and exports (from 138.8 Mt to 73.3 Mt over the same period). This new round of sanctions targeted Iranian petroleum exports and imports, forbidding large investments in the hydrocarbon industries and cutting off sources for financial transactions with the EU and the US. In the last years, Iran has been able to increase its production and exports as the international community reached an agreement with Iran based on the Joint Comprehensive Plan of Action (JCPOA) related to its nuclear sector and to the possibility to remove several sanctions allowing foreign investments (see Chap. 5, Sect. 5.1.3).

Iran's gas potential is constrained by several factors resulting in a diametrically opposite position compared to Qatar, even though the two countries share the South Pars/North Dome gas field. Indeed, the two countries are in stark contrast in the gas sector: Qatar is a leading gas exporter, while Iran is unable to export large quantities of gas due to a much larger domestic gas market (population of 89.3 million in Iran vs. 2.8 million in Qatar) combined with geopolitical and regulatory constraints. Indeed, Iran's gas production is almost entirely consumed domestically (Fig. 3.24). Gas exports account for a small share of total production, characterizing Iran as an inward-looking gas power. Indeed, Iran is the world's third largest producer of natural gas but its exports (only via pipeline) constitute only less than 2% of global gas trade in 2019. The country has been able to increase its production levels, which have been crucial to meet domestic power demand. The prioritization of gas for the domestic market was part of the strategy to free oil export volumes for additional revenues. Since Iran is striving to substitute oil with natural gas for power generation and natural gas consumption levels are astonishingly high (it is the fourth largest consumer of natural gas worldwide), the need to refrain internal demand has grown (EIA 2019).

Thus, while gas production has increased since the 1980s, the share of gas exported, mostly to Turkey and Iraq via pipeline, has remained steady. More recently, Iran has been able to increase its gas production and divert such additional volumes to export rather than to the domestic market. Nonetheless, one of the most important features of Iran's gas industry is the limited role of gas exports compared to its reserves. In 2019, Iran exported 16.9 bcm of gas via pipeline out of a total production

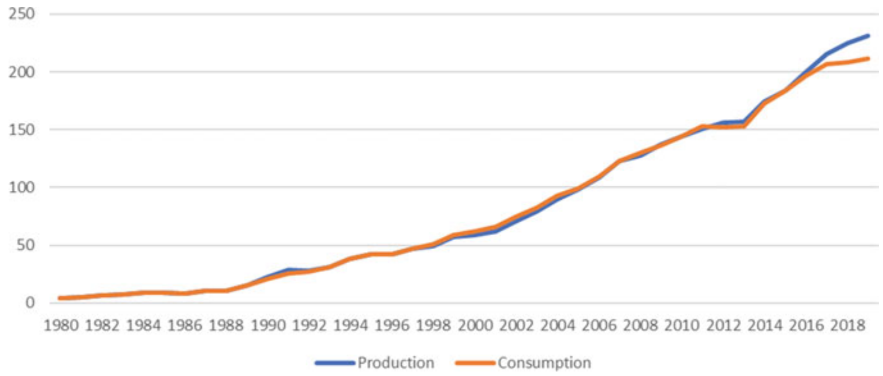


Fig. 3.24 Iran's gas production and consumption, 1980–2019, bcm. *Source* Authors' elaboration on ENERDATA

of 244.2 bcm, while the domestic market consumed 223.6 bcm (BP 2020). Turkey and Iraq are the main gas markets for Iran's exports. A more modest share flows to CIS countries, namely Armenia and Azerbaijan (Fig. 3.25). At the same time, Iran also imports some gas volumes from Turkmenistan, and a smaller volume from Azerbaijan (Fig. 3.26). These two countries usually supply gas to Iran's northern provinces and during the winter season. Since Iran has been concurrently exporting and importing natural gas, over the years it has sometimes been a minor net gas exporter, and sometimes a minor net gas importer, only recently has it established itself as a consequent gas exporter by reducing imports from Turkmenistan and increasing exports in particular to Iraq. With some 16 bcm of net exports in 2019, Iran remains a very modest gas exporter in particular considering its vast reserve base (the second largest in the World after Russia).

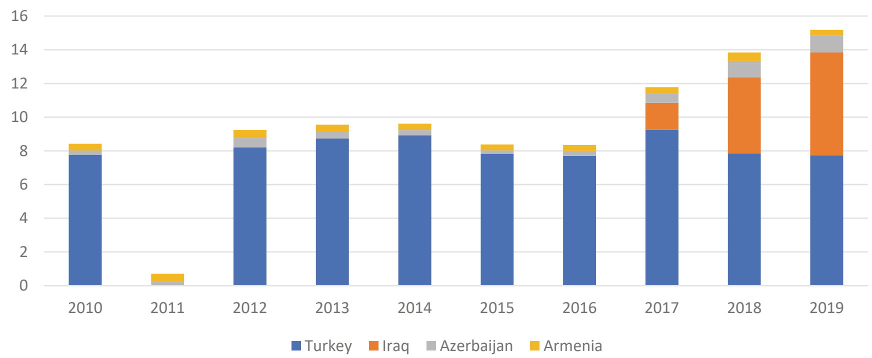


Fig. 3.25 Iran's gas exports by country 2010–2019, bcm. *Source* Authors' elaboration on CEDIGAZ

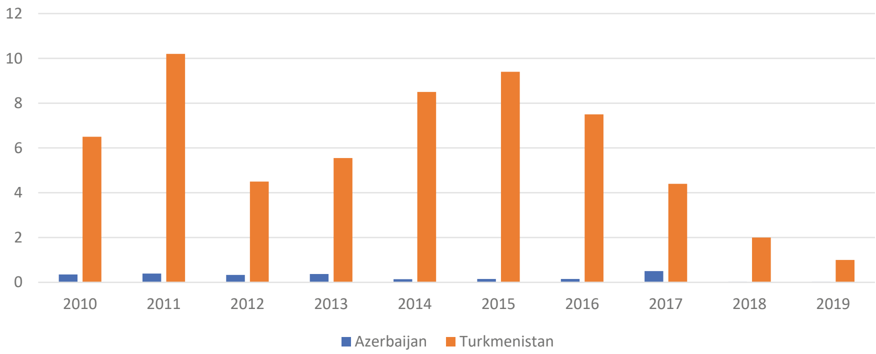


Fig. 3.26 Iran's gas imports by country 2010–2019, bcm. *Source* Authors' elaboration on CEDIGAZ

- **JCPOA: changes in the hydrocarbon sector to attract foreign investments**

Following prolonged and difficult negotiations, the international community marked a milestone with the signature of the Joint Comprehensive Plan of Action (JCPOA) between Iran and a group of countries, P5 + 1[6] together with the EU, in July 2015. The agreement entered into force in 2016. With this agreement, Iran saw a new window of opportunity to increase foreign investments, in particular in its hydrocarbon sector.

In order to attract foreign capital and expertise, Iran changed its petroleum fiscal regime, which historically represented one of the greatest constraints for the positive development of Iran's hydrocarbon sector. The 1979 Islamic Constitution referred specifically to natural resources in some articles (Art. 44, 45 and 81), shaped by the desire to strictly control the terms of any agreement with foreign companies (Tagliapietra 2014). Legally, the Iranian government was the only authority that could deal with natural resources. Therefore, the NIOC took control of the Iranian petroleum industry and canceled Iran's international oil agreements, holding complete ownership of the assets in line with the Iranian law. In the early 1990s, a new type of contract (called buyback contract) was developed in order to allow the so-much required foreign investments in the hydrocarbon sector in respect of the overall Constitution. A buyback contract is essentially a service contract under which a foreign company develops a hydrocarbon deposit and recovers its costs and a pre-negotiated remuneration fee from sales revenues, but has no share in the project's profit. Moreover, the agreement's duration was limited to five to seven years so as to prevent any single firm from having too much power in Iran and fixed a relatively low rate of return (Brumberg and Ahmar 2007). Such conditions have inevitably discouraged IOCs to invest in the Iranian oil and gas industry.

Notwithstanding these disadvantages, this scheme remained in place for over 20 years until mid-2016, when Iran introduced a new legal framework: the Integrated

[6] The term 'P5 + 1' refers to the five permanent members of the United Nations Security Council (the US, Russia, China, the United Kingdom and France) plus Germany.

(or Iran) Petroleum Contract (IPC). Through the IPC, Iran aimed to offer more attractive terms to IOCs. For example, the term of the contract is extended to a maximum of 20 years from the start of development. In the presence of enhanced oil recovery (EOR), the term can be extended up to another 5 years (Farimani et al. 2020). The IPC also modified some of the previous issues regarding remuneration. Under the buyback, the remuneration fee was paid as a percentage of total capital costs, while under the IPC the fee is based on production rate and set as a fee per barrel of oil or per cubic foot of gas. However, the IPC does not allow foreign ownership of reserves.

As international and domestic circumstances appeared to improve, Iran fixed more ambitious targets for its hydrocarbon sector: 6 mb/d of oil production and 1055 mcm per day (about 350 bcm) of gas production by 2020. A positive consequence was the signature of two contracts with IOCs, within the IPC framework, between 2016 and mid-2018: in July 2017 with the French IOC Total and the Chinese CNPC to develop phase 11 of the South Pars field, and in 2018 with the Russian Zarubezhneft for the development of the Abadan and West Paydar onshore fields, on the border with Iraq. Total and CNPC preferred to focus on the production of gas and condensate, which are considered less geopolitically sensitive than oil. This promising start, however, did not translate into concrete developments due to the resume of unilateral sanctions decided by the Trump administration which forced companies to leave the projects.

Regarding the gas sector, Iran has historically prioritized its residential, industry and power demand rather than exports. This strategy aimed at freeing oil volumes for export, the latter being more remunerative than gas and easier to transport. To maximize its oil production (and consequent revenues), Iran also utilized large quantities of gas for injection into its oil fields for enhanced oil recovery (EOR) activities, a particularly crucial process given that more than 80% of Iran's active oil fields are depleting (losing around 8–12% of their production capacity per year) and that their recovery factor is 20% lower than the global average (35%) (Mordor Intelligence 2019). EOR techniques might thus contribute to increasing annual production volumes by around 7% per year. In a nutshell, Iran has struggled to find the perfect equilibrium between meeting its domestic demand, enhancing its more remunerative oil production and exporting some gas volumes. Moreover, Iran could not benefit from growing gas consumption in the Middle Eastern countries also due to its political isolation.

For these reasons, Iran's gas exports have been relatively low despite its vast gas reserves. Nevertheless, Iran aimed at increasing its gas exports via pipeline (also because international sanctions prevented the development of LNG facilities). Traditionally, Iran exported to Turkey and at a smaller scale to Armenia and Azerbaijan. It started exporting gas to Turkey via the Tabriz-Ankara-Pipeline in the 1990s. Natural gas trade between these two countries was geopolitically relevant due to Turkey's membership to NATO. However, the volume was not particularly relevant. In 2019, Iran exported 7.4 bcm to Turkey. The pipeline flows were also disrupted as a result of sabotage attacks by the Kurdistan Workers' Party (PKK). In Turkey, Iranian gas exports face growing competition from LNG and from the Russian gas pipeline due to the recent opening of TurkStream. Iran exports also to Azerbaijan (since 2005) and Armenia (since 2009). In 2013 and 2015 Iran signed two supply agreements with Iraq. Moreover, in 2017, Iran started exporting gas via pipeline to Iraq to power electricity generation plants. Despite its great potential and its geographical location, Iran imported gas from Turkmenistan in order to meet its domestic consumption, especially for its northern areas. The two countries, however, have had several disagreements over the terms of the contract. Iran also explored other regional export projects (for example to Pakistan and India or to the Gulf countries). However, the likelihood of these projects coming online is not high due to geopolitical tensions in the region and beyond, which adversely affect Iranian investments in its promising oil and gas sector (Mordor Intelligence 2019).

The US unilateral decision to withdraw from the JCPOA at the end of 2018 inexorably affected the numerous targets and goals that Iran had set for its energy sector, especially in terms of exports and domestic and foreign investments in its upstream. China and Russia were the last ones to remain in Iran, operating as "contractors" to obfuscate their presence in order to avoid both American sanctions and the Iranian public's backlash, since the contracts signed were not deemed to fully protect Iranian interests (Watkins 2020).

The withdrawal of the United States from the JCPOA and the reintroduction of numerous sanctions have inevitably undermined the country's economy in the last few years. Indeed, a 37% decline in the gas sector was the main cause behind the 7.6% contraction of GDP between April and December 2019, since non-oil GDP growth registered a 0% change in this timeframe (The World Bank 2020e). Besides international financial sanctions, Iran was also one of the countries in the MENA region that was hit the hardest by the Covid-19 pandemic, in terms of number of infections and deaths, further affecting the country's economy. Also, Iran's foreign reserves fell to about $85 billion in 2020 (losing one-fifth of 2019 value) and are expected to fall to $69 billion in 2021 (Fathollah-Nejad 2020). Thus, unsurprisingly, the country is facing rampant inflation, which reached 34.4% in September 2020 from the previous year. Indeed, the riyal lost nearly 50% of its value against the dollar in 2020, hitting a low of 300,000 to $1 on October 1st, 2020 (Motamedi 2020).

Natural gas and oil inevitably play a major role in Iran's total primary energy supply and power generation. In 2019, the total primary energy supply (271.5 Mtoe) in Iran is mostly composed of natural gas (56%), followed by oil (42%). Other sources, nuclear and renewables, account for 2% of TPES (Fig. 3.27). Natural gas has increased its relevance throughout the past 30 years in the TPES and electricity generation, replacing oil, thanks to the development of the South Pars field, which resulted in higher gas production despite the unfavorable international framework.

Similarly, natural gas is predominant also in electricity generation by source, accounting for 84% of total electricity generation (314 TWh) (ENERDATA n.d.), as shown in Fig. 3.28. Natural gas has steadily gained relevance within Iranian electricity production, with the particular aim to free oil export volumes. Since 2013, Iran has benefited from the previous development of South Pars, which resulted in higher gas production. The additional gas caused the replacement of oil in the power sector. The other two main sources for power generation in Iran are hydro and nuclear.

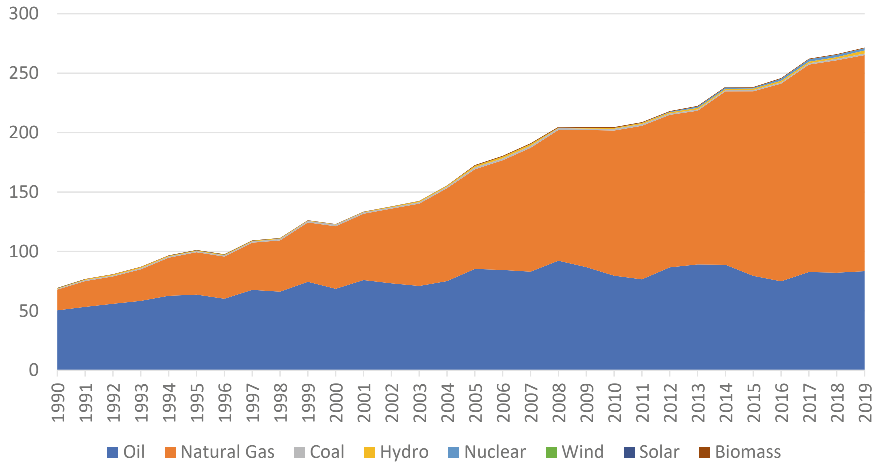


Fig. 3.27 Total primary energy supply of Iran 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

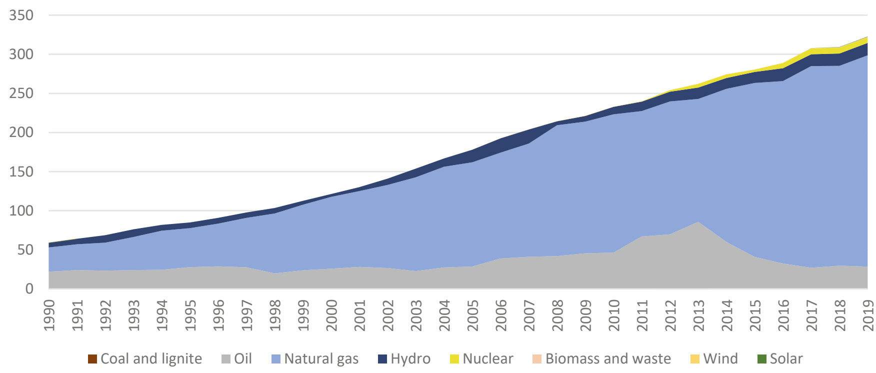


Fig. 3.28 Electricity production of Iran 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

The highly controversial nuclear energy represents a minority share in electricity generation (around 2%). Moreover, electricity final consumption has witnessed a strong growth of 6% per year on average between 1990 and 2020, increasing three times faster than the country's population, thanks to economic growth, localization and development of industries, especially energy-intensive ones.

- **Nuclear energy for power generation: a chess game**

Nuclear power, a key energy source for electricity generation, has been at the center of international attention and a driving force to imposing sanctions. In the case of Iran, the highly debated stage of the nuclear fuel cycle regards fuel supply, with the

Iranian government fearing disruption of the enriched uranium supply. Such a threat would depend on the political context, since there is a substantial global surplus of both uranium and enrichment capacity. Indeed, the price per separative work unit for uranium enrichment has dropped from ~$160 in 2010, to ~$40 in 2018. Contrary to the model adopted by the UAE, which relies on the diversification of fuel suppliers, Iran has been bound by its contract with Russia as the sole supplier of nuclear fuel for the entire life of the Bushehr's nuclear power plant. The reliance on a single supplier makes Iran's nuclear power program vulnerable to disruptions from Russia, which could have played a role in Iran's insistence to carry out front-end activities within its borders. Indeed, Russia has already taken advantage of its role as a nuclear energy supplier as a political leverage. For instance, Russia has used its key position in Turkey's Akkuyu nuclear power plant to further its agenda in Syria. After Turkey shot down a Russian fighter jet that had briefly violated Turkish airspace by flying over Syria for a mission, Russia suspended the plant's construction and cancelled the training programs it had already signed with four Turkish universities (Reuters 2015a). After mending its relations with Turkey, Russia resumed the construction of Akkuyu.

Since Iran possesses some uranium deposits and has recently discovered new ones in its territories, having enrichment facilities would make the country less reliant on nuclear fuel imports and even self-sufficient (Reuters 2015b). At the same time, the international community saw this decision as a potential threat to regional and international stability (the most vociferous countries were Israel, the United States, the Kingdom of Saudi Arabia and the United Arab Emirates, which fear that these uranium enrichment facilities could also be used to build nuclear bombs). Iran thus became the target of international sanctions increasing the country's vulnerability to fuel supply disruptions.[7] Enrichment facilities, in particular in the Natanz nuclear site, have thus been targeted and damaged in the first half of 2020, presumably by Israel (Bergman et al. 2020). Overall, localizing nuclear fuel supplies is more expensive for Iran, as it cannot benefit from economies of scale, and it also goes against Russia's interests, since exports of nuclear fuel to Russian-built nuclear power plants are highly profitable (Obergfaell 2019).

Iran's petrochemical industry, accounting for 3.6% of worldwide petrochemical output, is the country's leading industrial sector, and according to Behzad Mohammadi, head of Iran's National Petrochemicals Company (NPC), it is forecasted to increase and cover 6.2% of global petrochemical production by 2025, (Kerimkhanov 2019). Indeed, Iran is striving to reduce its dependence on crude oil exports, by turning its attention to and enhancing investments in the petrochemical sector, which represents its second largest export industry. In 2020–2021, three petrochemical projects - worth $1.6 billion - were inaugurated, in 2021 13 new petrochemical projects are expected to come onstream, and between 2022 and 2026 additional investments in petrochemical activities are projected to amount to $37 billion (MEMO 2020).

[7] International sanctions hinder any trade exchange, including fuel imports/exports.

- **Iranian energy subsidy reform: a "Basic income" model**

Iran was forced to implement some major energy policies aimed at curbing fast-growing energy demand. In 2010, Iran carried out an innovative energy subsidy reform, which also represents one of the most comprehensive attempts of basic income, even though its characteristics partly diverge from the basic income model *par excellence* adopted in Alaska[8] (Howard and Widerquist 2012). In 2011, Iran managed to halve its subsidy expenditures, which in 2010 where the highest in the world, amounting to 25% of Iranian GDP, without causing social unrest thanks to universal cash transfers. The government opened bank accounts for all families, regardless of individual characteristics (income, wealth, age etc.) and unconditionally distributed around $40–$45 per person per month (roughly 15% of the national income), following the rollout of subsidy reforms. This transfer program was financed by eliminating subsidies thus increasing prices for goods, without putting a burden on the country's budget.

Regarding direct effects, the subsidy reform was deemed successful to reduce energy consumption: from 2010 to 2011 the demand of fuel oil, diesel, petrol, and kerosene decreased by 36.4%, 9.8%, 5.6% and 2.9%, respectively (Hassanzadeh 2012). Also electricity and natural gas demand for households contracted by 1.7% and 1.5%, respectively, even though total natural gas demand increased as it replaced oil products in electricity generation. Also, this program led to positive spillover effects since inequality and poverty indicators in 2011 significantly decreased with respect to 2010. In the first year, replacing subsidies with cash transfer directly benefited the local population, especially the least well-off (Deutschmann et al. 2014). However, while inflation was dramatically on the rise and even doubled by 2015, energy prices remained constant, reducing, in real terms, the positive effects of the subsidy reform in limiting energy consumption levels. In 2015 the Iranian government decided to increase gasoline and diesel prices by 20% to catch up with previous inflation, and to retain the impact of the subsidy reform (Krane and Monaldi 2017). Similarly, in December 2018, President Rouhani tried to increase fuel prices, but the move was blocked by the Parliament following social protests. In 2019, Iran managed to considerably increase pump prices by 50%, and the revenues were given to the worst-off households as cash handouts. This move was also partly triggered by inflation with the riyal value plummeting compared to the US dollar (France24 2019).

Iran's hydrocarbon development and exports face several constraints, both domestically and internationally. The legal framework has historically undermined the partnership with foreign companies that Iran is in much need of to foster natural gas production. Indeed, gas production has been mostly used to satisfy domestic gas consumption, incentivized through energy subsidies and infrastructure development. The international environment further exacerbated challenges to positively develop the sector. Thus, Iran has faced some major economic hurdles over the last decades, now further aggravated by the COVID-19 pandemic. Despite all these challenges,

[8] Under the Alaska model, the state distributes the rent as cash payments rather than employment and free or subsidized goods and services.

Iran has been able to become particularly resilient to both internal and external difficulties.

3.2 Mashreq

Seven heterogeneous countries—Egypt, Jordan, Lebanon, Israel, Syria, Iraq and Palestine—compose the Mashreq cluster. Among these countries, there are some old oil provinces, such as Egypt, Syria and Iraq, while others have struggled to maintain a high degree of energy security due to the lack of adequate domestic hydrocarbon reserves, for example Israel, Jordan and Lebanon. They vary significantly in terms of socioeconomic indicators (Table 3.5).

Different population sizes and economic relevance represent the most striking differences. Within this cluster, Egypt is the most populated country, with 100 million citizens in 2019 (almost doubled compared to 1990), Iraq 39 million and Syria 17 million, while the other countries are home to about 4–10 million people. In its median scenario the UN projects that by 2050 Egypt will reach about 160 million (+60 million), Iraq 7 million (+32 million), while Syria will reach 33 million (+16 million) people. Of all MENA countries, these are the countries where the population is expected to grow the most.

World War I was a disruptive event for this region, drastically changing the power in place. In December 1914, the British proclaimed a protectorate over Egypt. With the end of World War I and the defeat of the Ottoman Empire, the UK and France drew the borders of the Levant region, based on the 1916 secret treaty of Sykes-Picot, resulting in the British Mandate for Palestine (currently south Iraq and Kuwait under direct control while Jordan, the Negev desert and north Iraq under British influence) and the French Mandate for Syria (Lebanon and south-East Turkey under direct

Table 3.5 Key socioeconomic and energy indicators for Mashreq countries in 2019

	Population	GDP (constant $2015 billion)	GDP PPP per capita (constant $2015)	TPES (Mtoe)	Power consumption (TWh)
Egypt	100.4	398	3965	98.1	154.7
Israel	9.0	345.4	38,152.7	24.2	60.4
Jordan	10.1	41.7	4133.5	7.8	17.9
Lebanon*	6.8	56.8	6824.9	8.8	18.4
Palestine	4.7	15.8	3378.4	1.3	6.2
Iraq	39.3	192.3	4893.5	67.7	45.3
Syria	17	NA	NA	9.2	12.5

*The data available for Lebanon are prior to the dramatic economic and energy crisis taking place since late 2019

Source Authors' elaboration on The World Bank Data, IEA, Palestinian Central Bureau of Statistics control, Syria and Mosul under French influence), while the northern part of historic Palestine was designated an "international zone" (with the exceptions of Haifa and Acre/Acca controlled by the UK).

Today, Lebanon has a precarious sociopolitical equilibrium due to a fragmented political system with different posts traditionally attributed to a specific sect (i.e. the President is a Maronite Christian, the Prime Minister a Sunni and the speaker of Parliament a Shia), originated from the 1943 National Pact and not eliminated by the 1989 Taif Agreement. This sectarian political arrangement has paralyzed most of the reforms.

Jordan's Hashemite dynasty originates from the appointment of Abdullah I King of Jordan by the British in 1921, while his brother Faisal was appointed King of Iraq. Both brothers were the sons of Sharif Hussein, who was the Sharif and Emir of Mecca after proclaiming the Great Arab Revolt against the Ottoman Empire and King of Hejaz (from 1916 to 2024). He was the 37th-generation direct descendant of Muhammad. He belonged to the Hashemite family. Nowadays, the Hashemite dynasty is still ruling Jordan with a parliamentary system of government, and plays a relevant role in the Muslim world.

In Iraq the Hashemite reign came to an end when Brigadier Abd al-Rarim Qasim and Colonel Abdul Salam Arif overthrew the Hashemite monarchy in 1958 and proclaimed Iraq a republic. In 1963 Qasim was assassinated when the Baath Party took power and retained it until the fall of Saddam Hussein in 2003. Saddam Hussein initiated the inconclusive and costly eight-year war against Iran (1980–1988) which devastated the Iraqi economy. He invaded Kuwait in 1990, starting the first Gulf War (1991). After the 2001 terrorist attacks on New York and Washington, linked to the group formed by multi-milionaire Saudi Osama bin Laden, American foreign policy began to call for the removal of the Baath government in Iraq. This finally led to the invasion of Iraq in 2003 by the United States and the United Kingdom (with military aid from other nations), followed by the fall of Saddam Hussein. The American occupation lasted from 2003 through 2011. The departure of US troops in 2011 triggered a renewed insurgency and a spillover of the Syrian civil war into Iraq. The Islamic State of Levant and Iraq seized large parts of Iraqi territory in 2013–14, but was finally defeated by the central Government in 2017. Regular protests over deteriorating economic conditions and state corruption continue, but the violence level is now (since 2018) the lowest of the last ten years.

Syria's current borders were set by the League of Nations' French Mandate, following the dismantling of the Ottoman Empire after World War I. The country has always been characterized by multiple and different ethnic groups. The French mandate ended in 1946, leaving the power to the Sunnis. However, the birth of the Baath party in Syria in 1947 provided the ideal platform and political vehicle to organize and unify the country, also for minorities like Alawites. Given its campaign of secularism, along with socialism and Arab nationalism, the Baath party met a strong opposition from the Sunni group. In 1963, the Baath party reached power through a military coup led by President Amin al-Hafiz. In 1970, then-air force commander and Defense Minister Gen. Hafez al Assad ended Syria's string of coups and counter-coups through a bloodless military coup. After Hafez's death in 2000, his younger son, Bashar al Assad, assumed the presidency. Initially, it was Hafez's eldest son, Bassel, who was groomed for power. However, Bassel's death in a car accident in 1994 thrust Bashar to the fore. Since 2011, the country has been lacerated by a civil war, further exacerbated by external interferences. Syria has been a traditional ally of Russia.

Israel was part of the British Mandate of Palestine from 1922 until the years following the end of WWII. In 1948, Israel proclaimed its independence triggering the fierce military response of five Arab nations (i.e. Egypt, Jordan, Iraq, Syria and Lebanon). A ceasefire agreement was reached in 1949, but since then several conflicts have erupted between Israel and its neighboring countries. Israel is a parliamentary democracy, with the parliament known as the Knesset. Between 2009 and 2021, Israel witnessed a continuity in terms of political leadership, with the 12-year long run of Netanyahu as Prime Minister. However, between 2020 and 2021, Israel held four elections, which ultimately ended with a new government led by the new Prime Minister Bennet. Regarding Palestine, the Palestinian Authority was established in 1994 and Mahmoud Abbas became PA's President in the 2005 elections. He still holds this post today, and was also appointed PLO leader following Arafat's death in 2004. In 2006, Hamas won the Palestinian Legislative Council elections, winning the majority of seats. One year later, Abbas dissolved the Hamas-led government, declared a state of emergency and since then Gaza is controlled by Hamas.

Egypt has been another crucial player in the region. Egypt has been ruled for several decades by long-lasting rulers until the Arab Spring in 2011. In 1922, Egypt gained its independence from the UK when Faud I become King. Indeed, Egypt was a British protectorate from 1914 to 1922. The British influence remained significant in the country until the 1950s, and formally ended with the Suez Canal crisis. In the 1950s, Gamal Abdel Nasser surged to power until his death in 1970. Initially, he developed good relations with the US as a potential driver for economy growth and development. Due to political disagreements, however, Egypt started to reorient its relations towards the Soviet Union, which became its major supplier of military equipment and its financial supporter for the construction of the Aswan High Dam. This alignment was reverted by President Anwar al-Sadat, who decided to reopen Egypt's relations with the West and to start a de-escalation process with Israel (culminating with the 1979 peace treaty). Anwar al-Sadat was killed in 1981, and he was succeeded by then-vice-president Hosni Mubarak, who ruled Egypt for 30 years until 2011. In 2011, social unrest led to the overthrowing of President Mubarak. The consequent elections resulted in the advent of the Muslim Brotherhood with President Mohamed Morsi. However, General Abdel Fattah Al-Sisi has emerged as leading political figure vis-à-vis Morsi and during the previous 2013–2014 government, becoming President in June 2014.

In this cluster, the strategic relevance of Iraq, Egypt, Israel, and more recently Syria, goes way beyond the MENA region, where these countries are among the main players in different sectors. From an economic perspective, Israel is considered a developed country with a service-based economy particularly focused on the technological sector. Among the Eastern Mediterranean countries, Israel has the highest GDP per capita, more similar to the ones of Western European countries. At the same time, Egypt has the highest GDP rate, albeit with a lower GDP per capita PPP rate compared to Israel. Egypt's economy is based on three main pillars: tourism, the hydrocarbon industry, and the Suez Canal. Jordan has historically been dependent on the international dimension (foreign loans, international aid, and remittances from expatriate workers), while the Lebanese economy has suffered from high debt and structural weakness in particular since late 2019.

Alliances have been forged, wars have broken out, shaky or robust peace treaties have been signed: these are some of the elements that characterize the East Mediterranean cluster. More recently, a common denominator strengthens the ties, as well as the rivalries, of these countries: the discovery of commercial offshore oil and especially gas fields over the last decade. The recent discoveries caused the advent of new hydrocarbon producing countries and allowed some other countries to increase their production. However, the Eastern Mediterranean is not a new oil and gas region, even though the East Mediterranean countries have limited oil reserves, with the exception of Iraq and Egypt and, to a lesser extent, Syria (Table 3.6).

Despite some political and economic challenges, East Mediterranean countries have managed to cooperate in the energy sector, establishing some energy trade schemes. In 2001 Egypt and Jordan agreed to build the Arab Gas Pipeline (AGP) to connect the two countries, including Lebanon and Syria. The pipeline became one of the most significant pipelines in the MENA region, as numerous other countries in the cluster planned to join (Map 3.5). A few years later, Israel, Iraq and Turkey expressed their willingness to participate in the project. While Israel was mostly excluded from the Pan Arab Electricity Project, an offshore gas pipeline was built to connect it with Egypt.

In 2004, the four countries involved—Syria, Lebanon, Egypt and Jordan—decided to connect their gas grid with the Iraqi one to allow Iraq to export gas to Europe. Further connections were also evaluated. In theory, based on a 2006 MoU, the AGP was supposed to be connected to Turkey, with the Nabucco pipeline, for the export of gas from this cluster to the European countries. However, the pipeline between Syria and Turkey was not built, as it faces huge political and security challenges, given the current civil war in Syria and the two parties supporting opposing sides in the conflict.

Political instability has also damaged the pipeline. Indeed, the Arab Gas Pipeline was sabotaged numerous times, predominantly in Syria, in the Sinai Peninsula and in the adjacent pipeline connecting Egypt with Israel, thus highlighting low reliability and resilience, and preventing security of gas supply. For instance, numerous attacks against this pipeline were carried out in southern Syria, which led to nation-wide blackouts. This is one of the main reasons why importing countries—Israel (since 2013), Jordan (since 2015)—have turned their attention to LNG by renting FSRUs.

Other energy infrastructures have been built throughout the years and have also been damaged causing in most cases the termination of energy exchanges. Iraq has been exporting oil to Turkey through the Kirkuk-Ceyhan Oil Pipeline connecting Kirkuk in Iraq to Ceyhan in Turkey. However, this pipeline has been severely damaged by ISIS causing its closure in 2014. Another pipeline was the Trans-Arabian pipeline, which connects Saudi Arabia to Lebanon via Jordan and Syria. It operated from 1950

Table 3.6 Key energy indicators by East Mediterranean country in 2019

	Oil				Natural gas				Electricity	
	Reserves (Mbl)	Production (Mt)	Consumption (Mt)	Balance of trade (Mt)	Reserves (bcm)	Production (bcm)	Consumption (bcm)	Balance of trade (bcm)	Capacity (GW)	Production (TWh)
Egypt	3146	30.5	29.6	0.9	2209	68.9	62.3	6.6	59.8	195.2
Jordan	1.512	0.001	2.4	– 2.39	6	0.11	4.9	– 4.8	5.9	21
Lebanon	0	0	0	0	0	0	0	0	3.8	20.5
Israel	3.025	0.211	15.2	– 15	547	9.2	9.9	– 0.7	19.1	71.9
Syria	2,500	0.951	6.8	– 5.9	285	3.5	3.5	0	10.0	17.2
Iraq	145,019	234.9	45.9	189	3714	15.2	17.4	– 2.2	38.2	97.3

Note Imports (–)
Source Authors' elaboration on ENERDATA

Map 3.5 Arab gas pipeline. *Source* Authors' elaboration

to 1982. In 1970, an incident in Syria prevented the export of 500,000 barrels per day of Saudi oil to the Mediterranean intensifying the pressure on oil transportation.

Over the last decade, the East Mediterranean region has drawn the interest of multiple players prompted by recent offshore hydrocarbon discoveries. The presence of hydrocarbon fields in the region was already signaled in 1999 with the discovery of the Marine gas field located 30 km from Gaza shores. Gas production from the

Marine gas field never took place due to Israel's harsh opposition, even though the Palestinian Authority had signed a concession agreement with the British Gas Group, Consolidated Contractors and Palestinian Investment Fund (PIF) (Alhelou 2020). A decade later, between 2009 and 2011, major offshore gas fields were discovered in Cyprus (Aphrodite field) and Israel (Tamar and Leviathan field). While the Tamar gas field entered the production phase as early as 2013, gas from the Leviathan field started flowing only in 2019. In 2015, the Italian energy company ENI discovered Zohr, the largest gas field in the Mediterranean Sea, in the Egyptian EEZ. ENI has a 50% stake and is responsible for the operations, while the other stakeholders are Rosneft (30%), BP (10%) and Mubadala Petroleum (10%) (Alhelou 2020). Gas production started less than two years later, with the main aim of satisfying the high domestic demand. These successful discoveries, along with numerous smaller ones, prompted also Lebanon to sign the Exploration and Production Agreement with the consortium ENI (40%), Total (40%) and Novatek (20%) to explore and develop the offshore blocks 4 and 9, located in the Lebanese EEZ (block 9 is in a disputed area with Israel).

The East Med region, however, is theatre of numerous tensions, which also reflect in the energy sector, through the disputes over the EEZ between countries in the cluster (Lebanon-Israel), and among external actors in the broader area (Turkey-Cyprus) (Map 3.6). Detailed cases and examples will be provided in Chap. 5 (*see* Sect. 5.2.2) with a geopolitical analysis of these tensions (i.e. between Cyprus and Turkey).

Map 3.6 Gas fields and Exclusive Economic Zones in the Eastern Mediterranean

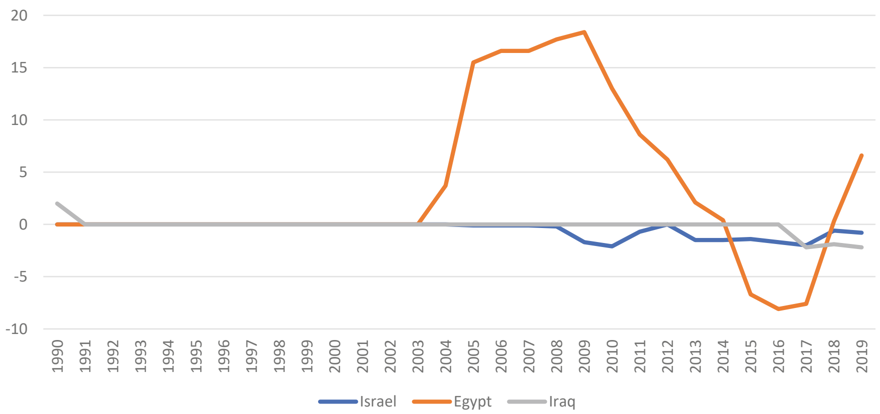


Fig. 3.29 Gas balance* of selected East Med countries, 2000–2019, bcm. *Production minus consumption. Exports (+) Imports (−). *Source* Authors' elaboration on BP

Notwithstanding the general geopolitical tensions in the region, gas exchanges can help promote energy security for importing countries (i.e. Jordan, Lebanon) and increase the economic benefits for gas exporting countries (i.e. Egypt, Israel). East Med countries have been trading natural gas throughout the past decades. Among East Med countries, Egypt has been a major gas exporter since the early 2000s. However, Egypt's fortune quickly declined in the 2010s due to the structural challenges of its gas industry and political instability, making the country a gas importer (Fig. 3.29). Since 2018, Egypt managed to reverse its status. By contrast, Israel has turned to gas imports even though it has started to export some of its offshore gas. Iraq has started to import gas since 2016—especially from Iran—albeit the country ranks as one of the world's largest flaring countries.

3.2.1 Jordan and Lebanon

Jordan and Lebanon share numerous characteristics in economic, societal and cultural terms as well as in terms of hydrocarbon endowment, which is very limited in both countries. Despite these similarities, their energy and electricity sectors present some major differences. The trend of Jordan's total primary energy supply by source has been more volatile than that of Lebanon, with the share of oil and natural gas changing abruptly from year to year. The most striking difference between Jordan and Lebanon is the role of natural gas.

Until the 2000s, Jordan's TPES has been heavily reliant on imported oil. However, Jordan underwent a transformation of its TPES and electricity production in the early 2000s, with the advent of natural gas imported from Egypt that progressively replaced oil. However, the region's growing instability, caused by the 2011 Arab

Spring, disrupted also the regional gas markets. Egypt fell into political turmoil, its gas production decreased, and its gas exports to Jordan stopped.

By contrast, Lebanon has relied on natural gas (Egyptian gas transiting Jordan and Syria) only for a very short period (2009–2010) and in very modest volumes before Egypt cut off its exports due to the Arab Spring. The lack of steady supplies resulted in a very limited role of natural gas in Lebanon. The country has no proven natural gas reserves and very few options to import gas from neighboring countries. Moreover, in the 1980s and 1990s low oil prices reduced the incentive to switch from the use of fuel oil in the power sector. As oil prices increased in the 2000s, Lebanon began to reconsider its energy supply options. In 2009, natural gas entered Lebanon's energy mix for the first time thanks to the Arab Gas Pipeline (AGP). Lebanon received 200 million cubic meters of Egyptian gas. Natural gas, however, had a short life in Lebanon's energy mix. Gas supplies were subject to several and frequent disruptions due to numerous factors, notably delays in payments and later a series of explosions targeting the AGP. In such a challenging context, Egypt stopped gas supplies to Lebanon at the end of 2010 (Fattouh and El-Katiri 2015). The country's TPES has thus been heavily dependent on oil imports (Fig. 3.31).

In the year 2014 the two countries had a comparable TPES (Fig. 3.30 and 3.32) and electricity mix (Fig. 3.31 and 3.33), when Jordan witnessed a peak of oil utilization and a low in natural gas. Due to the sudden reduction of Egypt's gas supply, Jordan had to return to massive oil imports. The result was that in 2014 the total primary energy sources for both Jordan (8.2 Mtoe) and Lebanon (7.6 Mtoe) were largely dependent on oil (imports) (above 90%) with little diversification from other sources. The same result was visible in their overreliance on oil in electricity generation, which accounted for 92.5% and 99% of total electricity generation, respectively (18.2 TWh for Jordan and 17.9 TWh for Lebanon) (IEA n.d.). In those years, the two countries' energy and economic sectors were thus highly exposed to the fluctuation of oil prices in the international market, further increasing the debt of the countries' public utilities.

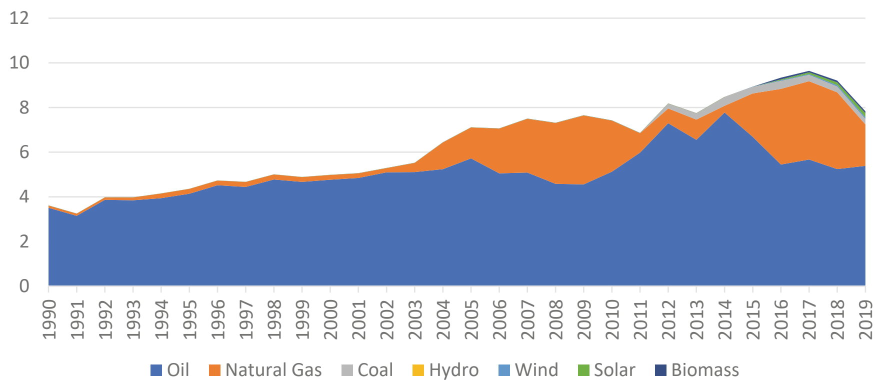


Fig. 3.30 Jordan's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

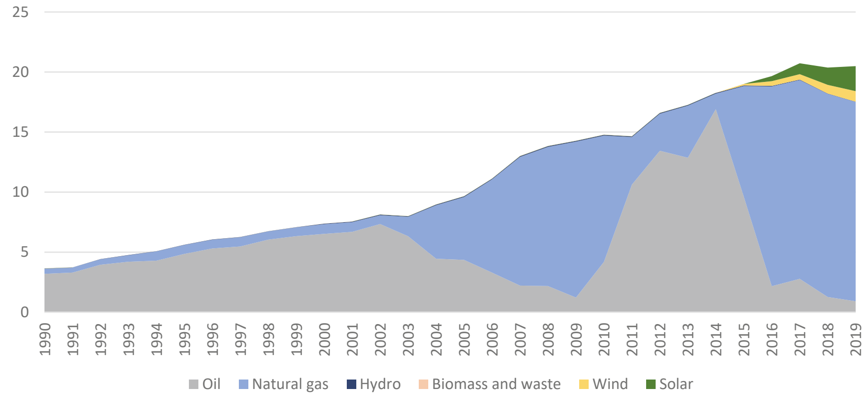


Fig. 3.31 Jordan's electricity generation 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

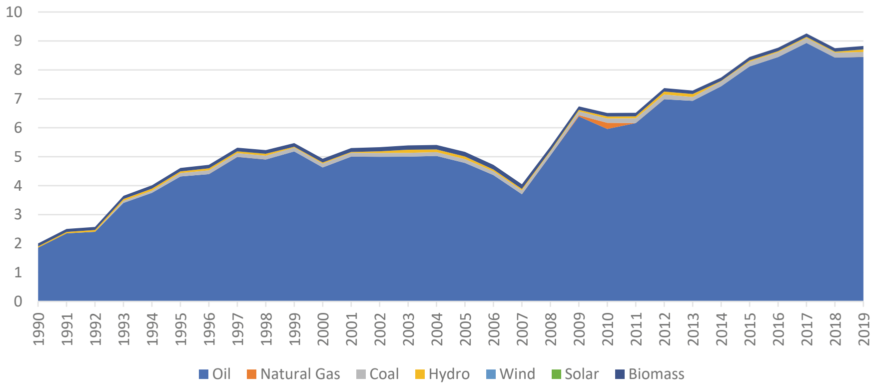


Fig. 3.32 Lebanon's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

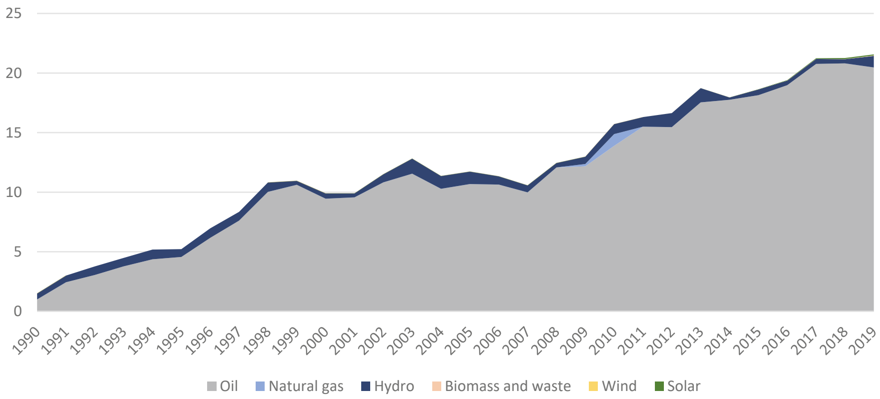


Fig. 3.33 Lebanon's electricity generation 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

However, in 2015, Jordan restarted to increase the share of natural gas in its energy mix and electricity generation (thanks in particular to LNG imports as well as pipeline gas imports from Israel – see below), while Lebanon's share of gas remained roughly the same. By 2017, natural gas in Jordan accounted for 37.9% (3.51 Mtoe) of the total primary energy source and 79.96% (2.8 TWh) of electricity generation (IEA 2018g), thus resulting in the second rapid adoption of gas for electricity generation, and the symmetric decrease in the share of oil.

Between 2000 and 2019 both countries witness an astonishingly high growth in electricity consumption rates: 5.8% per year for Jordan and 3.4% per year for Lebanon. In Lebanon, power production at peak periods (e.g. 2050 MW in 2018) does not satisfy the domestic power demand in peak times (e.g. 3500 MW in 2018) so that power blackouts occur daily ranging from 3 to 4 h in well-off areas to 12 h per day in worse-off places. With the current dramatic economic crisis, power cuts have become longer on average in all cities and neighborhoods. Thus, consumers have to rely also on highly polluting private diesel generators, buying electricity at high prices to satisfy their electricity needs. For both countries, high domestic demand for electricity is mostly due to population growth, enhanced by the large influx of Syrian refugees during the war in Syria: as of November 2021, Lebanon received about 844 thousand registered refugees and Jordan 672 thousand, while hundreds of thousands more are unregistered (UNHCR 2020). This represents around 12% of the population in Lebanon and 6.5% of the population in Jordan which had to be absorbed in a short time frame. The inefficiencies of the countries' electricity sectors, also resulting in high electricity demand, are increased by old and inefficient power plants, high transmission line losses, non-authorized illegal cables that take unpaid-for electricity to entire areas, and the generalized inability of the power utility to fully collect payments. Indeed, Lebanon's public utility *Electricité du Liban* (EDL) collects payment for just 50% of the electricity it produces. Due to the resulting unreliability of the country's electricity supply, many people who can afford it use their own diesel-based power generation sets.

Both Lebanon, with EDL, and Jordan, with National Electric Power Company (NEPCO), have a legacy of indebted public utilities. Due to the absence of resource endowments, both countries are large importers of hydrocarbons to satisfy their domestic energy demand. Thus, high reliance on oil, with consistently high oil prices in the late 2000s and first half of 2010s, coupled with the aforementioned energy system's inefficiencies led to an astonishingly high debt of the countries' public utilities. For instance, EDL benefits from net governmental transfers amounting to $1–1.5 billion per year, which correspond to 25% of the country's public deficit for the year 2018. The accumulated cost for Lebanon to subsidize EDL amounts to 40% of the country's public debt since 1992. Similarly, NEPCO's debt amounts to $7 billion, corresponding to 18% of the total Jordanian debt, especially due to the substantial operating losses that the utility incurred between 2011 and 2014, when oil prices were above $100 per barrel (Fairbanks 2019).

The year 2015 was a turning point for Jordan, a radical year of change in terms of energy policy. That year, it became clear that NEPCO losses were unsustainable in the medium term, thus the country decided to diversify its energy sources especially for power generation. This decision marked the rise of gas and renewable sources. Regarding gas, Jordan had imported gas from Egypt through the Arab Gas Pipeline from 2003 to 2014, when several accidents on the Egyptian section of the pipeline and gas supply constraints in Egypt disrupted imports. After the Arab Spring, imports dropped sharply, with a volume ten times lower in 2014 than in 2010. In 2015, imports have restarted following the opening of an LNG regasification terminal. By 2019, imports had again reached the 2010 levels (3 bcm), but from different sources. LNG is the main source of this gas, with the US and Russia being the main suppliers. Since 2015, Jordan has Golar Eskimo, a Floating Storage and Regasification Unit (FSRU), off the Red Sea port of Aqaba. The unit has a total capacity of 5.1 bcm/year. Moreover, Jordan envisaged gas imports from Israel's offshore gas fields. In 2017, it started importing small amounts of gas (2 bcm over 15 years) from Israel's offshore Tamar gas field, while in 2019, a 15.5 km-long gas pipeline connecting Leviathan to Jordan was laid near the southern end of the Dead Sea. Noble Energy and its Leviathan partners supply 45 bcm over 15 years (equal to 3 bcm/year). As a result, in only two years, gas experienced a remarkable come-back in the power mix (increasing from 7% in 2014 to 84% in 2016). Thanks to the increasing tariffs (elimination of subsidies) and the low oil (and thus gas) prices, NEPCO managed to register for the first time in decades a net profit in that period.

Since 2015, the country introduced conspicuous renewable energy capacities, primarily solar PV and wind, enabling the renewable share to increase from zero to almost 7% of the country's electricity generation, (IEA 2018g). Some important renewable projects came online, such as the wind plant in Al-Tafileh (117 MW) in 2015 and the solar plant in Ma'an (200 MW) in 2016. By 2020, Jordan had a capacity of installed solar PV amounting to 1 GW, close to the 1.2 GW target by 2025. Similarly, the country's wind capacity is estimated at 500 MW in 2020, close to the 800 MW target by 2025.

- **Energy sector today: two diverging paths**

A question may arise: "Why hasn't Lebanon followed the example of Jordan, in terms of a rapid adoption of gas and renewable energy sources?". Indeed, since 2015, the energy sectors of the two countries have again experienced two diverging paths. Numerous reasons may explain this difference. Jordan, for instance, does not hold gas reserves, while Lebanon has hoped for many years to exploit its East Med gas potential. Moreover, Lebanon's political and prolonged stalemate dramatically hinders changes to its energy sector or the adoption of energy subsidy reforms.

Natural resource endowment

A stark difference between the two countries regards their abundance of natural resources. Jordan is poor in conventional hydrocarbon resources while rich in oil shale[9] reserves (the world's fifth largest), which cover around 60% of the country

[9] Oil shale is unlike shale oil in that oil shale is essentially rock that contains a compound called kerogen, which is used to make oil. It is also much more difficult to recover than shale oil.

(Ababsa 2013), and uranium reserves, estimated at 59,500 tU (World Nuclear Association 2019). To date, these reserves have not been fully exploited and have not contributed to the country's energy mix. Negligible gas reserves and high domestic gas demand oblige the country to import 95% of its gas consumption.

Similarly, Lebanon is not a hydrocarbon resource-rich country. However, thanks to the recent discoveries in neighboring EEZs, in 2017 Lebanon awarded the first license for offshore oil and gas exploration and production to a consortium composed of Eni, Total and Novatek. In February 2020, the consortium announced the start of drilling activities for the exploration phase in blocks 4 and 9 (Asharq Al-Awsat 2020). Nevertheless, in April 2020, Total announced that while traces of gas were found in block 4, no reservoir was discovered. Lebanon also approved a second licensing round for offshore energy development with Russian companies, Malaysian Petronas and BP expressing interest in this latest bidding. Overall, while Jordan might be tempted to start developing oil shale, its investments in infrastructure for importing gas are not likely to be lost. On the contrary, investments in infrastructure to import gas (i.e. FSRU) in Lebanon seem to be in stalemate, since they are conditional on possible discoveries of commercially viable offshore gas fields.

Energy subsidy reforms

Both Jordan and Lebanon have been witnessing high domestic electricity demand, but their approach to energy subsidy reforms has been quite different. Lebanon, due to its internal political struggles, maintains energy subsidies, which in turn keep energy consumption rates high. As an example, in June 2019, the constitutional court halted a subsidy reform that the government had managed to agree on and approve. Nevertheless, a reform of the subsidy scheme was carried out by the Central Bank in the summer of 2021 when it decided to end subsidies for petroleum products, which had cost the country $3 billion per year. This is a noteworthy amount especially in the context of a significant drop of foreign exchange reserves, which went from $40 billion in 2016 to $15 billion in March 2021. The subsidy reform resulted in an increase of the gasoline price by 35% and of the diesel price by 38% in June 2021. It should here be pointed out that while energy subsidies are distortive and should be reformed and eliminated, they should be coupled with other accompanying measures that ensure safety nets to low-income families. Thus, the energy subsidy reform in the case of Lebanon was not beneficial or advantageous at all, given the dire economic conditions of the population, and the lack of accompanying policies to absorb the strong price increases for the poorest parts of the population. As detailed here below in "Lebanon's free fall" section, the country is sinking, with more than half of the population below the poverty line and with the current crisis being labeled by the World Bank as one of the worst 3 economic crises in the last 150 years worldwide.

Jordan's electricity sector situation remains very similar to Lebanon's, though it has been a front-runner in petroleum subsidy reforms in the MENA region. Indeed, Jordan has not yet carried out an electricity reform, even though the disruption of gas supplies from Egypt led to a significant increase in the production costs of electricity, which were borne by NEPCO and not passed onto final consumers (Atamanov et al. 2015). Thus, similarly to Lebanon, NEPCO started running a deficit every year since it did not increase the electricity price for consumers. However, Jordan has made a step further in petroleum subsidy reforms. Due to fiscal pressures, Jordan rolled out a subsidy reform of petroleum products between 2008 and 2010, by setting prices at the international level with a consequent subsidy decrease (from 2.5% of GDP in 2007 to 0.3% in 2010). However, in 2010, oil prices increased to above $90 per barrel so that the government was obliged to phase out the reform. Already in 2012, petroleum subsidies amounted to 2.8% of GDP, or 9% of the government's budget, leading to an unsustainable fiscal burden. Thus, in the same year, Jordan drastically cut subsidies on petroleum and implemented a large-scale cash transfer to all those earning less than JD 10,000 (equivalent to 7100 USD) a year, roughly corresponding to the income of two-thirds of the total population. This program is therefore similar to the Iranian subsidy reform, which however, provided cash transfer to all Iranians, regardless of their income or wealth.

- **Case study: Lebanon's freefall**

Reforms in the Lebanese energy sector have become even more unlikely and challenging with the country's dire economic crisis. Social unrest in Lebanon began on October, 17th, 2019, when the government suggested the implementation of a tax on calls via social media, in particular WhatsApp, which was seen as a tipping point after years of governmental mismanagement. Demonstrators, regardless of social class and religious affiliation, started to peacefully block roads demanding an end to sectarian politics, corruption and the introduction of fair taxes and a system to hold the corrupt accountable. At the end of October, the then Prime Minister Saad Hariri resigned. However, in November, banks started to impose limitations on the amounts withdrawn in dollars, and later banks and ATMs were shut down. It should be noted that in Lebanon there was a fixed exchange rate of $1 corresponding to 1500 Lebanese Lira, and the two currencies were used interchangeably in any daily life activity. The availability of dollars in the system was based on high interest rates paid to wealthy investors, however, over time, the gap between the dollars needed to repay investors and the real amount of money available in the banks widened. With the political crisis, Lebanese citizens rushed to withdraw dollars from their bank accounts while investments diminished due to the country's political instability and difficulty in repaying interest rates. Thus, a shortage of dollars occurred, drastically diminishing the availability of imported goods, on which Lebanon is highly dependent. The economic crisis escalated in March 2020 with the country defaulting on debt payments—$1.2 billion in Eurobonds—for the first time and the slowdown of economic activities due to the Covid-19 lockdown. As a result of all the aforementioned concomitant effects, in July 2021, the Lebanese Lira lost 90% of its value since October 2019, leading to skyrocketing food prices as Fig. 3.34 depicts (food inflation reached 400% in December 2020 with respect to the previous year), shortage of imported goods, including oil, which is necessary to run the power plants resulting in a so-called "fuel crisis". Figure 3.33 depicts the catastrophic consumer prices trend between July 2019 and November 2020. Indeed, the low levels reached by foreign exchange reserves resulted in worrying shortages of medicines and oil. Oil products make up 98% of the country's electricity mix, and they are also used to run the private generators (diesel). Indeed, in August 2021, the Lebanese Minister of Electricity stated that the country needs 3 GW of power, but it is only able to produce 750 MW due to fuel shortages, resulting in only 1–2 h of electricity per day. Given the high scarcity of public electricity, also private generators are unable to satisfy the power demand. Due to the shortage, the skyrocketing prices of generator and diesel made them inaccessible for the majority of the population. Consequently, businesses had to reduce the number of opening hours, including bakeries, and hospitals which were on the verge of closing down some of their departments. Long queues at petrol stations have become the norm. Another dramatic effect of the fuel crisis hitting Lebanon regards the public water system which was also "on the verge of collapse" according to UNICEF in July 2021. The UN Agency has estimated that 71% of the population is at risk of losing access to water, as the majority of water pumping is forecasted to stop operating in the following months due to shortage of fuel, funding and chemicals (i.e. chlorine).

In 2021 this dire economic situation has led about 50% of the population under the poverty line and 75% in need of aid and assistance, far beyond the percentage of the previous year, when mostly refugees (Syrian and Palestinian) relied on aid (Qiblawi 2020). Indeed, Lebanon is the country with the highest per capita concentration of refugees in the world, where only Syrian refugees constitute 30% of the total population (European Civil Protection and Humanitarian Aid Operations 2020).

Amid this socio-economic crisis, the Lebanese population also had to endure the blast at Beirut Port on August 4th, 2020, due to the explosion of 2750 tons of ammonium nitrate, which tragically killed 218 people and wounded thousands, causing significant infrastructure and economic damages.

Regardless of the highly unstable situation, the different political parties in Lebanon have been unable to agree on the formation of a government and on highly needed economic reforms. Indeed, Prime Minister Hassan Diab, who was leading a

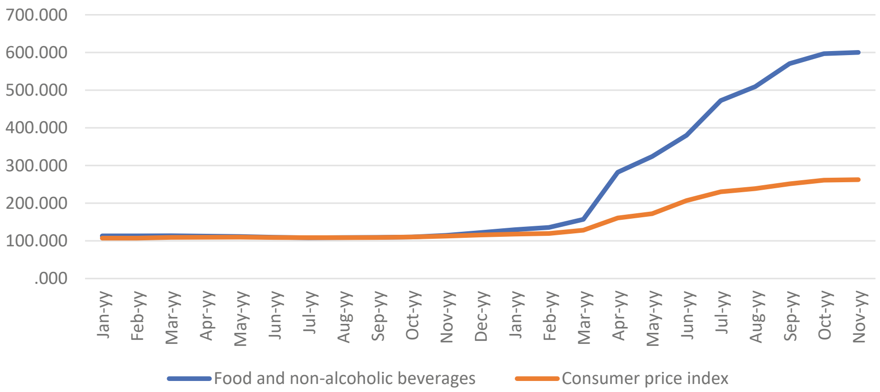


Fig. 3.34 Lebanese consumer prices trend (changes in %) between July 2019 and November 2020. *Source* Authors' elaboration on Central Administration of Statistics (Lebanon)

caretaker government, resigned in the wake of the Beirut explosion and was substituted by Saad Hariri, the prior Prime Minister between 2009 and 2011 and between 2016 and 2020. Nevertheless, in July 2021, Hariri also resigned and multibillionaire Najib Mikati (who had already been Prime Minister in 2005 and between 2011 and 2014) was appointed as new Prime Minister with the goal of forming a government, which is a priority to secure international support. By the fall of 2021 (the time we finished writing this book), the government had not yet reached an agreement on reforms aimed at reducing corruption, carrying out fiscal policy reforms and increasing the efficiency and effectiveness of public services, which are conditional on receiving a $10 billion loan from the IMF.

Similarly, Lebanon did not manage to agree on reforms in order to access a $11 billion package of loans and grants available since 2018 and decided at the so called Paris Conference, made up of 50 countries and international organizations. (Irish and Pennetier 2018). Carrying out fiscal reforms was deemed necessary by investors and donors, as Lebanon has a staggering and highly unsustainable projected public debt of 161.8% of GDP in 2020. Even potential oil and gas discoveries would not solve Lebanon's structural problems. Overall, energy security has become paramount with the dollar shortage, which has forced the country to drastically reduce fossil fuel imports for electricity generation. Thus, despite the current crisis, the country, investors and donors, in addition to tackling economic and governance reforms, should focus on a green recovery by investing in sustainable technologies including renewable energy.

In conclusion, the starting points of the energy sectors of Lebanon and Jordan were very similar. Nevertheless, Jordan managed to partly solve some issues with a combination of favorable factors, while changes to the Lebanese energy sector were hindered by broader socio-economic, domestic, political and geopolitical forces. For all these diverging issues, Lebanon adopted a "wait-and-see" approach, which is also fueled by the hope of possible gas fields discoveries, which may dramatically change Lebanon's energy system landscape and spillover in broader economic and political spheres, but which may also never happen. In the meantime the country is struggling against a deep socio-economic and energy crisis.

3.2.2 Egypt

- **Opposing forces in Egypt's energy sector between 2010 and 2016: decreasing production and increasing consumption**

Egypt is a large, old oil province, as oil had already been discovered in 1886, and in 1907 the Egyptian Oil Trust Ltd was established with the aim of developing, drilling and producing oil. Most of its crude oil production is traditionally located in the Western Desert and Gulf of Suez. Other important producing areas are the Eastern Desert, Sinai, Mediterranean Sea, Nile Delta, and Upper Egypt. In the last decades, Egypt has changed its energy status from being an important net oil exporter up to the mid-2000s to a brief net oil importer, and in the 2010s again a net oil exporter, although to a lesser extent (Fig. 3.35). The declining ability to export was the result of rising domestic consumption combined with declining production. Egypt is facing a steadily declining production rate from its legacy onshore fields. Since 2014, oil production has declined by 11%. At the same time, Egypt's oil consumption has significantly increased throughout the last decades and up to the mid-2000s when the government introduced measures to curb oil demand by substituting it with gas. Over the last decades, the increasing demand was driven by a larger population and economic development, while the drop in supply was due to a combination of difficulty in finding new reserves to substitute depleting fields, and a consequent drop in new investments in the oil sector. Besides being a traditional oil province, Egypt also plays a vital role in global and regional oil infrastructure thanks to the Suez Canal and the SUMED oil pipeline (from the Red Sea to the Mediterranean Sea).

There is an interesting story on Egypt's natural gas. Until the late 1980s, natural gas in Egypt was considered a by-product of oil production. Natural gas has become a linchpin of Egypt's energy policy only since the mid-1990s, when this country's oil production began to decline. Egypt changed its regulatory framework providing better economic conditions for the discovery and development of its gas resources. These changes made possible substantive discoveries throughout the 1990s, with reserves increasing from 364 bcm in 1990 to 2127 bcm in 2010 (BP 2020), as shown in Fig. 3.36. Egypt decided to incentivize its gas production in order to meet growing power consumption caused by population growth, limited hydro generation capacity and a switch from oil to gas.

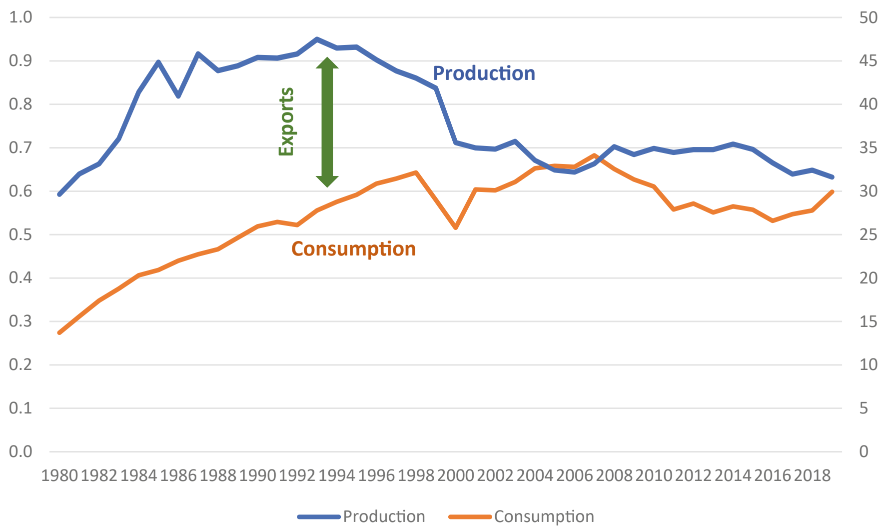


Fig. 3.35 Egypt's oil production and consumption 1980–2019, Mt (left) mb/d (right). *Source* Author's elaboration on ENERDATA

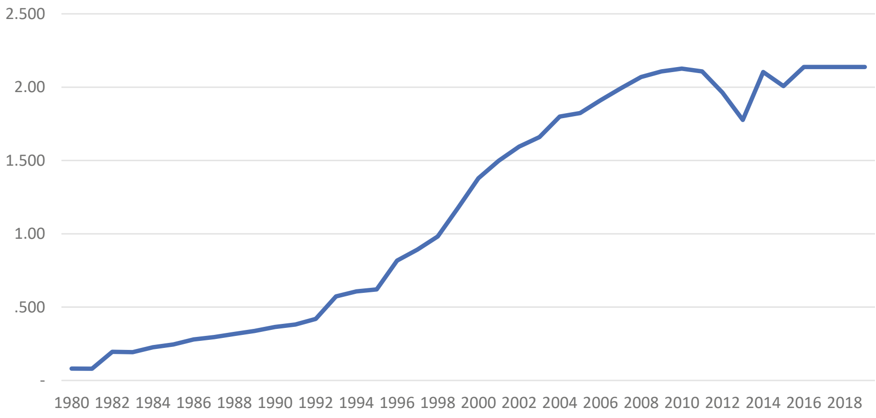


Fig. 3.36 Egypt's proven natural gas reserves 1980–2019, Trillion cubic meters. *Source* Authors' elaboration on BP (2020)

In 2009, Egypt's gas production reached its then peak, amounting to 60.3 bcm, while domestic consumption was 40.9 bcm (BP 2020), leaving 19.4 bcm for export. However, Egypt could not maintain these production levels and the context drastically changed in the subsequent years. New contracts were halted in 2012–2013 and the government chose to curb the amount of natural gas for industries rather than residential areas to avoid social discontent, especially following the Arab Spring protests (Meighan 2016). Political disorders following the 2011 Arab Spring contributed to the inability of Egyptian authorities to continue exploration activities. Thus, the country's gas production decreased by 31% between 2012 and 2016 (Fig. 3.37).

To satisfy growing domestic demand, Egypt progressively stopped exports, ordered the diversion of gas to the domestic market and even started to rely on

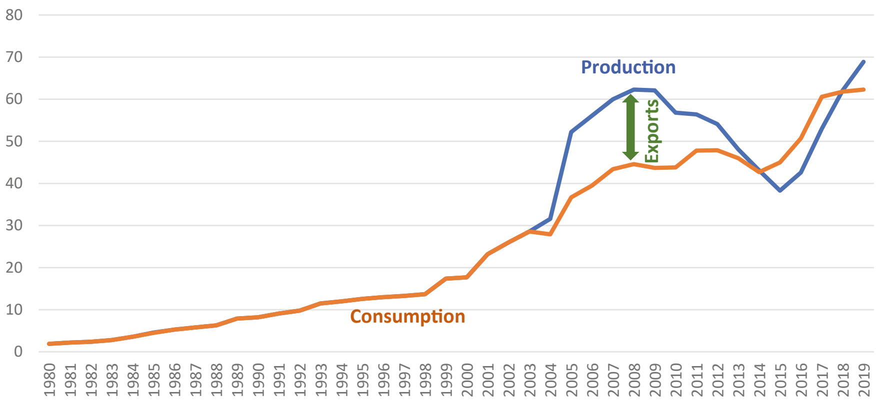


Fig. 3.37 Egypt's gas production and consumption, 1980–2019, bcm. *Source* Authors' elaboration on ENERDATA

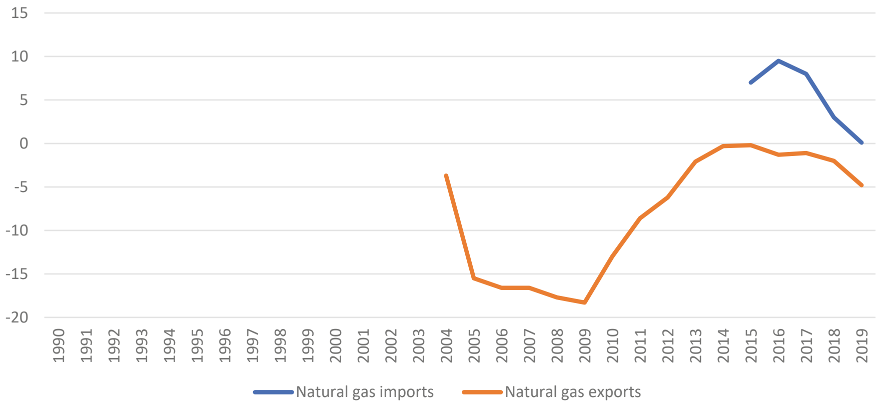


Fig. 3.38 Egypt's natural gas imports and exports, 1990–2019, bcm. *Source* Authors' elaboration on ENERDATA

LNG imports. In 2015, Egypt acquired two Floating Storage Regasification Units (FSRU), started importing natural gas (amounting to 8% of total natural gas consumption) and received LNG from numerous international players (BP, Shell, Gazprom and PetroChina). However, higher domestic production came on line in 2015, in particular also thanks to the commissioning of the large offshore Zohr discovery, which allowed Egypt to progressively stop using its two FSRUs and cancelling the third planned FSRU (Fig. 3.38).

By 2016, Egypt's natural gas production reached a decade-low of 40.6 bcm, while becoming at the same time the largest natural gas and oil consumer in Africa, accounting for 37% and 22% of total consumption in 2016, respectively. Such high levels of hydrocarbon consumption are mostly due to an increasingly high domestic energy demand, which currently represents one of the main challenges for Egypt.

A wide range of factors contribute to the increasingly high energy consumption, ranging from population growth (an average of 1.9% per year between 2010 and 2020) (The World Bank 2019a), economic growth (an average of 3.78% per year between 2010 and 2020) (Trading Economics 2019c), increased industrial localization and production, especially of energy-intensive sectors, limited energy efficiency and high energy subsidies. Industry is Egypt's major added value as a percentage of GDP, reaching a peak of almost 40% in 2014. In particular, Egypt has developed Africa's largest refining sector, which is the second most energy-intensive industry after the chemical one. The key role of refineries in the country contributes to the high energy consumption in the industry sector, despite their current underproduction, due to aging and maintenance issues. Another key driver of high energy demand in the country regards low energy efficient levels. As a matter of fact, energy intensity in Egypt is the highest in the North African region, being twice as high as Morocco and four times higher than other industrialized countries. Industrial and residential appliances consume an average of 20% more electricity than the recommended international measures.

- **Measures to satisfy high energy demand**

The increase in energy consumption coupled with the decrease in gas production—from 60.3 bcm in 2009 to 40.3 bcm in 2016 (BP 2020)—led the Egyptian government to publish the "Integrated Sustainable Energy Strategy to 2035" in cooperation with the European Union in 2013. Within this framework, renewable energy sources were set to represent 20% of the electricity mix by 2022 and 42% by 2035. The following section will provide an overview of renewable energy development in Egypt, in terms of objectives, projects and possible scenarios regarding the attainment of the aforementioned targets.

Energy subsidy reform in an unstable economic context

Energy subsidies being a major driver of Egypt's increasing energy demand, a reform was enacted in 2016 with the aim of eliminating them. It was carried out as part of broader economic and financial reforms in order to reduce the high fiscal deficit, which reached 12.5% of the GDP in the fiscal year 2015–2016. The exchange rate was overvalued, the current account deficit reached 6% of GDP in 2015–2016 and GDP growth, averaging 4.3%, grew less than in the period 2004–2010 (5.5%).

When the first reform to energy subsidies was introduced in 2014, the Egyptian economy was not thriving. At that time, the combined subsidies on electricity and fuel represented 6% of the GDP and 21.9% of total government expenditures. With the first wave of reform in 2014, diesel prices were increased by 64%, gasoline 80 prices by 78%, gasoline 92 prices by 40%, natural gas prices six-fold, while LPG prices remained subsidized, since the majority of LPG consumers were the worst-off. The Egyptian subsidy reform was timely, since it also took advantage of low international prices in 2014–2015. In 2016 and 2017, the Egyptian government decided to further cut down on energy subsidies, aiming at eliminating fuel subsidies by 2019 and halving electricity subsidies by 2020. Thus, LPG prices rapidly increased by 100%, gasoline 80 by 47% and gasoline 92 by 43%. In this second round of reforms, electricity prices were also raised by 40% (Breisinger et al. 2018). However, the devaluation of currency at the end of 2016 meant that fuel was still heavily subsidized. Overall, the government reduced spending in fuel subsidies by 46% in the fiscal year 2020–2021 compared to the previous year, while it increased electricity prices by 17–30% in July 2020. To mitigate the negative impact of energy price increase for the worse-off households, in 2018 Egypt rolled out a conditional cash transfer scheme and food subsidies for over 2 million families (Breisinger et al. 2019).

- **Gas discoveries in Egypt: a relief for the country's energy sector and beyond**

Despite this grim framework, between 2011 and 2016 some of the major challenges faced by Egypt in the gas sector—satisfying the high and increasing energy demand and offsetting the decrease in hydrocarbon production—were partly solved with the recent discoveries of large and commercially viable offshore natural gas fields. These discoveries may also contribute to reviving industrial production, preventing potential social unrest, while reducing economic instability and the exacerbation of foreign exchange shortage.

Eni's discovery of Zohr, the largest gas field ever discovered in the offshore Mediterranean Sea in 2015, represented a true blessing for Egypt. In 2020 the Zohr field contributed to 40% of Egypt's total gas production, and it has reached an output of about 28 bcm, which represents the peak plateau production. Natural gas production from Zohr started flowing though offshore pipelines to Egypt at the end of 2017. Other smaller fields were discovered in the same years, among which the Atoll field (2015) in the East Nile Delta, with BP being responsible for all the field development and holding 100% equity in the discovery (Offshore technology n.d.). Thanks to recent discoveries and the quick ramp up of production, Egypt was able to halt all of its LNG imports through its two FSRUs (and to cancel the planned third FSRU).

In recent years, Egypt has re-emerged as an LNG exporter. In 2019, Egypt's LNG exports amounted to 4.5 bcm, more than doubling its 2018 level, mostly thanks to the ramp up in gas production from the Zohr gas field. Egypt owns the only two LNG export terminals present in the East Mediterranean region: the Idku and Damietta plants. The two plants have a combined capacity of 19 bcm per year. However, for several years only the Shell-operated Idku was in operation and running at full capacity. Only in 2021, Eni, along with its Egyptian partners, managed to restart the Damietta plant, which had been idle since 2012. Egypt sells its LNG to a wide range of importing countries, both in Europe (France, Italy and Greece) and Asia (India, China, Singapore, Japan and Pakistan). Overall, total gas production reached 64.9 bcm in 2019 so that the country has the possibility to export around 6 bcm of natural gas, net of domestic gas demand.

Despite these major discoveries and developments, Egypt also started importing gas from Israel in January 2020: the paradox lies in the fact that a decade ago, until 2012, it was Israel that was importing gas from Egypt, satisfying 40% of its natural gas demand. The new deal signed to import gas may have been a way to settle the dispute with Israel, which accused Egypt of reneging contracts when the latter cut gas exports in 2012, following numerous attacks on the connecting subsea gas pipeline Arish-Ashkelon. Overall, the new gas deal with Israel, amounting to $19.5 billion for 85 bcm over a 15-year period, might also represent an opportunity for Egypt, since it ensures the country's capacity and reliability as LNG exporter.

Along with natural gas, Egypt aims at harnessing its renewable potential. In 2016, Egypt released the 2035 Integrated Sustainable Energy Strategy setting a target of 20% of electricity production from renewables by 2022, and 42% by 2035. By that date, solar is expected to account for 25% of total power production, while wind and hydropower for 14% and 2%, respectively. The private sector is expected to play a key role in developing new capacities, as further detailed in Chap. 4 (*see* Sect. 4.3.2).

The long history as an oil province and the four-decade development of the gas sector contributed to the dominant role of hydrocarbons in Egypt's TPES. In 2019, oil and gas represented together 91.9 Mtoe, or 96% of TPES. Egypt is thus still almost entirely reliant on oil and natural gas, with natural gas accounting for 62% of total TPES and oil for 34% (Fig. 3.39).

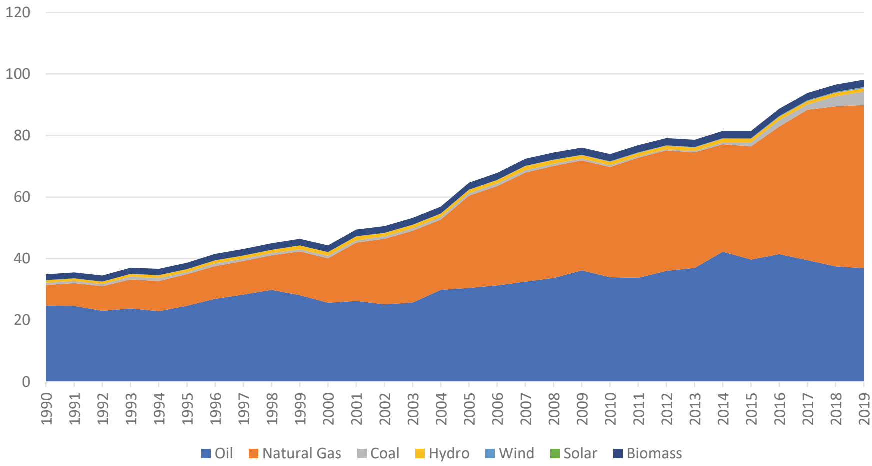


Fig. 3.39 Egypt's TPES 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

Natural gas plays a predominant role also in electricity generation (195.2 TWh in 2019), accounting for 79% of the total (ENERDATA n.d.) and growing strongly (Fig. 3.40). Natural gas increased its relevance as Egypt decided to install 3.6 GW of gas turbines in an emergency program for 2015. Indeed, the country has traditionally faced a context of chronic electricity shortages. Egypt used its domestic gas production to satisfy its growing power consumption. Also, hydro traditionally occupies a relevant position in the country's electricity generation (7%), while solar and wind energy still represent a minority share in the electricity mix—1% and 2%, respectively. But wind and solar energy capacity are expected to steeply increase thanks to numerous new renewable projects coming online in the next few years.

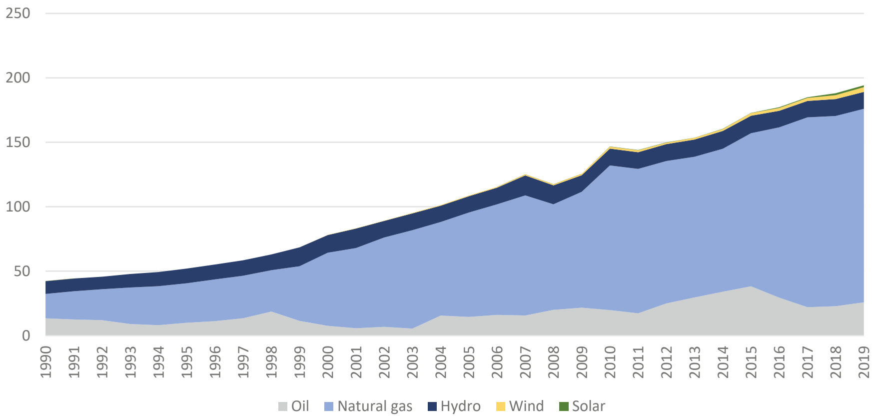


Fig. 3.40 Electricity generation of Egypt 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

Regardless of the huge difference in size, the current energy mix allows a comparison between Egypt and Jordan as they share some similarities regarding power generation by source. In both countries, natural gas represents about 80% of total power generation, followed by oil and then other sources. And in both countries the latest efforts have focused on developing renewable energy capacities. Nevertheless, a major difference arises: while Jordan imports more than 93% of oil and gas utilized for electricity generation, Egypt is a major oil and gas producer with large reserves. It is therefore midway between resource-rich countries in the GCC and Iran and resource-poor ones (e.g. Jordan and Lebanon).

In conclusion, Egypt may take advantage of the global energy transition, namely the increasingly important role of gas, by becoming a relevant player in gas production, thanks to large gas fields discoveries. In the short to medium term, gas—as the cleanest of all fossil fuels—has a certain potential also in transition scenarios in order to replace more polluting fuels. Also, the country may develop into a key transport hub for gas, thanks to its ability to export imported gas through its LNG terminals and its strategic regional location. The expected increase in LNG trade in the coming years also implies higher revenues from the tolls collected for the Suez Canal and its LNG terminals. In the longer term, Egypt could take advantage of its important solar and wind potential to export either renewable electricity (exporting solar electricity to Europe is an old Egyptian dream since the 1990s) or synthetic fuels, for instance in the form of green hydrogen or similar.

3.2.3 Israel and Palestine

Israel's energy sector has recently witnessed a significant transformation fostered by the newly discovered offshore gas fields and by increasing investments in the renewable energy sector. Domestic natural gas and renewables have replaced coal and oil imports in the Israeli energy mix, enhancing its energy security. On the contrary, ensuring energy security of supply remains a priority for Palestine, which heavily relies on Israel, and often faces political and financial constraints to extend the grid and increase imports from Jordan and Egypt.

- **Israel: Main trends, targets and discoveries: enhancing energy security**

Israel has notoriously lacked its own oil and gas reserves, in particular compared to other MENA countries. The lack of hydrocarbon endowment, combined with being the only non-Arab country in the region, forced Israel to find energy solutions to preserve its energy security in an unfavorable political regional context due to political animosity with its Arab neighboring (and oil producing) countries. Coal imports have thus played a crucial role, since they come with a significant lower geopolitical risk compared to oil. However, since the 2000s, Israel has increasingly developed its gas industry following the offshore gas discoveries in the Eastern Mediterranean Sea (Fig. 3.41).

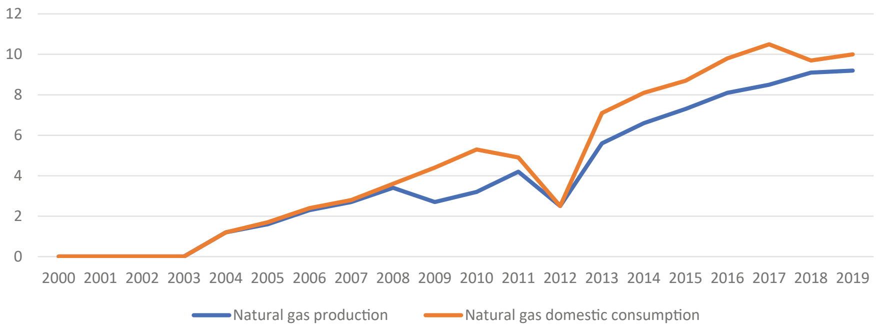


Fig. 3.41 Israel's natural gas production and domestic consumption 2000–2019 bcm. *Source* Authors' elaboration on ENERDATA

Israel's energy mix has thus become more diversified thanks to the considerable gas discoveries which date back only a decade. In 2019, Israel's TPES (24.1 Mtoe) was composed of 44% of oil, 33% of natural gas and 20% of coal and the rest of renewable energy sources.

Traditionally, Israel's TPES was totally reliant on oil and coal imports. Similarly to Morocco, coal satisfies energy security concerns, given the peculiar geopolitical landscape. In the early 2000s, natural gas started to appear in the energy balance, and it progressively gained market share in the Israeli TPES (Fig. 3.42). The main source was Egypt. However, following the 2011 Arab Spring, Egypt halted gas exports to Israel, thus forcing Israel to briefly increase its oil imports once again. Then, starting already in 2013, while waiting to develop its own gas fields, Israel imported LNG thanks to a FSRU with a capacity of 3.5 Mt/y. With the commissioning of Leviathan, LNG imports decreased to 0.55 Mt/y in 2020.

Natural gas has expanded its role in the generation of electricity (Fig. 3.43). Figure 3.42 illustrates the impact of the development and production of gas fields discovered at the end of the 2000s-beginning 2010s, leading to coal being partly replaced by natural gas. Since 2000, coal use for power generation in Israel decreased by 31%. In 2019, natural gas accounted for 66.2% of total electricity generation (68.74 TWh), coal for 30.6%, oil 0.5%, and solar PV and wind 2.8% (ENERDATA n.d.).

Israel still lags behind other oil-importing countries (i.e. Jordan and Morocco) in the MENA region in terms of renewable energy sources for electricity generation. As aforementioned, between 2005 and 2015 Israel decreased its reliance on oil and especially coal, which represented the main energy source for electricity generation (Fig. 3.42), while natural gas consumption increased fourfold in the same time period. The change in the share of energy sources for electricity generation was vital for Israel, which attained a high level of energy security shifting away from its precarious position of net importer of coal, oil and natural gas (mainly from the neighboring Egypt).

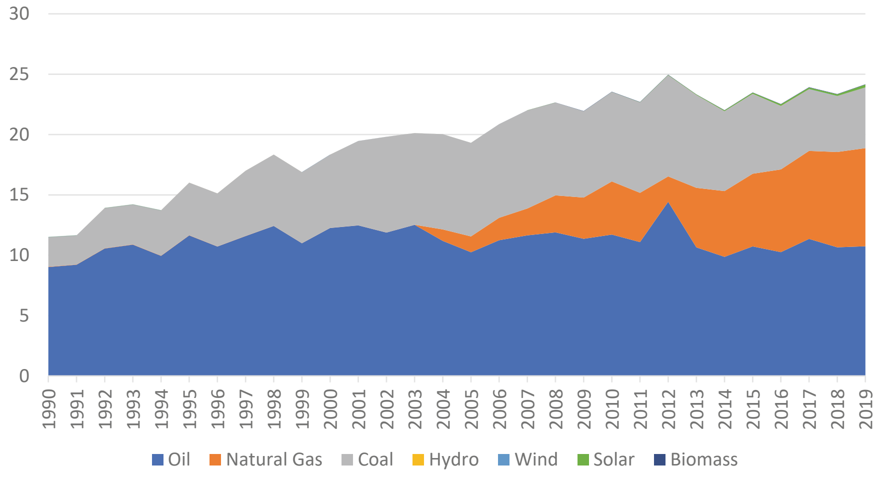


Fig. 3.42 Israel's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

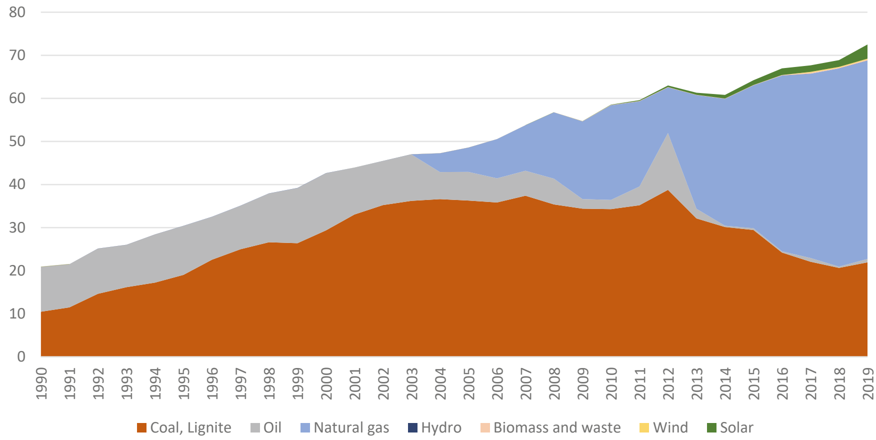


Fig. 3.43 Israel's electricity generation 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

This move was possible thanks to the discovery of numerous offshore gas fields over time, which also allowed the replacement of gas production from almost depleted gas fields with newly developed ones. Gas production, started in 2004, increased strongly from 2013, reaching 11 bcm in 2019. Israel has three operational offshore gas fields. The first commercially viable gas field Mari-B, which satisfied 40% of total gas demand, entered the depletion phase in 2012 and gas production was halted in 2013. The depletion of production from the Mari-B field combined with the cessation of Egypt's gas imports contributed to the steep drop in the share of natural gas for electricity generation shown in the graph above. In the same year, the 280 bcm Tamar gas field replaced the Mari-B field by entering the gas production phase and satisfying more than 50% of Israel's electricity needs and nearly 100% of the fuel needs for industry (EIA 2016). Nevertheless, the greatest discovery, the Leviathan gas field (605 bcm), was made in 2009 by Noble Energy, Ratio Oil Exploration and Derek drilling, and entered the production stage in December 2019 (Beckman 2020).

The management of these resources has generated strong political sentiments and arguments, resulting in the delay of key investment decisions (Hafner and Tagliapietra 2016). Having always been reliant on imported fuels, Israel looked at its offshore natural gas resources as a valuable tool to improve its energy autonomy in a region dominated by Arab producing countries. Therefore, Israel was immediately committed to using its natural gas to meet its domestic demand. This approach clashed inevitably with Noble Energy's business ambitions to export gas in the global gas markets earning revenues. After long negotiations, Israel set limits on how much gas could be sold abroad, earmarking nearly 60% of reserves for domestic use. In the 2010s, Israel and Noble Energy looked into different export solutions to earn profits from offshore gas. LNG would be the most rational solution to gain market share in the profitable and growing Asian markets. However, the construction of a LNG liquefaction terminal on the Israeli coast was strongly contested, while the FLNG terminal was abandoned due to its high costs compared to the limited reserves volumes. Also connecting Israeli reserves with Cyprus' ones and building an LNG export terminal in Cyprus was dismissed for security reasons. Lastly, Israel evaluated the possibility to build a pipeline to Israel's mainland and then to Eliat in the Gulf of Aqaba on the Red Sea. This option would allow Israeli gas to bypass the Suez Canal on its way to Asia. However, the limited dimension of the Gulf of Aqaba did not allow LNG tankers to operate safely, hence inducing Israel to abandon the project. Exporting gas to Turkey was also not an option for geopolitical reasons.

In 2014, Israel and Jordan reached a deal for 2 bcm of gas over 15 years. In 2017, Israel has begun to export gas from the Tamar field to Jordan. Noble Energy has also signed a contract with Jordan for a 3 bcm gas supply. Moreover, at the end of 2019, Israel authorized natural gas exports from the Tamar and Leviathan fields to Egypt using the existing pipeline offshore Gaza, adapted with reverse flow. The $19.5 billion deal envisages the supply of 85 bcm of gas from Leviathan over 15 years.

In order to further enhance energy independence, in 2020 Israel announced it would scale up its renewable target in the energy mix for 2030 from 17 to 30%, with solar PV playing the primary role. Indeed, these targets seem highly ambitious, as of 2018 renewable energy sources represented 2.8% of electricity generation and 2.36% of TPES (IEA n.d.). Renewables are expected to replace, with natural gas, coal in electricity generation as Israel signed the Powering Past Coal Alliance in 2018 with the aim of phasing out coal by 2030. The large investments needed to attain the 2030 targets are expected to come mostly from the private sector with around $23 billion (Bellini 2020). The deployment of solar PV is now supported by a regulatory framework including net metering and feed-in-tariffs for rooftop solar PV and tenders for large-scale solar PV projects.

Overall, Israel's energy sector is not yet competitive so that, in order to attract conspicuous private investments in the renewable field, reforms in this sector have to be carried out. Indeed, the Israel Electricity Corporation (IEC) dominates generation and distribution, even though in the last couple of years the share of independent generators has grown, reaching 35% of the market share in 2018. As generation from renewable energy sources is private, the share of independent generators is expected to further grow in the coming decade within the framework of 2030 renewable targets. IEC had established the National Coal Supply Corporation, which is responsible for coal imports. Regarding gas, the private sector is in charge of gas fields' discoveries, development and production while gas transmission is in the hands of the government's subsidiary Natural Gas Lines Company (INGL) (OECD 2019).

- **Trends and key characteristics of the Palestinian energy sector: lack of energy security**

Palestine is inexorably dependent on Israel for its energy sector—as in most other fields. Imports from Israel satisfy 99% of total electricity supply in the West Bank and 64% of total supply in Gaza. Overall, 87% of the electricity consumed is imported from Israel, 4% is imported from Egypt and Jordan and the remaining 9% is provided by the sole Gaza power plant (Dawabsheh 2019). In Palestine, power demand is higher than power supply, resulting in seasonal electricity blackouts in the West Bank, which are also due to an increasing number of unpaid bills. Daily blackouts are particularly severe in Gaza, lasting an average of 16–18 h per day. These blackouts particularly affect the most vulnerable part of the population, who is not able to afford a private diesel generator.

The West Bank and Gaza experience two different energy conditions. Overall, recent agreements have enhanced energy security for the West Bank, while Gaza remains excluded from any amelioration also in the energy sector. In May 2018, the Palestinian Electricity Transmission Co. Ltd. (PETL) reached a 15-year agreement with the state-owned utility Israel Electric Corporation (IEC) to gain the responsibility for electricity distribution in the West Bank. In order to increase energy security and diminish the nearly total dependence on Israel, the Palestinian Authority has negotiated with Jordan to increase the amount of imported electricity. Nevertheless, Israel has prevented the construction of power networks as well as the entry of material and development of solar PV in Area C, as will be discussed in Chap. 4 (*see* Sect. 4.3.3). These restrictions play a crucial role in preventing Palestine from developing an efficient, effective and sustainable energy sector, as Area C comprises 60% of the total territory of the West Bank and, according to the World Bank, it has the highest potential of solar power, corresponding to some 34.5 GW. Conversely, the potential of solar PV for Areas A and B combined amounts to only 103 MW (Hilal and Nassar 2018).

A very different framework regards Gaza's energy sector. Gaza's power supply (200–210 MW) does not satisfy the total demand, amounting to 450 MW per year. The main sources of power supply in Gaza are represented by electricity imported from Egypt (20–30 MW), Israel (120 MW) and by electricity produced locally with the Gaza Power Plant (GPP, 60–140 MW depending on degree of operation and damages). The GPP runs on diesel, but it operates only at half capacity due to prohibitive fuel costs for the Palestinian Authority. The mismatch between power demand and supply results in extenuating blackouts up to 18 h per day, which dramatically hinder the provision of key services such as healthcare.

The energy sector is inexorably linked with the political context, especially in the case of Palestine and Israel. An illustrative example regards Palestine's inability to take advantage of its resources of the Meged oil and gas field and of the gas fields Marine 1 and Marine 2 offshore Gaza (Map 3.6). The former is situated in Area C of the West Bank. Divergent views on border agreements and local political developments have substantially hindered the positive development of these offshore resources.

In conclusion, the Israeli and Palestinian energy sectors are undeniably interconnected, or rather the latter has to depend on the former, so that an analysis focused on only one system would be incomplete. While Israel has attained a high level of energy security thanks to conspicuous quantities of gas discovered and its progressive inclusion of renewable energy sources in its electricity mix, Palestine's energy security remains extremely low, being highly dependent on Israel. Solar PV represents a huge opportunity for a secure energy supply for Palestine especially in Area C, but this country may not be able to fully exploit this potential due to stringent political and economic constraints on the part of Israel.

3.2.4 Iraq and Syria

Iraq and Syria have a long hydrocarbon history, even though their reserves vary significantly. However, both countries have been struggling with major political instability since the 2000s. Syria has plugged into a civil—and proxy—war since 2011. Iraq has experienced three wars in the last 40 years (Iraq-Iran War in the 1980s, First Persian Gulf in the 1990s, and the US invasion in the early 2000s). Since the collapse of Saddam Hussein's regime, the country has been suffering from major political and security instability.

- **Iraq**

Iraq is a key producing country, responsible for the production of 4.8 mb/d in 2019. It has the third largest conventional reserves in the world (145 thousand million barrels), with also conspicuous unconventional reserves. It is home to several super giant fields (with more than 5 billion barrels of reserves). Iraq also holds 3.5 tcm of gas reserves in 2019. However, approximately two-thirds of those reserves are associated with crude oil reserves, while one third are not. Figures 3.45 and 3.46 show the historical evolution of Iraq's TPES and power generation, which still rely heavily on oil.

The (geo)political events have deeply affected the country's oil output. In the early 1980s, Iraq's oil production fell drastically due to the 8-year war with Iran, but

Iraq managed to progressively increase its production during the 1980s despite the conflict. In the 1990s, oil output suffered a heavier burden: the first Gulf War and the international sanctions pushed production down from 2 mb/d in 1990 to 0.35 mb/d in 1992. After 1996, Iraq was able to increase its domestic production again and was able to produce up to 2.6 Mt in 2001. The second Gulf War in the early 2000s, with the consequent collapse of Saddam Hussein's regime and political instability, depressed once again oil production, but to a far lesser extent. Oil production has increased strongly since 2010 (2.5 mb/d), reaching 4.8 mb/d in 2019. The increase was driven by rising production in southern Iraq and in the Iraqi Kurdistan Region, offsetting the decline in the north. Iraq exports most of its oil (above 80% of the production) in 2019, Iraq exported 3.8 mb/d (Fig. 3.44).

Conversely, its entire natural gas production (9.5 bcm in 2019) is used domestically. Gas production may be affected by OPEC's production quotas as the majority of Iraq's gas reserves is associated. Since 2015 the production has increased on average by 8% per year, as Iraq was able to boost its production within OPEC. However, Iraq is among the four largest gas flaring countries (with Russia, the US and Iran). This has significantly adverse environmental impacts, but it also creates a paradox since Iraq relies heavily on Iran both for electricity and natural gas imports. In 2019, Iraq received around 7 bcm of gas and 1.57 GW of electricity from Iran. Some estimated that Iran, directly and indirectly, met a whooping 28% of Iraq's peak summer power supply. This dependence comes with great geopolitical competition, as the US seeks to reduce Iraq's reliance on Iran imports.

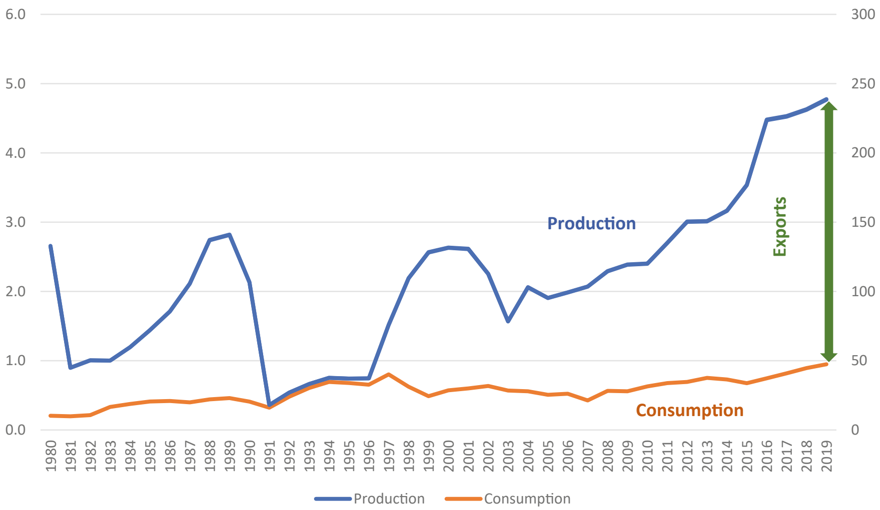


Fig. 3.44 Iraq's oil production and consumption 1980–2019, Mt (left), mb/d (right). *Source* Authors' elaboration on ENERDATA

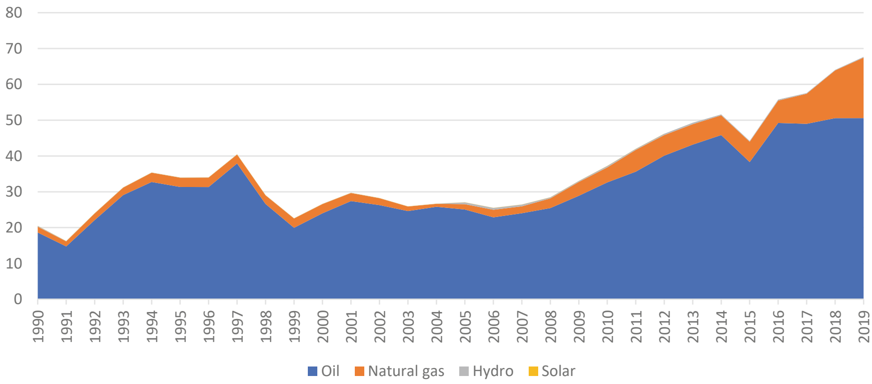


Fig. 3.45 Iraq's TPES 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

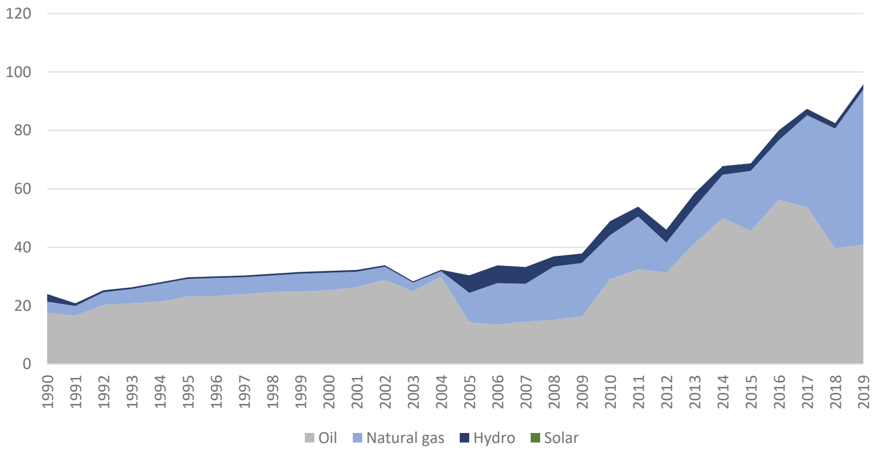


Fig. 3.46 Iraq's power generation, 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

- **Syria**

By contrast, Syria's oil and gas resources have hardly any impact on the world market. Syria's oil production before the civil war began in 2011 was at 385,000 b/d, which was less than 0.5% of world supply. In 2019 Syria's proven oil reserves were estimated at 2.5 billion barrels (BP 2020). Syria also holds 241 bcm of natural gas reserves, and in 2010 it produced 8.4 bcm of natural gas, most of which was used for electricity generation. Syria's oil reserves are mainly localized in its two principal oil producing regions: the northeastern Hasakah Province and the Euphrates Valley. It is somewhat astonishing that Syria's reserve figures are small compared to its neighbor to the East (Iraq).

The conflict has inevitably affected its limited oil production and upstream activities. Crude oil production dropped from an average of 385,000 b/d prior to the conflict to an average of 164,000 b/d in 2012 and to just 28,000 b/d in 2013 and further down to 9000 b/d in 2014. At the start of 2019, the regime declared that Syria was producing 24,000 b/d of crude oil (Butler 2019). The collapse of oil production forced Syria to increase its crude oil imports in order to keep its refineries running. In addition, it also needed imported products to meet domestic demand for gasoline, liquefied petroleum gas, and diesel. Syria began to rely on its partners for energy imports, especially Iran, in addition to buying volumes from the Kurdish-controlled fields in northeastern Syria. Syria looks with interest to natural gas, which is considered to be the only solution to its power generation woes. Also, Syrian offshore reserves in the Mediterranean Sea are very promising in terms of natural gas reserves. Some non-Western companies, notably Russian and Chinese, might be interested to invest and explore the area.

3.3 Maghreb

The Maghreb cluster comprises four countries—Algeria, Libya, Morocco and Tunisia—with very different features in the main socioeconomic indicators (table 3.7) as well as in the energy sector (table 3.8).

These four countries diverge also in socio-political terms, albeit they have some common heritage. Algeria, Morocco and Tunisia share a similar colonial history under French authority, while Libya was an Italian colony during part of the first half of the twentieth century (1912–1943) followed briefly (1943–51) by British and French rule before declaring independence in 1952 under King Idris I, Libya's only monarch. He ruled the country until the 1969 coup by Muammar Ghaddafi. Thus Libya was under foreign rule for a shorter time compared to Algeria (1830–1962), Tunisia (1881–1956) or even Morocco (1907–1956) where the French introduced their own administrative system, which to a large extent survives until today. While Algeria was considered an integral part of the French state, Tunisia and Morocco were formally protectorates. The independence of Morocco and Tunisia was relatively

Table 3.7 Key socioeconomic and energy indicators by Maghreb country in 2019

	Population (mln)	GDP	GDP per capita	GDP per capita PPP	TPES (Mtoe)	Power consumption (TWh)
Algeria	43	177	4111.3	11,510.6	65.7	70.6
Libya	6.8	40.5	5971.8	15,174.2	21.8	18.4
Morocco	36.4	112.7	3407.8	7537.5	23.1	32.7
Tunisia	11.7	46.2	3951.8	10,755.6	11.5	17.7

Source Authors' elaboration on World Bank, United Nations, IEA, ENERDATA

Table 3.8 Key energy indicators by West Mediterranean country in 2019

	Oil				Natural gas				Electricity	
	Reserves (Gb)	Production (Mt)	Consumption (Mt)	Balance of trade	Reserves (tcm)	Production (bcm)	Consumption (bcm)	Balance of trade	Capacity (GW)	Production (TWh)
Algeria	12.1	66.2	37.8	28.4	4.5	90	47.2	42.8	21.9	89.9
Libya	48.2	60.2	6	54.2	1.5	15.8	12.9	2.9	10.9	35.1
Morocco		0.004				0.1	1		10.8	41.8
Tunisia	0.4				0.06	2	6.4	– 4.4	5.8	22.1

Note Imports (–)
Source Authors' elaboration on BP and ENERDATA

bloodless, but the long eight-year very bloody independence war in Algeria (1954–1962) has left unhealed wounds between Algeria and France. Today, Morocco is the only monarchy in North Africa. Its King, Mohammed V, is directly descended from the Prophet Muhammad. As such, the King of Morocco and the Kind of Jordan, Abdullah II, are the only two rulers in all MENA countries to be considered direct descendants of the Prophet Muhammad, which gives them additional prestige in the Muslim world.

More recently, the Western Mediterranean countries experienced different sociopolitical developments. Tunisia was at the origin of the 2011 Arab Spring that spread across the region, while Algeria, which had its own bloody civil war in the 1990s, did not experience any major social unrest during the Arab Spring. In 2019, however, it witnessed the highest levels of social unrest since the 1990s, following the candidacy of Abdelaziz Bouteflika for the fifth presidential term. In Libya, the Arab Spring led to a bloody civil war including an international intervention which eventually led to the fall of Muammar Gaddafi in 2011, thus ending 42 years (since 1969) of Gaddafi leadership in Libya. The following political vacuum has caused a decade long civil war among different Libyan fractions, further exacerbated by international and external interferences (*see* Chap. 5 Sect. 5.3.2). Conversely, Morocco has been one of the relatively most stable countries in the MENA region, without the capacity of oil rent redistribution, which is typical of other countries in the region, to ensure socio-political stability.

Algeria and Libya are fossil fuel endowed countries, representing the classic rentier state, while Tunisia transited from a minor hydrocarbon net exporter to a net importer (in fact, Tunisia is still a small oil exporter but a gas importer). Morocco has always been a hydrocarbon-poor country so that its energy strategies and development reflect the priority of ensuring security of supply. Although Morocco does not hold any significant hydrocarbon resources, the country is one of the world's largest phosphates producer and exporter.

For a more detailed overview of the main energy indicators of the four countries constituting this cluster, see Table 3.8. It is interesting to notice that, although the two important hydrocarbon rich countries in this cluster, Libya and Algeria, have an overall similar level of hydrocarbon reserves, Libya's reserves are constituted of two thirds oil and only one third gas, Algeria's reserves on the contrary are constituted of two thirds natural gas and one third oil. So, even though both countries export both oil and gas, Libya is mainly an oil player, while Algeria is mainly a natural gas player as far as exports are concerned.

Nevertheless, countries in the Maghreb cluster share a key feature: their strategic location in the Sun Belt and their geographic vicinity to Europe, which have contributed to ensure revenues for Maghreb countries, and security of supply for Western Mediterranean European countries. Indeed, this proximity and strategic position between the two Mediterranean shores has led to the construction of several gas pipelines exporting gas to Europe (Maps 5.6 and 5.8).

Due to its proximity, Algeria is strategically more important to Europe than most other hydrocarbon endowed countries in the MENA region (Map 5.6 in Sect. 5.3.1). Algeria built the first international commercial LNG chain in 1964 (initially to the

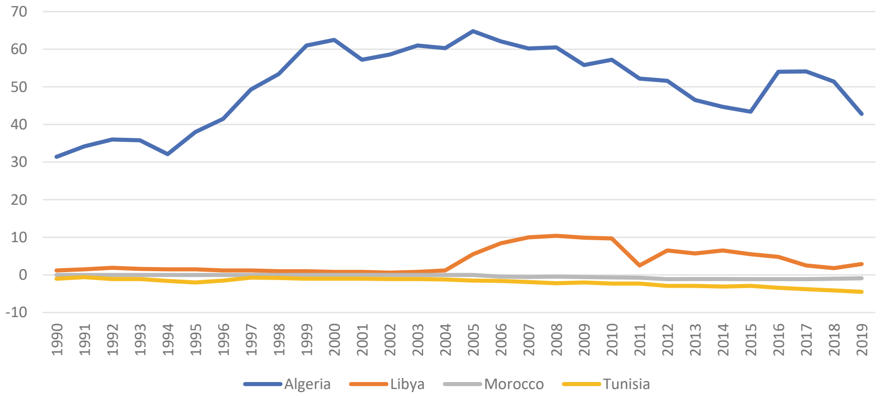


Fig. 3.47 Gas balance* of Maghreb countries, 2000–2019, bcm. *Production minus consumption. Exports (+) Imports (−). *Source* Authors' elaboration on BP

UK) before it became technically possible to build pipelines across the Mediterranean Sea. In 1983, the TransMed pipeline, later renamed Enrico Mattei,[10] became operational connecting Algeria to Italy via Tunisia. It was the first time that a 600-m-deep sea (between Tunisia and Sicily) had been crossed. In the following decades, Algeria was also connected to Spain in 1996 with the Gazoduc Maghreb-Europe (GME), later renamed Pedro Duran Farell[11] Pipeline, which passes through Morocco. As soon as the technological capabilities were reached to lay very deep-water pipelines (at 2000 m), the exporters and importers preferred to connect directly. This is the case of MEDGAS which connects directly Spain to Algeria, and it would have been the case with the GALSI Pipeline (Algeria Sardinia Italy Gas Pipeline), which would have connected Algeria directly to Italy via Sardinia. The construction of GALSI was never realized, however, because of gas pricing issues and low demand outlook in Italy and Europe after 2010, and the project was finally called off. Libya started to export its own gas to Italy in 2004 when the Greenstream pipeline came online. Thus, Algeria and, more recently and to a minor extent, Libya, managed to export considerable gas volumes (Fig. 3.47), becoming an important pillar of (mainly South) European gas supply strategy and security.

Despite difficult political relations between Algeria and the two transit countries (Morocco and Tunisia), all countries involved in the gas trade managed to ensure their security of gas demand and supply. Several factors limited the bargaining power of the transit countries, avoiding the political risks and gas crises that had occurred in other contexts (e.g. Russia-Ukraine-Europe in the 2000s). After long negotiations, the importing countries (Italy and Spain) managed to create a scheme to reduce the interference of political issues in gas flow. While the gas lines in Tunisia and Morocco are owned by these respective countries, the operational rights of the pipelines belong

[10] Founder of the Italian oil company, Eni.

[11] Former President of the Gas Natural Company, the Spanish gas company, now known as Naturgy.

to the importing countries. Transit countries can request to be paid either in cash or in kind (gas volume). In doing so, transit countries receive some 5–7% of transit gas (in cash or in kind) as royalty under an agreement with the importing country (Italy or Spain) rather than the producing country (Algeria) (see box on transit countries in Chap. 5). In short, Morocco and Tunisia take advantage of gas pipelines which connect Algeria to Spain and Italy, respectively, to ensure their security of gas supply, and at the same time they cannot cut off supplies since the operation of the pipelines is managed by the importing countries' companies.

In order to satisfy its domestic gas demand, Tunisia relies on gas imported from Algeria via the Trans Mediterranean (Enrico Mattei) gas pipeline (52% of total gas consumption through commercial agreements and 13% through transit fee payments for the Trans Mediterranean pipeline in 2019) (Oxford Business Group 2019). The imports from the Trans Mediterranean gas pipeline are paramount for Tunisia, given its almost entire reliance on gas for electricity generation. Morocco benefits from the *Gazoduc Maghreb-Europe* (GME), from Algeria to Spain via the Kingdom, to import significant quantities of gas, and to satisfy 45% of the country's gas consumption (500 cmc out of 1.1 bcm). It is well-worth to note that, similarly to Qatar and the UAE, energy needs are prioritized above and beyond (geo)political tensions also in the case between Morocco and Algeria, even though Spain and the European Union played a role in bringing the two countries to the table and to an agreement. Indeed, Morocco and Algeria are in a decades-long dispute regarding the Western Sahara, where Morocco claimed two-thirds of the territory, while Algeria supported Sahrawi Arab Democratic Republic (SADR) guerilla who were fighting for independence (Berkhahn and Kruse 2018). In 2021, the political disagreement between the two countries prevented renewing the transit contract, which expired in November 2021.

Overall, countries in the Maghreb cluster display a great potential not only for further regional energy integration, but they may also benefit from their strategic locations (windy, close to the Sun Belt and Europe) to integrate high capacities of renewable energy sources to enhance their energy security and their exports to Europe.

3.3.1 Algeria

Algeria is a major hydrocarbon rich country in Africa. The country is endowed with both oil and gas reserves, though gas reserves are more abundant than oil reserves. Algeria is indeed an important gas producing country, and natural gas plays a major strategic role for the country.

- **A historical overview of the Algerian hydrocarbon sector**

The history of the hydrocarbon sector in Algeria dates back to the 1950s when Algeria was still under French rule. 1956 was an important year in the Algerian hydrocarbon sector with the discovery of three of the largest oil and gas fields in the country:

Edjeleh and the well-known Hassi Messaoud oil fields, as well as large volumes of gas at Hassi R'Mel, all of which were developed rapidly in the years to come. Oil production started in 1958 (Kamen-Kaye 1958). Algeria showed great potential for the exploration and development of the oil and gas sector, thus its hydrocarbon resources were first exploited by France—former colonial power until 1962—as well as by foreign investors, especially American oil companies. However, the American companies faced numerous limitations and their operations were confined to only few areas of the country. After Algeria's independence in 1962, the National Oil Company (NOC) Sonatrach was established. Algeria's energy sector is dominated by two public companies: Sonatrach in the hydrocarbon production and trade, and Sonelgaz in electricity production and distribution as well as in gas distribution. In the 1960s, Algeria became a major player on the world's energy stage. In those years, Algeria commissioned the first LNG production and export facility worldwide in Arzew with exports beginning in 1964. In the late 1960s, as oil production grew, Algeria joined OPEC. Over the 2010s, oil and gas exports represented, on average, around 95% of total exports (94% in 2019), while oil and gas contributed, on average, to 20% of GDP, 40% of fiscal revenues (ENERDATA n.d.) and 60% of government revenue.

Given the abundance of oil and gas production, Algeria's total primary energy supply is not well diversified: in 2019, oil accounts for 38% while gas for 61% of TPES (Fig. 3.48). TPES grew strongly over the last decades. During the 2010s, average TPES growth rate was 4.5%. From 2000 to 2015, a period of high oil prices, the average annual TPES growth rate was 7%, while during the second half of the decade after the fall in oil prices and the consequent economic crisis, the average growth rate fell to 3%.

The power sector is almost entirely dominated by gas, with a 98.7% share of total electricity generation, while the remaining share was provided by diesel oil in

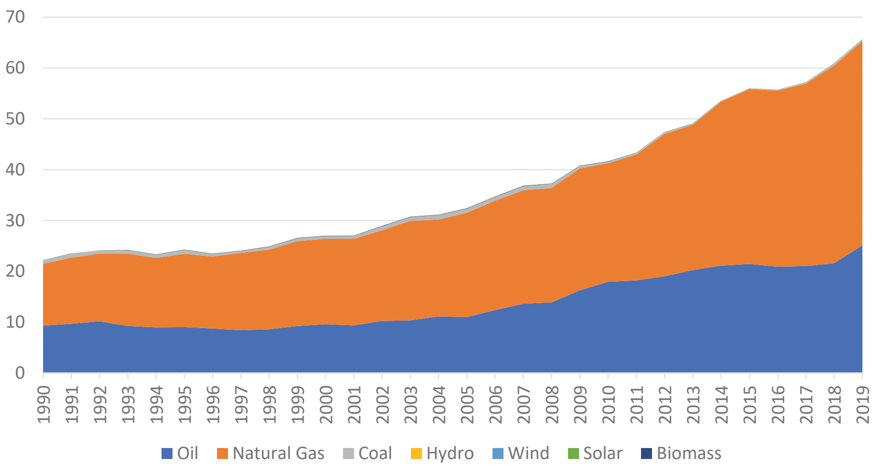


Fig. 3.48 Algeria's TPES by source 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

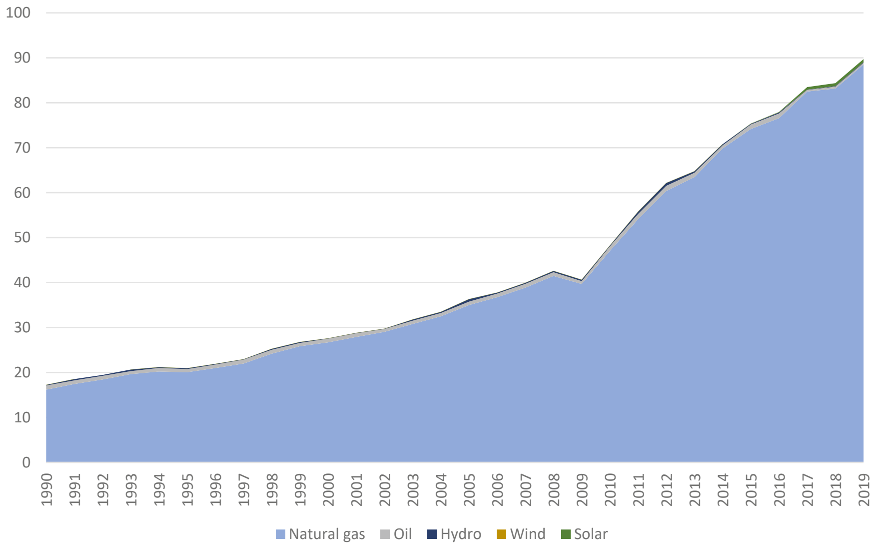


Fig. 3.49 Algeria's electricity generation by source 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

remote villages of the South as well as some solar PV and hydro. Power generation has increased significantly between 2010 and 2015 (around 11% per year) (Fig. 3.49). Since 2015, it has slowed down, even though still witnessing high growth rates (4.5% per year). In 2019, power generation reached almost 90 TWh. To meet rising demand, power capacity has been expanded significantly: from 6.4 GW in 2000 to 12.5 GW in 2010 and to 22 GW in 2019. Since 2010, Algeria has installed additional 9.3 GW. Over the last two decades, Algeria has multiplied its installed capacity by 3.4.

Algeria is the third country in Africa in terms of proven oil reserves with 12.2 thousand million barrels in 2019 (preceded only by Libya and Nigeria). Together with Angola, it is the second largest oil producer in Africa, after Nigeria, with 1.5 million barrels per day. Algeria is also the top producer of natural gas liquid products in Africa (247 thousand barrels per day) (BP 2020). However, Algeria has to deal with a declining oil production. Since 2007, its production has decreased by 26% from almost 2 mb/d to almost 1.5 mb/d in 2019. Consequently, Algeria could not export the same share of its production, which dropped from 65% in 2007 to 41% in 2019. Meanwhile, oil consumption in the country has increased over the last two decades from 190 kb/d in 2000 to 454 kb/d in 2019, with a growth rate per annum over the last decade of 3.1% (BP 2020) (Fig. 3.50). Algeria is an OPEC member since 1969 (OPEC 2019b).

The result of decreasing production and increasing demand was inevitably the reduction of Algeria's oil exports, from 1.36 mb/d in 2000 to 1.03 mb/d in 2019. Moreover, Algeria has seen its oil exports to the US declining following the shale oil boom in North America. Like the US shale oil, Algerian oil is very light and has a

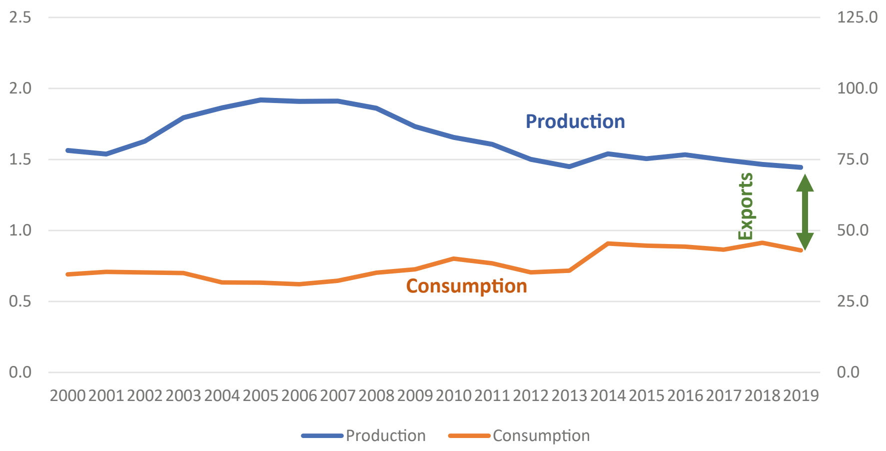


Fig. 3.50 Algeria's oil production and consumption 2000–2019, Mt (left) mb/d (right). *Source* Authors' elaboration on ENERDATA

low sulfur content; US refineries have thus increased the use of American oil at the expense of Algerian oil imports.

Algeria is also an important gas producing country. In 2019, Algeria holds the second largest proven gas reserves (4.3 tcm) in Africa, preceded only by Nigeria, and corresponding to 2.2% of the world's total proven gas reserves. With an output of 87 bcm in 2019, Algeria is the first gas producer in Africa and the fourth in the MENA region (preceded by Iran, Qatar and Saudi Arabia) (BP 2020). However, the country faces growing domestic gas consumption (45.1 bcm in 2019), enabling the export of only about 52% of its total gas production. This ratio has declined over the years, in 2000 with a similar production level but a much lower domestic demand, it was 78%. Between 2000 and 2015, Algeria's gas production declined steadily from around 90 bcm to around 80 bcm, but over the period 2013–2018, Algeria increased its natural gas production by around 4%/year reaching 93.8 bcm in 2018. Approximately 60% of the country's gas production comes from the Hassi R'mel area. Algeria is also an important gas and LNG supplier for Europe through pipelines to Italy and Spain. Algeria exports most of its gas via pipeline to Spain (MedGaz and Maghreb pipeline) and Italy (TransMed pipeline) (Table 3.9). The two European countries receive around 60% of total Algerian gas exports (Fig. 3.51).

Table 3.9 Algeria's gas export pipelines

	Capacity (bcm/y)	Destination	Transit country	Inauguration
MedGaz Pipeline	8	Spain	/	2011
Maghreb Pipeline	11.5	Spain/Portugal	Morocco	1996
TransMed Pipeline	33.5	Italy	Tunisia	1983

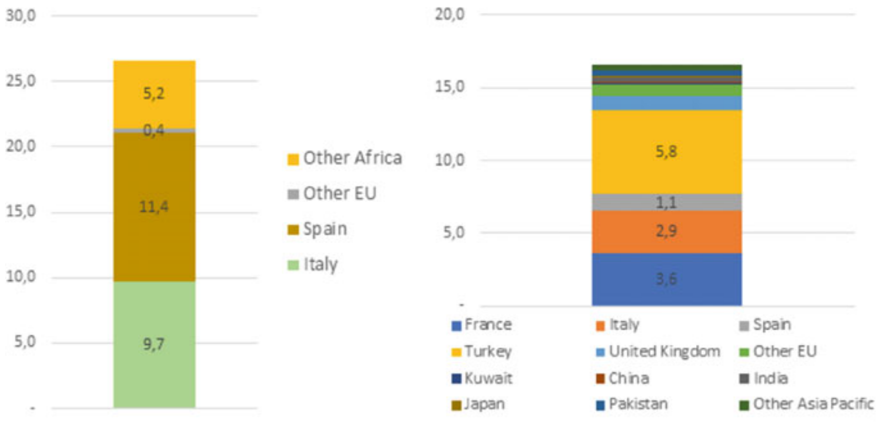


Fig. 3.51 Algeria exports via pipeline (left) and LNG (right) by country in 2019, bcm. *Source* Authors' elaboration on BP Statistical Review of Energy 2020

In 2019, Algeria exported 26.7 bcm via pipeline and 16.6 bcm via LNG, (Fig. 2.6). Nevertheless, the 2019 export volumes mirror the declining use of Algerian gas pipelines in its two key markets, Spain and Italy. The trend has worsened in 2020, due to the collapse of gas demand in these countries following the outbreak of COVID-19 and soaring gas demand in Algeria.

Despite Algeria's long history in the LNG industry (it became the first world producer of LNG in 1964), it has not fully exploited its potential. Algeria has four liquefaction plants with a total capacity of 25.3 Mt per annum (i.e. Arzew GL1Z with a capacity of 7.9 Mtpa, Arzew GL2Z with a capacity of 8.2 Mtpa, Azew GL3Z with a capacity of 4.7 MTpa and SKikda GL1K with a capacity of 4.5 Mtpa). However, the non-utilization rate of Algeria's LNG export facilities is particularly significant (higher than 45% in 2019). This is caused by declining output from its largest gas field, Hassi R'Mel, and delayed new field development in the southwest region.

Between 2016 and 2020, Algeria has experienced higher competition in the European markets due to low gas prices, especially with the surge of the US LNG imports to Europe. In late 2020 and early 2021, Algeria managed to increase its market share in the European gas markets thanks to the steep increase of gas prices. At high gas prices, Algeria's oil-price indexation provided a temporary buffer for European gas buyers.

- **Prioritizing the gas sector: reasons, drivers and challenges behind this decision**

The current picture of Algeria's hydrocarbon sector is not particularly rosy despite its large potential. Sonatrach, which owns 75% of all fossil fuel projects and fields in the country, has prioritized the development of new gas projects rather than oil. Sonatrach focuses on enhancing the recovery rate of its largest oil field (Hassi Messaoud) rather than promoting the exploration and development of new oil projects.

The strategy to prioritize gas over oil is driven by a few intrinsic factors: Algeria's fossil fuel endowments (Algeria's proven gas reserves represent a much higher share than it's proven oil reserves) and geographical characteristics (its vicinity to Europe made Algeria a key component of the European diversification strategy). Moreover, the decision is mainly motivated by the deterioration of the gas balance due to the combination of two simultaneous forces: the decrease in gas supply and the rapid increase in domestic gas demand.

On the supply side, natural gas output has undergone some ups and downs. Between 2005 and 2013, it declined by 11%. It then stagnated for two years and lastly increased by 14% by 2017. In 2018, gas production reached 93.8 bcm as a consequence of some previous investments. In fact, Algeria managed to add production from three main projects: in 2017 Touat (4.6 bcm/year) and North Reggane, composed of six gas fields (4.4 bcm/year), as well as in 2018 Timimoun (1.8 bcm/year). Many analysts believe that Algeria's gas production will decline in the coming years due to multiple factors. However, disagreements over the timeframe arise. Indeed, thanks to recent investments, Algeria could see its gas production increase to around 110 bcm[12] or a bit less by 2025–2027 in order to allow exports not to decline but to last longer. Nonetheless, if no specific and additional measures are taken, the export potential may drop starting from around 2030 due to decreasing production and increasing demand. To maintain high gas export levels, Algeria will thus need to implement important strategies, such as developing its vast shale gas potential (above 20 tcm resource base), and curbing demand growth.

Algeria therefore faces several challenges, which could lead to a strong decline in gas production and export unless important strategies and measures are implemented during this decade. Firstly, Algeria's gas fields are very mature, meaning depletion is growing. For example, the production of the largest gas field, Hassi R' Mel, is already beyond the plateau stage. Secondly, Algeria has not managed to attract enough foreign investments in the upstream sector to explore and potentially develop new gas fields mainly due to legal constraints. That has also prevented the country from acquiring access to advanced technology to address production issues in the country's mature fields. The legal constraints to foreign investments are set by the country's hydrocarbon law, similar to the case of Iran, albeit with some differences. Throughout the decades, there have been some changes in the general hydrocarbon law, but for sure it has been one of the key drivers and constraints for Algeria's hydrocarbon industry and production.

The 1986 Hydrocarbon Law (Law 86–14), amended in 1991 to open up the gas upstream sector, established favorable conditions for large hydrocarbon discoveries and the successful development of the Berkine hydrocarbon basin in the 1990s through the successful Production Sharing Contracts (PSC) system. In the 2000s, Algeria decided to revise its hydrocarbon law, introducing the 2005 Hydrocarbon Law, then amended in 2006 and 2013. These three laws (2005, 2006 and 2013) present a common feature and some differences on the engagement with IOCs. The common

[12] This figure was provided during a conversation between the authors and well-informed Algerian sources.

feature was the decision to abandon the PSC system, which however resulted in discouraging IOC investments in Algeria's upstream. If the 2005 Hydrocarbon Law introduced some clauses that deterred foreign investments, including the prohibition of employing Production Sharing Contracts, the 2006 amendment was mainly responsible for discouraging foreign investments since it introduced the compulsory 51% participating share of Sonatrach in any hydrocarbon project: the so-called 51/49 rule. Under this law, only four international rounds were carried out over 15 years with limited success: for instance, in 2008, out of the 45 blocks offered, only 4 were awarded and this trend continued in the following years (King and Spalding 2020). Lastly, a slow and daunting bureaucratic system resulted in substantial delays in the permits for the exploration, development and implementation phases of hydrocarbon projects, hindering foreign investments. At the end of 2019, Algeria approved a new hydrocarbon law, which set more favorable terms for IOCs despite preserving some major obstacles (i.e. the 51/49 rule).

The challenges for the country's oil and gas industry do not come only from the supply side, but also, and especially, from the demand side (Fig. 3.52). The country has witnessed a steep growth in domestic gas consumption, which has witnessed an average growth of 5.6% per year between 2008 and 2018 (BP 2020). On the other hand, Algeria's gas production experienced a growth rate per annum of 1.3% over the same period.

High energy subsidies (oil, gas and electricity combined) are a leading driver of high consumption. Algeria is ranked third worldwide in terms of lowest gas prices, following Turkmenistan and Venezuela, with gas prices in the wholesale markets (roughly 0.5/MMBtu) lower than the cost of production (around 0.7/MMBtu) (Aissaoui 2016). In 2019, around 7.6% of Algeria's GDP went into subsidies: oil was subsidized by \$8.8 billion, gas by \$2.3 billion and electricity by \$2 billion. Political willingness seems to be lacking for a comprehensive reform and (gradual) reduction

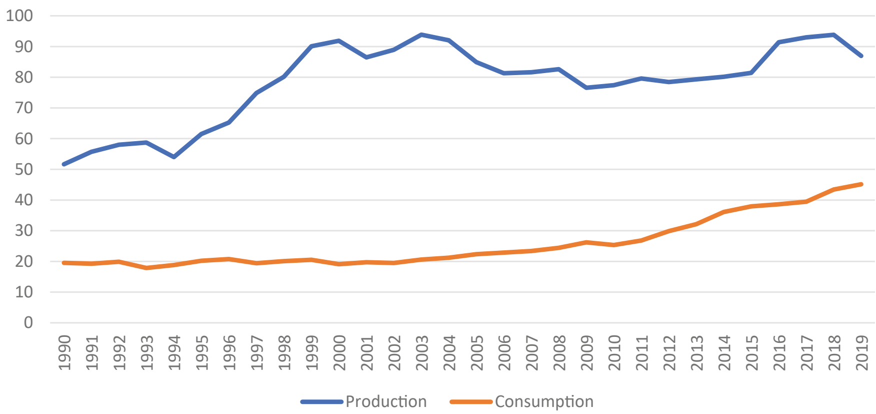


Fig. 3.52 Algeria's gas production and consumption, 1990–2019 (bcm). *Source* Authors' elaboration on BP (2020)

of energy subsidies. In order to offset this strong growth in domestic gas consumption, different ministries and Sonatrach have enacted energy efficient measures, especially for large energy-intensive industries. Sonatrach has also expressed its willingness to carry out energy audits to enhance the energy efficiency of its facilities. Nevertheless, without an overarching energy subsidy reform, energy efficient measures are deemed neither sufficient nor effective. High energy subsidies in Algeria not only entail lower gas export volumes, thus lower gas revenues and a higher current account deficit, but they also weigh importantly on the governmental budget (they account for 7.6% of total GDP in 2019).

- **Strategies to offset the deterioration of Algeria's gas balance**

The latest wave of political instability and social unrest that started in 2019 has so far prevented the realization of a significant energy subsidy reform to limit and decrease gas consumption in Algeria. Indeed, Algeria has missed the opportunity to adopt a relevant energy subsidy reform when oil prices were over $100/b in the second half of the 2000s. Moreover, Algerian officials increased the public expenditure after the eruption of the Arab Spring across the region in 2011 to tackle social unrest. Lack of political will to reduce domestic consumption via economic and efficiency measures is one of the key bottlenecks for Algeria's oil and gas sector. Additionally, governance issues are further hampering the development of the industry. Such challenges may be further enhanced due to political unrest and the transition. For example, the continuous changes in Sonatrach's executive figures hindered a stable and long-term strategy, which is necessary to tackle the many challenges the hydrocarbon industry is facing in the country. In February 2020 Mr. Toufik Hakkar was appointed as Sonatrach's fourth CEO in less than a year and eight in the past ten years. Notwithstanding this general context, the company has taken some steps to contrast the decline in gas production, while preserving export volumes, tackling different but interconnected spheres.

In order to boost hydrocarbon output, Algeria requires the essential contribution of IOCs both in terms of investments and technology; thus, a positive legal petroleum framework for foreign companies is crucial. In this sense, in November 2019 Algeria's National Assembly approved a new hydrocarbon law and promulgated it the day before the presidential election in December 2019. The new law introduced some new positive details, without changing the famous term (51/49 rule) (Elliott 2019). It modified some fiscal terms in the effort to put Algeria more in line with its peers. For example, it reintroduced Production Sharing Agreements in parallel to Royalty/Tax Participation Agreements and Risk Service Agreements. Moreover, it abolished the VAT tax on professional activities within the oil and gas sector and on all imported materials and goods to carry out the hydrocarbon projects, in conjunction with the elimination of custom duties.

Another strategy is to boost Algeria's shale gas potential (with more than 20 tcm estimated reserve base, i.e. about four to five times the proven conventional gas reserves), as a way to enhance gas production. Indeed, it is estimated that Algeria holds the third largest shale gas reserves in the world. However, the development of shale gas is hampered by the limited openness to international companies and the lack of water needed for hydro-fracking. Indeed, regions with the highest shale gas potential are the most water-stressed ones, leading to strong opposition to shale projects and popular unrest. The first shale gas drill carried out by Sonatrach in 2014 in the south-west region of Salah was met with mobilization of the local population mostly for concern over the already depleted water resources (Clemente 2019). These protests led to the termination of exploratory drills for shale gas so that it has not yet been possible to properly assess its potential and reserves.

Nevertheless, Algeria is attempting to sign joint ventures with foreign investors to explore and develop not only shale gas sites, but also underexplored areas in the south of the country and in the Mediterranean offshore, where to date only three drills have been carried out. The Italian company Eni has already signed an agreement for offshore development. Sonatrach hopes to attract foreign investors thanks to the new favorable conditions of the updated Hydrocarbon Law as well as Algeria's export infrastructure potential, which is currently underutilized and in expansion. As a matter of fact, in 2019 Algeria shipped 16.6 bcm of LNG out of an export capacity of 34 bcm, and pipelines transported 26.7 bcm of gas out of an export capacity of 53.5 bcm.

In 2019, Sonatrach successfully managed to renew numerous long-term oil-indexed gas contracts that were going to expire for roughly another decade. Indeed, the Algerian NOC Sonatrach renewed agreements with Italian companies, mainly ENI, Enel and Edison for the supply via pipeline of 9 bcm, 3 bcm and 2 bcm, respectively, until 2027–2028. It also signed new deals with Botas (Turkey), Naturgy (Spain) and Galp (Portugal) (Elliott and Lalor 2019). However, the renewed contracts entailed lower volumes due to two main elements. First, Algeria insists on oil-indexed contracts. Indeed, in October 2020, following falling oil prices due to the Covid-19 pandemic, oil-indexed gas contracts became competitive with European gas hub prices. Also, during the 2021 gas price spikes, oil price indexation was very competitive. Second, Sonatrach is considering opportunities to bolster LNG sales to its European partners. However, Sonatrach must deal with a growing competition in the LNG market along with some structural challenges of its LNG industry.

Overall, despite these positive attempts to boost gas production and exports, Algeria has to face political unrest at all levels, from protests in the streets to the continuous management changes in the hydrocarbon sector (e.g. four chief executives changes in Sonatrach between April 2019 and February 2020). Thus, stabilizing Sonatrach's production, management and image has become a priority for an economically sustainable energy sector and beyond.

3.3.2 Libya

Libya has the largest crude oil reserves and the fifth largest gas reserves in Africa, holding 6.3 Mt of oil reserves (2.8% of the world's total proven reserves), and 1.4 tcm of gas reserves. Libya quickly became a major pillar of the oil (and later gas) security strategy of European countries. However, Libya's oil and gas sector have experienced numerous ups and downs over the last decades. With the fall of its long-lasting ruler Qaddafi in 2011, the country fell into an escalation of violence and chaos, which have deeply affected oil and gas production and exports.

Its oil and gas industry began at the end of the 1950s, with the discovery of its first oil in 1959. Two years later, Libya began exporting oil, and in 1962 it became a member of OPEC. The country's oil industry was born under the monarchy of Idris I, which set a positive and open environment to foreign investments for the industry. The first Libyan oil industry managed to attract foreign companies thanks to high competition through smaller concession areas than usually done in the other countries of the MENA region at the time (Fattouh 2008). Moreover, Libyan oil gained more strategic relevance at the end of the 1960s following several political events. The Suez Canal closure in 1967 due to the Six-Day War, in particular, considerably increased the value of Libya's oil, since the country is located west of Suez and the main demand centers were in the Western world. Thus, Libya and its oil earned strategic relevance thanks to their proximity to European markets. In those years, Libya's oil production grew rapidly, reaching a peak of around 3mb/d in 1970 (Fig. 3.53).

With the advent of Colonel Muammar Qaddafi in 1969, Libyan energy resources became more and more essential for political power. Qaddafi used revenues derived from hydrocarbon resources to provide economic prosperity to the small population in Libya, which became a classic petro- and rentier state. In 2012, revenues from the sale of oil and gas accounted for 96% of government revenues, 98% of export revenues and 65% of GDP (EIA 2015). During Qaddafi's regime, Libya amassed significant cash revenues and ran a debt-free economy for years; however, it was almost entirely dependent on the import of food, medicine and consumer goods.

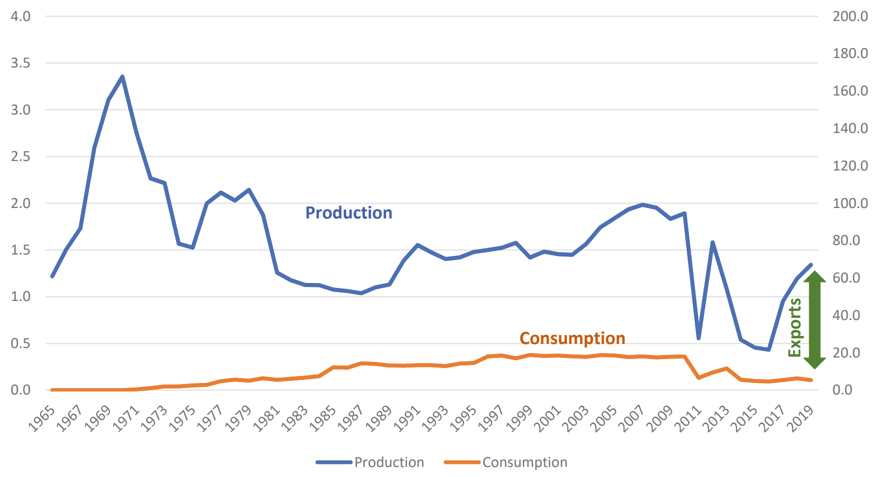


Fig. 3.53 Libya's oil production, 1965–2019, Mt (left) mb/d (right). *Note* Data of the period 1965–1970 are from BP, while 1970–2019 from ENERDATA. *Source* Authors' elaboration on ENERDATA and BP

The Libyan National Oil Corporation (NOC) was created in 1970. Meanwhile, the new Libyan regime initiated its campaign to strengthen its bargaining position vis-à-vis foreign companies. At the time, Libya was supplying 30% of Europe's oil. The new political course on the oil industry undertaken by Qaddafi affected the balance of power between the governments of the producing countries and the oil companies (Yergin 2009).

In 1971–1973, shortly after Qaddafi's rise to power, Libya decided to revise existing concessions in favor of 51% participation agreements with the state oil company NOC (Fattouh 2008). For those companies that rejected the new participation terms, on September 1, 1973 the government issued a decree nationalizing 51% of their concessions. However, in the early 1980s, the nationalization of oil assets led to a decrease of production to around 1 mb/d (from 3 mb/d in 1970). Oil production also suffered from growing international pressure in the 1980s and 1990s due to political confrontation between Libya and key Western countries, especially the US. This led to the UN and US enforcing sanctions against Qaddafi's regime and Libya's oil and gas industry, preventing its full development.

A reconciliation process between Libya and the Western countries began in the late 1990s. International sanctions were lifted in the early 2000s, rehabilitating Libya and its hydrocarbon sector, which underwent a positive development since the 2000s. Libya tried to attract new international investments and E&P activities by foreign companies to its oil and gas industry. The result was a moderate increase in Libya's overall output and a relatively stable period for Libya's oil sector. Most of Libya's oil flows to Europe, with Italy as one of the main recipients.

Natural gas also witnessed a strong growth after the lifting of sanctions, with the domestic production increasing from an average of 6.0 bcm in 2000–2004 to 13.6 bcm in 2005–2010 (Fig. 3.54). This was possible thanks to the partnership between Italian ENI and NOC. The two companies own the Western Libya Gas Project and the associated 520 km GreenStream pipeline (8 bcm capacity) that transports Libyan gas from Mellitah to Italy.

The Greenstream pipeline is the main avenue of Libya's gas exports. Nonetheless, Libya has also been an LNG exporter. In 1971, it became the third country in the world (after Algeria in 1964 and the United States in 1969) to export LNG. The 3.2 Mtpa LNG plant, built in the late 1960s at Marsa al-Brega, is owned by NOC and operated by Sirte Oil Company (EIA 2015). From this terminal, Libya has exported its gas to Spain and other countries even on a spot basis. The sanctions prevented the Libyan government from properly renovating this facility, so its output has declined over time to about 15% of nameplate capacity. Finally, the civil war outbreak in 2011 severely damaged the infrastructure and halted LNG exports.

Indeed, the period of stability did not last more than a decade. The oil and gas industry began to face a period of great uncertainty and insecurity since the outbreak of the revolution in 2011. In February 2011, the '17th February Revolution' began in Libya's eastern region (Cyrenaica) and led to the overthrowing of Muammar Qaddafi on October 20th, 2011—after 42 years of power.

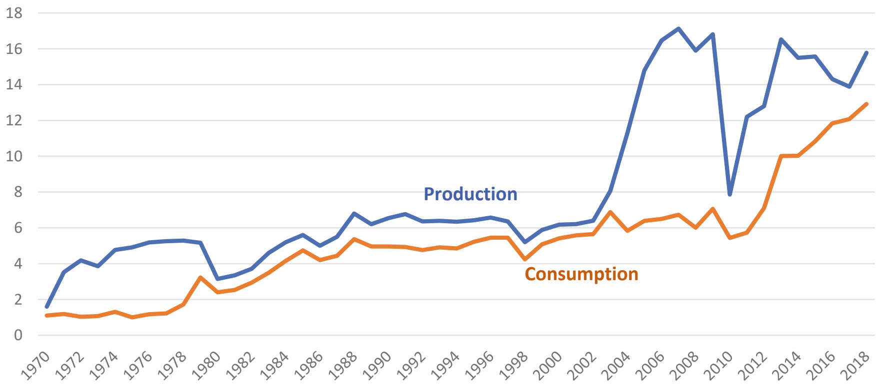


Fig. 3.54 Libya's natural gas production 1970–2019, bcm. *Source* Authors' elaboration on ENERDATA

Notwithstanding the conflict, Libya's oil and gas exports have shown a remarkable resilience. Despite widespread violence and fierce clashes around energy infrastructures, Libya managed to preserve its oil and gas exports to some extent. Natural gas has declined since 2015 to less than half Greenstream's 11 bcm capacity. Oil exports have been affected by oil output and the conflicts over the control of oil fields and export terminals. The year 2019 was a relative success for the Libyan upstream sector with positive consequences for its exports. Indeed, in 2019 Libya managed to export 5.4 bcm to Italy, reaching a four-year high. The year 2020 witnessed an intensification of conflicts and the quest for the control of energy infrastructure. In January 2020, a blockade of export terminals in the Gulf of Sirte and the shut-in of the giant El Sharara and El Feel fields crashed Libya's crude output and exports. Nonetheless, gas continued to flow to Italy, even though at limited capacity. In 2020, Italy still imported 4.2 bcm from Libya.

On the domestic side, fossil fuels dominate its total primary energy supply (TPES) and power generation. Oil represents 53.2% of TPES, while natural gas 43.5% (Fig. 3.55). Moreover, natural gas has increasingly replaced oil in power generation as domestic gas production was unleashed in the 2000s (Fig. 3.56). In 2019, 70% of power generation was based on natural gas and 29.8% on oil. Libya had managed to electrify its territory almost entirely decades ago. Power consumption grew at an average growth rate of 6.9% per year over the 2000–2010 period. Such growth was also caused by the high subsidization of energy prices, a key component of the social contract.

3.3.3 Tunisia and Morocco

Unlike other hydrocarbon-endowed countries of North Africa (Algeria, Libya and Egypt), Tunisia's and Morocco's oil reserves and production are quite negligible:

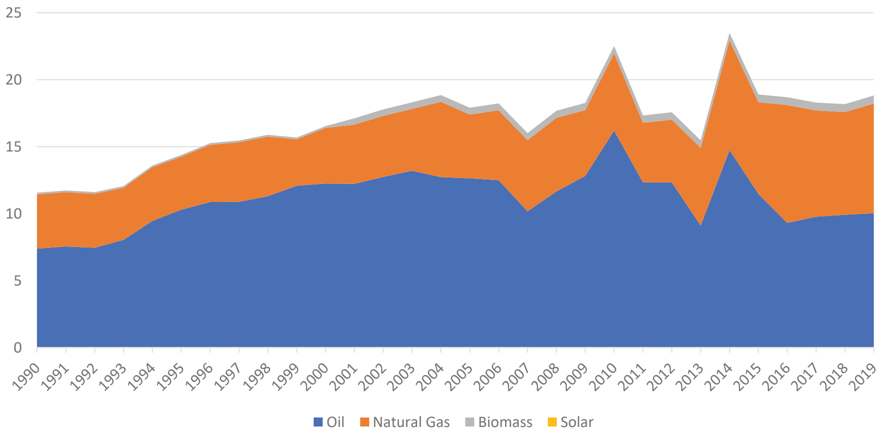


Fig. 3.55 Libya's total primary energy supply 1990–2019, Mtoe. *Source* Authors' elaboration on ENERDATA

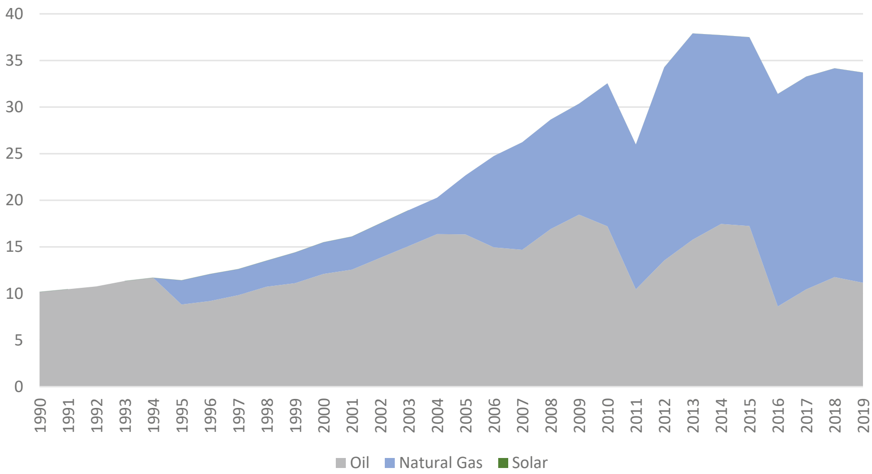


Fig. 3.56 Libya's power generation 1990–2019, TWh. *Source* Authors' elaboration on ENERDATA

425 million oil barrels in reserves with an annual production of 42 thousand barrels per day for Tunisia in 2019 (BP 2021) and almost nil for Morocco. The same applies to natural gas reserves and production. Tunisian proven gas reserves are estimated at 64 bcm with an annual gas production of 2 bcm in 2019 (BP 2021), while Morocco is estimated to hold 1 bcm of natural gas reserves. Energy policies in Tunisia and Morocco have therefore traditionally prioritized energy security. However, the two countries have not followed the same path in terms of energy source diversification both in terms of TPES and electricity generation.

Morocco has preferred to import coal rather than depending on Algeria's gas volumes due to high political disagreements with its neighbor. On the contrary, even though Tunisia does have an arm's-length political relationship with its Algerian neighbor, political relations between these two countries are not as conflicting as those between Morocco and Algeria, where even the border is closed since 1994. This has allowed Tunisia to benefit from trade with Algeria, also thanks to imports of natural gas. Both countries have benefited over the years (Tunisia since 1983, Morocco since 1996) from the transit fees of Algerian gas exports to Italy (via the Transmed pipeline) and to Spain (via the GME pipeline). Nonetheless, no more gas is flowing through the GME across Morocco since November 2021 following political disagreements that prevented the extension of the transit deal.

The Tunisian energy and electricity sectors are not well diversified (Figs. 3.57 and 3.58), since they still mostly rely on an energy model set decades ago, when oil and gas were quite abundant in the country. In Tunisia the predominance of gas (mainly imported from Algeria) is particularly evident, gas being the almost exclusive source for electricity generation (about 96% of total electricity produced in 2019). Conversely, Morocco has the most diversified energy and electricity mixes not only of the West Med cluster, but of the whole MENA region (Figs. 3.59 and 3.60). Interestingly, Morocco still mostly relies on coal for power generation, while being the pacesetter for the adoption and development of renewable energy sources (more than 15% of the country's electricity mix in 2019) in all the MENA region. The share of coal in Morocco's power mix has increased since 2010, reaching 65%. As a direct result, coal replaced oil (the share of oil dropped from 24% in 2010 to 1% in 2019). Hydropower generation can vary widely from year to year because of climatic variations. For example, in 2010 it accounted for 15% compared to only 4% in 2019. Wind accounted for 11% of the power mix in 2019 and solar for around 4%.

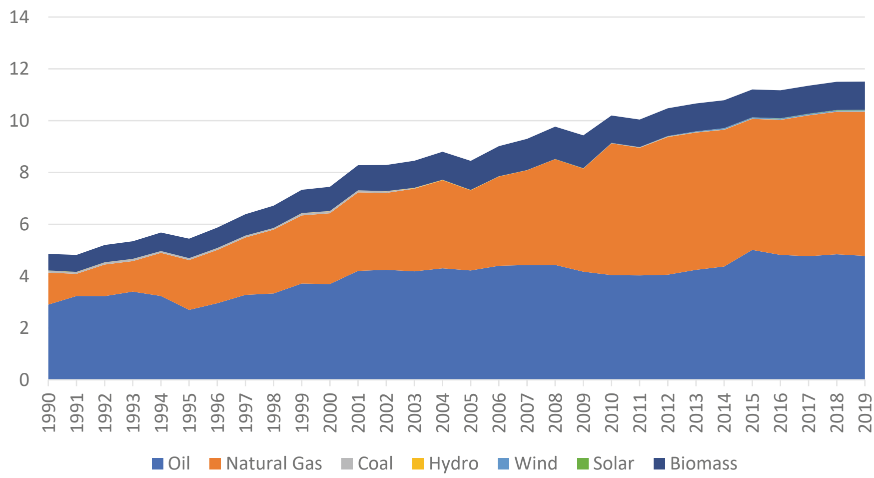


Fig. 3.57 Tunisia's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

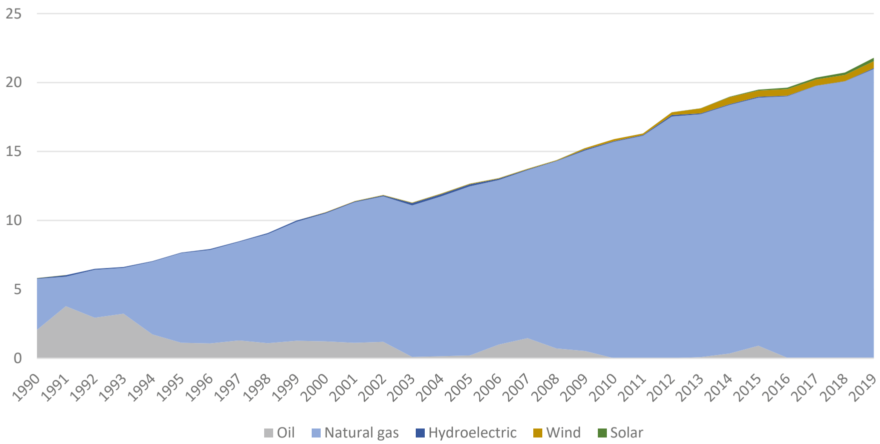


Fig. 3.58 Tunisia's electricity generation 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

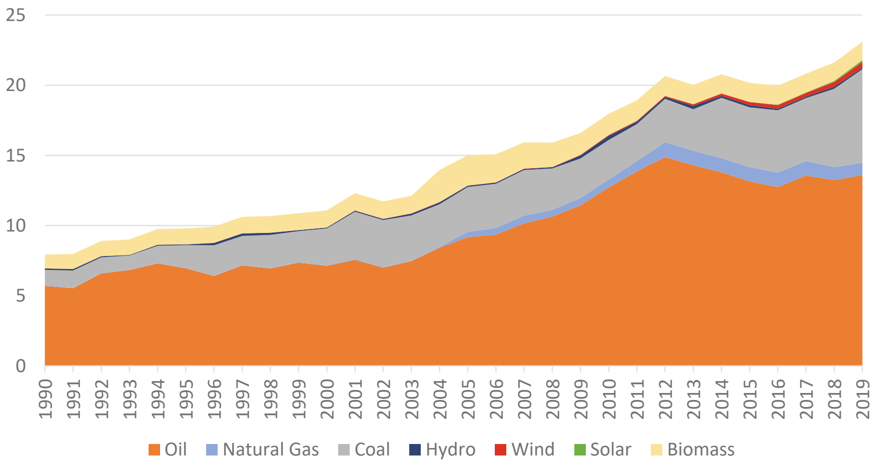


Fig. 3.59 Morocco's TPES 1990–2019 Mtoe. *Source* Authors' elaboration on ENERDATA

Overall, despite environmental concerns on coal, Morocco may be deemed to have highly enhanced its energy security, while Tunisia may still fall behind since it almost entirely relies on imported gas for electricity generation.

This section will analyze the major characteristics between Morocco's and Tunisia's energy sectors and their main challenges related to security of supply. It will then discuss the main strategies put forward to enhance energy security, taking advantage of the countries' intrinsic peculiarities (i.e. location).

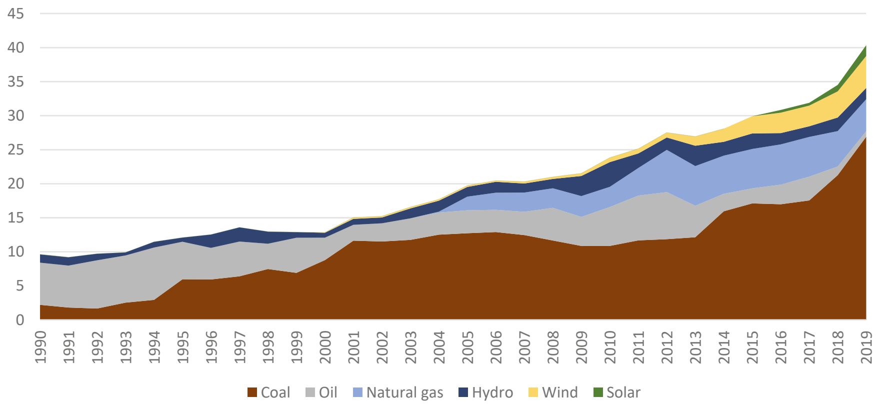


Fig. 3.60 Morocco's electricity generation 1990–2019 TWh. *Source* Authors' elaboration on ENERDATA

- **Features and challenges of the countries' energy sectors**

Tunisia

In the 1970s Tunisia started to substitute oil with gas for power generation, following the oil shocks and a simultaneous decline in oil production and growth in gas output and discoveries. Natural gas has gained a relevant role in the power sector under the supervision of the state-owned gas distribution and electricity utility *Societé Tunisienne d'Electricité et du Gaz* (STEG) which had the monopoly. Today, STEG is the main supplier of electricity, providing 84% of the country's electricity production, and it has the monopoly of power distribution, while the rest is produced by Independent Power Producers (IPPs). STEG also has the monopoly of gas distribution, thus being the main player for the development of gas infrastructure. Due to its limited gas reserves and production (2 bcm in 2019), Tunisia relies heavily on Algerian imports (4.5 bcm, i.e. 70% of its domestic consumption). The increasing gas demand is largely due to its growing electricity consumption, which is driven by population and economic growth and low electricity prices mostly thanks to energy subsidies.

Tunisia pays only for importing gas above the share of transit gas it is entitled to, as per the royalty agreement with Italy. Above this threshold, importing gas puts pressure on STEG finances, and thus public finances. According to the National Institute for Statistics, Tunisia's energy trade deficit accounted for around one-third of total trade deficit.

In order to prevent political risks and enhance security of supply for all the parts involved, Tunisia is entitled to receive some 6–7% of the transit gas either in kind (gas) or cash. Tunisia's level of free gas thus depends on the amount of gas Italy imports from Algeria. In the second half of the 2010s, Italy bought fewer gas quantities from Algeria, thus Tunisia was obliged to increase its purchases of extra gas beyond transit agreements. For instance, Tunisia had to increase direct contractual quantities with Algeria by 9% in 2018 and 22% year-on-year in 2019 (Oxford Business Group 2019). Already in 2017, STEG's financial situation had become so dire that its losses amounted to 42% of total revenues, weighing substantially on public finances. Indeed, the Tunisian Ministry of Finance covered STEG revenue gaps with direct subsidies, which make up 20% of total public spending, a higher percentage than programs related to health (The World Bank 2019b).

Economic difficulties and inefficiencies at STEG have resulted in overall lower investments in gas, which, in turn, entailed a higher unemployment rate as STEG is the leading employer in the country within the framework of the social contract. A major challenge to decrease expenses for STEG and, more broadly, for Tunisia's energy sector, regards social distrust towards state institutions, especially in the aftermath of the Arab Spring. Accumulated unpaid bills have reached 28% of STEG's annual revenues in 2018 and past attempts to reduce energy subsidies reforms, conditional on IMF loans, were met with social discontent and revolts (The World Bank 2019b). Energy subsidies represent quite a burden for the country, since they accounted for one-third of the fiscal deficit and 2.5% of GDP in 2018 (The World Bank 2019b). Despite the reluctance of policymakers to carry out energy subsidy reforms following the 2011 revolts, in January 2014 Tunisia managed to reduce electricity subsidies to low and medium-voltage consumers by 10% and by a further 10% in May 2014, and to eliminate energy subsidies to cement companies (Oxford Business Group 2016). In April 2020, Tunisia moved to phase out fuel subsidies (diesel and gasoline) taking advantage of very low oil prices, thus preventing the immediate increase of fuel prices (Cockayne and Calik 2020).

Morocco: striving for energy security

Morocco is a hydrocarbon resource-poor country and its territories are still largely unexplored. Thus, the North African kingdom has strived to attain higher levels of energy security thanks to coal imports and the exploitation of its hydroelectric potential on the Atlas Mountains. More recently, Morocco has expanded its security of supply by promoting a favorable regulatory environment for renewable energy sources. In 1996, Morocco has also started to import natural gas through the transit agreement between Spain and Algeria, benefiting from the same legal framework applied to the Italy-Tunisia-Algeria gas deal. However, this 25-year-old transit agreement expired on 31 October 2021 and was not renewed by Algeria for political reasons (Chap. 5, Sect. 5.3.1), resulting in zero gas volumes from Algeria. This forces Morocco to find alternatives for this gas, either by increasing coal imports, renewable development or LNG imports. Finally, Morocco has started to consider attracting investments for upstream activities in order to increase its own domestic hydrocarbon production.

These strategies have become paramount for the country's energy security, especially following a steep surge in energy consumption levels (an annual average rate of 6.6% between 2002 and 2015), driven by population growth, economic development and increased electricity access rate. Morocco has also successfully attained nearly universal access to electricity, also in its rural areas which were only 18% in 1995 (Hafner et al. 2018). In fact, in 1995, Morocco launched an ambitious electrification program for its rural areas, the Rural Electrification Programme (PERG). The objective was to achieve 99% of electricity access in the rural areas in 2017. The target was reached in 2015.

Due to the lack of hydrocarbon endowments, Morocco must rely almost entirely on energy imports to satisfy the growth of its domestic energy consumption. Imports cover 100% of the country's oil and coal consumption and 90% of its gas consumption (in 2019). In 2018, Morocco imported almost 92% of its energy, which accounted for 15.6% of the country's total imports. Morocco has recently launched numerous renewable projects in line with its climate ambitions, the favorable wind and solar resources. The fast-pace development of renewable energy could also contribute to reducing government expenses on energy imports.

Coal represents the main base load fuel of the country, guaranteeing energy security. The most important coal power plant is located in Jorf Lasfar and is composed of four units with a capacity of 330 MW each. The first two units were commissioned in 1994, while the third in 2000 and the fourth in 2001. Morocco is expected to decommission these units in 2044 in line with its climate targets. However, Morocco commissioned a new coal power plant of 1.21 GW at Cap Ghir Safi in 2018, boosting the country's coal-fired plant capacity to 4.3GW (MEES 2019). This is in stark contrast with Morocco's "green ambition", which resulted in a remarkable increase of renewable projects in the last five years.

- **Strategies to enhance energy security and economic sustainability**

Tunisia: hydrocarbon and renewable developments

Tunisia has witnessed a surge of its total primary energy supply. A major contributor is natural gas, although oil still plays an important role (Fig. 3.57). A relevant strategy put in place partly to enhance energy security and to increase the economic sustainability of Tunisia's energy sector regarded the rapid increase of licenses issued by the government for new oil and gas exploration rounds. The 2011 Tunisian Revolution resulted in waning interest in the country's oil and gas, mainly due to political instability. The 2014 Tunisian Constitution further limited attractiveness for foreign investors as its article 13 stipulates any new exploration awards to be approved by parliament. Political instability has also prevented Tunisia from reforming its legal regime, inducing some Western oil companies (i.e. Shell and Eni) to consider leaving the country's upstream sector (Reuters 2021).

Despite these barriers, a major gas project, the Nawara gas field, started up in February 2020, and will produce 1 bcm, representing roughly 50% of the current total gas production. Nawara gas field production is expected to satisfy 17% of total domestic consumption and decrease energy deficit by 30%. This project is jointly operated, through a 50:50 concession, by the Austrian company OMV and Tunisia's state-owned company responsible for hydrocarbon exploration and development, the *Entreprise Tunisienne d' Activités Pétrolières* (ETAP) (The Arab Weekly 2019). However, the Nawara gas field illustrates the issues of Tunisia's upstream sector and developments, namely underinvestment and instability. The gas project came online twelve years after its conception, but it has not been immune to further delays and challenges due to several shutdowns since its commission (OME 2021). A few offshore gas fields are also present in Tunisia, comprising the Hasdrubal and Miskar fields, which are 50 and 100% owned by Shell. However, in 2021, Shell seems to be trying to sell these two assets, along with an onshore oil field.

Most of the aforementioned challenges for Tunisia and its state-owned company STEG may be offset with the inclusion and enhancement of renewable energy sources for electricity generation, also thanks to the high potential of solar and wind energy, especially in the south (UNDP 2018). Renewable energy sources could help decrease the burden on public finance. The use of Independent Power Producers (IPPs) could play a crucial role in developing the country's renewable potential avoiding upfront investments.

Also, since solar energy projects have the highest potential in the south, a significant uptake of solar projects by IPPs would contribute to meeting the demands of the Kamour movement in 2017, which reflects the state-of-art in the southern regions (Tataouine and Kerbili provinces): young, unemployed men asking to be employed in the oil and gas companies operating there. This movement showed a remarkable change in terms of social contract: residents were willing to work in the private sector, and thus requested to put quotas to hire a minimum number of Tunisians. Nevertheless, in June 2020, revolts in the Tataouine province erupted again with protesters demanding jobs in the oil and gas sector and infrastructure projects. Indeed, the government was perceived not to deliver on its promise, dating back to 2017, regarding the creation of job opportunities in southern Tunisia (Al Jazeera 2020b).

Given the numerous advantages from the development of renewables and the introduction of IPPs, Tunisia took some first steps to boost "green" electricity and to attract foreign investors. In 2012, under the Tunisia Solar Plan (TSP), the country announced the target of 30% of solar penetration by 2030. In 2015, the Parliament passed Law No. 12, which aimed at enhancing private investments for renewable development and liberalizing the market for the access, network and transport of electricity generated from renewables. Nevertheless, with this law, STEG remained the sole entity allowed to sell electricity to final consumers. Today renewable projects are thus mostly held by STEG, accounting for 91.5% of Tunisia's installed capacity and 81% of electricity sold, while the remainder is provided by the Carthage Power Company, the country's first IPP, with a 471 MW combined-cycle power plant commissioned in 2002. Overall, it would be extremely advantageous to also boost IPPs for renewable projects, as IPP would be an advantageous tool to exploit in order not to pay directly upfront. As of 2021, the only IPP in renewable projects regards the Sidi Mansour wind farm, which commenced construction in 2020. Numerous tenders were introduced in the last 4–5 years so that IPPs will follow suit in the next years. More in detail, in 2017 a tender process was launched with a capacity of 140 MW of wind and 70 MW for solar PV under the form of a PPA with STEG as the off taker (UNDP 2018). However, in 2018, STEG still operated all renewable projects, which amounted to a total capacity of 244 MW for wind, while no utility-scale solar PV was present in the country. A leap forward was taken in 2019 when Tunisia held a solar tender of 500 MW in an attempt to attract foreign investors in the country. In December 2019, the Tunisian Ministry of Mines and Energy announced the five winners of the tender: 300 MW of the project were attributed to the Norwegian developer Scatec Solar, which offered the lowest bid to build a 200 MW facility in the Tataouine governorate and sell electricity to STEG. The Norwegian utility was also awarded other projects of smaller capacities. Other two projects, each 100 MW, were won by the consortium led by ENGIE and the Moroccan NAREVA, and by the consortium led by the Chinese TBEA and the Emirati AMEA Power (Bellini 2019).

Challenges and opportunities arise from striving to enhance the presence of IPPs in renewable projects in the south for solar energy, and predominantly in the north (but also central and southern regions) for wind energy. Indeed, STEG has to expand and strengthen the north–south electricity interconnection, especially to allow solar development in the south. It may well be the case that lower power purchasing agreement (PPA) prices for ideally located RES projects, thanks to higher capacity factors, may offset grid expansion costs. Also, the availability of transmission infrastructure is critical to improve investor confidence in RES, as it provides an assurance that the newly developed capacity will be integrated into the system and dispatched in line with the contractual arrangements agreed with STEG. Lastly, Tunisia's large potential for solar and wind energy also provides an important growth opportunity for the country. Indeed, the added RES capacity may also be used for electricity export purposes, especially once Tunisia is connected to the European electricity market through the planned Tunisia-Italy Power Interconnector.

Morocco: the "green" country of the MENA region?

In order to offset energy security challenges, trade deficits and increasing energy consumption in a hydrocarbon-resource poor framework, Morocco has become the country with the highest share of renewables in the energy and power mixes, mostly thanks to substantial investments and regulatory improvements in the renewable field.

Already in 2009, Morocco set out the National Energy Strategy, which set the targets of 42% of total installed power capacity from renewable sources (primarily solar, wind and hydropower resources) by 2020. In 2020, this share was 32% i.e. three quarters of the target. In 2015, during the 21st UNFCCC Conference of Parties (COP21) in Paris, the Kingdom announced its willingness to have 52% of the total installed power capacity coming from renewable sources by 2030 (20% solar, 20% wind and 12% hydro) (IEA 2019). In order to attain these ambitious objectives, the country has envisaged two programs for renewable development, one for solar and one for wind.

The Moroccan Agency for Sustainable Energy (MASEN) agency is responsible for the Moroccan Solar Plan and set the target of 2000 MW of solar capacity installed, both PV and CSP, by 2020 and 4800 MW by 2030. In reality, in 2020 the total solar capacity installed was 734 MW, i.e. about one third of the target.

Regarding the development of wind energy, the Moroccan Integrated Wind Program has been promoted, which aimed at reaching 2,000 MW of wind capacity installed by 2020 and 5000 MW by 2030. In 2020, the total wind capacity installed in the country represented 1410 MW, i.e. 70% of the target. Wind has a lot of potential in the country, demonstrated by the success of the 300 MW Tarfaya wind complex, the largest in Africa. This complex has been developed through a joint venture, similar to solar projects, between the French company ENGIE and the Moroccan NAREVA Holding company. Recently awarded wind projects, amounting to a total combined capacity of 850 MW, have been developed by a consortium of NAREVA Holding, ENGIE, ENEL Green Power and Siemens Wind Power, leading companies in this sector (Oxford Business Group 2020).

In order to accommodate large shares of renewable capacity, the Kingdom has changed the energy regulatory setting. Prior to 2012, *Office National de l' Electricité et de l' Eau Potable* (ONEE), the national utility in charge of electricity production, transmission grid and the majority of distribution, was the sole responsible for buying, selling, importing and exporting electricity. The national regulatory change Act No. 13-09 in 2012 opened up the market to the free exchange of electricity coming only from renewable energy sources. In other words, private green electricity developers were allowed to access the national grid, produce electricity from renewable sources, and buy it in the market. Thus, since Act No. 13-09, two parallel electricity markets coexist: the liberalization of the electricity market from renewable sources and the IPP scheme contract for the conventional electricity market. In 2016, an update of Act No. 13-09 was adopted, the Act No. 58-15, which further strengthened the liberalization of the electricity market from renewable energy sources. Indeed, the newly passed law envisages, among other provisions, the development of a low-voltage electricity market (i.e. rooftop solar PV) and the trade of surplus electricity from renewable sources to ONEE (up to 20% of the annual generation) (Khatib 2018).

Large-scale renewable projects, in line with most other countries in the MENA region, are usually envisaged in the framework of international tenders, with IPPs. Under this scheme, bidders sign power purchasing agreements (PPAs) with ONEE, which will buy electricity produced from the project for the following 20–30 years. These schemes have contributed to providing financial guarantees to investors, diminishing the cost of electricity produced (i.e. for NOOR III solar project) and introducing concentrated solar power plant (CSP) for peak load. Contrary to wind power and PV, the advantage of CSP, connected to melted salt storage, is that it produces heat which can be stored, making the plants dispatchable.

However, Morocco is currently characterized by a contradictory situation: on the one hand, great renewable potential and green ambitions, and on the other hand, the 'brown' reality of its energy mix, which still relies on coal imports to satisfy growing energy consumption that has been strongly increasing during the 2010 decade. A similar pathway can be traced in the United Arab Emirates, with Dubai commissioning a coal power plant and Abu Dhabi aspiring to become a leading renewable hub in the region. Overall, Morocco is simultaneously the "greenest" country in the MENA region, in terms of renewable uptake, and the "dirtiest" in terms of its reliance on coal. With the construction of new renewable and coal power plants, Morocco managed to enhance its power production (since 2010 by around 6% per year), almost halving its power imports, mostly from Spain, which still represent 8% of Moroccan electricity demand. Nevertheless, over the years, Morocco also put forward other strategies to strengthen its domestic power production and overall energy security.

Morocco: Complementing renewable energy sources with other strategies

Only recently, Morocco has also focused its attention on the exploration of hydrocarbon sources within its territory as a way to increase its security of supply. The upstream sector, which is under the *Office Nationale des Hydrocarbures et des Mines* (ONHYM), mostly benefits from international investments, with ONHYM contributing only 1.7% of total annual investments in 2018. Indeed, Morocco has managed to successfully attract foreign developers thanks to a favorable regulatory framework, which is set by changes to the country's Hydrocarbon Law of 2000. Under the current regulatory framework, ONHYM can hold a maximum stake of 25% for upstream projects and the first 300–500 tons of oil and 300–500 mcm of gas produced are exempted from the payment of royalties. Other beneficial fiscal arrangements include a 10-year exemption from the corporate tax for foreign investors as well as an exemption from custom duties and other taxes related to imports of materials, equipment and services needed for hydrocarbon exploration and development (Oxford Business Group 2020).

Moreover, Morocco has also considered diversifying its gas import sources, given its strained political relations with Algeria. In November 2021, the Moroccan section of GME was closed at the end of the multiyear contract due to political clashes. LNG has become a topic of interest in Rabat. Already back in 2014, Morocco envisaged spending around $4.5 billion for the construction of a 5 bcm/year LNG terminal at Jorf Lasfar. However, this plan did not move forward as planned. In 2021, Morocco has started considering a more flexible and economic solution: a FSRU terminal. Morocco plans to start to import 1.1 bcm via LNG in 2025, going up to 1.7 bcm in 2030 and 3.1 bcm in 2040. LNG imports would supply mainly industry and power generation, and they would provide a direct alternative to Algeria's gas (between 0.8 and 1 bcm). Moreover, Morocco is increasingly considering LNG imports in order to phase out of coal, in line with its climate targets and in response to the growing pressure on the most polluting fossil fuel source. Under these terms, LNG imports will be crucial to prevent further coal use as Morocco stopped receiving Algeria's gas in November 2021.

In the long run, Morocco may well become a renewable power exporter. In 2019, Morocco and Spain signed a Memorandum of Understanding (MoU) for the construction of a third power interconnection, bringing the interconnection capacity from today's 800 MW to 1,500 MW. The Spanish Electricity Grid Operator REE has strongly supported the construction of a third power line stating that it would boost green power in the Spanish grid, and it would contribute to reaching the goal of 100% renewable energy by 2050. Nevertheless, REE's statement may be over-optimistic for two main reasons. First, despite electricity consumption growing at a slower pace in 2011–2020 (3.1% average annual growth rate per year) compared to the period 2000–2010 (4.5% average annual growth rate per year), it is still rising, possibly limiting the country's export capacities in the years to come, especially in case hydrocarbon exploration and development remain unsuccessful. Second, as Morocco is the country most reliant on coal for power generation in the MENA region, electricity exports to Spain may not be that "green" and may therefore not contribute to reaching the Spanish decarbonization target by 2050.

All in all, despite similarities, Tunisia and Morocco display two different track records in the energy sector, which are highly influenced by the presence (or lack) of fossil fuel endowments. On the one hand, Morocco, being used to importing energy sources, has shown great adaptability and flexibility to ensure a secure and resilient energy mix (despite its dispute with Algeria), and it may well be on the right track to become a relevant power exporter. On the other hand, Tunisia has kept relying on gas, even though its domestic production cannot satisfy the country's total demand. Thus, regulatory changes regarding the introduction of renewables took more time to take place and renewable capacities lag behind with respect to Morocco. Nevertheless, it may be concluded that Tunisia is following Morocco's example to ensure a high degree of renewable energy development.

Bibliography

Ababsa M (2013) Atlas of Jordan: histories, territories and societies. IFPO, Paris

Aissaoui A (2016) Algerian gas: troubling trends, troubled policies. The Oxford Institute for Energy Studies Paper NG(108):1–24

Al Ghamdi A (2020) Saudi Arabia energy report, KAPSARC, November 2020

Al Jazeera (2020a) The oil price war is a nightmare for US shale producers. Al Jazeera. https://www.aljazeera.com/ajimpact/oil-price-war-nightmare-shale-producers-200309173245129.html. Accessed 21 Mar 2020a

Al Jazeera (2020b) Police, protesters clash in southern Tunisia over lack of jobs. Al Jazeera. https://www.aljazeera.com/news/2020b/06/police-protesters-clash-southern-tunisia-lack-jobs-200622144613022.html. Accessed 6 July 2020b

Al Rasheed M (2018) Salman's legacy-the dilemmas of a new era in Saudi Arabia. Hurst & Company, London

Alhelou Y (2020) Israel kicks off Middle East gas exports while continuing to deny Palestinians their drilling rights. The New Arab. https://english.alaraby.co.uk/english/indepth/2020/1/17/palestinians-denied-drilling-rights-in-mediterranean-gas-fields. Accessed 8 May 2020

Al-Riffai P, Breisinger C, Eldidi H, Mondal MAH, Ringler C, Wiebelt M (2019) Long-term optimization of Egypt's power sector: policy implications. Energy 166:1063–1073

Al-Saidi M (2020) Instruments of energy subsidy reforms in Arab countries—the case of the Gulf Cooperation Council (GCC) countries. Energy Rep 6(1):68–73

APICORP (2018) Saudi energy price reform getting serious. APICORP Energy Res 3(5)

Asharq Al-Awsat (2020) Drillship off Lebanon to start oil and gas exploration. Asharq Al-Awsat. https://aawsat.com/english/home/article/2149311/drillship-lebanon-start-oil-and-gas-exploration. Accessed 11 May 2020

Atamanov A, Jellema J, Serajuddin U (2015) Energy subsidies reform in Jordan: welfare implications of different scenarios. World Bank Group Policy Res Working Paper 7313:1–23

Azhari T, LOGI (2020) Oil and gas revenues won't exceed 10% of public debt. Lebanese Oil & Gas Initiative. https://logi-lebanon.org/KeyIssue/Oil-and-gas-revenues-wont-exceed-ten-of-public-debt. Accessed 16 June 2020

Barbuscia D, Rashad M (2020) Saudi foreign reserves fall at fastest for two decades. Reuters. https://www.reuters.com/article/us-saudi-budget/saudi-foreign-reserves-fall-at-fastest-for-two-decades-idUSKCN22B0W5. Accessed 7 April 2020

Beckman J (2020) Deepwater Leviathan gas project secures Israel's energy needs. Offshore magazine. https://www.offshore-mag.com/field-development/article/14075204/deepwater-leviathan-gas-project-secures-israels-energy-needs. Accessed 22 June 2020
Bellini E (2019) Winners and prices of Tunisia's 500MW PV tender. PV magazine. https://www.pv-magazine.com/2019/12/20/winners-and-prices-of-tunisias-500-mw-pv-tender/. Accessed 27 May 2020
Bellini E (2020) Israel wants another 15 GW of solar by 2030. PV magazine. https://www.pv-magazine.com/2020/06/03/israel-wants-another-15-gw-of-solar-by-2030/. Accessed 22 June 2020
Bergman R, Fassihi F, Pérez-Pena R (2020) Iran admits serious damage to Natanz Nuclear Site, Setting Back Program. The New York Times. https://www.nytimes.com/2020/07/05/world/middleeast/iran-Natanz-nuclear-damage.html. Accessed 10 July 2020
Berkhahn A, Kruse M (2018) Gas directive amendment and relations with third countries. Arthur D Little, pp 1–16
Bostock B (2020) Saudi Arabia is tripling its value-added tax rate in a plan to save $27 billion amid plummeting oil prices and the coronavirus. Business Insider. https://www.businessinsider.com/saudi-arabia-value-added-tax-tripled-coronavirus-savings-package-2020-5?IR=T. Accessed 14 April 2020
BP (2020), Statistical review of world energy, 2020
BP (2021) Statistical review of world energy, 2021
Breisinger G, Mukashov A, Raouf M, Wiebelt M (2018) Phasing out energy subsidies as part of Egypt's economic reform program: impacts and policy implications. International Food Policy Res Inst Working Paper 7:1–32
Breisinger G, Mukashov A, Raouf M, Wiebelt M (2019) Energy subsidy reform for growth and equity in Egypt: the approach matters. Energy Policy 129:661–671
Bussewitz C (2019) Saudi Aramco to buy liquid natural gas from US company. AP News. https://apnews.com/2b784148478a4d059f168b2ba1b47e1c. Accessed 21 April 2020
Butler N (2019) Kuwait's action on green energy fails to match best intentions. Financial Times. https://www.ft.com/content/bdcee818-c35f-11e9-ae6e-a26d1d0455f4. Accessed 4 May 2020
Clemente J (2019) Algeria's falling oil output shifts focus to shale gas. Rigzone. https://www.rigzone.com/news/algerias_falling_oil_output_shifts_focus_to_shale_gas-06-nov-2019-160247-article/. Accessed 20 May 2020
Cockayne J, Calik A (2020) Tunisia moves to eliminate fuel subsidies. MEES 63(16)
Country Economy (2019) Saudi Arabia national debt. Country Economy. https://countryeconomy.com/national-debt/saudi-arabia. Accessed 7 April 2020
Dawabsheh M (2019) Towards a resilient energy sector in the State of Palestine. UNDP Programme of Assistance to the Palestinian People. https://www.ps.undp.org/content/papp/en/home/blogs/towards-a-resilient-energy-sector.html. Accessed 15 June 2020
Deutschmann J, Salehi-Isfahani D, Stucki BW (2014) The reform of energy subsidies in Iran: the role of cash transfers. Emerg Mark Financ Trade 51(6):1144–1162
Dipaola A (2019) Saudi Aramco seeks to double its refining network to 10MMbopd by 2030. World Oil. https://www.worldoil.com/news/2019/4/11/saudi-aramco-seeks-to-double-its-refining-network-to-10-mmbopd-by-2030. Accessed 4 May 2020
EIA (2015) Libya, country analysis brief, November 19, 2015
Elliott S (2019) Algeria's Sonatrach points to 'encouraging' shale gas tests, eyes more JVs. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/112819-algerias-sonatrach-points-to-encouraging-shale-gas-tests-eyes-more-jvs. Accessed 23 May 2020
Elliott S, Lalor D (2019) Algeria's Sonatrach renews long-term gas sales contract with Italy's edison. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/111219-algerias-sonatrach-renews-long-term-gas-sales-contract-with-italys-edison. Accessed 6 Nov 2020

ENERDATA (n.d.) Global energy & CO_2 data, enerdata database

Energy Information Administration (2016) Israel. Energy Information Administration. https://www.eia.gov/international/analysis/country/ISR. Accessed 22 June 2020

Energy Information Administration (2019) Background reference: Iran. Energy Information Administration. https://www.eia.gov/international/content/analysis/countries_long/Iran/background.htm. Accessed 21 Mar 2020

European Civil Protection and Humanitarian Aid Operations (2020) Lebanon. European Commission

Fairbanks W (2019) Jordan's NEPCO: an end to operating losses. MEES 62(22)

Fathollah-Nejad A (2020) Emerging pandemic triple crisis raises fears of protests in Iran. Brookings Op Ed. https://www.brookings.edu/opinions/emerging-pandemic-related-triple-crisis-raises-fears-of-protests-in-iran/. Accessed 2 Nov 2020

Fattouh B (2008) North African oil and foreign investment in changing market conditions. The Oxford Institute for Energy Studies, WPM37, July 2008

Fattouh B, El-Katiri L (2015) Lebanon's gas trading options, The Lebanese center for policy studies, policy paper. https://www.lcps-lebanon.org/publications/1453981980-fattouh-katiri_for_web.pdf

Faucon B, Said S (2021) Saudi-owned motiva suspends $6.6 billion petrochemical expansion. The Wall Street Journal. https://www.wsj.com/articles/saudi-owned-motiva-suspends-6-6-billion-petrochemical-expansion-11626698498

France24 (2019) Iran radically raises petrol prices by 50 percent. France24. https://www.france24.com/en/20191115-iran-radically-raises-petrol-prices-by-50-percent. Accessed 27 July 2021

Gambrella J (2020) Oil giant Saudi Aramco sees 2019 profits drop 20% to $88.2B. abc News. https://abcnews.go.com/Business/wireStory/saudi-aramcos-net-income-drops-882-billion-2019-69602704. Accessed 21 Oct 2020

General Secretariat for Development Planning (2008) Qatar national vision 2030. General Secretariat for Development Planning

GIIGNL (2020) Annual report 2020. GIIGNL, pp 1–64

Gross S (2019) The Saudi Aramco IPO breaks records, but falls short of expectation. Brookings. https://www.brookings.edu/blog/order-from-chaos/2019/12/11/the-saudi-aramco-ipo-breaks-records-but-falls-short-of-expectations/. Accessed 28 Mar 2020

Gulf Labour Markets and Migration (2018) GCC: total population and percentage of nationals and non-nationals in GCC countries (National Statistics, 2017–2018) (with numbers). Gulf Labour Markets and Migration. https://gulfmigration.org/gcc-total-population-and-percentage-of-nationals-and-non-nationals-in-gcc-countries-national-statistics-2017-2018-with-numbers/. Accessed 23 April 2020

Hafner M, Tagliapietra S (2016) The future of European gas markets—balancing act between decarbonisation and security of supply, Claeys & Casteels, Energy Scenarios & Policy Volume I, October 2016

Hafner M., Tagliapietra S, de Strasser L (2018) Energy in Africa. In: Challenges and opportunities. Springer, SpringerBriefs in Energy, 2018. https://www.springer.com/gp/book/9783319922188

Hassanzadeh E (2012) Recent developments in Iran's energy subsidy reforms. International Institute for Sustainable Development Policy Brief, pp 1–12

Haykel B, Hegghammer T, Lacroix S (2015) Saudi Arabia in transition: insights on social, political, economic and religious change. Cambridge University Press, Cambridge

Hilal R, Nassar T (2018) Private sector engagement analysis in electricity/solar energy, and youth job opportunities study. Optimum Consultancy & Training, pp 1–58

Howard M, Widerquist K (eds) (2012). Palgrave Macmillan, New York

IEA (2018a) Saudi Arabia. IEA. https://www.iea.org/countries/saudi-arabia. Accessed 26 Mar 2020

IEA (2018b) The future of petrochemicals. IEA. https://www.iea.org/reports/the-future-of-petrochemicals

IEA (2018c) United Arab Emirates. https://www.iea.org/countries/united-arab-emirates. Accessed 22 April 2020

IEA (2018d) Qatar. IEA. https://www.iea.org/countries/qatar. Accessed 22 April 2020
IEA (2018e) Kuwait. IEA. https://www.iea.org/countries/kuwait. Accessed 4 May 2020
IEA (2018f) Iran. IEA. https://www.iea.org/countries/iran. Accessed 16 March 2020
IEA (2018g) Jordan. IEA. https://www.iea.org/countries/jordan. Accessed 8 May 2020
IEA (2018h) Lebanon. IEA. https://www.iea.org/countries/lebanon. Accessed 8 May 2020
IEA (2018i) Egypt. IEA. https://www.iea.org/countries/egypt. Accessed 8 March 2020
IEA (2018j) Israel. IEA. https://www.iea.org/countries/israel. Accessed 19 June 2020
IEA (2018k) Algeria. IEA. https://www.iea.org/countries/algeria. Accessed 18 May 2020
IEA (2018l) Tunisia. IEA. https://www.iea.org/countries/tunisia. Accessed 26 May 2020
IEA (2018m) Morocco. IEA. https://www.iea.org/countries/morocco. Accessed 3 June 2020
IEA (2019) Energy security. IEA. https://www.iea.org/topics/energysecurity/. Accessed 25 April 2020
IEA (2020) Gas 2020. IEA, Paris
IMF (2020) Regional economic outlook Middle East and Central Asia. IMF, Washington D.C
Ingram J (2021) Qatar sets 4 GW renewables target. MEES 64(2)
IRENA (2014), Sultanate of Oman, renewables readiness assessment, IRENA, November 2014. https://www.irena.org/publications/2014/Nov/Renewables-Readiness-Assessment-Sultanate-of-Oman
IRENA (2019) Renewable energy market analysis: GCC 2019. IRENA, Abu Dhabi
IRENA, MASDAR Institute (2015) Renewable energy prospects: United Arab Emirates. IRENA, Abu Dhabi
Irish J, Pennetier M (2018) Lebanon wins pledges exceeding $11 billion in Paris. Reuters. https://www.reuters.com/article/us-lebanon-economy-france/lebanon-wins-pledges-exceeding-11-billion-in-paris-idUSKCN1HD0UU. Accessed 16 June 2020
Ismail ND, Narayanan A (2020) Gulf State most vulnerable to oil war seeks over $1 billion. Bloomberg. https://www.bloomberg.com/news/articles/2020-03-10/gulf-state-most-vulnerable-to-oil-seeks-more-than-1-billion?sref=CYTJPSEd. Accessed 6 May 2020
KAHRAMAA (2016) Sustainability report 2016. Qatar General Electricity and Water Corporation
Kamen-Kaye M (1958) Petroleum development in Algeria. The Geographical Review 48(4):463–473
Kent S (2015) A brief history of the Iranian oil industry. The Wall Street Journal. https://www.wsj.com/articles/a-brief-history-of-the-iranian-oil-industry-1428063016. Accessed 24 Mar 2020
Kerimkhanov A (2019) Iran's share of world's petrochemical production revealed. Azernews. https://www.azernews.az/region/158469.html. Accessed 18 Mar 2020
Khan SA, Salam MA (2018) Transition towards sustainable energy production—a review of the progress for solar energy in Saudi Arabia. Energy Explor Exploit 36(1):3–27
Khatib N (2018) Country profile: Morocco 2018. Renewable energy solutions for the Mediterranean country profiles, pp 1–65
King & Spalding (2020) Overview of the new Algerian hydrocarbons law. JD Supra. https://www.jdsupra.com/legalnews/overview-of-the-new-algerian-83303/. Accessed 19 May 2020
Krane J (2019a) Energy kingdoms. Oil and political survival in the Persian Gulf. Columbia University Press, January 2019a
Krane J (2019b) Energy governance in Saudi Arabia: an assessment of the kingdom's resources, policies, and climate approach. Rice University's Baker Institute for Public Policy, CES, January 2019b
Krane J, Monaldi FJ (2017) Oil prices, political instability, and energy subsidy reform in MENA Oil exporters. James A. Baker Institute III Institute for Public Policy, pp 1–30
Lahn G (2016) Fuel, food and utilities price reforms in the GCC: a wake-up call for business. Chatham House, pp 1–26
Li X, Ou M, Song Y, Zhang XP (2017) Review of middle east energy interconnection development. J Mod Power Sys Clean Energy 5(6):917–935

Ma A (2020) How the Strait of Hormuz, a narrow stretch of water where ships carry $1.2 billion of oil every day, is at the heart of spiraling tensions with Iran. Business Insider. https://www.businessinsider.com/strait-of-hormuz-explainer-oil-us-iran-tensions-2019-7?IR=T. Accessed 19 Mar 2020

Maddocks A, Reig P, Young RS (2015) Ranking the world's most water-stressed countries in 2040. World Resource Institute. https://www.wri.org/blog/2015/08/ranking-world-s-most-water-stressed-countries-2040. Accessed 5 Mar 2020

Magdy M, El Wardany S (2020) Egypt hedges against oil volatility for second year, Maait Says. Bloomberg. https://www.bloomberg.com/news/articles/2020-02-13/egypt-hedges-against-oil-volatility-for-second-year-maait-says. Accessed 4 Mar 2020

MASDAR (2017) Reflecting the Nation's commitment

MEES (2019) Morocco: wind up, solar up coal up more. MEES 62(20):1–16

Meighan B (2016) Egypt's natural gas crisis. Carnegie endowments for international peace. https://carnegieendowment.org/sada/62534. Accessed 8 Mar 2020

Meliksetian V (2020) UAE's latest natural gas discovery is a Gamechanger. OilPrice. https://oilprice.com/Energy/Energy-General/UAEs-Latest-Natural-Gas-Discovery-Is-A-Gamechanger.html. Accessed 28 April 2020

MEMO (2020) Iran moves from oil to petrochemicals in export. MEMO—Middle East Monitor. https://www.middleeastmonitor.com/20200807-iran-moves-from-oil-to-petrochemicals-in-export/. Accessed 27 July 2021

Moerenhout T (2018) Energy pricing reforms in the Gulf: a trend but not (yet) a norm. International institute for sustainable development GSI report, pp 1–25

Moerenhout T (2020) Fuel and electricity reform for economic sustainability in the Gulf. Springer, Berlin

Mordor Intelligence (2019) Iran oil & gas exploration and production market—growth, trends and forecasts (2020–2025). Mordor Intelligence Report

Motamedi M (2020) Humour, resignation, despair: living with inflation in Iran. Al Jazeera. https://www.aljazeera.com/economy/2020/10/5/hldhumour-resignation-despair-living-with-inflation-in-iran. Accessed 2 Nov 2020

Mukherjee P, Ulmer A (2019) Reliance to sell 20% in oil-to-chemicals arm to Saudi Aramco. Reuters. https://www.reuters.com/article/us-reliance-stakesale-saudiaramco/reliance-to-sell-20-stake-in-oil-to-chemicals-arm-to-saudi-aramco-idUSKCN1V20FG. Accessed 18 April 2020

NS Energy (n.d.) South Pars gas development project, Persian Gulf. NS Energy. https://www.nsenergybusiness.com/projects/south-pars-gas-field-persian-gulf-iran/. Accessed 19 Mar 2020

Obergfaell K (2019) Nuclear energy trends: geopolitics, export drivers, governance norms. International Institute for Strategic Studies Workshop Report

OECD (2019) Fossil fuel support country note—Israel. OECD inventory of support measures for fossil fuel

Offshore Technology (n.d.) Atoll Gas field, North Damietta Offshore concession, East Nile Delta. Offshore Technology. https://www.offshore-technology.com/projects/atoll-gas-field/. Accessed 11 Mar 2020

Olver-Ellis S (2019) Building the New Kuwait: the role of the private sector in the post-oil economy. London School of Economics

OPEC (2019a) Annual Statistical Bulletin 2019a Saudi Arabia. OPEC. https://www.opec.org/opec_web/en/about_us/169.htm. Accessed 20 Mar 2020

OPEC (2019b) Annual statistical bulletin Algeria. OPEC. https://www.opec.org/opec_web/en/about_us/146.htm. Accessed 18 May 2020

Oxford Business Group (2016) Rising energy consumption and falling production in Tunisia are prompting a push to increase efficiencies and diversify the energy base. In: Oxford Business Group (ed) The report: Tunisia. Oxford Business Group, Oxford

Oxford Business Group (2018) The report: Kuwait 2018. Oxford Business Group

Oxford Business Group (2019) Qatar focuses on energy efficiency, reduced consumption of utilities. In Oxford Business Group (ed) The report: Qatar 2019. Oxford Business Group, Oxford
Oxford Business Group (2020) Morocco turns to renewable resources and natural gas to diversify its energy mix. In: Oxford Business Group (ed) The report: Morocco 2020. Oxford Business Group, Oxford
Pyper J (2020) Saudi Aramco energy ventures plans new $500M fund. Green Tech Media. https://www.greentechmedia.com/articles/read/saudi-aramco-energy-ventures-plans-launch-of-500-million-fund. Accessed 19 April 2020
Qatargas (n.d.) Ultimate reliability in LNG supplies. Qatargas. http://www.qatargas.com/english. Accessed 2 May 2020
Qiblawi T (2020) 75% of Lebanon needs aid after Coronavirus, and Hungry protesters are back on the streets. CNN. https://edition.cnn.com/2020/04/28/middleeast/lebanon-hunger-aid-coronavirus-intl/index.html?utm_source=PremiereUrgenceInternational&utm_campaign=052020. Accessed 15 July 2020
Ratcliffe V, Di Paola A, Martin M (2020) Aramco reviewing multi-billion Texas LNG terminal investment plan. World Oil. https://www.worldoil.com/news/2020/9/3/aramco-reviewing-multi-billion-texas-lng-terminal-investment-plan. Accessed 31 Oct
Reuters (2015a) Russia halts work in Turkey's first nuclear power plant after spat—officials. Reuters. http://www.reuters.com/article/mideast-crisis-turkey-russia-nuclear-idUSL8N13Y2WB2015a1209. Accessed 23 Mar 2020
Reuters (2015b) Iran says finds an unexpectedly high uranium reserve. Reuters. https://www.reuters.com/article/us-iran-nuclear-uranium/iran-says-finds-unexpectedly-high-uranium-reserve-idUSKCN0RC0A02015b0912. Accessed 23 Mar 2020
Reuters (2020) Saudi Aramco raises IPO to record $29.4 billion by over-allotment of shares. Reuters. https://www.reuters.com/article/us-saudi-aramco-stocks/saudi-aramco-raises-ipo-to-record-29-4-billion-by-over-allotment-of-shares-idUSKBN1ZB03D. Accessed 28 March 2020
Saadi D (2020) UAE still needs LNG, Qatari gas imports after huge Jebel Ali discovery: analysts. S&P Global Platts. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/020420-uae-still-needs-lng-qatari-gas-imports-after-huge-jebel-ali-discovery-analysts. Accessed 29 April 2020
Saudi Aramco (2021) FY 2020 results, March 22, 2021. https://www.aramco.com/-/media/publications/corporate-reports/saudi-aramco-fy-2020-webcast-presentation-english.pdf
Seznec JF (2020) The Saudi Aramco-SABIC merger: how acquiring SABIC fits into Aramco's long-term diversification strategy. Atlantic Council Issue Brief, pp 1–15
Shehabi M (2017) Assessing Kuwaiti energy pricing reforms. The Oxford Institute for Energy Studies Paper MEP(17), pp 1–37
Shehabi M (2019) Quantifying impacts of energy subsidy removal as a response measure and just transition policy solutions for low carbon development. OIES-UNFCCC/ILO Asia-Pacific region awareness workshop
Statista (2020) Kuwait: budget balance between 2009 and 2021 in relation to GDP. Statista. https://www.statista.com/statistics/438901/kuwait-budget-balance-in-relation-to-gdp/. Accessed 4 May 2020
Tagliapietra S (2014) Iran after the (potential) nuclear deal: what's next for the country's natural gas market? Fondazione Eni Enrico Mattei, Nota di Lavoro 31.2014, Milan, Italy
Thafer D (2020) Coronavirus: Oman faces tough choices as crisis hits finance. Middle East Eye. https://www.middleeasteye.net/opinion/coronavirus-will-oman-seek-financial-relief-gcc-neighbours. Accessed 5 May 2020
The Arab Weekly (2019) Tunisia optimistic over energy prospects with new gas field. The Arab Weekly. https://thearabweekly.com/tunisia-optimistic-over-energy-prospects-new-gas-field. Accessed 28 May 2020
The State of Qatar (2018) Secondary voluntary national review 2018. The State of Qatar
The World Bank (2017a) Energy use. The World Bank Data. https://data.worldbank.org/indicator/EG.USE.PCAP.KG.OE?locations=AE. Accessed 7 May 2020

The World Bank (2017b) Securing energy for development in West Bank and Gaza-Brief. The World Bank Group Brief. https://www.worldbank.org/en/country/westbankandgaza/brief/securing-energy-for-development-in-west-bank-and-gaza-brief. Accessed 15 June 2020

The World Bank (2019a) Population growth (annual %)—Egypt, Arab Republic. The World Bank Data. https://data.worldbank.org/indicator/SP.POP.GROW?locations=EG. Accessed 31 May 2020

The World Bank (2019b) Project information document/integrated safeguards data sheet (PID/ISDS). The World Bank energy sector performance improvement project (P168273), pp 1–16

The World Bank (2020a) Population growth (annual %)—Saudi Arabia. The World Bank Data. https://data.worldbank.org/indicator/SP.POP.GROW?locations=SA&display=graph. Accessed 2 April 2020a

The World Bank (2020b) GDP Growth (% annual)—Saudi Arabia. The World Bank Data. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=SA. Accessed 10 April 2020b

The World Bank (2020c) Macro poverty outlook: Middle East and North Africa. The World Bank

The World Bank (2020d) Unemployment, total (% of total labor force) (modeled ILO estimate)—Iran, Islamic Rep. The World Bank Data. https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?locations=IR. Accessed 25 Mar 2020d

The World Bank (2020e) Iran's economic update. The World Bank

The World Bank Middle East and North Africa Region (2019) Reaching new heights: promoting fair competition in the Middle East and North Africa. MENA Economic Update

Total (2019) Total Energy Outlook. Total

Trading Economics (2019a) Bahrain Government Debt to GDP. Trading Economics. https://tradingeconomics.com/bahrain/government-debt-to-gdp. Accessed 5 May 2020

Trading Economics (2019b) Oman Government Debt to GDP. Trading Economics. https://tradingeconomics.com/oman/government-debt-to-gdp. Accessed 5 May 2020

Trading Economics (2019c) Egypt GDP growth rate. Trading Economics. https://tradingeconomics.com/egypt/gdp-growth. Accessed 9 Mar 2020

UAE Ministry of Energy & Industry (2017) Vice president unveils UAE energy strategy for next three decades. UAE Ministry of Energy & Industry

Ulrichsen KC (2020) The political economy of Dubai. In Page MT, Vittori J (eds) Dubai's role in facilitating corruption and global illicit financial flows, carnegie endowment for international peace, July 7, 2020. https://carnegieendowment.org/2020/07/07/political-economy-of-dubai-pub-82182

UNDP (2018) Tunisia: derisking renewable energy investment 2018. UNDP Full Report

UNHCR (2020) Syria regional refugee response. UNHCR Data. https://data2.unhcr.org/en/situations/syria. Accessed 9 May 2020

United Arab Emirates (2020) Energy. United Arab Emirates. https://u.ae/en/information-and-services/environment-and-energy/water-and-energy/energy. Accessed 23 April 2020

Watkins S (2020) The two global powers controlling Iran's oil sector. OilPrice. https://oilprice.com/Energy/Crude-Oil/The-Two-Global-Powers-Controlling-Irans-Oil-Sector.html. Accessed 26 Mar 2020

WEO (2021) World Economic Outlook database. International Monetary Fund IMF

World Nuclear Association (2019) Nuclear power in Jordan. World Nuclear Association. https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx. Accessed 16 Mar 2021

World Nuclear Association (2020) Uranium enrichment. World Nuclear Association. https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/uranium-enrichment.aspx. Accessed 23 Mar 2020

Wright S (2018) Why Qatar left OPEC. Al-Jazeera. 6 December 2018. https://www.aljazeera.com/opinions/2018/12/6/why-qatar-left-opec/

Chapter 4
Low-Carbon Energy Strategies in MENA Countries

This chapter presents the different strategies envisaged by each MENA country regarding the low-carbon energy transformation, mainly in the field of renewable energy sources.

While all MENA countries have announced renewable energy targets, MENA countries have undertaken different strategies regarding their national energy transformation. This is due to different level of commitments, ambitions and preferences regarding the renewable energy source and project size. Given their high potential, all MENA countries are considering solar projects, and at some extent wind projects (for example in Morocco and Egypt).

The transformation of the global energy system and the internal challenges in MENA countries are driving changes in the energy sector of these countries at varying speed, depending also on their hydrocarbon endowment (or lack thereof).

Among the ***Gulf*** *countries, some have announced major renewables targets, such as the UAE and Saudi Arabia. These two countries have increased their renewable targets and they are eager to benefit from their large financial capabilities to gain political and economic gains through energy diversification. Others have been more prudent due to different reasons. For example, Qatar has been a late mover in the renewable energy sector as it strongly believes in the role of natural gas within the energy transition. Iran has increasingly set renewable energy targets and has expanded its hydro-power generation, while nuclear capacity has produced limited results.*

The ***Mashreq*** *countries have experienced an uneven growth in the renewable energies. Egypt, Israel and Jordan have increasingly worked on renewable projects driven by rising population, energy security concerns and economic*

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_4

opportunities. Egypt has managed to attract significant international investments for its renewable projects. Conversely, Lebanon faces major sociopolitical and economic challenges that severely undermine its ability to reach its targets.

Among the ***Maghreb*** *countries, Morocco has been one of the first mover in the renewable energy development in the entire region motivated by political and security reasons. It set a target of 52% of installed renewable capacity by 2030. The other hydrocarbon-poor country (Tunisia) has set important targets, but political instability and economic challenges may undermine its ability to attract international investments. By contrast, Algeria has lagged behind with its targets as it has prioritized other investments during low oil prices.*

Enhanced electricity interconnections among countries and clusters would bring numerous benefits in terms of energy security, energy trade opportunities and allow for an increasing share of renewable energy sources in the energy mix of MENA countries and beyond. Countries need to address regional power interconnections as it will be a crucial factor for supporting renewable projects.

4.1 Drivers of the Low-Carbon Energy Push in MENA Countries

Why is it that numerous/most countries in the region—including hydrocarbon-rich ones—are willing to (partly) change their energy system, by outlining ambitious renewable objectives and targets? Are countries in the MENA region seriously committed to pursuing the renewable path? Why are hydrocarbon-rich countries increasingly adopting renewable energy in their energy and electricity mix, given the very low cost of oil and gas supplies (i.e. low breakeven prices)? Are international negotiations (i.e. Conference of Parties (COPs) and the broader United Nations Framework Convention on Climate Change (UNFCCC)) playing a role in the increasing share of renewable energy in the MENA energy mix?

These are some of the questions this chapter attempts to answer by taking into account the socio-economic, financial and political peculiarities of each country in the region. The initial focus will be on the main external and internal drivers of the energy transition in the MENA region including its challenges and opportunities. The chapter will then highlight the most relevant mid- and long-term strategies and policies adopted by the single MENA countries, as well as the state-of-art of renewable energy development. Finally, it will assess whether these countries are likely to achieve their renewable targets within the planned timeframe, or if they may delay/fall short of their goals. In order to extend the discussion and provide a potential assessment of the path undertaken, each country will be analyzed within the framework of the relevant cluster (The Arabian-Persian Gulf, the East Mediterranean and the West Mediterranean).

The growing fight against climate change by governments worldwide represents a major external driver for the energy transformation of MENA countries. Action against climate change has shaped international politics, as governments have increasingly committed to implementing deep decarbonization policies. This ever-growing global consensus, combined with a more extensive scientific knowledge of the harm caused by climate change, has led to the creation of the international climate change regime, which forces MENA countries to act in cooperation with all the other countries. Moreover, climate change is expected to further exacerbate some of the existing challenging conditions that MENA countries must deal with: increasing air and water temperature, water scarcity, desertification, and so on. These conditions have a direct impact also on the energy sector.

In compliance with the international climate change regime and pushed by the domestic dimension of the fight against climate change, MENA countries have submitted their climate pledges, i.e. their nationally determined contributions (NDCs). The previous chapters have highlighted the fact that the MENA region, though often considered a homogeneous group, is far from being so. This is also true for climate change policies. Oil-producing countries have often combined actions to fight climate change with their need to diversify the domestic economy, as well as rendering it more efficient. Non-hydrocarbon producing countries have often set more ambitious decarbonization plans due to their dependency on imports and related macroeconomic imbalances.

Indeed, energy transformation in the MENA region is dictated not only by external drivers, but also by internal factors, in particular the socio-economic, political and energy context. These factors, which are different in each country, also shape their individual decarbonization policies. Economic improvements pass through energy sector transformation. There are few other places around the world where the social, political and economic destiny is deeply intertwined with the energy sector as in the MENA region. Therefore, countries in this area are also incentivizing significant changes in the energy sector to make it a driver of economic diversification. The transformation of the domestic energy sector may have several positive spillovers across multiple sectors (e.g. labor diversification, economic diversification, reduced vulnerability to volatility and low oil prices). However, its transformation also faces multiple challenges since energy policy is strongly linked to issues related to political economy and governance, with energy subsidies perfectly embodying this inexorable connection. Similarly, MENA countries need to expand their power capacity as domestic energy demand is expected to continue to increase at a high rate due to population growth, average GDP growth and planned localization of numerous industries in the countries, in line with diversification efforts. All these factors contribute to the growing water demand, which heavily relies (depending on the country between 60 and 90%) on energy-intensive desalination plants, thereby further increasing electricity demand.

Countries in the MENA region would highly benefit from the exploitation of their strengths (e.g. energy endowment and geographical location) and from the wide adoption of renewable energy not only for environmental reasons, but also to satisfy social demands, to offset economic downturns and to enhance economic diversification, creating positive spillover effects, including technological adoptions and breakthrough, which may maintain this region at the forefront of the future energy sector. The development and deployment of renewable energy contributes to the diversification of energy sources and to the enhancement of domestic productivity with the possible localization of the manufacturing industry and knowledge transfer. Wind and especially solar energy have an enormous potential in the MENA region, thanks to the large resources available in this area. Both oil-importing and oil-exporting countries would benefit from the development of renewable energy projects. Over the last years, to different degrees, all countries have therefore set ambitious targets in renewable energy, which are regularly being revised upwards.

Hydrocarbon-rich countries are aiming to find new business models that will enable them to remain key energy actors also in a decarbonized world. Some of these solutions in the energy sector include the decarbonization of the hydrocarbon sector, which is in any case expected to continue to play a certain role in the future. The competitive advantage of hydrocarbon-rich MENA countries is represented by their low-cost reserves and the long-lasting and excellent know-how of this industry. More in detail, exporting countries could decarbonize both the production process of hydrocarbons and the final products. For instance, these countries could invest in capital-intensive carbon capture, utilization and storage (CCUS) technology, enabling the decarbonization of the final petroleum products and enhancing the long-term sustainability and prospect of the hydrocarbon industry (Fattouh and Poudineh 2020). The CCUS technology is not yet widely adopted due to its high costs, which encourage hydrocarbon-exporting countries to invest in R&D and have cost efficiency gains. It could also be combined with enhanced oil recovery (EOR) and thus create value. Overall, this technology would partly offset the medium and long-term lower hydrocarbon demand related to environmental issues, while taking advantage of the know-how of countries in this industry. Integrating decarbonized solutions in the oil and gas industry of oil-exporting countries may result in lower profits as margins are smaller, but also in lower risks, making this industry more sustainable in the long run. In any case, in a progressively decarbonized world, adaptations are necessary for survival, and MENA hydrocarbon exporting countries have a competitive advantage and could in addition exploit a first mover advantage.

Another field that hydrocarbon-exporting countries may explore in terms of innovative, environmentally friendly solutions in the oil and gas business, regards methane abatement technologies, which are not yet well developed. Indeed, CO_2 is not the only concern for GHG emissions in the oil and gas sector, but also methane emissions have recently attracted a lot of attention, as they are considered the second main cause of global warming. In 2019, the oil and gas industry emitted 82 Mt (2.5 $GtCO_2$ equivalent) (Gould et al. 2020). While methane lasts less than CO_2 in the atmosphere, it is 28 times more potent with a 100-year timespan and 84 times more potent with a 20-year timespan (EU Commission 2020). It is quite challenging to precisely measure methane emissions, which were estimated at 570 Mt in 2019: 40% originating from natural sources and the remaining 60% from human activities—the so-called anthropogenic emissions. The three main sectors emitting the highest quantities of methane are the agricultural sector (145 Mt), the energy sector (134 Mt) and the waste sector (68 Mt) (IEA 2020a, b, c). Regarding the oil and gas industry, since methane has a value, it is estimated that up to 45% of methane emissions could be avoided at no net cost. For instance, a cost-effective way to cut methane emissions would be to detect and repair leaks, which are one of the main causes of uncontrolled methane emissions. Overall, countries in this region may enhance their efforts and become key players in the abatement of methane emissions. By coupling methane reduction policies and technologies with other decarbonized solutions (e.g. CCUS), these countries may well advertise their hydrocarbon production as more eco-friendly.

These technological solutions could also create further business opportunities for MENA countries, which may consider the production and supply of blue and green hydrogen to the rest of the world, contributing to the overall decarbonization, especially in the so-called ‘hard-to-abate’ sector. Due to technological challenges, MENA countries could consider the production of decarbonized industrial products thanks to their domestic production of clean and cost-competitive hydrogen.

MENA countries have put in place different regulatory, financial and political supports depending on their national peculiarities and political commitment—as shown in their NDCs. This chapter seeks to highlight these differences, presenting the evolution of past and current national plans and commitments regarding the transformation of the domestic energy sector.

MENA countries have high energy and, in particular, electricity demand growth rates. These must and can be curbed by eliminating universal subsidies and investing in energy efficiency. At the same time these countries need to progressively move away from fossil fuel-based power generation and move towards renewables, in particular considering the region’s high endowment of solar (and wind) energy resources. In fact, MENA countries have already set numerous renewable targets (Table 4.1).

Table 4.1 Renewable energy targets and indicators in the MENA countries in 2019

Country	National RES target	Installed electricity capacity (MW)	Installed RES capacity (MW)	Share of RES in electricity capacities (%)	Electricity production (GWh)	RES generation in (GWh)	Share of RES in total power generation (%)
Algeria	27% of power generation and 37% power generation capacity by 2030	23,469	734	3.13	89,967.8	834.5	0.01
Bahrain	5% of power capacity mix in 2025	8770	7	0.08	34,767.3	0.0	0.00
Egypt	20% of electricity production in 2022 and 42% for 2035,	59,855	5894	9.85	195,211.8	17,491.2	0.09
Iran		80,210	12,558	15.66	314,062.7	31,020.3	0.10
Iraq		38,238	2730	7.14	97,330.1	2535.1	0.03
Israel	30% of RES in total electricity generation by 2030	19,141	1500	7.84	71,964.1	3023.6	0.04
Jordan	31% of RES in power mix and 14% of RES in energy mix by 2030	5926.8	1485.6	25.07	21,001.3	3039.0	0.14
Kuwait	at least 15% of its electricity needs from renewables by 2030	19,778	105	0.53	75,071.0	60.1	0.00
Lebanon	30% in electricity and power demand by 2030	3809	400	10.50	20,547.3	1038.7	0.05

(continued)

Table 4.1 (continued)

Country	National RES target	Installed electricity capacity (MW)	Installed RES capacity (MW)	Share of RES in electricity capacities (%)	Electricity production (GWh)	RES generation in (GWh)	Share of RES in total power generation (%)
Libya		10,869	5	0.05	35,113.0	8.1	0.00
Morocco	52% of total installed power capacity by 2030	10,675	3701	34.67	41,786.7	7927.6	0.19
Oman	30% of power generation by 2030	8884	59	0.66	38,102.7	4.0	0.00
Qatar	20% of its energy demand by 2030	12,675	5	0.04	49,872.7	0.0	0.00
Saudi Arabia	50% by 2030	85,185	412	0.48	366,746.7	728.4	0.00
Syria		10,057	1497	14.89	17,266.9	754.0	0.04
Tunisia	30% in electricity mix by 2030 (= 3.6 GW of capacity)	5760	369	6.41	22,099.3	766.9	0.03
UAE	44% of its energy consumption by 2050	37,460	1918	5.12	138,454.1	3779.8	0.03

*As of November 2021
Note Renewables capacity and generation include also hydroelectricity
Source Authors' elaboration on UNFCCC, National documents, Enerdata

An aspect, which is often overlooked when addressing the electricity sector, is grid strength and interconnections with adjacent countries, which bring important benefits from an economic and technical perspective. There is a vast literature explaining these benefits, which include:

- *Improving reliability and pooling reserves*: the amount of reserve capacity that must be built by individual networks to ensure reliable operation when supplies are short can be reduced by sharing reserves within an interconnected network;

- *Reduced investment in generating capacity*: individual systems can reduce their generating requirements, or postpone the need to add new capacity, if they are able to share the generating resources of an interconnected system;
- *Improving load factor and increasing load diversity*: systems operate most economically when the level of power demand is steady over time, as opposed to having high peaks. Poor load factors (the ratio of average to peak power demand) mean that the utilities must construct generation capacity to meet peak requirements, but that this capacity sits idle much of the time. Systems can improve poor load factors by interconnecting to other systems with different types of load, or loads with different daily or seasonal patterns that complement their own;
- *Economies of scale in new construction*: unit costs of new generation and transmission capacity generally decline with increasing scale, up to a point. Sharing resources in an interconnected system can allow the construction of larger facilities with lower unit costs;
- *Diversity of generation mix and supply security*: interconnections between systems that use different technologies and/or fuels to generate electricity provide greater security in the event that one kind of generation becomes limited. In many countries, this complementarity has been a strong incentive for interconnection between hydro dominated systems and thermal dominated systems. A larger and more diversified generation mix also implies more diversity in the types of forced outages that occur, improving reliability;
- *Economic exchange*: interconnections allow the dispatch of less costly generating units within the interconnected area, providing an overall cost of savings that can be divided among component systems. Alternatively, it allows inexpensive power from one system to be sold to systems with more expensive power. This, for instance, is presently the case in Europe where countries with nuclear power generation export massively to those with more expensive fossil fuel power generation;
- *Environmental dispatch and new power plants siting*: interconnections can allow generating units with lower environmental impacts to be used more, and units with higher impacts to be used less. In areas where environmental and land use constraints limit the siting of power plants, interconnections can allow new plant construction in less sensitive areas;
- *Coordination of maintenance schedules*: interconnection permits planned outages of generating and transmission facilities for maintenance to be coordinated so that overall cost reliability for the interconnected network is optimized.

Electricity interconnections do, however, not only provide technical and economic benefits. They can also contribute to fostering international cooperation amongst the countries involved. In fact, the significant legal, economic, and organizational linkages between nations trading power, which are obligatory parts of most successful grid interconnections, offer the potential to spur government-to-government cooperation in other areas. A grid interconnection necessarily sets up means of communication between governments in that representatives of the governments involved in the interconnections must agree on the terms of power sales and purchase agreements and must cooperate in the operation of shared power lines.

The international political and legal frameworks necessary to build and operate major international energy infrastructure such as power lines (and, for example, gas or oil pipelines) thus provide experience and channels for international communication on economic (such as trade in other goods and services), social (such as indigenous peoples and cultural exchanges), and security (such as border control) issues, to name just a few.

Cross-border interconnections are expected to play a more important role in MENA countries as renewable energy sources and electrification increase. Yet, the current level of grid connectivity in the MENA region is still very limited, and mainly refers to interconnections among countries of the same geographical cluster. As of today, there is a lack of adequate interconnection infrastructure between countries, but sometimes even between regions within the same country. And although some interconnections do exist within the clusters, electricity trade is still modest. The existing electricity trade between countries generally occurs at small-scale and is governed through bilateral contracts rather than by market forces. And if there is some trade among countries of a cluster of countries, there is extremely little trade between the clusters. As of today, cross-border electricity trade within clusters consists of:

- the GCC power interconnection, which connects countries in the Arabian Peninsula, namely Kuwait, Saudi Arabia, Bahrain, Qatar, the UAE and Oman;
- the interconnection infrastructures within the West Mediterranean countries (Algeria, Morocco and Tunisia), and
- The Eight Countries (EIJLLPST[1]) regional energy interconnection project.

All these interconnections suffer from insufficient utilization and synchronization difficulties. Very little connectivity exists between the three clusters or with adjacent regions. In fact, so far, the MENA region is synchronously interconnected to Europe only through the Morocco-Spain link.

It should be noted that interconnecting power grids is not a simple process and requires cultural changes, trust between countries and institutional reform, which often takes several decades, as well as a clear and robust legislation and regulation. Moreover, the interconnected systems are often not synchronized, but based on Direct Current interconnections which do not allow easy integrated electricity market creation. In order to pursue the synchronization of electricity markets within and outside the region, countries need to address and pursue stability in their electricity market. Some MENA countries need to cope with market instability and blackouts, which discourage synchronized interconnectivity, especially with the EU. Thus, grid reinforcement inside countries and among countries in the MENA region needs to go hand in hand with structural reforms related to subsidies and to greening the energy mix in the power sector.

[1] Egypt, Iraq, Jordan, Libya, Lebanon, the West Bank and Gaza, the Syrian Arab Republic, and Turkey.

Overall, given the primary role and relevance of renewable energy for MENA countries, it is important to understand the state of the art in renewable development: what are MENA countries' renewable targets and are these countries on the right track to attain them? This chapter will provide answers to this question firstly by outlining the main renewable energy targets and projects for each country in the three clusters; and secondly, by analyzing the likelihood of attainment of the renewable targets, also highlighting the main driving forces and challenges countries face on their path. The regional electricity interconnection status and future expansion plans will also be highlighted.

Table 4.1 shows the latest[2] declared renewable energy targets in MENA countries and compares them with the present penetration of renewables in the energy and power mixes.

4.2 The Arabian-Persian Gulf

Economic diversification is fundamental for countries in this cluster since their socio-economic model, based on the rentier economy, is deemed unsustainable in the medium-long term. Indeed, the oil and gas sector accounts for more than half of exports and GDP in most countries of the region (i.e. 70% of exports and 50% of GDP in 2019 in Saudi Arabia). Volatile and low oil prices do not satisfy these countries' fiscal breakeven oil prices,[3] which range from $50 (Qatar) to $197.8 per barrel (Iran) in 2019 (IMF 2020b).

Growing budget deficit and national debt are expected in the coming years due to lower oil demand forecasts, challenges posed by economic diversification, while striving to maintain high levels of economic benefits for the nationals. These economies have already shown some weaknesses. Indeed, Saudi Arabia runs a high deficit since 2015, the surpluses of Kuwait, Qatar and UAE have continued to shrink, and Bahrain and Oman have already experienced difficulties in keeping their accounts positive in periods with high oil prices. Oil-producing economies need to address oil price volatility, which could exacerbate this condition, and is expected to intensify in the medium- and long-term. On the other hand, oil demand is expected to decrease due to stronger decarbonization policies and international conventions (e.g. UNFCCC) resulting in oil supply–demand shock. Following oil demand drop, both NOCs and IOCs were obliged to revise their investment plans. For instance, in August 2020 Aramco cancelled a $10 billion project for a refinery in China's Liaoning region (MECEI 2020). The project was planned to enhance the company's presence in Asia and to comply with the horizontal diversification discussed in the previous chapter (McFarlane and Said 2020).

The unsustainability of the rentier model is also reflected on the saturation of the public sector in the vast majority of countries in this region, resulting in a high youth

[2] Up to end 2021.

[3] Oil price needed to balance the fiscal budget.

unemployment rate. Most countries have enacted more stringent "nationalization" policies, especially in the public sector, since it is regarded as the best fit for nationals in terms of skills, reputation and wages. For instance, Kuwait has started to lay off 50% of expats working for subcontractors in government ministries (Al Faisal 2020), while Oman has not renewed 70% of foreign consultant contracts for advice to the government (Al Monitor 2020). Policymakers may face challenges to enact courageous reforms in this field, as they may antagonize the population.

The diversification of the energy mix triggers positive spillovers, also contributing to economic diversification. Iran has attained moderate levels of diversification with non-oil exports exceeding oil ones in most years since 2011 (Mohamedi 2019). The GCC countries are attempting to shift to a knowledge and technology-based economy, rather than relying on a cheap foreign labor force. The domestic production of solar panels may therefore foster the localization of a high-tech manufacturing industry, enhancing know-how in the sector and possibly reducing the reliance on oil revenues. Similarly, some countries are pushing towards technological and green advances in the energy sector, such as hydrogen production and exports in the case of Saudi Arabia and Oman. Also, given the saturation of the public sector, renewable energy might boost employment in the private sector, in a context of high youth unemployment (i.e. 63.4% for young Saudi women and 23.6% for young Saudi men in 2019) (General Authority for Statistics 2018).

Overall, in order to diversify their economies, countries in the Gulf cluster have published documents, the so-called Visions, with a set of objectives and targets to be reached by a precise year, as detailed in Table 4.2.

The goals set in the Visions of each country are different, even though they all tackle similar sectors and fields (healthcare, education, labor market, tourism, high-tech etc.). The Visions or affiliated documents also include targets related to the energy transition, focusing primarily on increasing the role of renewable energy in the countries' energy mix. Renewable energy objectives vary greatly, also depending on the target year of the Vision: 44% of renewables in the energy mix of the UAE by 2050, 9.5 GW of renewable energy (revised upwards in 2019 to 59 GW) in

Table 4.2 Gulf countries' economic diversification strategies, Vision

Country	Vision
Bahrein	Economic Vision 2030
Iran	Vision 2025
Kuwait	Vision 2035
Oman	Vision 2040
Qatar	National Vision 2030
Saudi Arabia	Vision 2030
United Arab Emirates	Vision 2021, Energy Strategy 2050, UAE Centennial 2071

Source Authors' elaboration on Vision websites for each country

Table 4.3 Targets of renewable energy for each country

Country	Renewable target
Bahrain	5% of RES in energy mix by 2025, 10% by 2035 (NREAP)
Iran	7500 MW RES by 2030
Kuwait	15% of RES in electricity mix by 2030
Oman	30% of electricity demand from RES by 2030
Qatar	20% of solar energy in electricity mix by 2030
Saudi Arabia	59 GW of renewable energy by 2030
United Arab Emirates	44% of RES in energy mix by 2050

Note Targets are not standardized, but as detailed in each Vision or affiliated document
Sources Authors' elaboration on SATBA, UNDP, Oxford Business Group & evwind.es

Saudi Arabia by 2030, 30% of renewables in total electricity demand by 2030 in Oman, 20% of renewables in the electricity mix of Iran by 2025 and so on. Also, differences arise regarding both the presence and the share of specific renewable energy sources: while wind energy and waste-to-energy may not be present in all Visions, solar energy predominates the cluster's renewable energy mix, even though some countries focus on large solar PV or CSP projects (e.g. Saudi Arabia, Kuwait), while others on small-scale rooftop PV (e.g. Bahrain). Thus, despite the numerous similarities, each country has considered its peculiarities in socio-economic, energy and geographic terms to come up with quite different renewable energy targets, as shown in Table 4.3.

Numerous factors may explain the different targets and sources set for renewable energy in the different Visions. Firstly, each country has a different degree of security of supply: the UAE, Oman and Bahrein may be considered to have low energy security, given their current reliance on imports to satisfy their domestic energy market. On the contrary, Saudi Arabia, Iran, Qatar and Kuwait may be deemed energy secure. Secondly, high-energy consuming countries in absolute terms—those with a large population—may benefit from conspicuously investing in renewable energy and free oil (and potentially gas) for export, with the notable example of Saudi Arabia. Also, countries with a large population or with a high degree of economic diversification (localization of industries) rely more, in absolute terms, on energy-intensive seawater desalination plants, which are key to water security. Thus, projects that combine desalination plants and renewable energy sources, primarily solar PV, have been planned (Dubai Emirate) or contracts have been awarded to build them (i.e. Al Khafji in Saudi Arabia) especially in countries with high water demand. Thirdly, compared to gas-rich countries (i.e. Qatar) oil-rich countries may be particularly willing to invest in renewable energy in order to diversify their revenues and overall economy from oil, which is expected to reach a global demand peak in the medium term.

Map 4.1 Approximate route and layout of the GCC interconnection. *Source* GCCIA https://www.gccia.com.sa/P/the_interconnection_project/55

Lastly, environmental concerns were not deemed the primary reason for switching towards renewables. However, some countries are going to face a greater likelihood of natural disasters, such as Oman with heatwaves, as well as Bahrein with the risk of being submerged (Bodetti 2019). These threats have pushed these countries to include the environmental aspect of renewable energy in their discourse.

As most of the Gulf countries announced ambitious renewable energy targets, these countries could benefit from higher interconnectivity. As of today, the six member states of the Gulf Cooperation Council (GCC)—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE – have an interconnection scheme (Map 4.1). They created the GCC Interconnection Authority (GCCIA) in 2001. In 2009, these countries signed two agreements, the General Agreement (GA) and the Power Exchange and Trade Agreement (PETA). The GA established the principles of electricity cooperation, while the PETA set the legal terms for commercial trade. GCCIA member countries developed cross-border interconnections through three phases:

1. First phase, completed in 2009, the GCCIA formed the GCC north grid by connecting the power grids of the northern states of Kuwait, Saudi Arabia, Bahrain, and Qatar.
2. Second phase, by 2006 it established the GCC southern grid by connecting UAE and Oman.[4]
3. Third phase, the north and south GCC grids were interconnected in 2011.

[4] It also formed the Emirates National Grid (ENG) by integrating the isolated networks of the various emirates and created an integrated northern grid in Oman.

At present, the GCC electricity trade consists of (a) scheduled exchanges or prearranged bilateral trades and (b) unscheduled exchanges or the contingency trade of electricity as a necessary basis, particularly during emergency shortages.

Today's design of the electricity markets of GCC countries only allows bilateral energy exchange and settlements of trade imbalances on an in-kind basis, or in-cash basis, based on the tariff set by the regulators. As of today, the low volume of cross-border energy flows has resulted in the underutilization of the GCC interconnection grid's designed capacity (< 5%), which also represents the potential for future trade. These countries are synchronized and connected, yet there is no connection with countries in the East Med cluster.

4.2.1 Saudi Arabia

- **Targets and projects**

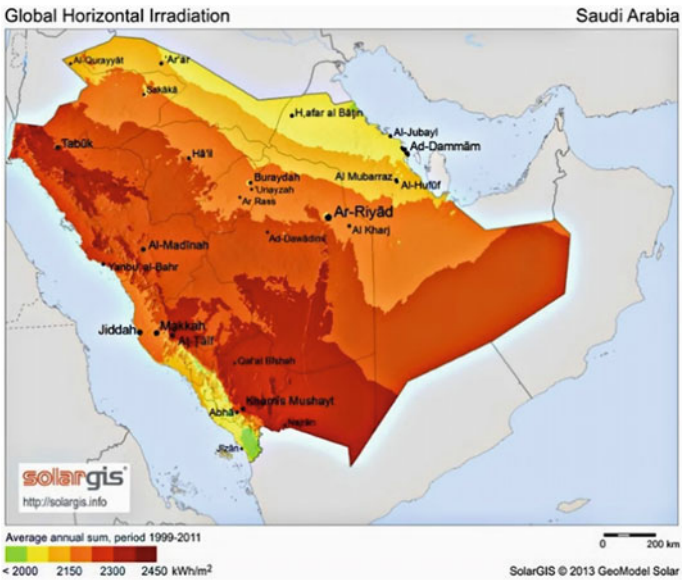
In the last decade, the Kingdom of Saudi Arabia has periodically set and later revised renewable energy targets, with a major focus on solar energy. In 2013, the King Abdullah City for Atomic and Renewable Energy (KA-CARE) published a white paper establishing a target for the production of 54 GW of renewables by 2032. However, this target was scaled down in 2016 with the publication of Vision 2030, which envisaged a first target of 5.9 GW of solar energy out of 9.5 GW of clean energy by 2023 (Vision 2030 2016), representing the generation of 10% of Saudi total production. The Renewable Energy Project Development Office (REDPO) was established within the framework of Vision 2030. REDPO operates under the Ministry of Energy, Industries and Mineral Resources, with the aim of carrying out the National Renewable Energy Project (NREP). Moreover, the Public Investment Fund (PIF) Program is set to complement REDPO, with REDPO expected to deliver 70% of the total capacity and PIF the remaining 30%. While REDPO adopted a competing tendering strategy to choose the projects, PIF has to negotiate with international actors and to rely on the domestic manufacturing industry to carry them out. The Electricity and Cogeneration Regulatory Authority (ECRA) is responsible for the regulation of the electricity and water desalination sector and it supervises the restructuring of the electricity sector. It also supervises the entry of private operators for private production projects in line with the Saudi Vision 2030.

Renewable energy targets in Vision 2030 were revised upwards at the beginning of 2019. REDPO announced new ones, which included a mid-term target—27.3 GW from solar energy by 2023—and a long term one with 59 GW from renewables by 2030 (40 GW solar energy, 16 GW from wind energy and 3 GW from CSP). These new targets reveal the increasing importance of concentrated solar power (CSP) for the development of the renewable sector. Indeed, as CSP stores heat, it can be used to power the water desalination projects the Kingdom has envisaged to carry out in the medium term. In April 2020, a new institutional body, the Supreme Committee for Energy Mix Affairs, for Electricity Production and Enabling Renewable Energy was established to oversee the renewable energy projects. The Supreme Committee is chaired by the Crown Prince MbS. Moreover, Saudi Arabia has unveiled its Saudi Green Initiative in March 2021, setting an ambitious target of 50% of electricity coming from renewable energy sources by 2030.

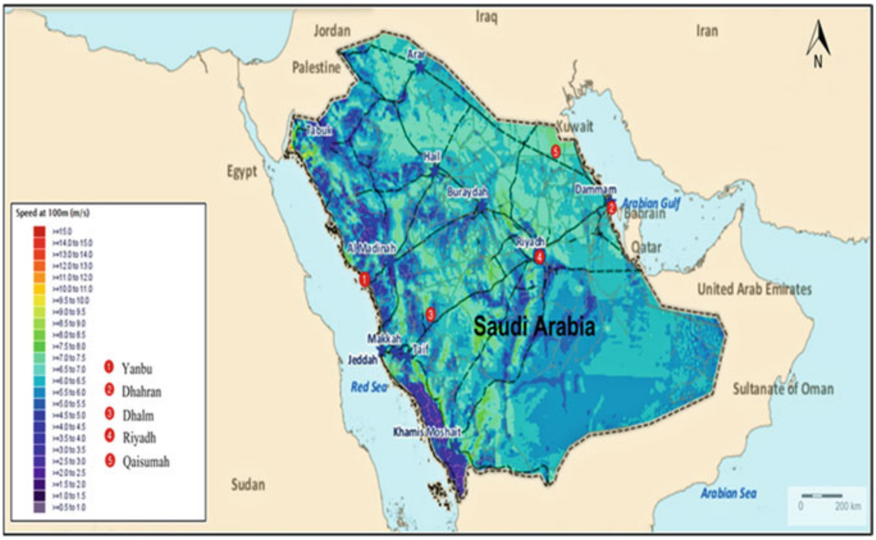
Despite the numerous targets announced by Saudi authorities, the development of renewable energy has so far been quite modest. Indeed, Saudi Arabia has a total installed capacity of 86 GW in 2019, of which only 413 MW from renewable energy corresponding to 0.5% of the total electricity capacity. Saudi renewable capacity accounts only for 835 GWh of electricity production, which accounts for 0.2% of the total electricity produced. The slow deployment of renewable energy sources pales if the great renewable potential of the country is taken into account. The country possesses large and uninhabited territories, where solar power infrastructures may well be constructed. The Kingdom can also take advantage of its strategic location in the Sun Belt as well as wind potential in some of the country's regions (Maps 4.2 and 4.3).

Even though the deployment of renewable energy sources in Saudi Arabia has so far lagged behind the targets, over the 2010 decade there have been some positive developments demonstrating the promising potential of solar energy, especially PV.

The renewable targets respond to the multiple challenges that Saudi Arabia seeks to address, such as growing energy demand, economic diversification, freeing up oil export volumes as well as participating actively in the international climate change policy debate. Renewable energy sources may bring significant advantages to



Map 4.2 Solar energy potential (horizontal irradiation) in Saudi Arabia. *Source* evwind.es



Map 4.3 Wind energy potential (speed) in Saudi Arabia. *Source* Mohamed, Eltamaly and Alolah 2016

Saudi Arabia also in terms of economic diversification and increased power capacity. Indeed, the country has to considerably expand its power capacity as domestic electricity demand is expected to continue to increase significantly. Between 2008 and 2018, internal power demand grew by around 4%/year in average, mostly driven by the expected annual population growth (+ 2.62%), annual average GDP growth (+ 3.81%) (World Bank 2019a, b) and planned localization of numerous industries in the country. These factors will also contribute to a growth of water demand, exacerbating the use of energy-intensive seawater desalination plants, which are generally supplied with fossil fuels. Also, the development of renewable energy is likely to trigger positive externalities in other domestic sectors, such as the manufacturing industry. These spillovers are deemed in line with Vision 2030, which aims at increasing both the diversification of the economy from oil and the competitiveness of the local economy. By doing so, thousands of new jobs are expected to be created, which would contribute to the reduction of the (youth) unemployment rate among Saudis. Renewable energy, especially solar, is relatively easy to adopt, and it is seen as a great opportunity to offset growth in power and water demand as well as to enhance economic diversification and competitiveness of both the local economy and labor market.

Despite major announcements, Saudi Arabia's solar PV capacity is still quite limited, as most projects are still in the planning or tendering phases. In 2020, solar installed capacity amounted to 409 MW (IRENA 2021a, b), mainly thanks to the commissioning of the first utility-scale solar PV in 2019, the Sakaka IPP PV project, with an output capacity of 300 MW. The first commissioned solar plant was the King Abdallah Petroleum Studies and Research PV solar field in 2010 with a capacity of

5.3 MW. The solar field closed a few years later. Since then, Saudi Arabia has tried to increase its solar capacity. In 2021, the construction of the 300 MW Jeddah solar power plant began. The project should be commissioned in 2022. ACWA Power has also reached financial close for the 1.5 GW Sudair solar power plant. Both projects have signed PPAs with Saudi Arabia in 2021 in the second round of the country's procurement scheme for renewable energies. PPAs were signed with five other projects totaling 1170 MW.[5] Also, REDPO launched three rounds of NREP to shortlist bidders for the 11 development projects.

The main renewable projects announced by the Kingdom may be divided in those deemed more likely to be developed and those considered less feasible, mostly with respect to the capacity planned and the level of current development. Table 4.4 summarizes the main solar PV projects and attributes the probability of their commissioning.

Saudi Arabia has also invested in Concentrated Solar Power (CSP). So far, Saudi Arabia has developed this technology integrated with the gas power plant, the integrated solar combined cycle (ISCC) power plant, in three projects. With a CSP capacity of 50 MW out of a total capacity (CSP plus CCGT) of 1390 MW, the Waad Al Shemal ISCC plant was the first plant of this type commissioned in 2018. However, the country's first project, Duba ISCC-1, was launched in 2015. The project will have a total capacity of 600 MW (50 MW of CSP and 550 MW of CCGT). The project is currently under construction by Saudi Electricity Company (SEC) and it should be commissioned in 2022. The third CSP project is the Taiba project, with an expected total capacity of 3780 MW. The project has been announced but it is witnessing delays due to uncertainties related to the development phase (possibly passing from Saudi Electricity Company -SEC- to an IPP (ENERDATA 2021a; Papadopoulou et al. 2019). Overall, Saudi Arabia is monitoring the 750 MW CSP plant project in Dubai to study its potential investment in this technology, as the prices of this technology may also decrease.

Wind is the other main renewable source included in the Kingdom's "clean energy" objectives. As of 2021, the only operational wind project is Turaif, operated by Saudi Aramco, with a capacity of 2.75 MW. Three large scale wind projects have been envisaged in the Kingdom. Its first wind project, the 400 MW Dumat Al Jandal wind plant, is expected to be fully commissioned before the end of 2021, starting to produce in 2022. The plant, whose construction started in September 2019, is the first large wind power plant in Saudi Arabia and the largest in the Middle East. A consortium of EDF Renewables and Masdar is responsible for the project, which is expected to produce 1.4 TWh/year under a 20-year PPA. The second wind project regards the on-shore Yanbu wind farm with a capacity of 850 MW, which was in the announcement phase in 2021 and the operator is REDPO. Lastly, the Plambeck floating offshore wind, with a capacity of 500 MW, was also in the announcement phase in 2021, and its operator is Plambeck Emirates (ENERDATA 2021a).

[5] The five other projects are: the 600 MW Shuaibah project, the 300 MW Rabigh project, the 200 MW Qurayyat project, the 50 MW Al Madinah and the 20 MW Rafha.

Table 4.4 Main solar PV projects in Saudi Arabia

Project	Capacity	Current phase	Probability of completion
1st round NREP (Sakaka)	300 MW	In operation (completed in 2019)	**NR**
2nd round NREP Category B (Rabigh, Jeddah, Qurayyat IPP and Al Faisailah projects	1.4 GW in total: Rabigh and Jeddah (300 MW each) Qurayyat IPP(200 MW) Al Faisailah (600 MW)	REDPO shortlisted bidders for Rabigh (Marubeni and Al Jomaih), Qurayyat IPP (ACWA Power consortium) and Jeddah (EDF, Masdar and Nesma Holding) while for Al Faisailah the two shortlisted companies (Masdar and ACWA Power) submitted their BAFO to REDPO	**High***
2nd round NREP Category A (Medina PV IPP and Rahfa PV IPP)	70 MW in total: Medina PV IPP (50 MW) Rahfa PV IPP (20 MW)	REDPO shortlisted Al Blagha Holding consortium for both projects	**High***
3rd round NREP (Layla, Wadi Al Dawaser, Saad and Al Rass)	1.2 GW in total: Layla (80 MW) Wadi Al Dawaser (120 MW) Saad (300 MW) Al Rass (700 MW)	REDPO shortlisted 49 consortia and companies for all the five projects	**Quite high****
Al-Jawf	200 MW	This solar project is in the bidding phase (2021) and it is fully owned and operated by Saudi Electricity Company (SEC)	**Quite high****
Sudair Solar	1417 MW	PPA has been signed and the commissioning year is 2022. The project is operated by Saudi Electricity Company (SEC) and its shareholders are ACWA Power (50%) and Badeel (50%)	**High***
Shuaibah PV	600 MW	It is operational and it is jointly operated by ACWA Power, Gulf Investment and Al Babtain. Contracting	**NR**

(continued)

Table 4.4 (continued)

Project	Capacity	Current phase	Probability of completion
Mekkah solar power project	2.6 GW	A MoU was signed. REDPO will tender 600 MW of the project while PIF will develop the remaining 2 GW	**Medium** (Capacity may change over time, given its high estimate and the project is still at the beginning phase so changes may occur)

*Company already shortlisted; **selection process underway; *NR* Not Relevant
Source Authors' elaboration

Saudi Arabia, akin to other regional peers, notably the UAE, is evaluating the development of a decarbonized hydrogen production industry under the responsibility of the Ministry of Energy. In this country the promotion of hydrogen is pursued along with renewable and gas projects. Indeed, several projects, regarding both blue and green hydrogen production, are under development. In March 2021, Air Products, ACWA Power and NEOM signed a $5 billion agreement to build a 1.2 Mt/year ammonia production plant in Saudi Arabia, which will be fed with green hydrogen produced using 4 GW of solar, wind and storage. The project is scheduled to be commissioned in 2025. A month later, ENEOS and Saudi Aramco signed an MoU to develop a blue hydrogen and ammonia supply chain connecting Japan and Saudi Arabia, while Altaaqa and AFC Energy have signed a MoU to develop and use AFC Energy's hydrogen fuel cell technology in Saudi Arabia and the Middle East.

- **Scenario**

Saudi Arabia is expected to reach, and likely exceed, the Vision 2030 target for solar energy that was set in 2016 (5.9 GW), before being revised in 2019. However, it will be undeniably challenging for the Kingdom to reach its new upgraded target of 40 GW from solar energy projects by 2030, even when including all the envisaged new solar projects. Also, the interim target of 20 GW of solar energy by 2023 seems difficult to attain, as the combined capacity of all current projects may not be sufficient to reach this objective. Saudi Arabia will need to massively push for the development of renewable projects, especially PV, in the 2020 decade if it wants to succeed in reaching the solar target of the Vision 2030.

While giant leaps have been made to increase the capacity of renewable energy in the Kingdom, numerous challenges may prevent the full exploitation of renewable sources. First, the roles of the two main bodies regulating renewable energy—King Abdullah City for Atomic and Renewable Energy (KA-CARE) and Electricity and Cogeneration Regulatory Authority (ECRA)—may be at times ambiguous, leading to administrative and regulatory problems (ETHRAA 2019). Furthermore, despite its great potential in the Kingdom, the adoption of small-scale solar PV is supported by only few incentives. To promote small-scale solar PV (from 1 kW to 2 MW), the

Electricity & Cogeneration Regulatory Authority introduced a net metering scheme in 2018, whereby the surplus solar electricity exported to the grid is subtracted from the quantity consumed the following month (Asif and Khan 2018). The rules were updated in July 2020 to better incentivize such decentralized installations. As this policy alone is not deemed to sufficiently incentivize the adoption of small-scale PV in the short term, the net feed-in tariff (NET-FIT) scheme might be introduced. Under this scheme, priority for the electricity generated is given to self-consumption and generators receive payments only for the net excess of power exported to the grid, with a tariff rate set above the retail price to incentivize the market. The NET-FIT scheme is deemed particularly suitable for the Kingdom for several reasons. Firstly, it does not disrupt the current net-metering framework, which simplifies its implementation. Secondly, the NET FIT scheme becomes even more financially advantageous for small generators, especially in a context of gradual decrease and abolishment of subsidies on electricity prices by 2025 as announced by Saudi Arabia in 2017 (Gnana 2017). Lastly, this policy promotes energy conservation, which is a key objective of the Kingdom given the projected growth in electricity demand. In the medium-long term, when small-scale PV is widely adopted and (if) electricity subsidies are eliminated, the government may gradually reduce the NET-FIT rate. Overall, this scheme might be applied to residential, commercial and industrial buildings. Financial incentives also enhance the adoption of small-scale solar PV. To help cover the upfront capital cost, Saudi Arabia could offer soft loans (below-market rate or zero interest loans with longer repayment periods) or capital subsidies (covering a share of this cost).

Despite the economic hardship caused by the Covid-19 pandemic, Saudi Arabia has expanded its commitment to renewable energy sources as the Saudi Green Initiative proves. However, in order to achieve its official targets, Saudi Arabia will need to provide financial resources as well as guarantee policy supports (e.g. reforming energy prices and subsidies) despite potential economic challenges and volatility.

In-depth assessment of possible attainment of renewable targets

The original goal of Vision 2030 (9.5 GW by 2030) may well be attained, thanks to the current projects proposed and their different level of development. As aforementioned, it will, however, be very challenging for the Kingdom to attain the new Vision 2030, i.e. the 40 GW solar target by 2030 and the interim 20 GW solar target by 2023, given that all the projects announced in 2021, regardless of their development phase, have a combined capacity slightly above 5 GW.

Regarding the CSP target, only three CSP projects are envisaged in the Kingdom, and they are at different phases: Waad Al-Shemal (50 MW) is operational, Duba ISCC-1 (43 MW) is under construction, while Taiba (180 MW) has been announced. Nevertheless, if all completed, the combined capacity of the three projects is relatively low (273 MW). Thus, it may be quite unrealistic for the Kingdom to considerably boost investments and attract CSP projects in such a short period of time to attain the 3 GW CSP target by 2030. However, since CSP plants are quite new in Saudi Arabia and the construction of the first two CSP plants has only recently begun (in 2017 and 2018), it is difficult to predict whether the 2030 objective (3 GW) will be reached.

Also, CSP technology costs continue to decrease, especially thanks to economies of scale and the 35-year power purchase agreement (PPA), hitting the lowest price of USD73/MWh. These recent developments may result in an exponential uptake of this technology (Helioscsp 2019a).

The Kingdom has to walk on a steep path to reach the new objective of 16 GW capacity in wind by 2030, as the only operational wind plant—the Turaif plant- has a capacity of 2.75 MW. Mackenzie Power and Renewables forecasted Saudi Arabia to develop numerous wind projects for a total capacity of 6.2 GW between 2019 and 2028 (Richard 2019). However, these figures might be over-optimistic since, to date, out of the three large-scale wind projects developed, only the Dumat Al Jundal wind project (400 MW) has been put forward. The others are just in the announcement phase or under construction (Midyan wind park) and have a combined capacity of 1.75 GW. Nevertheless, it may well be possible for the Kingdom to develop a total wind capacity of around 3.1 GW in the medium term (by 2030), especially in light of the evaluation of the new wind project. By doing so, Saudi Arabia could reach the original objective of Vision 2030, which included 3.5 GW of clean power, excluding solar energy.

Saudi Arabia has also envisaged the development of nuclear energy, as it would provide a base load to the electricity sector, while solar energy would guarantee the peak load. 70% of electricity demand in the Kingdom is represented by air conditioning, part of which is base load and part of which has a good correlation with sunshine. In this regard, the Kingdom established King Abdullah City for Atomic and Renewable Energy (KA-Care) in 2010, and this institution set the goal to build 16 nuclear reactors producing a total of 17 GW by 2040 on the Gulf. To date, Saudi Arabia has planned a tender process in 2020 for the development of two large nuclear plants (2.8 GW) and has updated its agreement with South Korea for the construction of one Small Modular Reactor (300 MW) (World Nuclear Association 2019a). In 2018, Saudi Arabia approved a new nuclear policy, planning to build 16 reactors with a total capacity of 18 GW over the next 20 years. It has been reported that Chinese companies had expressed their intention to collaborate with Saudi energy companies and authorities in this sector. Saudi Arabia would particularly benefit from the adoption of Small Modular Reactors (SMRs) compared to large nuclear plants for various reasons. Since SMRs are a new and emerging technology, Saudi Arabia may leverage the partnership with South Korea's vendor to localize and export a portion of the SMR value chain, enabling human capital development and the growth of private and public investments. While the costs and the risks are higher for the first units constructed, the overall costs per unit of electricity of SMRs (\$2-\$4/MW) are lower than large reactors (\$9.8/MW) (Mansouri 2019). Other economic advantages include lower upfront capital costs per unit, lower investment risks and simplified design.

To sum up, it is challenging for the Kingdom to attain the latest ambitious targets announced by REDPO in 2019 (40 GW from solar, 16 GW from wind and 3 GW from CSP by 2030), given the projects proposed and the current wind or solar power plants already in operation. However, Saudi Arabia is very likely to reach its Vision 2030 objective regarding solar energy (5.9 GW) and to surpass it (even doubling it in the best-case scenario). Also, even though the country may not reach its wind objective (3.5 GW), it is likely to exceed its solar power targets, enabling the Kingdom to reach the original 9.5 GW objective of total renewable energy by 2030.

4.2.2 United Arab Emirates

- **Targets and Projects**

The UAE is composed by a group of emirates, which could pursue different policies in different fields. Regarding renewable energy sources, the UAE is characterized by a multi-vector policy, due in particular to the different energy policies pursued by Abu Dhabi and Dubai. Surely, the UAE—especially Abu Dhabi—has elevated itself from a respectable oil and gas producer to become a key leader in clean energy solutions in the MENA region. The IRENA headquarters, located in Masdar City, Abu Dhabi, are proof of the great emphasis that the UAE puts on renewable energy sources. Renewable energy also represents a great opportunity to enhance and display its technological, financial and political capability and ambitions. Meanwhile, Dubai had considered more polluting solutions (i.e. coal power plant) to raise its energy status, stressing the multi-vectoral energy policy in the UAE.

Despite its complex nature, the UAE has published ambitious renewable targets over the years, showing its appetite to play a key role in the future energy sector at world level. In 2015, the UAE published the "UAE State of Energy Report", which set the target of 27% of the country's energy mix from clean energy by 2021. A couple of years later, in 2017, the "Energy Strategy 2050" was published with the goal of increasing the percentage of clean energy (intended as renewables plus nuclear) in the energy mix from 25 to 50% by 2050. More in detail, the UAE aims at producing 44% of the energy mix from renewables, 38% from gas, 12% from clean coal and 6% from nuclear (UAE Ministry of Energy and Infrastructure 2017). These ambitious targets also reveal the great effort conveyed to strengthen energy self-sufficiency for the country. While coal can be easily imported, without any particular economic or geo-political implications, in Abu Dhabi gas will continue to be produced mainly domestically, thanks also to the new gas discoveries, or imported to other Emirates through the Dolphin pipeline from Qatar, or imported thanks to LNG. With long-term contracts between the UAE and Qatar expiring in 2032, security of gas supply could be partly reduced, as uncertainty surrounds new gas contracts and gas prices. All in all, the Energy Strategy 2050 pushes for a 70% reduction of the carbon footprint in power generation. In order to reach these targets, the UAE is committed to using its abundant financial capability, announcing the investment of AED 600 billion (around $163 billion) by 2050 for renewable energy. Similarly, in December 2020 the UAE updated its NDC, including the first emission reduction target by 2030, corresponding to a decrease in emissions of 23.5% below the Business-As-Usual scenario (BAU) by 2030. In May 2021, the Ministry of Energy and Infrastructure of the UAE reiterated its commitment to reduce the country's CO_2 emissions by 70% by 2050, as defined in the Energy Strategy 2050, and to increase the use of clean energies—renewables and nuclear—by 50% by 2050. The UAE aims at reducing its emissions especially thanks to solar and green hydrogen. Also, the country plans to reduce electricity consumption by 40% as its electricity consumption per capita is one of the highest in the world. The Emirati policymakers are increasingly committing to renewable energy sources. The country aims to reach 20% of its installed capacity (50 GW) from clean sources (11 GW, including nuclear) in the short term (by 2024). Finally, in October 2021 the UAE restated more vigorously its climate ambitions with the announcement of its pledge to become carbon–neutral by 2050. To achieve the pledge, the UAE needs to face both significant challenges (high carbon intensity, overdependence on fossil fuels) and some advantages (small population, vast financial resources and limited economic complexity).

In 2020, the UAE had a renewable energy capacity of 2540 MW over a total installed capacity of 40,026 MW, corresponding to 6.3% of the total electricity capacity. However, their lower capacity factor (compared to thermal generation) resulted in a much lower share contribution in terms of power generation. In 2020 renewable energy sources produced in the UAE were only 5034.8 GWh, which accounted for 3.6% of the country's total electricity production.

In order to reach these targets, various projects have been planned and, in some cases, commissioned. Numerous proposals, especially solar energy in the Emirates of Dubai and Abu Dhabi, if implemented, are set to break various world records, in terms of capacity and LCOE. Firstly, in Dubai, the renowned Mohammed bin Rashid Al Maktoum Solar Park is expected to become the largest single site solar energy park in the world with a capacity of 5 GW by 2030 and total investments amounting to AED 50 billion ($13.5 billion). The first two phases of the project have been carried out in 2013 and in 2017 with a capacity of 13 MW and 200 MW, respectively. The third phase was commissioned in November 2020 with a capacity of 1000 MW, while the last phase will take place at the end of the 2020s with an expected capacity of 800 MW by 2030. When fully operating, the Al Maktoum Solar Park is expected to meet 25% of Dubai's total domestic demand for electricity (EIA 2020). In 2019, DEWA announced that the ACWA Power would build and operate the fifth phase (900 MW solar PV power plant) of the project. The 900 MW fifth phase would bring the current production capacity of the Mohammed bin Rashid Al Maktoum solar plant to 1313 MW. Once fully operational, the plant will have a total capacity of 5000 MW. In August 2021, ACWA Power announced the official inauguration of the 300 MW first stage of the 900 MW Shuaa Energy 3 PS.

Moreover, in 2016, the Abu Dhabi Water and Electricity Authority (ADWEA) tendered the first PV project of this Emirate at utility level: the Sweihan solar power plant (1117 MW). At the end of the bidding, in terms of capacity, the proposals were surpassing 1 GW. The construction began in May 2017 and commercial operations started in April 2019. The photovoltaic IPP was initially proposed as a 350 MW project, but the capacity was increased to the present capacity due to the availability of additional land. As of 2021, the Sweihan solar power plant is operated by ADWEA with a capacity of 1177 MW and its shareholders are ADWEA (60%), Marubeni

(20%) and JinkoSolar (10%). Also, smaller and worse-off emirates are planning to invest in renewables to satisfy the targets of the Energy Strategy 2050. The Emirate of Umm Quwain, for instance, is developing a solar park with an expected capacity of 500 MW, which is in the bidding phase, as of 2021.

In terms of CSP, the Emirate of Dubai started the construction of the largest Concentrated Solar Power—Noor Energy 1—in the Mohammed bin Rashid Al Maktoum Solar Park, with a capacity of 700 MW, which is planned to come online in 2021. To put this project into context, the current largest CSP in Morocco has a capacity of 150 MW. Similarly, in 2013 the Emirate of Abu Dhabi commissioned the largest concentrated solar power plant in the world (at that time) named Shams 1, which provides electricity to roughly 20,000 households thanks to a capacity of 100 MW. It was developed and financed by the Shams Power Company, a joint venture between the Emirati Masdar (60%) and a consortium composed of Total (20%) and Abengoa Solar (20%). The latest investments of Dubai and Abu Dhabi Emirates in Concentrated Solar Power reflect the main advantage of this technology, which enables energy storage. Indeed, solar heat is retained through thermal storage for 8–12 h and it is converted to electricity at night in order to meet the demand.

In its "Energy Strategy 2050", the UAE also set a target for nuclear energy (6% of the energy mix by 2050). Thus, the country has pursued an ambitious nuclear program, which accomplished some major developments. The nuclear program envisages an investment of $24 billion for the construction of a nuclear power plant in Barakh, Abu Dhabi. The plant consists of four reactors (with a capacity of 1400 MW each) for a total capacity of 5600 MW. The first unit was connected to the grid in August 2020, becoming the first operating nuclear reactor in the Arabic peninsula. The other three units are expected to be commissioned in 2021/2022. Once fully operational, the power plant will cover almost 25% of domestic electricity needs.

On the contrary, the UAE does not prioritize wind energy, which is not yet particularly developed in the UAE, in line with other GCC countries. Overall, the UAE is the first GCC country to have installed a wind turbine on Sir Bani Yas Island with a capacity of 30.85 MW, commissioned in 2008.

All in all, the UAE has been pushing renewable energy as an essential pillar of its energy policy. With its aggressive strategy of renewable energy adoption, with respect to most other MENA countries, it has actively contributed to an overall decrease of the costs of renewable energy technology, primarily solar PV.

- **Scenario**

Predicting whether the UAE will reach the objectives set in its Energy Strategy 2050 is deemed more challenging and unforeseeable with respect to other GCC countries, because of the longer time spam considered (2050 for the UAE vs. 2030 for KSA). Thus, more variables come into play, which may affect the speed of adoption of renewable installations (i.e., economic growth, the global economic crisis, oil prices, technological development for renewables and transport, the role of gas in the energy transition, weather conditions). However, given the data and trends currently available, some projections might be envisaged. Since the renewable targets set for the UAE correspond to a percentage of its energy mix, in order to achieve these objectives, the level of investments and the capacity of new solar and wind projects will depend on the growth of the total primary energy consumption over the next 30 years.

Even though the UAE has displayed a remarkable interest in renewable projects, a large amount of additional capacity is deemed necessary to reach its 44% of energy mix coming from renewable sources by 2050 (considerably more than the one planned to date).

The main renewable projects proposed in the UAE represent less than 1% of the country's primary energy demand and 3% of power generation in 2019. The current renewable projects planned seem far from the clean energy targets (44% of renewables in the energy mix by 2050). It is therefore necessary to significantly increase investments in renewable energy projects to attain the country's renewable targets, also given the forecasted growth in total primary energy consumption.

The exact additional capacity needed to attain these targets depends on the growth of the electricity demand. Regarding electricity consumption, in the last two decades electricity demand has grown by approximately 7% per year. Such a high growth rate might not be followed by the same growth in the capacities of renewable projects. However, the growth rate in demand might tend to diminish since one of the main points highlighted in Energy Strategy 2050 regards improvements in energy efficiency (by 40% compared to 2017 levels) including higher prices. Moreover, also a change in the country's immigration policies might lead to a change in demand since 90% of the total population in the Emirates is composed of foreigners (Forstenlechner and Rutledge 2011). Regarding the effects of investments on the capacity of the renewable power plants proposed, technological improvement plays a fundamental role also with respect to the total renewable capacity that might be attained with the investments planned (AED 600 billion by 2050). In this regard, sovereign wealth funds (SWF) play a key role in "green" investments. For instance, the Abu Dhabi Investment Authority (ADIA), one of the main SWFs amounting to $710 billion at the end of 2020, started a climate change equity portfolio in 2020 and is a shareholder in projects that generate a total of 20 GW of power from clean sources (Arabian Business 2020). Similarly, the Mubadala Investment Company, an Emirati SWF, fully owns Masdar, one of the leading developers and operators of renewable energy projects at utility-scale in the MENA region and beyond. Since 2006, Masdar has invested a total amount of $2.7 billion (Masdar 2021).

At the same time, the UAE presents a curious dichotomy regarding energy transformation and climate policy, especially in its two major emirates: Abu Dhabi, though being a hydrocarbon producer, set itself as a major clean energy pioneer in the region, while Dubai decided to invest in coal power plants. Indeed, the Hassyan coal-fired power plant, when fully operational with a planned capacity of 3.6 GW, will not only be the first coal plant in the GCC, but the largest one in the broader MENA region, surpassing even Turkey (Afsin-Elbistan power station, 2.8 GW). The first phase of Hassyan is expected to be completed in 2020–2021, with a capacity of 2.4 GW. Hassyan is categorized as a "clean coal" power plant, as it follows the strictest environmental regulations and a CCS is to be built. Thus, this plant contributes to the attainment of the UAE 2050 target of 7% of clean coal in the energy mix, as a way to enhance energy security. However, in 2022 Dubai announced that the Hassyan power plant will be converted to use natural gas amid the UAE's wider pledge to reach net-zero by 2050 (AP 2022).

Some key challenges arise for the wide deployment of renewable energy, due to intrinsic peculiarities as well as external circumstances. Indeed, a major difficulty the UAE is likely to face consists of accompanying R&D with the development of local manufacturing capacity and intellectual property rights, which may contribute to the localization of industries and economic diversification.

Lastly, since each Emirate has a relatively high degree of freedom in energy regulation, it may be quite challenging to carry out a cohesive strategy and development in the renewable energy field. A clear example regards the Hassyan coal power plant, revealing divergence in energy policy between Abu Dhabi and Dubai. While Abu Dhabi aims at reducing energy vulnerabilities by lowering the share of gas in the energy mix to become less dependent on Qatar, Dubai also seeks more autonomy in the energy field from Abu Dhabi itself.

Overall, the UAE is a pioneer in renewable energy technology and investments in the MENA region. It has made considerable investments in R&D for renewable technology, as part of the wider diversification effort to become a technology and green hub. Nevertheless, some challenges are present in the UAE, regarding not only the attainment of the ambitious 2050 renewable targets, but also a struggle of intentions. Energy is not a federal competence, allowing each emirate to maneuver with a certain degree of freedom. Emirates came together as the UAE produced its NDC. However, some frictions and disagreements could prevent coherent energy policy in the UAE. The initial commissioning of the Hassyan coal plant is quite illustrative. Nonetheless, the UAE is strongly committed to leading renewable energy policies and development in the MENA region, taking advantage of its small population and vast financial resources.

4.2.3 Qatar

- **Targets and Projects**

Qatar is considered a late adopter of renewable energy compared to its regional peers. This condition may be motivated by its vast gas reserves combined with a small population. These features have historically allowed the country to export large amounts of gas—and consequently earn massive rents. Natural gas has been considered the 'fuel bridge' for the global energy transition, contributing to replacing more polluting sources (notably coal) in the energy mix and reducing CO_2 emissions. This status has also contributed to rosier forecasts of gas demand compared to oil demand, and it may have induced Qatar to prefer investing and consolidating its position in the gas industry, especially in the LNG sector, rather than committing to and implementing plans for the development of renewables. However, natural gas' environmental footprint has increasingly been put under scrutiny, threatening its label of 'fuel bridge'. Natural gas emits less CO_2 (carbon dioxide) compared to other fossil fuel sources, yet it is responsible for the emission of CH_4 (methane). With methane being increasingly put in the spotlight, especially following the 2021 IPCCC Report, Qatar may revise and expand its commitment in favor of renewable energy sources and other technological solutions (i.e. CCUS) that may preserve the country's current business model based on exporting natural gas. Qatar ratified the Paris Agreement in April 2016 and it submitted a Nationally Determined Contribution (NDC) in 2015. The country did not make any firm commitment to reduce its GHG emissions in its first NDC in 2015. In August 2021, the Gulf country submitted an updated version of its NDC, which enhanced Qatari ambitions towards reducing its overall emissions. Indeed, Doha announced its intention to achieve a 25% reduction of its GHG emissions by 2030, relative to baseline scenario.

Regarding renewable energy, the country strives to meet 20% of its energy demand from RES by 2030. Qatar's plans to develop renewable energy sources have so far been delayed for years even though it inaugurated the first solar-panel factory (300 MW/year) in 2014. Doha planned to build a large 3.5 GW solar complex in the long term, which however has been frozen. Qatar was committed to exploit its solar potential, reaching a capacity of 1800 MW by 2020 for a cost estimated between $10–20 billion. However, the first large-scale solar power plant (the 800 MW Al Kharsaah photovoltaic power project) has been commissioned in October 2022. The project is composed of two phases. Developed under the build, own, operate and transfer (BOOT) model, the project will be owned by Siraj Energy, Marubeni and Total for a period of 25 years. The ownership of the power plant will then be transferred to Qatar General Electricity & Water Corporation Kahramaa (Power-technology n.d.).

The targets set in the renewable energy field were published in the Qatar National Development Strategy, envisaging the commissioning of 200 MW solar energy projects by the end of 2020, to be increased to 500 MW afterwards (Planning and Statistics Authority 2019). By contrast, Qatar's National Development Strategy 2018–2022 does not outline any wind energy target. The slower pace of renewable adoption and deployment of renewable energy sources is shown by the lack of a precise deadline at governmental level to increase the renewable capacity to 500 MW. Nevertheless, Qatar Petroleum has stepped up its efforts in the renewable energy field, aiming at installing 4 GW of solar PV by 2030 (Adler 2021). Moreover, Qatar Petroleum launched its new Sustainability Strategy, which establishes several targets in line with the goals of the Paris Agreement in January 2021. In the Strategy, QP outlines several targets to reduce greenhouse gas emissions by 2030. It aims at reducing the emissions intensity of its LNG facilities by 25%, of its upstream facilities by at least 15%, and at reducing flare intensity across upstream facilities by over 75% (QP 2021). In order to reduce its GHG emissions, QP is also working on one of the most crucial technological solutions for Qatar's gas exports, carbon capture storage (CCS). In 2019, QP successfully inaugurated the largest CO_2 recovery and sequestration facility in the MENA region with a design capacity of 2.2 Mtpa of CO_2 at Ras Laffan (QP 2020). Under its sustainable strategy in 2022, QatarEnergy (the former QP) announced that it aims to develop of CCS facilities to capture more than 11 Mtpa of the country's CO_2 by 2035 in Qatar.

With respect to other Gulf countries, Qatar has a lower economic and strategic need to develop renewable energy, as demonstrated by the lack of specific renewable targets for the energy sector in the Qatar National Vision 2030. Indeed, given the abundancy of gas and the expected growing demand of gas in the medium term, Qatar may be less pushed to invest in renewable energy than oil-rich countries. Therefore, only a few broad statements regarding renewables have been formulated in Qatar's Vision, while the main focus is the pivotal role of gas in the security of supply and in the country's energy mix as well as exports. In order to preserve its business model and its status of world's top LNG exporter, Qatar has emphasized and invested in decarbonization solutions for its LNG industry, such as CCS, rather than developing renewable energy sources. At the beginning of 2021, in the Qatar Petroleum final investment decision (FID) for the planned Qatargas expansion, a CCS was also envisaged, which would reduce carbon emissions by 25% with respect to other comparable projects worldwide (Adler 2021). This CCS project is expected to be completed by 2025 and to have the largest capacity in the LNG industry worldwide. The carbon could then be used for enhanced oil recovery (EOR) in existing oil and gas fields.

Solar energy represents the main pillar of the development of renewable energy in the country, while wind energy is largely absent from official documents and discourses. Despite the rather low and short-term targets set for renewable energy, the Ministry of Municipality and Environment has announced that Qatar is likely to exceed the 20% solar energy production level in 2030, during a high-profile meeting organized by UNGA on the topic "Climate and Sustainable Development for all" at the beginning of 2019 (The Peninsula 2019). Moreover, Qatar has placed particular emphasis on the enhancement of energy efficiency and the subsequent reduction of electricity and water consumption by 25% and 35%, respectively, by 2022. It is the only country that has set a target for the reduction of water consumption in energy efficiency measures, reflecting the quasi-total dependency of water supply on energy-intensive desalination plants (IRENA 2019).

As of 2020, few renewable energy projects are present in Qatar. A ground and roof mounted solar plant is currently operating with a capacity of 1.1 MW (Qatar Solar Technology n.d.). However, the first large-scale project for solar power generation—located in Al Kharsaah—was announced at the end of 2018 by Qatar General Electricity and Water Corporation (Kahramaa), which also owns and manages the country's transmission and distribution systems. At the beginning of 2020, the French Total and the Japanese Marubeni won the bid for its construction with an estimated capacity of 800 MW to be operationalized by 2022. The total project is estimated to cost around $500 million with Total and Marubeni owning a 40% stake while Siraj Energy—a joint venture between QP and Qatar Electricity & Water Company—the remainder (TotalEnergies 2020).

Despite the rather low and vague renewable targets at government level, some changes are underway. Indeed, in 2021, Qatar Petroleum has stepped up its efforts in the renewable energy field, as it aims at installing 2–4 GW of solar PV by 2030 (Adler

2021). The willingness of Qatar Petroleum to boost its renewable portfolio is likely to reflect the country's present renewable ambition, as H.E Saad Sharida Al-Kaabi is both the President and CEO of the NOC, and the country's Energy Minister.

In conclusion, Qatar is taking its first steps in the renewable world, as it probably sees this sector as a great opportunity to show its technological progress. Unlike most of the other countries in the MENA region, Qatar does not have the same urgency to invest in renewable energy, because it expects decarbonized gas to play a key role within the global energy transition. For these reasons, it is increasingly considering investments in decarbonization technologies (CCUS) and detection and reduction of methane leakages to make its LNG acceptable in a low-carbon future.

- **Scenario**

Given the small capacity projects and the lack of specific renewable targets in its Vision 2030 as well as in its updated NDC in 2021, it might be concluded that the country does not yet consider the development of renewable energy projects as one of its key priorities. Indeed, the increasing key role of gas in the country's energy mix and energy transition in the mid-term, the limited territory available for the development of large solar parks and the slow processes of investment, bidding and tendering (The State of Qatar 2018), might represent some key challenges for a strong political commitment in favor of the full exploitation of Qatar's renewable energy potential. Moreover, the country needs to perhaps better delineate the responsibilities in setting renewable targets between the government and Energy Ministry and Qatar Petroleum.

Nevertheless, Qatar is likely to achieve its renewables objectives declared in the Qatar National Development Strategy 2018–2022. In order to be in line with the Qatar National Development Strategy 2018–2022, the first phase (350 MW) of the solar PV project in Al Kharsaah is going to be commissioned in 2021, while the remainder in 2022. The President of Kahramaa—who signed a 25-year PPA for the output of the solar plant—stated that PPA prices were the lowest ever, without disclosing them (Parnell 2020). Thus, very low prices in Qatar and in the GCC region for solar PV may further incentivize Qatar to make conspicuous investments in renewable energy, and employing solar energy domestically may even become economically more convenient than gas, which has the opportunity cost of export. Moreover, thanks to its important financial capabilities, Qatar is focusing on the development of small-scale renewable projects, especially those representing a technological breakthrough in this field. By doing so, Qatar has the opportunity to show off its technological advancement and its willingness to invest in renewable energy.

To conclude, Qatar has moved more slowly than its regional peers in the development of renewable energy. However, greater political pressure and economic considerations may incentivize Doha to take advantage of favorable and lower renewable costs increasing its investment efforts in energy transformation. At the same time, Qatar has enhanced its commitment to position itself as leading player in the LNG industry in a low-carbon scenario, investing in CCS projects.

4.2.4 Oman and Bahrain

- **Targets and projects**

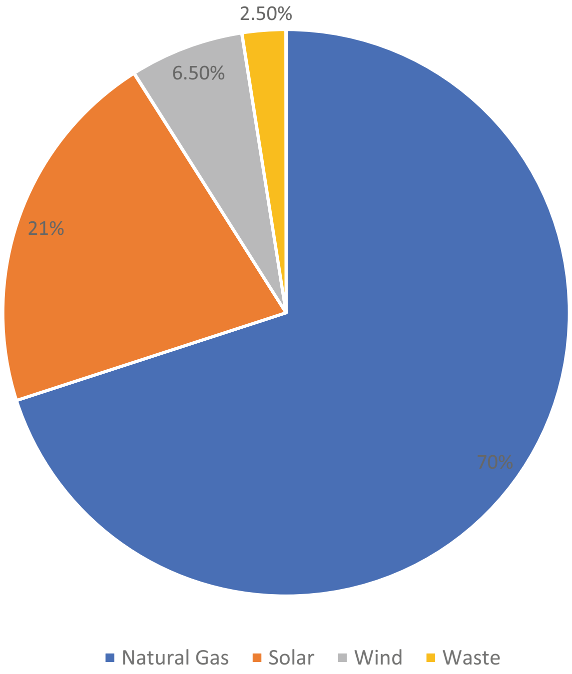
Oman and Bahrain currently rely only on gas to meet their domestic electricity demand. However, the development of renewable energy in both countries has been pushed by numerous factors including the strong growth in internal electricity consumption (around 8.6% of average annual growth rate in Oman and 4.8% in Bahrain between 2009 and 2019) (IEA 2020b, c), the depletion of fossil fuel reserves and a relatively high rate of nationals' unemployment, especially among the young. For instance, Oman is striving to develop a domestic solar energy industry through the transfer of know-how from foreign companies with the aim to create thousands of jobs in this sector.

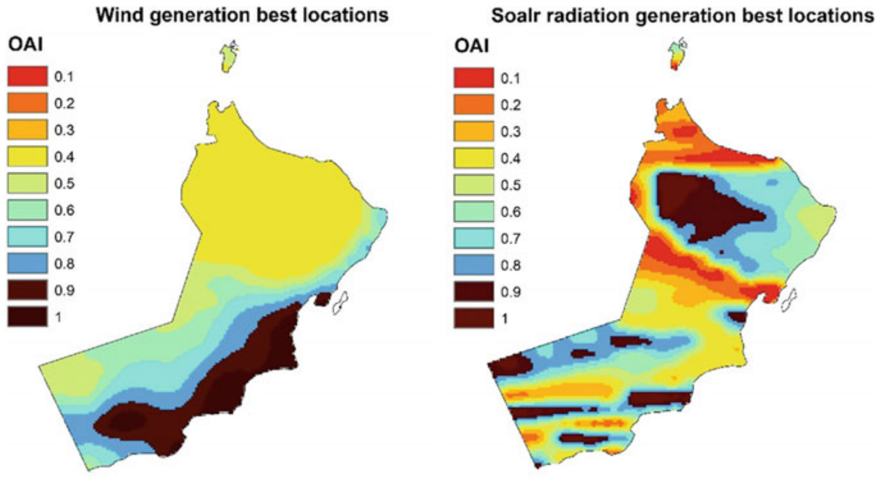
Thanks to its large territory, Oman holds a great potential for the development of renewable energy projects. Indeed, a 2008 study carried out by Oman's Authority for Electricity Generation found that 50% of homes with a 20 m^2 rooftop could install solar panels for a combined solar capacity of 420 MW. Moreover, the study affirmed that using only 0.1% of the country's land area, CSP plants could be built in the desert, and would provide 2.8 GW of solar energy capacity. The study also projected the potential capacity of 375 wind turbines to amount to at least 750 MW. Thus, if all these projects were to be carried out, the overall renewable energy capacity would amount to 3.97 GW, corresponding to nearly 50% of the country's total installed capacity in 2018 (Al-Sarihi and Bello 2019). Thus, in 2019, the Oman Power and Water Procurement Company (OPWP) set the renewable energy target of 30% of the country's energy mix by 2030: the predominant source is solar (21% of the total energy mix), followed by wind (6.5%) and waste energy (2.5%), as shown in Fig. 4.1. Map 4.4 highlights the most suitable locations in the Sultanate for the installation of solar and wind capacities.

OPWP also planned to generate 3.05 GW from renewable energy sources by 2025. While from 2014 to 2018 renewable energy increased only from 1 to 8 MW (less than 1% of the country's electricity mix), in the last couple of years the Sultanate has stepped up its efforts to steadily increase the share of renewable energy in the country's energy mix. Indeed, regarding large-scale solar projects, in March 2019, the OPWP awarded the first IPP for the construction of the 500 MW Ibri 2 Project to the consortium led by the Saudi ACWA Power, with an expected investment of $400 million and in operation in June 2021. The OPWP also issued a request for qualification in July 2019 for the development of a second IPP—Manah 1—with a total capacity of 1.1 GW. Other solar IPPs have been planned with a timeframe for the bidding process, construction and operationalization as detailed in Table 4.5.

IPPs for wind are also scheduled in the coming years, as Table 4.5 shows. The first Omani wind plant, developed by Masdar, came online in Dhofar in 2019 with a capacity of 50 MW, which is seen as a success, as it is also the first wind plant in the GCC. Also, a waste-to-energy plant (120–160 MW) has been planned to come into operation by 2024.

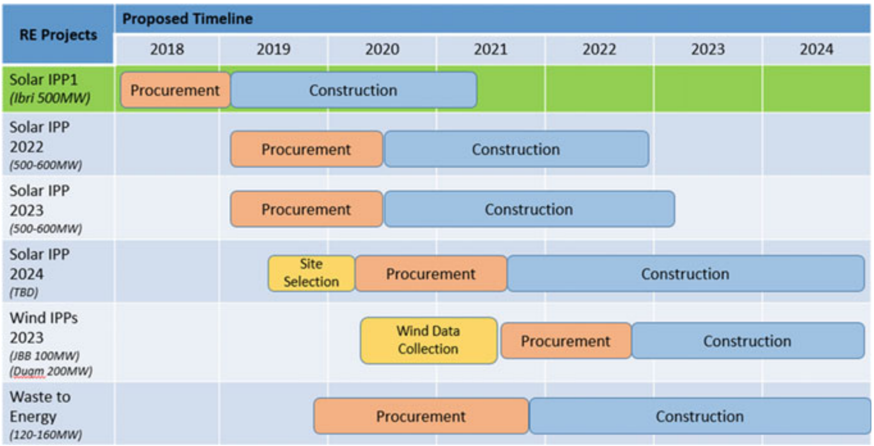
Fig. 4.1 Oman's energy mix by 2030. *Source* Authors' elaboration





Map 4.4 Solar and wind energy potential in Oman. *Source* Hereher, Al-Kenawy 2020

Table 4.5 Planned solar IPPs in Oman



Source Authors' elaboration on Prabhu (2020)

Lastly, Oman has stepped up its efforts in renewable energy also thanks to the Sahim project, which is projected to boost the adoption of small-scale solar energy, which holds a high potential in the country. Indeed, the first phase (2018) of this initiative pushed for the adoption of rooftop solar panels, with the possibility to export excess electricity to the grid. The second phase (2019) aimed at the installation of rooftop solar panels in 10–30% of houses, for roughly a total of 1 GW of capacity (Oxford Business Group 2020a).

Bahrain is focusing on the development of renewable energy, especially to compensate the widening gap between the growth in domestic primary energy supply (4.2% per year) and domestic consumption (5.3% per year) over the last twenty years (Sustainable Energy Unit 2018). The gap widens even further when non-industrial energy consumption is taken into account, as it grows at 6.6% per year. Thus, also to partly offset this issue, in 2014 Bahrain set the target of 255 MW of solar energy capacity to come online by 2025, thanks to mostly small-scale solar projects (with a target of around 150 MW) and the rest coming from Power Purchasing Agreements (PPPs) for large-scale projects (Cosgrove 2019). The renewable targets were set out in the National Renewable Energy Action Plan (NREP), which was partly developed by the Sustainable Energy Unit (SEU), established by the Kingdom in 2014. Renewable energy is extremely limited in Bahrain, as according to the IEA (2019a, b), renewable energy capacity was not yet developed.

Contrary to Oman, Bahrain has so far focused on decentralized, small-scale renewable energy projects, especially solar. A tender for rooftop solar panels was launched in 2019 for 66 government buildings, for a total capacity of 3 MW. Also, plans to install solar panels for public lighting, parking slots as well as commercial and residential buildings were proposed and discussed. The adoption of rooftop solar panels is encouraged with a net metering framework. Regarding large-scale solar projects, at the beginning of 2019 the Kingdom launched a tender for the Askar landfill solar farm, which has a planned capacity of 100 MW.

Overall, Oman and Bahrain have similar reasons to develop renewable energy capacity, but they had two diverging approaches due to their intrinsic peculiarities. Oman is relying mostly on large-scale renewable projects from various sources, thanks to its large and scarcely populated territory. On the contrary, Bahrain, given its limited availability of territory and smaller population, has concentrated its investments in small-scale projects, focusing primarily on solar PV.

- **Scenario**

Oman has been very ambitious both in terms of renewable energy objectives and planned projects. The main renewable projects in planning and construction phases may be considered on track with the OPWP deadlines to the attainment of 3.05 GW of renewable installed capacity by 2025. However, in order to reach this target, roughly 1 GW of renewable capacity remains to be developed, meaning that further investments are needed.

Nevertheless, to fully exploit its renewable potential, the Sultanate has to face and overcome a few challenges especially regarding its regulatory framework in the energy sector. Oman needs to assign clear roles and responsibilities to the numerous actors in the energy field and it should also adopt a cohesive strategy among the numerous entities to include renewable energy in different spheres (transport, electricity). Indeed, to reduce inefficiency and have a coherent strategy in the energy field, Oman started to reorganize the different bodies operating in the sector. In 2018, the Ministry of Oil and Gas was designated to become the policy-maker of all sources of energy, including power. Similarly, the independent regulator—Authority for Electricity Regulation—remained the oversight body, also incorporating water regulation. The energy-water nexus in GCC countries is becoming more and more relevant, given the projected steep growth in energy-intensive seawater desalination plants to satisfy an increasing water demand. In 2017, the Sultanate successfully introduced financial incentives to adopt small-scale solar PV, namely a Feed-in-Tariff. Nevertheless, households are required to cover the upfront expenses related to solar panels, and electricity tariffs are still very low, discouraging the switch towards self-generation. This challenge also derives from the presence of relatively high energy subsidies for electricity deriving from fossil fuel sources.

Oman could gradually liberalize the energy market in order to further attract private and foreign investments (Al-Sarihi and Bello 2019), which are highly needed, especially to reach the target of 30% of the country's total capacity from renewable energy sources by 2030. The Sultanate eyes this opportunity and puts a lot of effort in starting a privatization of utilities, as most of them are partly or fully owned by the government. At the end of 2019, Nama Holding (owned by the Nema Group, fully owned by the Ministry of Finance) announced its intention to sell a 49% stake in the Oman Electricity Transmission Company (OETC) and a 70% share in the Muscat Electricity Distribution Company (MEDC). Other utilities are projected to carry out a gradual privatization.

All in all, the recent developments and strategies carried out by Oman to overcome its main challenges in the energy and electricity sector may be quite successful in developing renewable energy sources at large scale. In this way the country's dependence on hydrocarbons would be greatly reduced, and the Sultanate could take advantage of the high renewable potential in its territory. Foreign investments could also significantly increase, with possibly positive spillovers, in terms of employment opportunities for the local population.

Bahrain has recently directed its efforts towards renewable energy by publishing its renewable energy targets in 2018, which are solely focused on solar energy. Despite Bahrain's focus on small-scale solar projects, the country may not reach its 150 MW target of small-scale solar projects by 2025 as only 3 MW of rooftop solar panels on governmental buildings are currently under discussion. Looking at large-scale renewable projects in planning, tendering, construction phases or in operation, the Kingdom may be able to reach the target of 100 MW by 2025 for large-scale solar projects. The Askar landfill solar farm, which has already been through the whole tendering process, may well signal Bahrain's ability to carry out large-scale projects thanks to a relatively attractive and reliable regulatory framework.

Nevertheless, Bahrain still faces considerable challenges for the development of renewable energy, due to intrinsic peculiarities and some inefficiencies. For instance, challenges may include the lack of vast land to construct large-scale solar or wind projects and the low level of engagement and cooperation between research institutions, public and private sectors in the renewable energy field. Moreover, other difficulties may regard financial capabilities especially for activities that enable the development of renewable energy capacity. Countries usually set up clean energy funds thanks to the allocation of a share of the government budget as well as public and private donations (SEU 2017). In the case of Bahrain, raising funds may be rather challenging, given a worsening trend in government debt over the last decade. Covid-19 further strained public finances, with government debt and government deficit reaching record-high levels in 2020, 129% of GDP and 16.8% of GDP, respectively (Fitch Ratings 2021). Nevertheless, Bahrain managed to boost the deployment of renewable energy sources through different financial incentives, namely net metering for decentralized small-scale solar PV, tender-based Feed-in-Tariffs to boost private deployment and the so-called Renewable Energy Mandate for all new buildings. The latter measure is particularly relevant as Bahrain has a thriving real estate sector (SEU 2017).

4.2.5 Kuwait

In its New Vision 2035, Kuwait has set an ambitious goal to generate 15% of its electricity from renewables by 2030. In 2020, installed renewable capacity in Kuwait stood at 106 MW, accounting for 0.5% of total installed electricity capacity. This produced 60 GWh, accounting for 0.1% of total power generation in the country.

Kuwait has also planned to develop renewable energy sources especially to free up oil and natural gas for external markets, given the relatively high growth of domestic electricity consumption—with an annual average growth rate of 3.9% between 2008 and 2018 (IEA 2020d). Indeed, energy consumption per capita in Kuwait is among the highest in the world due to high energy subsidies, almost complete reliance on energy-intensive desalination plants to meet domestic water demand and extreme temperatures in the summer, which has recently extended from April to October.

Despite the fact that in 2018 renewable energy accounted for less than 1% (80 MW) of the total country's generating capacity, Kuwait set the target of 15% of the country's power mix to come from renewable energy by 2030. In order to reach the 2030 renewable target, the country has started changing its energy regulatory framework: Law No. 39 of 2010 and Law No. 10 of 2014 opened up the development of the energy market to independent power producers (IPPs) through public private partnerships (PPPs), while previously the Ministry of Electricity and Water was the sole responsible (Oxford Business Group 2018a). Despite the high ambitions and some developments, so far Kuwait has not implemented any flagship policy to speed up the development of renewables.

Following these changes in legislation, a stream of renewable projects was planned, and some were constructed and commissioned. The Umm Guidar PV solar project, consisting of solar panels with a capacity of 10 MW in the Umm Guidar oil field, came online in 2018, without being connected to the national grid. The major renewable energy project in Kuwait regards the Shagaya renewable energy complex with an expected capacity of 4 GW from CSP (around 56%), PV (35%) and wind (7.5%) (Reuters 2019). The Shagaya complex, with a planned capacity of 4 GW by 2030, was developed by the Kuwait Institute for Scientific Research (KISR), initially in three phases, later extended to four: the first phase, consisting of a capacity of 70 MW (50 MW CSP, 10 MW solar PV and 10 MW wind), was connected to the grid in 2018. Phase 2 will be entirely developed by the Kuwait National Petroleum Company with the construction of the Dibdibah solar PV project for a combined capacity of 1.5 GW by 2021. Phase 3 and 4 will be tendered through Public Private Partnerships and will comprise a mix of PV, CSP and wind by 2027. The third phase would have a total capacity of 2000 MW.

In conclusion, Kuwait, similarly to Oman, has focused on utility-scale projects, primarily solar energy. Nevertheless, Kuwait may be considered to be falling behind on renewable energy projects and investments with respect to other GCC countries, as to date very few projects have been envisaged and planned. This trend may be partly explained by a small population coupled with high oil production and reserves.

- **Scenario**

Kuwait has recently stepped up its efforts to further develop renewable energy projects. An example is the expansion of the Shagaya renewable energy complex's capacity from 2 to 4 GW. Also, the actual timing for the construction and commissioning of the Shagaya renewable complex seems compliant with the timeframe set for both the project and the renewable targets. Nevertheless, the total renewable energy capacity to come online by 2035 is likely to amount to 5 GW, less than the capacity needed to achieve the country's renewable target (15% of the country's power mix from renewable energy by 2030). Despite the establishment of the Higher Energy Committee to enhance cooperation in the energy sector, numerous agencies and authorities (Ministry of Energy & Water, Kuwait Authority for Partnership Projects and Kuwait Foundation for the Advancement of Sciences) operate in the power sector so that collaboration and synergy in the renewable field may be at times challenging. The rather blurred role of the different entities is also partially related to the divergent positions the National Assembly and the government take in numerous stances.

The low level of private sector involvement in the energy sector may further hinder the development of renewable energy in the country despite the push towards the establishment of Public Private Partnerships (PPPs). Indeed, Law No. 16 of 2014 stipulated the creation of a joint public company consisting of a minimum 50% share to Kuwaiti citizens, 26% share to the private company and 6% share to the reaming agencies involved in the project. This division of shares also contributed to discouraging FDIs (Kuwait Institute for Scientific Research 2019). Kuwait may also focus on small-scale rooftop solar PV, which would not only contribute to the renewable targets, but may also keep in check the skyrocketing energy consumption rate by offering a net metering or a feed-in-tariff or a combination of the two.

In conclusion, having only recently entered the renewable energy world, Oman, Bahrain and Kuwait still have to address numerous challenges. All three countries need to boost cooperation and integration of agencies in the renewable field, in order to put forward efficient, fast-pace and coherent renewable energy decisions as well as to further attract private (and foreign) investments.

4.2.6 Iran

- **Targets and Projects**

Iran holds a great, yet untapped potential for renewable energy thanks to its location and available land for the development of solar and wind energy. To date, hydropower is the most exploited renewable energy source, representing 9% of power generation in 2019. The development of renewable energy in the country would entail numerous benefits, including the reduction of air pollution, especially in large cities (i.e. Tehran).

SUNA (Iran Renewable Energy Organization) was responsible for overseeing renewable policy development and project licensing as well as securing PPAs with renewable power producers until its integration into SATBA (Renewable Energy and Energy Efficiency Organization).

In the 20-Year Vision (2005–2025), Iran aimed at becoming a regional power in terms of renewable energy production by 2025: Iran envisages that electricity generated from renewable energy sources (excluding hydroelectricity) would account for

10% of the total electricity generated in the country by 2025 (Moshiri and Lechtenböhmer 2015). In its Fifth Development Plan (2010–2015), Iran announced its ambitious intention to install 5000 MW of renewable energy (excluding hydro). The lifting of international sanctions in 2016 prompted Iran's ambitions in renewable energy as the legal environment for foreign investment improved. The Sixth Development Plan (2016–2021) set out specific renewable targets and objectives. Besides the construction of non-renewable energy power plants, the country's Sixth Development Plan aims to achieve 4.5 GW of wind and 0.5 GW of solar capacities by 2021, with an additional 2.5 GW of wind and solar capacities by 2030. These targets were also instrumental in reducing environmental concerns, as Iran is a signatory of the 2015 Paris Agreement, where it pledged to attain a renewable capacity (excluding hydro) of 7.5 GW by 2030.

In order to reach 5 GW of renewable (excluding hydro) as specified in the Sixth Development Plan, an investment of $10 billion was estimated, which was deemed feasible with the lifting of sanctions on the country. A key role was to be played by foreign investors, with European countries proposing investments amounting to $3.6 billion in 2017. For instance, in 2017, Norway's Saga Energy signed a $2.9 billion deal with the state-owned Amin Energy Developers to build a solar power plant with a generation capacity of 2 GW (Dudley 2017). Similarly, a 50 MW solar plant was planned to be constructed by an Italian company in Qeshm island, while a Danish company also signed a contract to build wind turbines. Technical support was also envisaged, as Spain was expected to provide technical services regarding renewable technologies to SUNA, the Renewable Energy Organization of Iran.

However, with the US reinstating numerous sanctions on Iran in 2018, foreign investments have been tremendously reduced (if not disappeared) and it has become even more challenging for Iran to develop its renewable energy capacity. Thus, Iran had little time to commission renewable projects in conjunction with foreign investors. The main example of a successful joint venture for Iran is represented by the commissioning of a 30 MW solar plant located in Jajarm, which was designed and constructed by a private Swiss company. As of 2021, a PPA was signed for this plant and the designated operator is Hamoon Mehr Afarin.

Despite the new sanctions, Iran has managed to increase renewable capacity (including hydro) between 2011 and 2020, from 8.8 GW to 12.9 GW (IRENA 2021a, b) 95% of which hydroelectricity. Iran has managed to increase its non-hydro renewable capacity also thanks to its focus on small-scale solar PV. Indeed, 3,403 small-scale solar PV have been installed and 2,500 other units are in the planning and construction phases (Jalilov 2019). Thus, contrary to some GCC countries, which do not have any hydro potential and have focused mainly on large-scale renewable (solar and wind) projects, Iran has also developed an advantageous framework for the adoption of small-scale solar and wind projects. For instance, a Feed-in-Tariff was put forward in the Fifth Development Plan (2010–2015), which is deemed to incentivize the adoption of solar and wind energy, with guaranteed prices extended from 5 to 20 years in 2015.

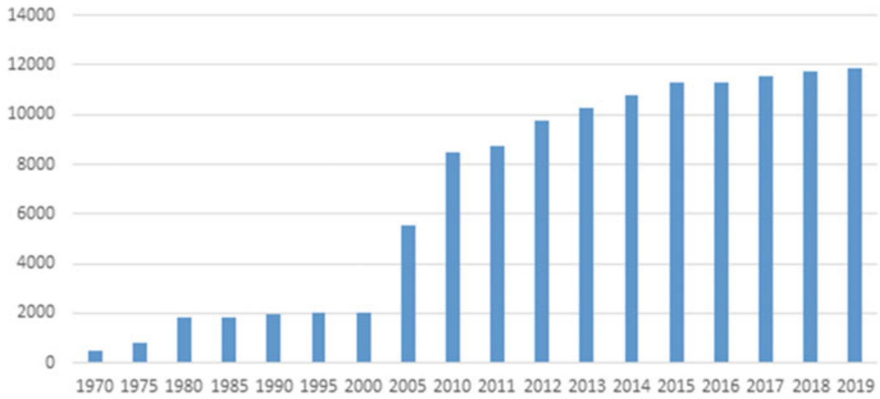


Fig. 4.2 Installed hydroelectricity capacity in Iran (MW). *Source* Authors' elaboration on Enerdata 2020a, b, c, d

Nevertheless, in 2019, the capacity of non-hydro renewable sources (669 MW) accounted for less than 1% (0.8%) of the country's production capacity (roughly 80 GW), while hydro for 14%. At the end of 2019, Iran had only 302 MW of installed wind capacity and 365 MW of solar. The country planned to develop several wind and solar plants; however, international sanctions have deeply undermined Iranian ability to implement and launch these projects.

Iran managed to develop hydropower (Fig. 4.2), taking advantage of its vast network of rivers—unlike most of the other MENA countries—and political commitment. Particularly since 2000, Iran has planned and built several dams across the country aiming at increasing food and energy security as well as supporting local and rural employment. Iran is working to additionally expand its hydro capacity with around 5 GW currently under construction. The main hydropower project is the 1500 MW Bakhtiari Dam, whose construction started in 2013 for an estimated total investment of $2.3 billion. However, the commissioning has been delayed.

Nuclear energy is also present in the country's energy and electricity mix, accounting for 1% of Iran's electricity generation capacity. Nuclear power plants in Iran date back to the 1950s under the Shah regime. Following the Islamic Revolution (1979), the nuclear power program was halted due to political reasons and economic constraints following the Iraq-Iran War, and later revived in the 1990s. As of today, Iran has one operating nuclear power reactor, the Russian built Bushehr Nuclear Power Plant, with a single 915 MW reactor unit and plans are in place to expand its capacity with the construction of two additional reactors.

The slow pace of installed renewable capacity also reflects the critical situation of Iranian power, which faces underinvestment because of huge debt and international sanctions. Under the Fifth Development Plan (2010–2015), Iran planned to add 5 GW per year, but it managed to add only 1.8 GW per year over that period.

- **Scenario**

The ambitious political intentions regarding renewable energy clash with the country's overall situation, characterized by international sanctions and a relatively weak economic outlook and regulatory uncertainties. Such a challenging situation hinders the full exploitation of Iran's renewable potential.

Since 2015, Iran commissioned 400 MW of renewable capacity, a figure considerably lower than the renewable target of 5 GW envisaged in the country's Sixth Development Plan by 2021. Regarding the 2030 renewable objective, the 7.5 GW target represents roughly 8.8% of the country's electricity production capacity with respect to 2019 (85 GW), which is an ambitious, yet attainable target also compared to other countries in the Gulf cluster (i.e. KSA, UAE). Despite the country currently lagging behind its renewable targets, it may be able to catch up in the coming decade if some challenges are addressed. In other words, the attainment of Iran's 2030 renewable objective largely depends on political circumstances both domestically and internationally.

From a geopolitical perspective, a potential reconciliation between the US and Iran may contribute to reestablishing a favorable international financial environment for foreign investments in Iran's renewable energy sector. With the election of Joe Biden as President of the US, some positive developments regarding the lifting of sanctions may occur. President Biden has expressed his intention to rejoin nuclear talks with Tehran. However, the US needs to overcome several challenges, such as Iranian and American political developments and other Middle Eastern countries' skepticism. The lift of international sanctions may be particularly beneficial for Iranian renewable energy development. Indeed, the lifting of US sanctions may also allow international financial institutions, such as the World Bank and the European Bank for Reconstruction and Development, to provide funds and expertise. Their role has been particularly relevant in the development of renewable energy sources in other countries.

The 2016–2018 period shows that if a more investment-friendly environment is in place at international level, Iran can attract foreign investments for its energy transformation. As already discussed, Iran managed to attract multiple foreign investments in the renewable sector from European countries, but also beyond. For instance, a consortium of Iranian, Indian and South Korean companies was planning to build a 1 GW solar park in the Khuzestan Province.

Moreover, small scale solar PV projects are deemed to be quite successful and may contribute to the attainment of the renewable targets and enhance the resilience of the country's energy system. The FIT policy may be deemed more incentivizing for small-scale projects with respect to the net metering scheme employed in Saudi Arabia, as it entails revenues for small-scale producers and not just savings on the bill.

All in all, Iran may decide to focus on wind and solar energy, also due to the numerous challenges nuclear and hydropower face. As of today, nuclear faces major political opposition from the US, which may be difficult to overcome unless a renewed nuclear deal between the US and Iran is achieved. Hydropower relevance, instead, may decrease over the next decades, as it is particularly exposed to climate change, which alters precipitation levels. Between 2017 and 2018, precipitation levels decreased by 25%, contributing to the reported reduction of water entering Iran's dams by 33% (Badawi 2018). Moreover, Iran already faces water scarcity due to assertive agricultural policies aimed at boosting food supply and self-sufficiency. This imperative to enhance the agricultural output is in line with the general goal to diversify revenues and exports from oil. However, a growing competition between agriculture and hydropower may hinder the contribution of this low-carbon energy source to Iranian decarbonization.

To conclude, Iran did not attain the Sixth Development Plan objectives by 2021, but it may be able to reach the 7.5 GW target by 2030, in particular if the US changes its foreign policy towards Iran. Indeed, the country is likely to attract large foreign investments in the renewable field, thanks to its untapped renewable potential and the availability of vast and diverse land (with specificities particularly suitable for solar energy in some regions and wind energy in others).

4.3 Mashreq

The East Med cluster has serious political challenges and the energy sector of these countries is quite heterogeneous. On one side, there are countries experiencing a relative hydrocarbon abundance, such as Iraq, Egypt, Syria and Israel (thanks to recent large offshore gas discoveries); on the other side, there are other countries (e.g. Lebanon and Palestine) witnessing energy shortages on a daily base with blackouts due to infrastructure and political barriers. Among the East Med cluster countries, Jordan represents a successful example, as it has managed to overturn its lack of energy security and energy independence mostly by attracting investors and developing renewable energy sources. The development of renewable energy would contribute to overcoming key domestic energy issues, as will be detailed for each country, relative to its intrinsic peculiarities. All countries have thus strived to enhance their uptake of renewable energy sources, with different targets, as summarized in Table 4.6. The present section does not include an analysis on renewable developments and energy transformation projects in Iraq and Syria given their current unstable sociopolitical condition that hinders their efforts.

Countries in this cluster have a huge potential to attain regional security of gas and power supplies, thanks to interdependence and complementarity. They strived with remarkable initiatives to establish energy and electricity networks, which, however, are neither very reliable nor resilient due to regional instabilities, (civil) wars and geopolitical forces at play. Also, energy exchanges in this cluster are limited by competition in the same market for gas and by electricity peaks at similar times for power.

Power exchanges are possible with power interconnections, which are currently used only for emergency situations. Cooperation and development of energy interconnections among countries in this cluster and the broader region date back to 1988,

Table 4.6 Renewable energy targets by country

Country	Renewable target
Egypt	20% of RES in electricity production by 2022 and 42% by 2035
Israel	30% of RES in total electricity generation by 2030
Jordan	10% of RES in TPES by 2020; 31% of RES in power mix and 14% of RES in energy mix by 2030
Lebanon	30% of RES in electricity and power demand by 2030
Palestine	Total installed RES capacity of 300–500 MW by 2030, depending on restrictions to Area C of West Bank

Note Targets are not standardized, but as detailed in each Vision or affiliated document
Source Authors' elaboration on national documents

with the establishment of "Eight countries regional energy interconnection" by Syria, Jordan, Egypt, Iraq and Turkey. A few years later, Palestine, Lebanon and Libya also joined the energy interconnection program, whereby each country signed an agreement to update its power system. In 1996, the countries signed trade agreements with conditions on using energy interconnections (Li et al. 2017). Up until the beginning of the 2010s, there was a momentum for the construction and synchronization of the countries' grids, so that the Jordanian-Egyptian-Syrian-Libyan interconnection was developed and the first power exchanges were carried out, while other projects were planned (i.e. Syrian-Turkish, Syrian-Lebanese, Iraqi-Turkish, Syrian-Iraqi and Egyptian-Libyan electric interconnections) (NEPCO 2013).

Overall, geographic factors, political disagreements and the lack of grid synchronization among some countries make exchanges almost an exception. Overcoming these challenges would represent quite a breakthrough for countries experiencing blackouts and energy insecurity, and would benefit the others economically, so that regional energy security and interdependence could be established. Also, with the increasing share of renewables in the countries' electricity mix, interconnections represent a key instrument to address the variable generation of some renewable sources (wind, power) in order to balance power production and consumption, as renewables are usually generated in remote areas at the periphery of grids.

It goes without saying that the main challenges to the establishment of reliable and efficient power exchanges regard security concerns in the region and geopolitical factors, which may prevent the full development of an effective network infrastructure and a common regulatory framework. For instance, Lebanon, with the precondition of solving key domestic issues, would greatly benefit from power imports to offset the daily blackouts. However, it may find it difficult to import electricity as Syrian infrastructure is either destroyed or unreliable, while it does not have any trade exchange with Israel for political reasons. Also, Palestine, and especially Gaza, which is the other worst area in the region in terms of energy security, is prevented from importing sufficient energy sources and electricity to satisfy the internal demand.

4.3.1 Jordan and Lebanon

- **Jordan**

As discussed in Chap. 3 (Sect. 3.2.1), Jordan and Lebanon have taken diverging paths in terms of renewable energy development since 2015. Both countries depend heavily on imports to satisfy their domestic energy demand, for instance Jordan imports 94% of its oil and gas, becoming vulnerable to oil price fluctuations. At the same time, they both witnessed a high growth in internal energy consumption up to 2017 (between 2010 and 2017: 4% on average per year in Jordan and 5% in Lebanon), as a result of a large influx of Syrian refugees, coupled with population growth. Nevertheless, Jordan's energy consumption has decreased by a total of 10% between 2017 and 2019 (ENERDATA n.d.). While Lebanon stabilized its energy consumption in 2018 and 2019, the 2020-21economic crisis resulted in a reduced energy demand. It should be remarked that, due to the country's dysfunctional energy system, in 2019 (prior to the economic downturn) Lebanon's per capita energy consumption was 60% lower than the regional average and the country's per capita electricity consumption 35% lower than the regional average (ENERDATA n.d.).

Targets and Projects

To face the above-decribed issues, Jordan developed a coherent strategy for the quick development of renewable energy, especially to increase its energy security. Under the National Energy Strategy Plan 2007–2020, renewable energy became pivotal in the country's energy policy and investments amounting to $20 billion in energy development by 2020 were planned. The same Plan set renewable energy targets corresponding to 7% and 10% (2 GW) of the total primary energy supply by 2015 and 2020, respectively (Abu-Raman et al. 2020). In the Renewable Energy Law adopted in 2012, the 2020 target corresponded to a capacity of 1800 MW. To reach the 2020 target, Jordan focuses on solar and wind. In 2020, installed solar capacity was 1359 MW and wind 515 MW. In the same year, renewables accounted for 29% of electricity capacity and around 14% of electricity production.

In support of this strategy, the Kingdom adopted the Renewable Energy and Energy Efficiency Law (REEL) No. 13 in 2012, which encouraged private sector investments in renewable energy by simplifying procedures and exempting investments from taxation. It also included energy management and efficiency measures especially for the industrial and service sectors, which represent the main energy consumers (ISMED 2014). To further incentivize an investment-friendly environment, the country successfully enhanced transparency of the power sector, a key challenge for most countries in the MENA region, through the so-called "Reference Price List". This List includes indicative prices per renewable source and it can be considered as a Ceiling Tariff, so that developers compete below the upper limit set by the government. Under this framework, investors can evaluate the feasibility and minimize the risks of their investments (Abu-Ramman et al. 2020). Favorable investment and regulatory conditions resulted in over $5 billion investments in the renewable energy sector between 2014 and 2020, which were attained also by attracting donations and loans from GCC, the European Union, the European Bank for Reconstruction and Development and the French Development Finance Institution.

Especially since 2015, Jordan has planned, constructed and also commissioned numerous renewable energy projects, in particular solar PV (and plans for CSP), wind energy and small-scale biomass projects. The first two renewable power plants commissioned were the 200 MW solar plant in Ma'an in 2016 and the 117 MW wind plant in Al Tafileh in 2015 (Ministry of Energy and Mineral Resources 2018). In 2019, renewable energy sources accounted for 7% of primary energy sources so that Jordan became the country with the highest degree of penetration growth of renewable energy sources in the MENA region and the third globally. Table 4.7 summarizes the main large-scale recent renewable power plant realizations in Jordan.

Jordan has a combination of large-scale renewable projects and small-scale projects through numerous incentives (generous feed-in-tariffs) so that renewable capacity amounts to 1.9 GW in 2020 and almost 30% of all residential buildings have solar water heating systems installed on the roofs. In the coming years, numerous additional renewable projects are expected to come online so that Jordan is projected to become a hub and frontrunner in renewable energy development in terms of capacity building, training and technology transfer for the MENA region.

In conclusion, Jordan represents a remarkable example of a rapid and successful development of renewable energy in just five years. Indeed, the country managed to adjust its regulatory, legislative and financial framework to attract investors and roll out such a large renewable program in only a few years. The government has unveiled its National Energy Strategy for 2020–2030 with new objectives in favor of energy diversification and the strengthening of local energy sources in order to reduce its energy dependence. The contribution of imported natural gas in the power mix will be reduced from over 80% to 53% by 2030. The strategy's targets by 2030 include a renewable share in total power generation of 31% (14.4% in 2019) and 14% in the total energy mix (7% in 2019).

Scenario

Jordan may well represent a model for the development of renewable energy in the MENA region: in 2019, renewable energy sources accounted for 14% of the country's total electricity generation, up from 0.7% in 2014. Also, Jordan reached 7% of total primary energy supply from renewable sources in 2018, three years later than planned. However, it has managed to almost attain its 2020 target of 10% of total primary energy supply from renewable sources, corresponding to around 2 GW. Indeed, in 2021, the total capacity of renewable power plants in operation amounts to 1715 MW. The 2020 renewable objective was particularly challenging to attain, especially due to the combination of two factors. Since January 2019, the country has decided to indefinitely halt all investments in renewable energy above 1 MW (IRENA 2021b) and the Covid-19 pandemic resulted in an economic downturn, also affecting renewable investments. All in all, similarly to the 2015 renewable target, the

Table 4.7 Main large-scale renewables in Jordan

Energy source	Large-scale project	Capacity (MW)	Year of completion	Current phase and description
Solar Energy	Baynouna solar PV plant	200	2018	Shareholders: Masdar (70%) and Taaleri (30%); Operator: Baynouna Solar Energy Company As of 2021, it is one of the largest operational PV plant in Jordan
	Ma'an solar PV plant	200	2016	12 direct PPA were finalized for the construction of the Ma'an plant in 2015
	Quweirah region PV plant	89	2018	Operator: Enviromena
	Mafraq Solar I & Mafraq Solar II	100 & 50	2019 & 2018	Operator: Fotowatio Renewable Ventures (FRV) for Mafraq Solar I & Acwa Power for Mafraq Solar II
Wind Energy	Fujeij	89.1	2019	It is situated in Shobak and it is operated and 100% owned by Korea Electric Power Corp. (Kepco)
	Ibrahimyya wind plant	0.32	1984	1st wind plant in Jordan. Operator: Central Electricity Generating Company
	Ma'an wind farm	80	2016	Funded by the Kuwait Fund for Arab Economic Development for an investment of $148 million Operator: Elecnor

(continued)

Table 4.7 (continued)

Energy source	Large-scale project	Capacity (MW)	Year of completion	Current phase and description
	JWPC Al Tafileh wind plant	117	2017	In 2013 international companies (mainly Masdar) and a Jordanian consortium signed an agreement to develop this plant. It increased the country's power generation by 4%
	Al Rajef wind farm	86.1	2018	Located in the Ma'an Governorate. It has been developed by Green Watts Renewable Energy on behalf of the project owner (Alcazar Energy)
	Shobak	44.85	2020	The plant is operated by Alcazar Energy and the shareholders are Alcazar Energy (90%) and Hecate Energy (10%)
	Tafila Daehan	51.75	2021	It is located in Tafilah. It is operated by DAEHAN Wind Power Co. and the shareholders are Korea Electric Power Corp. (Kepco)(50%) and DAELIM Energy (50.%)
Biogas and biomass	Plant to capture methane gas at Amman dump site	0.6	2000	A joint venture has been established between the Amman Municipality and Jordan Biogas Company

Note Numerous solar PV projects in Jordan have a capacity of roughly 50 MW (i.e. Al Safawi −51 MW, Al Manakher −52 MW, Al Husainiyah −50 MW, Risha Solar −50 MW and Shams Ma'an −52.5 MW

Source Authors' elaboration on Enerdata (2020a) and (2021a), and Jordan Times (2019)

Kingdom may add roughly the missing 300 MW needed to reach the 2020 renewable targets by 2025.

Regarding the recently set renewable targets by 2030, it is challenging to forecast the country's renewable trajectory, due to the uncertainty in terms of economic recovery from Covid-19 not only for the Kingdom, but worldwide, given the significant share of foreign investors in renewable energy projects. Another uncertainty regards the country's energy policy that prevents investments in projects above 1 MW. However, since 2015, Jordan has been a pacesetter in the uptake of renewable energy in this cluster and in the whole MENA region, so that by 2030 the country may well keep its role in this field. Moreover, in developing its energy policy, Jordan considers a key aspect: energy security. This is because of its quasi-total dependence on energy source imports, which may force Jordan to prioritize all domestically produced energy sources. It may thus be beneficial for the country to accompany renewable energy with an increasing role of oil shale[6] and possibly nuclear energy, in the form of Small Modular Reactors (SMRs).

Jordan owns the eight largest reserves of oil shale in the world so that it plans to produce around 25,000 barrels per day by 2022. The oil shale program runs since 2008 (when oil prices were above $100 per barrel) in cooperation with Estonia's company Enefit, which is the world's largest oil shale producer (Gnana 2019).

Regarding nuclear energy, Jordan canceled its ambitious plan to build two 1000 MW nuclear power plants by 2025. Instead, it is promoting and prioritizing the possible development of Small Modular Reactors (SMRs) in cooperation with Saudi KA-CARE, in order to enhance the country's grid resilience. Indeed, the two conventional nuclear power plants may have posed some challenges in case of a shutdown, as combined they would have provided almost one-third of the country's total electricity. The nuclear program has been quite active especially because of the country's uranium reserves that also led to an agreement with the French company AREVA for exclusive mining rights (World Nuclear Association 2019b).

All in all, it may be quite challenging to forecast Jordan's trajectory and the new energy policy given the possible role of oil shale and nuclear energy. Indeed, the development of these two energy sources depends on numerous factors (economic recovery, interconnections, oil prices, country's geopolitics) so that their role in the country's energy mix, with respect to renewable energy, is quite unpredictable. Given the economic downturn following Covid-19 it may also take longer to attract investments in the renewable field to attain the renewable targets, but the country's excellent historical record will keep attracting investors.

- **Lebanon**

Targets and Projects

Renewable energy sources for Lebanon represent a great opportunity to defuse major challenges in the energy and especially power sector, such as oil imports for electricity

[6] Oil shale is unlike shale oil in that oil shale is essentially rock that contains a compound called kerogen, which is used to make oil. It is also much more difficult to recover than shale oil.

generation, reliance of the population on private diesel generators, social discontent on energy sector mismanagement, highly indebted public utility and so on. More in detail, similarly to Jordan, Lebanon is highly insecure in terms of energy, relying entirely on fossil fuel imports, thus domestic renewable production would represent a huge benefit for the country. Moreover, energy demand exceeds the country's generation capacity, leading to daily blackouts lasting many hours, depending on the region. Renewable energy would contribute to offsetting the large gap between energy demand and supply, enhancing economic growth (by reducing blackouts) and saving almost $250 million in the power sector per year (with a 30% renewable electricity consumption target), mostly thanks to significantly lower fossil-fuel imports (IRENA 2020). But of course, renewable energy has high investment costs and needs to be financed.

In 2011, Lebanon framed its energy policy through the publication of the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan, which set a target of 12% of power and heating consumption from renewable energy sources by 2020, primarily wind (200 MW), large-scale PV (150 MW) and distributed PV (100 MW). In 2018, Lebanon, in cooperation with IRENA, set a new target of 30% of electricity and heating demand to come from renewable energy sources by 2030. This target may be deemed particularly ambitious, given the current total renewable capacity. Indeed, in 2020 total renewable power capacity amounts to 344 MW: 253 MW from hydropower, 79 MW from solar energy, 3 MW from wind energy and 9 MW from bioenergy (IRENA 2021a). Overall, the main renewable energy source is represented by small-scale solar PV projects and 63% of distributed solar capacity is on-grid, while wind energy has practically not been developed yet.

Lebanon, in cooperation with the country's central bank, also established the National Energy Efficiency and Renewable Energy Action Plan (NEEREA), which provided low interest rates for loans (up to $10 million) for renewable energy and energy efficiency projects and other financial benefits. This initiative may be considered quite successful as 938 projects were financed by March 2019. Nevertheless, the growth of solar PV installation decreased after 2017, also as a result of growing interest rates on loans offered by NEEREA (Ahmad 2020). Regarding the regulatory framework, the country signed its first PPA for electricity consumption from renewables in 2018.

The push towards the adoption of renewable energy may be offset by the political and economic context. The country has experienced hyperinflation[7] since July 2020. Moreover, the sociopolitical landscape has been shaken by an explosion at Beirut Port—resulting in 204 fatalities and thousands of wounded. The ever-growing economic challenges and political inactions resulted in protests against the political class. After more than a year of political deadlock and a worsening economic situation, a new government has finally been formed in September 2021. The new government is called to implement a serious reforming process in order to alleviate the economic burden. The government's reforming effort should devote particular

[7] Hyperinflation occurs when a country's inflation is above 50% per month over a period of 30 days.

attention to the Lebanese energy sector, which represents about 40% of the country's public debt since 1992 (Ahmad et al. 2021).

In conclusion, despite the enormous energy, economic and political challenges Lebanon is facing, the country is striving to increase the adoption of renewable energy sources, which would provide energy security, lower reliance on private diesel generators and would counteract the longer electricity blackouts. Indeed, following the default on its debt in March 2020 and the outbreak of Covid-19, the daily blackouts became longer and more frequent across the whole country. As the international community, headed by France, is currently pushing for reforms in numerous areas, the highly inefficient and indebted energy sector has become a priority and it is under the spotlight of citizens and donor countries alike.

Scenario

Lebanon has a target of 30% of power and heating consumption from renewable energy sources by 2030 (IRENA 2020). However, the achievement of this renewable target depends on numerous variables, especially given the country's economic and political instability in the foreseeable future. The coming years are crucial for Lebanon's overall stability and the development of renewable energy may actively contribute to offsetting the country's energy issues thus leading toward a long due reform in this field.

In line with numerous other sectors, there is a low level of political commitment to adopting renewable energy, and more broadly, to reforming the highly inefficient energy sector. Indeed, in order to reach its renewable target, Lebanon needs to address numerous challenges in its energy sector, which has not yet considered the adoption of renewable energy sources from a regulatory and technical perspective. For instance, the 2030 renewable target does not state the share to be attained for each energy source or the path to be followed for the development of renewable energy. Various laws were amended to integrate renewable energy policy, but a coherent and integrated legal framework regarding renewable energy in electricity law is still missing.

Another key signal of the political stalemate and low political commitment regards the inability to carry out an energy subsidy reform, as discussed in Chap. 3. The high levels of energy subsidies and low electricity tariffs reduce the competitiveness of renewable energy sources. The lack of energy reform is due to political issues rather than social issues, as the population is already heavily reliant on private diesel generators, which are not only highly polluting, but also very expensive. The current economic fallout, especially inflation, results in an increasing use of diesel generators, in a context of staggering poverty growth and the absence of safety net mechanisms. Despite these significant challenges, Lebanon is striving to focus on distributed generation, which provides numerous advantages, as detailed in Table 4.8.

In this regard, since 2011, Lebanon has employed the net metering scheme mostly for commercial and industrial use, which, however, involves numerous technical difficulties, such as complex administrative steps, manual net metering and so on.

In conclusion, Lebanon has to address key issues, from both regulatory and technical perspectives, in order to enhance the efficiency of its energy sector and move

Table 4.8 Potential benefits and main beneficiaries of distributed renewable energy systems in Lebanon

Added Value		Major Beneficiary
Lower generation and transmission investments	→	Treasury/EDL
Net costs savings	→	Consumers
Reduce exposure to fuel price volatility	→	Consumers
Improved energy security	→	Consumers
Short lead-time	→	Consumers
Lowering air pollution and noise	→	Consumers
Change in social attitude towards RE	→	Society at large
New business opportunities	→	Private sector

Source Authors' elaboration on Ahmad (2020)

towards a wider adoption of renewable energy. Lebanon needs to successfully overcome these challenges to gain the trust of its population and of the international community, as the energy sector is perceived as one of the key examples of the country's mismanagement and inefficiency. It is also a precondition for economic development.

Lebanon and Jordan have undertaken two different paths towards the adoption of renewable energy and broader energy security. Irrespective of the economic crisis and political stalemate in Lebanon, the two different strategies resulted in diverging outcomes in terms of energy sector performance. Indeed, Jordan has managed to decrease the public utility's debt, attract private and foreign investments and ensure a reliable and affordable access to energy and electricity to its population. On the contrary, Lebanon's energy sector is an emblem of its economic and political conditions: inefficient, dysfunctional, challenging to reform, unreliable and expensive, highly indebted and a major driver of social dissatisfaction.

4.3.2 Egypt

- **Targets and projects**

Prior to roughly 2015, Egypt strove to develop its renewable energy capacity as a way to satisfy its increasing domestic energy demand, at a time when gas production and reserves were decreasing. Despite the numerous offshore gas fields discovered in its waters, among which the largest one in the Mediterranean (Zohr), Egypt continued to consider renewable energy a fundamental pillar of its energy policy for numerous reasons.

Firstly, Egypt's geographical features, such as location and vast uninhabited territories, provide renewable energy with great potential. Secondly, increasing the share of renewables in the power sector may meet growing energy demand, enhance energy security and preserve vital foreign exchange income from gas exports. The large use of natural gas for electricity generation would otherwise result in the rapid depletion of gas reserves and the simultaneous erosion of natural gas exports. Moreover, a relevant share of renewable energy may also result in the development of a “green economy”, which may boost job opportunities within the country. If developed, this new approach would represent a great benefit for Egypt, as it is witnessing a high rate of youth unemployment (26%) and a growing population (Al-Riffai et al. 2019). In Egypt, numerous industries related to the solar PV value chain are already present, (i.e. steel and glass manufacturing, pump fabrication plants) representing a considerable potential to underpin its green industrial ambitions (IEA 2020e).

Egypt’s commitment to renewable energy dates back to 1986, when it established the New and Renewable Energy Authority (NREA), the main agency responsible for the development of renewable projects, with a particular focus on solar and wind projects. In order to boost the renewable energy potential, Egypt also published numerous documents and laws incentivizing the adoption of renewable energy technologies. The main document, passed by the cabinet in 2016, comprises the “Egypt Integrated Sustainable Energy Strategy to 2035”, which envisages a total installed capacity of 61 GW of renewable energy by 2035: 31 GW solar PV, 12 GW CSP and 18 GW wind energy (IRENA 2018). These targets should enable Egypt to increase electricity production from renewable energy sources to 20% by 2022 and 42% by 2035. In terms of share, solar would produce 25% of Egypt’s electricity production, wind 14% and hydropower 2% by 2035. However, these targets may understate the high potential of electricity coming from renewable energy sources, as the Remap analysis carried out by IRENA assessed renewable energy sources to possibly satisfy 53% of the electricity mix by 2030 (IRENA 2018). This gap with the country’s targets may also be due to the significant discoveries of large gas fields, which would also contribute to satisfying the domestic electricity demand at relatively low costs.

It is well-worth to highlight Egypt’s capability to attract investors for its renewable projects, since it has only recently started to develop renewable energy sources at large scale. More in detail, Egypt has enacted legislative reforms to its electricity sector in order to enhance its competitiveness, hence incentives to invest in renewable energy projects. Indeed, Law No. 2013/2014 aimed at involving the private sector in electricity generation from renewable energy sectors by introducing numerous schemes, such as feed-in-tariffs, competitive bids and independent power production with third party access. One year later, Egypt passed Law No. 87/2015, which was regarded as a breakthrough for the establishment of a competitive electricity market. This law envisaged the separation of electricity generation, transmission and distribution activities, putting an end to the single-buyer model. Nevertheless, although high voltage consumers could choose among electricity generators in a fully competitive market, medium and low voltage consumers are supplied with a regulated tariff, thus two electricity markets were established depending on the electricity consumed by the users (Elkadi Salah 2019). Also, the state-owned Egyptian Electricity Transmission Company can buy electricity produced by private companies at a tariff (8.4 cents per kw), which is deemed to attract investors (Hammad 2020).

Partly thanks to these reforms, to date Egypt has quite succeeded in providing confidence to international agencies and attracting foreign investments primarily through joint ventures for large-scale solar and wind projects. A successful financing case regarding wind energy is represented by the Zafarana wind farm, located in the Gulf of Suez. This large wind farm, with a capacity of 550 MW, is the second largest wind farm in Egypt after the Gabal El Zeit wind farm (580 MW) (Magoum 2020). The total cost of the project amounted to $912 million: $456 million were obtained with a Public Private Partnership (PPP), $306 million from international organizations and development banks (e.g. African Development Bank, International Finance Corporation), $100 million from local governments and $50 million from the Clean Technology Fund. The largest share of funds was provided by a PPP, in the form of a joint venture between Egypt's NREA and Emirati Masdar (Mansour 2015). Overall, numerous wind projects for a combined capacity of 3990 MW are currently under development (to come online by 2023) and located in the Gulf of Suez, Gabal El Zayt and the West Nile, while a 600 MW wind project is under the tender-bidding phase (IRENA 2018).

Along with the UAE and Morocco, Egypt is one of the most "attractive" countries for foreign investments in renewable energy projects. Egypt attracted over one third of total renewable energy investment by EBRD in the region (more than €1 billion) (OME 2021). For instance, foreign organizations, companies and donors are involved in the development of the Benban Solar Park, currently the largest solar park in the Mediterranean and the fourth in the world (1650 MW), comprising 41 solar power plants. In 2018, the first section of the park—50 MW "Infinity 50"—was connected to the grid. It was completed in 2019.

More than 30 companies from 12 countries joined the development phase, such as the Emirati Alcazar Energy, the Italian Enerray and the French Total Eren and EDF (Lewis 2019). This mega-project is estimated to cost $2.1 billion, thus foreign investments and loans were necessary to concretize it. Egypt managed to have international and multilateral active support. For instance, the International Finance Corporation (IFC), an institution of the World Bank Group, with a consortium of nine international development banks, loaned $653 million while the Multilateral Investment and Guarantee Agency (MIGA) provided $210 million to cover political risk insurance in order to attract private investments for this project. (IFC 2019).

Egypt's competitiveness in sustainable finance, compared to other MENA countries, is shown by the latest developments in this field, i.e. the launch of its first green bonds, amounting to $750 million, the largest value in the whole MENA region (Oxford Business Group 2020d). These bonds are considered key instruments for renewable investments. Indeed, the country is striving to become a "green" energy hub for the East Med cluster and for the broader region. At a global level, sustainable financial instruments, such as green bonds, have been issued in the first 9 months of 2020 with a 24% increase compared to the same period in 2019.

Overall, large-scale solar PV projects for a total capacity of 3161 MW are in the bidding, tendering or under development phases, and they are expected to come online by 2023 (IRENA 2018). In addition, in Egypt a Concentrated Solar Power (CSP) is also operational in the Kuraymat region since 2011. This CSP is part of ISCC

Kuraymat, an integrated solar combined cycle technology with an overall capacity of 140 MW (120 MW combined cycle and 20 MW CSP). Hydropower also plays a relevant role in the Egyptian energy sector, as it represents 1.2% of the country's total energy supply and 6.7% of the country's electricity mix (IEA 2019a, b). In Egypt, the construction of (diversion) dams dates back to the mid nineteenth century, with the so-called barrages at the Delta of the Nile River. The first dam was built at the turn of the twentieth century—the Aswan Dam—which was later also equipped with a hydroelectric plant with a capacity of 345 MW. The most well-known dam in Egypt is the Aswan High Dam, built between 1959 and 1970, accompanied by a 2.1 GW hydroelectric plant. The primary objective of this dam was to guarantee a relatively stable water flow to Egypt by storing water in the reservoir. Hydropower is not only the primary source of renewable energy in Egypt, but it is also a source of geopolitical tensions with neighboring countries. Indeed, the Grand Ethiopian Renaissance Dam (GERD) has been a source of dispute between Egypt, Ethiopia and Sudan since 2011, the beginning of the dam's construction. Egypt feels threatened by this dam, located in Ethiopia in upstream Nile, as it may reduce the river's water flow, which is essential for livelihood and agriculture.

Following the Arab Spring, Egypt experienced periodic blackouts in 2013–2014. However, it overcame these challenging conditions by developing new gas fields and by boosting small-scale distributed solar projects. The development of small-scale distributed solar projects benefited from the adoption of a feed-in-tariff, which contributed to increasing the total capacity installed from 10 MW in 2014–300 MW in 2017, as envisaged by the introduction of the FIT program. Other initiatives to incentivize the installation of distributed solar PV were carried out, such as the CoM Initiative and Egypt-Sun Initiative for governmental buildings (IRENA 2018).

Egypt has also evaluated the development of the nuclear sector. In 2017, the country agreed with Rosatom for its first nuclear power plant in El Dabaa, composed of four units of 1200 MW each. The project has an estimated cost of $30 billion of which $25 billion could be lent by the Russian government.

In conclusion, Egypt has carried out numerous legislative reforms and set out clear renewable objectives with the aim of becoming a key player in "green" energy in the cluster and beyond.

- **Scenario**

Despite great improvements, Egypt may not be able to attain the renewable interim target—20% of electricity generation from renewable energy sources by 2022, but a few years later. Indeed, in 2020, the country had only 3.36 GW of installed capacity of renewable energy sources, which amount to 3.5% of Egypt's power generation (excluded hydro). However, as aforementioned, the great majority of renewable projects are expected to come online in 2023 (around 7.9 GW), which will strongly boost renewable energy capacity and reach the interim target just a couple of years later, especially if delays in the projects are also taken into account.

Egypt successfully moved from a period with recurrent blackouts, until 2014, when electricity demand was not satisfied, to the current overcapacity situation.

Indeed, in 2019 Egypt employed only 55% of its total installed capacity and, given the renewable targets, this gap is forecasted to remain also in the coming decades. The electricity demand is expected to reach 70–85 GW by 2035, while total installed capacity will amount to 160 GW, including the renewable targets. The gap is considerable, also taking into consideration that the renewable energy utilization rate is quite low. Therefore, Egypt has already signed agreements with neighboring countries to export its electricity surplus, for instance with Sudan, Cyprus, Greece and Saudi Arabia. The agreement with Saudi Arabia considers a project to establish a 3 GW power interconnection, given the complementary condition of the electricity sector of the two countries. Indeed, the two countries have electricity peaks at different times: Saudi Arabia during the day due to air conditioning and Egypt after sunset due to appliances usage. The project was discussed since the early 2010s and stalled for a few years due to political instability and overlap of the interconnection route with the Saudi mega-project NEOM. In 2014, negotiations retrieved, and Saudi Arabia is expected to pay 60% of the infrastructure of the power interconnection while Egypt the remaining, for a total estimated amount of $1.6 billion (Mahmoud 2020). This project is particularly relevant as it is one of the first attempts to interconnect electricity networks among countries in different clusters of the MENA region, and it may reduce Egypt's power overcapacity.

Overall, in the long term, the power overcapacity situation may also hinder the attainment of the 2035 objective, as it may not be economically convenient and feasible to further expand the installed capacity for electricity generation. In the short term, this risk is reduced as renewable energy projects have already been developed and are expected to come online by 2023.

The Covid-19 pandemic has affected the subsidy reform, as the country reduced gas prices for industrial providers as well as electricity prices for high voltage consumers to counteract the industrial slowdown with the pandemic (Oxford Business Group 2020c). As economic growth was severely hit, consumers also reduced their power consumption so that the government had to freeze electricity prices for all users until 2025. It also decided to extend the period of energy subsidies phase-out to 2025, instead of 2022.

In conclusion, Egypt is facing a power overcapacity situation, which may also limit its efforts to reach the 2035 objective, as it would entail further investments and installation of renewable power capacity. Nevertheless, this may also represent a relevant opportunity for Egypt to scale up power interconnections, which are pivotal also in a framework of increasing renewable penetration in a country's electricity mix. As Egypt is successfully managing to attract considerable investments in renewable energy projects, it may also enhance cross-border interconnections within the cluster, the MENA region in the longer run and possibly directly or indirectly with Europe.

4.3.3 *Israel and Palestine*

- **Israel**

Targets and Projects

Being an overall energy-importing country, Israel would benefit particularly from the development of renewable energy sources both economically and politically as well as environmentally. Indeed, the country has traditionally relied on coal for energy security reasons. However, over the last decade Israel has been able to replace coal with gas in the electricity mix, thanks to the recent offshore gas discoveries. An increasing share of renewable energy sources would allow Israel to devote additional gas volume to exports, without diminishing energy security and, at the same time, contributing to improve Israel's regional foreign policy. Natural gas would remain a key energy source for Israel's energy mix in the foreseeable future, ensuring stability to the power sector. Israel has well-known solar potential and an advanced high-tech sector. Renewable energy technology may also boost this sector, possibly enabling exports of these technologies. Despite the great potential, Israel faces some major challenges in decarbonizing its power sector. First, despite improvements in energy efficiency, electricity demand is expected to grow by 2.1% per year to 2030 mainly due to population growth and further need of desalination (OECD 2020). Second, Israel lacks electricity interconnection to neighboring countries, and it is considered an energy island due to its geopolitical landscape. Third, land availability next to major consumption centers is a barrier to scaling up low-cost utility-scale solar PV (OECD 2020).

Over the last decade, Israel has stepped up its efforts in the development and adoption of renewable energy. An initial step was taken by the Government in 2011, when it approved a plan to promote renewables for power production. It set a target of 2760 MW of renewables by the end of 2020, representing 10% of the power mix. It also set an interim goal (1550 MW by 2014), which however it did not reach (706 MW in 2014 and about 1500 MW reached in 2019). The 10% target for 2020 was expanded in 2015 through the submission of Israel's Intended Nationally Determined Contribution (INDC). In the INDC, Israel adopted a target of 17% of renewables in electricity production in 2030. Throughout the last decade, Israeli policymakers have increasingly prioritized solar PV rather than wind and CSP. In 2018, the Israeli Ministry of Energy released a plan on energy economy objectives for the year 2030. In this plan, Israel committed to terminating the use of coal in electricity production in all coal-fired power plants by 2030, using natural gas. At the same time, it reaffirmed the 2030 target of 17% production from renewable energy.

In June 2020, Israel announced an increase in the renewable target from 17 to 30% of total electricity generation by 2030. To achieve this target, Israel established an investment plan of $22 billion in the 2020 decade, and the installation of 15 GW more in renewable energy, which will be predominantly covered by solar energy (Shumkov 2020). Contrary to the policies proposed and enacted in most of the other countries of the MENA region, the private sector will play the primary role in the large-scale adoption of renewable energy, especially solar PV.

The country's solar capacity is developing rapidly and reached 1.4 GW at end 2019, starting from 76 MW in 2010. The development of renewable energy, especially solar PV, is carried out thanks to tenders for large-scale solar PV projects as well as net metering and feed-in-tariffs for small-scale solar PV projects (i.e. rooftop PV panels) (Bellini 2020a). The development of large-scale solar PV projects is quite recent, as the largest solar PV power plant—the Zeélim solar park—with a capacity of 120 MW, came online in October 2019. This project is based on a joint venture between Shikun & Binui Energy (SBE) and Belectric, which has already commissioned 25 solar PV projects in Israel through its subsidiary Belectric Israel Ltd (PV Europe 2018). The country is working on another large-scale solar PV project, the Dimona solar project in the Negev desert, for which the government has relaunched a tender for its construction. In line with the updated and ambitious targets, the capacity of the Dimona project will be extended from the initial planned capacity of 300–500 MW, making it the largest solar project in Israel once commissioned. Construction is expected to start in 2021 with commissioning in 2023 (Bellini 2020b). However, disagreements emerged between Israel Land Administration and the solar sector, as authorities feared that the land to be occupied by the solar plant would be needed for sand mining. Nevertheless, the procurement phase is still ongoing. Since 2015, Israel has commissioned several other smaller capacity solar parks like the 50 MW Zmorot solar power plant in 2016 as well as the 60 MW Mashabei Sadeh PV and the 53 MW Sunlight 1 in 2018.

Regarding small-scale solar projects, a new incentive scheme was launched at the end of 2017, under which PV projects smaller than 15 kW can benefit from net metering (all excess electricity would be sold to Israeli Electric Corporation) or from a feed-in-tariff lasting 25 years ($0.137/kWh). For PV projects between 15 and 100 kW, a 25-year feed-in-tariff of $0.129/kWh would be applied (Bellini 2018). Israel experienced the deployment of 1.6 GWh rooftop PV capacity by 2020.

Concerning CSP, Israel is the second market for CSP technologies in the South and East Mediterranean—behind Morocco. Ashalim CSP 1 and 2 (110 MW each) were commissioned in 2019. The project required a total investment of $1 billion thanks to an agreement signed between Abengoa and Shikun and Binui Renewable. It satisfies the consumption of roughly 70,000 households (Shikun and Binui Ltd 2019). The CSP plants are complemented by a solar PV project (30 MW), which came online in 2018.

Even though it has traditionally prioritized solar energy, Israel has planned several wind projects. The country indeed could enhance its installed wind capacity from around 30 MW in 2020 to hundreds of megawatts in a couple of years. Around 700 MW of wind projects are planned or under construction. The largest wind park projects are located in the Golan Heights, with over 450 MW total capacity. The Emek Habacha project (99 MW) is currently under construction and is expected to be commissioned in 2021. Other two large-scale wind projects have been authorized: the 190 MW Emek Haruchot poject and the 130 MW Ruach Bereshit. Once fully commissioned, the Emek Haruchot will be Israel's largest wind farm. Moreover, Israel has also approved the 152 MW Aran wind farm and announced other smaller projects. Yet, the country did not meet its 2020 wind energy target of 800 MW.

Israel is committed to exploiting its renewable energy potential with a specific focus on solar energy. Given the promising future of solar energy in Israel, with the positive spillovers in the high-tech sector, in April 2020 the Ministry of Energy announced that a key pillar of the plan to recover from Covid-19 would include investments to add 2 GW in solar energy to the existing capacity. In order to reach this new solar energy, Israel's government proposed a $1.9 billion investment as part of its $7.1 billion economic plan for recovery. Furthermore, the Israeli government envisages supporting the planned solar projects through $1 billion of loans and $143 million of state guarantees (Bellini 2020c).

In conclusion, Israel is also taking steps in the renewable energy world, thanks to a combination of both large-scale and small-scale renewable projects and a focus on attracting private investments.

Scenario

It is quite unlikely that Israel will attain its upgraded renewable target in time. Indeed, the combination of the largest projects coming online in the coming years does not seem to reach the extra 15 GW needed to achieve the new 2030 renewable target (30% of power generation from renewable energy sources, primarily solar energy). However, it is quite likely that Israel will reach its previous 2030 renewable target (17% of electricity generation from renewable sources) and it may even exceed it thanks to the latest investments envisaged to recover from Covid-19. Israel also attempted to rely on clean energy imports to meet its renewable targets, but with little success. For instance, a recent and underground talk for the import of clean energy (25 MW) from Jordan has been ongoing in the summer of 2020, but the outcome is still uncertain (Holmes and Kierszenbaum 2020). It may be quite challenging to import electricity generated from renewable energy sources due to Jordan's opposition and broader geopolitical tensions. Having said that, Jordan, being in dire need of gas, signed the agreement with Israel despite the popular revolts.

Israel, which was a main energy importer, has recently become an energy exporter. It has used its gas reserves in order to replace its diesel and coal power plants. Thanks to gas-fired power plants, coal is expected to be phased out in the energy mix by 2030. Given the great availability of gas and the high potential and investments in renewable energy, electrification has become a popular theme in energy discussions and policies.

- **Palestine**

Targets and Projects

Renewable energy may represent a high value added given the specific context of Palestine. First of all, the peculiarities of the Palestinian energy sector drive the need to develop renewable energy sources: Palestinians have the lowest energy consumption (0.79 MWh per inhabitant), while paying the highest price, in the MENA region.

Energy demand is also steeply increasing thanks to progressive industrialization, high population growth and improved living standards so that the current reliance on fossil fuel imports (100%) and electricity imports (87%) is becoming economically and socially unsustainable (Juaidi et al. 2016). All these elements contribute to the occurrence of blackouts, which last several hours per day in Gaza, disrupting daily activities. Renewable energy may well represent a solution to overcome these challenges. Indeed, solar energy in particular has a high potential in the region (3000 h of sunshine per year) and, in the next few years, renewable energy is projected to be the cheapest and most reliable energy source, as fossil-fuel based power plants require continuous fuel imports, which are at times restricted by Israel. Renewable energy may thus be regarded as one of the most viable solutions for Palestine in order to move towards energy security and independence as Israel's legislation adds another level of complexity to the Palestinian energy sector, which would also require an update in legislation. Palestine is not allowed to build a national transmission system, and permits to establish new connection points are extremely difficult to obtain. Also, Palestinian distribution companies are restricted from connecting their electrical grids (Khaldi and Sunnika-Blank 2020). These constraints highlight the need for Palestine to develop solutions closer to energy consumers, namely renewable energy.

Given the numerous benefits renewable energy sources would bring—first and foremost energy security—and their high potential, in 2012 the Council of Ministers published the so-called "General Strategy for Renewable Energy in Palestine", which provided the legal basis for the development of renewable energy. Under the General Strategy, renewable targets were set and later revised, given the restrictions to access certain zones in Palestine. The Council of Ministers set the target of 10%—corresponding to 130 MW—of electricity from renewable energy sources by 2020 while the Palestinian Energy and Natural Resource Authority (PENRA) expanded the target to 500 MW in the timeframe 2020–2030 (80% from solar PV, 10% from wind and 10% from biogas/biomass). The target of 500 MW is reduced to 300 MW in case access to area C of the West Bank continues to be restricted, as this area holds the highest renewable energy potential (Milhem 2020).

In order to reach the renewable targets, in 2015 the Palestinian Investment Fund (PIF) established Masdeer, the agency responsible for the implementation of renewable projects worth $2.5 billion. Thus, Masdeer was charged with the "Noor Program", which comprises renewable projects for a total capacity of 200 MW by 2026. In the framework of the Noor Program, the construction of the first Palestinian solar PV plant was started in Noor, Jericho in 2019, with a capacity of 7.5. The next two scheduled solar PV plants are Noor Jenin plant (5 MW) and Noor Tubas (4 MW).

Due to the scarce availability of land in Palestine, numerous renewable projects are planned to be small-scale, especially rooftop solar PV. The main project of this kind regards the installation of rooftop PV panels on 500 public schools across the West Bank, which would provide electricity to over 16,000 houses for a combined capacity of 35 MW. This project is funded by a $8.1 million loan signed between Masdeer and the International Finance Corporation (IFC) as well as a $8.1 million loan signed between Masdeer, the Dutch MENA Private Sector Development Program and the Finland-IFC Blended Finance for Climate Program (Gordon 2020). Through a net metering scheme, the schools would see their bills reduced and excess electricity would also be sold to Palestinian distribution companies at very competitive rates. Regarding Gaza, a similar project for rooftop PV panels was carried out in 2014 by UNDP and financed by the OPEC Fund for International Development (OFID), providing electricity to around 107,000 people. The project included, among other things, the installation of rooftop PV panels on 4 schools and on 2 maternity health care clinics (UNDP 2012, 2016).

Overall, Palestine is striving to develop an independent, secure and sustainable energy policy and sector, and renewable energy sources may be its best tool. Progress on regulation and legislation should be stepped up in order to boost the viability and efficiency of renewable energy as well as to attract foreign investments. The international community should also advocate for an independent and reliable energy system for Palestine, free from imposed infrastructure restrictions, and with free access to area C of the West Bank. Indeed, this area does not only hold the largest solar potential, but it also suffers the most in terms of underdevelopment due to Israeli restrictions.

Scenario

Palestine has not been able to reach its 2020 renewable target (130 MW) and given the current projects in operation it may not attain it soon. Also, regarding the renewable target of 300 MW/500 MW (depending on the restrictions to access Area C of the West Bank) of electricity from renewable energy sources by 2030, Palestine has to face significant obstacles for the attainment of these targets and the full exploitation of renewable potential. Indeed, the progress of renewable energy development depends on numerous variables, such as the amount of funds provided by international organizations, external forces and policies (i.e. Israeli energy policies and restrictions to area C), internal forces (i.e. highly fragmented internal politics between Gaza and the West Bank) and the decrease in technology costs for solar PV.

Moreover, despite being the most viable tool, renewable energy sources are not sufficient to satisfy energy and electricity demand so that other complementary policies should also be carried out. A sustainable energy transition for Palestine envisages two other pillars: energy efficiency (as in most other countries) and energy infrastructure. Energy efficiency is a key pillar to accompany the development of renewable energy, and the “National Energy Efficiency Action Plan 2” showed political awareness of these issues, as it envisages the utilization of smart technologies and demand management. However, new energy efficiency measures seem quite challenging to put in place due to the level of development of the Palestinian grid as well as the restriction to access numerous meters. Lastly, infrastructure for fossil fuel goes back to the discussion in Chap. 3 (Sect. 3.2.3) regarding the inability to exploit fossil-fuel natural resources and restrictions to the development of adequate infrastructure imposed by Israel. Also in this case, the development of fossil-fuel infrastructure seems quite unlikely in the short and medium term given the historical and current dynamics in this sector.

To conclude, international organizations and donors should pay particular attention to renewable energy sources, especially small-scale decentralized solar PV (i.e., on rooftops), as they would partly enhance Palestine's energy security by reducing its dependence on Israel. Both Palestine and Israel would highly benefit from a further development of renewable energy, primarily solar energy. While Israel is focusing on replacing coal with gas and renewable energy and attaining higher electrification in numerous spheres, Palestine aims at increasing its energy security and independence at cheaper prices. However, also in the renewable energy field, the Israeli and Palestinian systems are inexorably interlinked, given the particularity of their political situation.

4.4 Maghreb

Countries in the Maghreb cluster—Algeria, Tunisia and Morocco—have a huge potential in terms of renewable energy sources, thanks to their geography and the availability of vast and scarcely populated territories, especially in the hinterland in the south (Sahara Desert). Also, they are located close to Europe, which can represent a large potential in terms of a "green electricity" export market. At the same time, Europe can provide stable imports when the domestic demand cannot be satisfied, which was historically driven by rising population growth, high energy subsidies and an increasing degree of industrialization. Another great advantage of Maghreb countries is their energy potential, and especially the electricity exchanges among themselves. Given these advantages, countries in this cluster have enhanced their efforts to increase their installed renewable capacity, with different renewable targets, as summarized in Table 4.9. The present section does not include the discussion and analysis on Libya's renewable developments given the ongoing political and security instability.

In terms of electricity interconnections, the West Med cluster has a long history. The Maghreb electricity interconnection—comprising Algeria, Tunisia and Morocco—dates back to the 1950s. There are several interconnections among these countries (OME 2021). Morocco and Algeria are currently linked through three AC lines for a total carrying capacity of 2500 MW and a NTC of about 1000 MW. Algeria is also linked with Tunisia through four AC lines, with a TTC of 1500 MW and a NTC of about 300 MW. Lastly, Tunisia is linked with Libya through two AC lines,

Table 4.9 Renewable energy targets by Maghreb country

Country	Renewable target
Algeria	Total RES installed capacity of 22 GW by 2030
Morocco	42% of total installed power capacity to come from RES by 2020 52% of total installed power capacity to come from RES by 2030
Tunisia	30% of RES in electricity mix by 2030 (equal to 3.6 GW of RES capacity)

Note Targets are not standardized, but as detailed in each Vision or affiliated document
Source Authors' elaboration

although they are normally not operated due to stability problems in connecting Tunisia to the Libya-Egypt synchronous system (OME 2021).

In 1989, the Arab Maghreb Union established the Comité Maghrébin de l'Electricité (COMELEC), which aimed at integrating the countries' electricity markets with the European one. Algeria, Morocco and Tunisia have been interconnected with ENTSO-E since 1993. In 2003, a non-binding document was signed, which aimed at further developing the regional electricity market among the three countries and integrating it with the EU network. The document also envisaged the establishment of a variety of institutions,[8] composed of the countries' energy ministers whose goal was to provide political coordination. During the first meeting of the Ministerial Council in 2010, a breakthrough took place with the agreement on the non-discriminatory access to the transmission network and the attempt to harmonize electricity rules.

While the Maghreb countries are well connected with their European neighboring countries in terms of gas pipelines, the two Mediterranean shores have a low level of power trade. The Maghreb countries' grid is synchronized with the European grid and the interconnections among Algeria, Tunisia and Morocco are well-developed at the infrastructure level, even though few exchanges take place at cluster level, usually only in emergency and extraordinary situations. The only existing interconnector between Maghreb countries and Europe is the one linking Morocco to Spain. With the realization of the Morocco-Spain submarine AC link in August 1997, the integrated grids of Morocco, Algeria and Tunisia were synchronized with the UCTE system. The first interconnection was a 700 MW (400 kV) submarine AC link. In July 2006, a second AC link, a 400 kV as well, was inaugurated increasing the total transfer capacity to 1400 MW. A second interconnection project is represented by the Italy-Tunisia interconnection, whose capacity is 600 MW. It would be the first link between these two countries and it received the full support of the EU as it is included in the list of Projects of Common Interest. It is expected to be achieved by 2027.

The need of a more interconnected power sector is crucial also for the intra-MENA countries. In order to have a truly regional electricity market, the West Mediterranean cluster should be linked, via power interconnectors, to the East Mediterranean one, in particular to the Eight Countries region network. Indeed, excess power in the Mashreq cluster (e.g. Egypt) may be exported to the Maghreb cluster, to complement electricity imports from Europe as a way to enhance Maghreb security of electricity supply (diversification of suppliers and routes). The East Mediterranean cluster, thanks to the links with the West Mediterranean grid, may also be able to export excess electricity to Europe, using the already existing infrastructure network. Therefore, the project of building an interconnection between Tunisia and Libya by 2022 is seen as vital for the development of a regional power market, even though it may encounter security and geopolitical challenges, which may offset the current power exchanges between the East-Med and the West-Med clusters. To actually implement and establish an interconnected and synchronized system among MENA

[8] Among others, the Ministerial Council, Forum of Electricity Rules, Permanent High-Level Group and Expert Group.

countries, it is crucial to reform power sectors, addressing the challenges in terms of reliability and overcoming conflictual conditions.

Given the key relevance of natural gas in the energy transition and as a complement to renewable energy sources, gas-importing countries—Morocco and Tunisia—rely on existing gas pipelines, which connect Algeria to Italy or Spain, passing through their territories, and on new plans to build LNG terminals to increase LNG imports, as in the case of Morocco. Thus, gas exchanges in the West Mediterranean cluster are quite well developed, even though they are unidirectional: from the resource rich country in the cluster—Algeria—or from gas-rich countries outside the cluster to resource poor ones, Tunisia and Morocco. In 2021, the gas exchange between Algeria and Morocco was interrupted as the two countries did not extend the expiring contract because of growing political disagreements over Western Saharan status. This decision resulted in stopping gas exports towards Spain via Morocco in December 2021.

All in all, this cluster holds a high potential for the development of renewable energy, especially in terms of geography and climate conditions. Thus, countries in this cluster may well be able to position themselves as leaders in this field in the Mediterranean, and more broadly in the MENA region and even Africa.

4.4.1 Algeria

- **Targets and Projects**

Having abundant domestic oil and gas reserves, Algeria has developed renewable energy sources more slowly compared to other Maghreb countries, with the exception of Libya which has been even more timid regarding renewables. Nevertheless, also Algeria has set out some objectives in terms of renewable energy sources and energy efficiency as a way to both diversify its economy and to partly limit the negative energy and economic consequences of an ever-growing domestic consumption too reliant on fossil fuels. Algeria has also been affected directly by climate change: during the last decade, it has witnessed years of extreme heat with a decline in yearly rainfall. Algeria is the third largest CO_2 emitter in Africa and ranks high (5th in 2019) in terms of flaring worldwide. Like other MENA countries, Algeria has some favorable characteristics to develop and deploy renewable energy: the geographic location (3000 h of sunshine per year) and the availability of vast and uninhabited areas (the Sahara Desert accounts for 75% of the country's territory).

Renewable energy sources may contribute to sustaining the high pace of the country's demographic growth—about 2% per year—which is one of the main drivers of the rising electricity demand, amounting to 5% per year between 2015 and 2019. As the population is forecasted to continue to grow at a sustained pace, increasing installation capacity for power generation becomes a priority for the country. Thus,

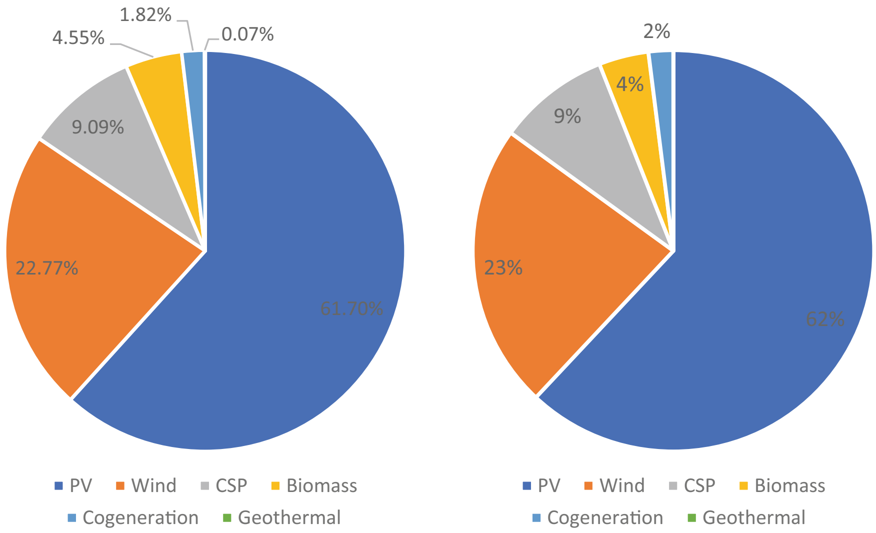


Fig. 4.3 Share of each renewable energy source for the attainment of the 22 GW RES target. *Source* Authors' elaboration on Algerian Ministry of Energy-Program of renewable energy and energy efficiency and cogeneration; Bouznit et al. (2020)

the adoption and spread of renewable energy sources would partly obviate these issues, in addition to freeing up gas for export and consequent revenues.

Throughout the last decade, Algeria has revised and enhanced its RES targets. It initially published in 2011 the Algerian Renewable Energy and Energy Efficiency Development Plan, which aimed at installing 12 GW of a new capacity coming from RESs by 2020. In 2015, the country extended its targets by envisaging the installation of 22 GW of renewable energy sources by 2030, so that renewables would account for 37% of installed capacity and should cover 27% of the country's electricity mix. Figure 4.3 shows that solar PV would play the main role in achieving the target accounting for 13.6 GW, followed by wind (5 GW), solar CSP (2 GW) and biomass (1 GW). Moreover, Algeria also considered the possibility to produce additional clean electricity (10 GW) for exports (Bouznit et al. 2020).

Over the last two decades, Algeria has developed mostly solar PV, as summarized in Fig. 4.4. To achieve its 22 GW target, Algeria has programmed to construct around 60 power plants, including 20 PV plants, 7 wind plants, 6 solar thermal plants and a few CSP. Over the period 2015–2020, Algeria planned to install 3 GW of solar. However, the country is far behind its objective as only 450 MW of solar had been installed by end 2019. In 2019, Algeria created the Commission for Renewable Energy and Energy Efficiency to speed up the development of renewables.

Despite small progress in solar installed capacity, Algeria has made several efforts to boost solar capacity as well as plants from other renewable sources. The Tafouk solar plant is one of the key initiatives in this sense. It consists in the deployment of

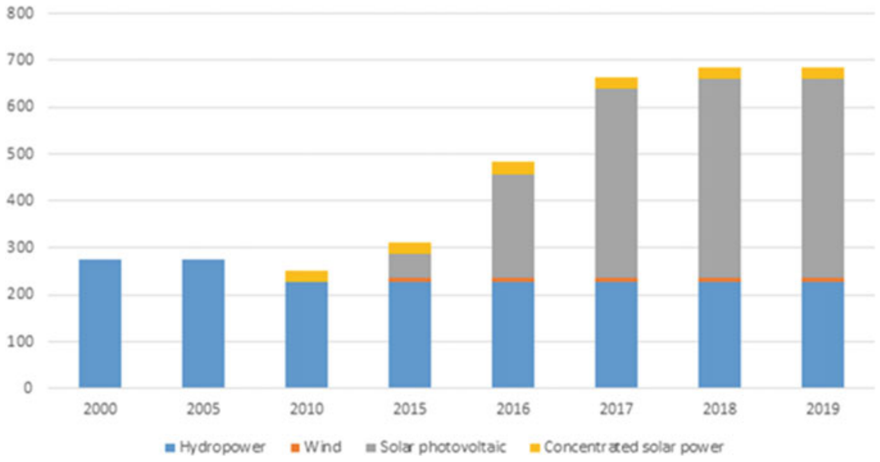


Fig. 4.4 Renewable Electricity Capacity, 2000–2019 (MW). *Source* Authors' elaboration on IRENA (2020)

4 GW of solar PV between 2020 and 2024, with 800 MW of solar capacity being tendered each year.

The second renewable energy source with respect to the 2030 targets is wind, but Algeria has encountered so far several obstacles in this sector. The highest potential for wind development is in the Sahara Desert, where the turbines may require higher levels of maintenance, making the projects less profitable. To date, the only wind plant online—Kabertene in the Wilaya of Adrar—has a capacity of 10 MW. Plans to expand the wind capacity with the development of two 20 MW wind farms were put on hold and postponed indefinitely.

The Algerian government looks to renewable energy also for its potential positive spillovers to the economic and labor sphere. For example, the Tafouk solar plant could yield some positive spillovers as the modules, cables and other structures will be made in Algeria (Bellini 2020d). Indeed, the construction of the Tafouk solar plant is expected to open up 56,000 construction positions and 2000 job opportunities when operational, which is highly relevant in the short term, due to the negative effects of the Covid-19 pandemic on the economy and on the labor market. The requirement of making the modules and cables in Algeria is also likely to create opportunities in the long term, as the country will have benefited from technology and knowledge transfer so that it may be able to become a "solar PV" manufacturing hub for the cluster and beyond. This would allow economic diversification in a sector with high potential and high demand in the coming decades, in terms of both manufacturing and "green" power generation. To do so, Algeria however should implement a series of policies in order to facilitate foreign investments, improve its educational system to develop the required job and knowledge skills. The current economic and political turmoil in the country may, however, hinder the adoption and implementation of such measures.

Despite all the challenges, Algeria announced numerous measures to ease the path towards the attainment of its 2030 renewable targets, including legislative reforms, tax incentives, feed-in-tariffs and financial aid. The backbone of renewable energy development is Law No. 09–09 of 2009, which envisaged the establishment of the National Fund for Renewable Energy (NFRE) with the aim of providing different financial aid to investors, by assigning 0.5% of oil royalties to this fund. Law No. 11–11 of 2011 further extended financial aid by devoting 1% of oil royalties to the fund, which was then denominated National Fund for Renewable Energies and Cogeneration (NFREC), also including cogeneration activities. Further incentives were offered with the Executive Decree No. 13–218 of 2013, which envisioned bonuses for the diversification costs of electricity generation and premiums above production costs for all the electricity produced by public and private companies. Indeed, electricity coming from renewable energy sources has to be sold exclusively to the only distribution company Sonelgaz with PPAs lasting maximum 25 years. Executive Decree No. 17–98 of 2017 completed the delineation of the market and conditions for renewable investments in Algeria: all renewable projects have to go through tenders or auctions (Bouznit et al. 2020). Furthermore, it is well worth to highlight that the 51/49 rule, whereby foreign investors have to enter into a partnership with a local company in Algeria as they are allowed to own maximum 49% of the project, does not apply to the renewable energy sector, enhancing its attractiveness to foreign investors (Proctor 2020). Lastly, Algeria has established a feed-in tariff (FiT) scheme for solar PV with capacities over 1 MW, granted for a period of 20 years. Throughout the period, there are different rates for the first 5 years and for the next 15 years. Table 4.10 summarizes the main elements and renewable energy incentives in the country.

In conclusion, Algeria is striving to develop an attractive framework to incentivize (foreign) investments as well as to diversify its economy from hydrocarbons revenues by establishing itself as a manufacturing hub for renewable technologies, primarily solar, in the region and beyond.

Table 4.10 Sum up of the renewable energy market in Algeria

NFREC (1% of oil royalties) = financial aid	Framework and incentives for renewable energy investments in Algeria
Feed-in-tariff (guarantee to buy + fixed premium)	
All RES projects: tenders or auctions	
Sonelgaz: single buyer	
49/51 rule does not apply to renewable energy	

- **Scenario**

Algeria has so far been unable to significantly exploit its great renewable potential despite having set several RES targets. With roughly 450 MW of solar energy capacity and 230 MW of installed hydroelectricity capacity, the original 2011 renewable target of 12 GW installed by 2020 has not been reached. This objective was increased in 2015 to the 22 GW of installed renewable capacity target by 2030. Political turmoil and economic constraints are deeply interlinked in Algeria's context, given Algeria's overreliance on revenues collected from hydrocarbon exports. To achieve its renewable targets by 2030, Algeria will need to attract and devote massive amounts of investment both from public and private sectors to sustain renewable energy sources, grid and infrastructure development.

The attainment of the 2030 renewable target may be undermined by higher oil price volatility. Algeria is one of the most hydrocarbon-dependent countries in the world, as in 2018 non-hydrocarbon exports accounted for just 2% of its total exports and hydrocarbons accounted for 19% of GDP and 40% of government budget. Due to the country's high reliance on hydrocarbons, lower oil and gas demand and exports may entail lower government revenues, and therefore higher fiscal deficit. Thus, the possibility to increase public investments in renewables may be limited in a period of low oil prices or oil prices volatility, which directly affects the government's revenues and expenditures. For example, one of the main providers of renewable energy investments in Algeria is the National Fund for Renewable Energies and Cogeneration (NFREC), which is made up of the income coming from 1% of oil royalties. A looming peak in oil demand (unless oil prices increase) may significantly reduce Algeria's oil rents hence reducing NFREC funds.

In order to maintain its social welfare, in 2014 Algeria started drawing from its large foreign exchange reserves, which drastically decreased from $195 billion in 2014 to $44.2 billion in 2020. Algeria may encounter serious political and economic challenges in its efforts to ramp up its renewable capacity. In a moment of higher oil price volatility and temporary austerity policies, policymakers may prioritize the pursuit of short-term policies and actions to appease Algeria's population as they did following the 2011 Arab Spring. This outcome may reduce the necessary political consensus for renewable development, especially as the country is experiencing major political turmoil (i.e. Hirak protest movement since February 2019).

Within this framework, renewable energy plays a vital role, going beyond and above energy transition and environmental considerations in Algeria. Indeed, given stagnant hydrocarbon production and high and increasing energy and electricity demand, renewable energy may partly reduce domestic gas consumption for electricity generation, enabling higher gas exports in the medium and long term. Additional revenues are paramount to carry out an effective economic diversification and to further invest in the renewable sector, which may make Algeria a "green energy production" and "technology" hub in the region, further diversifying the country's economy. Thousands of jobs may be created in the manufacturing sector as well as in high-skilled positions, and this favorable climate may further incentivize investments in the country also in other sectors with high potential, such as tourism. This may be particularly beneficial as Algeria's economic and regulatory environment was not quite conducive to attracting investments. The World Bank ranked Algeria 157 out of 190 countries in terms of ease of doing business.

Although its regulatory framework was updated with the introduction of a reverse tender scheme, Algeria is still facing challenges in attracting investments also in its renewable sector. For instance, while the first reverse tender scheme called for a total capacity of 150 MW in 2019, offers were submitted for a 90 MW capacity (Hochberg 2020).

Moreover, Algeria needs to address energy inefficiency, which leads to fast-growing consumption underpinned by its growing population. To meet such a consumption increase, Algeria traditionally prioritized the construction of fossil fuels power plants, taking advantage of its resources. Now the time has come to foster energy efficiency along with renewable energy sources. This requires a revision of the energy prices, although this process could be stalled by political impediments given the country's critical political situation.

To conclude, Algeria has set increasingly ambitious renewable targets. However, several factors have prevented a full and successful development of renewables in the country. A more investment- friendly environment will be crucial to draw foreign public and private investments into Algeria's renewable sector, which requires political consensus. Nevertheless, current political and economic constraints may undermine this task and may lead Algeria's political establishment to focus on short-term policies instead of structural reforms to enhance investments and fully exploit the country's renewable potential.

4.4.2 Tunisia

- **Targets and Projects**

The energy sector and rather challenging economic conditions are highly intertwined in Tunisia. A considerable share of the large national trade deficit is due to the low and decreasing levels of energy security, mostly dictated by its high dependence on imports to satisfy a growing domestic energy and electricity demand. The deployment of renewable energy sources offsets these issues by enhancing *in loco* production, which explains why Tunisia has ramped up the development of renewable energy in the last few years. In 2012, within the framework of the Tunisia Solar Plan (TSP), the country announced that renewables would cover 12% of its electricity mix by 2020 and 30% by 2030, envisaging the installation of 3.6 GW of capacity from renewable energy sources with total investments amounting to roughly €3 billion (UNDP 2018). In 2019, Tunisia's capacity reached 5.8 GW, which is heavily reliant on gas. At the end of 2019, natural gas accounted for 86% of total capacity (5 GW), while the rest comes from oil (7%), wind (6%) and hydro (1%). Renewables accounted for 3.5% of the power mix, missing the 2020 target.

Like in other countries of the region, Tunisia's power sector was dominated by the state-owned electricity and gas utility STEG. In 1996, Tunisia introduced a law that entitled private operators to produce electricity, under public concessions, up to a quantity not exceeding 12.5% of the present volume. To accomplish its renewable objectives, achieve decarbonization and cope with its increasing electricity demand, Tunisia took some steps to boost "green" electricity and attract foreign investors by introducing favorable legislative reforms. In 2015, the Parliament passed Law No. 2015–12, which aimed at enhancing private investments for renewable development and liberalizing the market for the access, network and transport of electricity generated from renewable energy sources. The 2015 Law established a framework that allows private investments in large scale renewable energy projects. Three regimes could be applied on a large scale: self-production, IPP for the local market and for exports (Nouicer and Dhakouani 2020).

More in detail, the 2015 law envisioned electricity production divided in authorization or concessionary regime. The authorization regime regards self-consumption and small renewable projects for a maximum capacity of up to 10 MW for solar PV and 30 MW for wind energy, while the concessionary regime tackles higher capacity renewable projects for both the domestic market and exports. Further legislative reforms have mostly focused on easing the path for self-consumption investments. Indeed, Law No. 2019–47 and Law No. 2020–105, which were passed in 2019 and 2020, respectively, allowed the establishment of a project company that sells electricity to eligible self-consumers. Regarding the authorization regime for small-scale renewable projects, three rounds were launched for solar and wind energy projects, resulting in a total of 12 projects granted for 10 MW each of solar PV, 4 projects granted for 30 MW each of wind and 6 projects in evaluation phase of 10 MW each of solar PV (Renewable Energy Solutions for Africa Foundation 2020).

Regarding the concessionary regime, a tender process was launched in 2017 with a capacity of 140 MW of wind and 70 MW for solar PV under the form of a PPA with STEG as the off taker (UNDP 2018). However, in 2018, STEG still operated all renewable projects, which amounted to a total capacity of 244 MW for wind, while no utility-scale solar PV was present in the country. A leap forward was taken in the summer of 2018 when Tunisia issued a call for tender for a 500 MW solar PV and a 300 MW wind plant with the aim of attracting foreign investors to the country (Demony and Goncalves 2019). Despite the relatively few offers (59) received, in December 2019 the Tunisian Ministry of Mines and Energy announced the five winners of the tender: 300 MW of the project were attributed to the Norwegian developer Scatec Solar, which would sell electricity to STEG thanks to the lowest bid to build a 200 MW facility in the Tataouine Governorate. The Norwegian utility was also awarded other projects of smaller capacities. Other two projects, of 100 MW each, were won by the consortium led by ENGIE and the Moroccan NAREVA and by the consortium led by the Chinese TBEA and the Emirati AMEA Power (Bellini 2019b). As of 2021, numerous solar projects have been launched. Tables 4.11 and 4.12 summarize, respectively, the main solar PV and wind projects tendered and/or developed in Tunisia. Regarding the 300 MW wind energy projects, in 2021, while the Kebili wind power plant (100 MW) was frozen, the Nabeul wind park was in the bidding phase. Nevertheless, numerous other wind projects have been announced or envisaged in the country. Around 3.5 GW of solar capacity are planned. With PPAs already signed, five power plants (with a combined capacity of 520 MW) are in more advanced stages of development: the 100 MW Kairouan solar park, the 120 MW Gafsa solar park, the 50 MW Sidi Bouzid solar, the 50 MW Tozeur solar park, and the 200 MW Tataouine solar park.

Tunisia is the fifth biggest wind power producer in Africa and the Middle East. At the end of 2019, its wind capacity reached 245 MW, thanks to the commissioning of the 55 MW Sidi Daoud wind park between 2000 and 2009 and two other wind parks built near Bizerte with a combined capacity of 190 MW between 2009 and 2014. Moreover, STEG is planning to commission three wind parks in the next

Table 4.11 Solar projects in Tunisia, 2021

Project	Technology	MW	Status	Commissioning year	Operator
Akarit Gabés CSP	CSP	50	Announced		STEG
Kasserine PV	PV	50	Announced		STEG
Kebili PV	PV	20	Announced		STEG
Medenine	PV	50	Announced		STEG
Sfax PV	PV	30	Announced		STEG
Sidi Bouzid	PV	100	Announced		STEG
Tataouine	PV	50	Announced		STEG
Tozeur	PV	20	Under construction	2021	STEG
TuNur	CSP	2250	Authorized		TuNur
Borj Bourguiba solar	PV	200	Bidding process		
Kairouan solar park	PV	100	PPA signed		TBEA/AMEA
Gafsa solar park	PV	120	PPA signed		ENGIE/NAREVA
Sidi Bouzid solar	PV	50	PPA signed	2023	Scatec solar
Tozeur solar park	PV	50	PPA signed	2023	Scatec solar
Tataouine solar park	PV	200	PPA signed	2023	Scatec solar
Total		3340			

Source Authors' elaboration on Enerdata (2020b) and (2021a), Ministère de l'Industrie, de l'Energie et des Mines, 2020

Table 4.12 Wind energy projects in Tunisia in 2021

Project	MW	Status	Commissioning year	Operator
Bizerte (Metline & Kchabta)	325	Frozen/Operational	2012–2014	STEG
CIOK WPP	15	Announced		CIOK
El Kef	100	Announced	2024	STEG
Jbel Abderrahmane	120	Announced	2022	STEG
Sidi Daoud	53.6	Operational	2000–2009	STEG
Tagba	100	Announced		STEG
Nabeul wind park	200	Bidding		
Sidi Mansour Wind	30	FID		IPP
Jbel Tbaga	80	Bidding		STEG
Total operational	244			
Total	1023.6			

Source Authors' elaboration on Enerdata (2020b) and (2021a), Ministère de l'Industrie, de l'Energie et des Mines, 2020

years: 80 MW in Jbel Tagba (2021), 120 MW of Jbel Abderrahmane (2021–22), and 100 MW in El Kef (2024). Given this context, a further step to incentivize renewable energy would be to include Independent Power Producers (IPPs) in the development of renewable projects. To date, one IPP accounts for 20% of electricity production and STEG for 78%, while transmission, distribution and sales are under STEG monopoly (Detoc 2016).

All in all, Tunisia enacted regulatory and legislative changes that contribute to attracting foreign investments, even though further opening of the energy and electricity market would be beneficial to further incentivize the renewable energy sector at both local and international level.

- **Scenario**

The 2030 renewable target—3.6 GW of renewable capacity installed by 2030 (30% of the country's electricity mix)—is quite ambitious for Tunisia, as only 325 MW of renewable capacity were installed at the end of 2019, representing 4% of the country's electricity mix. Due to this limited share of renewable energy in the power mix, the country did not achieve its 2020 target. Nevertheless, the country has stepped up its efforts in the last few years to boost its renewable energy potential and capacity, by promoting regulatory reforms especially for decentralized renewable and tendering large-scale renewable energy projects.

Political consensus will be crucial for strategic projects that require strong institutional support. Despite Tunisia being traditionally represented as a successful story of the Arab Spring, in 2021 the country experienced a major political turmoil culminating with President Kais Saied's decision to freeze Parliament and dismiss the government. However, political uncertainties were already an issue as the country saw the succession of 11 energy ministers over the last decade while several ministries have been reorganized and reshuffled (Bennis 2021). In order to exploit its renewable potential, a stable and clear political and regulatory framework will be crucial. Furthermore, budgetary constraints could prevent the government from issuing sovereign guarantees that could otherwise enhance the creditworthiness of renewable projects. Indeed, the negative impact of the Covid-19 pandemic on the country's global economy and energy sector may slow the pace of renewable energy deployment in the short and medium term, further exacerbating weak macroeconomic and investment outlooks.

This context may be particularly relevant for the renewable sector, as numerous renewable energy projects that are planned to be commissioned in 2022–2024 were undertaken in 2020–2021, at the peak of the economic crisis. Indeed, in 2020, Tunisian real GDP contracted by 8.8%, with a fiscal deficit of 10% that contributed to a rise in public debt from 71.8% of GDP in 2019 to 87.2% of GDP in 2020 (The World Bank 2021). Worsening economic conditions also have a strong negative impact on unemployment—already a major concern before the pandemic (14.9%)—which reached 17.4% at the end of 2020, the highest level since the "Arab Spring" of 2011. This current framework, also exacerbated by increasing vulnerability, may represent a great challenge for the new government led by Hichem Mechichi, appointed in September 2020.

The Covid-19 pandemic also heavily affected electricity demand, as businesses and industries were shut down, resulting in a 20% reduction in demand in April 2020, compared to the same month in 2019. STEG did not curtail electricity production coming from renewable energy sources. Also gas demand substantially decreased, as 70% of the country's natural gas demand is used for electricity generation (representing more than 98% of the country's electricity mix). In April 2020, natural gas demand was 26% lower than in the same period in 2019. This enabled STEG to rely 34% less on natural gas imports, which represented a benefit for a country heavily dependent on gas imports (Nouicer and Dhakouani 2020). Renewable energy sources would also significantly contribute to the reduction of STEG's energy deficit.

All in all, despite the current economic contraction, Tunisia should continue to move forward towards the wider deployment of renewable energy sources, as they are also likely to bring great economic advantages in the medium and long run. Thanks to its strategic geographic location, Tunisia would be able to export electricity coming from renewable energy sources to Italy and Europe, given its ambitious targets by 2050. Europe should be interested in increasing clean electricity imports from its southern neighbors, given their enormous renewable potential. By doing so, the EU would achieve more easily its own decarbonization targets and at a lower cost (since in particular the solar resource base in North Africa is higher than in Europe). It would need to pursue and widen its climate diplomacy, supporting and spurring broader decarbonization efforts across the Mediterranean region. The conditions to create a "green" power exchange are favorable, as a 600 MW bilateral power interconnector between Tunisia and Italy—Elmed—is expected to be completed by 2027. The project has a total estimated cost of €600 million and it is identified as a Project of Common Interest (PCI). Moreover, Tunisia is also relatively well connected with

Algeria and Libya as explained before. As these power interconnectors are employed only in exceptional circumstances, there is room for enhancing power exchanges between neighbors, even though the power demand profiles of these countries are quite similar (OME 2021).

In conclusion, Tunisia could have a setback for the development of renewable energy dictated by the current political and economic challenges. The country could also exploit its strategic location, at the crossroad of West and East Mediterranean clusters and Europe, to boost green power trade. In order to fully exploit the country's renewable potential, Tunisia has to focus its investments in upgrading its infrastructure. Indeed, the greatest potential of renewable projects—especially solar PV—is in the south of the country. The north–south interconnection should therefore be strengthened to accommodate renewable development with an overall grid expansion. Regarding the domestic development of renewables, Tunisia has partially improved its legal framework, even though it still has to address issues such as financial sustainability, energy subsidy reforms and political consensus.

4.4.3 Morocco

- **Targets and projects**

Morocco has been at the forefront of renewable energy adoption and development for the whole MENA region, as electricity coming from renewable energy sources (solar, wind and hydropower) accounted for more than 34% of its total electricity mix in 2018. Morocco also expressed its high commitment for renewable energy sources and fighting climate change by hosting COP22 in Marrakesh in 2016. The development of renewable energy projects addresses numerous issues the country faces, primarily very low levels of energy self-sufficiency for an increasing domestic energy and electricity demand. As mentioned in Chap. 3, energy consumption has been rising since 2010—around 3% average annual growth—despite growing at a slower pace compared to the previous decade. Thus, it is likely that energy consumption will also increase in the mid-run, in coherence with the current trend.

Morocco's political commitment for renewable energy and the fight against climate change led to the publication of the National Energy Strategy in 2009 with the target of 42% of installed power capacity from renewable energy sources by 2020 (with 14% each for hydropower, solar and wind energies). This target was envisaged to be reached by installing 2 GW of capacity for each renewable source (hydro, solar and wind) by 2020. A few years later, at the COP21 in Paris, the target was extended to include 52% of total installed power capacity renewable sources by 2030: 20% from solar, 20% from wind and 12% from hydro (IEA 2019b). As of 2020, the Kingdom has total installed renewable capacities amounting to 3.88 GW, specifically 1.77 GW of hydropower (unchanged capacity since 2010), 1.41 GW of wind, 704 MW of solar energy (540 MW of CSP and 194 MW of solar PV) and 7 MW of bioenergy. To offset rapid increases in energy and electricity demand, at the COP21 Morocco also focused on energy efficiency measures, with a target to decrease energy consumption by 12% by 2020 and 15% by 2030, compared to a baseline scenario. Nevertheless, Morocco has also enhanced its energy self-sufficiency and electricity production capacity with the construction of a new 1.4 GW coal power plant. A divergence in energy policy seems to arise, which is partly explained by the Kingdom assigning top priority to meeting domestic energy and electricity demand.

In order to attain these ambitious targets, Morocco established ad hoc institutions to manage and oversee renewable projects. The Moroccan Agency for Sustainable Energy (MASEN) is responsible for the Moroccan Solar Plan and set the target of 2 GW of installed solar capacity, both PV and CSP, by 2020 and 4.8 GW by 2030. This Agency has successfully accomplished the development of the Ouzarzate CSP complex, comprising Noor I (160 MW) in 2016, Noor II (200 MW) and Noor III (150 MW) in 2018. MASEN also managed the construction and operationalization of the first solar PV plants—Noor IV (70 MW), Noor Laâyoune (80 MW) and Noor Boujdour (20 MW) (Khatib 2018). In 2020 and 2021, the Kingdom proceededs with the call for tender and interest of numerous high-capacity solar PV projects. For instance, in January 2020, MASEN issued a call of expression of interest for a 400 MW solar PV plant, which is part of the first phase of the Noor PV II project—comprising numerous solar projects in eight different sites (Bellini 2020e). In 2021, the deadline for the call of tender of Noor PV II was extended until the end of August 2021. Numerous other solar projects have been tendered over the last five years (Table 4.13). In 2019, solar accounted for around 4% of the power mix.

Morocco holds high potential in wind energy, contributing to the promotion of the Moroccan Integrated Wind Program. Under this Program, Morocco aims at installing 2 GW by 2020 and 5 GW of wind capacity by 2030. Wind accounted for 11% of the power mix in 2019. Even though over the past decade Morocco has rapidly increased its wind capacity from less than 300 MW in 2010 to 1.4 GW in 2020 (Table 4.14), it did not reach its target.

The strong increase was possible, among other things, thanks to the 300 MW Tarfaya wind complex, the largest in Africa, which has been developed through a joint venture between the French ENGIE and the Moroccan NAREVA Holding company. Several other wind projects have also been awarded, amounting to a total combined capacity of 850 MW. These projects have attracted foreign and leading companies in this sector as they have been developed by a consortium of NAREVA Holding, ENGIE, ENEL Green Power and Siemens Wind Power (Oxford Business Group 2020e).

Furthermore, hydropower is a key element of renewable energy sources for the Kingdom, accounting for nearly half (47.8%) of the electricity generated from renewable energy sources in 2018 (Ameur et al. 2019). Indeed, hydropower was the first renewable source adopted and deployed by Morocco, probably thanks to the lower costs and lower technology needed compared to wind or solar energy. The target of 2 GW of hydropower capacity was to be reached through the installation of new dams, which, however, mainly concern water management, and the construction of a 464 MW Pumped-Storage Power Plants (PSPP). This technology has been devised

Table 4.13 Main solar energy projects completed or commissioned in Morocco

Project	Technology	MW	Status	Commissioning year	Operator
Noor Boujdour	PV	120	Operational/Announced	2018	ACWA Power
Foum El Oued	PV	500	Announced		
Noor Atlas	PV	200	Bidding	2021	ONE
Noor Laâyoune	PV	480	Operational/Announced	2018	ACWA Power
Noor Midelt-I	PV/CSP	795	Bidding	2021	MASEN
Noor Ouarzazate	PV/CSP	580	Operational	2016–2018	ACWA Power
Noor Tafilalt	PV	40	Under construction	2021	MASEN
Noor Tata	PV	1,000	Authorized		MASEN
Sabkhat Tah	PV	500	Announced		MASEN
Noor Argana	PV	200	Bidding	2021	ONE
Noor Midelt-II	PV	230	Announced		MASEN
Total operational		734			
Total		4645			

Sources Authors' elaboration on Enerdata (2021a) and (2020c)

not only for power generation, but especially for the storage of solar and wind energy (Boulakhbar et al. 2020). Overall, hydropower generation has gained momentum in the last decade thanks to several Pumped-Storage Power Plants (PSPP: Afourer (in construction) with 465 MW capacity, M'Dez El Menzel (in design) with a 170 MW capacity and Abdelmoumen (in construction since 2018) with a 350 MW capacity (Vedie 2020). Nonetheless, hydropower is particularly vulnerable to climate change as its output varies annually depending on precipitation levels.

To better accommodate large shares of renewable capacity, the Kingdom has carried out changes to the energy regulatory setting. Prior to 2012, l'*Office National de l'Electricité et de l'Eau Potable* (ONEE), the national utility in charge of electricity production, transmission grid and the majority of distribution, was the sole responsible for buying, selling, importing and exporting electricity. The national regulatory change Act No. 13-09 in 2012 opened up the market to the free exchange of electricity coming only from renewable energy sources. In other words, private green electricity developers were allowed access to the national grid, producing electricity from renewable sources and buying it in the market. Thus, since Act No. 13-09, two parallel electricity markets coexist: the liberalization of the electricity market

Table 4.14 Main wind energy projects in Morocco

Project	MW	Status	Commissioning year	Operator
Akhfenir	100	Operational	2013	NAREVA
Akhfenir 2	100	Operational	2016	ONE
Al Koudia Al Baida (Abdelkhalek Torrès Farm)	350.4	Operational/under construction	2000–2025	Compagnie Eolienne du Détroit
Amogdoul	60	Operational	2007	ONE
Boujdour	300	Under construction	2022	NAREVA
Ciments du Maroc	5	Operational	2011	Ciments du Maroc
El Haouma	50	Operational	2013	NAREVA
Foum El Oued wind	50.6	Operational	2013	NAREVA
Jbel Khalladi	120	Operational	2017–2018	UPC
Jbel Lahdid	270	Under construction	2023	NAREVA
Midelt	180	Operational	2021	NAREVA
Safi Wind Farm	200	Under construction	2021	
Tanger Wind	140	Operational	2009–2011	ONE
Tanger 2	100	Under construction	2023	NAREVA
Tarfaya	300	Operational	2014	Tarfaya Energy Company
Taza	150	Under construction/Bidding	2022–2025	ONE
Tetouan WPP	32	Operational	2008–2010	Lafarge
Tiskrad	100	Bidding	2021	NAREVA
Aftissat Wind Farm	200	Operational	2019	EEM
El Oualidia	36	Synchronized	2021	Innovent
Aftissat Wind Farm II	200	Authorized	2022	EEM
Total operational	1410			
Total	3044			

Sources Authors' elaboration on Enerdata from renewable sources and the IPP scheme contract for the conventional electricity market. In 2016, Morocco decided to further strengthen the liberalization of the electricity market from renewable energy sources with Act No. 58-15, an update of Act No. 13-09. Indeed, the newly passed law envisages, among other provisions, the development of a low-voltage electricity market (i.e. rooftop solar PV) and the trade of surplus electricity from renewable sources to ONEE (up to 20% of the annual generation) (Khatib 2018).

Large-scale renewable projects, in line with most other countries in the MENA region, are usually envisaged in the framework of international tenders, with IPPs. Under this scheme, bidders sign PPAs with ONEE, which will buy electricity produced from the project for the following 20–30 years. These schemes have contributed to diminishing the cost of electricity produced (i.e. for NOOR III solar project) and to introducing the expensive CSP technology during peak times.

All in all, Morocco has become a frontrunner in the renewable energy industry across the MENA region. Its strong political commitment towards energy transformation is driven by energy security concerns, economic opportunities and climate ambitions. Therefore, Morocco has designed an attractive framework for the development of renewable energy sources.

- **Scenario**

The pipeline of renewable energy projects completed, commissioned or tendered demonstrates Morocco's efforts to widely adopt renewable energy and to become a leader in the sector in the West Mediterranean cluster, in the MENA region, and in Africa. Morocco did not attain its 2020 renewable energy targets, as installed capacities of hydropower (1.77 GW), wind (1.41 GW) and solar (704 MW) were below the 2 GW objective for each of these sources. These 2 GW targets per renewable source are likely to be attained in the next couple of years. Indeed, in 2020, the renewable share of electricity capacity amounted to 34%, below the 42% target set. In the medium and long run, it is likely that the deployment of renewable energy sources will continue and the 2030 target may well be timely attained. The country will need to install 10 GW of additional capacity over the period 2018–2030, consisting of 4.6 GW of solar, 4.2 GW of wind and 1.3 GW of hydro.

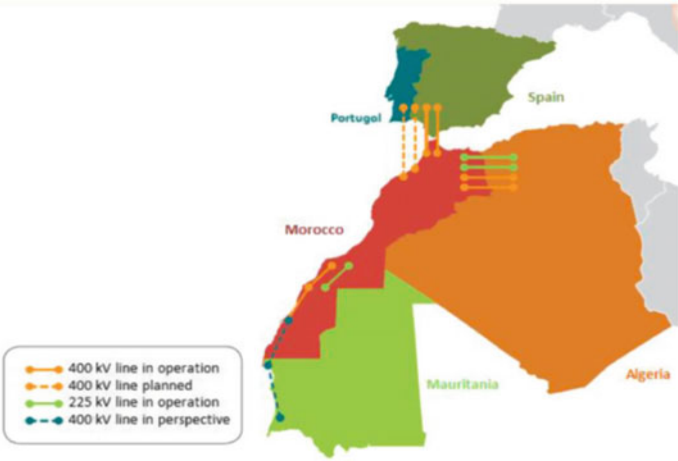
Morocco seems on track to achieve its 2030 renewable target—52% of electricity coming from renewable energy sources—thanks to the numerous renewable projects tendered. The attainment of 52% of renewable energy sources in the electricity mix and the increased adoption of smaller local renewable units (decentralized energy sources), thanks to the opening up of the electricity market, pose the great challenge of integrating renewable energy in the grid (Eberle 2020). It is thus paramount for Morocco to ensure grid stability and flexibility in order to truly become a key player in the renewable energy field. Indeed, the grid has to be adapted in order to keep up intermittent electricity production with a lower utilization rate, following the widespread use of decentralized energy sources, entailing self-consumption.

Morocco's power system network was mostly constructed over 50 years ago, with the integration of new technological elements over the years. The majority of the network is not in good condition and in need of an update, being subject to stress conditions resulting from water infiltrations and extreme temperatures. The National Agency for Electricity and Water (ONEE) reinforced the grid in 2019 and 2020, but it is not deemed sufficient to keep up with the high levels of electricity from renewable energy sources envisioned in the 2030 objective (Boulakhbar et al. 2020). In addition, in Morocco, variable renewable energy sources (solar and especially wind energy) are situated in remote locations, far from large consumption areas. There is thus an urgent need to step up grid modernization efforts to allow the transmission and distribution of electricity coming from renewable sources from locations at the extremities of the grid to high-consuming regions, without encountering significant congestion problems. In order to ensure flexible production to offset renewable intermittency and enhance grid stability, Morocco will have to devise some solutions, such as storage, decentralized production, increased and active grid management.

Morocco is also striving to complement its intermittent renewable energy production with gas, as it plans to build and commission a new LNG terminal in Jorf Lasfar by 2025 with a capacity of 7 bcm per year for an investment of $4.5 billion. Additional imported gas will then be partly used in a new combined cycle power plant, for a total capacity of 2.4 GW (MEED 2019). Meanwhile, Morocco is expected to start import gas from Spain through the GME in reverse flow.

Another way to efficiently integrate renewable energy production in the grid regards the enhancement of interconnections, as electricity exchanges enable the balance between supply and demand. Morocco is in an ideal position at the crossroads between Europe, North Africa and West Africa. It could therefore take advantage of its renewable energy production for export to these markets. Regarding international interconnections, Morocco is linked to Spain with two submarine AC interconnections (Map 4.5). The first one (700 MW) was deployed in August 1997, while the other was put into operation in July 2006 doubling the total transfer capacity to 1400 MW. As of 2021, it is the only interconnection between the North and South of Mediterranean countries (OME 2021). The Kingdom is already interconnected with Algeria (1.2 GW) (The World Bank 2017), while projects are on the table to interconnect Morocco with Portugal (1 GW), with Mauritania and to build a third interconnection line with Spain (700 MW) (OME 2021; Tsagas 2019). Map 3.6 highlights Morocco's main planned or operational cross-border interconnections. Moreover, particularly relevant and ambitious is the plan of the British company Xlinks to connect Morocco with the UK directly with a submarine cable, without using Spanish or French grid infrastructure, which would then satisfy 6% of UK's electricity demand (Xlinks n.d.). Indeed, Xlinks is planning to build a 10.5 GW renewable energy complex (7 GW of solar capacity and 3.5 GW of wind) in Morocco, which would be connected to the UK power network via a 3800 km high voltage direct current (HVDC) transmission line. Low LCOE for the solar and wind power plants in Morocco justifies cable losses, which are expected to be between 10 and 12%. An investment of about £18 billion is estimated for this project.

Overall, these interconnection projects are particularly promising and would represent a "win–win" solution for all parties involved, as excess electricity from renewable energy sources could be exported without compromising the grid due



Map 4.5 Operational and planned interconnections. *Source* Authors' elaboration on Boulakhbar et al. (2020)

to considerable congestion issues. This is why at COP22 the EU countries signed a declaration regarding these possible electricity exchanges with a "Roadmap for Sustainable Electricity Trade" (Boulakhbar et al. 2020). However, as discussed in Chap. 3 (Sect. 3.3.3), Morocco has also boosted its coal capacity with the construction of a new coal power plant (Cap Ghir Safi) with a capacity of 1.4 GW, thus the country's electricity exports may not be completely "green".

In conclusion, Morocco may be considered quite on track to reach its 2030 renewable targets. Nevertheless, it has to face some challenges related to the high percentage of electricity coming from renewable energy sources. For this purpose, it aims to strengthen the grid, which may not yet be sufficiently strong, despite several upgrades in the last couple of years. Overall, Morocco is also striving to solve issues concerning the intermittency of renewable energy production by strengthening interconnections and enhancing gas imports, as they are deemed a necessary source to accompany renewables in the energy transition.

Bibliography

Abouzzohour Y, Ben Mimoune N (2020) Algeria must prioritize economic change amidst Covid-19 and political crisis. Brookings Doha Center. https://www.brookings.edu/blog/order-from-chaos/2020/12/02/algeria-must-prioritize-economic-change-amidst-covid-19-and-political-crisis/. Accessed 27 Dec 2020

Abu-Ramman G, Khdair AI, Khdair SI (2020) Current status and future potential in renewable energy in Jordan: an overview. Heliyon 6:1–8

Adler K (2021) Qatar petroleum commits to low-carbon LNG in latest expansion. IHS Markit. https://ihsmarkit.com/research-analysis/qatar-petroleum-commits-to-lowcarbon-lng-in-latest-expansion.html. Accessed 15 May 2021
Ahmad A (2020) Distributed power generation for lebanon: market assessment and policy pathways. World Bank Group, Washington D.C.
Ahmad A, Mahmalat M, Noumba UP, Saghir J (2021) Power sector reforms are new Lebanese governments' ultimate test. The Middle East Institute. https://www.mei.edu/publications/power-sector-reforms-are-new-lebanese-governments-ultimate-test
Albuflasa H (2019) Renewable energy in Bahrain: background paper. University of Bahrain, pp 1–28
Al Faisal L (2020) Kuwait Ministries Begin 'Kuwaitization', 50% of Expats to Be Laid Off: Report. Al Arabiya. https://english.alarabiya.net/en/News/gulf/2020/08/04/Kuwait-ministries-begin-Kuwaitization-50-percent-of-expats-to-be-laid-off-Report. Accessed 7 Sep 2020
Al Monitor (2020) In latest spending cut, oman not renewing majority of foreign consultant contracts. Al Monitor. https://www.al-monitor.com/pulse/originals/2020/05/oman-contracts-spending-coronavirus-economy-oil-royal-court.html. Accessed 7 Sept 2020
Al-Riffai P, Breisinger C, Eldidi H, Mondal MAH, Ringler C, Wiebelt M (2019) Long-term optimization of Egypt's power sector: policy implications. Energy 166:1063–1073
Al-Sarihi A, Bello H (2019) Socio-economic and environmental implications of renewable energy integrity in Oman: scenario modelling using system dynamics approach. In: Qudrat-Ullah H, Kayal A (eds) Climate change and energy dynamics in the middle east. Understanding Complex Systems. Springer, Cham
Ameur A, Berrada A, Loudiyi K, Aggour M (2019) Analysis of renewable energy integration into the transmission network. Electricity J 32(10)
AP (2022) Dubai says planned coal-fired power plant to instead use gas, 4 February 2022. https://apnews.com/article/science-business-middle-east-dubai-united-arab-emirates-c32651d394c6969cca76d2269f34ad2a
Arabian Business (2020) Abu Dhabi wealth fund targets Africa, green energy to drive greater returns. Arabian Business. https://www.arabianbusiness.com/energy/455598-abu-dhabi-wealth-fund-targets-africa-green-energy-to-drive-greater-returns. Accessed 30 June 2021
Asif SM, Khan SA (2018) Transition towards sustainable energy production—a review of the progress of solar energy in Saudi Arabia. Energy Explor Exploit 36(1):3–27
Badawi T (2018) Iran's water problem. Carnegie Endowment International Peace. https://carnegieendowment.org/sada/77935
Bellini E (2017) Morocco: government-run agency Masen authorized to buy minority stake in 170 MW NOOR PV I project. PV Magazine. https://www.pv-magazine.com/2017/05/30/morocco-government-run-agency-masen-authorized-to-buy-minority-stake-in-170-mw-noor-pv-i-project/. Accessed 8/4/2020
Bellini E (2018) Israel Issues 1.6GW Scheme for Rooftop Solar. PV Magazine. https://www.pv-magazine.com/2018/03/29/israel-issues-1-6-gw-scheme-for-rooftop-solar/. Accessed 25 Sept 2020
Bellini E (2019a) UAE: 200 MW solar park under development in emirate of Umm Al Quwain. PV Magazine.https://www.pv-magazine.com/2019/01/03/uae-200mw-solar-park-under-development-in-emirate-of-umm-al-quwain/. Accessed 10 Aug 2020
Bellini E (2019b) Winners and Prices of Tunisia's 500MW PV Tender. PV magazine. https://www.pv-magazine.com/2019/12/20/winners-and-prices-of-tunisias-500-mw-pv-tender/. Accessed 27 May 2020
Bellini E (2019c) Morocco opens 230 MW solar tender. PV Magazine. https://www.pv-magazine.com/2019/07/11/morocco-opens-230-mw-solar-tender/. Accessed 2 Oct 2020
Bellini E (2019d) EDF-led consortium wins Moroccan tender for 800 MW CSP-PV project with price of $0.070/kWh. https://www.pv-magazine.com/2019/05/23/edf-led-consortium-wins-moroccan-tender-for-800-mw-csp-pv-project-with-price-of-0-070-kwh/. Accessed 2 Oct 2020
Bellini E (2020a) Israel Wants Another 15GW of Solar by 2030. PV Magazine. https://www.pv-magazine.com/2020/06/03/israel-wants-another-15-gw-of-solar-by-2030/ . Accessed 22 Sep 2020

Bellini E (2020b) Israel Launches 300MW Solar-Plus-Storage Tender. PV Magazine. https://www.pv-magazine.com/2020/01/24/israeal-launches-tender-for-300-mw-of-solar-plus-storage/#:~:text=Israel's%20largest%20operational%20PV%20plant,was%20finalized%20in%20October%202019. Accessed 24 Sep 2020

Bellini E (2020c) Israel's Plan to Recover from Covid-19 Crisis Includes 2 GW of New Solar. PV Magazine. https://www.pv-magazine.com/2020/04/29/israels-plan-to-recover-from-covid-19-crisis-includes-2-gw-of-new-solar/. Accessed 25 Sept 2020

Bellini E (2020d) Algeria Plans 4GW of Solar Tenders. PV Magazine. https://www.pv-magazine.com/2020/05/29/algeria-plans-4-gw-of-solar-tenders/. Accessed 26 Dec 2020

Bellini E (2020e) Morocco Kicks Off Tender for 400 MW Solar Park. PV Magazine. https://www.pv-magazine.com/2020/01/31/morocco-kicks-off-tender-for-400-mw-solar-park/. Accessed 30 Dec 2020

Bennis A (2021) Power surge: How The European Green Deal Can Succeed In Morocco And Tunisia, ECFR, Policy Brief, January 2021. Available at: https://ecfr.eu/publication/power-surge-how-the-european-green-deal-can-succeed-in-morocco-and-tunisia/

Ben Kilani K, Haj Hamida A, Elleuch M (2019) North Africa grid interconnection weakness: impact on the Tunisian PES emergencies. Energy Rep 5:1420–1425

Betancourt-Torcat A (2018) An introduction to UAE energy production and challenges. The Petroleum Institute

Bodansky D, Rajamani L (2016) Evolution and governance architecture of the climate change regime. In: Sprinz D, Luterbacher U (eds) International relations and global climate change: new perspectives, 2nd edn. MIT Press

Bodetti A (2019) Renewable energy: how the gulf is preparing for a future without petroleum. The New Arab. https://www.alaraby.co.uk/english/indepth/2019/4/4/renewable-energy-industry-in-the-persian-gulf. Accessed 24 July 2020

Boubekeur A (2020) Demonstration effects: How the Hirak protest movement is reshaping Algerian politics. European Council on Foreign Relations Policy Brief, pp 1–23

Boulakhbar M, Lebrouhi B, Kousksou T, Smouh S, Jamil A, Maaroufi M, Zazi M (2020) Towards a large-scale integration of renewable energies in Morocco. J Energy Storage 32:1–18

Bouznit M, Pablo-Romero M, Sanchez-Braza A (2020) Measures to promote renewable energy for electricity generation in Algeria. Sustainability 12(1468):1–17

Broom D (2019) How the Middle East is suffering on the front lines of climate change. World Economic Forum, 5 April 2019. Available at: https://www.weforum.org/agenda/2019/04/middle-east-front-lines-climate-change-mena/

CMS (2016) Renewable energy in Iran. CMS Law-Tax

Cosgrove C (2019) Renewable energy in Bahrein-Perspectives. EcoMena. https://www.ecomena.org/renewable-energy-in-bahrain/. Accessed 31 Aug 2020

Dhakouani A, Znouda E, Bouden C (2020) Impacts of electricity subsidies policy on energy transition. In: Dynamics of energy, the environment and economy. Springer Nature 77

Demony C, Goncalves S (2019) Tunisia boosts renewables with 'game-changing' solar tender. Reuters. https://br.reuters.com/article/us-tunisia-energy-renewables-idUSKCN1TD1SH. Accessed 29 Dec 2020

Detoc L (2016) Country profiles: Tunisia. Renewables Energy Solutions for the Mediterranean Country Profiles 1–43

Dudley D (2017) European firms pour money into iranian renewable energy projects, FORBES, 24 Oct 2017. Available at: https://www.forbes.com/sites/dominicdudley/2017/10/24/iran-renewable-energy/?sh=5f217ad34d00

Eberle S (2020) Improving grid integration of renewable energy. Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIS). https://www.giz.de/en/worldwide/86943.html. Accessed 1 Jan 2021

Elkady H, Salah F (2019) Renewable energy law and regulation in Egypt. CMS Law, Tax. https://cms.law/en/int/expert-guides/cms-expert-guide-to-renewable-energy/egypt. Accessed 21 Dec 2020

ENERDATA (2019a) Jordan energy information. ENERDATA. https://www.enerdata.net/estore/energy-market/jordan/. Accessed 5 Sept 2021

ENERDATA (2019b) Lebanon energy information. ENERDATA. https://www.enerdata.net/estore/energy-market/lebanon/. Accessed 5 Sept 2021

ENERDATA (2020a) Saudi Arabia updates its net metering scheme for rooftop PV systems. ENERDATA. https://www.enerdata.net/publications/daily-energy-news/saudi-arabia-updates-its-net-metering-scheme-rooftop-pv-systems.html. Accessed 14 Sept 2021

ENERDATA (2020b) Jordan country energy report. ENERDATA, pp 1–30

ENERDATA (2020c) Tunisia country energy report. ENERDATA, pp 1–38

ENERDATA (2020d) Morocco country energy report. ENERDATA, pp 1–40

ENERDATA (2021a) Power Plant Tracker. ENERDATA

ENERDATA (2021b) Saudi Arabia targets 50% of electricity from renewables by 2030. ENERDATA. https://www.enerdata.net/publications/daily-energy-news/saudi-arabia-target-electricity-renewable-energy.html. Accessed 14 Sept 2021

Energy Information Administration (EIA) (2020) Country analysis executive summary: United Arab Emirates. EIA, pp 1–8

ETHRAA (2019) The challenges of implementing solar systems in Saudi Arabia. ETHRAA. https://www.ethraa-a.com/the-challenges-of-implementing-solar-systems-in-saudi-arabia/. Accessed 29July 2020

EU Commission (2020) Methane emissions. EU Commission. https://ec.europa.eu/energy/topics/oil-gas-and-coal/methane-emissions_en. Accessed 20 Nov 2020

Evwind (2019) Oman targets 30% renewable energy share by 2030. Evwind. https://www.evwind.es/2019/03/19/oman-targets-30-renewable-energy-share-by-2030/66472#:~:text=In%20a%20bid%20to%20diversify,renewable%20energy%20projects%20by%202030. Accessed 31 Aug 2020

Farag M (2019) Egypt will produce 61,000 MW of renewable energy, of which 12,000 MW concentrated solar power, and 18,000 MW wind power. EVwind. https://www.evwind.es/2019/12/18/egypt-will-produce-61000mw-of-renewable-energy-of-which-12000mw-concentrated-solar-power-and-18000mw-wind-power/72588. Accessed 19 Oct 2020

Fattouh B, Poudineh R (2020) MENA: a fundamental compromise. World Energy 47:92–99

Financial Tribune (2017) Iran targets 1GW per year in renewables. Financial Tribune. https://financialtribune.com/articles/energy/103467/iran-adding-green-energy-capacity. Accessed 28 Aug 2020

Financial Tribune (2020) Iran adding green energy capacity. Financial Tribune. https://financialtribune.com/articles/energy/103467/iran-adding-green-energy-capacity. Accessed 27 Aug 2020

Fitch Ratings (2021) Fitch Affirms Bahrain at "B+"; Outlook Stable. Fitch Ratings. https://www.fitchratings.com/research/sovereigns/fitch-affirms-bahrain-at-b-outlook-stable-12-04-2021#:~:text=The%20general%20government%20budget%20deficit,10%25%20decline%20in%20nominal%20GDP. Accessed 18 May 2021

Forstenlechner I, Rutledge EJ (2011) The GCC's "Demographic imbalance": perceptions, realities and policy options. Middle East Policy Council 18(4):25–43

General Authority of Statistics (2018) Education and training survey 2018. Kingdom of Saudi Arabia. https://www.stats.gov.sa/en/survey/13533. Accessed 1 Aug 2020

General Secretariat for Development Planning (2008) Qatar National Vision 2030. General Secretariat for Development Planning, Doha

Gnana J (2019) Exclusive: Jordan Eyes oil shale production by 2022, Energy Minister Says. The National. https://www.thenational.ae/business/energy/exclusive-jordan-eyes-oil-shale-production-by-2022-energy-minister-says-1.847735. Accessed 10 Sept 2020

Gnana J (2017) Saudi Arabia Extends Deadline for Energy Price Reform. The National. https://www.thenationalnews.com/business/energy/saudi-arabia-extends-deadline-for-energy-price-reform-1.689473. Accessed 19 March 2021

Gordon P (2020) Palestine's West Bank to Gain Rooftop Solar thanks to Funding Boost. Smart Energy International. https://www.smart-energy.com/industry-sectors/policy-regulation/palestines-west-bank-to-gain-rooftop-solar-thanks-to-funding-boost/. Accessed 6 Oct 2020

Gould T, McGlade C, Schulz R (2020) Methane emissions from oil and gas. IEA Tracking Report

Government of Dubai (2019) Mohammed bin Rashid Al Maktoum Solar Park- a Leading Project that Promotes Sustainability in the UAE. Dubai Electricity and Water Authority. https://www.dewa.gov.ae/en/about-dewa/news-and-media/press-and-news/latestnews/2019/03/mohammed-bin-rashid-al-maktoum-solar-park. Accessed 7 Aug 2020

Griffiths S (2017) A review and assessment of energy policy in the Middle East and North Africa region. Energy Policy 102(2017):249–269. https://doi.org/10.1016/j.enpol.2016.12.023

Hafezi P, Nichols M (2020) Despite US Sanctions Bid, Iran Aims to Keep Nuclear Deal Alive until US Election. Reuters. https://www.reuters.com/article/us-usa-iran-un/despite-u-s-sanctions-bid-iran-aims-to-keep-nuclear-deal-alive-until-u-s-election-idUSKCN25E2JH. Accessed 31 Aug 2020

Hammad M (2020) Saudi and Emirati investments to develop solar power projects in Egypt. The Arab Weekly. https://thearabweekly.com/saudi-and-emirati-investments-develop-solar-power-projects-egypt. Accessed 21 Oct 2020

Helioscsp (2019a) IRENA: Middle East concentrated solar power cost reductions require creative financing. Helioscsp. http://helioscsp.com/irena-middle-east-voncentrated-solar-power-cost-reductions-require-creative-financing/. Accessed 25 Aug 2020

Helioscsp (2019b) World's largest concentrated solar power plant is in Dubai. Helioscsp. http://helioscsp.com/worlds-largest-concentrated-solar-power-plant/. Accessed 8 Aug 2020

Hereher M, Al-Kenawy AM (2020) Exploring the potential of solar, tidal, and wind energy resources in Oman using an integrated climatic-socioeconomic approach. Renewable Energy 161:662–675

Hessler U (2018) Saudi Arabia Puts World's Biggest Solar Power Project on Hold. DW. https://www.dw.com/en/saudi-arabia-puts-worlds-biggest-solar-power-project-on-hold/a-45706685. Accessed 20 Aug 2020

Hill JS (2019) Saudi Arabia increases solar targets to 20 Gigawatts by 2023 & 40 Gigawatts by 2030. Clean Technica. https://www.power-technology.com/comment/saudi-renewable-energy-targets/. Accessed 17 Aug 2020

Hochberg M (2020) Algeria charts a path for renewable energy sector development. Middle East Institute. https://www.mei.edu/publications/algeria-charts-path-renewable-energy-sector-development. Accessed 26 Dec 2020

Holmes O, Kierszzenbaum Q (2020) Israel moots plan to buy solar power from former enemy Jordan. The Guardian https://www.theguardian.com/world/2020/aug/23/israel-moots-plan-to-buy-solar-power-from-former-enemy-jordan. Accessed 26 Sept 2020

Hydrocarbons Technology (n.d.) Arab Gas Pipeline (AGP), Jordan, Syria, Lebanon. Hydrocarbons Technology. https://www.hydrocarbons-technology.com/projects/arab-gas-pipeline-agp/arab-gas-pipeline-agp1. Accessed 8 Oct 2021

IEA (2019a) Egypt. IEA. https://www.iea.org/countries/egypt. Accessed 18 May 2021

IEA (2019b) Energy Security. IEA. https://www.iea.org/topics/energysecurity/. Accessed 25 April 2020

IEA (2020a) Methane Tracker 2020. IEA. https://www.iea.org/reports/methane-tracker-2020. Accessed 21 Nov 2020

IEA (2020b) Oman. IEA. https://www.iea.org/countries/oman. Accessed 15 May 2021

IEA (2020c) Bahrain. IEA. https://www.iea.org/countries/bahrain. Accessed 15 May 2021

IEA (2020d) Kuwait. IEA. https://www.iea.org/countries/kuwait. Accessed 15 May 2021

IEA (2020e) Clean Energy Transitions in North Africa. IEA. https://www.iea.org/reports/clean-energy-transitions-in-north-africa. Accessed 6 May 2021

IFC (2019) Bright days ahead for solar power in Egypt. World Bank Group. https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/new-market-egypt. Accessed 25 Oct 2020
IMF (2019) Regional economic outlook: Middle East and Central Asia. IMF, Washington D.C.
IMF (2020a) Regional economic outlook: Middle East and Central Asia. IMF, Washington D.C.
IMF (2020b) Regional economic outlook update: Middle East and Central Asia Statistical Appendix. IMF, Washington D.C.
IRENA (2018) Renewable energy outlook Egypt. IRENA, Abu Dhabi
IRENA (2019). Renewable energy market analysis: GCC 2019. IRENA, Abu Dhabi
IRENA (2020) Renewable energy outlook: Lebanon. IRENA, Abu Dhabi
IRENA (2021a) Renewable energy statistics. IRENA, Abu Dhabi
IRENA (2021b) Renewables readiness assessment: the Hashemite Kingdom of Jordan. IRENA Executive Summary, pp 1–4
ISMED (2014) Jordan assessment report: optimising the incentives framework for renewable power infrastructure. OECD
Jalilov O (2019) Iran increases renewable energy production. Caspian News. https://caspiannews.com/news-detail/iran-increases-renewable-energy-production-2019-10-15-56/. Accessed 31 Aug 2020
Jamil M, Ahmad F, Jeon YJ (2016) Renewable energy technologies adopted by the UAE: prospects and challenges—a comprehensive review. Renew Sustain Energy Rev 55:1181–1194
Jordan Times (2020) $148 million wind power projected inaugurated in Maan. Jordan Times. http://www.jordantimes.com/news/local/148-million-wind-power-project-inaugurated-maan. Accessed 2 Sept 2020
Juaidi A, Montoya FG, Ibrik IH, Manzano-Agugliaro F (2016) An overview of renewable energy potential in Palestine. Renew Sustain Energy Rev 65:943–960
Kalehsar OM (2019) Iran's transition to renewable energy: challenges and opportunities. Middle East Policy Council 26(2)
Khaldi YM, Sunnika-Blank M (2020) Governing renewable energy transition in conflict contexts: investigating the institutional context in Palestine. Energy Transitions 4:69–90
Khatib N (2018) Country profile: Morocco 2018. Renew Energy Solutions Mediterranean Country Profiles 1–65
Kraemer S (2020) Morocco pioneers PV with thermal storage at 800 MW Midelt CSP Project. Solar Power & Chemical Energy System. https://www.solarpaces.org/morocco-pioneers-pv-to-thermal-storage-at-800-mw-midelt-csp-project/. Accessed 30 Dec 2020
Krauss J (2019) Israel's energy dilemma: more natural gas than it can use or export. The New York Times. https://www.nytimes.com/2019/07/05/business/energy-environment/israel-natural-gas-offshore.html. Accessed 26 Sept 2020
Kuwait Institute for Scientific Research (2019) Kuwait energy outlook: sustaining prosperity through strategic energy management. Energy Building and Research Center-Kuwait Institute for Scientific Research, pp 1–84
Leal-Arcas R, Akondo N, Alemani Rios J (2020) Energy trade in the MENA region: looking beyond the Pan-Arab electricity market. J World Energy Law Bus 10(6):520–549
Lewis A (2019) Giant solar park in the desert jump starts Egypt's renewable push. Reuters. https://www.reuters.com/article/us-egypt-solar/giant-solar-park-in-the-desert-jump-starts-egypts-renewables-push-idUSKBN1YL1WS. Accessed 25 Oct 2020
Li X, Ou M, Song Y, Zhang XP (2017) Review of middle east energy interconnection development. J Mod Power Sys Clean Energy 5(6):917–935
Luomi M. (2020), Gulf States' climate change policies amid a global pandemic, The Arab Gulf States Institute in Washington, Issue Paper #6, September 25, 2020. Available at: https://agsiw.org/wp-content/uploads/2020/09/Luomi_Climate-Change_Online-1.pdf

Magoum I (2020) Egypt: Zafarana 30 MW wind farm to be closed in 2021 after 20 years of operation. Afrik21 Green Economy and Sustainable Growth in Africa. https://www.afrik21.africa/en/egypt-zafarana-30-mw-wind-farm-to-be-closed-in-2021-after-20-years-of-operation/. Accessed 24 Oct 2020

Mahmoud R (2020) Egypt to export electricity to Saudi Arabia. Al-Monitor. https://www.al-monitor.com/pulse/originals/2020/05/egypt-saudi-arabia-interconnection-electricity-energy-hub.html. Accessed 22 Dec 2020

Mansour M (2015) Financing energy efficiency and renewable energy projects in Egypt. Global Pol 6(4):522–525

Masdar (2021) Masdar clean energy factsheet. Masdar 1–6

Mansouri N (2019) Are small modular reactors a good option for Saudi Arabia?. KAPSARC Commentary 1–8

McFarlane S, Said S (2020) Diversification plans amid industry downturn. Wall Street J. https://www.wsj.com/articles/saudi-aramco-slows-diversification-plans-amid-industry-downturn-11599054505. Accessed 4 Sept 2020

McKernan B (2020) Arab gas pipeline explosion caused Syria blackout-state media. The Guardian. https://www.theguardian.com/world/2020/aug/24/arab-gas-pipeline-explosion-leads-to-total-blackout-in-syria-state-media. Accessed 24 Dec 2020

MECEI (2020) Saudi Aramco cancelled an investment of $10 billion in a Refinery in China. Oil & Gas World Magazine. https://mecei.org/saudi-aramco-canceled-an-investment-of-10-billion-in-a-refinery-in-china/#:~:text=According%20to%20Bloomberg%2C%20Aramco%20decided,crude%20prices%20and%20rising%20debt_ . Accessed 8 Sept 2020

MEED (2019) Morocco LNG tender worth $4.5bn expected to be floated before 2020. Hydrocarbons Technology. https://www.hydrocarbons-technology.com/comment/morocco-lng/. Accessed 1 Jan 2021

Méndez C, Bicer Y (2019) Qatar's wind energy potential with associated financial and environmental benefits for the natural gas industry. Energies 12(3329):1–19

Milhem Z (2020) Paving the way for a renewable energy future in Palestine. This Week in Palestine. https://www.thisweekinpalestine.com/paving-the-way-for-a-renewable-energy-future-in-palestine/. Accessed 8 Oct 2020

Ministry of Development, Planning and Statistics (2018) Qatar Second National Development Strategy 2018–2022. Gulf Publishing and Printing Company, Doha

Ministry of Energy and Mineral Resources (MEMR) (2018) Annual Reports. Ministry of Eenrgy and Mineral Resources, Amman

Mhoseni-Cheraghlou A (2021) Iran's unrealized economic potential, MEI, 9 Feb 2021. Available at: https://www.mei.edu/publications/irans-unrealized-economic-potential

Mohamed M, Eltamaly AM, Alolah A (2016) PSO-Based smart grid application for sizing and optimization of hybrid renewable energy systems. PLoS ONE 11(8):1–22

Mohamedi F (2019) The ups and downs of Iran's economy. Castlereagh Associates. https://castlereagh.net/the-ups-and-downs-of-irans-economy/. Accessed 4 Sept 2021

Moshiri S, Lechtenböhmer S (2015) Sustainable energy strategy for Iran, Wuppertal Spezial, No. 51, ISBN 978-3-929944-98-3, Wuppertal Institut für Klima, Umwelt, Energie, Wuppertal. https://www.econstor.eu/bitstream/10419/142741/1/861697359.pdf

NEPCO (2013) Electricity Interconnection Projects. NEPCO. https://nepco.com.jo/en/electrical_interconnection_en.aspx. Accessed 26 Dec 2020

Nouicer A, Dhakouani A (2020) The Tunisian power system and the COVID-19 pandemic. European University Institute. https://fsr.eui.eu/tunisian-power-system-and-the-covid-19-pandemic/. Accessed 28 Dec 2020

NREL (2017) Concentrating solar power projects. NREL. https://solarpaces.nrel.gov/iscc-duba-1. Accessed 24 Aug 2020

OECD (2020) Accelerating climate action in Israel: refocusing mitigation policies for the electricity. Residential and Transport Sectors, OECD Publishing, Paris. https://doi.org/10.1787/fb32aabd-en

OME (2021) Mediterranean energy perspectives to 2050, Observatoire Méditerranéen del'Energie, 2021 edn
Oxford Business Group (2016) Rising energy consumption and falling production in Tunisia are prompting a push to increase efficiencies and diversify the energy base. In Oxford Business Group (ed) The Report: Tunisia. Oxford Business Group, Oxford
Oxford Business Group (2018a) Kuwait turns to solar energy to further renewable goals and harness low-cost power. In: The Report: Kuwait 2018. Oxford Business Group, Oxford
Oxford Business Group (2018b) Algeria's solar and wind power industries grow. In: The Report: Algeria 2018. Oxford Business Group, Oxford
Oxford Business Group (2020a) More renewable energy projects planned as Oman diversifies its power mix. In: The Report: Oman 2020. Oxford Business Group, Oxford
Oxford Business Group (2020b) Bahrain's National Renewable Energy Action Plan to increase large-scale solar projects. In: The Report: Bahrein 2020. Oxford Business Group, Oxford
Oxford Business Group (2020c) Covid-19 Impact: energy sector year in review 2020. Oxford Business Group. https://oxfordbusinessgroup.com/news/covid-19-impact-energy-sector-year-review-2020. Accessed 23 Dec 2020
Oxford Business Group (2020d) Does solar have a bright future in Egypt after Covid-19?. Oxford Business Group. https://oxfordbusinessgroup.com/news/does-solar-have-bright-future-egypt-after-covid-19. Accessed 21 Dec 2020
Oxford Business Group (2020e) Morocco turns to renewable resources and natural gas to diversify its energy mix. In: Oxford Business Group (ed) The Report: Morocco 2020e. Oxford Business Group, Oxford
Papadopoulou A, Vasileiou G, Michas S, Flamos A (2019) Current project structures and financing opportunities for CSP projects. University of Piraeus (UPRC), MUSTEC project, pp 1–62
Paraskove T (2017) Foreign investors Offer $3.6B to develop iran renewables. Oil Price. https://oilprice.com/Latest-Energy-News/World-News/Foreign-Investors-Offer-36B-To-Develop-Iran-Renewables.html. Accessed 26 Aug 2020
Parnell J (2020) Total and Marubeni to build 800MW solar plant in Qatar ahead of World Cup. Green Tech Media. https://www.greentechmedia.com/articles/read/totals-qatar-deal-nudges-middle-east-bifacial-pipeline-towards-2gw. Accessed 28 July 2020
Peskett J (2020) IATA 'Not Satisfied' by MENA Governments' Response to Aviation Disaster. Aviation Business. https://www.aviationbusinessme.com/covid-19/21476-iata-not-satisfied-by-mena-governments-response-to-aviation-disaster. Accessed 27 Dec 2020
Planning and Statistics Authority (2019) Qatar second national development strategy 2018–2022, Qatar planning and statistics authority. https://www.psa.gov.qa/en/knowledge/Documents/NDS2Final.pdf
Power Technology (n.d.) Al Kharsaah solar power project, Qatar, Power Technology. https://www.power-technology.com/projects/al-kharsaah-solar-power-project/
Power Technology (2019a) Energy storage is key for the future of the concentrated solar power market. Power Technology. https://www.power-technology.com/comment/csp-energy-storage/. Accessed 9 Aug 2020
Power Technology (2019b) Saudi Arabia resets renewable energy goals. Power Technology. https://www.power-technology.com/comment/saudi-renewable-energy-targets/. Accessed 17 Aug 2020
Prabhu C (2020) Oman targets 3050MW of renewables by 2025. Oman Observer. https://www.omanobserver.om/article/18401/11/oman-targets-3050-mw-of-renewables-by-2025. Accessed 28 Aug 2020
Proctor D (2020) Algeria targets renewables to diversify generation. POWER. https://www.powermag.com/algeria-targets-renewables-to-diversify-generation/. Accessed 27 Dec 2020
PV Europe (2018) PV power plants in Israel advancing. PV Europe. https://www.pveurope.eu/solar-generator/pv-power-plants-israel-advancing. Accessed 23 Sept 2020

Qatar News (2016) Qatar plans to launch a wind turbine to produce electricity. Qatar News. https://www.qatarliving.com/forum/news/posts/qatar-plans-launch-wind-turbine-produce-electricity. Accessed 27 Sept 2020

QP (2020) Sustainability report 2019, Qatar Petroleum. https://qp.com.qa/en/MediaCentre/Lists/QPPublications/Attachments/29/QP%202019%20Sustainability%20Report.pdf

QP (2021), Qatar petroleum launches landmark sustainability strategy—a turning point in the way it operates, Media Release, 13 Jan 2021. https://qp.com.qa/en/MediaCentre/Pages/ViewNews.aspx?NType=News

Qatar Solar Technologies (n.d.) Facilities. Qatar Solar Technologies. https://www.qstec.com/about/where-we-operate/facilities. Accessed 27 July 2020

Rashad M, Barbuscia D (2020) Saudi foreign reserves fall at fastest for two decades. Reuters. https://www.reuters.com/article/instant-article/idUKL5N2CH04K. Accessed 24 June 2020

Renewable Energy Solutions for Africa Foundation (2020) How to unleash the full potential of Tunisia's renewable energy market?". Renewable Energy Solutions for Africa Foundation Online Event. https://www.res4africa.org/2020/11/27/tunisia-re-market-webinar/. Accessed 28 Dec 2020

RES4Africa (2020) How to unleash the full potential of Tunisia's Renewable Energy Market?. RES4Africa. https://www.res4africa.org/2020/11/27/tunisia-re-market-webinar/. Accessed 4 Jan 2021

Reuters (2019) Kuwait eyes up 400 MW of CSP in expanded solar park. Reuters. https://analysis.newenergyupdate.com/csp-today/kuwait-eyes-400-mw-csp-expanded-solar-park. Accessed 4 Sept 2020

Reuters (2020) Algeria cuts energy revenue, Forex Forecasts for 2020. Reuters. https://www.reuters.com/article/algeria-economy-idUSL8N2CL0L8. Accessed 28 Dec 2020

Richard C (2019) Saudi Arabia to 'lead middle eastern power'. Wind Power. https://www.windpowermonthly.com/article/1581315/saudi-arabia-lead-middle-eastern-wind-power. Accessed 18 Aug 2020

Roscoe A (2019) Saudi Arabia awards contract for first wind project. MEED. https://www.meed.com/saudi-arabia-awards-contract-first-wind-project/. Accessed 21 Aug 2020

Salam MA, Khan SA (2018) Transition towards sustainable energy production—a review of the progress for solar energy in Saudi Arabia. Energy Explor Exploit 36(1):3–27

Sarac A, Podgore JE (2021) The future of rooftop solar in the Middle East. Addleshaw Goddard LLP. https://www.lexology.com/library/detail.aspx?g=37bc31ff-20b1-4b29-b93f-580f49ce0b6b. Accessed 15 May 2021

Saur Energy News (2019). Qatar to adopt first renewable energy strategy. Saur Energy International. https://www.saurenergy.com/solar-energy-news/qatar-adopt-first-renewable-energy-strategy. Accessed 29 Sept 2020

SEU (2017) The Kingdom of Bahrain: national renewable energy action plan (NREAP). Sustainable Energy Unit

Shams Power Company (2017) Reflecting the Nation's Commitment. Shams Power Company, pp 1–17

Shikun & Binui (2019) Shikun & Binui to launch commercial operations of negev energy thermo-solar power plant at Ashalim. PR Newswire. https://www.prnewswire.com/il/news-releases/shikun-amp-binui-to-launch-commercial-operations-of-negev-energy-thermo-solar-power-plant-at-ashalim-896988633.html. Accessed 25 Sept 2020

Shpitsberg A, Kiener E, Timponi R (2020) COVID-19 pressures Egypt's power and gas sectors. IHS Markit. https://ihsmarkit.com/research-analysis/covid19-pressures-egypts-power-and-gas-sectors.html. Accessed 23 Dec 2020

Shumkov (2020) Israel targets 16 GW of solar capacity by 2030 with new plan. Renewables Now. https://renewablesnow.com/news/israel-targets-16-gw-of-solar-capacity-by-2030-with-new-plan-701513/. Accessed 20 Sept 2020

Sustainable Energy Unit (2018) National energy efficiency action plan (NEEAP): Executive Summary. Kingdom of Bahrain, pp 1–12

Tehran Times (2019) Iran's nominal electricity generation capacity touches 85 GW. Tehran Times. https://www.tehrantimes.com/news/439481/Iran-s-nominal-electricity-generation-capacity-touches-85GW. Accessed 28 Aug 2020
The Peninsula (2019) Qatar's dependency on solar energy to exceed 20% by 2030. The Peninsula. https://www.thepeninsulaqatar.com/article/31/03/2019/Qatar%E2%80%99s-dependency-on-solar-energy-to-exceed-20-by-2030. Accessed 31 July 2020
The State of Qatar (2018) Secondary voluntary national review, 2018. High level political forum on sustainable development, pp 1–44
The World Bank (2012) Renewable energy desalination: an emerging solution to close the water gap in the Middle East and North Africa. The World Bank, Washington D.C.
The World Bank (2017) Electricity transmission network Morocco. The World Bank. https://datacatalog.worldbank.org/dataset/resource/402d5767-1daa-44e7-bbb8-4ed84ba4347d. Accessed 2 Jan 2020
The World Bank (2019) Project information document/integrated safeguards data sheet (PID/ISDS). The World Bank Energy Sector Performance Improvement Project P168273:1–16
The World Bank (2020) The World Bank in Tunisia. The World Bank. https://www.worldbank.org/en/country/tunisia/overview. Accessed 29 Dec 2020
TotalEnergies (2020) Total to develop Qatar's First Large-Scale (800 MWp) Solar Plant, Press Releases, 20 Jan 2020. https://totalenergies.com/media/news/press-releases/total-develop-qatars-first-large-scale-800-mwp-solar-plant
Tsagas I (2019) Spain's third interconnection with Morocco could be Europe's chance for African PV—or a boost for coal. PV Magazine. https://www.pv-magazine.com/2019/02/20/spains-third-interconnection-with-morocco-could-be-europes-chance-for-african-pv-or-a-boost-for-coal/. Accessed 31 May 2020
UNDP (2012) Renewable energy generation through solar panels for public education, health and water facilities in the Gaza strip. UNDP Programme of Assistance to the Palestinian People. https://www.ps.undp.org/content/papp/en/home/operations/projects/environment_and_energy/renewable-energy-generation-through-solar-panels---gaza.html . Accessed 5 Oct 2020
UNDP (2016) Delivering sustainable energy in a changing climate. Strategy Note on Sustainable Energy: 2017–2021. UNDP, New York
UNDP (2018) Tunisia: Derisking Renewable Energy Investment 2018. UNDP Full Report
United Arab Emirates Ministry of Energy and Infrastructure (2017) Vice President unveils UAE energy strategy for next three decades. United Arab Emirates Ministry of Energy and Infrastructure. Accessed 7 Aug 2020
Van de Graaf T, Sovacool BK (2020) Global energy politics. Polity Press
Vedie HL (2020) Renewable energy in Morocco: a reign-long project. Policy Center for the New South Policy Brief 1–10
Yergin D (2020) The new map. Energy, Climate, and the Clash of Nations, Penguin Press
Walton M (2019) Desalinated water affects the energy equation in the Middle East. IEA. https://www.iea.org/commentaries/desalinated-water-affects-the-energy-equation-in-the-middle-east. Accessed 6 Jan 2021
Willuhn M (2019) Palestine to bring online its first PV Plant, at 7.5 MW. PV Magazine. https://www.pv-magazine.com/2019/05/24/palestine-to-bring-online-its-first-pv-plant-at-7-5-mw/. Accessed 7 Oct 2020
World Bank (2018), Beyond scarcity: water security in the Middle East and North Africa, World Bank, MENA Development Report, Washington, DC. Available at: https://openknowledge.worldbank.org/handle/10986/27659
World Bank (2021) MENA economic update—living with debt: how institutions can chart a path to recovery in the Middle East and North Africa. World Bank Middle East and Africa region, 1–70
World Bank Data (2019a) GDP Growth (annual %)- Saudi Arabia. World Bank. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=SA. Accessed 2 Aug 2020

World Bank Data (2019b) Population growth (annual %)- Saudi Arabia. World Bank. https://data.worldbank.org/indicator/SP.POP.GROW?locations=SA. Accessed 2 Aug 2020

World Meters (2018) United Arab Emirates Energy. World Meters. https://www.worldometers.info/energy/united-arab-emirates-energy/#:~:text=Energy%20Consumption%20in%20the%20U.A.E.&text=consumed%204%2C667%2C004%2C234%2C000%20BTU%20(4.67%20quadrillion,its%20annual%20energy%20consumption%20needs. Accessed 11 Aug 2020

World Nuclear Association (2019a) Nuclear power in Saudi Arabia. World Nuclear Association. https://world-nuclear.org/information-library/country-profiles/countries-o-s/saudi-arabia.aspx. Accessed 4 Aug 2020

World Nuclear Association (2019b) Nuclear Power in Jordan. World Nuclear Association. https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/jordan.aspx#:~:text=Jordan%20imports%20most%20of%20its,of%20small%20modular%20reactors%20instead. Accessed 10 Sept 2020

Xlinks (n.d.) 24/7 solar energy from the Sahara to the UK. Xlinks. https://xlinks.co/. Accessed 3 Jan 2020.

Zafar S (2019) Solar Energy in Saudi Arabia: Perspectives. EcoMENA. https://www.ecomena.org/solar-saudi-arabia/. Accessed 19 Aug 2020

Part III
Energy Geopolitics in the MENA Region

Chapter 5
Geopolitics of Oil and Gas in the MENA Region

This Chapter analyses key geopolitical aspects related to oil and gas in the MENA region.

The MENA region has become a major geopolitical hotspot given its key role in the current global energy system. Over the past two decades global oil and gas supply–demand patterns have rapidly changed with the consolidation of new major fossil fuel buyers, especially in Asia, rising climate ambitions in other world's regions, namely the European Union, and the advent of the US as major hydrocarbon producer and exporter thank to its shale revolution. These developments have changed global players' energy and economic interests for the MENA region. At the same time, the region has fermented with intra-regional tensions, geopolitical competition, which in some cases have entailed energy consequences.

*The **Gulf** cluster has been characterized by two major crises: one within the Gulf Cooperation Council and the other the clash between Iran and most of the Gulf monarchies. Neither of them has been caused by energy issues. Yet, both of them have entailed profound energy consequences. The GCC crisis erupted in 2017 between some GCC countries (Saudi Arabia, the UAE, Bahrain) and Qatar because of political disagreements on regional affairs and geopolitical competition. Energy was not the cause and energy and energy trade (including Qatar-UAE gas exports) has been preserved. Nonetheless, growing political disagreements have also contributed to Qatar's withdrawal from OPEC, though this decision was also driven by the Qatari intention to exploit its competitive advantages in natural gas. The other crisis (GCC-Iran) has been a key component of energy geopolitics of the region. The international confrontation against Iran has moreover prevented Iran to fully develop its energy resources and potential, including limiting access to key technologies, such as LNG. Geopolitical confrontations have been visible in the growing tensions around key chokepoints (Hormuz Strait) and major attacks on critical energy infrastructure in Saudi Arabia.*

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_5

*The **Mashreq** cluster has been at the center of multiple geopolitical developments in the past decade. The Eastern Mediterranean has become a geopolitical hotspot since the discovery of major offshore gas reserves. Thanks to these discoveries, some countries have become (or returned to be) net gas exporters, while geopolitical competition has increasingly soared in the region. Nonetheless, the geopolitical competition is not purely and primarily caused by energy resources. Around the Eastern Mediterranean energy resources, some countries (Israel and Egypt) have expanded and strengthen their bilateral partnerships. Other two countries in the cluster (Syria and Iraq) have experienced major political and security instability. While for the Syrian case, energy resources are not the main motive for geopolitical competition and instability, Iraq's huge energy resources have in the past been center place of energy conflicts and they remain heavily affected by the ongoing social unrest.*

*In the **Maghreb** cluster, there are two main hydrocarbon producers: Algeria and Libya. Algeria has been a key supplier for European energy markets for many decades. The country has recently experienced major political instability especially in 2019, which resulted in the step down of president Bouteflika after 20 years of power. Rising domestic consumption and declining production have caused the erosion of hydrocarbon export volumes. Political disagreements with Morocco caused the end of gas export flows to Spain* via *Morocco. Italy remains a key buyer for Algeria's gas volumes and the North African country has gained more relevance in light of Italy's diversification efforts in response to Russia's invasion of Ukraine. Libya has been suffering from political and security instability since 2011 when Gaddafi was overthrown. Local militias have been fighting over hydrocarbon reserves and in several occasions the operations have been halted or hindered by militias. Different factions have been fighting over the control of hydrocarbon resources and their revenues. Numerous external players have supported different local militias causing the impossibility to find a peaceful solution for the country. Libya was a key supplier for Europe, but its inability to attract investments and security concerns have left the country's oil and gas sector underperforming.*

The abundance of oil and gas resources and the strategic role of fossil fuels in the present global energy landscape have made the MENA region one of the key hotspots of energy geopolitics for decades. The region attracts numerous geopolitical and geo-economic interests of external actors, primarily the US, European countries, Russia and China. The US has been the most important external player in the Gulf region, whereas the European countries have had stronger relations with the North African countries due to their geographical proximity and historical relations (i.e. the colonial heritage). Over the last decades, other players, such as Russia and China, have increased their energy, economic and political stakes in the region. Moreover, external influence lies on regional dynamics and competition—such as the well-known and ancestral conflict between Sunnis and Shiites.

Over the last decade, the MENA region, just as the world as a whole, has undergone several major transformations in the socioeconomic, political and energy spheres, and so have the international relations of MENA countries among themselves as well as with outside players. This ongoing transformation has been characterized by several turning points: (i) the 2011 'Arab Spring', with the fall of long-ruling leaders, illustrates the weakness of the political structures and social contracts in numerous countries; (ii) the signature of the JCPOA, supported by the then-US President Barack Obama, aims to redesign the regional geopolitical structure engaging with the Islamic Republic of Iran; (iii) the assertive foreign policy pursued by President Trump and the consequent withdrawal from the JCPOA; and lastly (iv) the steady American retrenchment from the region has left a political vacuum that regional and other extra-regional countries are attempting to fill.

Developments in the global oil markets and oil price volatility have contributed to reshaping some political cooperation among MENA oil producing countries and other players (i.e. the US and Russia). In a context of great regional and global transformation, it is inevitable that the balance of power within the region has suffered and will continue to suffer some major shocks.

This Chapter seeks to present and analyze these major changes and shocks for each of the three clusters: Arabian Persian Gulf, Eastern Mediterranean and Western Mediterranean. Old and new conflicts are beginning to meddle with each other. This is the result of the fading supervisor role of the US throughout the region. The reduction of US interests in the region has been caused by numerous factors: the advent of the US shale industry, the reconsideration of its role in the globe, its increasing attention to China's rise. Whatever the reason, this process has encouraged regional countries to increase their activism to secure their own national interests.

5.1 The Arabian-Persian Gulf

The geographical cluster of the Arabian-Persian Gulf (hereafter 'Gulf') holds a special place in current energy geopolitics. Indeed, it is deeply interlinked with the development of the geopolitics of oil and gas—especially in the second half of the XX century. The vast hydrocarbon resources have positioned the area in the geopolitical energy map of the XX century.

The meeting between US President Roosevelt and Saudi King Abdul Aziz Ibn Saud on the USS Quincy in the Suez Canal on Valentine's Day 1945 marked the dawn of a new regional architecture in the Gulf region. It also represented the beginning of the longest US relationship with an Arab State, the Kingdom of Saudi Arabia. The Gulf became the strategic heartland of America's energy security.

The post-WWII structure of the region was then shaken by two episodes: the Islamic Revolution in Iran and the Soviet invasion of Afghanistan in 1979. When the Red Army crossed into Afghanistan, Washington expressed their strong concern for oil security, and US President Jimmy Carter outlined his doctrine ('Carter Doctrine'), which ensured the full (even military) US protection of the Gulf monarchies. A decade later, this doctrine was implemented by President George H. W. Bush, who decided to intervene to halt Saddam Hussein's 1990 invasion of Kuwait.

The Doctrine outlined the structure of the regional order: the US provided security for the Gulf states, which were militarily weak, ensuring that oil would flow out of the region, especially through the Strait of Hormuz and other chokepoints, to keep the world supplied. At the same time, the Gulf monarchies were committed to providing oil supplies to the US as well as the global economy. This division of tasks has remained untouched for several decades.

In the last decade, the regional order has experienced new major developments: the decision of US President Barack Obama to engage internationally with Iran—the main US regional enemy since 1979—and the advent of the US shale industry that has enabled the US to become a major oil and gas player. The US decision to engage with Iran resulted in more assertive policies of the Gulf monarchies, which considered the agreement a potential security threat fearing a potential loss of the US security umbrella. The outcome was an intensification of conflicts (i.e. Yemen and Syria) between the two parts.

In 2016, Donald Trump was elected President of the United States. The Trump administration declared Iran a major threat for the regional and international systems. Trump's foreign policy was based on a strong political support to the Gulf monarchies (and Israel) against Iran. In a sense, this represented the return of US Middle East foreign policy to its post-1979 nature, identifying Iran as a threat while providing security to the Gulf monarchies. To do so, the Trump administration pursued the so-called 'maximum pressure strategy' against Tehran, seriously undermining Iran's oil and gas production and its potential comeback to the global energy markets. In 2021, another potential key turning-point in US foreign policy occurred with the election of Joe Biden. The newly elected President supported the idea of rejoining the JCPOA in stark opposition with the previous administration. Nonetheless, a new international nuclear deal seems quite challenging due to the numerous obstacles put in place by the Trump Administration (e.g. the inclusion of the Islamic Revolutionary Guard Corps (IRGC) in the State Department's Foreign Terrorist Organization (FTO) list).

Other major economies have enhanced their presence and relevance in the Gulf region. Russia started to increase its political and economic collaboration with the Gulf monarchies, while cooperating with OPEC for the global oil market's stability. China has steadily strengthened its economic presence while becoming a major energy market for MENA oil and gas exporters.

Given their strategic value, fossil fuels have shaped coalitions as well as conflictual positions in the region, which has experienced two major crises with consequences on the political and economic relations of the cluster and beyond. First, the crisis within the Gulf Cooperation Council (GCC) regarding the role of Qatar. Second, the cleavage between the Gulf monarchies and Iran. In addition to these two crises, the region has seen major setbacks and transformations.

Before diving into these two internal crises in the Gulf (Sects. 5.1.2 and 5.1.3), a short introduction will outline the major evolutions of global oil markets, the role of the MENA region and the recent developments regarding the international actors in the region.

5.1.1 Global Oil Markets Evolutions and the Major Developments in the Middle East

In 1960, Saudi Arabia, Iran, Iraq, Kuwait and Venezuela founded the Organization of the Petroleum Exporting Countries (OPEC). At that time, the international oil industry was mainly dominated by a few large international Western oil companies, known as the ‘Seven Sisters’.[1] The creation of OPEC resulted from the interplay of different political, economic and energy relations. From the political standpoint, countries around the world were eager to take control over their destiny and resources as decolonization was unfolding.

Until the early 1970s, OPEC acted as a ‘trade union’ whose main objective was to prevent the income of its member countries from falling (Fattouh and Mahadeva 2013). During this period, OPEC did not succeed in influencing prices, but started to gain market power. In fact, the 1955–1970 period was characterized by declining prices as the Seven Sisters’ aim was to keep out competitors. Simultaneously, global oil demand increased rapidly from 30.8 mb/d in 1965 to 45.3 mb/d in 1970 (BP 2020). OPEC countries met most of this demand increase. This contributed to the shift in market power from IOCs to producing countries.

From the 1970s, OPEC, thanks to the initiative of Libya and Iran, began to reverse the power relationship between oil companies and producing countries, with a consequent increase in oil prices. Saudi Arabia is often considered the de factor leader of the Organization because of its weight in OPEC’s reserves, production and exports as well as the relative stability of its supply. However, in the first years of OPEC, Saudi Arabia did not exercise a leadership role. Its main contribution to OPEC was its ability to ensure a consensus-building approach and distance OPEC from the inter-Arab conflicts (Al-Moneef 2020). Saudi Arabia stepped up its prominence within OPEC decisions in the 1970s by leading Arab oil production cuts until late 1973

[1] ‘Seven Sisters’ were the seven international oil companies that had dominated the global oil markets in those years. They were: Anglo-Iranian Oil Company (now BP), Royal Dutch Shell, Standard Oil of California (now Chevron), Gulf Oil (now Chevron), Texaco (now Chevron), Standard Oil of New Jersey (Exxon) and Standard Oil of New York (Mobil).

thus initiating the oil price rise and leading OPEC to assume the price administration role. Saudi leadership was expressed through the charismatic figure of Ahmed Zaki Yamani, who served as Saudi Minister of Petroleum and Mineral Resources from 1962 to 1986 and key figure of OPEC for 25 years.

The economic recession of the 1980s, combined with the growth in non-OPEC crude oil production prompted by high oil prices, caused a decline in oil demand in the mid-1980s depressing oil prices. Global oil markets turned from a ‘seller’s market’ to a ‘buyer’s market’. In 1982, OPEC introduced a formal quota system, which however did not help reverse the slide in the oil price. Over 1982–1985, Saudi Arabia acted as ‘swing producer’, absorbing the brunt of OPEC’s supply adjustment. The loss of market share and low prices proved to be costly for OPEC countries, and in particular Saudi Arabia. In 1985, Saudi Arabia decided to abandon the defense of the official OPEC price and opted for defending its market share. From this shift, a 15-year period of moderate oil prices was inaugurated, which ended with the second oil price boom over the 2000–2014 period, which was fueled by China’s impressive and long-lasting economic growth. After the economic crisis, where oil prices plummeted, from 2011 to mid-2014, global oil markets were broadly stable with prices included between 100 and 120 US$ per barrel. Demand was recovering from the 2008 financial crisis, whereas supply was growing, especially driven by the US shale oil boom. Geopolitical aspects contributed to shaping the supply side in those years. The political instability in Libya significantly reduced its oil output, while Iranian production dropped by almost a third due to the western embargo on Iranian oil exports since 2012. Moreover, the rise of ISIS in northern Iraq and the Russia-Ukraine crisis have contributed to maintaining oil prices above $100 per barrel because of the fear of potential supply disruptions. However, in 2014 oil prices collapsed, with Brent dropping from $111/barrel in June to $62 in December. The preceding years had witnessed a strongly growing US shale oil output (4 mb/d of output were added between 2010 and 2014) fueled by high prices, and at the same time moderate oil demand growth rates due to these very same high oil prices. The collapse of oil prices in 2014 was determined by the Saudi decision to drive higher-cost competitors (i.e. US shale producers)—which had been eating into the revenues of established producers—out of the market. Pouring additional barrels into the global oil market (and thus ending its strategy of withholding production in order to maintain high prices), Saudi aimed at stopping its fall in the market share due to the ever increasing US shale production. Going forward, with the world engaged in decarbonization, and the power struggle between established OPEC+ producers (which can sit together and collectively try to shape a strategy), and US shale oil producers (which cannot sit at a table with OPEC+ because they are very dispersed), will inevitably lead to an uncoordinated oil market and thus high volatilities.

Falling oil prices in late 2014 and early 2015 (Fig. 5.1), which remained low until early 2022, have seriously challenged the Gulf economies, forcing them to consider how to diversify their economies. Since then, the area has witnessed major developments with rising competition among countries, major regional crises and the growing influence of non-US power.

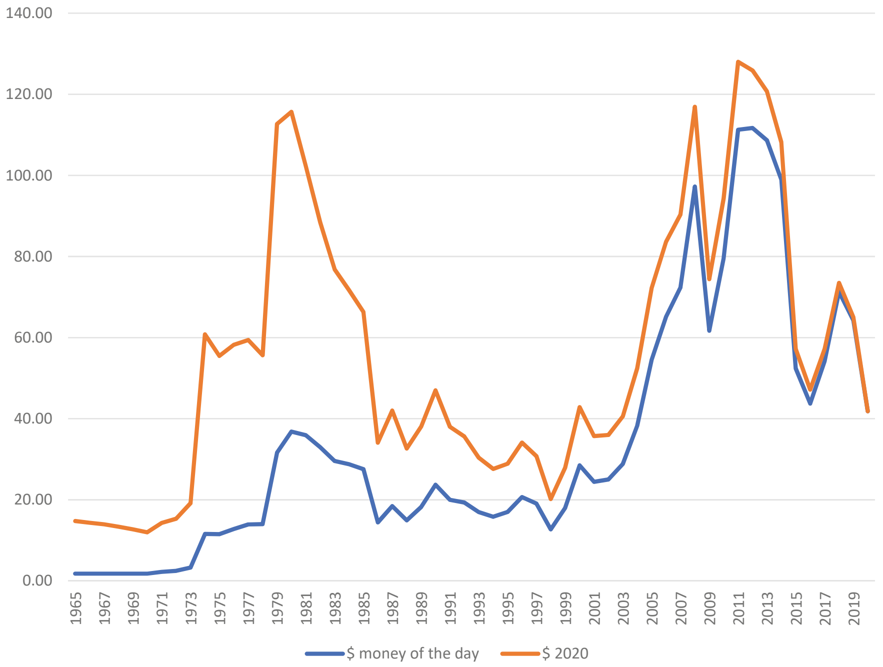


Fig. 5.1 Oil crude (Brent) price, 1965–2020, US$ per barrel. *Source* Authors' elaboration on BP Statistical Review of World Energy, June 2021

Notwithstanding this general context, Russia increased its presence in the Middle East. As mentioned before, Moscow actively supported Bashar al-Assad in Syria with the deployment of the Russian army. Moreover, in December 2016 OPEC agreed with a group of non-OPEC countries on a curtailment of crude oil. The two groups' leaders and the kingmakers of the so-called OPEC+ [2] agreement are Saudi Arabia and Russia. Since the great reliance on hydrocarbon rents of these countries, the decline of oil prices threatened their economic and social stability, following a period of high oil prices. Although prices matter, this union is not just about oil prices. Indeed, the Saudi-Russian cooperation can be explained by several geopolitical elements, beyond the economic rationale.

Russia looked for opportunities to increase its influence in the region beyond its existing partnerships (i.e. Iran and Syria), to avoid getting stuck in the prevailing divisions of the region. Moreover, Moscow aspired to being considered a global power in key geopolitical stages. Its involvement in Syria, Libya, Iraq and its

[2] The OPEC+ agreement was reached between OPEC countries and selected non-OPEC countries, led by Russia. The 13 non-OPEC countries taking part in the agreement are: Russia, Azerbaijan, Bahrain, Brunei, Equatorial Guinea, Kazakhstan, Malaysia, Mexico, Oman, Sudan, South Sudan, Brazil and Bolivia.

improving ties with Sunni Arab Gulf states, along with Israel, symbolize this ambition. Russia's Sunni Muslim minority could also have contributed to Russia's decision to consolidate ties with Sunni Arab Gulf states.

Meanwhile, Saudi Arabia was interested in hedging its foreign policy by establishing a firmer alliance with Russia because of the retreating US influence in the region. In 2017, King Salman became the first ever Saudi monarch to visit Russia, cementing the Saudi-Russian ties. Their relationship is mainly centered on energy issues. The two countries discussed potential partnerships and investments, without, however, attaining any concrete results. This contributed to increasing internal frustration in Russia regarding the OPEC+ agreement. It is also important to note that the two countries disagree on several regional geopolitical issues, notably Syria, Iran, Qatar. And it seems reasonable to believe that oil cooperation will not reduce such disagreements.

China is another player that is advancing its relations with the Middle East area. Energy is one important element of Sino-Gulf relations. Indeed, the relationship can appear as a natural fit. China is a fast-growing energy market, while the Middle East countries hold a significant portion of the world's oil and natural gas reserves and they are major producers and exporters. Beijing has become the world's largest oil importer, importing more than 11 million barrels per day in 2018 (BP 2020). The Middle East accounting for more than 40% of China's oil imports, explains the importance of Sino-Gulf relations. China's growing energy market is particularly important for Gulf countries, which struggle to secure energy exports. Saudi Arabia competes with Russia to rank the largest source of oil for China. Other Gulf countries export significant quantities as well. For example, Iran managed to continue exporting hydrocarbons to China, which provided vital financial revenues. China is also becoming a major LNG market, becoming one of the largest importers in the world with Japan and South Korea. That is particularly relevant for Qatar, which aims to gain market share through long-term contracts, as seen in the 22-year contract for LNG signed in 2018.

However, China's influence on the region does not end with energy. Between 2000 and 2017, trade between China and GCC countries has grown from just under $10 billion to nearly $150 billion per year (Fulton 2019). Moreover, China's foreign direct investment into GCC countries has increased, with over $60 billion invested between 2005 and 2017. Chinese companies have won several major infrastructure construction contracts in the Gulf monarchies, such as the lead venue for the 2022 FIFA World Cup in Qatar, Lusail Stadium, or Saudi Arabia's Yanbu Refinery as well as the highspeed rail line that connects Jeddah with Mecca and Medina. Sino-Iranian relations have expanded significantly both politically and financially as well as from the energy perspective. The two countries signed a 25-year partnership agreement that envisages ambitious cooperation targets in the investment, economic, political and security fields.

Thanks to their geographical position, the Gulf countries could also contribute to the success of a major Chinese project: the Belt and Road Initiative (BRI). The Arabian Peninsula as well as Iran hold great geostrategic importance, linking South and Central Asia to the MENA region and further to the Mediterranean. Although the newcomers (Russia and China) have increased their stakes in the area, the US is still the dominant power in the Gulf. Washington guarantees security in the region, ensuring that oil chokepoints such as Hormuz remain open.

5.1.2 GCC Crisis: Political Causes and Energy Implications

The political and energy interests of the three main countries of the Arabian Peninsula (i.e. Saudi Arabia, the UAE and Qatar) have become increasingly conflicting as a result of growing intra-regional tensions. The major outcome of these tensions has been the crisis within the Gulf Cooperation Council (GCC) which started in 2017 and ended in 2021.

The GCC is a regional organization created by Saudi Arabia, the UAE, Qatar, Oman, Kuwait and Bahrain in 1981. These six countries decided to constitute the GCC motivated by the need for an effective collective security institution. Back then, the region had witnessed some major security developments: in 1979 the Islamic Revolution in Iran and in 1980 the beginning of the Iraq-Iran War. Thus, GCC countries were worried about how these developments could threaten their vital security interests.

Since the 2011 Arab Spring, the entire MENA region experienced an intensification of tensions and competition among its key regional players. As a consequence, in June 2017 Saudi Arabia, the UAE, Bahrain—along with Egypt—decided to cut off diplomatic relations with Qatar and imposed a land, sea, and air blockade on the peninsular Emirate, preventing any economic exchange with it.

The key reason for this dramatic decision was Qatar's alleged support to political Islam and extremism. Moreover, the core competition lies in the substantial differences in foreign and regional policy. For years, Qatar has operated as the main supporter of the Muslim Brotherhood, while Saudi Arabia and the UAE have seen the Muslim Brotherhood as an existential threat to their domestic stability and order. Moreover, the two blocs disagree on their approach towards Iran: Doha is more willing to adopt a cautious approach towards Tehran, whereas other Gulf monarchies look at Iran as a competing regional country and a security threat (*see* Sect. 5.1.3).

Although Qatar and Saudi Arabia had disagreements before, the GCC crisis came as a surprise for Doha. Saudi leadership was quite cordial to Qatar in the years before the blockade. Nevertheless, higher security concerns and increasing divergence on foreign and regional policies were exacerbated by the more assertive and personalized foreign policy of the new young regional elites, such as Saudi Crown Prince Mohammed bin Salman. He has undertaken to operate more actively and decisively on the regional stage, personalizing Saudi foreign policy.

Another source of higher security and political concerns has been the political vacuum left by the US, the traditional security guarantor. Although the US remain the main security player in the region, Washington has started to reconsider its role in the region's security architecture, aimed at avoiding additional conflicts and costs as well as repurposing its attention to other world regions (i.e. Asia). All of these elements led to a deterioration of intra-regional relations.

In January 2021, the GCC embargo was officially lifted at the 41st GCC Summit in al-Ula under the lead of Saudi Arabia which aimed to ensure its good will and standing with the new and more Saudi-skeptic administration in the US. Despite the positive development, the key issues that led to the blockade have not been resolved, meaning that renewed tensions could emerge among the countries in the future. Moreover, the crisis has reduced the relevance of GCC for Qatar. For example, the GCC no longer serves its purpose as security provider for Qatar. Indeed, the key security allies for Qatar are the US and Turkey. With Washington, Doha built a protective relationship when it signed the 1992 Defense Pact. The security relation was enhanced when in 2002 Qatar began hosting US forces et al.-Udeid, home to the largest US military base in the Middle East. Yet, during the first phase of the embargo, the US-Qatari relationship was questioned as President Trump expressed his support to the blockade. This political position shifted only after the intervention by then-Secretary of Defense James Mattis and then-Secretary of State Rex Tillerson (Smyth 2020). Over this period, Qatar and US have re-consolidated political relations with two state visits by Qatar's Emir to the US in 2018 and 2019.

The GCC crisis has pushed Doha toward other countries, making GCC countries less relevant for Qatar's trade and economy. By contrast, China, India, Iran and Japan are more important partners than the three hostile GCC countries (al-Jabar and Coates Ulrichsen 2020). After three years, the blockade has achieved little or nothing. Qatar has strengthened its relations with Turkey, increasing food imports, upscaling security as well as financial and economic ties. Moreover, Doha has begun using Iranian airspace for its flights and Iranian territorial waters aiming to avoid disruption to its energy exports. Moreover, the blockade decided by three GCC countries (Saudi Arabia, the UAE and Bahrain) did not receive the support of the other GCC members, while obtaining Egypt's solidarity, showing the limitations of their political decisions and actions.

Given the important role of the GCC countries in the oil and gas markets, at the time of the crisis outbreak, concerns were expressed about its potential spillovers to the energy sphere. However, these countries have managed to limit damages in the energy markets. Firstly, there are no substantial oil or gas exchanges between Qatar and Saudi Arabia or Bahrain. Thus, the political tensions between these countries have had limited impacts on their energy policies. However, Qatar does export gas to the UAE via the Dolphin pipeline.[3]

[3] The Dolphin pipeline is a 364 km-long pipeline that starts from Qatar's North Field, reaches the Taweelah Power Station in Abu Dhabi, continues to Dubai and to the port of Fujairah Harbor and from there to Oman. It became operational in July 2007.

Despite the deterioration of the political relations between GCC countries, the contending countries preserved a pragmatic approach regarding energy relations. In 2019 Qatar exported 19.5 bcm to the UAE and 2 bcm to Oman. These figures illustrate that the ongoing GCC crisis did not affect existing energy relations. This is also due to the fact that Doha does not want to be seen as an unreliable supplier hence choosing not to shut down its gas flows to the UAE, albeit its great political isolation.

Nonetheless, future gas relations may be hindered by the remaining distrust among countries coupled with a shift in energy strategy. Indeed, the UAE's state-owned energy company, ADNOC, has recently expressed its intention to reach gas self-sufficiency. This strategy could undermine future gas flows through the Dolphin pipeline. Yet, questions over economics may arise as the pipeline provides cheap gas (still below $2/MMBtu) to the UAE (S&P Global 2019).

Even though Qatar would represent one of the least costly solutions for GCC countries Bahrain, Kuwait and the UAE, thanks to short pipelines or existing LNG facilities, an interconnected gas network in the GCC has been hindered by Saudi concerns over Qatar's influence in the region. That was the case of the Qatar-Kuwait pipeline project. In the early 2000s, Kuwait and Qatar discussed the construction of a gas pipeline, but in 2006 the project was vetoed by Saudi Arabia forcing Kuwait to turn to LNG imports. On the other hand, Saudi Arabia and the UAE are committed to developing and increasing their domestic gas production, for example from the Jafurah shale development in Saudi Arabia or the Jebel Ali gas field in the UAE, even though production from these formations requires significant investments. In conclusion, Qatar represents the least costly solution for GCC gas ambitions, but political tensions and personalized foreign policy often undermine a political solution and an improvement of intra-GCC (gas) relations.

Although energy has not been an issue of the embargo, it is clear that the enormous role of natural gas for Qatar is a crucial element of inter-regional tensions. Natural gas, and the LNG industry, has allowed Qatar to amass vast financial reserves, which have been used to extend its soft power across the region, and pursue a more autonomous foreign policy vis-à-vis its neighbors, such as Iran. Saudi Arabia and Qatar represent two of the most relevant countries in the global energy system, with two opposite energy sources: Saudi Arabia holds a leading position in global oil markets, whereas Qatar in global gas markets.

As Sect. 3.1.2 explained, Qatar has developed its LNG industry since 1996, rapidly becoming the world's largest LNG player. In 2019, it exported 107 bcm of LNG, exporting 72 bcm to Asia and 32.2 bcm to Europe. Benefitting from its geographical position between Europe and Asia, Qatar has the possibility to implement a diversified strategy of energy security of demand and supply two major gas markets. However, its leading role in the global LNG market is threatened by the advent of other major LNG exporters, notably Australia, the US and Russia (Fig. 3.12, see Chap. 3 Sect. 3.1.2). These three countries, along with Qatar, are expected to lead the LNG industry in the upcoming years. All of them are increasingly looking to Asia, Qatar's main gas markets. Higher competition is likely to take place also in the European gas markets as LNG is seen as the main solution to reduce Europe's dependence on Russian gas in the medium term.

However, Qatar has taken courageous decisions during the embargo years despite low energy prices and an oversupplied market. In 2017, Qatar lifted its self-imposed 2005 moratorium on the expansion of North Field, which will expand its LNG export capacity from 77 million tons per annum (Mtpa) in 2017 to 110 Mtpa in 2026. In 2019, Doha announced a second stage that will ultimately increase output to 126 Mtpa in 2027. The expansion strategy aimed to use Qatar's numerous competitive advantages to respond to mounting competition from other LNG exporting countries despite low oil and gas prices. The first new volumes from North Field are expected to be available by late 2025. Moreover, Qatar is further consolidating its LNG position through the Golden Pass LNG project[4] in Texas in collaboration with ExxonMobil—Qatar Petroleum's first overseas investment in a liquefaction project. The over 10 billion USD project has a capacity of around 16 Mtpa of LNG and exports are expected to commence in 2024. By 2024/25, Qatar is expected to regain its leading role in the LNG industry. Lastly, in 2018 Qatar decided to integrate its two energy companies (Qatargas and RasGas) in order to improve the efficiency of its energy industry and benefit from its several competitive advantages.

Throughout the years, Qatar has increasingly prioritized its gas industry over oil. This was clear when it withdrew from OPEC in 2018. Qatar was an OPEC member since 1961, and although it is not the first country to leave the organization, it is the first country from the MENA region to take such a decision. For oil markets, the decision has little relevance: in 2017 Doha produced 600 kb/d of crude oil, less than 2% of OPEC's oil output. It is more a political matter. The small emirate's decision was driven partially by its desire to free itself from transnational institutions that are under de facto Saudi leadership. Also, Qatar was able to withdraw from OPEC because it earns far more from natural gas and related liquid products than from crude oil. LNG provided 42% of export earnings for the country from 2013 to 2017 (Tsafos 2018). However, the role of gas is far more important than this as Qatar is a major producer and exporter of condensates and natural gas liquids, which can only be recovered by producing natural gas. On international markets, liquids command a much higher net-back price than gas. Moreover, Qatar is also home to the largest Gas-to-Liquids (GTL) plant—known as 'Pearl GTL plant'—jointly operated by Shell and Qatar Petroleum, which however is only profitable when oil prices are very high.

The leading role in the LNG industry has granted newfound political support since late 2021 when Europe has started to deal with rising energy prices and a growing political crisis, which erupted in 2022 with Russia's invasion of Ukraine. The US and the European countries have been courting Qatar to supply the European gas markets. Qatar expressed its availability to divert some LNG volumes to Europe if Russia decided to cut its gas supplies as geopolitical tensions were surging. This approach granted Qatar newfound status in the US as well. In early 2022, the Emir of Qatar visited the White House and US President Biden announced that the US

[4] A joint venture between Qatar Petroleum (70%) and ExxonMobil (30%).

would grant Qatar the title of major non-NATO ally. This was also due to its crucial diplomatic role in key regional issues for the US: Afghanistan and Iran. In short, in just a year (2021–22), Qatar has managed to regain centrality in the political debate after the isolation period (GCC Embargo 2017–21).

The Ukraine war and the European Union's consequent wish to reduce as much as possible and as quickly as possible its gas dependence on Russia, is boosting Qatar's relevance in global LNG markets and helping to consolidate Doha's newfound political and strategic status in the West. Qatar holds extensive competitive advantages in the LNG industry as its LNG projects are generally attractive in economic terms, resulting in a lower effective average cost of LNG production compared to other competitors. This is also due to the production of condensate and natural gas liquids in association with natural gas. Moreover, Qatar is in a favorable geographic position between the two major global LNG markets—Asia and Europe—and thus able to play in both markets.

5.1.3 GCC Versus Iran

The animosity between most of the Gulf monarchies and the Islamic Republic of Iran has been a feature of the regional political competition since 1979. This can be attributed to the historical division between Sunni and Shiite. However, different Sunni countries do not share the same approach regarding relations with Iran. Precisely the different approach towards Iran is one of the main causes of the GCC crisis described in previous Sect. (5.1.2). Doha has adopted a cautious approach towards Tehran, eager to promote economic and cultural links. The Qatari approach is mainly motivated by the need to avoid collision with the country that controls the other half of the North Field (South Pars in Iran), which is the source of Qatari wealth. By contrast, other Gulf monarchies see Iran as a competing regional country and a security threat.

Since the Islamic Revolution in 1979, Tehran has felt isolated in the region due to constant pressure. Indeed, Tehran has attracted the animosity of the US, Gulf monarchies and Israel. Right after the Islamic Revolution, Tehran had to face the eight-year war against Iraq. As a response to these challenges, Tehran built a coalition of Shiite groups across the region as the foundation of its sphere of influence, and used those factions to shape events in the region (Friedman 2019a, b). The Iranian arc of influence covers Iraq, Syria, Lebanon and Yemen. However, though its influence in the region is large, it is far from absolute; it is indeed vulnerable to other powers' activities.

The US identifies Iran and its sphere of influence as a significant threat to U.S. interests and allies since the foundation of the Islamic Republic of Iran and the overthrowing of the Shah. Washington's main strategic goal in the region is to counterbalance Iran's influence and prevent any single power from dominating the region. This strategic opposition was sharpened by the US 'War on Terror' and the State of the Union speech given by President George W. Bush in 2002 in which he articulated the existence of an 'axis of evil', composed of Iran, Iraq and North Korea.

That speech and the 'War on Terror' had a traumatic impact on the region's politics. Indeed, the US invasion of Iraq in 2003 created space for the empowerment of Shi'a parties supported by Iran, following the dismantlement of the Ba'ath regime of Saddam Hussein. Further pressure and enmity have occurred with the advent of the Trump Administration and its 'maximum pressure' strategy. Between these two phases of hostility, President Barack Obama tried to engage positively with Iran through an international agreement and by reducing the burden of economic sanctions on Iran's economy. With the election of Joe Biden in 2020, the US has recommenced nuclear talks and engagement with Iran with the aim to re-create the international framework on nuclear issues despite the numerous challenges.

Since the 1980s, sanctions have been an essential component of US policy towards Iran. At first, US sanctions were intended to prevent and cease Iran's support to terrorist groups and to limit its strategic power in the Middle East. Since the mid-2000s, the US and its international allies have imposed sanctions targeting Iran's nuclear program with the aim to persuade Tehran to agree to limiting it.

Sanctions have targeted several sectors of the Iranian economy, with a special focus on the energy sector given its great potential. Throughout the years, countries, mainly the US and the EU, and international organizations, such as the UN, have issued a complex set of sanctions that forced international companies to leave Iran, limited the international sale of Iranian oil, prevented American and European investments in the Iranian energy sector, excluded Iran from the SWIFT banking network, and effectively forced major European banks and insurance companies to stop dealing with the country.

International sanctions have strongly affected Iran's gas export potential as they have prevented access to the LNG technology. Indeed, Iran and Qatar, which share the North Field/South Pars field, have experienced opposite results in the LNG, with Qatar becoming the leading player while Iran holding zero LNG capacity. For many years, Iran has considered LNG exports in order to fully exploit its large gas reserves. The Iranian ambition clashed with the reality of international sanctions that stalled LNG projects over the past decades. An example, French's Total and Royal Dutch Shell had two projects, the 10 Mtpa Pars LNG and 16.2 Mtpa Persian LNG, respectively. However, they had to abandon them as sanctions intensified in the 2000s and early 2010s. International sanctions prevented the development of the two LNG projects under the management of the state-owned oil company NIOC due to the re-imposition of sanctions in 2018.

The sanctions enforced by the US and the EU in 2012 had negative repercussions on Iran's economy as well as on its oil and gas production. Iran's oil production declined to 2.7 mb/d in 2013, down from 3.7 mb/d in 2011 and Iranian exports of crude and condensate shrunk from 2.5 to 1.1 mb/d in the same period (Jalilvand 2018a). Iran tried to offset the negative consequences of international sanctions, creating a set of counter policies under the umbrella of the 'resistance economy' strategy. Under this economic strategy, companies affiliated to the Islamic Revolutionary Guard Corps (IRGC) sought to fill the gap left behind. However, neither IRGC nor the National

Iranian Oil Company (NIOC) managed to counterbalance the loss of cooperation with Western companies. Indeed, Iran was unable to stop the decline of its energy industry under sanctions (Jalilvand 2017).

The Iranian energy industry experienced a spark of hope with the signing of the Joint Comprehensive Plan of Action (JCPOA), known as the 'Iran nuclear deal'. It was concluded in July 2015 between Iran and the 'E3 + 3', composed of the European countries France, Germany and the UK, along with the EU, and the world powers, the USA, China and Russia. The JCPOA was formally implemented on January 16, 2016. It allowed the lifting of several sanctions against Iran in exchange for limitations on, and greater international inspections of, Iran's nuclear program. Under the deal, European companies were allowed back to Iran, investments in the energy sector were possible again and restrictions on exports were no longer in place. Even though the JCPOA did not completely erase uncertainty and all contentious issues, its implementation attracted the interest of several international oil companies (IOCs) from around the world. Numerous companies began signing several memoranda of understanding (MoUs). Among these companies there were American-Dutch Schlumberger, British-Dutch Shell, Chinese CNPC, French Total, German Wintershall, Italian Saipem, Japanese Inpex, Norwegian DNO, and Russian Gazprom.

In July 2017, Iran reached a first and important milestone by signing a $4.8 billion contract with Total and CNPC, which formed a consortium to develop the eleventh phase of the giant South Pars. The contract was welcomed enthusiastically at first, but it turned out to be the exception rather than the rule; indeed, it did not produce further deals with Western partners.

Total had a long history with Iran's energy industry, having developed the second and third phases of the South Pars field, and it was the last European company to leave the country in 2010. Additionally, Total affirmed that it could afford the initial investment of $1 billion from the company's own cash reserves, overcoming a major obstacle to cooperation and investment in the country. Moreover, the decision to cooperate on gas rather than oil was probably motivated by the belief and hope that natural gas projects in Iran might be more acceptable to the US than oil (Jalilvand 2018b). Indeed, natural gas is mostly used for the Iranian domestic market, whereas oil is exported abroad providing hard currency for the Iranian regime. For example, in 2016, the IMF estimated that Iran's oil exports account for between 50 and 60% of total exports and almost 15% of GDP (Ratner 2018). This is the main reason why Washington imposed sanctions on Iranian oil, aiming at preventing revenues that could finance Iran's activities in the Middle East.

In March 2018, Iran signed a second contract with a foreign company, Russia's state-owned Zarubezhneft, marking a potential growth of international cooperation. The Russian company agreed to develop jointly with NIOC and private Iranian company Dana the Aban and West Payedar oil fields, both shared with Iraq. Under the 10-year deal, the Russian company had a stake of 80% (Jalilvand 2018a, b). Moreover, Zarubezhneft would have provided enhanced oil recovery (EOR) technologies that would allow adding 48,000 b/d to Iran's production from the two fields. The advent of a Russian company was a major news for Iran, representing Iran's ambition to diversify its international energy portfolio. Indeed, all previous international energy contracts were concluded either with Asian or (West-) European companies.

Meanwhile, the removal of several international sanctions contributed to the increase of domestic output (back to 4.5 mb/d in 2016) and its comeback into the international oil markets. Iran has increased its oil production to 4.5 mb/d in 2016.

The JCPOA was also a major change for US regional policy. It was at the heart of Obama's vision on the region. Obama decided to engage positively with the moderate and reformist area of the Iranian regime, led by President Hassan Rohani and Foreign Minister Mohammad Javad Zarif. However, the substantial change of the US Middle East policy caused alienation between Washington and its more traditional allies in the region, notably Saudi Arabia, the UAE and Israel. These countries expressed their great anxiety over the risk of the fading US security supervision within the region as well as its engagement with Tehran.

Saudi Arabia is seen as the regional nemesis of Iran. Traditionally, the 1979 Revolution is considered as the watershed moment in the region. This event certainly played a crucial role in shaping the relationship between the two countries. However, in the years before the revolution, both Iran and Saudi Arabia were seen as 'twin pillars' of Gulf security following the UK withdrawal from the region. In this security structure, Iran played a key role as a bulwark against the Soviet threat to the region (Mabon and Wastnidge 2020). Both countries had regional ambitions and roles as major oil producers. Nevertheless, as Riyadh began to assert its position as a key oil producer, it was able to undermine Iran's regional clout thanks to its role in the Arab oil embargo in response to the Yom Kippur War and its rapidly swelling coffers (*Idem*). Thus, in the lead up to the events of 1979, both states ramped up their military spending to reinforce their regional standing and domestic control. Since the 1979 Islamic Revolution, Saudi Arabia and the US has consolidated their security ties more and more.

Obama's decision to engage with Iran has shaken the traditional security and political structure of the region. Moreover, under the Obama Administration, the US foreign policy has begun to focus toward other areas, notably Asia (i.e. "pivot to Asia"). Simultaneously, in those years, the US had increased its oil and gas domestic production, resulting in a decrease of reliance to Middle East hydrocarbon imports. These transformations contributed to increasing uncertainty in the region, with Saudi Arabia and the UAE starting to fear that the US security umbrella would be reduced or worse. That led to a more assertive foreign policy undertaken by these regional players and their leadership. In this scenario, in 2015 Saudi Arabia and the UAE waged the Yemen war, seeking to restore the previous Yemeni government to power. The military operations targeted the Houthis group, backed by Tehran, starting another proxy war between Saudi Arabia and Iran.

However, the election of Donald Trump as President of the US in November 2016 marked the turning point of this region's politics. He has consolidated a strong (personal) relationship with the Saudi and Emirates leadership—particularly with the Saudi Crown Prince Mohammed bin Salman. An odd group of countries has been gathered around Trump's foreign policy toward Iran. Indeed, the strong animosity against Tehran was welcomed by Saudi Arabia, the UAE and Israel. Israel and the

Gulf monarchies have begun a coordinated action against Iranian activities in the region, marking a major development in the region's politics. The three countries were particularly worried about Iran's nuclear program, criticizing the signature of the JCPOA. Thus, they found a new ally in Washington with the advent of Donald Trump. Indeed, during the presidential campaign and his presidency, Trump has openly criticized the Iran nuclear deal, condemning Iranian activities in the region against US interests and allies.

In the pursuit of reducing Iran's sphere of influence in the region, the Trump Administration established the so-called 'maximum pressure' strategy, designed by Ambassador John R. Bolton.[5] Under this strategy, the US has re-imposed sanctions against Iran weakening the international architecture of the JCPOA. On May 8, 2018, the Trump Administration announced the immediate and full withdrawal from the JCPOA, resuming all nuclear-related US sanctions. To further put pressure on Iran, on November 6, 2018 Washington re-imposed all US secondary sanctions, which are applied also to third countries that have economic ties with Iran. The US has increased its pressure on Iran's energy industry through its unilateral sanctions. The US decided to prevent not only the international sale, but also exports of Iranian oil products and natural gas—unlike before the JCPOA (Jalilvand 2019). At the same time, the US decided to grant temporary sanctions waivers[6] to eight importers of Iranian oil: China, Greece, India, Italy, Japan, South Korea, Taiwan, and Turkey. In doing so, these countries could continue importing Iranian oil for a period of 180 days.

Despite these concessions, the US decisions prevented Iran's full return to the international energy landscape. All IOCs left the country in 2018 and Iran's oil exports fell sharply. Crude oil exports collapsed from an average of 2.5 mb/d in 2017 to just around 1 mb/d in April 2019 (Greenley 2019). In the first half of 2020, Iranian crude and condensate exports averaged just 238,000 b/d, worsening Iran's economy. Oil and gas revenues brought in just $8.9 billion for the last Iranian calendar year[2], compared to $27.8 billion in the year before—the last year before the renewed sanctions took effect.

The unilateral withdrawal from JCPOA reverberated also on transatlantic relations, with a political drift between Washington and its European allies. Indeed, Europeans expressed their commitment to keeping the JCPOA in place, supporting trade and investments with Iran. In August 2018, the EU introduced its Blocking Statute, asking European companies not to follow US sanctions. Yet, all European IOCs left the country and by February 2019 no Iranian oil reached European shores. As a consequence, Iran lost the European market which accounted for 25% of its exports in 2017 (Jalilvand 2019). Asian countries were also affected by US decisions. Most of them are also traditional allies of the US, such as South Korea, Japan and India.

Russia and its energy relations with Iran were affected too. On the one hand, Russia effectively cancelled its investment in Iran made by Zarubezhneft. On the other hand,

[5] He served as the US National Security Advisor from 2018 to 2019.

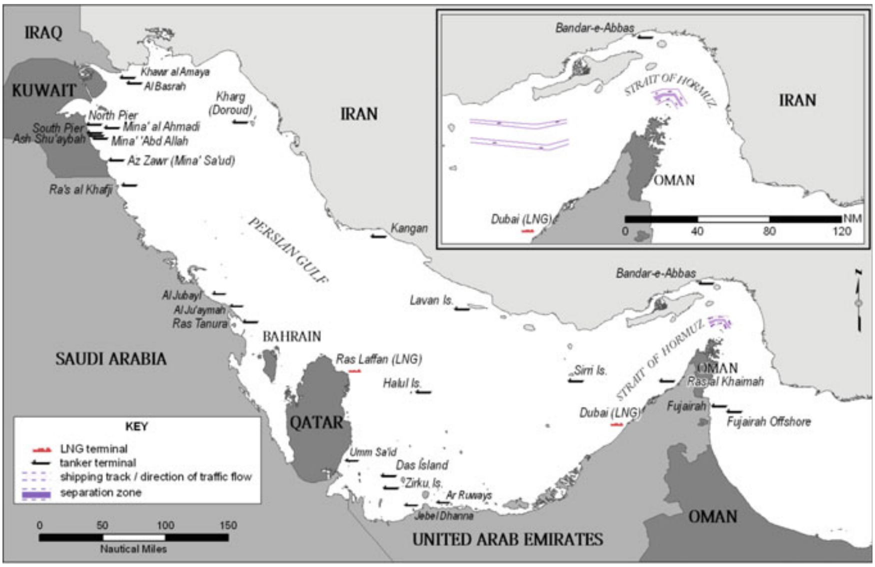
[6] The so-called significant reduction exemptions (SREs).

Russia has benefited to some extent from the US sanctions regime against Iran's oil and gas sector. The blockade of Iranian oil has left room for other producing countries, including Russia. As the grades of Russia's oil are similar to Iran's, Moscow has thereby contributed to replacing Iranian oil globally.

One major consequence of the maximum pressure strategy has been the increase of security concerns among US regional partners. Tehran has responded to increasing pressure with some important activities and operations in the region, which led to an intensification of tensions among regional players. Iranian activities and responses targeted both Saudi and international oil facilities as well as energy infrastructures. Additionally, Iran has decreased its compliance with some of the nuclear commitments of the JCPOA since mid-2019.

Since May 2019, Iran has staged operations in the region, increasing tensions on the global oil market. For example, Tehran targeted ships in port, then tankers in transit and finally it captured a British tanker and crew on the high seas. These activities were undertaken in the world's most important chokepoint for oil and gas trade: the Strait of Hormuz (Map 5.1).

Iran has always used the Strait of Hormuz as a strategic element of its security policy. It has never hesitated to use it as a geopolitical instrument for pressuring the change of US policies. For such reasons, every time tensions in the region rise, concerns about the chance of a closure of the Strait by Iran are expressed globally. Therefore, there is a direct correlation between the threat level perceived by Iran and the actions undertaken by the regime in the Strait. Its actions must be read with this lens.



Map 5.1 Persian Gulf and the Strait of Hormuz. *Note* Location of terminal icons are indicative and not a precise location. *Source* https://fas.org/sgp/crs/mideast/R45281.pdf

The Hormuz Strait is a crucial element of the global oil and gas market. In 2018, the daily oil flow through this narrow passage—just 41 km wide at its narrowest point—averaged 21 mb/d, which accounts for about 21% of global petroleum liquids consumption. The top oil supplier through the Hormuz Strait is Saudi Arabia, followed by Iraq. Given the security risks, alternative routes are often considered by Gulf producers. Until 2021, the only operating bypass pipelines are of Saudi Arabia and the UAE: Riyadh has the East–West pipeline and the UAE controls the Habshan-Fujairah pipeline. However, these existing alternative routes are very limited and face some challenges.

The Saudi East–West pipeline carries crude to the Red Sea Yanbu ports, which have crude storage of around 22.5 mn b/d and can export in excess of 5 mn b/d. The pipeline delivered 1.53 mn b/d to refineries in 2018, which would still leave space for more than 3 mn b/d crude for exports—less than half of typical Saudi exports of 7 mn b/d. Saudi Arabia is boosting its Red Sea capacity by expanding the East–West pipeline to 6.5 mn b/d by 2023 in order to further reduce its vulnerability on Hormuz. Saudi vessels headed to Asian markets would need to pass through the Bab al-Mandeb. The Habshan-Fujairah pipeline links the onshore Habshan with the port of Fujairah located outside the Strait of Hormuz. Abu Dhabi typically exports up to 800,000 b/d from Fujairah, while total Emirati exports are typically around 2.4 mb b/d. Thus, the two alternative routes could accommodate an additional 3.5 million barrels per day. However, to put into context, it corresponds to only 17% of current Hormuz oil exports (Schaus 2019). Furthermore, also these routes have been targeted by some attempted attacks, leaving the security concerns unanswered. Indeed, the Bab al-Mandeb is a perilous stretch of water and there have been episodes of attacks to Saudi tankers in July 2018 when transiting the passage.

In July 2021, Iran itself has built and inaugurated its first oil export terminal on the Indian Ocean. The Bandar-e Jask terminal cost $2 billion and is located at the end of the 1,100 km-long Goureh pipeline (with a transmission capacity of 1 mb/d) in the Gulf of Oman (Map 3.2 in Chap. 3 Sect. 3.1). Obviously, the construction of the terminal is not motivated by security concerns over blockade, but it can provide new room for future periodic threats from Iran to block Hormuz. Indeed, until the commissioning of the terminal, Iran would have blocked also its own oil export.

It is clear that a potential closure would have important consequences for importing countries depending on the degree of reliance on oil or gas imports from this area. From this perspective, Asian countries are more reliant on the hydrocarbon trade through Hormuz than Western countries (Fig. 5.2). In 2018, 76% of the crude oil and condensate that moved through the Strait of Hormuz went to Asian markets; with China, India, Japan, South Korea as the largest destinations (accounting for 65% of all Hormuz crude oil and condensate flows in 2018). In terms of volumes, China is the largest importer of oil from the region, but it is not the most reliant country on these flows given the size of its overall oil demand. Japan, South Korea and India are particularly dependent on these exports. The US still imported 1.35 mb/d in 2018 (Schaus 2019).

Thus, Japan, South Korea and India have an immediate vulnerability to any potential disruption at the Strait. However, an extended disruption would have pricing

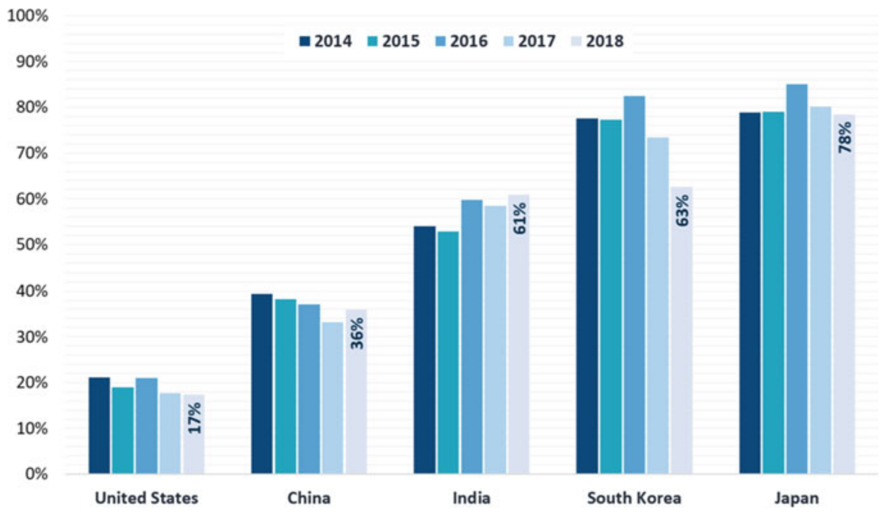


Fig. 5.2 Asian Importers rely heavily on Hormuz Export Flows. *Source* CSIS research and analysis using data from EIA, IEA, PPAC, KEEI, and PAJ; John Schaus and Andrew J. Stanley, "Oil Markets, Oil Attacks, and the Strategic Straits," CSIS, CSIS Commentary, July 19, 2019, https://www.csis.org/analysis/oil-markets-oil-attacks-and-strategicstraits. Reprinted with permission

impacts not limited only to these markets but globally. The Asian economies would feel more economic pressure, while the US could have some benefits as exporter. However, also the US economy would be affected to some extent by higher prices, as the entire world's economy.

The Strait of Hormuz is critical also for the global LNG trade. Indeed, the Middle East accounted for 26.3% of global LNG exports in 2018, being one of the main supply sources of LNG in the world. Qatar exported 76.8 Mt (24.5% of global LNG exports), while UAE exported 5.5 Mt (1.8% of global LNG exports). These LNG volumes must pass through the Hormuz Strait. Although the maritime natural gas trade through the Hormuz Strait represents a relatively small proportion of global natural gas trade (8.4%), any disruptions to these flows could have severe energy pricing impacts for LNG dependent importers. Of the top 10 importers of Qatari LNG (the main source from Hormuz), eight are Asian countries and two are European, stressing the shift of destination of Qatari LNG throughout the years (Table 5.1). This could potentially change in the future as Europe seeks to import high LNG volumes to reduce its overdependence on Russia's gas.

However, the world today is very different from the one of 1973. Recent assertive operations along this narrow passage had a smaller impact on oil prices. By contrast, geopolitical risks added a premium to oil prices in the 1970s. Today, climate policies and technological developments are expected to drastically reduce the use of hydrocarbons. Moreover, over the period 2015–2020, both oil and gas markets witnessed an oversupply condition with low prices. Therefore, assertive operations along this narrow passage had less impact than those back in the 1970s. Nevertheless, some

Table 5.1 Top 10 importers of Qatari LNG in 2021, (MT)

Country	MT imported
South Korea	11.72
India	10.20
China	9.17
Japan	8.97
Pakistan	5.24
Taiwan	4.76
Italy	4.71
United Kingdom	4.36
Bangladesh	2.97
Thailand	2.59
Spain	1.72

Source Authors' elaboration on GIIGNL

countries are concerned about regional tensions in the Hormuz Strait, especially those that rely heavily on oil and gas flowing through the Strait and that could be harmed by potential disruptions. In 2018, 76% of the crude oil and condensate that moved through the Strait of Hormuz went to Asian markets; with China, India, Japan, South Korea as the largest destinations (accounting for 65% of all Hormuz crude oil and condensate flows in 2018). A different scenario would be a closure of the Strait, which currently seems unlikely. A complete blockade of transits through Hormuz would cause major oil and gas price spikes and potential disruptions due to the relevance of exporting countries in this region for the global oil and gas markets.

China has been a major importer of Iranian oil, helping the Iranian regime to collect revenues that are vital for its economy. Following the JCPOA, China's CNPC entered the Iranian upstream sector through the international consortium with Total for the development of the eleventh block of South Pars. Beijing has also been one of the top importers of Iranian oil. In 2018, Iran exported around 650,000 b/d of oil to China (S&P Global 2020a, b). However, Iranian oil exports to China were severely hit by US sanctions. Indeed, in the second half of 2019, Iranian crude and condensate exports declined to around 225,000 b/d down from around 400,000 b/d in the first half of the year (*Idem*). Moreover, CNPC left the consortium for the development of the eleventh block of South Pars, following Total's withdrawal in August 2018, showing the Asian buyers' sensitivity to US sanctions.

Moreover, China must face a broader and increasing political confrontation with Washington. Since Beijing is one of the most relevant importers of Iranian oil, China will want to avoid Iran's crude imports getting caught up in the broader US-China relations—mainly in light of the risk to its large energy traders—even as negotiations with the US have once again reached a dead-end (Meidan 2019).

An example is the US Department of State's announcement on July 22, 2019 concerning its decision to impose sanctions on a Chinese trader, Zhuhai Zhenrong, and its chief executive for knowingly purchasing or acquiring oil from Iran, contrary to US sanctions (*Idem*). The US decision was driven by the need to pursue its maximum pressure strategy. Meidan (2019) explains that the US decision may be seen as a sign of further escalation in the already fraught relations between the US and China, but in reality the choice of Zhuhai Zhenrong allows both the US and China to maintain opposing diplomatic stances on Iran, without further damaging their increasingly tense bilateral relations. Indeed, Zhuhai Zhenrong has limited exposure to the US market, so the designation is effectively meaningless (*Idem*). Despite the effects of these sanctions, Beijing will therefore tread carefully with its Iranian imports.

Regional tensions reached a new level on September 14, 2019, shaking the oil markets. On that day, a drone and missile strike hit Saudi Arabia's Abqaiq and Khurais oil facilities. Iran's direct (or indirect through its proxy) role in the attacks was a critical development in the region's politics and in the global energy system. Indeed, Friedman (2019a, b) explained that Iran aims at generating pressure on the US to ease US pressure on the Iranian economy. Tehran identified Saudi Arabia as both vital to the anti-Iran coalition and yet vulnerable to regional tensions. Additionally, Tehran evaluated that Saudi is most vulnerable in oil revenue. So, it supported the attack in order to demonstrate the vulnerability of the Saudi oil industry, while reducing Saudi oil production and inflicting real pain (*Idem*). Indeed, Abqaiq is the most important oil facility in Saudi Arabia; the plant has a processing capacity of 7 mb/d. Although it was running at 4.5 mb/d at the time of the attack, its capacity accounted for more than 50% of the Kingdom's output (MEES 2019a, b, c). The Saudi Energy Minister affirmed that the attack curtailed Aramco production by 5.7 mb/d to around 4.1 mb/d, implying that the Khurais facility operated at 1.2 mb/d at that time (*Idem*). Despite its profound significance, the action had only a limited effect on the global oil market and on oil prices. Also, the US did not respond as strongly as they would have done in the past. This can be mainly motivated by the impressive growth of US domestic oil production, which has reduced Washington's vulnerability and produced a more assertive foreign policy.

The greater assertiveness of US foreign policy thanks to its oil production was reaffirmed by a remarkable operation. On January 3, 2020, the US killed Iranian Lieutenant General Qassem Soleimani, head of Iran's Islamic Revolution Guards Corps (IRGC) Qods Force, with an air strike at the Baghdad International Airport. It was an unprecedented event, given the relevance of the target. The air strike produced a sense of uncertainty on the GCC countries and US regional allies, which called for a de-escalation of regional tensions. Indeed, the Sunni countries have begun to fear a military escalation between the US and Iran, especially after Iran demonstrated its capability to target both Saudi and Emirati shipping and assets. This risk persuaded leading GCC players to take a more prudent approach, adopting a relatively conciliatory tone.

With the election of Joe Biden, the US has restarted talks with Iran in Vienna aimed at re-establishing the JCPOA. A potentially renewed JCPOA could contribute to bringing Iranian hydrocarbons back to the international energy markets. Yet, the diplomatic effort faces several challenges. Within the US, Republicans have expressed their opposition to the deal, while in the region the US needs to address

Gulf countries' concerns. Lastly, Western sanctions imposed on Russia following its invasion of Ukraine have driven Russia to abandon its facilitating role in Iran's nuclear negotiations. Moscow has requested Western governments guarantees that the sanctions related to the Ukraine invasion do not affect and threaten Russia's relationship with Iran. In doing so, Russia has limited the potential comeback of Iranian oil into the world's tight market and halted the negotiations.

5.2 Mashreq

The East Mediterranean cluster, which in this book comprises Egypt, Iraq, Israel, Jordan, Lebanon, Palestine and Syria, has been characterized by rising geopolitical tensions and energy hopes. Over the past decade, energy and power politics have shaped major developments in the area. A growing number of exploration and production activities in the Eastern Mediterranean Sea have brought several oil and gas discoveries offshore Egypt, Israel and Cyprus. Meanwhile, Iraq and Syria have experienced serious social unrest and military conflicts within their borders, which reverberate throughout the entire region.

Cooperation and competition have developed often around energy as it plays an important role in the area. In this cluster, Iraq, Egypt and Syria are traditional hydrocarbon producing countries, while Israel has become a gas producing country only in the last decade. By contrast, Lebanon and Jordan have not found exploitable reserves so far. Old and new regional competition meddles with new energy discoveries and regional energy potential. This section will analyze first two of the traditional hydrocarbon producers in the area: Iraq and Syria. The other major hydrocarbon producer, Egypt, will be analyzed with special emphasis on the East Mediterranean gas saga, which started around 2010.

5.2.1 Oil and Gas Sector in Conflict Countries: Iraq and Syria

- **Iraq**

Within the East Med cluster, Iraq stands out as a major oil player. Iraq holds a great amount of reserves of oil and gas (145 thousand million barrels and 3.5 trillion cubic metres at the beginning of 2020, respectively). Iraq holds the world's fifth largest proven oil reserves, accounting for around 10% of the global total. Most of its resources are considered as the world's least expensive and easiest oil to extract. Although these reserves are geographically dispersed throughout the country, the majority is located in the south, concentrated in and around the city of Basra, while 17% are found in the north. According to the IEA (2019), Iraq's oil fields in the

South contain abundant conventional, low-cost onshore oil resources. This area are also includes the “big 4” oil fields of Rumaila, West Qurna, Zubair and Majnoon. The “big 4” fields combined account for 60% of Iraq’s oil production in 2018, and an estimated 70% of the increase in Iraq’s production to 2030 (*Idem*).

Rumaila and West Qurna are ranked among the top-15 largest oil fields globally based on remaining reserves. By contrast, just under a fifth of Iraq’s production in 2018 came from the North, primarily from the Kirkuk and Bai Hassan fields. The area of Kirkuk is where Iraqi oil was first discovered in 1927, but the area is at the heart of the dispute over land rights and oil revenue sharing between the central government in Baghdad and the Kurdistan Regional Government (KRG) in Erbil, which delayed the development of the region’s resources. It has been further frustrated by the battles against ISIS in the 2014–17 period.

However, Iraq’s oil production and exports have consistently lagged behind the potential of its resources. For example, Iraq’s oil output (1.3 mb/d) did not diverge widely from that of Saudi Arabia (2.2 mb/d) in the mid-1960s; but Iraq had reached only 2 mb/d in 1973 while at the same time Saudi production was close to 8 mb/d (IEA 2012). Additionally, three wars (against Iran from 1980 to 1988 and US-led coalition forces in 1991 and 2003), international sanctions and internal instability have prevented Iraq’s oil output expansion. For example, Iraq had some success in the 1970s, bringing oil towards the strategic goal of creating a 5.5 mb/d production capacity by 1983 formulated at that time. However, this goal was never reached because of the Iran-Iraq war. The war reduced Iraq’s production to 1 mb/d, with exports collapsing from 3 mb/d to 750,000 b/d. A subsequent plan to raise capacity to 6 mb/d by the mid-1990s was once again not realized, because of the First Gulf War in 1991. The US-led Operation Desert Storm inflicted severe damages on Iraqi oil infrastructure. Lastly, Iraq’s oil output suffered another major setback following the US-led invasion in 2003 and the collapse of the former Hussein regime. Indeed, it fell from 2.5 mb/d in the early 2000s to approximately 1.4 mb/d after 2003.

Conflicts and regional politics have also affected Iraqi export growth and potential routes, particularly from the northern region. Indeed, oil produced in the southern regions is exported via sea from the Basra and Khor al-Amaya ports. However, the existing infrastructure does not provide adequate capacity for the potential growth of export volumes. Instead, most of Iraq’s major crude oil pipelines are located in the north (Map 5.2).

The Iraq-Iran War altered the Iraqi pipeline map. At the time, Iraqi oil moving eastwards via Syria was blocked due to President Hafez al Assad’s support to Iran during the conflict. Therefore, with no viable export route for Iraqi oil through Syria, Baghdad increased its reliance on Turkey via the Iraq–Turkey pipeline (whose capacity was raised from 750,000 b/d to 1.5 mb/d) (Mehdi 2018). Additionally, Baghdad tried to further diversify its export routes striking a deal with Saudi Arabia to have a pipeline from southern Iraq to the Saudi Yanbu port on the Red Sea. It was commissioned in 1990 but closed and expropriated by Riyadh after the Iraqi invasion of Kuwait (IEA 2019).

Iraq’s oil exports are mainly shipped to Asia, which accounts for over 60% of its total crude oil exports, while Europe is the destination of 25% of Iraq’s crude oil

Map 5.2 Iraq's oil and natural gas infrastructure. *Source* https://www.eia.gov/international/content/analysis/countries_long/Iraq/iraq_bkgd.pdf

exports. Asia, China, India and South Korea are the key buyers of Iraq's crude oil, with China and India importing almost 1 mb/d each.

Despite damages due to conflicts and impressive domestic challenges, Iraq has been able to nearly double its oil production over the past decade to 4.7 mb/d, accounting for a fifth of the net increase in global supply. In 2019, Iraq ranked as the fifth-largest source of global oil supply (IEA 2019). The recent growth cemented Iraq's position as OPEC's second largest producer, with federal production capacity just under 5 mb/d as in early 2020. Oil production growth has produced an increase also in the export volumes, with southern exports passing from 1.7 m b/d in 2007 to an average of 3.5 m b/d in 2019.

Oil and gas are core pillars of the country's economy, accounting for almost 60% of the country's GDP, 99% of export earnings and 90% of government revenues, making the Iraqi economy one of the most oil-dependent in the world (IEA 2019). At the same time, this abundance is also Iraq's Achilles' heel due to poor management and its unstable political economy. Following a "pro-cyclical" fiscal policy, the Iraqi economy suffers the volatility of oil prices, especially when oil prices fall under its breakeven fiscal price undermining the government's expenditures and plans to improve the living standards of its own citizens.

Moreover, the Iraqi energy sector must deal with some challenging features. Iraq's oil sector has been undergoing a significant upstream growth, while its midstream and downstream have failed to keep pace. Unlike its upstream regional peers, Iraq is the only major producer heavily reliant on refined product imports, reflecting an underdeveloped refining system and a misalignment between the production yield of Iraq's refining output and its domestics demand (Mehdi 2018).

The hydrocarbon industry is also at the center of a national political debate between the central government in Baghdad and the KRG in Erbil. Baghdad and Erbil have debated strongly over the control of the resources and their revenues. Under the 2005 Iraqi constitution, KRI enjoys considerable administrative autonomy. However, relations between the KRG and the central government are shaken by issues concerning territory, energy and revenue sharing. As already mentioned, Erbil and Baghdad fight over the control of the oil-rich area of Kirkuk. In 2014, the Iraqi military abandoned Kirkuk, as ISIS was emerging and expanding across the area. The Kurdish Peshmerga units fought against ISIS and regained control over the area. From that moment on, the Kirkuk oil has been sold by the KRG rather than the central government. This has inevitably ignited Baghdad's opposition. In 2022, the Federal Supreme Court ruled Iraqi Kurdistan's 2007 oil and gas law unconstitutional. The law regulates the Kurdish oil sector and is the basis for foreign companies' investment in the region.

Oil is essential for the cash flow of both Baghdad and Erbil, but the two entities disagree over oil export revenues. In September 2017, the KRG held a controversial advisory referendum on independence, amplifying political tensions with the national government. As a response, the Iraqi military forces reentered some disputed territories, regaining control of some oil fields in the region. The two entities have extensively discussed revenue sharing and exports of oil and gas produced in the country. In 2018, the central government and the KRG reached an agreement to resume the export of Kirkuk oil to Turkey's Ceyhan port via the KRG pipeline, which can handle up to 1 mb/d of export flows (IEA 2019). Regarding export routes through KRI, Russia has risen as a potential broker of a deal between Baghdad and Erbil.

Moreover, Iraqi ambitions to increase its oil production in the future cannot be translated into reality unless significant quantities of water are available for field injection. Indeed, many of Iraq's oil fields have relatively low recovery factors. Therefore, secondary oil recovery is needed to boost recovery factors and maintain or increase production rates. Being essential for secondary oil recovery, water availability and supply are great concerns for the Iraqi oil industry and IOCs in the country. For example, plans were drafted in 2011 to build the Common Seawater Supply Project (CSSP) that would process seawater from the Gulf and transport 5 mb/d of treated seawater to the largest oil fields in the South to be used for injection. IEA (2019) estimated that in total, by 2030, over 8 mb/d water will be required for Iraq's oil production, up from 5 mb/d used in 2019.

Contrary to its well-developed oil sector, Iraq's gas sector has been ignored for a long time. Its reserves and production are large, but Baghdad has not been able to use it efficiently and sufficiently. The vast majority of its gas reserves is associated gas, with some significant reserves of non-associated gas. Since Iraq does not have adequate infrastructure in place to allow the production of associated gas and provides few incentives to produce and use it efficiently, Iraq flares a large portion of its gas production, ranking as the world's second-largest source country of flared gas in the world behind Russia. However, natural gas would be highly beneficial for Iraq's economy and independence. As of today, Iraq continues to suffer power shortages, which often lead to social unrest like that occurred in Basra in mid-2018.

The great potential of Iraq's oil and gas industry has attracted several foreign companies and actors. Some IOCs have invested in the promising Iraqi oil upstream sector. The IOC operations in Iraq are governed by the Technical Service Contract (TSC) model. Under the TSCs[5], IOCs are reimbursed for their production costs on a quarterly basis and receive a taxable remuneration fee on incremental production, meaning production above pre-contract levels. The big 4 fields (Table 5.2) are operated by ExxonMobil (West Qurna-1), BP (Rumaila), Eni (Zubair) and Lukoil (West Qurna-2).

IOCs have contributed to sustaining and developing Iraq's oil sector. Also, the natural gas sector has attracted some major international companies. For example, Shell decided to end its oil activity in Iraq but it is the most active IOC in the gas sector through its gas-capture program in Basra, which is jointly operated with the Iraqi government (the Basrah Gas Company) (IEA 2019).

Furthermore, Baghdad's energy sector is caught up in the competition between Washington and Tehran. Iraq relies heavily on Iran both for electricity and natural

Table 5.2 Companies in Iraq's "big 4" fields

Field	Companies	Production in 2019	Major developments
Rumaila	BP (47.6%) CNPC (46.4%) State Oil Marketing Organization (6%)	Around 1.5 million barrels per day	
West Qurna-1	ExxonMobil (32.7%) PetroChina (32.7%) Itochu (19.6%) Pertamina (10%) Oil Exploration Company (5%)	Average around 445,000 b/d	Shell sold its 19.6% stake to Itochu for $406 million in May 2018
West Qurna-2	Lukoil (75%) North Oil Company (25%)	Average around 400,000 b/d	Statoil sold its stake in 2012
Zubair	ENI (32.81%) Occidental Petroleum (23.44%) Korea Gas Corporation (18.75%) Missan Oil Company (25%)	Around 500,000 b/d	
Majnoon	Basra Oil Company (45%) Petronas (30%) Missan Oil Company (25%)	Around 250,000 b/d	Shell left in 2018

Source Authors' elaboration

gas. As previously mentioned, Iraq flares the vast majority of its gas output and at the same time imports gas from Iran. In 2019, Baghdad received around 7 bcm of gas and 1.57 GW of electricity. Some experts have estimated that Iran, directly and indirectly, met a whooping 28% of Iraq's peak summer power supply (MEES 2020a). The US seeks to create and support a strong Iraq, capable of tackling Iran's expansion activities in the region.

Because of its geographic location in the center of the Levant, Iraq has long been a key state in the Middle East balance of power. Moreover, additional geographical features (proximity to the Mediterranean, an easy access to the Persian Gulf, abundance of proven oil and gas reserves) make Iraq an interesting state for regional stability and competition. Therefore, Iraq has been in the midst of the competition between the US and Iran, being a key part of the Middle East strategies of both countries. Both US and Iran want to prevent Iraq from becoming too powerful as it was between the 1980s and 2000s, but their approach towards Iraq diverges. Iran seeks to project its influence across the region; thus, it wants to keep Iraq fragmented and easily exploitable through the support of Shia militias in the country. Inversely, the US wants to strengthen Iraqi institutions in order to weaken Iranian influence in the country. In doing so Baghdad will be able to stand on its own again, frustrating Iran's plans. This strategic goal will enable the US to achieve its long-term objective to reduce its presence in the region (Rose 2020). With this strategy, the US aims at reducing the use of hard-power projection in the region, choosing to rely on soft-power as its primary tool of influence in the Middle East. Given the great competition between Iran and the US in Iraq, energy ties between Baghdad and Tehran produce concerns in Washington for two reasons: firstly, because Baghdad is considerably dependent on its neighbor, which can try to exploit this advantage; and secondly, because Tehran can collect revenues from its exports to Iraq, undermining the US "maximum pressure" strategy. Nevertheless, Iraq has sought relief from US sanctions on their imports from Iran since 2018. In 2020, following the formation of the new Iraqi government, the US granted Baghdad another sanctions waiver (for 120 days) to continue importing natural gas from Iran. The US keeps granting Iraq waivers as long as they make long term progress toward independence for its energy sector. Iraq is trying to keep its promises, ending imports by 2022 and relying solely on domestically produced gas. Despite the effort, the target seems unreachable in the short term. Baghdad is too dependent on Tehran and the interruption of gas imports would provoke power shortages and social unrest.

For these reasons, the Trump Administration promoted and invited US companies to aid Iraq's power generation capacity and gas sector to help Iraq achieve energy independence. The US companies can provide the expertise and investment that Iraq's oil and gas sectors are desperate to attract. Yet, the Administration's praise has very limited positive results as the US firms still hesitate to invest in risky Iraq. Domestic instability, security concerns and the unfavorable investment environment make IOCs unwilling to enter the country. For example, Exxon Mobil was awarded the Common Seawater Supply Project (CSSP) in 2010, but Iraq suspended the project contract in 2011 after Exxon signed an oil extraction deal with KRG in the north (the Pirmam block). Four years later, Exxon reportedly re-entered the project, but little progress has been made. In 2019, ExxonMobil was given the initial government nod for its involvement in the South Iraq Infrastructure Project (SSIP), which could contribute to the positive development of the Iraqi energy sector. However, the presence and future investments of US companies might suffer setbacks due to security concerns as well as unstable and unfavorable conditions.

A potential supporter of Iraq's energy independence could surprisingly be Iran's bitter rival Saudi Arabia. Indeed, Saudi Arabia and Iraq have halted bilateral relations since 1990. However, there was a rapprochement in 2015. That year, Saudi Arabia returned an ambassador to Iraq after an almost 25-year absence. A Saudi-Iraq rapprochement has always been called by the US, in the belief that it could undermine and curtail Iran's influence in the country. However, the US decided to apply a more pragmatic diplomacy in Iraq, abandoning its assertive foreign policy against Iran, which has produced no remarkable success so far (i.e. Yemen War, Lebanon and GCC crisis against Qatar) (Mansour 2018). Saudi Arabia has some political and economic tools to gain influence in Iraq. Firstly, it can exploit the growing intra-Shia rift in the country. Indeed, numerous protests have taken place in Iraq against the elite, criticized of being too dependent on and influenced by Tehran. Secondly, it can propose strengthened integration, establishing interdependencies with Baghdad and weakening the role of its regional antagonists Turkey and Iran. Iraq would welcome Saudi investments in its oil and gas sector as well as in the reconstruction process, and Saudi Arabia would be pleased to reduce Iran's influence in the country. One sector in which the mutual goals could be easily achieved is power generation. If Saudi Arabia helps Iraq overcome its lasting electricity shortages, it would be a major diplomatic success. In this context, through the GCC Interconnection Authority (GCCIA) Saudi Arabia and its allies have already agreed to help Iraq providing 1 GW via Kuwait to Basra (MEES 2020b). Moreover, a separate agreement could see Saudi Arabia provide additional electricity via its grid at Arar within a year. These projects could result in Saudi Arabia and the GCC supplying 10% of Iraq's electricity demand (*Idem*). This would be an important step toward deepening Saudi-Iraq relations; however, it is unlikely to wean Iraq off Iranian electricity imports in the short-term.

In 2021, Total signed with Baghdad a $27-billion deal to invest in oil, gas and renewables in the country. This represents a new formula of major deal, addressing both fossil fuels and renewable energy, to help Iraq improve its electricity supply. Under the deal, the French energy major plans to initially invest $10 billion in infrastructure, which will then allow a second round of investment of $17 billion. The first investments cover: (i) increasing oil production capacity from the Ratawi oil and gas field in the Basra province from 85,000 b/d to 210,000 b/d of crude oil; (ii) new gas gathering networks and treatment units to supply local power stations and optimization in the oil and gas production; (iii) the construction of a water injection facility for reinjection into oil reservoirs; and (iv) 1GW solar facility for power generation.

Besides the US (and Saudi Arabia) and Iran, other countries are interested in the Iraqi energy sector, albeit the numerous challenges. Russia and China are two of the most relevant countries in Iraq. These two countries began to enter the Iraqi energy sector when Saddam was in power. Indeed, Saddam signed two major Production Sharing Contracts (PSCs) with Russian and Chinese companies in the 1990s. One of these was with Lukoil for West Qurna, while the other with CNPC for Ahdab. The choice of Russian and Chinese companies was due to sanctions. Whilst Lukoil's contract was cancelled in 2002 for failure to perform, the PSC with CNPC was renegotiated as Iraq's first major Technical Service Contract (TSC) in 2008.

Energy is a key pillar of bilateral relations: Russia has invested more than $10 billion in Iraq's energy sector over the last decade. Moscow has sought to gain influence in the country since 2003, when the new government in Baghdad cancelled many of the Saddam Hussein-era energy contracts. In 2008, Russia agreed to write off most of Iraq's $12.9 billion debt in exchange for a $4 billion oil deal that included access of Lukoil to the West Qurna-2 field. Lukoil has managed a 75% stake of the giant oilfield since Equinor left in 2012. Furthermore, Russian companies have gained relevance also in the KRG since 2012. Russian companies have increased their footprint as American and Western energy companies began to decrease their presence due to security concerns—especially after 2015/15 due to ISIS—and recent major discoveries around the world. Lukoil and Gazprom Neft entered the energy market of the KRI in 2012 and have won a number of contracts since (Sassi 2019). Lukoil played an important role also in exploration activities. In 2017 it discovered the largest Iraqi oil field of the last 20 years, Eridu, whose reserves were estimated to be as high as 7–10 billion barrels. The field is operated by Lukoil (60%) and Inpex (40%). Gazprom Neft participates in several oil and gas projects in the region (the Garmian and Shakal blocks), but it faces logistical and security concerns that delay the progress. Gazprom Neft is also developing the Badra oil field in eastern Iraq.

In recent years, the Russian giant oil company, Rosneft, has stepped up as a leading partner for the energy sector of both central government and KRG, signing oil contracts with both entities. However, since 2017, Rosneft has surged as a main investor in Iraqi Kurdistan. Indeed, it has invested a significant amount of money securing a solid position in the area. Between 2017 and 2018, Rosneft has signed multiple deals with the KRG for a total value of about $3.5 billion. This represented a potential lifeline for KRG energy development. Firstly, it signed a contract for the purchase of Kurdish oil in February 2017. Rosneft lent Kurdistan around $1.2 billion to cover the region's budget deficit. In October 2017, the KRG allowed Rosneft to carry out exploratory work covering five blocks within its territory under a PSA. The contract was estimated at $400 million. In October 2017, Rosneft has agreed to take control of Iraqi Kurdistan's main oil pipeline, which connects the Kirkuk oil area to Turkey's Ceyhan port. Rosneft owns 60% of the pipeline while the KAR Group retains 40%. The investment was about $1.8 billion. The role of Rosneft in the Kurdish oil export lines provides Russia with a degree of leverage with Baghdad, placing Rosneft and Russia at the center of talks between Baghdad and Erbil.

Rosneft has also consolidated its activities in the rest of the country, balancing its support to the Kurdish area and the central government. It discovered new reserves in Block-12, in south-eastern Iraq, which could contribute to the increase of export volumes. In May 2018, Rosneft enhanced its presence in the KRI, signing an agreement for the development of gas reserves in the area. The deal also includes the construction of a gas pipeline (whose capacity would be around 30 bcm) for exports to Turkey. It would run parallel to the existing oil export pipeline, meeting with the

Turkish gas pipeline system. Rosneft's involvement in Kurdish natural gas development and export routes sparks competition with its domestic rival, Gazprom (and its subsidiary Gazprom Neft). Russia's role in Iraq's energy sector underscores how Moscow sees energy as a foreign policy tool, gaining influence through its companies and taking advantage of the fading role of the US in the entire region. Through investments in upstream and pipelines, Russia aims at holding a favorable strategic position in the long-term with the KRG, Baghdad and also widely with regional politics. Nonetheless, there are growing questions over the ability of Russian companies to invest in Iraq and actively operate their assets after being hit by the international sanctions following the Ukraine invasion.

China and Iraq have enhanced their bilateral relations throughout the years. Their political and economic relations have improved despite the wars, sanctions and domestic unrest experienced by Iraq. In September 2019, the two countries signed eight wide-ranging MoUs, a framework credit agreement, and announced plans for Iraq to join China's Belt and Road Initiative (BRI) (Calabrese 2019). The two countries have been strengthening their trade ties. Bilateral trade amounted to $30 billion in 2018. By contrast, the volume of bilateral trade between Russia and Iraq amounts to $1.7 billion. The lion's share of China-Iraq's bilateral trade consists of Iraq's crude exports. In 2018, it amounted to $22.5 billion. This figure illustrates the relevant role that energy plays in the bilateral relations. With the PSC in the 1990s to CNPC for Ahdab the involvement of Chinese energy companies began. However, their involvement had been halted between 2003 and 2007, during the domination of US and Western companies after Saddam's fall. In August 2008, CNPC managed to renegotiate a contract with Baghdad to implement the Ahdab oilfield, which was the first major oil deal Iraq made with a foreign company since 2003. This renegotiation marked China's commercial comeback in Iraq. Its growing appetite for energy has led China to enhance its presence in Iraq's energy sector. The energy relations between these two countries have grown and expanded since then. Indeed, in 2009 during the first round of bidding, the Chinese NOC CNPC (partnered with BP) struck a major deal in Iraq, winning a service contract to develop the Rumaila oilfield, the largest oilfield in Iraq (*Idem*).

CNPC further boosted its presence in the country six months later when it won the contract for developing Iraq's Halfaya oilfield, jointly with Total and Petronas (*Idem*). In the same year, China secured a presence in Kurdistan through the acquisition of Addax Petroleum's operation in the region made by Sinopec. Baghdad inevitably expressed its strongest opposition to the acquisition. The central government cancelled Sinopec's participation to bid for oil and gas licenses because of its ties with Erbil. Despite some disagreements on Erbil, Beijing has managed to expand its presence in Iraq through its companies. In 2013, China increased its strategic presence when PetroChina entered the West Qurna-1project, reaching a 32.7% stake in the project. Moreover, Chinese services and engineering companies obtained contracts in important Iraqi oilfields; for example, since April 2011, CPEEC has been the main contractor of the Rumaila oil field, and in 2018 China's Anton Oil was awarded by Basra Oil Company a 3-year contract to ramp up production at the Majnoon field after Shell's departure. Chinese companies are also called in Iraq to foster recovery in several oilfields. For example, in May 2018 Zhenhua Oil finalized an agreement to develop Iraq's huge 8 billion-barrel East Baghdad field. Through the deal, Zhenhua has the chance to become a potentially key player in Iraq's upstream sector. The East Baghdad field has a great potential, which is not properly expressed. Zhenhua was mandated to exploit this great potential, increasing production from the current 10,000 to 40,000 b/d by 2023. However, it is encountering multiple challenges related to investments and the infrastructure required to achieve the target. Despite some delays, Chinese companies have emerged as a major player in the Iraqi oil sector (MEES 2020c). China is importing a growing volume of Iraqi crude and it is committed to securing stable supplies. This is also why the Chinese companies (notably CNPC and CNOOC) are seriously considering buying ExxonMobil's 32.7% stake in the West Qurna 1 license. Currently, the field is producing 465,00 b/d of oil, with a plateau target of 1.6 mb/d by the 2030s.

China is not only a key investor in Iraq, but it is also a key market for Iraq's oil exports. Iraq was China's second largest oil supplier in 2019. Additionally, Chinese dependence on energy imports from Iraq accounted for 8.9% in 2019 (ChinaMed 2020). China is becoming more and more interested in the reconstruction effort of the country. The World Bank estimated Iraqi needs of post-ISIS reconstruction at $88 billion (World Bank 2018). A potential response came from the visit of Iraqi then-Prime Minister Adel Abdul Mahdi to China in September 2019. During that visit, Iraq and China agreed on an "oil-for-reconstruction" and investment program. Under this agreement, Iraq would sell around 3 million barrels of oil a month to China in exchange of projects that Chinese companies would carry out in the country (Al Monitor 2019). The projects should be related to the construction and modernization of critical infrastructure such as roads, railways, schools, hospitals, residential cities, ports and airports (*Idem*). Such an agreement should last 20 years. Nevertheless, the deal has been heavily criticized domestically because the government did not disclose its details. Although political instability has cooled down the implementation of the deal, China has not reduced its engagement with the country. In 2021, Sinopec won a deal to develop Iraq's Mansuriya gas field near the Iranian border, while Beijing struck $10.5 billion in new construction deals in Iraq in the same year, cementing its position in the country.

It is noteworthy to underline a trend in the Iraqi energy sector and the involvement of foreign companies and countries. In the aftermath of the fall of Saddam's regime, US and Western countries had a special advantage. Through the IOCs, these countries supported Iraqi oil production growth. However, the role of IOCs, most of which from Western countries, in Iraq's oil production, has gradually decreased. Indeed, today around half of Iraq's oil production is operated by IOCs, down from around 65% in 2012 (IEA 2019). The (Western) IOCs have tended to be replaced by NOCs, notably from Russia and China. A low security environment, an oversupplied oil market, low oil prices, unfavorable economic and social conditions undermine the involvement of IOCs. For example, in 2021/22 ExxonMobil announced its decision to exit Iraq altogether. The IOC decided to quit the Primam block in KRG and announced its intention to sell its share of the West Qurna-1 field.

By contrast, Russian and Chinese NOCs have shown a great propensity to take risks, aiming at increasing their relevance in the Iraqi energy sector with a long-term strategy view. This approach is strongly supported by their political elite at home. Investments and operations of these NOCs are highly motivated by political goals.

In conclusion, Iraq has been the battleground of the wider competition between the US and Iran. Iran has been able to exploit sectarian divisions in the country to gain influence, although it has been recently criticized and its influence is far from solid. Iraq is a major player in the world's oil system; it holds significant reserves and it has a primary role in OPEC production. Nevertheless, its energy industry is facing substantial challenges, notably lack of security guarantees, geological challenges in oil production, low water availability required for recovery techniques, electricity shortages and limited export infrastructure. These challenges undermine Iraq's oil and gas sector which has gained relevance for Russia and China. These two countries, through their NOCs, have enhanced their role in Iraq, providing investments in critical oilfields. Regional competition might undermine Iraq's potential growth.

- **Syria**

Over the last decade, Syria has been at the center of a brutal clash between local, regional and international actors. In 2011, social unrest turned into a major civil war that lacerated Syria's precarious socioeconomic structure.

Syria's current borders were set by the League of Nations' French Mandate, following the dismantling of the Ottoman Empire after World War I. Its current borders also represent its main geographical challenges: diverse ethnic groups under one domestic power. Although Syria deliberately avoids conducting censuses on religious demographics, some estimates are possible. The total population—19 million as of 2020—is composed of Muslims (87%), Christians (10%) and Druze (3%) (CIA 2020). However, Sunni is the largest ethnic group accounting for 74% of the total population, while Alawite (the ruling group) accounts for 7%. The Alawite minority group combined with Shia and Ismailis (non-Sunni groups) represent around 13% of the total population (Bhalla 2011).

The Alawites are often, but erroneously, categorized as Shia. They have many things in common with Christians and are often shunned by Sunni and Shia alike. The Alawites' homeland is the Latakia province, which provides critical access to the Mediterranean coasts. Historically, the Alawites represented the impoverished lot in the countryside while the urban-dwelling Sunnis dominated the country's businesses and political positions. The French mandate encouraged the rise of the Alawites in Syria's political order. Under the French, for the first time the Alawites—along with other minorities—enjoyed subsidies, legal rights and lower taxes than their Sunni counterparts. France implemented the minority manipulation strategy in the Levant, especially in Lebanon and Syria. This strategy helped France reverse the Ottoman designs of the Syrian security apparatus, allowing the Alawites to secure military, police and intelligence posts to suppress Sunni challenges to French rule (*Idem*). Nevertheless, the Sunni focused on maintaining their position in the top ranks of the security apparatus, leaving the lower ranks to the rural Alawites.

This structure and strategy represented the perfect ingredient for sectarian and demographic clashes. With the end of the French mandate in 1946 the urban Sunni elite targeted the Alawites. However, the birth of the Baath party in 1947 in the country provided the ideal platform and political basis to organize and unify around the country, also for minorities like Alawites. Given its campaign in favor of secularism, along with socialism and Arab nationalism, the Baath party met a strong opposition from the Sunni group. In 1963, the Baath party reached power through a military coup led by President Amin al-Hafiz.

Al-Hafiz conducted several purges against the Sunni in the military, opening positions for hundreds of Alawites to fill top military positions between 1963 and 1965. Alawites steadily gained power. In 1970, the Alawite rivalries and Syria's string of coups and counter-coups were put to rest with a bloodless military coup led by then-air force commander and Defense Minister Gen. Hafez al Assad. The al Assads co-opt in the security apparatus loyal clansmen while taking care to build patronage networks with Druze and Christian minorities that facilitated their rise.

Syria's history can be described as a struggle between the Sunnis on the one hand, and a group of minorities on the other, rather than a more traditional and clearer Sunni-Shiite religious-ideological division. Despite the precarious balance and the fact that the Alawite power in the country is relatively young, the al Assads have managed to consolidate their power quite remarkably in about five decades. After Hafez's death in 2000, the presidency was assumed by his younger son, Bashar al Assad. Initially, it was Hafez's eldest son, Bassel, that was groomed for power. However, Bassel's death in a car accident in 1994 thrust Bashar to the fore. Despite a tough security and political control, Syria has developed a precarious political order.

Syria's political weaknesses clearly emerged with the outbreak of social unrest in 2011. When mass protests broke out in the country in February 2011, they were viewed as the next episode of the Arab Spring. At the beginning, numerous commentators affirmed their belief that Bashar al Assad would have had the same destiny of the other regional long-lasting presidents, such as Tunisian President Zine El Abidine Ben Ali and Egyptian President Hosni Mubarak. The regime decided to stamp out the protests, adopting a strong response. By doing so, it sharpened social discontent, triggering much more vigorous protests. Social discontent soon turned into a widespread domestic conflict, which then quickly became the battleground for regional and international powers. Several external actors began to support different parts of the conflict to either defend or increase their own influence in the region. In the midst of the ongoing civil war, the Assad regime once more reaffirmed its resilience against domestic and international challenges.

During the conflict, Bashar al Assad and his regime have received significant support from Russia and Iran, while rebel groups were supported by the Gulf monarchies, Turkey, the US and European countries such as France. Ironically, France supported those factions against the Alawite regime, which France had helped to rise in post-WWII. The dramatic result of these developments has been a more-than-10-year-long civil and proxy war with no sign of a peaceful and stable resolution in the foreseeable future. Syria's conflict has gone through several phases and external powers have been involved with it in different ways throughout the last decade. In early 2012, the role of external forces increased.

Syria represents the US' reluctance to intervene directly in Middle Eastern conflicts, as shown by President Obama's unwillingness to get involved in the conflict in August 2013 following reports about a chemical attack in the eastern part of Damascus, known as Ghouta, even though the use of chemical weapons was considered a "red line". Nonetheless, the US did take part in the conflict, supporting some Syrian opposition groups. In 2013, Congress authorized nonlethal assistance to vetted Syrian opposition groups, and in 2014 the Obama Administration requested authority and funding from Congress to provide lethal support to rebel groups. Furthermore, Washington has formed an international coalition for conducting airstrikes against ISIS' bases and operations as ISIS[7] began to operate in Syria.

The US' limited involvement in the Syrian crisis allowed three countries to surge as the most relevant actors in the country: Russia, Iran and Turkey. These three countries have forged a temporary triumvirate to manage the conflict, which, however, represents only a marriage of convenience in the short-run. Indeed, these three countries cooperate only on some short-term issues because they do not share long-term strategic goals in Syria or in broader regional affairs.

Russia and Iran both support Bashar al Assad's regime and at the same time they have some opposing interests in the broader region. Iran's strategic goals in Syria are different from Russia's. As Russia seeks stability in the region by preventing the supremacy of any regional power, Iran seeks to expand its influence in the region. By contrast, Turkey supports anti-governmental forces and operates in the northern region of Syria, mostly aiming at preventing the consolidation of Kurdish forces alongside its borders. To do so, Turkey has cooperated partially with Russia, and later with the US. An example is the agreement between Moscow and Ankara reached on March 5th, 2020, that formalized new lines of control in the Idlib province.

Russia's role in the Syrian conflict represents one of the most important developments of Russia's Middle East policy. It has allowed Moscow to enter heavily into Middle Eastern politics, gaining a role that could become a bargaining chip for relations with other Middle Eastern countries (such as the Gulf monarchies). This important step was taken through Moscow's decision to launch a military campaign in favor of Syria's central government since September 2015. Through this military campaign, Russia has surged as the top supporter of the Assad regime. Moreover, this decision marked a turning point on the battlefield. Indeed, Russia's airstrikes were essential for Assad, who had been suffering losses on the ground until then. Since then, Assad has managed to regain most of the national territory.

The decision was motivated by both domestic and foreign considerations. Back then, Moscow was facing a critical internal and international situation. Domestically, Russia's economy was struggling, so the intervention provided a distraction from the country's internal challenges. Additionally, Russia was dealing with an unfavorable international context. At that time, Moscow was dealing with the Crimean crisis and

[7] The Islamic State of Iraq and Syria (ISIS) is a militant Islamist group, which proclaimed itself to be a worldwide caliphate.

its consequences (i.e. the establishment of an international sanction regime against its core industries and companies). Russia seized the opportunity to establish a foothold in the Middle East, increasing its status as a global power. Moreover, it was committed to rescuing a long and good ally in the region. Indeed, Syria was one of the closest partners of Russia in the area. The two countries had established bilateral relations as soon as Syria became independent in 1946. Syria quickly fell in the midst of the Cold War, consolidating its ties with the Soviet sphere. Syria has a strategic relevance for Russia, because it hosts the only Russian naval base in the Mediterranean Sea. Indeed, Syria has hosted the Russian navy in the Tartus base since 1971 (Lovotti and Sučkov 2020). Thus, Russia's intervention was motivated also by the need to protect its Tartus naval base, which could be at risk if a less friendly regime took power in Damascus. More important, Moscow wanted to prevent potential spillover of the chaos in Syria into the entire region, which could have threatened stability and expanded north into the Caucasus. The Caucasus is considered Russia's soft underbelly, and Moscow couldn't afford the risk of chaotic and threatening conflicts spreading to Russia's doorstep, especially groups like the Islamic State (Snyder 2019).

Iran shares with Russia the tactical goal to preserve and maintain in power the Assad regime even though Syria has a different relevance for Iran. Indeed, Syria is an essential element of Iran's regional strategy and policy. Tehran has pursued the consolidation of a "land bridge" from its border to Lebanon via Iraq and Syria. Therefore, Iran has supported Assad since the beginning of the conflict through its multinational Shiite militias, such as Hezbollah. Through the Shiite land bridge, Iran would gain direct access to the Mediterranean Sea and would substantially challenge its historical opponents in the region. For this reason, its presence in the country is continuously challenged by the US and Israel, which has undertaken several airstrikes against Iranian-linked targets in Syria.

Turkey has supported the rebels against Bashar al Assad, and one of its top priorities is to prevent the consolidation of Kurds along its borders. For such reasons, Ankara has launched some operations in northern Syria. The first operation is the so-called Operation Euphrates Shield that Ankara launched from August 2016 to March 2017. The Operation's scope was to support the activities of the Free Syrian Army as it pushed Islamic State fighters back from the Turkish border. In doing so, Turkey intended to achieve a double goal: (i) pushing ISIS fighters away from its borders and (ii) stopping the Kurdish militias—the so-called "People's Protection Units" (YPG)[3]—from crossing the Euphrates westward and consolidating their presence alongside its borders.

A second operation occurred in early 2018. In January 2018 Turkey decided to intervene in the Afrin province with the "Olive Branch" Operation, specifically targeting the Syrian Kurds instead of government forces. The main goal was to prevent the connection between the Kurds located in Syria's northeastern region and their forces in the northwestern areas of the country. That operation, agreed upon by both Russia and the US, marked an important development regarding Kurds and international support. Indeed, the US has worked together with the Kurds in Iraq and Syria and has been the Kurds' main security guarantor since 2014. Moreover, the US and its coalition gains against the Islamic State have come largely through the assistance of Syrian Kurdish partner forces. Nonetheless, the increasing presence of Kurdish forces along the Turkish ones poses a security challenge for Ankara as the Kurds seek to establish a Kurdish nation at the expense of Turkey. Yet, the US does not support this project and over the years, Turkey has gained more relevance than the Kurds for the US vis-à-vis Iran's presence in the Middle East (Friedman 2019b). For these reasons, the Trump Administration decided to approve some Turkish operations in the northern part of Syria at the expense of the Kurds. In October 2019, Turkey launched a third operation, the Turkish "Peace Spring" Operation, consisting of a series of airstrikes in the north-east of the country against the Kurds. Through this operation, Turkey's objective is to create a 30-km "safe zone" in northeastern Syria—called Rojava by the Kurds—and its border. In doing so, Turkey would accomplish simultaneously two objectives: firstly, to decimate the presence of SDF fighters in the area, which are connected with the Turkish Kurdistan Workers Party (PKK); secondly, to create a space in which Turkey could gradually resettle the around 3.5 million Syrian refugees currently living inside its borders (MEES 2019a).

The US has tried to stay out of Syria's conflict, leaving the regional powers clashing and offsetting among themselves. With the advent of Trump, that became clearer. For example, in December 2018 he announced the US withdrawal from Syria, having stated that ISIS was defeated. However, the decision met the strong opposition from the Administration's members and Congress. For example, then-Defense Secretary James Mattis announced his subsequent decision to resign (Humud and Blanchard 2020). A year later, in conjunction with the Turkish "Peace Spring" Operation, President Trump ordered the withdrawal of some forces from the country and the repositioning of others in areas of eastern Syria, freed by the Islamic State. In doing so, Trump has shifted the US presence in eastern Syria, an oil-rich region, and a good position to tackle Iranian presence (Trombetta 2019).

The Syrian conflict is motivated by this geopolitical competition rather than by its oil and gas resources. It is often, but erroneously, believed that oil and gas are the key driver of the conflict. Although it might be an attractive theory, this assumption is wrong. Indeed, Syria's oil and gas resources have hardly any importance for the world's oil market. Syria's oil production before the civil war began in 2011 was at 385,000 b/d, which was less than 0.5% of the world's supply. In 2019 Syria's proven oil reserves were estimated at 2.5 billion barrels (BP 2020). Syria's crude oil production peaked at 610,000 b/d in 1996, but since then it has declined. Syria also holds 241 bcm of natural gas reserves, and in 2010 it produced 8.4 bcm of natural gas, most of which was used for electricity generation. These figures are very small compared to those of some of its neighboring countries.

Syria's oil and gas resources are too small to be considered a prize and the main driver of the struggle over the country's destiny. Given its geographical location, Syria could have a strong potential as an energy transit hub. Several pipeline connections run through Syria to Egypt, Jordan, Lebanon and Iraq. In 2009 Bashar al Assad attempted to maximize Syria's favorable geographical position by announcing an ambitious policy[4] aimed at connecting the Mediterranean Sea, the Black Sea, the Caspian Sea and the Persian Gulf and turning the country into a major energy hub. Some analysts put forth the theory that the proxy war was about two pipelines:

the first (allegedly backed by the US) would run from Qatar through Saudi Arabia, Jordan to Syria; the second (allegedly backed by Russia) would go from Iran to Syria via Iraq. The key market for both pipelines would be Europe. Despite some popularity of such theories, it seems odd to think that the main reason of the conflict was the competition over pipelines, which were challenging projects both economically and politically. Even though the Syrian crisis has not been resolved, Syria is expected to become a transit country under the agreement between Egypt and Lebanon announced in late 2021. The agreement aims to address Lebanese power shortages thanks to Egyptian gas. Syria has also agreed to transfer Jordan's electricity to Lebanon. The Biden Administration has expressed support for this regional deal, describing it as a humanitarian effort funded by the World Bank.

Although Syrian oil has small relevance for the world's oil markets, it has always been of prime relevance to the Assad regime. The oil and gas industry was a crucial contributor to Syria's government revenue and foreign exchange earnings. Prior to the civil war, the sector contributed about 35% of export earnings and 20% of government revenue in 2010 (Syria Report 2020).

Syria's oil reserves are located in two principal oil producing regions. The first fields to be developed were those discovered in the 1950s and 1960s around Sweidiyeh in the northeastern Hasakah Province. The second region is located in the Euphrates Valley, running from Deir ez-Zor down to the Iraqi border. Here, oil production began in 1980 following the discoveries made by Pecten, a US branch of Royal Dutch Shell (Butter 2014). The second region accounted for about one-third of Syria's total output on the eve of the 2011 uprising.

Most of the oil sector is dominated by the state-owned Syrian Petroleum Company (SPC). In March 2011, 55% of the total oil production was from SPC-operated oil fields and the rest from the joint ventures between SPC and foreign companies. The tight governmental control on the resources is highlighted by the fact that SPC takes a 50% stake in development work with foreign partners. Before the war, a relatively diverse foreign investor mix was present in Syria; there were both large companies (notably Total and Sinopec) and small companies such as Gulfsands, which were all working alongside SPC in production-sharing agreements (Diwan and Yergin 2019). Nevertheless, Syria was not particularly attractive for foreign oil companies. The government took 85% of the revenues from operations, compounded by heavy-handed administration by the regime (*Idem*). Additionally, the reserves in Syria are small, dispersed and far from export facilities in the Mediterranean.

Nevertheless, the foreign partners were critical elements of the attempt to counter the declining trend in oil production. Of Syria's pre-war output, about 125,000 b/d came from the Deir ez-Zor fields operated by two 50–50% joint ventures: the Shell-led Al Furat Petroleum Company (100,000 b/d) and the Total-led Deir Ez-Zour Petroleum Company (25,000 b/d) (MEES 2019b).

The conflict, combined with international sanctions, has posed further challenges to Syria's declining oil industry and economy. As the US and EU implemented sanctions, Western companies were forced to leave the country and Syria saw its oil exports collapsing. Indeed, the EU implemented sanctions against Syria's oil, banning import of Syrian oil. Before the sanctions, Syria's crude oil exports went almost entirely to the European market, in particular Germany (32% of the total), Italy (31%), France (11%), and the Netherlands (9%) (EIA 2011). Before the war, Syria was a net exporter, shipping some 150,000 b/d of crude oil, albeit it imported some oil products (around 40,000 b/d).

As the conflict exacerbated, oil production collapsed. Crude oil production dropped from an average of 385,000 b/d in 2010 prior to the conflict to an average of 164,000 b/d in 2012 and to just 28,000 b/d in 2013 and further down to 9,000 b/d in 2014 (Butter 2014; MEES 2020d). The government declared that Syria produced 43,000 b/d of oil in 2020. According to the government, in 2021 the production increased to 86,000 b/d, although most of it was produced in Kurdish-controlled areas (MEES 2022).

The collapse of production forced Syria to increase its crude oil imports in order to keep its refineries running. The country has also increasingly needed imported products to meet domestic demand for gasoline, liquefied petroleum gas, and diesel. In 2021, only 16,000 b/d of the domestic production went to refineries under the control of the Assad regime (MEES 2022). Syria began to rely on its partners for energy imports, especially Iran, in addition to buying volumes from Kurdish-controlled fields in northeastern Syria. By early 2013, the Central Bank of Syria reached an agreement with Iran for $3 billion worth of letters of credit to cover oil supplies, as part of an overall line of credit of up to $7 billion (Butter 2014). Indeed, Iran has emerged to save the regime, supplying Syria's 125,000 b/d (pre-war) capacity Baniyas refinery, and to a lesser extent the 120,000 b/d (pre-war) capacity Homs refinery with enough crude to survive (MEES 2020d). Iranian supplies of oil products were a lifesaver for the battered regime and economy; the lack of oil products led to massive protests across the country in the winter of 2018–2019. The energy trades have been beneficial also for Tehran, tightened by the US sanctions on its oil exports. Indeed, in 2020 Syria has become the top importer of Iranian crude for the first time in history, overtaking China (MEES 2020d).

The establishment of Western sanctions against Syria has inevitably left a vacuum for other non-Western companies. Among these, Iran and Russia are commonly considered to be the potential contributors to Syria's economic survival and reconstruction. Their political and military engagement in the country justifies their contribution, whereas other countries may be more reluctant to invest in the country and in the energy sector due to the current challenging context.

In 2019, two Russian companies were awarded three exploration and production contracts for Block 7, 19 and 23 (MEES 2019c). For example, Russia's Stroytransgaz won a 49-year concession to operate Syria's commercial seaport at Tartous in early 2019 (MEES 2019c). In January 2018, the two countries signed a "road map" agreement for the reconstruction of several assets. Through the agreement, Russia should rehabilitate the damaged infrastructures of the country. Stroytransgaz signed a deal with Baghdad to connect those fields operated respectively by Lukoil and Gazprom in Iraq and in the Kurdistan Region of Iraq, with the Syrian port of Baniyas through the construction of an oil pipeline (Sassi 2019). This reiterates that Moscow has been interested in translating its military gains achieved in the country into broader geopolitical and geo-economic gains, capable of shaping the stability of the region.

China could also emerge as a potential and crucial contributor to economic recovery in Syria—also for the energy sector. Jointly with Russia, China opposes any efforts to sanction Syria in the UN Security Council, contributing to forging positive relations. Additionally, not only China's CNPC produced some oil from Syrian oil fields before the war, but it is also a stakeholder in the two largest Syrian oil companies: SPC and Al Furat Petroleum (*Idem*). Moreover, in early 2015 Ali Suleiman Ghanem (Ministry of Petroleum and Mineral Resources) estimated that the conflict damaged facilities for a value of over $27 billion (*Idem*). China's significant financial resources, which often come without parallel demands for socio-democratic reforms, might play an important part in the reconstruction phase, further enhancing the partnership between Beijing and Damascus.

As aforementioned, the conflict has affected the Syrian oil industry. Militias and regime have been struggling with the control of key oil fields. However, the regime has lost control over most of the oil fields. By mid-2013, the northeastern oil fields were generally held by the Kurds, with the support of the US forces, while in the eastern region the Islamist groups took over. Thanks to the airstrikes undertaken both by the Russian and the US-led coalition, the Islamic State's presence on the ground was strongly reduced. As the ISIS lost ground, the Kurds have gained territorial control in the east of the Euphrates Valley. The conflict attributes great importance to Syria's oil, although it has small relevance and potential in the world's oil markets. For example, in conjunction with the Turkish "Peace Spring" Operation in 2019, the US announced the repositioning of US forces in northeast Syria "to secure the oil". There are several reasons that motivated the US to maintain a presence in defense of Syria's oil fields despite their relative irrelevance. Firstly, in doing so, the US prevents the oil fields from falling into the hands of ISIS, and consequently benefiting their coffers. Secondly, they can keep oilfields out of reach of Assad (and also Russians or Iranians), maintaining a bargaining chip for the opposition in the post-war scenario. Lastly, they preserve these oil fields as an engine of recovery for a possible post-Assad regime (Diwan and Yergin 2019), something reaffirmed by US Vice President Pence. He stated clearly that U.S. troops in Syria will "secure the oil fields so that they don't fall into the hands of either ISIS or Iran or the Syrian regime" (Humud and Blanchard 2020).

If the oil industry is deeply affected by the conflict, the regime looks with some hope to natural gas. The natural gas situation is more comfortable for the government. Most of the major production facilities are in the government's hands in the region between Raqqa, Palmyra and Homs. ISIS has inflicted severe damages to some facilities, but in 2018 gas production has been brought up to about 16 mcm/d (Butter 2019). Given the reduction of oil production, Syria considers natural gas the only solution to its power generation woes. SPC's gas division the Syrian Gas Company (SGC) aims to nearly double raw gas output from its current 16.5 to 20 mcm/d by 2023 (MEES 2019d). Also, Syrian offshore reserves in the Mediterranean Sea are very promising in terms of natural gas reserves. Some non-Western companies, notably Russian and Chinese, might be interested in investing and exploring the area. E&P activities in Syria's offshore will inevitably further complicate the rush in the East Med gas from a geopolitical point of view.

To increase gas production and boost its economy, Syria needs to find a significant amount of money. As aforementioned, some countries are moving in order to gain potential influence in the post-war phase. However, the US have taken important steps to influence this stage. The US Treasury Department began implementing new sanctions on June 17, 2020. These new sanctions are under the so-called "Caesar Act", which represents a new level in the long history of US sanctions against the Assad regime. Indeed, it is the most wide-ranging US sanctions ever applied against Syria. Indeed, unlike previous sanctions, the Caesar Act brings under its jurisdiction third-country companies and people for economic activities that support Syria, raising the costs of economic engagement with the Assad regime. In expanding sanctions to third parties through the Caesar Act, the US seeks to influence Syria's future reconstruction. Obviously, this effort might be undermined if Trump does not earn the second term in office. The Caesar Act potentially poses Lebanon, Russia and China at risk of sanctions. However, it also throws serious obstacles in the path of some Gulf monarchies (and US allies), notably the UAE. Indeed, the UAE have begun a process aimed at normalizing their relations with the Assad regime, abandoning their initial support to Syria's opposition.

In conclusion, Syria's oil and gas (given their limited sized compared to that of its neighboring countries) are neither the main driver of the conflict nor the main reason for the involvement of external countries. Oil and gas reserves are far more important for the well-being of Syria (and its government) rather than for the world's oil market. Therefore, the US decided to protect oil fields in Syria mainly because it aims to prevent their monetization by the Assad regime (and Russians and Iranians) or by the Islamist militias. While Syria's oil was crucial for the government's coffers, it's still unclear whether the hydrocarbon industry will be an important contributor to the economic recovery and reconstruction. To do so, Syria should make significant investments in energy infrastructure and production. Thus, Syria will encounter obstacles in restarting its oil exports and in regaining its past market share (i.e. in Europe).

5.2.2 East Med Gas: A Potential Gas Export Hub

Among the East Med riparian countries, Egypt is the only one with a long hydrocarbon production and export history. Egypt's hydrocarbon history began with oil and then started developing its gas resources in 1990 (Chap. 3 Sect. 3.2.2). Thanks to its hydrocarbon industry, and the Suez Canal, Egypt has managed to become a pivotal player in the region. In doing so, Egypt has shifted from being a large oil producing and exporting country to a gas producing and exporting country. This structural shift was made possible in particular thanks to the latest discoveries in the East Mediterranean offshore, which have allowed Egypt to partially overcome its domestic energy constraints.

Over the last decade, the East Mediterranean has become a hotspot of major geopolitical competition and energy interests following numerous gas offshore discoveries (Table 5.3). Such discoveries have increasingly attracted the interests of several international oil companies (IOCs), such as ExxonMobil, Shell, Italy's Eni, France's Total, the US' Noble Energy and Qatar Petroleum, as well as those of other countries.

All started in 2009 with Noble Energy's announcement of the discovery of Israel's Tamar offshore field. Despite its relatively small gross mean resources (280 bcm), the discovery of the Tamar field pushed forward new exploration activities in the area. Noble Energy also announced the discovery of the Leviathan field (in 2010) in offshore Israel and the Aphrodite field (in 2011) in offshore Cyprus. While it is estimated that the gross mean resources of the Aphrodite field are 140 bcm, the estimates for the Leviathan are more relevant—620 bcm (Hafner and Tagliapietra 2016).

The real game-changer for the region occurred in 2015 when Eni announced the discovery of the giant Zohr gas field in offshore Egypt. With its 850 bcm of estimated gross mean resources, the Egyptian offshore field is the largest ever discovered in the Mediterranean Sea. In 2016, Rosneft bought a 30% participating interest in the Shourouk Concession, offshore Egypt, where the supergiant Zohr gas field is located, marking the entry of Russia's Rosneft in the East Mediterranean gas rush.

These discoveries reinforced the promising prospects of the resources in the area, although the region remains one of the world's most under-explored or unexplored areas. Back in 2010, the US Geological Survey (USGS) estimated the presence of nearly 9800 bcm of undiscovered technically recoverable gas and over 3.4 billion barrels of oil resources in the region in two assessments (Hafner and Tagliapietra 2016).

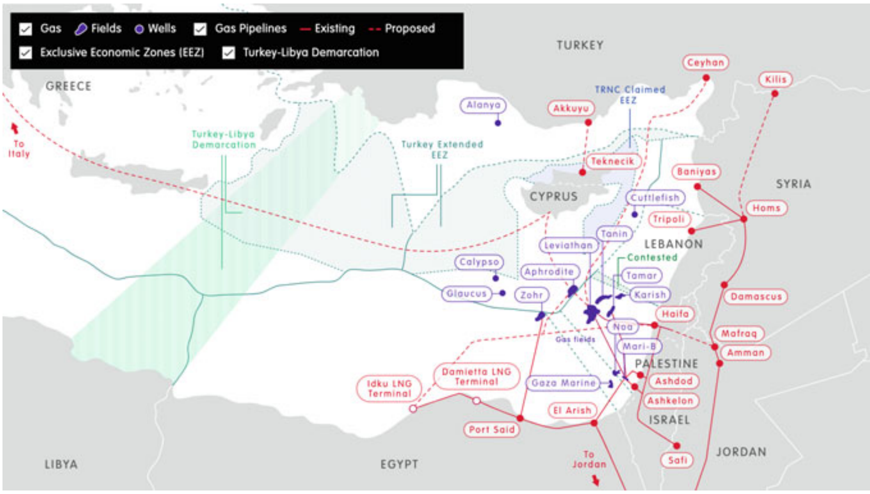
In light of these figures and the recent discoveries, the East Med countries have expressed their ambition to make the area an important natural gas hub. This goal has traditionally faced some relevant infrastructural, economic and geopolitical challenges: viability of the potential export options; natural gas prices required to

Table 5.3 Main discoveries of gas fields in the East Med

Year	Country	Field	Estimated reserves (bcm)	Company
2009	Israel	Tamar	280	Noble Energy[a]
2010	Israel	Leviathan	620	Noble Energy[a]
2011	Cyprus	Aphrodite	140	Noble Energy[a]
2012	Israel	Tanin	31 Tanin 85 Total	Energean
2013	Israel	Karish		
2015	Egypt	Zohr	850	ENI
2018	Cyprus	Calypso	200	ENI
2019	Cyprus	Glaucus-1	142–227	ExxonMobil & QatarPetroleum

[a]since July 2020, owned by Chevron

Source Authors' elaborations on companies and countries data



Map 5.3 Main gas fields, pipelines and EEZ in the Eastern Mediterranean. *Source* https://www.ecfr.eu/specials/eastern_med

make projects economically viable; and lastly, geopolitical competition over the resources and maritime borders. Each of these issues is deeply interlinked to the others (Map 5.3).

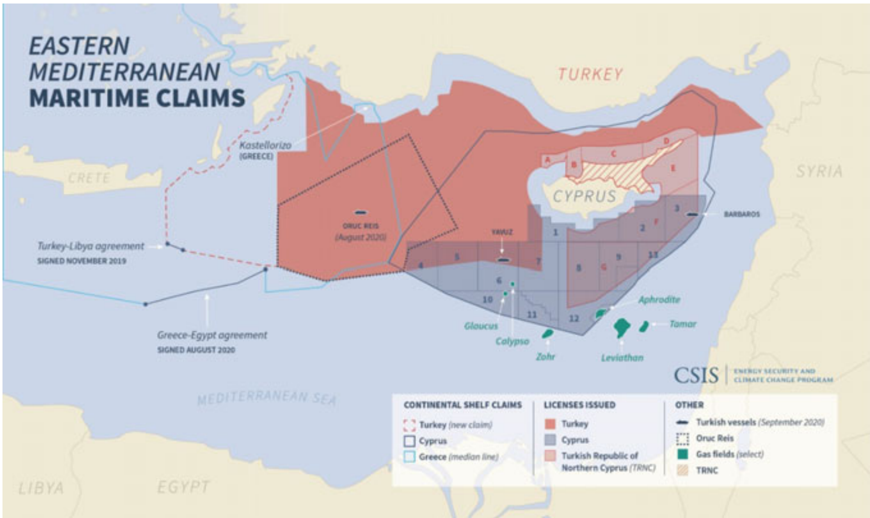
Before addressing major energy and geopolitical issues over East Med gas, it is important to consider that geopolitical competition in the area is not only related to energy resources. A growing (geo)political confrontation has gathered pace around the East Mediterranean. The geopolitical confrontation has also affected partners, such as the extraordinary tensions between France, Greece and Turkey in summer 2020 (despite their common NATO membership) due to the collision of a Greek and Turkish frigate.

(Geo)political tensions and confrontation are driven by several issues. The core issues are maritime claims and the demarcation of exclusive economic zones (EEZs). Each issue is linked to the other and is related to several countries. In time, Turkey has emerged as the most assertive actor in the area regarding these two issues.

The first political dispute is about the status of Cyprus. Since 1974, the island is divided into two entities: the Republic of Cyprus in the southern part of the island and the Turkish Republic of Northern Cyprus (TRNC) in the northern part. While the Republic of Cyprus is recognized by the entire international community, the TRNC is recognized only by Ankara. Turkey believes that the Republic of Cyprus does not have the sovereignty to explore and exploit offshore resources without an agreement with TRNC. Additionally, Turkey demands that energy profits be equally shared between the two Cyprus entities. The two parts have not yet reached an agreement on the issue, and an understanding does not seem reachable in the foreseeable future. Without an agreement, Ankara considers illegal all the activities pursued by the Republic of Cyprus in Cyprus' waters. This standoff has several repercussions on the right to issue and grant licenses offshore Cyprus. While the Republic of Cyprus has issued licenses offshore its southern coast, the TRNC did not only issue licenses only in waters off its coast, but also in the south, overlapping with licenses issued by the Republic of Cyprus. The legal assumption is that both entities have the right over the whole island. Ankara believes that Turkish Cypriots have an equal right to issue licenses around the island. In order to prevent further exploration (or at least, to gain some leverage in the development), Ankara has aggressively asserted its sovereignty over the waters it claims, implementing the so-called "gunboat diplomacy". In response to Cyprus' ambitions, Turkey has undertaken naval activities that prevent further drilling and exploration activities in some Cyprus offshore blocks. In February 2018, Turkey's navy intercepted a drillship of Italy's Eni that was heading to Block 3 of the Cypriot EEZ, forcing Eni to abandon that effort. Since then, Turkey has conducted naval activities and exercises offshore Cyprus. Nevertheless, Cyprus did not halt its ambitions, approving licenses for Eni and Total to explore Block 7 of its EEZ in July 2019. It did not take too long before the Turkish response arrived. Ankara sent its own drilling ship into Block 7, escorted by a pair of Turkish warships. This prompted harsh criticism from the EU in early 2020 although with limited real economic consequences. Indeed, the EU did not want to alienate a key ally in the containment of mass migration from the Middle East towards Europe, especially from war-torn Syria. Meanwhile, both Eni and Total suspended their activities, affirming that they did not seek a war over gas. Turkish activities reflect the relevance of this issue for the Turkish agenda.

The other major political issue in the area is opposing claims over maritime boundaries and the influence of islands in claiming a continental shelf and in creating an EEZ. On this important issue, Turkey is involved against both Republic of Cyprus and Greece. Turkish's legal base is that islands, under international law, do not have any right to a full EZZ automatically. Turkey declares that its long coastline should entitle it to a sizable EEZ in the region, while describing as "unfair" the recognition of a full EZZ to various islands. Such a legal and political position produces several conflicts. The Turkish position collides with Greece over its island of Kastellorizo, which is the easternmost island of Greece, located near the Turkish mainland. Greece claims that all islands are entitled to a full EZZ, something that Turkey considers a potential threat since it would significantly reduce Turkish EEZ while granting Greece a bigger EEZ (Tsafos 2020).

Turkey pursues a similar position regarding Cyprus and the Republic of Cyprus. Despite the fact that Cyprus is an island state and it is bigger than Kastellorizo, Turkey affirms that its coastline should be more important than Cyprus' EEZ. On this legal basis, Turkey has issued licenses for exploration in areas that are claimed by Cyprus. Lastly, a further confrontation emerged following the signature of a Memorandum of Understanding between Ankara and the Tripoli-based Libyan government in November 2019. The agreement expanded the areas that Turkey claimed as part of its continental shelf. The westernmost point in the delimitation agreement is about 50 nautical miles south of the island of Crete. In doing so, Turkey altered the EEZ demarcation in the area, positioning itself between Greece and the Republic of Cyprus EEZs. Additionally, this MoU represents a potential obstacle to



Map 5.4 Eastern Mediterranean Maritime Claims. *Source* CSIS research and analysis; Nikos Tsafos, "Getting East Med Energy Right," CSIS, CSIS Commentary, October 26, 2020, https://www.csis.org/analysis/getting-east-med-energy-right. Reprinted with permission

the development of the EastMed gas pipeline, one of the possible export routes for East Med gas as explained below. With this agreement Turkey aims to play a key role in the regional and energy landscape. The Turkey-Tripoli agreement also highlights the growing connection between the evolution in the Eastern Mediterranean and the Libyan conflict. The two blocs in the Libyan conflict mirror the blocs that are being formed in the East Mediterranean (i.e. Turkey against Egypt). For example, on May 11, 2020, Egypt announced an anti-Turkey alliance, which gathers Greece, Cyprus, the UAE and France, to confront Turkish moves in Libya and the Mediterranean (Al Monitor 2020a, b, c) (Map 5.4).

The primary reason for the soaring geopolitical competition is the fading role of the US as "supervisor" and "external guarantor" in the region. The increasing perception of this political vacuum led to the current geopolitical competition in the region, prompting regional players, with their own interests and strategic goals, to rise and interact directly between each other without an ultimate judge. Furthermore, the entire area has suffered from growing geopolitical competition and ambitions in the aftermath of the 2011 Arab Springs. In this context, Turkey has expanded its presence and role in the area with a more assertive foreign policy, as highlighted in the previous paragraphs. As it seeks to expand its influence in the area, Turkey has been driven by the "Mavi Vatan" (also known as "Blue Homeland"[8]). The slogan refers to the Turkish doctrine in place until 2006 and revived in 2019, i.e. the ambition to turn Turkey into a regional power, which would compel every other power not

[8] The 'Blue Homeland' doctrine's goal is to achieve Turkey's control and consolidation across three seas: Eastern Mediterranean, Aegean and Black seas.

only to take its interests into account, but to view it as an essential partner (Haaretz 2020).

The Eastern Mediterranean region has been characterized by conflictual positions and political tensions well before the discovery of offshore natural gas. The existing tensions and competition are only to be considered as a byproduct of energy discoveries. The ongoing tensions did not occur near natural gas discoveries and none of the natural gas fields discovered so far are a matter of dispute, being entirely within the EEZ of Israel, Cyprus and Egypt (with the exception of Aphrodite which is in Cyprus but extends into Israel's EEZ). Natural gas discoveries have essentially reinforced pre-existing tensions or rapprochements. Energy is often seen as a factor for political competition, tension and conflict. Yet, energy can also be a powerful factor for political and economic cooperation. These natural gas resources have been able to shape and form political ties to some extent among some countries (i.e. Egypt, Israel, Greece, Jordan and Cyprus). The cases of gas trade between Egypt and Israel and Israel and Jordan testify the potential for cooperation.

Initially, some regional countries and international commentators hoped that the natural gas discoveries would enhance cooperation among regional countries, in an area traditionally characterized by tensions and animosity. This position was based on the history of the European integration process, launched and built upon coal and steel. This position has special relevance for Israel, which is committed to using these resources in order to improve its relations with its Arab neighboring states. To overcome some of the major political challenges, closer energy cooperation was encouraged on the basis of economic considerations. For example, a joint effort to develop regional natural gas would be particularly convenient for Cyprus and Israel, given the size of their current gas fields. A positive development occurred on January 14th, 2019, when Egypt, Israel, Jordan, the Palestinian National Authority, Cyprus, Greece and Italy launched the East Mediterranean Gas Forum (EMGF), the first regional organization, with the aim to improve energy policy coordination in the region. However, Turkey declared the EMGF and its activities to be unlawful since the agreements reached between Egypt, Israel, Jordan, the Palestinian National Authority, Cyprus, Greece and Italy do not respect Turkish territorial claims.

East Mediterranean Countries have started to consider export options in order to fully develop their offshore resources due to the limitations of their domestic markets. However, export plans ought to deal with the extensive legal and political disputes that have deeply influenced the feasibility of export options. All East Mediterranean countries are willing to find energy markets for their resources in order to exploit and monetize them. A wide range of export options both as pipelines and LNG have been discussed:

1. Israel-Jordan and Israel-Gaza pipelines;
2. Israel-Cyprus-Greece pipeline (known as 'EastMed pipeline');
3. Israel-Turkey pipeline;
4. Israel-Cyprus-Greece electricity interconnector;
5. LNG plant at Vasilikos;
6. (F)LNG plants in Israel;

7. Connection between Israel-Cyprus fields to existing Egypt's LNG plants;
8. Israel-Egypt pipeline (to Egypt's LNG plants)

Each of the above export options needs to overcome economic and geopolitical issues, which are particularly challenging for some of them. For example, unless new gas is found offshore Cyprus waters, the construction of an LNG plant at Vasilikos, Cyprus, is unrealistic due to the limited size of the available resources in Aphrodite and high costs in building such a scheme. In fact, the project's cost was estimated at about $10 billion (Tagliapietra 2017).

Other options are limited to the local market, i.e. Israeli attempts to deliver its gas locally through the Israel-Jordan and Israel-Gaza pipelines. In September 2016, Jordan became the first official buyer, signing a 15-year $10 billion agreement that commits Israel to deliver a total of 45 bcm of gas to Jordan commencing in 2020. The US has pushed through the deal for Jordan, which has a peace treaty with Israel, despite opposition in Jordan (Reuters 2020). After securing the supply to its domestic market, Israel started to look for external markets large enough to cover the cost of full-scale production from Leviathan. However, the Jordan and Palestinian markets are too small, and Israel is evaluating possible options in larger markets, notably Turkey, Egypt or Europe.

Nevertheless, a difficult equilibrium on the development of both resources and export options has to be found among the region's three main poles, namely Israel, Egypt and Turkey. As already mentioned, the resources have produced some degree of cooperation among these countries in the name of economic interests, as illustrated by the EMGF. On the other side, the forum does not include some important countries—i.e. Turkey, Syria and Lebanon—alienating them and inflaming the geopolitical competition. Israel, Egypt and Turkey yearn to take the lead in East Med energy affairs; each of them aims to become a regional gas hub. The three main export options (the Israel-Turkey pipeline, the EastMed pipeline and Egypt's LNG plants) embody economic and geopolitical challenges.

The Israel-Turkey pipeline encounters more geopolitical obstacles than economic ones. The project consists of a 470-km gas pipeline connecting Israel and Turkey, with a capacity of 16 bcm per year. In 2013, Turkey's Turcas Holding submitted a $2.5 billion offer to Israel for the construction of the pipeline. Initially this project would have also served the Turkish ambition to become an important energy hub between the East and West after the South Gas Corridor[9] and TurkStream.[10] Nonetheless, the project suffered several setbacks due to the increasingly complicated relations

[9] The Southern Gas Corridor project transports natural gas from Azerbaijan to Europe and includes three connecting pipelines with an annual capacity of 16 bcm (roughly half the proposed capacity of TurkStream): the South Caucasus Pipeline (SCP) in Azerbaijan and Georgia; the TransAnatolian Pipeline (TANAP) through Turkey; and the Trans Adriatic Pipeline (TAP), currently under construction from Greece to Italy, via Albania. First delivery through TANAP to Turkey was in June 2018, and TAP began to ship gas end of 2020. Turkey has contracted for 6 bcm from TANAP, while the rest is delivered to Greece, Albania and Italy.

[10] The TurkStream project consists of two parallel pipelines with a total capacity of 31.5 bcm per year (15.75 bcm each). TurkStream 1 provides gas to the Turkish market, whereas TurkStream 2 delivers gas only to European markets.

between Israel and Turkey. In 2016, the two countries reached a reconciliation agreement, ending their six-year diplomatic freeze due to the 'Gaza flotilla raid' of 31 May 2010. Following the reconciliation, the project seemed to gain new momentum. However, the US' decision to move its embassy in Israel from Tel Aviv to Jerusalem in May 2018, triggered a diplomatic crisis, and Turkey and Israel haven't had ambassadors in their respective capitals since that date. However, the two countries share some mutual interests in the Syrian conflict and in the fight against Iran's regional policy. These mutual interests could make the two countries converge their actions also in the field of energy, albeit several obstacles. A much greater obstacle to the realization of the pipeline lies in the unresolved hostility between Cyprus and Turkey since a potential Israel-Turkey pipeline would need to pass through the Republic of Cyprus' offshore territory. Thus, an agreement between Nicosia and Ankara on the last-lasting Cyprus issue is the fundamental prerequisite for the positive development of the Israel-Turkey gas pipeline project. Given the presented features, it is reasonable to believe that there is little hope that Turkey will receive Israeli gas through a direct pipeline or, indeed, that Turkey would act as a conduit of Israeli gas to Europe in the foreseeable future. Therefore, Israel is attempting to create alternative export routes for its gas.

Other two options gained great interest: the EastMed pipeline and the utilization of Egypt's existing LNG plants. These two alternatives provide different solutions for the ongoing transformation of the gas markets. While a pipeline ensures greater energy security to the buyers (yet, raising questions over the future gas demand in the importing countries), LNG would provide more flexibility to the exporting countries in a more globalized gas market. The EastMed pipeline consists of a 10 bcm pipeline delivering the resources located in the Levantine Basin to Europe linking Israel, Cyprus, Greece and Italy. The project consists of a 1900 km long pipeline and the final costs are estimated to be between $6–7 billion with Greece as final destination or $8–10 billion with the extension to Italy. The project is being designed by IGI Poseidon, a 50–50% joint venture between Greek DEPA and Italian/French Edison. The pipeline is projected to be built in conjunction with the Interconnector Turkey-Greece-Italy (ITGI) and the Interconnector Greece-Bulgaria (IGB) pipelines, to supply Italy and other South East European countries.

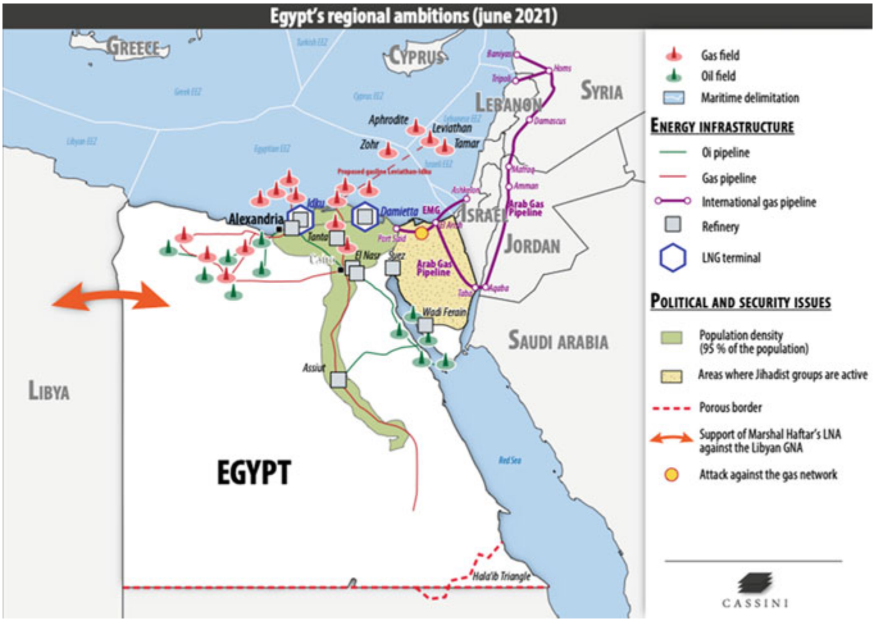
Some regional countries have started working together on this option. In January 2020, Israel, Cyprus and Greece signed an inter-governmental agreement for the EastMed gas pipeline in Athens. The inter-governmental agreement sets the legal framework for the possible construction and operation of the EastMed gas pipeline, if implemented, but it does not call for its construction. For this purpose, exporting countries need to secure buyers of their gas in Europe and companies to invest in the pipeline. Within this framework, market and price conditions might be two challenging factors—besides geopolitical issues.

Initially, the project gained the support of the EU and the US, which appreciate any attempt to reduce European dependence on Russian gas imports. Indeed, the project was welcomed as a key infrastructure for the improvement of Europe's energy security of supply. This is why the EastMed pipeline was enlisted in the EU Project of Common Interest (PCI) list since 2013 and reconfirmed in the fifth EU PCI list at the end of 2021. Yet, in early 2022 the US expressed reservations on the project due to economic viability and environmental issues.

Indeed, given the limited production base and glut market until 2021, countries have been struggling to put forward such a project. Moreover, questions on future European gas demand have arisen as the European institutions have set numerous and ambitious climate targets, which are expected to reduce the consumption of fossil fuels—especially after 2030. This is a particularly relevant issue for the European countries, given the rigidity of a point-to-point infrastructure.

In this respect, another approach to exploit and monetize the region's resources is through Egypt's LNG facilities (Map 5.5). This option would involve the transportation of Israeli and Cypriot gas to Egypt for re-export from the Idku and Damietta LNG facilities on Egypt's northern shore. Egypt's total LNG export capacity amounts to 19 bcm per year (Idku with a total capacity of 11.48 bcm/y and Damietta with a capacity of 7.56 bcm/y) almost twice the capacity of the EastMed pipeline. This export option would be the cheapest way to export East Med gas, given the current under-utilization of these two LNG facilities. This solution would put Egypt in a central position in the East Med gas developments besides fulfilling Egypt's ambitions to become a major regional player and energy hub.

The use of the existing LNG infrastructure, which can be expanded at low cost if necessary, could allow the region to become a gas supplier for Europe and beyond. Indeed, Egypt's LNG plants could provide the required flexibility in a changing regional and global scenario. This solution, which would be the least expensive option



Map 5.5 Egypt's regional ambitions. *Source* CASSINI

to export, has been praised by those who raise the uncertainty about Europe's future gas demand. The proximity of three of the main fields in the area (Zohr located only 90 km away from Aphrodite, which in turn is only 7 km off from Leviathan) could allow the coordinated development of the fields and thus the creation of the economies of scale needed to put in place a competitive regional gas export infrastructure (Hafner and Tagliapietra 2016).

The creation of EMGF provides a partial response to this issue. Meanwhile, the establishment of EMGF's headquarters in Cairo is evidence of Egypt's weight in the political debate on the region's energy affairs. Due to its geographical position at the crossroads of North Africa, the Persian Gulf, Middle East and Europe, Egypt craves to become the region's gas hub and leader. The country has launched several drilling activities in its offshore areas and attracted numerous IOCs, including Chevron, ExxonMobil, ENI, Shell and also QatarEnergies.

Moreover, some countries have already started some cooperation and energy exchange. Egypt already has an agreement with Cyprus to construct a pipeline. On September 19, 2018, Egypt and Cyprus signed an agreement to construct a $1 billion undersea pipeline linking Cyprus' Aphrodite gas field to Egypt's gas liquefaction stations (Al Monitor 2020b). On the other hand, Israel and Egypt agreed on natural gas trade. In February 2018, Noble signed a 10-year supply deal with Dolphinus for the supply of a total of 64 bcm of gas from Leviathan and Tamar to Egypt. In October of the same year, the two parts extended the previous contract to 15 years, increasing the total volumes contracted to 85 bcm (S&P Global 2020b). In January 2020, Israeli gas began to flow to Egypt through the El Arish-Ashkelon pipeline. The gas flow marks one of the highest points of economic cooperation between Israel and Egypt since the peace treaty signed by the two countries in 1979. The El Arish-Ashkelon pipeline came into operation in 2008 to flow Egyptian gas to Israel and it has a design capacity of 7 bcm per year. However, following the Arab Spring in 2012 Egypt unilaterally halted its gas supplies to Israel. In order to receive Israeli gas, the pipeline has been engineered to allow reverse flows in the Israel-Egypt direction (*Idem*).

At the current volumes, the use of existing Egypt's LNG facilities and the construction of the EastMed pipeline are in contrast, stressing the difficulties to find the right coordination and cooperation among countries with similar ambitions. For example, the EastMed pipeline would position Israel as a critical element of the European energy security structure. According to Israeli Energy Minister Yuval Steinitz, direct gas trade with the EU would deprive Arab states of the opportunity to put Israel under political pressure (Wolfrum 2019). However, the project will produce an exclusive access to the EU gas market for Israel, Cyprus and Greece. This would marginalize the Arab countries of the EMGF, paralyzing and weakening the organization as well as undermining Egypt's aspirations. The economic and political potential of a common gas market in the Eastern Mediterranean, as envisaged by the EMGF, would remain untapped (*Idem*).

Yet, the two options could potentially coexist if new production commenced. On the other side, further gas could boost the momentum for other export options at a time in which countries are still struggling to be combined into a single option that can be attractive for investors and buyers. On this issue, Tsafos (2019) affirmed that more gas is probably necessary to underpin the EastMed gas pipeline, but more gas could also tip the scales toward other development options or further complicate the task of aggregating disparate supplies.

Even though the East Med gas has been seen as a potential option to increase European energy security and reduce Russia's dominant role, until 2021/22 its actual role has been quite modest. The EastMed gas pipeline was initially supported by the EU and the US because of its potential contribution to European gas security and diversification strategy, but the potential political benefits were not fully met by the commercial ones. Low oil prices and an oversupplied market have fundamentally undermined the development of the EastMed pipeline, which had to face fierce competition in the European gas market, which was dominated by other traditional suppliers, notably Russia, Norway, Algeria, Libya, Qatar, and the US. Moreover, European climate policies, namely the European Green Deal, poses questions over European gas demand in the long run. For these reasons, importing from Egyptian LNG terminals would have represented the best and least-cost option suited to Europe's climate ambition because it provides adequate flexibility.

The entire paradigm and picture have been dramatically and drastically changed with Russia's war in Ukraine. Since 2021/22, Europe has expressed its strongest political commitment to weaning itself off Russia's gas as response to the growing energy prices and political crisis. In light of this shift, the pipeline project argument is nevertheless gaining momentum, despite some remaining challenges. The EastMed gas pipeline could be instrumental for European energy security as it seeks to find alternative suppliers and supplies. The project is also expected to be hydrogen ready in order to be in line with EU climate targets, which was one of the reasons why the EU maintained the project in its PCI list. Additionally, importing via pipeline would prevent Europe from competing for supplies with other consuming countries (i.e. Asia) as in the case of LNG. In conclusion, the East Med region could benefit from the tectonic shifts caused by Russia's war in Ukraine, but it will need to satisfy both political and commercial requirements before becoming a major gas export hub.

5.3 Maghreb

Algeria and Libya are two of the most relevant oil and gas producing countries in the region. Nevertheless, they are dealing with major political challenges, due to their critical domestic situation. Since 2019 Algeria has been experiencing important political and economic issues, triggered by the massive popular protests that led to the fall of its long-lasting president, Abdelaziz Bouteflika. Libya has fallen into a civil war following the fall of its former leader, Muammar Qaddafi, in 2011. External players enhanced the division in the country leading to a *proxy war*, similar to the Syrian conflict and whose end is unlikely to be foreseen.

5.3.1 Algeria

Algeria's abundant hydrocarbon reserves make the country an important player in the global energy system. Historically, Algeria had strong ties with Europe and especially with France, its former colonial power. Algeria gained its independence from France in 1962 after eight years of war. The newly independent country built its economy on the hydrocarbon industry. Oil production began in 1958, but thanks to major investments in the 1960s and 1970s the domestic output grew quickly. In 1969, Algeria also became a member of OPEC. In a few years, Algeria became a major energy supplier to Europe and beyond, reaching also the US. In 1964 Algeria also became the first exporter of LNG in the world.

Algeria's entire economy is rooted in oil and gas resources, and its economy is based on the revenues from its oil and gas exports. Indeed, hydrocarbons revenues make up 93% of its export earnings. At times of high oil prices, oil and gas revenues accounted for nearly 80% of overall budget revenues (they still accounted for around 40% in 2019).

Regarding oil exports, traditionally Algeria exports most of its oil to Europe and Eurasia, with a significant share to the West Hemisphere (Fig. 5.3). However, since the 2010s Algeria's export volumes and market share have decreased. For example, Algeria's oil exports suffered a major loss in the US market, one of its largest markets in the Western Hemisphere. This loss was due to the US energy revolution triggered by fracking. The first consequence of the shale oil boom was the collapse of Algeria's oil exports to the American market, as shown in Fig. 5.4.

The shale oil boom increased the competition for Algeria's oil exports, while reducing the US' need of Algerian crude imports. This is because Algeria exports

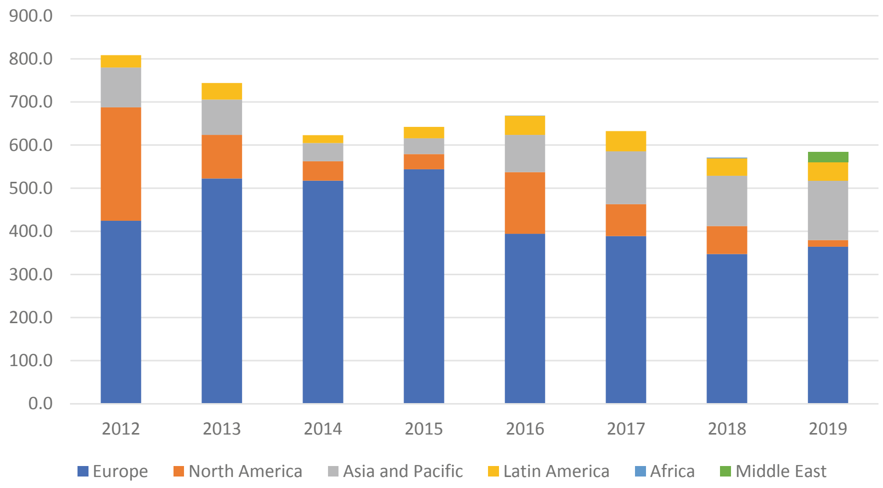


Fig. 5.3 Algeria's crude oil exports by destination region, 2012–2019 (thousand barrels per day). *Source* Authors' elaboration on OPEC ASB 2020 data

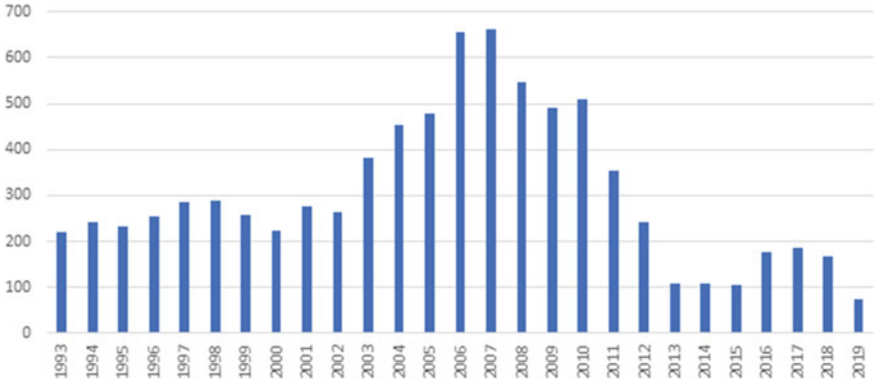
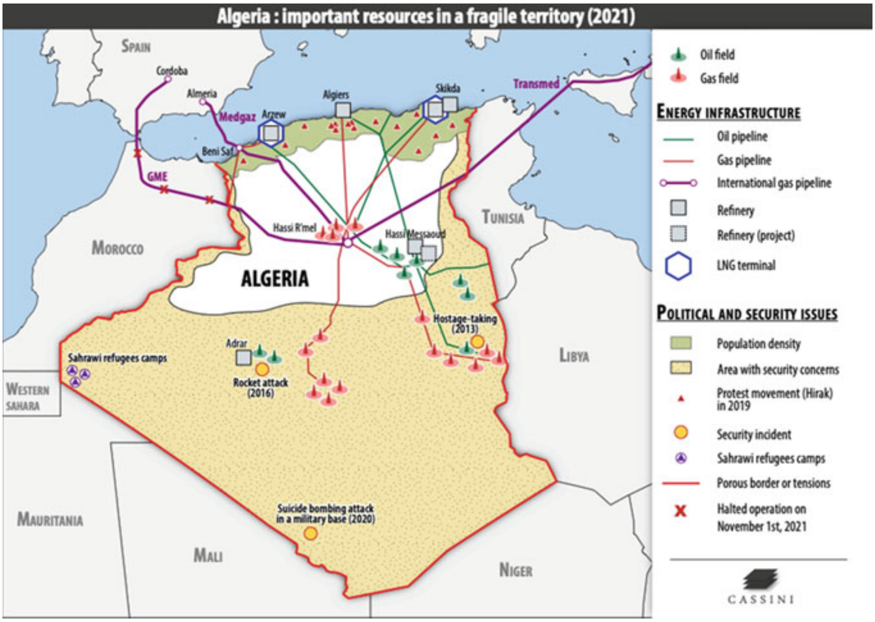


Fig. 5.4 US imports from Algeria of crude oil and petroleum products (thousand barrels per day). *Source* Authors' elaboration on EIA data

the light sweet naphtha-rich Saharan Blend, a grade whose quality is similar to the US shale output. Therefore, Algerian oil was one of the first types of crudes that the US stopped importing. Moreover, given their similar quality, the Algerian and US crude oil compete for the same markets.

However, Algeria must face competition not only in the global oil markets, but also in the natural gas markets. This is particularly challenging because natural gas is a key pillar of Algeria's economy. Indeed, it is estimated that the natural gas of Algeria's total hydrocarbon export revenue ($40 billion in 2018) could be between 35 and 40% (Ouki 2019). Such a gas export revenue is critical to both the Algerian economy and the energy sector, which needs significant investments in order to offset the declining trend of production and export volumes. Algeria is one of the key suppliers to European gas markets especially via pipeline (Map 5.6). However, the expansion of the global natural gas supply and the strong growth of LNG has led to a reduction of prices, which pressures Algeria's gas exports. The combination of these factors started to give economic leverage to gas buyers worldwide, which are reluctant to commit to long-term and oil-indexed contracts. Algeria is one of the most determined defenders of long-term and oil-indexed contracts in natural gas trade. Moreover, Algeria's gas exports are challenged also from the inside. A soaring domestic gas consumption and the depletion of its aging fields leads to reduced availability of export volumes, posing a threat to the country's main source of revenue.

Algeria exports most of its gas to Europe and via pipeline to Italy (via the TransMed pipeline) and Spain (via the MedGaz pipeline and Maghreb-Europe pipeline). While the MedGaz pipeline provides a direct link to Spain, the other two pipelines cross through Morocco (Maghreb-Europe pipeline) and Tunisia (TransMed). These three pipelines have a total capacity of 53.5 bcm (Table 3.9 in Sect. 3.3.1). Italy and Spain combined receive around 60% of total Algerian gas exports (Fig. 3.51 in Sect. 3.3.1).



Map 5.6 Algeria resources in a fragile territory. *Source* CASSINI

Over the past two decades, Algerian gas exports have dropped, mirroring the declining use of Algerian export gas pipelines, which reached their lowest point in 2020 due to the collapse of gas demand in these countries following the outbreak of COVID-19 and soaring gas demand in Algeria (Fig. 5.5).

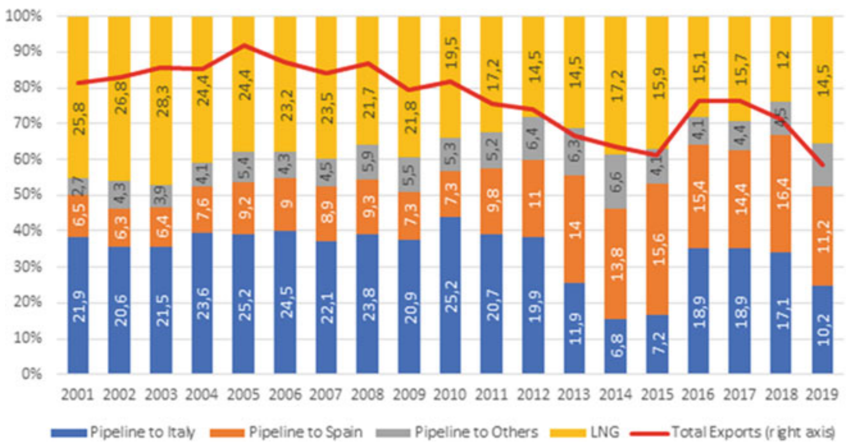


Fig. 5.5 Algeria's natural gas exports, 2001–2019, bcm. *Source* Authors' elaboration on MEES. *Note* Others: Tunisia, Morocco and Portugal (via Spain)

With the rise of gas prices in Europe in 2021/22, Algeria's gas has become increasingly relevant for some importing countries, particularly for Italy as it seeks to reduce its overdependence on Russian gas. Algeria's gas prices—often oil-indexed—have enhanced the competitiveness of Algerian gas vis-à-vis spot prices.

Italy is Algeria's overall largest trade partner and export market. The Algerian-Italian relationship dates back to the years of the independence war, and since then energy has had a major role. Indeed, Enrico Mattei—the first chairman of the Italy's oil company Eni—supported the independence cause both in Algeria and in general in order to increase Eni's presence abroad at a time when global hydrocarbon markets where dominated by the 'Seven Sisters'. To do so, Mattei offered better economic conditions to the hydrocarbon producing countries in the South Mediterranean. Throughout the years, Rome has promoted energy connectivity with Algeria through Tunisia, which led to the construction of the 2475 km Transmed pipeline in 1983. Since then, Algeria has become a key pillar of Italy's energy security. The strong energy relation between the two countries is highlighted by the fact that Eni is the first IOC by reserves in the country thanks to its leading position in the North Berkine basin (in the eastern part of the country) since 1981, where all its current production assets are located. Algeria has earned a renewed strategic role amidst the energy and geopolitical crisis in 2021/22 due to Russia's war in Ukraine given the existing (underutilized) interconnection (Fig. 5.6).

The other major gas market for Algeria is Spain. The two countries have a long history of energy relations, which benefit from the close geographical vicinity of the two countries. Algeria can easily and quickly supply gas to Spain through two gaslines and LNG. The first pipeline, the Maghreb-Europe Gas (GME) pipeline, brings gas to Spain via Morocco with a total capacity of 11.5 bcm/y, while the

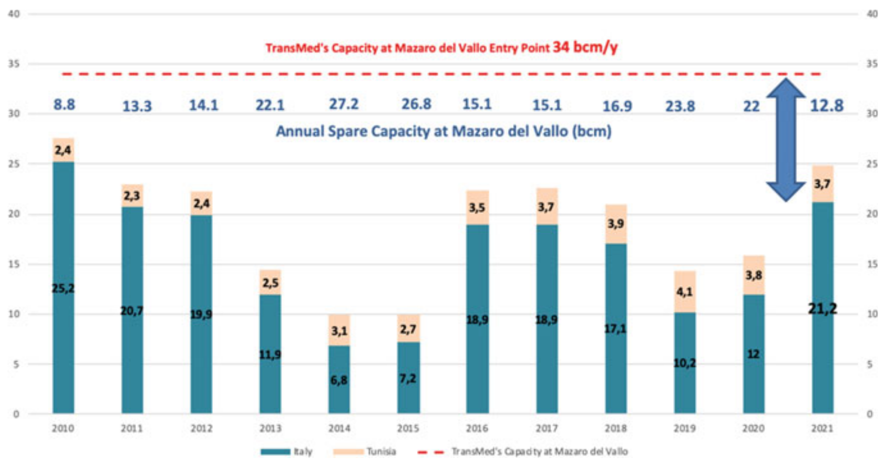


Fig. 5.6 Algeria's natural gas export via TransMed pipeline, 2010–2021, bcm. *Source* Authors' elaboration

second, the MedGaz pipeline, links the two countries with a current capacity of 8 bcm/y.

The 11.5 bcm/y GME pipeline has long been the key conduit for Algeria-to-Spain shipments. However, poor political relations between Algeria and Morocco have undermined this route. In November 2021, gas flows through the GME pipeline were halted as the multiannual contract between Algeria and Morocco expired. The two countries did not renew the contract due to political disagreements on the status of the Western Sahara. This decision was the peak of ever-growing tensions between the two countries in the previous months and years. In the meantime, Algeria has started working on expanding the MedGaz pipeline to 10 bcm/y in order to balance the potential loss of GME's capacity. Algeria is also building a 4.5 bcm/y pipeline linking Kasdir (just before the GME pipeline crosses the Morocco border) to the Medgaz jump-off point of Beni Saf in order to reduce its dependence on the GME pipeline and Morocco. Moreover, Sonatrach and Naturgy bought Mubadala's 42.09% stake in MedGaz, reaching 51% and 49%, respectively. However, this long history of energy relations was not immune from episodes of confrontation and litigation. A key issue has been the pricing formula. Renegotiation talks have been characterized by lengthy discussions and sometimes have led to arbitration procedures. The Algerian-Spanish relationship has been increasingly under pressure due to the shift of Spain's position on Morocco and Algeria's territorial dispute in the Western Sahara. Moreover, in 2022 Spain has considered the possibility to redirect some Algerian gas to Morocco as a way to support its partner's needs. This possibility has prompted a harsh warning from Algerian officials.

Spain has substantially reduced the share of Algerian gas in its supply mix over the last few years. In 2019, Algeria's gas share accounted for 33% of Spain's gas imports, down from 60% in 2015. Algeria's gas was displaced mostly by two LNG sources (i.e. the US and Russia).

Although the European gas markets are witnessing a greater diversification of supply at lower prices, in the period 2018–2019 Sonatrach managed to renew several gas contracts with key markets which were set to expire in 2019 and 2020 (Table 5.4). In June 2018, Sonatrach agreed with Spanish Naturgy to extend gas trade until 2030 through an 8 bcm/y deal. In May and June 2019 Sonatrach signed two separate agreements with ENI and Enel renewing its gas supply.

Extending these contracts was crucial for Algeria's economic and political situation; however, the new contracts are shorter, more flexible and generally speaking for lower volumes (stressing the great competition in the global gas markets).

Despite the long-lasting energy relations and the relative relevance of Algeria's gas supply for South Europe, Algerian gas is losing ground in the European gas markets. In order to offset some of this decline, Algeria could use its LNG potential. Algeria has four liquefaction plants with a total capacity of 25.3 Mt per annum. Indeed, Algeria could utilize LNG as an option to reach both long-haul buyers and spot buyers when prices and demand in its core Mediterranean region are depressed. In 2019, Algeria managed to boost its LNG exports, but it is still far too small compared to the collapse of its pipeline exports to key markets (MEES 2020e). However, the non-utilization rate of Algeria's LNG export facilities is particularly significant (higher than 45%

Table 5.4 Algeria's new gas supply contracts

Country	Company	Signed	Years from-to	Bcm/y	Export mode
Spain	Naturgy	06/2018	2030	9	Pipeline
Turkey	BOTAS	09/2018	10/2019–10/2024	4.5	LNG
Italy	ENI	05/2019	2019–2027 (+2)	9	Pipeline
Italy	Enel	06/2019	2019–2027 (+2)	3	Pipeline
Portugal	Galp Energia	06/2019	2029	2.5	Pipeline
Italy	Edison	11/2019	2019–2027 (+2)	1	Pipeline
France	Engie	11/2019	n/a	n/a	Pipeline & LNG
Italy	ENI	04/2022		9	Pipeline

Source Authors' elaboration on MEES and companies' press releases

in 2019). This is caused by the declining output from its largest gas field, Hassi R'Mel, and the delayed new field development in the southwest region. However, the availability of liquefaction capacity will not be enough to counterbalance the collapse of gas exports and revenues, unless Algeria tackles its limited gas supply and uncompetitive gas export pricing and contractual terms.

Indeed, international investors and international oil companies have encountered several obstacles, which undermine the positive development of Algeria's oil and gas sector. The inglorious 51/49 rule and other legal and economic conditions discourage IOCs from investing in Algeria's abundant hydrocarbon reserves. The new government has made some adjustments with the new hydrocarbon law; however, the "51/49" rule remains. In 2020, Sonatrach managed a series of MoUs with some IOCs (i.e. Chevron, Zarubzhneft, TPAO, ExxonMobil, Lukoil, OMV and CEPSA) on possible opportunities in the exploration, development and exploitation of oil and gas in Algeria. Despite the lack of details, the deals highlight the potential attractiveness of Algeria's upstream sector after the introduction of the new hydrocarbon law. Nevertheless, these deals will need to overcome a difficult energy and economic landscape, characterized by lower energy prices, lower demand, lower energy investments and the boost of decarbonization policies. The challenging environment for energy investments and expansion of upstream activities in Algeria is also fueled by political instability and political opposition to international deals. A clear example of the latter is the political decision to halt major international acquisitions in Algeria's upstream sector, especially against Total's purchase of Occidental's ex-Anadarko assets or Energean's purchase of Edison's E&P assets. Political obstructionism might represent an obstacle for BP's divestment strategy. Indeed, BP expressed its intention to sell its 45.9% stake in the key In Amenas gas plant located in the Sahara Desert. Sonatrach is unlikely to give the green light, stressing once again the immobilism of Algiers. Furthermore, the ongoing domestic social unrest undermines the stability of the country and its energy sector. Sonatrach has been caught in the fire of this power struggle, jeopardizing its ability to implement a serious strategy for the recovery of its oil and gas activities and assets.

Besides its energy relations, Algeria holds an important strategic position in North Africa. It is located at the crossroads between the Mediterranean Sea and Sub-Saharan Africa—a strategic position especially for European countries. Moreover, it is encircled by troubled countries and regions, such as Libya and Sahel. While increasing its stakes in North Africa (especially in Libya), Turkey is keen to strengthen its relations with Algeria. Indeed, Algeria is considered to be one of Turkey's most important gateways to the Maghreb and Africa (Tanchum 2020). Thanks to its $3.5 billion of investments, Turkey is one of Algeria's top foreign investors, highlighting Turkey's strong bid for a strategic presence in the country. Additionally, Erdogan announced his goal of increasing Turkey-Algeria bilateral trade to $5 billion, calling for a free trade agreement. Currently, Algeria is exporting LNG to Turkey (a fast-growing LNG market) with a 4-Mtpa deal due to expire in 2024.

China and Russia have had long relationships with Algeria as well. The relationship with China is also motivated by ideological reasons. The Chinese communist party endorsed the *Front de Liberation National* during the independence war from French colonial rule, and China was the first non-Arab country to recognize the newly independent country. However, this cultural and ideological root did not translate into a major economic relationship until the beginning of the 2000s. As security and stability was restored in the country following the "black decade[11]", Algeria was committed to revitalizing and diversifying its economy through massive public investment programs. Since the 2000s China has built its economic relations with Algeria on two pillars: major infrastructure projects and trade. China played an essential role in Algeria's construction boom and participated in other major infrastructure projects (e.g. the East–West Highway and the Great Mosque of Algiers). Slowly but steadily, China has become a major trading partner for Algeria. It has overtaken France as Algeria's largest source of imports (Calabrese 2017). Although the two countries have increased their economic relations, it is true that Algeria's exports represent a small share of the total trade balance. Moreover, Algeria's energy sector has small relevance for China, compared to other producing countries in Africa and in the world. Indeed, Western firms still dominate the energy landscape in Algeria, while China has an interest in Algeria's Zarzaitine field in the eastern Sahara desert, operated jointly by Sinopec and Sonatrach.

By contrast, Russia-Algeria trade relations are dominated by weaponry trade. Indeed, between 2014 and 2018, Russia supplied the Algerian military with 66% of its weapons and Algeria was Moscow's largest African client. In 2017, Russian companies, Gazprom and Transneft, have cooperated with Sonatrach on pipeline construction projects, and Gazprom also conducts exploration activities in the El Assel onshore area in the Berkine Basin.

Among external powers, the US has always been interested in North Africa in general and in Algeria more specifically. The US has minimal direct diplomatic, economic, and military exposure to Algeria. Some American oil and gas companies (e.g. Chevron and ExxonMobil) have been operating in the country and they have

[11] Black decade refers to Algeria's civil war due to the clash between the Algerian government and various Islamist groups that lasted a decade between December 1991 and February 2002.

recently signed some MoU to develop the upstream sector. However, the increasing turbulence and shifting dynamics in the country might damage a wide range of US interests. For example, Algeria is strategically important for the US for its influence on counterterrorism efforts. The growing presence of external and competing players in North Africa have forced the US to rethink its approach towards the region and Algeria. The visit of US Defense Secretary Mark Esper in October 2020 confirms the US' intention to step up its presence in the region against Russia and China.

Thanks to its abundant hydrocarbon reserves, Algeria has become a pillar of Europe's energy security of supply strategy. Nevertheless, a soaring domestic consumption and the depletion of its aging fields are threatening the future of gas exports, which are a key revenue source for Algeria's economy. Over the period 2014–2020, a fierce competition in the global gas markets, especially from LNG exporters, had depressed gas prices in Europe. Higher competition and low prices have resulted in a reduction of gas imports from Algeria by its two main markets, Spain and Italy.

Since 2021/22, European gas prices have steadily increased reaching their highest level with the eruption of Russia's war in Ukraine, while European countries seek to wean themselves off Russia's gas. Higher gas prices and a favorable geographical position has put Algeria back in the European gas market. Nonetheless, this new position has not come without constraints. While Algeria has enhanced its energy relationship with Italy (through the signature of a new contract in 2022), it has been experiencing a deterioration of its political relations with Spain due to the territorial dispute with Morocco that could potentially undermine a stable energy relation with the Iberian Peninsula. Lastly, Algeria needs to address chronic domestic issues in order to benefit from the new context in the European energy landscape. For example, political instability and obstructionism undermine the attractiveness of future upstream developments for international investors, which are key to the future sustainability of gas exports.

5.3.2 Libya

Libya ranks as Africa's largest oil reserves, holding 648 billion barrels of oil reserves (2.8% of world's total proven reserves), while it holds Africa's fifth largest gas reserves (1.4 tcm), behind Nigeria, Algeria, Mozambique and Egypt. Globally, Libya holds the 10th and 18th largest oil and gas reserves, respectively.

Libya quickly became a major pillar of the oil (and later gas) security strategy of European countries. However, Libya's oil and gas sector have experienced numerous ups and downs over the last decades. With the fall of its long-lasting ruler Qaddafi in 2011, the country fell into an escalation of violence and chaos, deeply affecting oil and gas production and exports (Fig. 5.7).

Its oil and gas industry began at the end of the 1950s, with the discovery of its first oil in 1959. Two years later, Libya began to export its oil and became a member

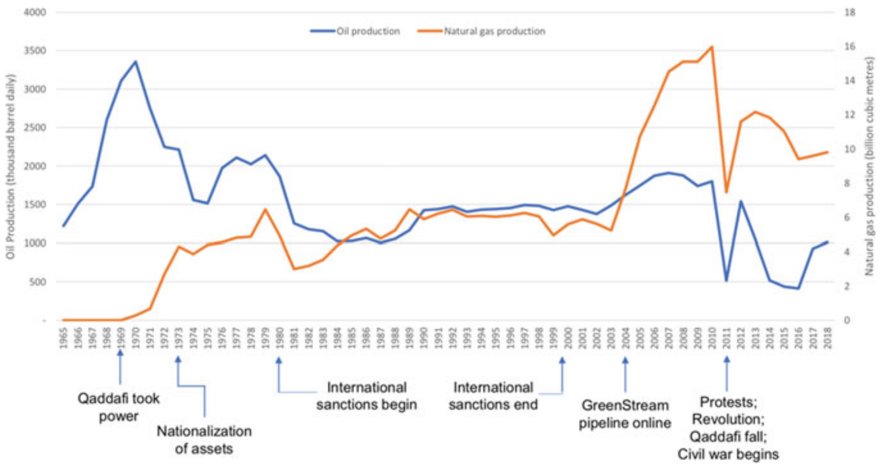


Fig. 5.7 Libya's oil and natural gas production. *Source* Authors' elaboration on BP Statistical Review of World Energy (2019)

of the OPEC in 1962. The country's oil industry developed under the monarchy,[12] which set a positive and open environment to foreign investments. The first Libyan oil industry managed to attract foreign companies thanks to the strong competition through smaller concession areas than usually done in the other regional countries at the time (Fattouh 2008). Moreover, Libyan oil gained more strategic relevance at the end of the 1960s following several political episodes. Due to the Six-Day War, the closure of the Suez Canal in 1967 considerably increased the value of Libya's oil that earned greater strategic relevance thanks to its proximity to European markets. During this time, Libya's oil production grew rapidly, reaching a peak of around 3 mb/d in 1970.

With the advent of Colonel Muammar Qaddafi in 1969, Libya's energy resources became more and more essential for his political power. Qaddafi used revenues derived from hydrocarbon resources to provide economic prosperity to the small population in Libya, transforming the country into a classic petrostate and a rentier state. In 2012, revenues from the sale of oil and gas accounted for 96% of government revenues and 98% of export revenues and 65% of GDP (EIA 2015). During Qaddafi's regime, Libya was able to amass significant cash revenues and run a debt-free economy for years; however, it was almost entirely dependent on the import of food, medicine and consumer goods. The new source of income (petrodollars) also allowed Qaddafi to pursue a strong foreign policy, emerging as a prominent player in the international and regional scene (e.g. within the African Union and the Arab League). Qaddafi's foreign policy, along with its financial and political support to some terrorist groups and activities, fueled a hostile relationship with several Western governments—especially with the US.

[12] After the independence (1951), the country became a monarchy, ruled by King Idris I until 1969 when Qaddafi overthrew the government.

In 1970, the Libyan National Oil Corporation was created to manage the country's hydrocarbon industry. Meanwhile, the new Libyan regime initiated its campaign to strengthen its bargaining position vis-à-vis foreign companies. The new course was favored by the propitious time in 1970. At the time, Libya was supplying 30% of Europe's oil, but the critical situation of global oil transportation enhanced Libya's strong position. Indeed, besides the Suez Canal closure, an incident to the Trans-Arabian pipeline[13] in Syria prevented the export of 500,000 barrels per day of Saudi oil to the Mediterranean intensifying the pressure on oil transportation. Although there was no shortage of oil, there was a shortage of transportation, putting Libya and Qaddafi in a strategic position because of Libya's geographic proximity to European markets (Yergin 2009). In September 1970 Libya reached an agreement with Occidental, which agreed to pay taxes on the basis of increased posted prices. Additionally, Libya managed to hike its profit share from 50 to 55%. Soon after, other foreign companies accepted the new terms. The new political course on the oil industry undertaken by Qaddafi, coupled with the evolution of global oil demand and supply and oil prices, affected the balance of power between the governments of the producing countries and the oil companies (Yergin 2009). Libya relaunched the exporters' campaign for sovereignty and control over their oil resources, which had begun a decade earlier with the foundation of OPEC, but then had stalled. Other Middle East oil producers invoked the same terms for themselves, triggering a wave of demand to the companies across the world. The wave of renegotiation led to the Tehran and Tripoli agreements in 1971. The Tehran agreement resulted in a 55:45% profit sharing for Gulf nations with annual increases in the posted price on February 14th, 1971. On the other hand, the Tripoli agreement on April 2, 1971 resulted in the posted price being raised 90 cents for the OPEC oil in the Mediterranean—well beyond that of the Tehran Agreement. The Tripoli group included Libya and Algeria and also Saudi Arabia and Iraq, since part of their production came to the Mediterranean through pipelines. During 1971–1973, Libya decided to revise existing concessions in favor of 51% participation agreements with the state oil company (Fattouh 2008). For those companies that rejected the new participation terms, the government issued a decree in September 1, 1973 nationalizing 51% of their concessions. However, the nationalization of oil assets led to a decrease of production to around 1 mb/d in the early 1980s (from 3 mb/d in 1970). Oil production also suffered from a growing international pressure in the 1980s and 1990s due to political confrontation between Libya and key Western countries, especially the US. This led to the enforcement of sanctions against Qaddafi's regime and Libya's oil and gas industry by the UN and US, preventing their full development.

In the late 1990s, the international context improved, and a reconciliation process between Libya and Western countries began. The international sanctions were lifted in the early 2000s, rehabilitating Libya and its hydrocarbon sector, which underwent a positive development since the 2000s. Libya tried to attract new international investments and E&P activities by foreign companies in its oil and gas industry. The

[13] Known as Tapline, the Trans-Arabian pipeline extended from Dhahran in Saudi Arabia to Zahrani in Lebanon and operated from 1950 to 1982.

result was a moderate increase in Libya's overall output and a relatively stable period for Libya's oil sector. Moreover, natural gas production witnessed a strong growth in this period, increasing from an average of 6.0 bcm in 2000–2004 to 13.6 bcm in 2005–2010. This was possible thanks to the partnership between Italian ENI and NOC. The two companies own the Western Libya Gas Project and the associated 520 km GreenStream pipeline that transports Libyan gas from Mellitah to Italy.

However, this period of stability did not last more than a decade. The oil and gas industry began to face great uncertainty and insecurity with the outbreak of the revolution in 2011. In February 2011, the '17th February Revolution' began in Libya's eastern region (Cyrenaica) and led to the overthrowing of Muammar Qaddafi on October 20th, 2011—after 42 years of power.

The social and popular revolt was part of the broader social unrest (i.e. Arab Springs) that was spreading throughout the region in that period. However, Libya's social revolt quickly gained the support of several external actors that pursued different strategic goals and began to get involved in the local protests. Western countries, namely France and the United Kingdom, and the Gulf monarchies decided to support the anti-governmental factions. Nevertheless, the regime showed a certain resilience to popular protests, compared to other regimes in the region at that time. It was not until the short but decisive mission undertaken by NATO (with the critical role of the US) that Qaddafi's regime began to lose ground and ultimately fell. The NATO decided to target Libyan governmental assets, destroying Libya's air force in order to prevent the regime's response against opposition forces.

Since the fall of Qaddafi in 2011, Libya has experienced a period of chaos from the political, security and energy point of view. The country is composed of three regions (Tripolitania, Cyrenaica and Fezzan) populated by several tribes with a background of strong rivalry. Indeed, Libya has experienced long-lasting conflicts between Arab tribes and the original native population of the region (the Amazigh, Touareg and Toubou), as well as between settled peasant populations and semi-nomadic and nomadic tribes. The Qaddafi regime had exploited these localized conflicts to play tribes off against each other, while keeping the country united through a hard-hand approach and the distribution of revenues in order to appease the tribes. However, Qaddafi often changed top officials, especially in the NOC, in order to prevent consolidation of power and possible opponents. Libya has thus been unable to create strong institutions. With the fall of Qaddafi's regime and weak institutions incapable of helping the transition, these regions and the several tribes failed to achieve unity under a new political structure.

Since 2011, the country is exasperated by violence and clashes between opposite armed groups and militias. National and local disunity has been further enhanced and exacerbated by external involvement. The interference of external actors was driven by the aim to increase their geopolitical power and by other reasons, such as Libya's geographical position and significant hydrocarbon reserves. Moreover, Libya's resources and the revenues derived from their sale are the central driver of this conflict. Armed groups, supported by external actors, struggle to take control over oilfields, oil and gas infrastructure and their revenues.

Hydrocarbon resources quickly became a bargaining chip for armed groups to increase their influence and control on the ground. In this context, oil production, exports and foreign companies' activities in the country have been affected by the evolution of violence on the ground and security concerns. Oil and gas production and exports have experienced ups and downs with different degrees of intensity over the last decade. Nonetheless, these clashes highlighted how oil, rather than gas, is at the heart of the political disputes in Libya with different groups and factions targeting the oil industry in order to gain leverage and political ground. This general context has strongly conditioned hydrocarbon output.

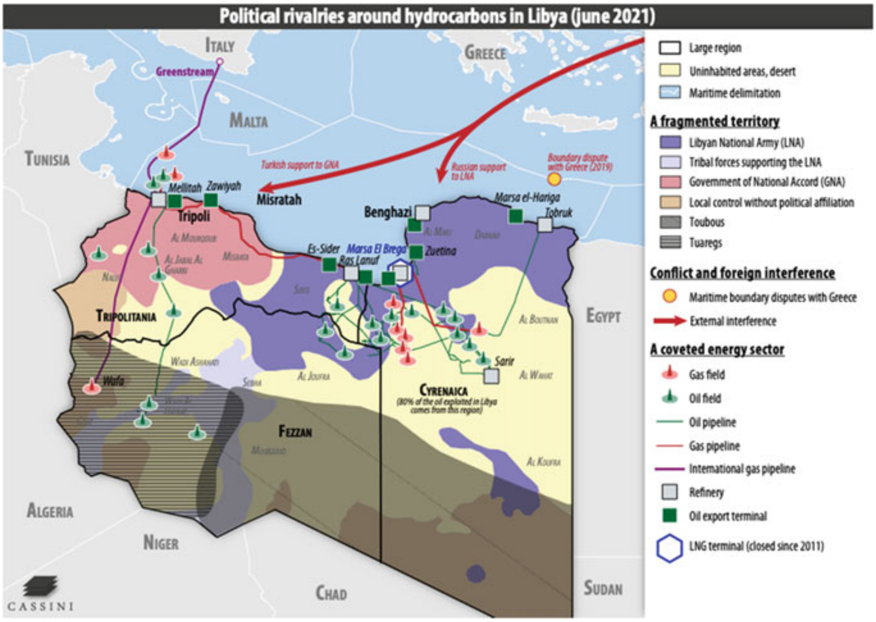
Initially, in 2011, the oil production rapidly recovered to 1.1 mb/d from the effects of major disruptions (which also led to a brief low of almost zero), stabilizing around 1.5 mb/d during 2012 (Barltrop 2019). This triggered a sense of hope for the future recovery of Libya's oil and gas production. However, the increasing activity of local armed groups and militias on the ground dashed all hopes of recovery. Lack of security standards, also due to the fragmentation of the Petroleum Facilities Guard (PFG) and local competition over oilfield control since mid-2014, caused major uncertainty for the country's oil and gas industry.

The disunity among key Libyan regions has deepened with the 2014 elections that took place without any political agreements and ultimately led to the dichotomy between two governments in the Eastern region (Cyrenaica) and in Western Libya (Tripolitania). Cyrenaica hosted the government supported by the House of Representatives (HoR), located in Tobruk, while the coalition called Libya Dawn formed an opposing government in Tripoli. With the UN-brokered Skhirat agreement in December 2015, Tripoli hosts the internationally recognized government, the Government of National Accord (GNA). The head of the GNA is Fayez al-Sarraj, who is head of the Presidency Council. The HoR supports the Field Marshal Khalifa Belqasim Haftar, who leads the Libyan National Army (LNA). Since then, the local fracture within Libya has crystallized.

This local dimension is the first level of the broader Libyan conflict, which consists of three different levels that make resolution almost impossible: local (between the two main different factions led by Haftar and al-Sarraj, respectively, but also between some other armed groups); regional (UAE and Egypt against Turkey and Qatar); and international (with the involvement of Italy, France, the US and Russia).

At the local level, the conflict is characterized by multiple armed groups with opposing and mutating interests. The situation on the ground is very complex with factions that are pursuing conflicting interests in a context of lack of accountability. The main two factions are the GNA and LNA, which are linked to the West–East dichotomy.

Within this clash (i.e. GNA vs. LNA) the geography of the resources, infrastructures and the revenues management system have a paramount relevance (Map 5.7). Regarding the geography of its resources, Libya has six large sedimentary basins: Sirte, Murzuk, Ghadames, Cyrenaica, Kufra and the offshore. However, Libya's natural resources are unequally distributed across the country. More than 85% of the discovered oil reserves are located in the Sirte Basin, with the balance being shared equally between the Murzuk Basin, Ghademes Basin and the Pelagian Shelf



Map 5.7 Political rivalries around hydrocarbons in Libya. *Source* CASSINI

(offshore). The Sirte basin also accounts for most of the country's oil production capacity (EIA 2015). The Sirte basin still accounts for over 70% of the remaining gas reserves, while the offshore Pelagian shelf has approximately 25% of the remaining gas reserves, with the rest located in the Ghadames and Murzuk basins. Moreover, five of six of export terminals and four of five refineries are located in the eastern part of the country.

As Haftar expanded his control in the east, LNA has taken control over most of the oilfields and infrastructure. Additionally, the request for autonomy of Cyrenaica, which accounts for 30% of Libya's population but 60% of its oil resources, and the economic inequality between Cyrenaica and Tripolitania are two of the main reasons behind Haftar's ascent (Varvelli and Lovotti 2019).

Another important outcome of the 2014 political split is the financial split between the Central Bank in Tripoli and the eastern branch in Benghazi that decided to operate autonomously. This division was decided by the Central Bank in October 2014 to disconnect its eastern branch from the automated clearing system, which all Libyan commercial banks use to manage their accounts with the Central Bank. The decision was taken to prevent east-based authorities from accessing government accounts and funds—both reserves and oil revenues (International Crisis Group 2019). In achieving this goal, Tripoli triggered a deep clash with the eastern part of the country, enhancing a polarized system and unleashing a sense of disenfranchisement in the region. Moreover, a financial squeeze in the east could also reignite fighting over Libya's sole source of revenues: its oil. The eastern faction could ask its international backers to bankroll its war effort. However, as the battle wears on, the east-based government could decide to shut down the country's oil fields and export terminals, most of which are under LNA control (*Idem*).

Libya's oil and gas resources have been weaponized by local players. For example, in 2020 Haftar took advantage of his control over most of the oil-rich areas and decided to weaponize hydrocarbon resources and exports. On January 17, 2020 the LNA has imposed a blockade of export terminals in the Sirte basin, forcing a shutdown of oil production, which also caused electricity blackouts in parts of the country, inflicting additional pain to the civilians. Due to the blockade, NOC declared a force majeure on the five key oil export ports of Brega, Ras Lanuf, Hariga, Zueitina and Sidra. In a parallel development, local militia also shut down production form the giant El Sharara and El Feel fields. As a consequence, all the oil and gas production was shut down except for the offshore fields of Bouri, Bahr Es Salam and Al Jurf and the onshore Wafa fields. This resulted in a major economic loss for Libya's economy and the slash of Libya's oil output (from 1.15 mb/d in December 2019 to 0.04 mb/d in April 2020). The decision was an attempt to put further pressure on the GNA, preventing it from collecting revenues from the sales of oil and gas and weakening social cohesion and support to the Tripoli-based government. However, the decision can also be interpreted as a sign of weakness as it confirms the failure of the military operation launched by Haftar in April 2019 to seize power, defeating the GNA and controlling the country's key institutions located in the city. The failure of the military operation launched in April 2019 showed the incredible resilience of GNA, which managed to resist the attack thanks to the military support of local forces and Turkey.

The role of Turkey highlights the increasing influence of external players in the conflict. Libya became the battleground for several countries—both regional and extra-regional—with competing interests. These external interventions worsened the situation, providing military supplies as well as financial and political support.

The conflict soon became the stage for regional competition between Egypt, the UAE, Saudi Arabia, Qatar and Turkey. This regional cleavage is driven by the desire of security, geopolitical competition as well as ideological—and religious—beliefs. The 2011 Arab Spring fostered the competition among these regional players, which aimed at establishing a new regional hegemony. The involvement of regional foreign players exploited and exacerbated the east–west division, with groups in western Libya backed by Qatar and Turkey, and the UAE, Egypt and Saudi Arabia backing the eastern militias.

The UAE is the main supporter of Haftar's political and military projection in Libya. The Gulf country is driven by both ideological and economic reasons. Ideologically, the UAE considers the possibility of Islamist groups in power as an existential threat to the survival of the Gulf monarchies. The 2011 Arab Spring unleashed these fears in the Emirates that have committed themselves to preventing the rise of the Muslim Brotherhood in the region, using Libya as the central battleground in this struggle. Moreover, Libya is particularly attractive for UAE's economic goals. Its geographical position is important for two main sectors in which the UAE have heavily invested as a diversification effort: shipping and port facilities, and construction. The UAE has thus provided significant financial and military assistance to Haftar's troops. Since 2014 the UAE provides drones that were essential in Haftar's operations against Tripoli, especially in 2019. Energy does not have a great share in the calculus of UAE's activities in Libya, given their reserves at home.

Haftar has also received critical support from Egypt, which shares a 1100 km-long desert border with Libya. This border is a threat to Egypt's national security, due to the possibility of terrorist crossing and activities in Egypt. Due to the deployment of his forces near the Egyptian border, Haftar is considered Cairo's natural ally. Given its geographical vicinity, a stable Libya can also be important to Egypt for economic reasons. Moreover, Egyptian President, al-Sisi, shares with Haftar the same belief that militarism is the only possible response to the Islamist threat. Al-Sisi has thus provided military and diplomatic assistance. In particular, during his visit to the US in April 2019, Al-Sisi promoted Haftar's cause with President Trump, leading to Trump's surprising call to Haftar (Megerisi 2019).

Lastly, Saudi Arabia—the de facto leader of the Sunni Arab world—took a different approach on Libya's conflict. Initially, Riyadh supported a Salafist group, known as the Madkhalist group, in the attempt to influence the political transition in Libya, using the religious authority instead of financial or military tools. Since 2011, the Madkhalist group gained relevance in Haftar's security services and Libya's religious institutions (Megerisi 2019). This group believes in total obedience to the national leader and expresses hostility towards the Muslim Brotherhood, making it a naturally ally for Haftar. Nevertheless, in April 2019 Haftar decided to wage an offensive against the Tripoli-based government after visiting Riyadh. This visit marked a turning point in Saudi policy, which became more assertive with an increasingly active support to Haftar. Many reasons might contribute to changing Saudi policy; for example a renewed wave of political turmoil in North Africa might create the opportunity for Saudi Arabia to act and shape the new regional order in alignment with the UAE; the intention to foster its economic diversification, exploiting the gas sector in particular; and finally, the mindset of the new Saudi Crown Prince Mohammed bin Salman, who is known for his energetic and assertive foreign policy.

On the contrary, the UN-backed government headed by al-Sarraj earned financial, military and economic assistance from Qatar and Turkey. The two countries shared the same views on the Islamist political movement, supporting the Muslim Brotherhood across the region. Qatar has been the key regional player in Libya since the beginning of the revolt. It supported the rebels also with its worldwide broadcasting services, Al-Jazeera, providing images and videos on the protests and the regime's responses. As the conflict continued, Qatar supported the GNA both financially and militarily. Along with Qatar, Turkey has strengthened its role in Libya by supporting the Tripoli-based government. Initially, Turkey was a late supporter of the revolution. Indeed, Ankara had contracts with Libya for roughly \$15 billion in 2011 and it desired to fulfil them. Nevertheless, Turkey strengthened its relationship with groups in western Libya not only because that is where its key economic interests lay, but also doubtlessly in opposition to Haftar's growing alliance with Egypt and the UAE (Megerisi 2019). As its influence was growing, Turkey managed to sign an agreement with the Tripoli-based government on maritime boundaries in the Mediterranean Sea on November 27th, 2019. The deal is crucial for Ankara's strategic goals in the Eastern Mediterranean (i.e. Cyprus). Additionally, thanks to this agreement, Ankara can start to develop exploration activities in the Libyan gas offshore, which is particularly attractive for Turkey. The deal alters maritime demarcation and allows Ankara to obstruct the plan of a potential gas pipeline from the East Mediterranean to Europe via Greece. Indeed, the preliminary agreement demarcates a 35-km line along the maritime boundary separating the two countries' respective exclusive economic zones. In this way, Ankara can break the continuity between the continental shelves and EEZs of Cyprus and Greece.

Libya's turmoil has also been influenced by extra-regional players. Due to its geographical position and historical background, Libya is particularly strategic for European countries, notably South European countries (i.e. Italy, France and Spain). France and Britain were crucial to support the initial revolt in 2011. Over the years, the UK has reduced its direct involvement in the country, decreasing its engagement with European foreign policy following Brexit.

Libya also became the stage of a clash between the different interests of single European countries. The EU has been incapable of developing a consistent policy to end the conflict in the country due to diverging national interests. The main rift is between France and Italy. France provides military and financial support to Haftar, while Italy backs the UN-supported government.

Since its initial decision to intervene in the 2011 revolt, France looked at the political evolution in Libya as a possible opportunity to increase its influence in the southern Mediterranean shore. As the crisis worsened, France considered Haftar a strongman capable of uniting the country, establishing domestic order and preventing the establishment of political Islam and radicalization. Moreover, France has important and strategic interests in the Sahel, which borders with Libya's southern areas (i.e. Fezzan). Thus, France believes that Haftar would be capable of contrasting terrorist activities in Libya's south border with the Sahel. Moreover, France would increase its interest in the country's oil and gas sector. French oil major, Total, is the second player in the country in terms of value and comes second only to Italy's Eni. The country does not currently contribute to a significant extent to Total's production, accounting only for 2.9% in 2019.

Traditionally, Libya has represented the most important country in the Mediterranean for Italy. From the political point of view, Italy has been suffering increasing marginalization in the country's post-Qaddafi era due to diplomatic missteps and the lack of strategic thinking, despite its long-standing position of influence in its former colony. Italy contributed significantly to the creation of the GNA in 2015, considered an important element in tackling immigration flows towards Italy.

As Haftar was expanding his power in the country, Rome tried to appease its relations with the Cyrenaica's strongman, driven by its increasing economic interests with Egypt. Nevertheless, this change in approach ended up by alienating and losing ground on both sides of the conflict, allowing the rise of more assertive and committed new players—Turkey and Russia.

Nevertheless, Italy still holds an important presence on the ground through the Italian energy company, Eni. The company operates extensively in the country, being the leading player in terms of value, leaving the company exposed to the evolution of the conflict. Indeed, Libya accounted for around 15% of Eni's net output in 2019 (with 282,000 boe/d). Moreover, Italy represents the sole export outlet for Libya's gas pipeline thanks to the Greenstream pipeline (with a total capacity of 11 bcm/y). Most of the gas that feeds the Mellitah gas terminal (where the Greenstream pipeline starts) comes from Wafa (in the western part of the country) and Bahr Essalam, Libya's biggest offshore gas field. Because of the important exposure of its main company in the country's western part, Italy officially supports the Tripoli-based government.

Since the fall of Qaddafi, the pipeline is underutilized with varying spare capacity available depending on the evolution of the conflict and the Italian gas market. National natural gas production has declined from 16.8 bcm in 2010 to 10.5 bcm in 2020 (Fig. 5.8).

Until 2019, gas supplies to Italy were not significantly disrupted by the almost-10-year civil war with few episodes of clashes near the Mellitah gas complex. Gas exports have been stable for some time mainly for two reasons: the offshore production has been largely immune to the political chaos and military activities that have deeply affected Libya's energy production since 2011, and neither the pipeline, the Wafa onshore gasfield nor the Mellitah processing and pumping complex on the Libyan coast have experienced significant levels of disruption over the past five years thanks to the security protection of several militias in the area. Nonetheless, since 2019 gas exports have started declining and in 2021 Libya's gas supplies reached their lowest level in a decade (Fig. 5.9) because of rising domestic consumption and a rapid natural decline. Libya's NOC announced that it aims to increase gas production, yet there are several challenges.

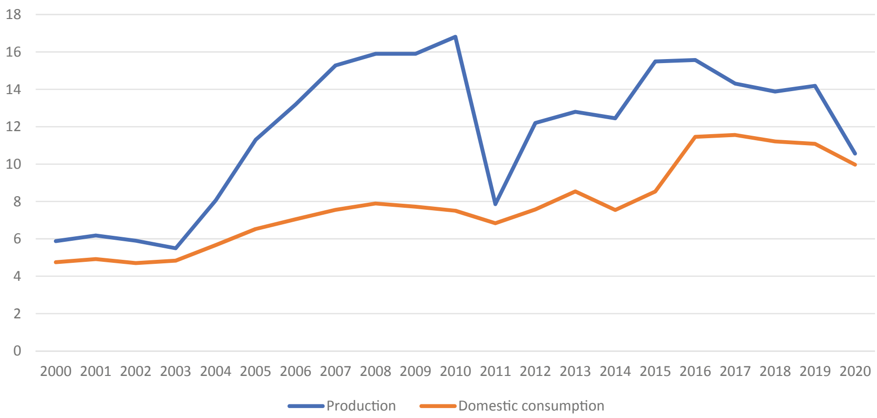


Fig. 5.8 Natural gas production and consumption, 2000–2020, bcm. *Source* Authors' elaboration on ENERDATA

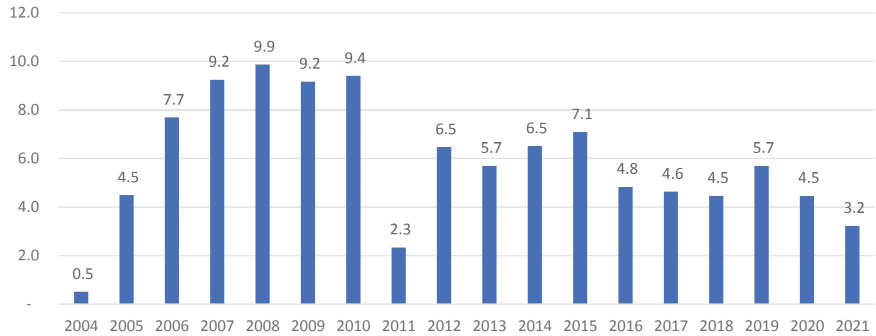


Fig. 5.9 Italy's gas imports from Libya, 2004–2021, bcm. *Source* Authors' elaboration on Italian Ministry of Economic Development (MISE)

Traditionally, the US did not have a direct influence on the country, despite the significant presence of American energy companies on the ground. At the beginning of the popular upheaval, Washington decided to pursue the "leading from behind" strategy, allowing its European allies to operate in the country. Despite its decisive involvement in the air bombing mission within NATO in 2011, the US considers the Libyan conflict a European issue, considering the country of little strategic importance for American core interests. Nevertheless, it endorsed and supported the UN-brokered Skhirat agreement in December 2015 which granted international recognition to the GNA. However, Trump's offensive attack on Tripoli in April 2019 might mark a shift in American strategy towards Libya. The call was reduced to a personal favor to Egypt, but it shows the pillars of Trump's policy in the region. Since Donald Trump became President, he has based US foreign policy towards MENA on the fight against terrorism thanks to his close allies, the Saudi Crown Prince and Egypt's President. Nevertheless, it is noteworthy to mention that the US guaranteed the Tripoli-based government and the Central Bank the right to collect oil revenues and operate in the international financial market as the legitimate Libyan institutions, through a resolution passed in the UN Security Council in 2016. As Turkey and Russia increase their influence in the country, Washington might decide to strengthen its role in order to counterbalance these two powers.

Indeed, the combination of the US lack of interest in Libyan affairs and the lack of political unity among European countries has produced a substantial political vacuum, easily occupied by other countries—i.e. Russia and Turkey. This development might result in the official transformation of the conflict into a proxy war, like in Syria.

Russia's attraction to Libya began in Postdam in 1945 with Stalin's attempt to control Tripolitania. During the Cold War, the Soviet Union established ties with the anti-Western ruler, Qaddafi. In 2008, Moscow wrote off most of Libya's nearly $5 billion debt in exchange for contracts on oil, gas, weaponry and infrastructure. Moreover, Qaddafi granted the Russian fleet access to Benghazi's port. Since the 2011 revolt, Russia has steadily increased its role in the country. Moscow pursues an opportunistic policy, exploiting the vacuum created by US disengagement and European disunity. Russia wants to be seen as a great power and an essential player in regional affairs, while creating opportunities to establish economic and political relations favorable to Russia's interests. Russia supports Haftar and the eastern part of Libya financially and through military equipment and personnel (around 1–2000 Russian mercenaries are on the ground). Such support is also part of the strategy to strengthen its ties with Egypt, the strong backer of Haftar. Russia's support to Haftar's campaign in 2019 and 2020 helped LNA's leader seize the control of major oilfields and oil export terminals, contributing to the blockade of Libya's oil production. Although it is partially motivated by tactical goals, Russia looks favorably to the possibility of reactivating energy and infrastructure projects signed before the 2011 revolution.

Lastly, China is a discreet but relevant player in the country, although it is often neglected by the multitude of great and regional powers involved in Libya. China has a long history of economic ties with Libya. Under Qaddafi's regime, China was present in the country with various infrastructure projects. By the year of the revolt, China had 75 companies conducting roughly $18.8 billion worth of business in Libya, involving 36,000 Chinese workers. These workers operated across 50 projects from residential and railway to telecommunications and hydropower ventures. Moreover, in 2011 Libya provided 3% of China's crude oil supplies (equal to roughly 150,000 barrels per day). Also, China's top state oil firms had standing infrastructure projects in Libya. Since 2014, China observed Libya's fractured landscape and decided to pursue a policy of cautious neutrality as well as diplomatic and economic diversification. Officially, China backed the creation of the GNA in 2015. In mid-2018, China and the GNA signed two MoUs committing to work together to bring China's Belt and Road Initiative to Libya. In 2019, bilateral trade between the two countries amounted to $6.2 billion, primarily due to rebounding Libyan oil exports to China (Wehrey and Alkoutami 2020).

Libya's geographical location is strategically relevant for China's Maritime Silk Road in light of increasing Chinese interests in the Mediterranean. Since 2014, China's involvement in the country has focused on the economic aspects (its main line of influence). China has managed to avoid becoming involved in the conflict and hedging its investments and bets. As it signed a BRI agreement with GNA, China's CNPC and subsidiary oil corporations are poised to engage with an increasingly autonomous east, which comprises a large portion of the oil infrastructure in Libya.

In 2020, Libya's conflict saw an intensification of clashes. Haftar experienced major setbacks failing to seize power in Tripoli. Libya's oil industry suffered a major drop following Haftar's blockade on oil export terminals in the Sirte Basin. The blockade of oil export terminals caused the halt of oil output. However, in October 2020 the two conflicting parties reached an agreement and Libya managed to quickly increase its output. The comeback of Libya's oil in the global oil markets poses further pressure to the OPEC+ agreement.

While Libya could easily monetize and benefit from its vast resources and geographical position, this potential has been significantly undermined by the ongoing conflict. Over the past decade, the conflicts and clashes among different factions have undergone several phases of intensity. Nonetheless, the general inability to stabilize its domestic dimension has limited Libya's role in the global oil and gas markets even in 2021/22 when energy prices and geopolitical tensions favored a potential comeback of Libyan hydrocarbon resources. Indeed, in 2021 and 2022, the two local factions (the House of Representatives in Tobruk and the Government of Unity) have restarted political confrontation with two competing governments. The hydrocarbon industry remains a potential target of the temporary rise of clashes, making Libya's serious and stable comeback of Libya in the global oil and gas markets uncertain.

Bibliography

Al-Jabar K, Coates Ulrichsen K (2020) Is there a future for the GCC? Responsible Statecraft, 15 June 2020. Available at: https://responsiblestatecraft.org/2020/06/15/is-there-a-future-for-the-gcc/

Al-Moneef M (2020) Saudi Arabia's role in OPEC's evolution. OPEC and the global energy order from its origins to the present time. In: Claes, Garavini (eds) Handbook of OPEC and the global energy order. Past, present and future challenges. Routledge International Handbooks

Al Monitor (2019) Iraq, China launch 'oil for reconstruction' agreement, 10 Oct 2019. Available at: https://www.al-monitor.com/pulse/originals/2019/10/iraq-china-india-oil-construction.html

Al Monitor (2020a) Egypt unruffled by EastMed pipeline project, 20 Jan 2020. Available at: https://www.al-monitor.com/pulse/originals/2020a/01/egypt-israel-greece-cyprus-east-med-pipeline-gas-deals-worry.html#ixzz6Oyn7nM5n

Al Monitor (2020b) Egypt announces international anti-Turkey alliance, 31 May 2020. Available at: https://www.al-monitor.com/pulse/originals/2020b/05/egypt-anti-turkey-alliance-libya-mediterranean-waters.html

Al Monitor (2020c) Egypt and Turkey's energy face-off in the Mediterranean, 27 Mar 2020. Available at: https://www.al-monitor.com/pulse/originals/2020c/03/egypt-agreement-drilling-gas-mediterranean-turkey-libya.html

Bhalla R (2011) Making sense of the Syrian Crisis, Stratfor worldview. Geopolitical Weekly, 5 May 2011. Available at: https://worldview.stratfor.com/article/making-sense-syrian-crisis-0

Barltrop R (2019) Oil and gas in a new libyan era: conflict and continuity. The Oxford Institute for Energy Studies, OIES PAPER: MEP 22, Feb 2019

BP (2020) Statistical review of world energy, June 2020

Butter D (2014) Fueling conflict: Syria's war for oil and gas. Carnegie Middle East Center, 2 Apr 2014. Available at: https://carnegie-mec.org/diwan/55195

Butter D (2019) Syria desperately seeks fuel. Petroleum Econ, 28 Mar 2019. Available at: https://www.petroleum-economist.com/articles/politics-economics/middle-east/2019/syria-desperately-seeks-fuel

Calabrese J (2017) Sino-Algerian relations: on a path to realizing their full potential? Middle East Institute, 31 Oct 2017. Available at: https://www.mei.edu/publications/sino-algerian-relations-path-realizing-their-full-potential#_ftnref25

Calabrese J (2019) China-Iraq relations: poised for a "Quantum Leap"? Middle East Institute, 8 Oct 2019. Available at: https://www.mei.edu/publications/china-iraq-relations-poised-quantum-leap#_ftn17

ChinaMed (2020) Iraq, ChinaMed.it. Available at: https://www.chinamed.it/chinamed-data/middle-east/iraq
CIA (2020) Syria, The World Factbook. Access on June 2020. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/sy.html
Diwan R, Yergin D (2019) Opinion: why Syria's oil matters. NPR, 31 Oct 2019. Available at: https://www.npr.org/2019/10/31/775142854/opinion-syria-s-oil-production-is-low-but-here-s-why-it-matters?t=1593523452396
EIA (2011) Syria, country analysis brief, Aug 2011. Available at: https://www.eia.gov/international/content/analysis/countries_long/Syria/archive/pdf/syria_2011.pdf
EIA (2015) Libya, country analysis brief, 19 Nov 2015
Fattouh B (2008) North African oil and foreign investment in changing market conditions. The Oxford Institute for Energy Studies, WPM37, Jul 2008
Fattouh B, Mahadeva L (2013) OPEC: what difference has it made? The Oxford Institute for Energy Studies, MEP 3, Jan 2013
Friedman G (2019a) The origins of new US-Turkish relations. Geopolit Futures, 14 Oct 2019a. Available at: https://geopoliticalfutures.com/the-origins-of-new-us-turkish-relations/
Friedman G (2019b) The geopolitics of Iran's refinery attack. Geopolit Futures, 16 Sept 2019b. Available at: https://geopoliticalfutures.com/the-geopolitics-of-irans-refinery-attack/
Fulton J (2019) China in the Gulf, Eni. Global Energy Scenarios, 21 Mar 2019. Available at: https://www.eni.com/en-IT/global-energy-scenarios/china-new-silk-road.html
Greenley HL (2019) The world oil market and U.S. policy: background and select issues for congress. Congressional Research Service, CRS Report R45493, Updated 23 Apr 2019. Available at: https://fas.org/sgp/crs/row/R45493.pdf
Haaretz (2020) How Turkey's Libya foray can backfire, and the Israeli dilemma, 4 June 2020. Available at: https://www.haaretz.com/middle-east-news/turkey/.premium-turkey-libya-mediterranean-backfire-israel-dilemma-1.8890823
Hafner M, Tagliapietra S (2016) The future of European gas markets: balancing act between decarbonization and security of supply. Claeys & Casteels Edward Elgar Publishing
Humud CE, Blanchard CM (2020) Armed conflict in Syria: overview and U.S. response. Congressional Research Service, CRS Report RL33487, Updated 12 Feb 2020. Available at: https://fas.org/sgp/crs/mideast/RL33487.pdf
IEA (2012) Iraq energy outlook, World energy outlook special report. IEA, 9 Oct 2012
IEA (2019) Iraq's energy sector. A roadmap to a brighter future. IEA, Apr 2019
International Crisis Group (2019) Of tanks and banks: stopping a dangerous escalation in Libya. Middle East and North Africa Report N° 201, 20 May 2019
Jalilvand DR (2017) Iranian energy: a comeback with hurdles. The Oxford Institute for Energy Studies, Oxford Energy Comment, Jan 2017. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/01/Iranian-Energy-a-comeback-with-hurdles.pdf
Jalilvand DR (2018a) The US exit from the JCPOA: what consequences for Iranian energy? The Oxford Institute for Energy Studies, Oxford Energy Comment, June 2018. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018a/06/The-US-Exit-from-the-JCPOA-What-Consequences-for-Iranian-Energy-Comment.pdf
Jalilvand DR (2018b) Progress, challenges, uncertainty: ambivalent times for Iran's energy sector. The Oxford Institute for Energy Studies, Oxford Energy Insight: 34, Apr 2018. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018b/04/Progress-challenges-uncertainty-ambivalent-times-for-Iran%E2%80%99s-energy-sector-Insight-34.pdf
Jalilvand DR (2019) Back to square one? Iranian energy after the re-imposition of US sanctions. The Oxford Institute for Energy Studies, Oxford Energy Comment, Mar 2019. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/03/Iranian-Energy-after-the-Re-Imposition-of-US-Sanctions.pdf
Lovotti C, Sučkov M (2020) In Medio Oriente per tornare a contare, Limes Rivista Italiana di Geopolitica, in: Limes (2020), La Russia Non È Una Cina, N.5 – 2020 [in Italian]. Available at: https://www.limesonline.com/cartaceo/in-medio-oriente-per-tornare-a-contare

Mabon S, Wastnidge (2020) Saudi Arabia, Iran: resilient rivalries and pragmatic possibilities. In: Saudi Arabia, Iran and de-escalation in the Persian Gulf, SEPAD. Available at: https://www.sepad.org.uk/app/sepad/files-module/local/documents/Saudi%20Arabia,%20Iran%20and%20De-Escalation%20in%20the%20Gulf%20-%20Formatted[1].pdf

Mansour R (2018) Saudi Arabia's new approach in Iraq. CSIS, Middle East Program, Analysis Paper, Nov 2018. Available at: https://www.csis.org/analysis/saudi-arabias-new-approach-iraq

Megerisi T (2019) Libya's global civil war. European Council on Foreign Relations, Policy Brief, June 2019

Mehdi A (2018) Iraqi oil: industry evolution and short and medium-term prospects. The Oxford Institute for Energy Studies, OIES PAPER: WPM 79, Oct 2018. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/10/Iraqi-Oil-industry-evolution-and-short-and-medium-term-prospects-WPM-79.pdf

Meidan M (2019) Why China will keep importing Iranian crude, but volumes will remain limited. The Oxford Institute for Energy Studies, Oxford Energy Comment, Aug 2019. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/08/Why-China-will-keep-importing-Iranian-crude-but-volumes-will-remain-limited.pdf

MEES (2019a) Turkey deployment to reshape Syria conflict, vol 62, no 41, 11 Oct 2019

MEES (2019b) Syria's oil reserves: trump's half-backed 'plan', vol 62, no 44, 1 Nov 2019

MEES (2019c) Russians Grab Syria acreage, vol 62, no 36, 6 Sept 2019

MEES (2019d) Syria eyes post-conflict gas gains, but bottlenecks loom large, vol 62, no 1, 4 Jan 2019

MEES (2020a) US sanctions strain Iran-Iraq energy trade, vol 63, no 5, 31 Jan 2020

MEES (2020b) Saudi Arabia looks to expand Iraq footprint, vol 63, no 22, 29 May 2020

MEES (2020c) Zhenhua finds east baghdad expansion no easy task, vol 63, no 19, 8 May 2020

MEES (2020d) Syria emerges as Iran's top crude 'customer', vol 63, no 15, 10 Apr 2020

MEES (2020e) Algeria gas exports plumb new multi-decade low, vol 63, no 26

MEES (2022) Syria says oil sector war damages hit $100bn As Assad Loyalists Scoop Contracts, vol 65, no 6, 11 Feb 2022

Ouki M (2019) Algeria gas in transition: domestic transformation and changing gas export potential. Oxford Institute for Energy Studies, OIES PAPER: NG 151, Oct 2019. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/10/Algerian-Gas-in-Transition-NG-151.pdf

Ratner M (2018) Iran's threats, the Strait of Hormuz, and oil markets: In: Brief, Congressional Research Service, CRS Report R45281, 6 Aug 2018. Available at: https://fas.org/sgp/crs/mideast/R45281.pdf

Reuters (2020) Jordan gets first natural gas supplies from Israel, 1 Jan 2020. Available at: https://www.reuters.com/article/jordan-israel-gas/jordan-gets-first-natural-gas-supplies-from-israel-idUSL8N2960Q9

Rose CD (2020) Iraq, caught between a neighbor and a superpower. Geopolit Futures, 6 Jul 2020

Sassi F (2019) Russia and China: forced cohabitation over Syraq energy? ISPI, Commentary, 8 Mar 2019. Available at: https://www.ispionline.it/it/pubblicazione/russia-and-china-forced-cohabitation-over-syraq-energy-22471

Schaus J (2019) Oil markets, oil attacks, and the strategic straits. CSIS, Commentary, 19 Jul 2019. Available at: https://www.csis.org/analysis/oil-markets-oil-attacks-and-strategic-straits

Smyth G (2020) BOOK REVIEW: a historian looks at Persian Gulf rivalries on third anniversary of GCC crisis. Responsible Statecraft, 6 June 2020. Available at: https://responsiblestatecraft.org/2020/06/06/a-historian-looks-at-persian-gulf-rivalries-on-third-anniversary-of-gcc-crisis/

Snyder X (2019) Russia and Iran: strange bedfellows no longer? Geopolit Futures, Analysis, 16 May 2019. Available at: https://geopoliticalfutures.com/russia-and-iran-strange-bedfellows-no-longer/

S&P Global (2019) Feature: UAE holds back from Qatari-Saudi detente and plans for gas independence, 23 Dec 2019. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/122319-feature-uae-holds-back-from-qatari-saudi-detente-and-plans-for-gas-independence

S&P Global (2020a) As US sanctions increases, China remains Iran's top crude, condensate importer, 10 Jan 2020. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/oil/011020-as-us-sanctions-increase-china-remains-irans-top-crude-condensate-importer

S&P Global (2020b) Israel begins gas exports to Egypt from giant Leviathan field, 15 Jan 2020. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/011520-israel-begins-gas-exports-to-egypt-from-giant-leviathan-field

SYRIA REPORT (2020) Syria's oil and gas industry—a sector profile. Available at: https://www.syria-report.com/library/reports-surveys/syrias-oil-and-gas-industry-sector-profile

Tanchum M (2020) Italy and Turkey's Europe-to-Africa commercial corridor: Rome and Ankara's geopolitical symbiosis is creating a new mediterranean strategic paradigm, AIES, Fokus 10/2020, 25 Aug 2020. Available at: https://www.aies.at/download/2020/AIES-Fokus-2020-10.pdf

Tagliapietra S (2017) Energy: a shaping factor for regional stability in the Eastern Mediterranean? European Parliament, Directorate-General For External Policies, Policy Department, June 2017

Trombetta L (2019) Trump ha dato a Erdogan un pezzo di Siria in cambio di al-Baghdadi, Limes Rivista Italiana di Geopolitica, November 29, 2019, [in Italian]. Available at: https://www.limesonline.com/usa-siria-isis-baghdadi-turchia-curdi-russia/115499

Tsafos N (2018) Qatar leaves OPEC. Center for Strategic & International Studies (CSIS), Newsletter Energy Fact & Opinion, 4 Dec 2018. Available at: https://www.csis.org/analysis/qatar-leaves-opec

Tsafos N (2019) Can the East Med pipeline work? Center for Strategic & International Studies (CSIS), Commentary, 22 Jan 2019. Available at: https://www.csis.org/analysis/can-east-med-pipeline-work

Tsafos N (2020) Getting East Med energy right. CSIS, Commentary, 26 Oct 2020. Available at: https://www.csis.org/analysis/getting-east-med-energy-right

Varvelli A, Lovotti C (2019) Starting from resources: a model for conflict resolution in Libya. ISPI, Analysis, 4 Jul 2019

Wehrey F, Alkoutami S (2020) China's balancing act in Libya. Carnegie Endowment for International Peace, 10 May 2020. Available at: https://carnegieendowment.org/2020/05/10/china-s-balancing-act-in-libya-pub-81757

Wolfrum S (2019) Israel's contradictory gas export policy. Stiftung Wissenschaft und Politik (SWP), Comment, No. 43, November 2019

World Bank (2018) Iraq's economic outlook, Oct 2018. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/mpoam18iraqirqks913fin.pdf

Yergin D (2009) The prize. The epic quest for oil, money & power. Free Press, Dec 2009

Chapter 6
Geopolitics of the Energy Transformation in the MENA Region

This chapter addresses the geopolitical consequences of the energy transformation in MENA countries. The global decarbonization entails both opportunities and challenges for all MENA countries. Their future geopolitical relevance will depend on how fast they manage to exploit their competitive advantages both in the hydrocarbon sector (for hydrocarbon-exporters) and in the clean energy sector (for all MENA countries).

For hydrocarbon exporters, the future geopolitical relevance will depend firstly on the type of energy source that they export the most (either oil or gas) as a faster decline for global oil demand than global gas demand is generally forecast in deep decarbonization scenarios. Notwithstanding the differences, all hydrocarbon countries will need to enhance the diversification of their export portfolio in order to balance declining demand in key regions. In general, those hydrocarbon exporters (North African countries) that rely heavily on certain world's regions that have more ambitious and tighter climate policy (e.g. Europe) may in the long run face more challenges than those (Gulf countries) which export most of their volumes to rising energy markets (e.g. Asia). Additionally, geopolitical relevance for gas exporters will be determined also by the transportation mode: those countries which rely more on pipeline (Algeria, Libya) will face more challenges compared to those who export most of their gas via *LNG, such as Qatar. The latter will be better positioned to respond to the variation and shifts of global demand. In short, energy demand will become a key component of the future energy geopolitics as exporters will compete for smaller markets. Furthermore, some of the MENA hydrocarbon exporters (Saudi Arabia, the UAE, Qatar) could remain geopolitically relevant in a low carbon future given their low-production costs and low carbon intensity of their production compared to other MENA and global producers. In order to remain competitive and geopolitical relevant, MENA hydrocarbon exporters will need to enhance the resilience of their industry to better face tighter demand and climate policies.*

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_6

All MENA countries could gain new geopolitical relevance by exploiting their great renewables potential. Key domestic factors determining the future geopolitical role of all MENA countries include population growth, financial capabilities, governance stability. These will define the ability to implement the required reforms as well as adapt and adjust the domestic dimension to the upcoming low-carbon future. Those with small population, high domestic financial reserves and stable governance will be better positioned to achieve their renewable targets, implement domestic reforms to transform the industry and the country in line with a decarbonized global energy landscape.

A key sector where all these countries have a potential is the export of clean energy both in the form of electricity and hydrogen. North African countries could eventually benefit from higher renewable installation, land availability and geographical proximity to export clean energy to Europe even though they would need to speed up renewable deployment for domestic and international purposes as well as enhance cross-border interconnections. Hydrogen fits well in the existing hydrocarbon industry and responses to the need to find new income sources. Numerous countries in the region have expressed their commitment to become major producers and exporters. Preferences on the 'color' of hydrogen vary among MENA countries. Maghreb producers have the advantage compared to other MENA countries to be able to export hydrogen to Europe cheaply through adapted but existing gas pipelines. Those countries which are considering to develop long-distance maritime hydrogen trade may face technical and economic challenges. Some countries may prefer to use domestically produced clean hydrogen in order to decarbonize their industry sector, often a key pillar of the industrialization of these countries, and then export final or semifinal decarbonized products.

The global energy transition is set to entail major geopolitical transformations that will impact the countries of the MENA region, given the current pivotal role of these countries in global energy geopolitics. Commonly, yet erroneously, the energy transition is seen as the end of the petrostates. Indeed, some petrostates are expected to remain relevant in the energy system as hydrocarbons will still play a significant role also in a future net-zero energy system. Moreover, MENA countries, thanks to their low production costs, have a competitive advantage. Energy markets have always been characterized by volatility and shocks. Strong price volatility may result in the fortune or crisis of hydrocarbon producing countries, enhancing or weakening their role in the geopolitical landscape. In fact, the energy transition entails opportunities for MENA countries, because they are all endowed with renewable energy sources, notably solar and wind. Therefore, both hydrocarbon-rich and hydrocarbon-poor countries may find solutions to remain or become relevant in the upcoming geopolitical map.

This chapter seeks to address these issues by explaining the impact of the changing global energy process on the MENA region, and then identifying which factors, both at the international and domestic level, could contribute to the repositioning of MENA countries in the evolving energy landscape. Finally, the chapter will try to outline further geo-economic implications for the region in light of the energy transition.

6.1 Geopolitical Impacts of the Changing Global Energy Landscape on the MENA Region

As illustrated in the previous chapter, the MENA region is a cornerstone of the current global energy system. Oil has shaped the domestic socioeconomic model, contributing to form the existing ruling élites, and positioning the MENA region at the center of the architecture of energy geopolitics. However, all of this could fade away—or at least be drastically weakened—as the global energy transition unfolds.

The clean energy transition, along with technological developments, is expected to challenge the socio-economic and geopolitical foundations of the region in general, and of its oil and gas producing countries in particular. This could cause major geopolitical risks as oil and gas producers could start a fierce competition war, while lower oil revenues could trigger domestic social instability. At the same time, however, both hydrocarbon producers and importers of the MENA region may benefit from the energy transition thanks to their important renewable energy potential (mainly solar, but in some countries also wind), positioning themselves as clean energy exporters.

In 2019, the International Renewable Energy Agency (IRENA) launched the report '*A New World. The Geopolitics of the Energy Transformation*' (2019), assessing the geopolitical consequences of the energy transition. This report takes into consideration its potential effects on oil producing countries, among which MENA oil and gas producers are particularly important.

In the last five years, several scholars have increasingly focused their studies on the evolution of low-carbon energy geopolitics (O'Sullivan et al. 2017; Scholten 2018; Hafner and Tagliapietra 2020), which may produce multiple and relevant consequences in the power relations among and between energy producers and consumers, affecting the geopolitical importance of MENA oil producers. MENA producing countries have historically enjoyed an important geopolitical influence because they supply a large portion of the fossil fuels needed to run the world's economy. However, they are likely to see a decline in their global influence due to the expected reduction in global oil demand, unless they can adapt and adjust their economy to the new energy era.

Oil and gas producers in the region must face a challenge that has two dimensions: domestic and international. A decline in global oil and gas demand would entail less revenues for producing countries. This would deeply challenge the socio-economic roots of these countries, considering their profound dependence on the oil and gas rents (the so-called 'Rentier state' model) see Chap. 2, Sect. 2.1. Moreover, the clean energy transition might push producers towards a fierce competition for global market share, exacerbating geopolitical risks both regionally and globally.

The evolution of oil, domestic stability and prosperity, as well as international influence, are deeply interlinked in the MENA region. Any geopolitical consideration of a more carbon-constrained world must therefore take into consideration the domestic aspects.

In 2020, MENA oil and gas producers experienced a situation that can be described as a preview of what the future might look like for them beyond 2030 and towards 2050, as global decarbonization takes more and more ground. The COVID-19 pandemic resulted in an unprecedented crash in global oil demand. Lockdown policies across the globe forced the shutdown of business, manufacturing, travel, entertainment, logistics and retail destroying the ability to consume oil, causing the strongest contraction in the oil industry's history (−20 mb/d in April 2020).

At the same time, oil prices collapsed due to a lethal combination of falling demand and OPEC+ coordination failure. Brent price dropped from $63.5 in January to $18.3 in April 2020. The benchmark price for US crude oil, the West Texas Intermediate (WTI), was even briefly negative in April 2020 for the first time in history due to the lack of available storage capacity in Cushing, Oklahoma, where the WTI trading hub is located. The combination of falling demand and oil prices generated a perfect storm for MENA oil and gas producing countries that led to significant macroeconomic imbalances.

All the countries of the region saw negative growth in 2020 (IEA 2020a). This weakness was manifested in both oil and non-oil sectors. Indeed, most of the oil and gas exporters had diversified their economies in sectors deeply affected by the COVID-19 outbreak, such as tourism, real estate and aviation. MENA oil and gas producers had to turn to public expenditure cuts and increase fiscal adjustments. Saudi Arabia decided to triple its VAT from 5 to 15% in July 2020, while suspending its cost of living allowance to shore up state finances. The allowance of 1000 riyals ($267) to state employees was introduced in 2018 to help offset increased financial burdens (BBC 2020).

After decades of (largely unfounded) concerns about supply disruptions and resource scarcity, COVID-19 exacerbated a trend started almost a decade before: abundance of energy. Underpinned by high oil prices, the 2000s have witnessed an expansion of oil production in different geographical areas, including US shale oil in the 2010s. A confirmation of the energy abundance dynamic is the relatively small oil price impact of major incidents to oil infrastructure and tensions between critical suppliers, such as the attacks to Saudi oil facilities, tanker seizures since 2020, and the increasing use of international sanctions against major oil and gas producers such as Venezuela and Iran. All these (geo)political episodes did not reignite fears over potential supply disruptions, while it is reasonable to say that the same events would have produced more long-lasting and serious oil price shocks only a decade ago.

Energy abundance has triggered the decline of energy prices, which were expected to enter into a "lower for longer" period—albeit with some volatility. So, the expansion of the supply side and lower oil prices are two of the main characteristics of the energy abundance period that started in 2014. Nonetheless, in 2021/22 the world has experienced a spike of energy prices caused by the sudden and strong restart of energy demand after months of lockdowns, massive public expenditure, limited spare capacity and geopolitical tensions. Although high energy prices may remain for quite a while, the current energy price spike highlights the increasing role of price volatility as a feature of the transitional process. Low energy prices may be the end outcome, while growing price volatility may be the transitional effect of a world that is steadily undergoing a fundamental overhaul.

Throughout the last two decades, the world's energy markets have witnessed an expansionary trend, with an increasing global output. Simultaneously, OPEC countries have seen their market share decline (Fig. 6.1).

COVID-19 has exacerbated some factors, shifting the attention from the supply to the demand side. Until 2020 the abundance of energy was related to the supply side; 2020 (and COVID-19) produced an energy abundance, which was mainly driven by demand constraints—a plausible scenario also for the decades ahead in a global deep decarbonization pathway.

As in other phases of high oil prices (e.g. 1980s), in the 2000s non-OPEC production grew extensively while demand growth was more moderate. Such an expansion was mainly driven by high prices (above $100 per barrel over the period 2011–2014) (Fig. 6.2). High prices were motivated by low spare capacities, thus the risk of potential supply disruptions, mostly due to geopolitical reasons.

Around 2010, the global energy markets were shaken by a major energy revolution pushed by small independent companies that tapped US oil and gas unconventional reserves through 'hydraulic fracking'. The so-called 'Frackers' allowed the US to

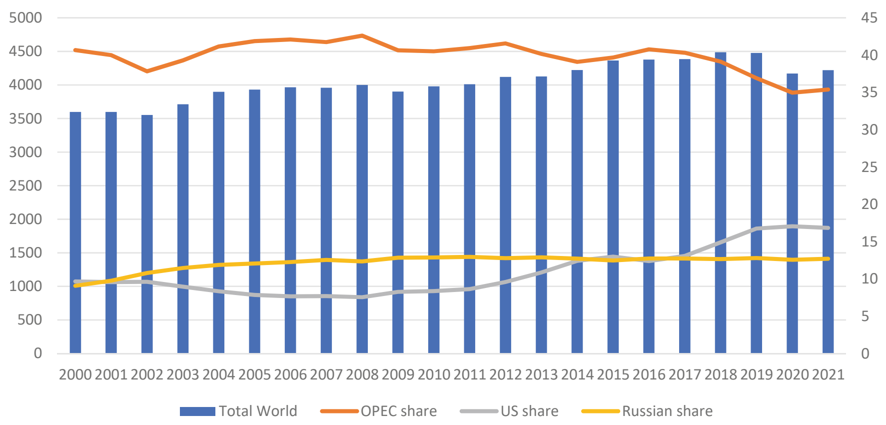


Fig. 6.1 World's oil output (million tonnes, left axis) and OPEC, US and Russian share (%, right axis), 2000–2021. *Source* Authors' elaboration on BP (2022)

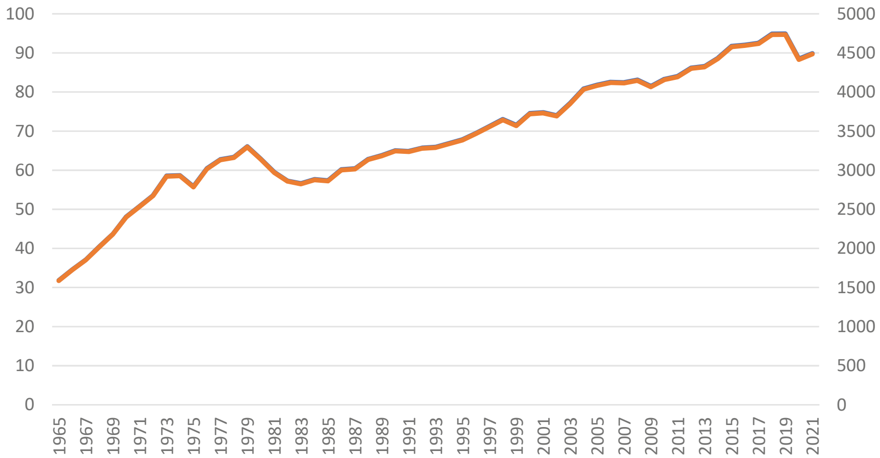


Fig. 6.2 World oil output 1965–2021, mb/d (right axis) and Mt (left axis). *Source* Authors' elaboration on BP (2022)

increase domestic output and reduce its import dependence towards unstable regions like the Middle East and North Africa.

Sustained by favorable economic, financial and technological conditions, the 'Frackers' allowed the US to abandon fears of energy scarcity, which had driven American energy policy and diplomacy for decades. The US' historical need to secure stable and ever-growing oil supplies had underpinned the traditional security architecture of the MENA region, influencing alliances and hostility.

The expansion of domestic oil and gas output (and the consequent ability to export) prompted lengthy discussions about the potential consequences on US-MENA relations and the region's loss of strategic relevance for US policymakers. The Trump Administration extensively invoked the achievement of 'energy dominance' and 'energy independence'. Thanks to the growing domestic output, Trump decided to pursue a more assertive foreign policy regarding energy and security issues, expanding financial sanctions (against Venezuela and Russia) and imposing higher pressure on other suppliers (Iran). This strategy has partially faded with the election of Joe Biden as President in 2021. Nonetheless, the new American energy status has enabled Washington to take a stand vis-à-vis Russia. Moreover, the Biden Administration has extensively affirmed its commitment to lead the energy transition.

The American oil and gas production may ultimately cause a reduction of US engagement in the MENA region, especially at a time of escalating power rivalry with China. Even though the US will increasingly focus on its broader competition with China and other world regions, the US will not completely withdraw from the MENA region or lose its interest in energy issues. O'Sullivan (2017a, b) affirmed that the US has three constant objectives that are easier to achieve thanks to the new energy abundance, i.e.: (1) ensuring that global energy markets—particularly the oil market—are well supplied; (2) encouraging allies to diversify their own sources of energy; and (3) using its power as the largest global oil consumer to penalize countries, or to compel them to change policies (O'Sullivan 2017a, b). As we shall see below, the US energy status is still far from the self-proclaimed 'energy independence'. Even though the US has reduced energy imports, the US oil and gas producers are exposed to price volatility. Thus, the MENA region is still strategically important for Washington and the US and its energy sector is still deeply affected by the developments of the global energy markets.

However, the growing role of the US in the global oil market has also impacted the long-lasting relation with Saudi Arabia. In 2014, Saudi Arabia increased its oil output in order to drive out of the market its higher-cost competitors, notably the US shale producers, which were constantly increasing output at prices above 100 $/b. This strategy caused a major drop in oil prices (Fig. 6.3), and MENA oil and gas producers started to take into consideration diversification strategies in order to reduce their vulnerability to oil price volatility. Oil prices were then stabilized thanks to the shared and coordinated effort of OPEC and non-OPEC countries (led by Russia) in 2016, which contributed to enlarging the governance of global oil markets.

From a demand perspective, fossil fuels have witnessed some downturns. The 2008 financial crisis caused a temporary decline of oil demand, especially in developed countries. Nonetheless, the demand of fossil fuels (especially oil) has increasingly been under pressure. The 2015 Paris Agreement represents a watershed episode for future fossil fuels demand. The COP21 marked climate change as one of the top priorities for the world's governments. National governments and international institutions have expressed their political commitment to decarbonize the world's economy in order to reduce global temperature and tackle the negative effects of climate change. Ever since, the global momentum for a global and deep decarbonization has increased.

Along with political decisions, technological developments have enabled governments and citizens to increase energy efficiency and allowed renewable energy sources to penetrate energy mixes. The strong development and prospects of electric vehicles (EVs), combined with regulatory bans on internal combustion engines (ICEs), may hinder future oil demand. Road transport accounted for more than 40% of global oil demand in 2019. The transport sector's growth has been responsible for over half of the total oil demand growth since 2000. The growing deployment of EVs, along with hydrogen and natural gas vehicles, will erode almost 15 mb/d of oil demand growth by 2040, according to BNEF (2020).

Energy geopolitics will further mutate, as the global energy transition gains pace. MENA oil and gas producing countries will feel geopolitical shifts, both in terms of domestic stability and international influence. Therefore, this chapter will evaluate the geopolitical implications of the consequences caused by the transition, taking into account also the domestic sphere.

The general context is thus characterized by increasing political support for decarbonization policies combined with technological progress aimed at increasing the penetration of technological solutions that reduce reliance on hydrocarbons. Despite this general context, it is important to stress again that the MENA countries are far

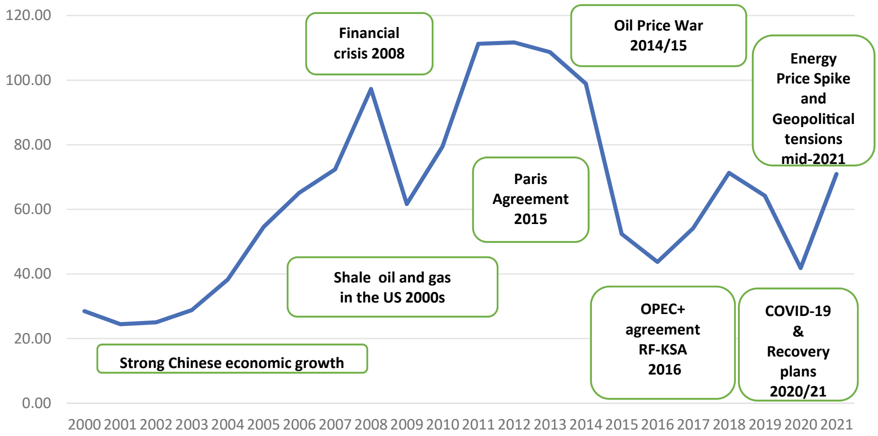


Fig. 6.3 Brent price ($/barrel, $ money of the day) and main (geo)political events, 2000–2021. *Source* Authors' elaboration on BP (2022)

from being a homogenous group, and that the impacts of the global energy transition may be very different depending on the country. Such differences are due to: the country being a hydrocarbon exporter or importer, if the country is a hydrocarbon exporter, whether its primary focus is on oil or gas; the country's export portfolio composition and its diversification, its economic diversification, and domestic characteristics (financial, political and institutional capacity to adapt to profound transformations).

6.2 Key Factors Determining the Future Geopolitical Role of MENA Oil and Gas Exporters

Today, MENA oil and gas producers need to take into consideration some international factors in order to design proper strategies to maintain their geopolitical influence and role. As discussed in the following pages, these international factors are: (i) the different trajectories of oil and gas demand as decarbonization policies are gaining momentum worldwide; (ii) the different pace of the energy transition across the world's regions; (iii) the crucial need for diversification of export portfolios; (iv) the higher competition experienced by producers in a constrained demand world; (v) the advantages of some producers (low-production costs and carbon intensity) compared to their competitors.

MENA producers are set to remain among the last producers in a decarbonized world thanks to their vast resources, low production costs and new competitive advantages. At the same time, MENA countries (including non-hydrocarbon producers) might try to exploit their renewable potential to contribute to the common effort against climate change and to position themselves as important clean energy players.

That is not, however, an easy task. Nonetheless, the global energy transition will further stress the strong tie between oil revenues and socioeconomic and political stability. The ability to collect and allocate oil revenues remains crucial as oil revenues may fade away in the longer run, while at the same time moving away from the rentier economy may prove socially difficult.

The following sections (from 6.2.1 to 6.2.5) are focused on the key factors that will affect oil and gas producing countries, while non-hydrocarbon producers in the MENA region are driven by different factors. They are not pushed by the need to protect their hydrocarbon industry and increase its resilience ahead of lower oil demand, but they need to find alternatives to produce wealth for their growing population as explained in the section (domestic factors).

6.2.1 Oil and Gas: Different Scenarios, but with Some Common Long-Term Challenges

In a decarbonized world, fossil fuel demand will decline significantly. However, future fossil fuel demand may witness differences across the world's regions due to climate policies as well as economic and demographic trends. Oil and gas demand are likely to have different trajectories in the future. Oil demand is expected to increasingly lose relevance as a result of growing decarbonization policies and technological developments in oil demand-driving sectors such as transport (i.e. electric vehicles), while natural gas will play a bridging role in the global energy mix for decades to come—often labelled as "transition fuel". Natural gas will, however, face higher political scrutiny due to methane emissions and it will need to be decarbonized in the longer run.

Thus, a first consideration is the different outlook that oil and gas producers may have. Oil producers may encounter challenges and a loss of geopolitical influence earlier than gas producers. In the last years, attention has moved from the concept of 'peak oil supply' to 'peak oil demand'. Peak oil demand consists of a decline of global oil demand in the relatively near term, caused by the climate policies (i.e. improvements in energy efficiency, greenhouse gas emissions limits) and the development of technological solutions (i.e. expansion of EVs). Estimates and forecasts diverge on when this might occur. A range from the mid-2020s to the 2040s or beyond is identified by different sources.

Section 2.6.3 in Chap. 2 outlines the evolution of future oil demand according to the International Energy Agency's scenarios. Global oil demand, which had reached its record level of 97.6 mb/d in 2019 before falling to 88.5 mb/d in 2020 during the shutdowns of the first Corona year, is expected to reach by 2050 a level of 45 mb/d (−54% compared to 2019) in the "Sustainable Development Scenario" (SDS) and even down to 21 mb/d (−78.5%, or compared to 2019) in the "Net Zero Emissions Scenario by 2050" NZE (Fig. 2.7, see Chap. 2, Sect. 2.6.3). In SDS, Middle East[1]

[1] The IEA definition of Middle East excludes North Africa.

oil production is expected to fall from some 30 mb/d in 2019 to some 18 mb/d by 2050, a reduction of 40%. At the same time, the global market share of MENA oil will increase from some 31% of today to 38% by 2050. Despite the expected peak of oil demand, global oil demand increased in 2021 (94 mb/d) underpinned by economic recovery and massive public investment plans. Apparently, oil demand has not reached its peak yet. Nonetheless, governments have committed to their climate ambitions. Moreover, technological developments, coupled with high fossil fuel prices, may incentivize consumers to shift towards more clean energy solutions in several sectors, such as transport.

Natural gas demand has a different, yet challenging, future (Figs. 2.8 and 2.9 see Chap. 2, Sect. 2.6.3). The IEA foresees that in decarbonization scenarios global natural gas demand remains roughly stable at around 3860 bcm (the 2020 level) up to 2030. After 2030, the global demand for natural gas (in particular for unabated natural gas) should decline rapidly. By 2050, natural gas demand is expected to reach around 2367 bcm (−39% compared to 2020) in the SDS and 1686 bcm (−56% compared to 2020) in the NZE. In NZE, natural gas demand falls largely in all regions, except those that are currently heavily reliant on coal, where natural gas largely displaces coal. In NZE, in 2050, about half the global gas will be produced in the Middle East and Russia. According to this deep decarbonization scenario, the Middle East production of natural gas would fall from around 650 bcm in 2019 to some 400 bcm in 2050, representing a quarter of the global natural gas supply (another quarter is expected to be supplied by Russia and the US, respectively—the balance by Africa and the rest of the world). Therefore, even though overall production in the Middle East would decline, its market share on a worldwide scale would increase from 14% of today to 24% by 2050. Still according to NZE, interregional trade of natural gas will fall to less than 300 bcm, around 40% of the current level.

In short, over the next decades, global oil and gas demand will need to fall in line with global climate targets. Compared to oil, the fall in gas demand will be less rapid and less dramatic. Due to the important reserves and low production costs of the MENA region, the market share of this area is expected to increase, even though their absolute exports will nevertheless fall importantly. The different pace of declining demand for oil and gas poses a different urgency to MENA oil and gas producers in the short term, while in the longer run they face the same challenges to preserve their geopolitical position in the global energy map.

As the following section illustrates, today's energy transition is mainly a policy-driven process, meaning that its speed across the world may vary significantly.

6.2.2 Energy Transition: Not with the Same Pace Across the Globe

Being a policy-driven process, clean energy transition will happen at different speeds across the world, and this will be a further factor in determining MENA geopolitical shifts. Moreover, it will determine divergent trends of fossil fuels demand in different geographical areas. For instance, Europe's oil and liquids demand is expected to decrease from the current 13.3 million tons of oil equivalent (Mtoe) to 8.6 Mtoe in 2040, according to the International Energy Agency (IEA)'s Stated Policies Scenario. By contrast, Asia–Pacific countries' oil and liquids demand is set to increase from the current 32.5 to 37.9 Mtoe in 2040 (IEA 2020b).

The pandemic has further exacerbated such divergent trends among different regions—especially between OECD and non-OECD. The focus of most governments in the post-pandemic period will be on restoring economies and stimulating employment. This focus might push global oil demand. However, a growing number of the world's economies (mainly advanced economies) have decided to use their recovery strategies and funds with a strong emphasis on supporting green investment. This will exacerbate the divergent trends in energy (and particularly oil) demand between OECD and non-OECD countries (OPEC 2020). The 2022 Ukraine war will also strengthen Europe's transition to green energies over the medium to long term as outlined by the REPowerEU plan.

These elements highlight an important feature of future energy geopolitics: the increasing dominance of energy demand. Particularly in an energy abundance period (oversupplied energy markets and constrained demand), energy demand will become more relevant in the geopolitical equation.

Following the recent IPCC reports of 2018 (*Global Warming of 1.5 °C*), 2021 (*Climate Change 2021: The Physical Science Basis*) and 2022 (*Climate Change 2022: Impacts, Adaptation, and Vulnerability*) calling for limiting global temperatures to 1.5 °C, a growing number of countries have announced their pledge to become carbon–neutral by mid-century (Fig. 6.4).

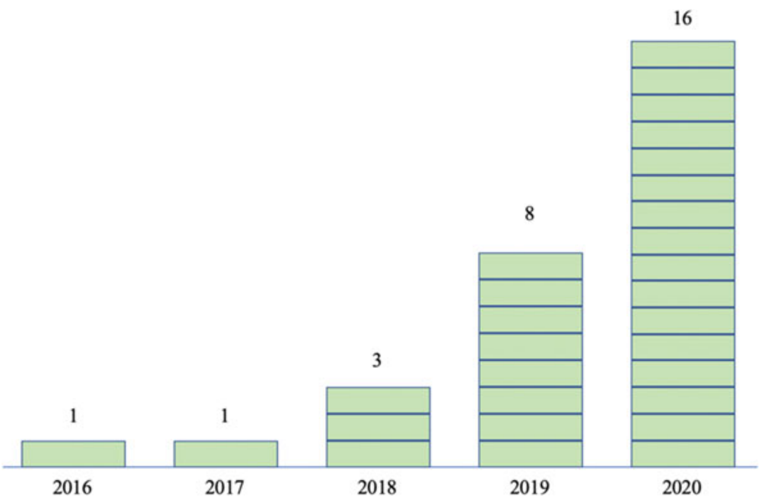


Fig. 6.4 Number of countries to announce net zero targets, count, split by year of announcement. *Source* Authors' elaboration on Rystad Energy (2020)

Many governments took advantage of the recovery plans to implement strong climate agendas and to prepare their economies for a decarbonized world. For example, the EU announced its ambition to become the first carbon–neutral continent. Climate policies and the European Green Deal are key pillars of its €750 billion recovery plan. In September 2020, China's President Xi Jinping announced that China will reach carbon-neutrality by 2060. And with the election of Joe Biden as President of the United States, the US rejoined the global climate arena aiming at reaffirming itself as an important player in the fight against climate change and the energy transition. In 2021, Russia joined the carbon neutrality club, with President Putin's announcement that Russia will reach carbon neutrality by 2060 at the latest.

Those MENA producers that are more dependent on the energy markets that have higher decarbonization commitments, such as the European Union, will be more exposed to economic and geopolitical loss unless they adapt to the new context. The producers, such as the North African ones, which are unable to diversify their export portfolio, may suffer the most and more rapidly from the energy transition of their key markets. By contrast, those MENA oil and gas producers that export to growing energy markets, like Asian countries, should be able to preserve their geopolitical influence. For such reasons, the export portfolio composition and its diversification are increasingly crucial in the new energy transition.

6.2.3 Export Portfolio Composition and Its Diversification

It will be of paramount relevance for oil and gas producers to ensure a proper and diversified export portfolio that will help them to navigate in the future geopolitical waters of the energy transition, and it will be crucial for MENA oil and gas producers to secure and create demand for their exports.

The main battleground will be Asia and its fast-growing energy markets. By contrast, Europe is expected to reduce its fossil fuels import dependence, especially in the long-term, as a consequence of strong climate policies (i.e. the European Green Deal). Therefore, those oil and gas exporters that are (and continue to be) heavily dependent on the European markets will see a reduction of geopolitical influence, alongside falling revenues.

Among oil exporters, the Gulf countries are already selling most of their products to the Asian markets. By contrast, the North African countries, such as Algeria and Libya, export most of their oil to Europe and North America. This divergence is clear in the following table that shows the different export outlets for key oil exporters and the relevance of the Asian markets in their export portfolio. Kuwait and the Emirates export about 84% of their oil to the Asian markets, while the percentage declines significantly for North African countries (26%) (Fig. 6.5).

A defining factor for successful diversification strategies also regards the type of fossil fuel and transportation mode in the case of gas. Indeed, while oil (and LNG) can easily follow demand changes, piped gas does not provide the same degree of

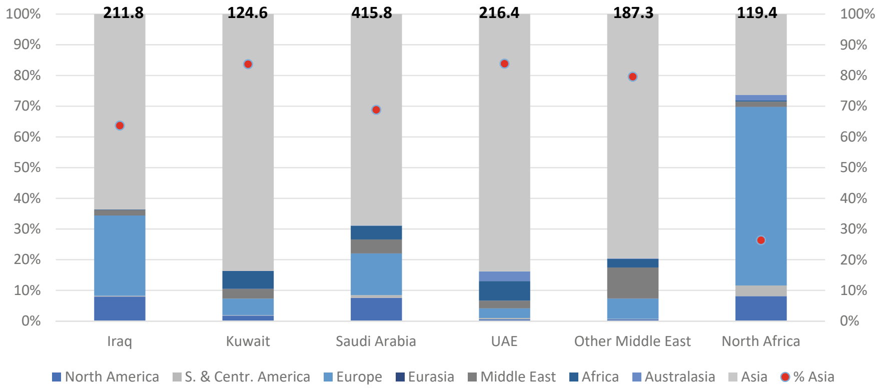


Fig. 6.5 Main oil exporters and their export outlets, 2019. *Note* Figures above the bars are the total export volumes in million tonnes in 2019. *Source* Authors' elaboration on BP data

flexibility, as it cannot shift according to demand dynamics. An example of challenge represented by demand changes is Algeria, once an important gas player in the European gas markets. The vast majority of its gas exports flows to Europe via pipeline: in 2019 85% of Algeria's total gas exports went to Europe, 62% of which via pipeline (BP 2020b), mainly to Italy and Spain (Fig. 6.6). To reduce its overdependence on European markets, Algeria could increase its LNG exports to its total capacity of 25.3 Mtpa, and thus diversify its gas export markets. Following Russia's invasion of Ukraine in 2022, the European Union wants to wean itself off Russian gas. This provides a new momentum for North African countries as they benefit from geographical proximity and existing political and energy relations with European countries.

Indeed, LNG provides more flexibility to gas exporters, which are better positioned to respond to the geographical shifts of energy demand, ensuring market

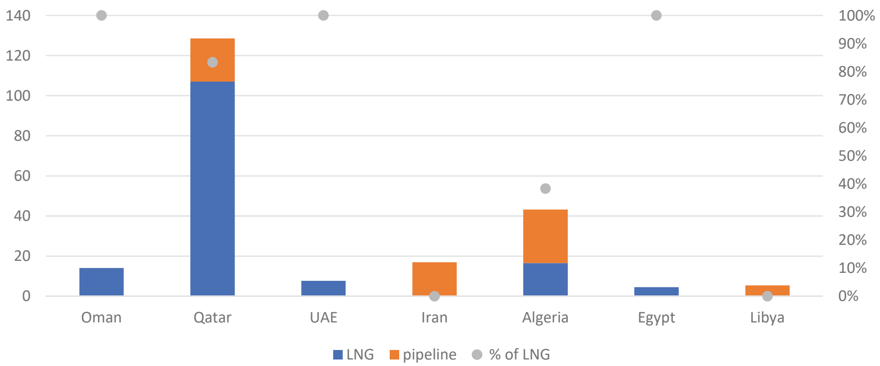


Fig. 6.6 Main MENA gas exporters' gas exports composition (LNG vs. pipeline), (left), and the LNG share of total gas exports (right) in 2019, bcm. *Source* Authors' elaboration on BP data

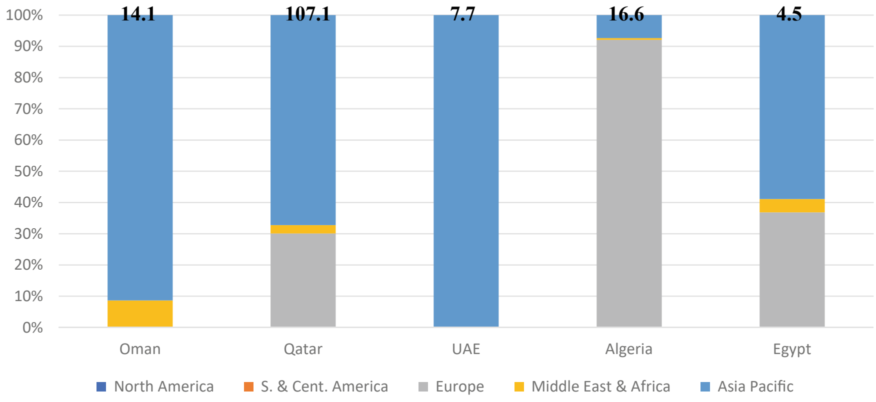


Fig. 6.7 Main LNG exporters and their export outlets, 2019. *Note* Figures on the top of the bars represent the total LNG export volumes in 2019. *Source* Authors' elaboration on BP data

shares in growing gas markets in particular in Asia. However, Algeria's LNG exports are highly dependent on European markets (92% of Algeria's total LNG exports in 2019) (Fig. 6.7). LNG exporters in the MENA region are divided between those located West of Suez (North African exporters) and East of Suez (Gulf exporters). This geographical factor will define competitiveness in the European or Asian markets, as passing through Suez entails higher costs (besides longer distances). Thus contributing to increasing costs. In fact, the competitive advantage of LNG exporters in the European or Asian markets will depend on whether they are located West or East of Suez.

Qatar inevitably holds a leading position within this group of countries, being the top LNG exporter. Indeed, in 2019 Qatar exported 107.1 bcm of LNG, which represents 83% of its total gas exports. Of this volume, 67% was directed to Asia Pacific countries (BP 2020b). Moreover, Qatar has developed a well-diversified export portfolio, with several LNG importing countries (both in Europe and in Asia), as Fig. 6.8 shows.

In fact, the Asian markets are expected to lead natural gas demand growth, with China and India as the two major gas importers in the coming decades. Furthermore, increasing global gas volumes are expected to be transported via LNG, while pipeline volumes (especially in Europe) are expected to decline, also in line with the effort of European countries to reduce their dependence on Russian gas due to Russia's war in Ukraine. LNG trade is thus expected to expand significantly at a global level in the next decades, and global LNG trade will expand from just over 50% of the traded volumes of today to 60–70% in 2050, depending on the scenario (IEA 2021). DNV GL forecasts that the seaborne trade of natural gas (LNG and liquefied petroleum gas combined) will increase fourfold from 415 Mt per year in 2018 to 1680 Mt per year in 2050 (DNV GL 2020). Bloomberg NEF et al. (2020) estimates that China will meet 54% of its demand through gas imports in 2040, while India's import share will rise from 48% in 2018 to 58% by 2040.

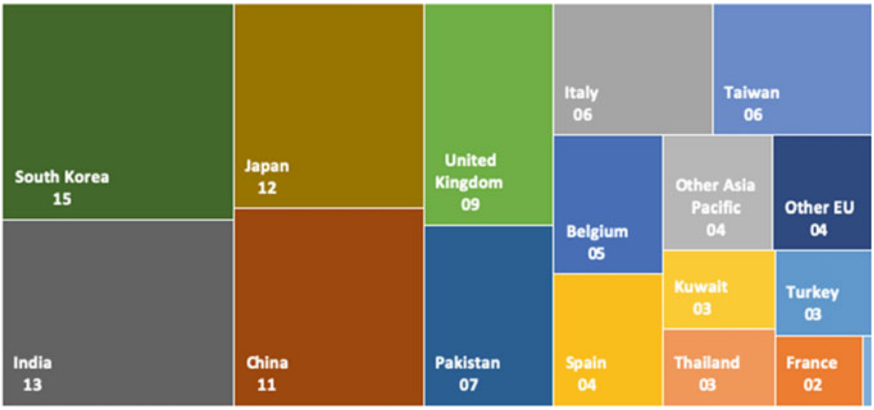


Fig. 6.8 Qatar LNG exports by country, 2019, (bcm). *Source* Authors' elaboration on BP (2020b)

In such a challenging context, both oil and gas producers will look to preserve and expand their competitive advantages as they will need to compete for a smaller market.

6.2.4 Competition Will Remain and Increase in a Constrained Demand World

Although energy demand will dominate the next phase of energy geopolitics, supply issues will not disappear. Oil and gas producers will still compete for markets and this competition could even increase. A peak of oil demand will result in harsher and more intense competition, and tighter revenues for MENA oil and gas producers. It is reasonable to believe that not all oil and gas producers will pursue the same supply strategy, as each producer will also make specific social and economic considerations related to its domestic sphere.

Indeed, the transition raises an existential dilemma of maximizing production and weakening higher-cost competitors, or coordinating production cuts to increase oil prices—vital for governments' revenues and their domestic stability. This is of paramount importance, as the future strategy will change global oil markets and the geopolitical relevance of MENA oil and gas producers.

Over the past few decades, high-cost producers have coexisted and competed alongside low-cost producers in the oil market. Due to the perceived scarcity fears, the laws of competitive markets have not been applied to the oil markets. High-cost producers have been able to operate without being driven out of the market; on the contrary, they have gained ground, as happened with the US. This is because low-cost producers, such as MENA countries, have effectively rationed their supplies of oil. They have preserved their resources for the future (since they are the government's

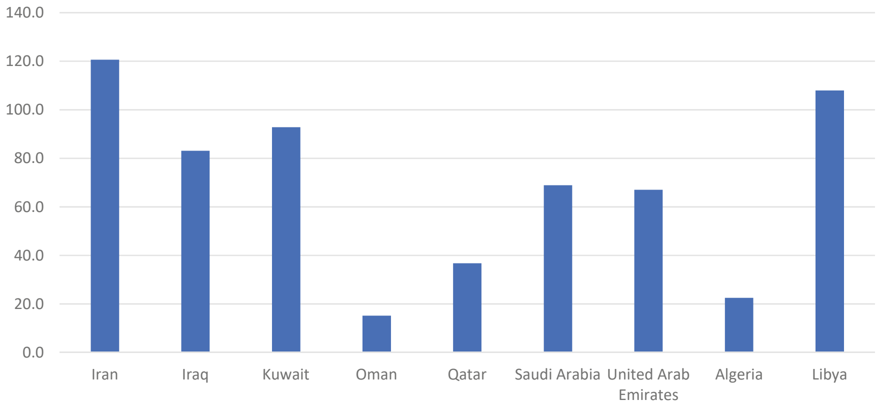


Fig. 6.9 R/P ratio in selected MENA oil producing countries, 2019 (years). *Source* Authors' elaboration on BP (2020b)

main revenue source) rather than using their competitive advantage to maximize their market share (Dale and Fattouh 2018). A consequence of this policy is that the proved reserve to production ratio (R/P) extends to several decades, beyond all peak oil demand forecasts (Fig. 6.9). This could undermine the ability of MENA countries to monetize their large reserve base, which is vital for the functioning of their economies.

To avoid major losses, MENA oil exporting countries could also pursue oil output strategies to boost their revenues. Such an approach does not come without important consequences and trade-offs, and thus requires to be carefully considered. A high volume or market share strategy could result in a fall in oil revenues as the higher revenue due to higher volumes may not compensate for the loss in revenues due to the lower oil prices. Such a risk is both related to the short term (as low oil prices may not result in the immediate shut-in of production in high-cost producers) and to the long-term (as revenues might not increase if other producers turn out to be more resilient to a low oil price environment—while in a high price environment, which implies a supply shortage, any supply maximization possibility will be pursued by all players). On the other hand, in a low price environment, MENA oil producers could cut output to support prices and increase their revenues even though this strategy comes with great uncertainty. It may result in loss of market share and may not lead to large increases in revenues if the cuts are replaced by increases in output from non-participating producers (Fattouh and Poudineh 2020) and/or a faster demand destruction.

2020 and COVID-19, characterized by a strong reduction of demand and thus prices, exacerbated the dilemma of low-cost producers. A maximization of production strategy would put into question established assumptions on saving reserves for future production and avoid stranded assets. However, greater competition among suppliers could undermine coordinated actions (i.e. agreements within OPEC), which are a key tool to oil price stability. The years 2021 and 2022 present a completely different situation in terms of energy prices due to an unbalanced supply–demand equilibrium and a geopolitical price premium due to additional risks. Nonetheless, high energy prices may induce some producing countries to ramp up their production, especially those that rely heavily on hydrocarbons to maximize their revenues. As a result, political coordination among producers may become increasingly difficult in a scenario characterized by tighter demand.

Throughout the period of low prices (2014–2020), producers managed to work together to stabilize oil prices. A crucial contribution was the expansion of oil governance with the formation of OPEC+ in 2016. Its relevance became even clearer in March 2020 when the agreement collapsed due to differences between the two kingmakers (Riyadh and Moscow). The disagreements regarded the best political response to the sudden halt of the world's oil demand due to lockdowns. Saudi Arabia waged a full price war, slashing their official selling prices (FT 2020) and announced plans to increase production to 10 mb/d or more since April 1st, 2020 (the day after the expiration of the OPEC+ agreement). Traditionally, Saudi Arabia is able to increase its supply at short notice and is willing to shift policy if there is no agreement on collective cuts and/or lack of compliance to enforce discipline in the absence of a formal enforcement mechanism (Fattouh 2021).

Moreover, the 2020 oil price war between Saudi Arabia and Russia also had another target: the US shale producers. Thanks to high oil prices, technological developments and financial advantages, the US has become one of the world's largest oil producers, gaining increasingly large market shares at the expense of the OPEC+ countries.

To end the economic bleeding, Russia and Saudi Arabia put aside their disagreements within weeks and OPEC+ agreed on a historic cut of 9.7 mb/d. On this occasion, the US played a pivotal role in the agreement, demanding a more collaborative approach to its long-lasting Gulf ally. The American involvement highlights the dual role of the US in the global oil markets and governance: on the one side, the US acts as a producer and calls for a higher oil price in a low-price environment, whereas in a high-price environment, it acts as a consumer calling for a lower oil price (Fattouh 2021).

OPEC+ managed to preserve its cohesion throughout the increase of oil prices in 2021/22 despite the growing political pressure of Western importing countries (US, UK and the EU). It was possible because its coordination is in the national interests of the producing countries. Nonetheless, some OPEC countries have announced their intention to pursue the maximization of their capacity, thus weakening the coordinated policy, because it is in the interest of some of the countries to remain relevant players (albeit potential lower oil demand). This is the case of cyclical tensions between the UAE (OPEC's third-largest oil producer) and Saudi Arabia. Indeed, the UAE announced an ambitious plan to increase its oil capacity from about 4 to 5 mb/d by 2030. Moreover, in late 2020, ADNOC announced a $122 billion investment plan for 2021–2025 (corresponding to an annual investment of $24.4 billion), suggesting that the UAE have abandoned their more cautious approach to the oil sector. To put its scale into context, the 2020 ADNOC's investment plans are broadly in line with those of Saudi Aramco. Indeed, Saudi Aramco slashed 2020's planned CAPEX by nearly 30% to $25–30 billion.

These expansion plans reveal that MENA oil producing countries are eager to benefit from their vast competitive advantages compared to other producing countries. For example, the UAE has a strong ambition on energy: it has announced a 5 mb/d target by 2030, setting its target of gas self-sufficiency by that time, tripling its petrochemicals capacity and boosting its refining capacity by 60%. These plans are underpinned by vast and existing fields and major additional discoveries such as those announced by Abu Dhabi's Supreme Council in November 2020, of an additional 2 billion barrels of conventional to 107 billion barrels oil reserves and a more notable discovery of 22 billion barrels of unconventional oil resources (Mills 2020b). This confirms the ability of ADNOC to increase its capacity with existing fields.

Despite the great unity throughout the Covid crisis and the following oil price spike, the growing prioritization of national interests, the potentially looming peak of oil demand and higher volatility may induce producers to increase their production and undermine coordinated policy. The pursuit of national interests may induce a change in oil policy and intensify disagreements within the OPEC and OPEC+ framework. Nonetheless, it seems that only few countries (Saudi Arabia, UAE and Kuwait) hold enough spare capacity to increase their production and gain higher market shares. Another source of potential tension within the OPEC+ framework may be the fact that Russia may be forced to increase its oil imports toward Asia, the main market for the Gulf countries, especially in China, due to the increasing pressure of Western sanctions in the wake of the Ukrainian war. This may put under scrutiny the Saudi-Russian pact and the broader OPEC+ framework.

All of this poses further pressure on the traditional alignment among Gulf OPEC producers, and challenges OPEC agreements particularly since the month-by-month revision of output limits is a source of potential tension every month. Although all oil producers agree on the necessity to cooperate in order to correct market and price volatility (given their negative effects on government revenues), they generally disagree over which producer should shoulder the burden of the cut. As the global clean energy transition unfolds, these disagreements might intensify, particularly if we consider the larger number of producers involved in the latest coordinated decisions (OPEC, non-OPEC, including also to some extent the US), the size of the needed cut, the diverse nature of the players and their different interests.

Indeed, other OPEC countries have repeatedly announced expansion plans. An example is Iraq that declared a capacity of not less than 7 mb/d by 2027 (Mills 2020b). However, such a target might seem unrealistic in the foreseeable future due to Iraq's specific characteristics, such as poor fiscal terms for IOCs, a lack of infrastructure and the inability of the Baghdad government to carry its share of costs.

In the gas sector, Qatar mostly competes with extra-regional producers, notably Australia, the US and Russia. Due to major changes in the LNG market and higher competition from other LNG producers, in 2017 Qatar ended its self-imposed moratorium of 77 Mtpa in place since 2005. The capacity expansion will be divided into 2 phases. Phase 1 encompasses four trains with a capacity of 32 Mtpa, which should become online by 2025 raising Qatar's overall liquefaction capacity to 110 Mtpa.

Phase 2 would produce an additional capacity of 16 Mtpa over the next two years. Such an expansion faces some challenges. Qatar will have to find markets for 32 Mtpa in new volumes by 2025 along with around 20 Mtpa in contracts expiring in that time (Cahill and Tsafos 2020). Qatar will evaluate whether to postpone the Phase 2 expansion according to market conditions. Qatar Petroleum (QP) also holds a 70% equity stake in Golden Pass LNG in the US, which has a capacity of 15.6 Mtpa. Its first train is expected to be on stream in 2024. QP decided to enter the US LNG market in the aftermath of the GCC embargo against Doha in the attempt to enhance its ties with Washington. Moreover, in the last years QP has expanded its international presence by acquiring upstream and downstream assets in the US, Brazil, Angola, Cote d'Ivoire, Guyana, Kenya, Morocco, Mozambique, Oman and South Africa.

In the upcoming competition, Qatar believes it is in the best position to defend and gain market shares, although it may suffer some losses on the price side. To gain market, QP may partially rethink its price strategy. Qatar has been one of the strongest supporters of oil-indexation and long-term contracts in Asia. Some contract negotiations suggest that at least in the short term QP will make concessions on prices to lock up long-term contracts. As a defense mechanism, Qatar expanded booking capacity at existing European import terminals—in particularly at the Zeebrugge terminal in Belgium and the Montoir-de-Bretagne terminal in France (Cahill and Tsafos 2020). Europe still represents the destination of last resort for LNG. Since Asian countries will play a crucial role in the expansion of LNG demand in the foreseeable future, QP could decide to solidify its ties with Asian importing states through concessions to Asian energy companies in its LNG expansion, as did Abu Dhabi with its offshore and onshore blocks.

In order to face the effects of the global energy transition and the potential oil demand peak, MENA oil and gas producers may pursue a strategy aimed at diversifying export portfolio (new and old markets), while generating more value from their existing production as highlighted by Mills (2020a).

However, MENA oil and gas producers are looking for value generation mostly outside the upstream sector. Investment in the oil upstream generally faces challenges caused by either domestic political or security problems, especially in some North African countries. Libya's upstream situation is highly influenced by security concerns and the evolution of the conflict. Algeria is facing a long-term decline of its oil and gas output unless major new discoveries or investment in EOR are made.

MENA oil and gas producers are increasingly moving toward the downstream sector like refining, petrochemicals, tankers, storage, trading and fuel retail in order to increase the value of, and securing market for, their products. Petrochemicals are seen as one of the most promising areas in the MENA energy landscape. The petrochemical sector is seen by international agencies as a key driver of future oil demand. According to APICORP Gas and Petrochemicals Outlook 2020–2024, planned petrochemical projects are expected to rise by $4 billion from the previous estimate to achieve $95 billion over the period 2020–2024 (APICORP 2020).

Middle Eastern countries have increasingly focused on integrating their large-scale refineries with petrochemical facilities in response to the changing global oil consumption habits. The Middle East—along with Asia—accounted for two-thirds of the global refining investment over the period 2015–2020 and for more than 80% of the refining capacity currently under construction.

Given such investments, by 2030 the Middle East and Asia will emerge as the largest global refining centers, overtaking more traditional ones. Moreover, COVID-19 and the following financial constraints are expected to accelerate the restructuring of the global refining industry in these two regions which have different but competitive advantages: the Middle East has the advantage of cheaper feedstocks, while Asia enjoys the vicinity to still-growing demand centers. As a result, the role of NOCs in global refining is likely to strengthen (IEA 2020c). Despite the great ambition, the road to the petrochemicals boom might face financial constraints, geopolitical threats and competition among producers. Among MENA countries, Egypt, Iran and Saudi Arabia are the top three countries in the region in terms of committed petrochemicals investments (Saadi 2020).

Mills (2020a) points out that the Gulf has developed a large basic chemical industry, mostly based on previously flared gas, and using methane and ethane as feedstocks to yield fertilizers, methanol, polyethylene and polypropylene. Currently, new petrochemical strategies focus on mega-scale integrated refining and petrochemical complexes. Such strategies are an important element for supporting local industries and diversification.

For example, Abu Dhabi's ADNOC has decided a $45 billion plan to boost its refining capacity by 60% and more than triple its petrochemicals capacity by 2025—starting from a total refining capacity of 1.3 mb/d in 2019 (BP 2021). A number of the planned petrochemicals projects would use natural gas feedstock. In line with this plan, ADNOC is aggressively expanding the Ruwais downstream hub. ADNOC formed with ADQ the Ta'ziz JV to develop the Ruwais hub. In November 2020, the joint venture outlined plans for the $5 billion first phase of the Ruwais Derivatives Park that will be built near the existing downstream hub. This first investment is a key element of ADNOC's $45 billion program to turn Ruwais into the world's largest integrated refining and petrochemicals complex.

Qatar has also invested in the petrochemicals sector, with the contribution of international partnerships with IOCs (Cahill and Tsafors 2020). For example, in June 2019 Qatar Petroleum signed an agreement with Chevron Phillips Chemical to build one of the world's largest ethane crackers in Qatar. The new petrochemical plant will be built in Ras Laffan Industrial City and will come online by 2025. The plant will include an ethane cracker with an annual ethylene capacity of about 1.9 Mt, increasing Qatar's polyethylene output capacity by 82% (Reuters 2019). The QP-Chevron partnership did not end with this project, reaching an agreement shortly after on an $8 billion petrochemicals complex in the US: the US Gulf Coast II Petrochemical Project (Al Jazeera 2019).

The strong focus on a more integrated strategy in the region was highlighted when Saudi Aramco announced the acquisition of a 70% stake in Sabic in July 2020. That decision was a key element of its long-term downstream strategy to expand its refining and petrochemicals capacity as well as to generate more value from their existing production. In line with this strategy, the two companies planned to build a $20 billion integrated crude-to-chemicals project at Yanbu, located on Saudi Arabia's west coast. Aramco and Sabic signed a preliminary agreement for the project in 2017. The plant would process 400,000 b/d of crude to produce some 9 Mtpa of chemicals and base oils (Argus Media 2020a). However, the project also represents a major setback in Saudi Aramco's petrochemical ambition. Following the economic crisis in 2020, the two companies decided to reassess the project. As an alternative, the companies are considering the integration of Saudi Aramco's existing refineries in Yanbu with a mixed feed steam cracker and downstream olefin derivative units. Moreover, Saudi Arabia invested heavily into the 400,000 b/d Jizan, or Jazan, refinery in the south of the country. The plant is linked to a petrochemical facility.

Egypt is focusing on two integrated projects. The $8.5 billion complex in Al Alamein, which includes a 2.5 Mt/year crude and condensate refinery, is expected to be completed by 2024. The project should meet local demand and could also export products. The other project is located in the Suez Canal Economic Zone. The $6.2 billion project is expected to produce up to 1.9 Mt/y of petrochemicals and up to 900,000 Mt/y of refined products. The project would import crude to be processed into petrochemical and refined products. These two projects are part of a $19 billion investment plan in 11 projects, highlighting Egypt's ambitions to reduce its dependence on refined products imports by 2023. In 2019, Egypt imported nearly a third of its oil products consumption (30.2 Mt/y) at a cost of $6.8 billion (Saadi 2020).

MENA NOCs have also evaluated opportunities in the downstream sector abroad. The overseas investments allow NOCs to guarantee a stable channel for their crude, mostly in Asia (e.g. India and China). For example, Saudi Arabia and the UAE are increasingly looking for opportunities in India, which is expected to be a growing energy market with ambitious petrochemical plans for the medium and long-term. In 2018 Aramco and ADNOC agreed to 25% of India's $70 billion 1.2 mn b/d refining and 18 Mtpa integrated petrochemicals JV project at Raigad. However, the project has suffered from serious delays. Costs have been soaring drastically and the planned completion was postponed, even before the COVID-19 outbreak, from 2023 to 2025. Aramco is also planning to invest $15 billion for 20% of the refining and petrochemicals business of India's Reliance Industries, although with slow progress. The other major market is China, where Saudi Aramco has also tried to expand its downstream foothold with two preliminary agreements. It signed with Zheijan Petrochemical for 9% of the Zhoushan refining and petrochemicals complex south of Shanghai; and for 35% of Norinco's complex at Panjin in the northeastern Lioning province. However, COVID-19 challenged also these projects. Saudi Aramco withdrew from the $10 billion project for the refining and petrochemicals complex in the northeastern Lioning province (ArgusMedia 2021). Nonetheless, the strategic goal is to create new business opportunities to ensure demand, and future projects may be signed depending on the evolution of oil prices and demand forecasts. Saudi Arabia and the UAE have key advantages over other current top suppliers, notably Iraq, which faces deep-rooted economic challenges that undermine its ability to carry out such strategy and investment.

The enhanced value generation involves also ‘in-country value (ICV) creation’, which is the attempt to improve the capacity of local firms or joint ventures to supply the domestic oil industry with equipment (Mills 2020a). One of its goals is to eventually produce internationally competitive oil services and engineering firms.

MENA oil and gas producers are looking at Norway as an example in ICV creation. Indeed, Norway was one of the first countries that devoted efforts to increasing value in its local supply chain. Seeing benefits from foreign investment in its resources, Norway set a series of policies to bolster ICV, such as requiring usage of local suppliers in procurement activities; mandating IOCs to enter into joint R&D agreements with Norwegian research institutes; and obligating IOCs to enter into training agreements in order to improve human capital and to recruit a specific share of Norwegian employees in projects.

ICV seeks to maximize the procurement of local goods and services as well as to improve the capacity and capability of MENA people and companies in order to secure sustainable commercial benefits for the regional countries. In doing so, MENA oil and gas producers could boost skills development and create high-skilled jobs for their citizens instead of hiring expatriates. Oman has implemented an important ICV strategy, while also ANDOC announced its effort to create ICV in the next years. Mills (2020a) warns of the collateral and negative effects of localization and protectionism that could result in higher production costs.

It is reasonable to believe that the oil and gas sector will remain dominant in the MENA countries’ economies in the years ahead. Renewables may replace hydrocarbon resources in the domestic energy mix, but not in the government budgets, because investment in renewables does not generate the high returns that the oil and gas industry does.

Fattouh and Poudineh (2020) claim that MENA oil and gas exporters could pursue a strategy that focuses on their competitive advantage and increases their resilience. This strategy is called conservative bet-hedging strategy, which in other words means that ‘a bird in the hand is worth two in the bush’. The core of this strategy is to enhance the competitiveness of the energy sector and increase its resilience against potential risks of disruption due to the energy transition.

The extraction and export of hydrocarbons is the core sector of these economies. It provides high return, but it faces high risk due to oil price volatility and potential change in demand patterns. MENA oil producers could thus adopt such a strategy to defend their economies from the risks of revenue disruptions. According to Fattouh and Poudineh (2020), MENA oil exporters could implement a set of key measures:

- Decarbonizing oil and gas production as it may become a new source of comparative advantage in a world of rising carbon prices and climate policies;
- Strengthening the sector’s cost efficiency to make it more competitive in a tough environment;
- Decarbonizing final petroleum products to ensure greater acceptance and demand for key products as the transition towards decarbonized sources of energy accelerates;

- Moving downward the value chain and producing decarbonized final products (e.g. steel and aluminum) through the use of clean hydrogen.

6.2.5 Low-Production Costs and Carbon Intensity Rate

The lowest-cost producers, the frontrunners of which are Saudi Arabia, the UAE, Kuwait and Iraq, will be able to keep selling their oil the longest. This position guarantees important competitive advantages to most MENA oil and gas producers vis-à-vis other global hydrocarbon producers. They have some of the lowest production costs and vast hydrocarbon reserves. Qatar has the world's cheapest production cost in the LNG. The co-production of associated natural gas liquids (condensates and liquefied petroleum gas) made the North Field exploitation very lucrative. However, the Qatari LNG expansion would be the cheapest new LNG supply, even if the associated natural gas liquids may become less abundant in this development. However, MENA oil and gas producers must take into account their social costs. Due to their rentier state structure, their lowest production costs are markedly inferior to their socioeconomic costs. Their social costs are represented by the breakeven fiscal oil price (Fig. 2.1 in Chap. 2, Sect. 2.1), which suffers from price volatility.

Low-cost oil producers cannot sustainably seek to gain market shares by adopting a higher volume/lower price strategy if this strategy requires selling their products below their production plus social costs (Fattouh 2021). This would be the case, because pursuing such a strategy would induce a reaction from other OPEC producers, further depressing oil prices and harming macroeconomic and fiscal sustainability for MENA oil and gas producers. In such a scenario, there is no (or little) room for cooperation among producers. This is particularly true for those economies that lack an economic and fiscal diversification. The more MENA oil and gas producers are dependent on oil rents, the less a higher volume/lower price strategy would be bearable, especially in the short and medium term. In the longer run, a higher volume/lower price strategy could guarantee higher revenues for MENA oil and gas producers if higher-cost producers are driven out of the market. On the other hand, those MENA countries that fail to adapt and adjust their economies to a tighter revenues scenario, may face serious problems. They would ultimately be deeply affected both in terms of social and political stability as well as economic sustainability. The domestic instability could not only prevent these producers from maximizing their reserves, but also from potentially maintaining their oil capacity. In that case some major producers (namely Saudi Arabia) could decide to pursue a high-volume-market share strategy in the next decades (Fattouh 2021). In short, MENA oil and gas producers should first reduce their social costs of production, diminishing their dependence on hydrocarbon revenues, and then fully benefit from their lowest production costs without hindering their fiscal and macroeconomic outlooks.

Thus, low-production costs are only one part of the equation in evaluating the best strategy. Another crucial issue will be the carbon intensity of the oil and gas production. Even if MENA oil and gas producers manage to secure and defend their market share, and to maximize their product value, their products would still face climate issues. Production, transportation and use of oil and gas still produce carbon emissions. On this issue, some MENA oil and gas producers are well positioned, having the lowest production carbon intensity, which is set to become more relevant in a high-carbon prices scenario. At low levels of carbon prices, differences in carbon intensity have a relatively low impact on overall costs and competitiveness. Saudi Arabia and the UAE have one of the lowest carbon intensity rates in the world (as shown in Fig. 6.10). Saudi Arabia is committed to further improving this condition. Saudi Aramco announced that it aims to reduce its upstream carbon intensity by 15% by 2035 against a 2018 baseline (Aramco 2022). On the other hand, other MENA oil producers, such as Algeria and Iraq, have higher carbon intensity rates, which could harm their competitiveness in the future energy system.

The Saudi, Qatari and Emirati lower carbon intensity is due to a combination of the nature of their reserve base and their heavy investment in infrastructure and technology. For example, Saudi Arabia—via its NOC Aramco—is the most advanced in thinking about demand defense in terms of climate compatibility (Mills 2020b) through significant investment in R&D. Moreover, Saudi Arabia has very low gas flaring rates per barrel and low water volume per unit of oil produced. According to World Bank data, Saudi Arabia has one of the lowest gas flaring rates per barrel of oil produced thanks to the implementation of major projects to mitigate routine gas flaring across its oil and gas value chain. Gas flaring is one of the main causes of the high carbon intensity rate of crude production. This is why Algeria, Iraq and Iran are considered to have higher carbon intensity. However, the issue is far more

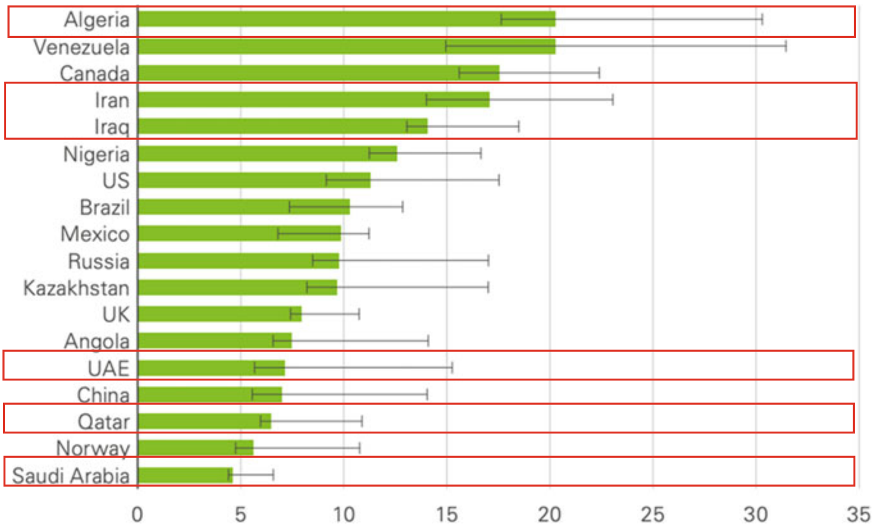


Fig. 6.10 Average carbon intensity of crude production by country, 2015 (g of CO_2e/MJ). *Note* Error bars include 5–95th percentile of fields. *Source* BP (2020a, b, c)

serious in Iraq compared to Russia and the US in relative terms to total gas production (Fig. 6.11).

Saudi Aramco prioritizes the reduction, reuse, recycle and removal of GHG emissions to harness its Circular Carbon Economy framework. Therefore, it announced that it aims to achieve emissions reduction and mitigation by 2035 through: renewable investment that will reduce 14 million metric tons of CO_2e annually ($MtCO_2e/y$); investing in CCUS for a reduction of 11 $MtCO_2e/y$; improving energy efficiency to reduce 11 $MtCO_2e/y$; reducing methane and flaring to cut 1 $MtCO_2e/y$; and other offsets to mitigate 16 $MtCO_2e/y$.

All these factors (low flaring, reducing methane leakage, improving energy efficiency of operations and inherent advantages such as prolific reservoirs and limited water cut) contribute to the greater competitive advantage of Saudi Arabia, Qatar and the UAE. The carbon intensity rate issue of oil and gas is expected to become a more decisive factor in a world of rising carbon prices and carbon border taxes, and is destined to become a key factor of the competitiveness of oil and gas producers.

A crucial issue is if the carbon intensity of different crudes and condensates can be reduced and at what cost. Electrification (via renewables) may offer some carbon intensity reduction to operational emissions at relatively little cost—especially in MENA countries. However, differences in carbon intensity may persist in the future. Similar issues also apply to natural gas supplies. In addition to the production side, carbon intensity also depends on the export mode (pipeline or LNG: the liquefaction process, for instance, has a very high self-consumption of 10–12%).

Concerning gas exporters, in November 2020 Qatar Petroleum signed a historic deal to supply Singapore's Pavilion Energy with up to 1.8 Mt per year of LNG for 10 years from 2023. Besides marking the launch of QP's new dedicated LNG trading arm (QP Trading), the deal is more meaningful because each delivered cargo will be accompanied by a statement of its GHG emissions measured from well to discharge

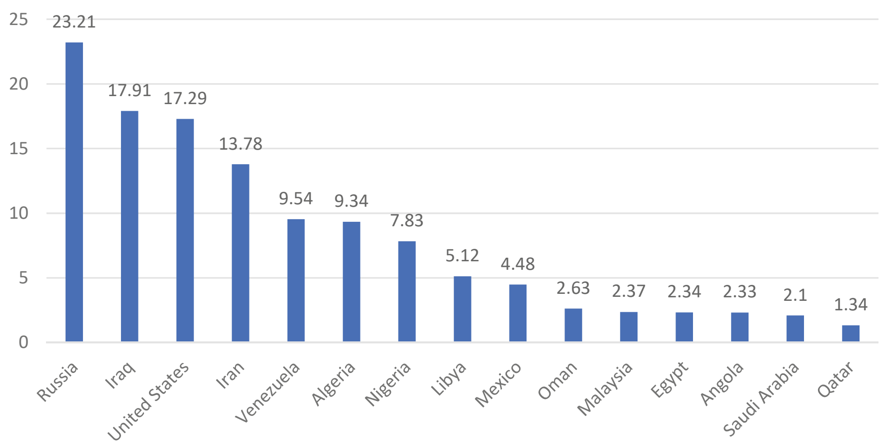


Fig. 6.11 Gas flaring in 2019, (bcm). *Source* Authors' elaboration on World Bank data

port (MEES 2020a). Even if it is not a common, binding methodology, it represents a key opportunity for the world's top LNG exporter to sell low-carbon LNG. QP aims at providing a reasonable methodology for its product, which could be a competitive advantage and a marketing tool within the energy transition.

IOCs have been setting several targets to reduce their carbon dioxide emissions pushed by governments, consumers and stakeholders. European companies, such as Total, BP, Eni, Shell and Equinor, have become leaders in this process, while US companies, like ExxonMobil and Chevron, have been more skeptical—even though higher investors' pressure has recently led to some developments also in the US. Companies can target both emissions within their own boundaries (direct, Scope 1, and indirect, Scope 2) and those associated with the intended use of their products (Scope 3). Emissions are categorized as Scope 1, 2 and 3. Scope 1 covers "direct emissions" from sources owned or controlled by a company; Scope 2 covers emissions from the transformation of energy purchased by a company, such as electricity or heat; and Scope 3 consists of all other indirect GHG emissions as a result of a company's activities from sources not owned or controlled by the company and the entire value chain. As public and political pressure grows, IOCs are increasingly considering to address also Scope 3. However, IOCs are only one factor in the fossil fuels industry; national oil companies produce 55% of the world's oil and gas. Thus, NOCs are also expected to be under greater scrutiny in the foreseeable future.

To respond to such a scrutiny and strengthen their existing advantage, major Gulf NOCs (Saudi Aramco, ADNOC and QP) have launched large carbon capture and storage (CCS) facilities. CCS could contribute to injecting carbon dioxide from gas processing or industrial facilities into underground reservoirs for safe disposal or enhanced oil recovery (EOR). For example, Qatar Petroleum has set several targets to position itself as a leader in the decarbonization of the LNG value chain: reducing the emissions intensity of LNG facilities by 25%; installing Carbon Capture and Storage (CCS) facilities with a capacity of more than 7 Mtpa; eliminating routine flaring by 2030; setting a methane intensity target of 0.2% across all facilities by 2025. Moreover, it set a new target to reduce flare intensity across upstream facilities by more than 75% from the 2013 level (MEES 2021a). In line with these strategies, some MENA NOCs are also members or considering becoming members of international fora, such as the Oil and Gas Climate Initiative (OGCI), as is the case of Aramco, along with leading international oil companies such as Chevron, ExxonMobil, BP, Total, Shell, ENI, Equinor and Occidental.

6.3 Key Domestic Factors Determining the Future Geopolitical Role of MENA Countries

The energy transition (and the consequent peak in oil demand) urges MENA countries to rethink their socioeconomic model, which depends heavily on oil rents. These rents are the core of the social contract across the region as shown in Chap. 2.

Therefore, domestic factors—along with the international factors—will be a key part of the future transformation of these countries, and will determine their future geopolitical trajectory. While international factors are mainly related to oil and gas exporting countries, domestic factors are valid for all MENA countries—including hydrocarbon importing countries—as all of them could exploit their vast renewable energy potential.

Demography, financial reserves and strong governance are the main factors that will determine the ability to adapt and adjust the domestic sphere to the forthcoming transformation. Demographic growth is particularly relevant in the MENA region, where governments have created a socioeconomic and political model based on the allocation of resources. The growing population may hinder the ability of MENA governments to implement diversification, producing domestic and geopolitical risks.

6.3.1 Population Growth Outlook

Demography cannot be ignored in a geopolitical analysis, as it is a powerful element in the geopolitical destiny of a country. While it provides the necessary human capital to succeed and transform each country into a relevant geopolitical power, a growing and young population can also be a risk if not properly handled. This is especially true in many MENA hydrocarbon producing countries, given the peculiar relation between population, ruling class and oil rents, where the allocation of resources is a key pillar of domestic stability, but even more so in net-hydrocarbon importing countries that do not have oil rents, but still need to find employment for their people.

The MENA region has one of the world's fastest growing populations in the world. In 2000, the region comprised 296 million inhabitants. Between 2000 and 2020, around 136 million people were added, almost the same figure (+125 million) is expected to be added in the next two decades (2020–2040). The region experienced an average population growth of around 2% per year over the last two decades, compared to the world's annual average of 1.3% (UNICEF 2019). Currently, the rate in MENA countries is of about 1.7% per year and is expected to decline to about 1.3% around 2030, reaching about 0.8% per year by mid-century (*Idem*). Despite slowing growth rates, MENA's population is expected to more than double in size during the first half of the XXI century, passing from around 296 million in 2000 to 650 million in 2060 according to the United Nations median population scenario (Fig. 6.12).

As with other issues, the region is far from being a homogenous group also in terms of demographic trends. Albeit the general increasing trend, the rate at which the population grows varies considerably from one country to another. At the national level, all MENA countries—with the only exception of Lebanon—are expected to see increases in their total population in the coming decades. Figure 6.13 shows the net addition of total population for all MENA countries in the period 2020–2060 according to the United Nations median population scenario, and illustrates the astonishing growth in countries like Egypt, Iraq, Iran and Algeria. The largest

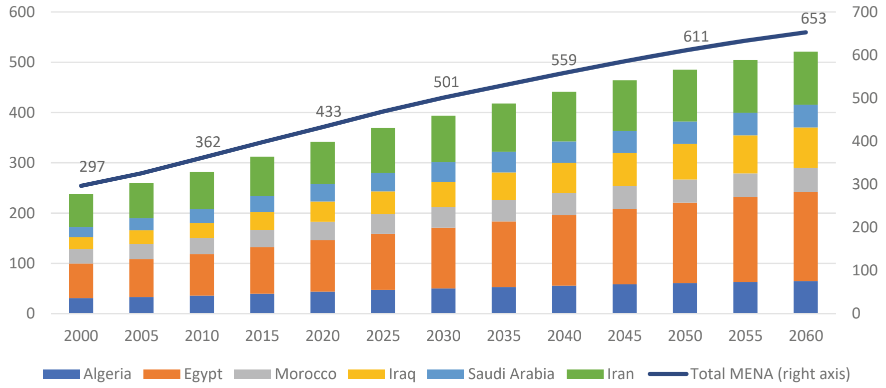


Fig. 6.12 Population growth in the largest populated countries and total MENA region (2000–2060), million. *Source* Authors' elaboration on UN DESA data

population increase in absolute terms is expected to be seen in Egypt, with an additional 75 million by 2060 bringing the total to 177.5 million, followed by Iraq with an additional 40 million, bringing the total population to 80 million, and Algeria with an additional 21 million bringing the total to 65 million, over the same period. By contrast, according to the same source, Lebanon is expected see its population decrease by more than 200,000 people.

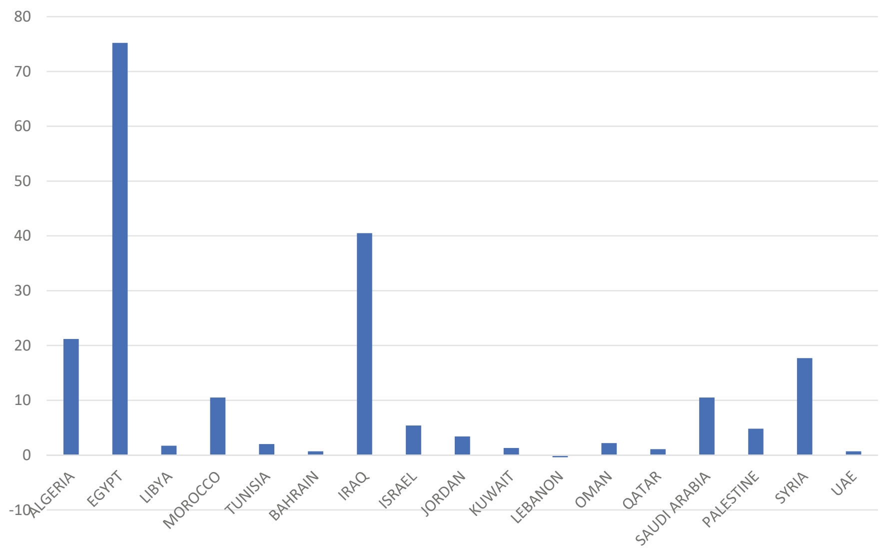


Fig. 6.13 Net addition of total population in the MENA countries 2020–2060, millions. *Source* Authors' elaboration on UN DESA data

Demography is a particularly important feature of future geopolitical influence for MENA oil and gas producers. Should demographic growth offset economic growth, it could determine domestic unrest and socioeconomic instability, which may in turn pose a threat to critical operations in the domestic hydrocarbon industry. Population growth influences per capita income and patterns of employment. Two of the largest producers, Iraq and Saudi Arabia, are expected to see an important population growth, +20 million and +7.7 million by 2040, respectively. Consequently, they could see a decline in net income from oil rents, calculated on a per-capita basis. By contrast, for producers with relatively small populations (e.g. UAE, Qatar and Kuwait) this is less of a concern. On the other hand, hydrocarbon-poor countries are expected to face challenges too. Indeed, oil exporting countries may further reduce the distribution of oil rents in the region prioritizing the domestic dimension of the distribution, as occurred in the second oil cycle, undermining the region's stability due to the widespread rentier mentality.

Given the high fertility rate, a large portion of the MENA population is extremely young (Fig. 6.14). In the years ahead, this proportion of population will need to find a job, thus stressing the MENA governments' ability to create adequate and sufficient jobs for their citizens. The energy transition may represent a positive opportunity in this sense both for hydrocarbon-rich and -poor countries given their renewable potential.

On this issue, population growth is expected to stress the weaknesses of the current socioeconomic model. A large number of young citizens will likely enter the domestic labor markets in the next decades, urging producers like Saudi Arabia and Iraq to diversify their economies and create new job opportunities. It has often been observed in the last decades that MENA producers have failed to foster private sector job creation for their young women and men, while significantly expanding public sector employment. If, on the other hand, these countries are able to diversify and create

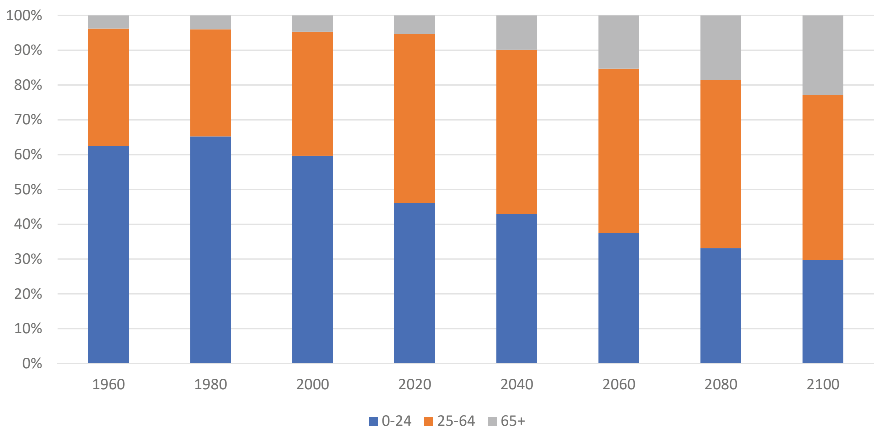


Fig. 6.14 MENA population by selected age groups. *Source* Authors' elaborations on UN DESA data

productive job opportunities, the increasingly larger workforce available (Fig. 6.14) should constitute a formidable driver for growth.

However, the lack of reforms could spark economic and political instability, resulting in a threat to the states. The 2011 Arab Spring embodies this fundamental challenge. Low living standards and lack of job opportunities were among the primary drivers of the uprisings that spread across the region in 2011. Long-lasting regimes were toppled, especially in North African countries, while others were torn apart by civil wars. In this general phenomenon demography played a significant role. Producers will thus need to diversify their economies, create job opportunities for their young populations and find new sources of revenues. Otherwise, they could see their geopolitical influence deeply affected by domestic instability.

6.3.2 Governing and Financing the Transformation

Given the urgency of reforms, another key factor in determining the future geoeconomic and geopolitical trajectories of MENA oil and gas producers, but also oil and gas importers, is the ability to govern the transformation. With some differences, MENA countries have launched diversification strategies, although the ability and strength to implement such strategies diverge significantly by country. Countries that are experiencing major domestic turmoil may not be able to pursue and implement the strategies required to position themselves in the forthcoming geopolitical map, and to adapt and adjust to the changing energy landscape.

Driven by their growing, young populations, governments will need to change their socioeconomic model and energy policies in order to navigate the new energy world. They will need the ability to govern and implement such transformations. Those countries that are experiencing major domestic turmoil may lag behind in the transition. For example, countries like Algeria, Libya, Iraq, Tunisia and Lebanon face significant domestic instability at different levels. These countries may be tempted to focus their energy policies on the maximization of their reserves, rather than addressing the reforms that will be needed to preserve geoeconomic and geopolitical influence.

Libya has been torn by the civil war since 2011. The inability to create a stable unity among different local groups undermines the possibility to implement some adjustments to the country's hydrocarbon sector. Currently, local—along with external—players are more focused on gaining control over the country rather than on transforming the oil sector and the country's economy. Moreover, hydrocarbon reserves are seen as a powerful political tool to gain political support and collect revenues, undermining political solutions.

In 2019–2020 Algeria has experienced unprecedented social unrest since the end of the civil war. The country has been a pillar of European energy security; however, its soaring domestic consumption is increasingly eroding gas export volumes, which are vital for the government's coffers. Further potential social unrest may undermine the ability to implement key legal, fiscal and economic reforms undermines Algeria's oil and gas industry.

Due to decades of political, economic and security shocks, Iraq is extremely fragile. It is one of the most oil-dependent countries in the world. According to the World Bank (2020), oil accounted for over 96% of exports, 92% of government budget revenues and 43% of GDP in 2019. Its energy and economic policies could be deeply affected by the continuous social unrest and negative economic outlook. Baghdad may focus on alleviating socioeconomic sufferings in the short-term without taking into consideration longer-term consequences.

Social and political instability are particularly common in hydrocarbon-poor countries, like Tunisia and Lebanon. Weak governance and inability to implement reforms may further undermine investment in the green transition exacerbating the fundamental weaknesses of their energy and economic systems (Fig. 6.15).

Another key factor is the ability of MENA countries (including oil and gas producers) to finance the transformation, while reducing the short-term negative economic effects of the clean energy transition. In this effort, countries with large foreign exchange reserves are better equipped to offset negative economic consequences in the short term, while financing economic transformation for the next generations (Fig. 6.16).

MENA oil and gas producers have large foreign reserves, supported by other considerable assets that allow these countries to resist the economic crisis caused by decreasing oil prices and/or volumes. MENA oil and gas producers have withdrawn

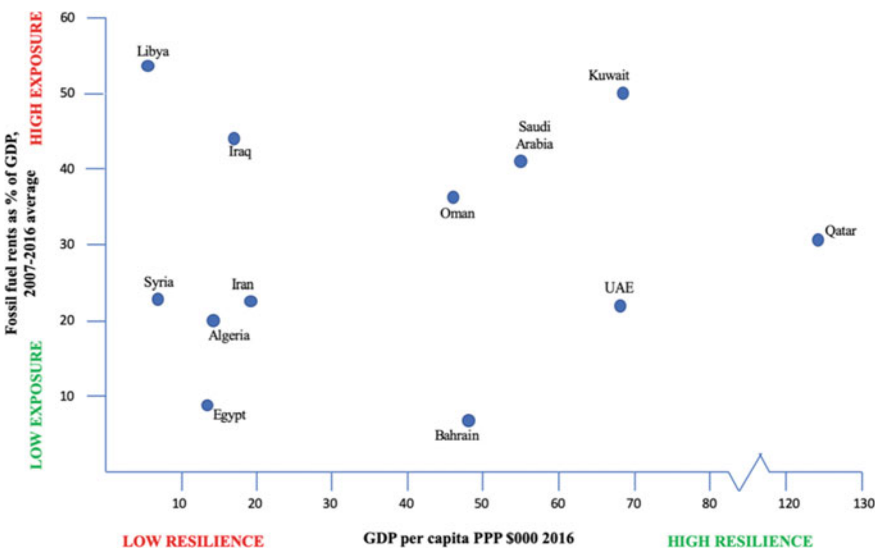


Fig. 6.15 The relative preparedness of MENA fossil fuel producing countries for the energy transition. *Note* The chart includes countries in which fossil fuel rents account for more than 5% of GDP. The GDP of Syria dates from 2010. *Source* Authors' elaboration on IRENA (2019)

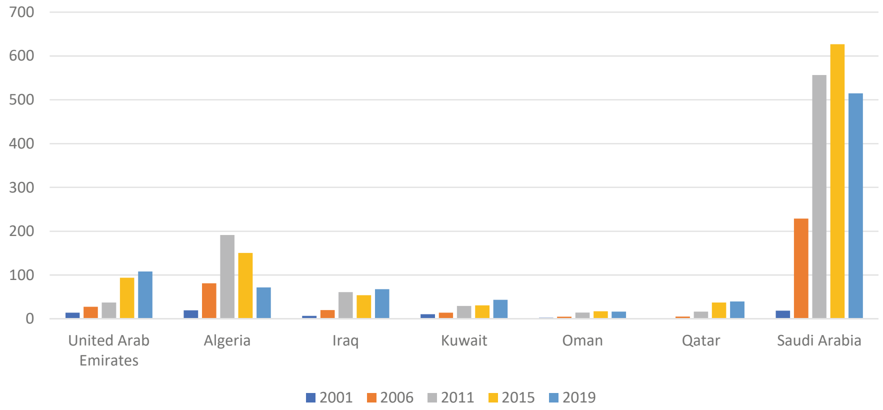


Fig. 6.16 Total reserves* in selected MENA oil and gas producers, (current US$ billion). **gold is included. Note* Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. *Source* Authors' elaboration on World Bank data

capital from their foreign reserves during previous oil price crises in order to alleviate the negative economic consequences and appease their citizens. Countries with low levels of reserves (and higher debt levels) are in a more vulnerable position to preserve their geopolitical role, potentially representing a greater geopolitical risk. Since renewables projects entail high CAPEX (yet low OPEX), importing countries with few financial reserves will need to rely more on external investors than exporting countries. To attract the required investments, importing countries will have to put in place favorable conditions and stable regulatory frameworks, removing market and infrastructure barriers.

Some countries have been able to build significant reserves during the past years, despite previous oil price shocks. Thanks to their larger reserves, the UAE, Qatar and Kuwait are in a better position to weather potential economic and fiscal crises due to the expected reduction of the world's oil demand. Other countries have seen their reserves decline in the last years of low oil prices, notably Saudi Arabia and Algeria. Despite this common negative trend, the two countries have different outlooks. Algeria's reserves have steadily declined since the 2014 oil price collapse due to poor economic management and failure to reform (EIU 2020), while Saudi Arabia still has a large amount of foreign exchange reserves, along with its sovereign wealth fund (SWF), to invest and offset negative economic downturns.

SWFs are another key element of a country's ability to finance the transformation and to weather negative effects. During the previous high oil prices periods, the prevalent approach of these funds was to accumulate wealth with the specific goal to safeguard the economic future in these countries. They usually serve as long-term investment vehicles aiming to provide economic stability during commodities price volatility. The UAE, Kuwait, Qatar, and Saudi Arabia have among the largest SWFs

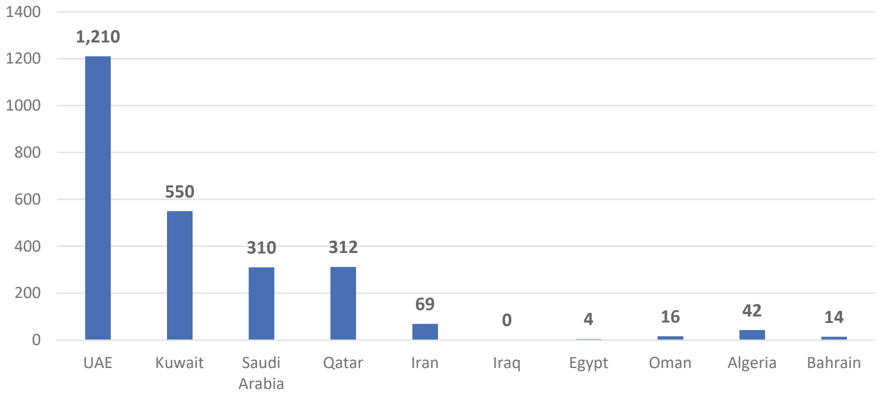


Fig. 6.17 Sovereign Wealth Funds assets under management in the MENA region, (US$ billion). *Source* Authors' elaboration on Bortolotti et al. (2020)

in the region, as Fig. 6.17 shows. Recently, the SWF of UAE has surpassed Norway's SWF, which is traditionally the world's largest.

Given their size, some of these funds can play a critical role in economic diversification efforts. MENA oil and gas producers may decide to use their accumulated wealth more actively to foster economic diversification, while investing on strategies to maintain their oil and gas sector competitive. However, SWFs in some countries are facing withdrawals or increased dividend distributions to fund their respective governments (Bortolotti et al. 2020). In consideration of the growing drawdowns in foreign exchange reserves and SWF assets, the IMF forecasts that financial wealth in the GCC could be depleted by 2035, with significant differences across the six nations (Bortolotti et al. 2020).

In conclusion, Qatar and the UAE are expected to be the best positioned countries given their larger financial buffers, while Algeria, Bahrain and Oman are in a weaker position (S&P Global Platts 2020a).

6.4 Energy Opportunities and Strategies for a Future Geopolitical Role of MENA Countries

6.4.1 Energy Transition in the Domestic Energy Sector: Natural Gas and RES

MENA oil and gas producers have announced major diversification strategies, aiming at adjusting and adapting their domestic energy markets, which are characterized by a soaring energy demand and a high dependence on fossil fuels.

The high dependence on fossil fuels of MENA oil exporters' domestic energy markets poses an economic threat to their public finance. Growing domestic consumption erodes fossil fuels export volumes and hence the primary source of revenues. MENA oil exporters may therefore decide to invest in renewable energy capacity and free exports of hydrocarbons to address the government's revenue maximization objective. The cases of Algeria and Saudi Arabia are quite illustrative, with a growing domestic energy consumption that has progressively reduced the availability of oil and gas exports directed to more lucrative markets. MENA oil importers may benefit from higher renewable capacity by reducing their import needs and consequently import expenditures. Thus, MENA countries have also developed ambitious plans to increase natural gas and renewables in the power generation mix, aiming also at reducing liquid burn in the power sector as is the case of Saudi Arabia.

In order to satisfy their growing domestic energy demand, MENA oil producers have considered the development of their domestic natural gas resources to increase the natural gas share in their energy mix. Traditionally, natural gas was considered a by-product of associated oil fields. With few exceptions (i.e. Algeria, Qatar and Egypt), MENA countries have not invested in non-associated natural gas fields, which are indeed relatively underdeveloped. The use of natural gas could allow MENA countries to develop a more diversified energy mix. Indeed, the use of associated gas in the power sector faces challenges especially under coordinated curbs on oil output, which consequently reduce gas output. Fattouh (2021) highlights the fact that the new increments of gas supplies in Saudi Arabia have reduced the volume and share of crude burn in power generation and moderated the sharp swings in crude burn. The development of non-associated gas fields is essential at a time of OPEC production cuts that reduce associated gas output. For example, Saudi Arabia brought online a major new non-associated gas processing plan (the Fadhili facility) which has helped offset the associated decline. Saudi Aramco has thus focused on developing shale gas and offshore non-associated gas reserves, allowing the Kingdom to meet its demand and increase the flexibility of its oil policy. This is evidence of the strong integration between Saudi oil and gas policies (Fattouh 2021).

Some MENA countries have resorted to their domestic gas resources while others had to resort to gas imports. Some countries (i.e. Algeria, Qatar, Saudi Arabia, Iran and Egypt) have been able to exploit their resources with no gas imports (in the case of Algeria, Saudi Arabia and Qatar) or very limited ones (in the case of Iran). To meet their domestic consumption, other MENA countries need to rely on gas imports via both pipeline and LNG. It is the case of the UAE, which imports both pipelined gas via the Dolphin pipeline from Qatar and LNG through two FSRUs. The decision on the transportation mode depends on several factors, among which geopolitical and energy security concerns. Some MENA countries therefore decide to rely on LNG imports to meet their demand even though they have important gas producers nearby (i.e. Qatar and Iran for the Gulf countries and Algeria for North African countries). In 2009, Kuwait commenced the Mina Al Ahmadi FSRU, which was replaced in 2014 with the newly-built FSRU Golar Igloo that extended the nominal capacity to 5.8 Mtpa. In July 2021, Kuwait received its first LNG cargo at its new Al-Zour LNG import terminal. The Al-Zour plant will be the Middle East's largest import terminal.

The first phase of the project includes 11 Mtpa of regasification plant and four storage tanks of 225,000 m^3 each, which could be doubled during the second phase allowing Kuwait to receive 22 Mtpa of LNG (Bloomberg 2020). In 2020, Kuwait signed a 15-year agreement with Sheel and Mitsui to secure a total of 8 bcm/y of LNG until 2035 and another set of contracts with QP and Qatargas running from 2022 to 2037 for 8 bcm/year. In January 2020, Bahrain completed the construction of its first LNG import terminal—the 6.1 Mtpa Hidd terminal—following some delays. Also, Saudi Arabia is evaluating importing LNG on its western coast. This decision came with Saudi Aramco's international presence: in 2019 Saudi Aramco signed a preliminary agreement with Sempra which called for Aramco to take a 25% stake in the US Port Arthur LNG project and offtake 5 Mtpa of supply from the terminal. However, Saudi Aramco and Sempra mutually agreed to let their 2019 agreement expire in 2021. In North Africa, Morocco has evaluated increasing its gas share as a way to reduce its dependence on coal-fired power generation and on its neighboring country, Algeria. Morocco is thus considering importing LNG through an FSRU that would allow it to import 1.1 bcm by 2025, 1.7 bcm in 2030 and 3 bcm in 2040.

Natural gas will also represent a way of diversifying oil-based economies. Natural gas provides feedstock for value-added industries such as petrochemicals, monetizing gas reserves and extracting more value from their hydrocarbon resources. Some MENA countries have declared ambitious development plans for their natural gas reserves, in particularly unconventional and non-associated gas. The region holds important unconventional resources, for example in Algeria's Ghadames and Timimoun basins and in Saudi Arabia's Jafurah basin, the offshore Khalij al-Bahrain area, both onshore and offshore in the UAE (e.g. Jebel Ali find) as well as Oman.

Saudi Aramco has identified the expansion of its gas production as one of its main strategic goals. The country aims to double its gas production capacity in ten years to more than 200 bcm/year in 2025. The unconventional gas reserves are a pillar of this goal. Back in 2013 Saudi Aramco identified three major shale gas deposits: Turaif in the Northern Borders province, South Ghawar near the supergiant oilfield and the Jafurah Basin to the east of Gahwar. Turaif in the northwest region is the site of Saudi Arabia's first ever unconventional gas production, having begun in 2018 at 55 mn cfd. A pillar of this goal is the development of the Jafurah Basin, among the largest shale gas resources in the world with 5664 bcm. Saudi Aramco envisaged a $110 billion investment plan for developing the field to reach a production of 63 mcm/d of gas (23 bcm/year) approximately 425 million cubic feet per day of ethane, and 550 thousand barrels per day (kb/d) of other natural gas liquids and condensates by 2036. Saudi Aramco is expecting to fund these expenses by selling stakes of the company. Its development will occur in stages. Jafurah will produce gas which will be primarily reserved for domestic use to meet future energy demand for power, water and petrochemical production. The Jurassic Tuwaiq Mountain formation is the primary target within Jafurah. Unconventional gas fields are major industrial projects. They could thus enable the growth of local small and medium enterprises, foster job creation and increase technical know-how, which would perfectly fit the goals of the Saudi Vision 2030.

Bahrain announced the discovery of the Khalij al-Bahrain tight oil reserves in 2019, with an estimated 80bn barrels of oil and 14 tcf gas in place. But the region's leading unconventional player is Oman. BP brought the Ghazeer project online in October 2020. It is the second phase development of Block 61's tight gas reserves, following the 2017 startup of 1 bcf/d Khazzan output. The Block 61 output should thus reach 1.5 Bcf/d. The Khazzan tight gas field is considered one of the largest unconventional gas developments outside North America. Initially, the gas from Khazzan was slated for domestic use to address the country's gas deficit. However, the gas from Khazzan has been able to satisfy Oman's domestic needs, leaving some available for export (Shabaneh and Al Suwailem 2020). Oman is also hoping to develop the Mabrouk North East field, which contains 4 tcf and was discovered in 2018. Domestic reforms and large unconventional reserves attracted international operators.

The UAE has decided to achieve gas self-sufficiency by 2030. The target is strongly motivated by the need to reduce its dependence on gas imports from Qatar via the Dolphin pipeline, as the contract expires by 2032. Energy security is still an important driver in this field. This is also the reason why LNG imports from Qatar to some Gulf countries appear to be challenged by political disagreements. The UAE is committed to reaching gas self-sufficiency through the development of several gas projects (unconventional, sour and offshore). Some of the key gas projects include the offshore Hail, Dalma, and Ghasha fields in the Ghasha concession and the Ruwais Diyab onshore project. In February 2020, ADNOC announced the discovery of a major gas field, the Jebel Ali, which comprises 80 tcf of gas.

Natural gas could play a greater role also in the Eastern Mediterranean, where countries are increasingly looking into natural gas for their domestic markets as well as export opportunities (see Chap. 5). Due to some economic and political challenges that prevent the region from becoming a gas export hub, the East Mediterranean producers could focus their efforts to find and create market share in the region as well as exporting LNG, which guarantees market flexibility. Natural gas could also enable some cooperation. Currently the three countries that are better positioned to become gas players in the area (Egypt, Israel and Cyprus) are expected to compete for the same regional markets. Due to market and size characteristics, this competition may hinder potential cooperation. Indeed, Jordan, Lebanon, Cyprus and Israel are small markets, while Egypt is largely self-sufficient, and Turkey and Syria are politically inaccessible to key regional gas producers—in particular Egypt and Israel. The better equipped are those producers that already have export infrastructure.

However, oil and gas producers in the region have traditionally been able to extract hydrocarbons at relatively cheap cost from onshore or shallow water offshore. Tapping their unconventional gas resources comes with some challenges, such as the vast amounts of water that are typically needed for fracking. To overcome this issue, Saudi Aramco is exploring using seawater for fracturing treatments. Moving to onshore or less easier reserves raises another key challenge for these projects, i.e. higher production costs compared to associated gas resources, which undermines a key driver for their development. Unconventional gas resources are often considered a vital feedstock for the petrochemicals sector, but higher costs would deprive Gulf countries of one of their most important advantages: cheap feedstock.

In the region, natural gas has experienced increasing competition from other generation options: RES, but lately also nuclear. Renewables could represent a competing alternative in the power sector mainly due to their declining costs and abundant potential in the region. Furthermore, they could fill the gap in those areas where gas delivery is uneconomical due to the lack of infrastructure. Meanwhile, some countries are evaluating other solutions, such as nuclear. This is the case of the UAE, which has inaugurated the first reactor of four at the Barakah nuclear plant—the Arab world's first nuclear power plant—in August 2020. Once fully operational (expected around 2024), the Barakah plant will have a total capacity of 5.6 GW. For several years Saudi Arabia has declared its ambition to develop a nuclear sector. However, high upfront costs, technological challenges and geopolitical complications have halted Saudi and other regional countries' ambitions. Nevertheless, there have been reports of some developments in the construction of a facility for the production of yellowcake from uranium ore mined in the Saudi northwestern region in collaboration with Chinese entities. This scenario, however, could attract further US criticism, as US-China competition is escalating.

Both exporting and importing countries in the MENA region have set numerous RES targets (see Chap. 4) in order to meet both internal and external pressures. The development of RES could also help MENA countries to maximize their revenues in the short term, freeing hydrocarbon export volumes for exporters, while reducing fossil fuels imports for importers and cutting the import bill. Despite the great potential, energy diversification towards renewable energy sources is not expected to contribute to the fiscal diversification in the long run, which is something much needed. The returns from investments in RES are not as high as those obtained from investments in the hydrocarbon sector.

MENA countries need to find solutions to remain geopolitically relevant, ensure future revenues, and reduce total emissions. Therefore, MENA oil and gas producers could decide to focus on decarbonizing products and replace oil exports with new, cleaner energy carriers, exploiting their strengths and competitive advantages (*next section*). This solution becomes feasible also for importers as they share similar renewable potential with exporting countries. To exploit this potential, the domestic factors analyzed in the previous pages become crucial.

6.4.2 Decarbonized Products: Electricity and Hydrogen

Even before considering the export of decarbonized products, MENA oil and gas producers have considered the possibility of using their high renewable energy potential, mostly solar, as an alternative tool to remain geopolitically influent in a low-carbon future. This option has also been taken into consideration by MENA hydrocarbon-poor countries as they could benefit both economically and geopolitically. MENA countries could decide to increase the role of RES domestically, and to export part of their clean electricity. This decision would allow them to position themselves in the new geopolitical map of the energy transition, and to collect alternative revenues.

The idea of producing clean energy in the MENA region and exporting it to the European markets goes back to the 2000s with the launch of several initiatives such as the Trans- Mediterranean Renewable Energy Cooperation (TREC) in 2003, the Desertec Foundation in 2009, and DII. This idea initially attracted a lot of interest in policymakers, industry and scholars. They stated that it could contribute to further integration between the two Mediterranean shores and the Middle East and Gulf countries. improving climate mitigation and enhancing energy security and economic prosperity. The idea was to seize the largely unused land of the MENA region and to exploit its favorable climatic conditions, making it an ideal location for renewable electricity production, and exporting part of this electricity to Europe. However, the ambition has so far failed to become reality. Indeed, the huge construction costs of such an electricity grid made electricity imports from North Africa uncompetitive, despite their lower production costs.

Currently, there is only one electricity interconnection between North and South Mediterranean countries, i.e. the two cables with a combined total transfer capacity of 1400 MW between Morocco and Spain. Until late 2018, subsea cables predominantly carried power from Spain to Morocco, but the direction has now reversed. Projects that will also connect Tunisia, Algeria, Libya and Egypt to the European grid have been under evaluation for many years. Their realization would enhance EU-MENA clean energy relations and ambitions. Moreover, as European countries are phasing out of coal, the EU may be interested in financing RES in those countries in order to prevent brown electricity imports and carbon leakage. In 2019, Egypt signed an agreement to create a 2 GW electricity interconnection (the 1.700 km long Euro-Africa interconnector) with Cyprus, Crete and mainland Greece (Tanchum 2020). The interconnection between Egypt and Cyprus should be commissioned in December 2022, while the Cyprus-Crete link will be operational in December 2023. In October 2021, the three countries signed a major agreement to link their electricity grids as a sign of the increasingly close and wide-ranging relations binding the three nations.

With an initial 1 GW subsea high-voltage direct current (HVDC) line, the EuroAfrica interconnector has a larger capacity compared to other EU-North African interconnectors. For example, in 2019, Tunisia and Italy signed an intergovernmental agreement for the development and joint construction of a 0.6 GW electricity interconnector (DW 2019). The ELMED interconnector was on the third list of EU Projects of Common Interest (PCI), which includes key infrastructure projects that can benefit from accelerated planning and permit granting.

As they increase the RES share in their domestic energy systems, MENA countries may need to increase the electricity trade among themselves. For example, Egypt could exploit its location and its ambitious RES plans. It already possesses interconnections with both Libya and Jordan (with a combined capacity of about 800 MW). Recently, it has worked with Saudi Arabia for the construction of a 3 GW electricity interconnection. The first 1.5 GW is expected to be operational in 2023 (Tanchum 2020).

Furthermore, Jordan is ready to connect its electricity grid to two of its neighbors (Saudi Arabia and Iraq) under separate deals. According to the MoU signed by the two countries, the integration with Saudi Arabia would allow both countries to supply each other as required through a 164 km electricity grid from North Western Saudi Arabia to East Amman (MEES 2020b). By contrast, the other deal aims to supply Jordan's eastern neighbor. Iraq is looking to import up to 200 MW of electricity via the Jordan link, which would make Jordan a regional hub for energy exchange. Moreover, it would allow Saudi Arabia to increase its role in the weak Iraqi power sector, currently highly dependent on Iran.

Lately, MENA countries are considering another option to position themselves in the new energy geopolitical landscape: the production and export of hydrogen. In the last years, hydrogen has regained a strong political momentum, and a growing number of countries consider it a way to decarbonize hard-to-abate sectors. Many countries have announced, drafted or published national hydrogen strategies, and some European post-COVID recovery packages include support measures for clean hydrogen.

Given the great political support, hydrogen also revives the idea of connecting the MENA region to the global energy markets in the future clean energy system. MENA oil and gas producers could benefit from their renewable energy potential, vast hydrocarbon reserves as well as existing oil and gas infrastructure, allowing MENA countries to build a new geopolitical influence. Countries in the MENA area may decide to participate in the upcoming competition to become part of the global hydrogen supply side and major exporters, given their abundant renewable and CCS potential (Fig. 6.18). OPEC's 2021 World Oil Outlook devotes considerable column inches to this fuel—much more than the 2020 edition did. The report assessed: "*All six Gulf Cooperation Council (GCC) states have expressed interest in developing hydrogen production capacity. With their combination of low-cost gas resources and low-cost renewable energy, as well as other advantages, the Gulf states are strong candidates to emerge as major exporters of blue and green hydrogen. Saudi Aramco and ADNOC are making a push to do just that—positioning themselves to build upon their well-established and extensive energy ties with the Asia–Pacific region.*" (OPEC 2021).

Countries across the region have increasingly been working on their hydrogen ambitions, considering both blue and green hydrogen projects. Among them, four countries have announced major hydrogen plans. Three of them are oil exporters (Saudi Arabia, the UAE, and Oman) and one is a net importer (Morocco).

The Gulf countries have showed their interests on hydrogen—albeit some different intensity (Map 6.1). For example, Saudi Arabia has initiated major undertakings with no formal framework, while Oman is creating new structures and introducing various projects. The UAE has announced a policy framework and successfully realized its first ventures (Ansari 2022). On the other hand of the spectrum, Kuwait and Bahrain remain cautious, and Qatar prioritizes its LNG industry and blue hydrogen production abroad. There are some differences also regarding the hydrogen color: the UAE and

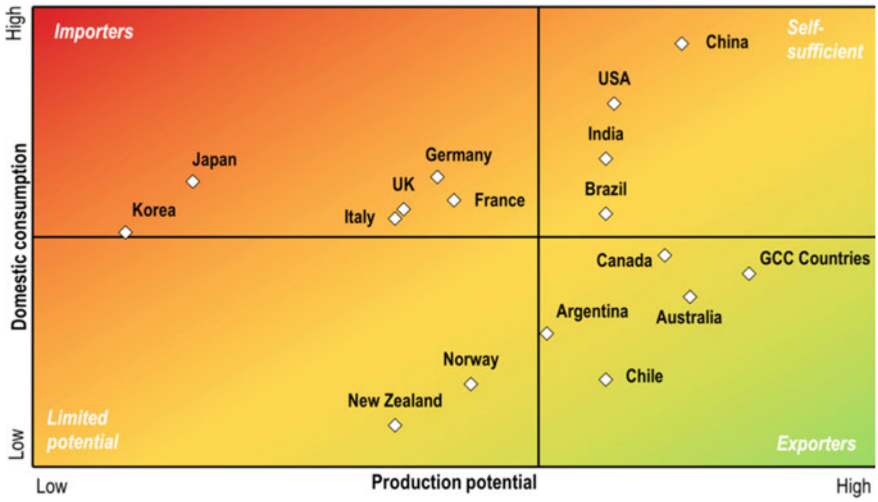
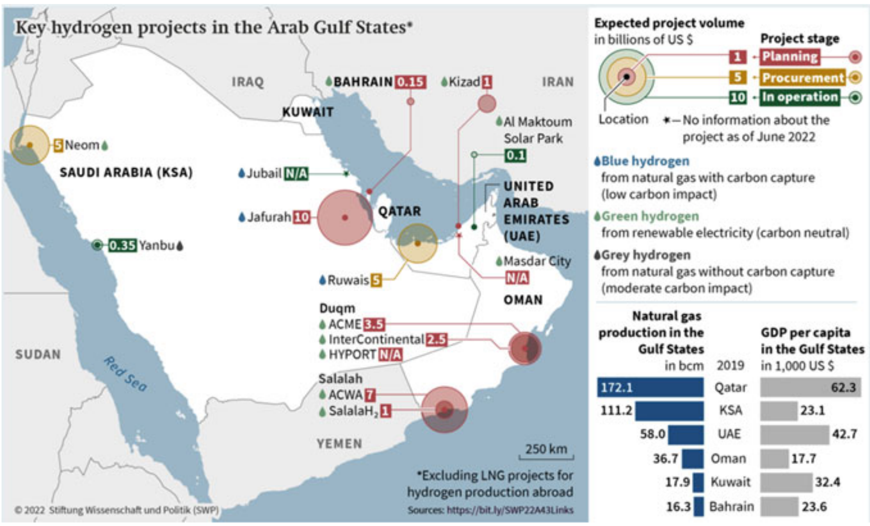


Fig. 6.18 Comparison of selected countries based on green hydrogen domestic consumption and production potential. *Source* Noussan et al. (2021)

Saudi Arabia are balancing between green and blue, while Oman is focusing on green and Qatar stays with blue.

In July 2020, Saudi Arabia revealed its green hydrogen ambition with the announcement of a joint-venture between Air Products, Saudi ACWA and Neom aimed at developing a $5 billion green hydrogen and green ammonia plant. It is



Map 6.1 Gulf hydrogen projects. *Source* Dawud Ansari (2022)

expected to become the world's largest project of green ammonia (producing 1.2 million tons per year) and green hydrogen (producing 650 tons/day, corresponding to 237,000 tons annually) (ACWA Power 2020). The project is expected to come online in 2025, and it will be supplied with energy through the integration of more than 4 GW of renewable power from solar and wind. The project is supported by the BMWi within the framework of the German National Hydrogen Strategy, a program to develop international energy cooperation. However, the project faces serious challenges from the announced renewable capacity to financial needs. In April 2021, ENEOS and Saudi Aramco signed an MoU to develop a blue hydrogen and blue ammonia supply chain connecting Japan and Saudi Arabia. Moreover, Saudi Altaaqa signed an MoU with AFC Energy to develop and use AFC Energy's hydrogen fuel cell technology in Saudi Arabia and the Middle East (AFC Energy 2021).

The UAE has also started to evaluate potential hydrogen projects. At the beginning of 2021, three of Abu Dhabi's biggest government-backed companies agreed to work together to position the UAE as an exporter of blue and green hydrogen. ADNOC, Mubadala and ADQ signed a MoU in January 2021 to establish the Abu Dhabi Hydrogen Alliance. The Alliance aims to develop a roadmap to accelerate the UAE's adoption and use of green hydrogen domestically. Meanwhile, ANDOC will continue to develop blue hydrogen (Gulf Business 2021) using its gas and CCUS potential. Moreover, the state-owned Dubai Electricity and Water Authority (DEWA) is committed to developing a green hydrogen mobility project, which will benefit from the solar-driven electrolysis facility at the Mohammed bin Rashid Al Maktoum Solar Park. The solar park is expected to have an installed capacity of 5 GW by 2030 (Noussan et al. 2021). The UAE is confident that competitive prices from solar power generation will be an enabler to reduce green hydrogen prices (S&P Global Platts 2020b). On the other hand, Abu Dhabi, with its important hydrocarbon reserves, is more focused on blue rather than green hydrogen. This approach is mainly supported by the ADNOC CCUS capacity, a crucial element for the production of blue hydrogen. It currently stands at 800,000 t/y, captured from the Emirates Steel plant and injected into the Bab and Rumaitha fields. This figure is still modest, but ADNOC set the target of 5 million tons/year by 2030, which would allow ADNOC to produce blue hydrogen.

Oman is the third country in the Gulf that has been considering the potential use of hydrogen domestically. It announced the construction of a green hydrogen plant at the Duqm port. The hydrogen project is developed through a partnership between a Belgian consortium (DEME Concession and the Port of Antwerp) and Oman. The first phase is expected to have an electrolyser capacity between 250 and 500 MW. The facility will produce hydrogen for an export-focused refinery and a petrochemical facility which are being developed in that area. According to the partnership, the location in Duqm has some advantages, such as the availability of cheap renewable energy (solar and wind) as well as a large, accessible site (DEME 2020).

Saudi Arabia and the UAE in particular have the financial strength to boost hydrogen projects. These financial resources represent a competitive advantage if coupled with low-cost gas reserves and high levels of solar irradiation.

With large hydrocarbon and renewable potential, MENA countries could decide to produce and then export both blue and green hydrogen. However, despite the great solar and wind potential, the green hydrogen ambitions of MENA countries must address their high water scarcity rate, which will only worsen due to climate change in the next decades. Lack of water resources challenges the likelihood of becoming hydrogen champions. A potential solution would be developing hydrogen projects along with desalination plants, as Saudi does in Neom.

However, the expansion of desalination capacity for hydrogen production presents several challenges. First of all, desalination is an energy-intensive process. In fact, two-thirds of the water produced from seawater desalination in the region today is from fossil fuel-based thermal desalination (Walton 2019). The rest is produced from membrane-based desalination that relies heavily on electricity produced using natural gas. Desalination will thus increase energy demand and consumption, potentially eroding further oil and gas export volumes and government revenues. Secondly, because water is largely scarce in the MENA region, renewable hydrogen production would directly compete with other water-intense industries, such as agriculture (Pflugmann and De Blasio 2020). The low trade-off from funding such projects could determine a preference for blue hydrogen projects.

Moreover, MENA oil and gas producers will need to dramatically increase their renewable energy capacity, if they are committed to becoming major global green players. They will have to deploy a massive amount of renewables in order to both decarbonize their energy systems and export some clean energy volumes. However, these countries have been lagging behind their ambitious green targets in terms of installed renewable energy capacity.

Among the North African countries, Morocco is often seen as the potential future leading hydrogen producer and exporter. It does not hold significant hydrocarbon reserves, but it seeks to use its great solar and wind potential in order to develop green hydrogen. According to government estimates, it has a potential installed capacity of 20,000 GW of photovoltaic and 6500 MW of wind power, (Hydrogen Economist 2021). Moreover, Morocco set an ambitious renewable target of 52% of installed electricity capacity by 2030, which corresponds to around 11 GW of installed renewable power. Moroccan authorities have seen renewables and hydrogen as potential ways to decarbonize its energy mix, lessen its high import dependence and become an international clean energy player. The plan is to devote one-third of Morocco's green hydrogen to the domestic market, while two-thirds to exports.

The region is expected to explore opportunities to enhance its geopolitical role in the upcoming energy landscape thanks to hydrogen. Some differences on potential export markets may appear between the two components of the area: North Africa and the Middle East. North Africa may be more interested in becoming a major clean hydrogen supplier to the European markets mainly because of their great energy potential and geographical vicinity. The Middle East, on the other side, may decide to export both green and blue hydrogen to Asia.

The EU has set ambitious decarbonization policies and key strategies, such as the EU Hydrogen Strategy, which also considers imports from southern Mediterranean countries. The EU Hydrogen Strategy envisages that 40 GW by 2030 would be imported from North African countries, especially Morocco.

Morocco—and other North African countries—could become key players in the export of green energies, exploiting their geographic position at the crossroads of Europe, the MENA region and Africa.

The EU Hydrogen Strategy explicitly stated that the EU's top priority is green hydrogen; however, it accepts blue hydrogen in the short- and medium-term. North African countries could meet both these targets. The region has abundant renewable energy potential—notably solar and wind. In Morocco, Algeria and Egypt, certain land areas have wind speeds that are comparable to offshore conditions in the Mediterranean, Baltic Sea and some parts of the North Sea (Van Wijk and Wouters 2019). However, these countries could also take advantage of the existing gas infrastructure in order to export blue hydrogen in the short-term. Algeria and Libya could indeed benefit from their gas reserves and pipeline connections to Europe. Algeria sends its gas to Europe through its three pipelines: MedGaz to Spain, the Pedro Duran Farell pipeline via Morocco and the Enrico Mattei pipeline to Italy. Libya is connected to Italy through the Greenstream pipeline, while Algeria and Libya could use their existing gas infrastructure linked to Europe to supply hydrogen to the EU.

Algeria has started to reconsider hydrogen projects as Europe is committed to developing a hydrogen economy. It has more options to evaluate than Morocco and Tunisia, as it holds vast hydrocarbon resources and extensive experience with CO_2 sequestration in geological structures, notably thanks to the In Salah project launched in 2004. The country, however, is not excluding the possibility to produce and export green hydrogen, but the success of green hydrogen production in Algeria crucially hinges on the significant expansion of its renewable energy production, which it so far lacks.

Algeria, however, is presently experiencing major domestic social unrest at different levels, and serious political and macroeconomic difficulties. Lack of strong governance and economic constraints hinder investment in hydrogen (and other diversification efforts). On the other hand, Libya is still suffering a civil war and lack of security on the ground. Until security is restored, a major transformation in Libya's energy sector is unlikely to occur.

Morocco is deeply committed to devoting a large part of its green hydrogen to exports, using its section of the Maghreb-Europe gas pipeline. The long-term gas supply agreement is set to expire by November 2021, which may open new opportunities, as this pipeline could be converted and used for the export of green hydrogen blended with gas up to 15% (Dii Desert Energy 2020). Nonetheless, both Morocco and Tunisia, which could benefit from their vast renewable potential combined with their geographical proximity to Europe, do not own pipelines connected to Europe, and they would thus need to either build new pipelines or find an agreement with the owners.

Egypt has started to consider producing hydrogen thanks to its high renewable energy potential as well as natural gas reserves. Egypt's Zaafarana region is comparable to Morocco's Atlantic coast, with high and steady wind speeds. Additionally, Egypt could tap its offshore gas resources to produce also blue hydrogen. According to some studies, new hydrogen gas pipeline infrastructure could be built to transport hydrogen to Europe. The debate over the construction of the EastMed pipeline, which has gained relevance in the aftermath of the Russian war in Ukraine, could provide another potential avenue for hydrogen exports from the Eastern Mediterranean, as the gas pipeline is expected to be built hydrogen-ready.

By contrast, Gulf countries are currently considering the export of hydrogen to some Asian countries, given their geographical location and the growing economic and energy partnerships with Asia. However, Gulf countries face technological and economic challenges in hydrogen transportation, especially for the long-distance routes. Hydrogen transport in ships requires the highest possible energy density per unit of volume, to avoid excessive costs. Since hydrogen cannot be economically transported in ships in its gaseous form, other solutions are being considered. One viable option for exporting hydrogen is transporting it as ammonia over long-distance routes (Noussan et al. 2021). According to the IEA (2019), ammonia can be competitive if the end user can use it without the need for reconversion back to hydrogen. In that case, importing ammonia as electrolytic hydrogen from North Africa to Europe could be cheaper than producing it in Europe.

Some Asian countries are considering the import of ammonia. Japan, a leading hydrogen player, announced that ammonia will play an important role in Japan's thermal power generation, as part of the Japanese efforts to reach carbon neutrality in 2050. In particular, Japan is committed to developing ammonia supply chains, and it is prioritizing the development of a supply chain for blue ammonia from natural gas rather than green ammonia (S&P Global Platts 2021). The Middle East is among the potential sources for Japan's ammonia imports, and in September 2020 Saudi Arabia announced the world's first shipment of 40 tonnes of blue ammonia to Japan. Despite the limited volume of the cargo, it shows that Saudi Arabia is increasingly considering opportunities in this direction.

However, global hydrogen trade will need to overcome serious logistic and economic challenges. The economics of intercontinental hydrogen ship transport will need to face lower volumetric energy densities in comparison with the current shipping of fossil fuels. Oil tankers, which are in some cases the largest ships in operation, can transport around 10.3 MWh of crude per each cubic meter of volume. LNG transport requires more space for the same energy content, since LNG has an energy density of 6.2 MWh per cubic meter. This figure is even worse for liquid hydrogen and ammonia, which have energy densities of 2.4 and 3.2 MWh per cubic meter respectively (Noussan et al. 2021). Moreover, liquid hydrogen will need to be kept at very low temperatures (i.e., around 20 K). This will require very high-quality insulation, and the energy losses during a long trip may be significant. Mitigation options are available, including the use of evaporated hydrogen to supply on-board power systems, and there is ongoing research on the possibility of applying them on large ships, although the evaporated hydrogen will need to be correctly removed to avoid safety issues.

In short, hydrogen is difficult and expensive to transport, and turning it into a more easily transportable non-carbon fuel entails further costs. Instead of focusing exclusively on hydrogen exports, MENA countries could develop clean hydrogen production in order to decarbonize their domestic heavy industries. It will always be more convenient to utilize renewable energy or blue/green hydrogen locally for the production of carbon-intensive intermediate or final products than to export hydrogen. In this way, MENA countries could overcome logistic and economic barriers and collect higher revenues, albeit lower compared to the oil and gas sector. Throughout the years, MENA countries have traditionally invested in carbon-intensive industries, such as steel, cement, aluminum and chemicals as well as fertilizers. The decision to decarbonize their domestic industrial output through hydrogen could protect a key economic/industrial pillar from potential and rising carbon prices at the borders of consuming countries. Moreover, it could become a competitive advantage vis-à-vis those industrial countries that do not hold hydrogen potential. MENA could also pursue an intermediate strategy, which consists in using hydrocarbons locally in energy-intensive transformations coupled with CCUS.

6.4.3 International Cooperation with Key Energy Geoeconomic Blocs

Both international and domestic factors will contribute to shaping the future role of MENA oil and gas producers within global energy geopolitics throughout the energy transition. Some consequences and anticipations of the future are already evident, and are expected to develop and grow during the next decades.

First, the energy transition may reaffirm the relevance of national oil companies (NOCs), especially those of the MENA oil and gas producers. NOCs currently hold most of the world's oil and gas reserves (Figs. 6.19 and 6.20). Over the past years, international oil companies (IOCs) have been forced to restructure their business models, mainly due to the energy transition, climate targets, and political and investors pressure. IOCs have steadily reduced their investment plans and CAPEX due to low oil prices, which were further depressed in 2020 due to the Covid crisis. Oil and gas companies have cut their CAPEX by a combined 34% in 2020, slightly more than the initial 28% reduction following the price decline that started in 2014 (IEF and BCG 2020).

Moreover, Western IOCs are increasingly stating their commitment to the decarbonization effort. They are devoting growing funds to RES and low-carbon technologies. In 2020, eight energy companies have agreed to apply a common set of "energy transition principles" across their businesses, including a commitment to industry decarbonization. The eight companies comprise BP, Shell, Total, Eni, Equinor, Repsol, Galp and Occidental Petroleum (Argus Media 2020a, b). All these companies have announced major climate targets, albeit with some differences. BP, Shell, Total, Occidental, Equinor and Repsol have all committed to a net-zero emissions goal by 2050, while Eni has set a target of reducing net emissions by 80% over the same period. Galp aims at being carbon neutral in Europe by 2050 while intending to dedicate over 40% of its future investment to energy transition opportunities (Argus Media 2020b).

The intention of some of the major Western IOCs is to become integrated "energy" companies, such as claimed by BP's latest strategy (BP 2020c). Within the new strategy, the British company announced major targets that will reshape its business as it pivots from being an IOC to an integrated energy company. The focus will thus shift from producing resources to delivering solutions for customers. To do so, BP aims to increase its annual low-carbon investment to around $5 billion a year (a tenfold increase). BP also announced the target to develop around 50 GW of net renewable generating capacity and, at the same time, a 40% reduction of its oil and gas production by 2030 (BP 2020c). The different approach between IOCs and NOCs towards decarbonization is driven by differences in the ownership of the oil and gas reserves. Moreover, IOCs usually need to respond to their shareholders, while NOCs need to respond to state needs.

Moreover, fossil fuels investments are increasingly under pressure. In its Roadmap, the IEA stated that there is no need for investments in new fossil fuel supplies beyond projects already committed as of 2021. However, lower CAPEX levels may hinder oil and gas market stability causing underinvestment, and thus future higher prices, especially without significant measures related to energy efficiency and the demand side. These CAPEX levels appear insufficient to deliver the volumes of oil and gas needed to maintain market stability. A CAPEX reduction due

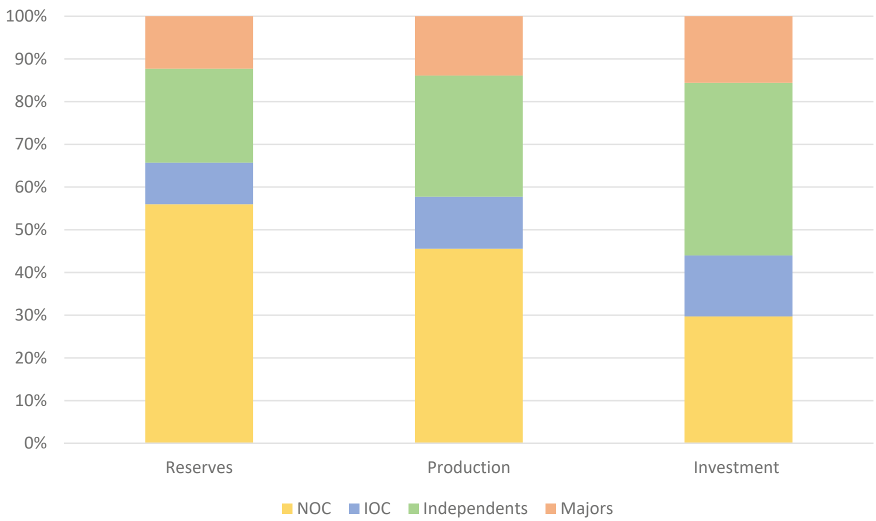


Fig. 6.19 Share of oil reserves, production and upstream investment by company type, 2018. *Source* Authors' elaboration on IEA

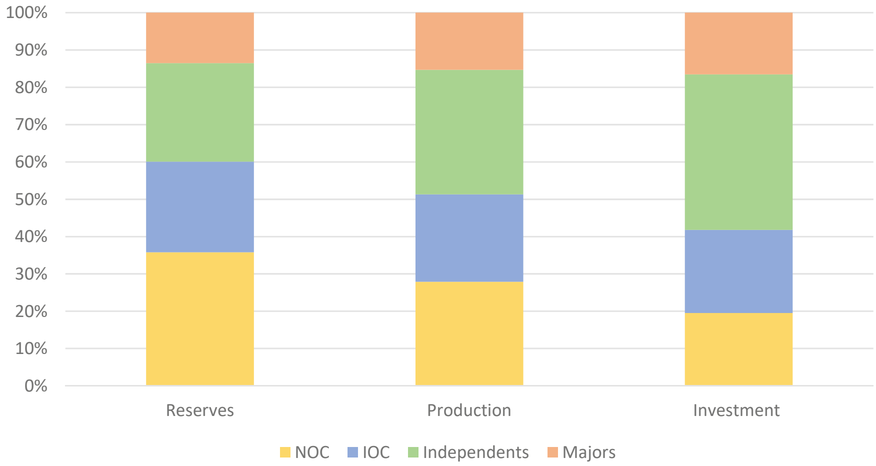


Fig. 6.20 Share of natural gas reserves, production and upstream investment by company type, 2018. *Source* Authors' elaboration on IEA

to COVID-19, combined with lower investments in the oil and gas sector pushed by the IOCs' decarbonization targets, may result in higher prices. Industry CAPEX in 2020 has fallen to levels last seen in 2004, when prices were similar to today's. Back then, low CAPEX and prices contributed to the rising cycle of oil prices, as Asian economic growth boosted demand. While oil demand in the longer run is expected to fall in line with net-zero targets, in the short- and medium-term lower investment may result in high price volatility due to tightness on the supply side. Indeed, the industry requires significant investments to compensate for production declines. IEA warns that, in the absence of investments, the rate at which production from existing fields declines is roughly 8% per year (IEA 2020d), which is greater than any plausible fall in global demand.

As of today, both the IEA and OPEC believe that by 2022 another 27 million to 30 million barrels of oil equivalent per day of capacity will be needed to close the gap between projected production declines and demand. This figure soars to 68–70 million boe/d by 2030 (Energy Intelligence 2021). Investment in existing and some new fields would be crucial to meet demand in the next years. Weak upstream investment could lead to a supply crunch in the oil markets. As investment falls and markets become increasingly competitive, MENA oil and gas producers may benefit from their low-production costs.

Periods of higher prices will inevitably occur due to under-investment, offering temporary relief to MENA oil and gas producers. However, higher prices/revenues, although temporary, could tempt some oil and gas producers into maximizing their resources, thus missing the opportunity to diversify their economy.

Furthermore, Russia's war in Ukraine, and the consequent political and social pressure, has led to the alienation of Russian hydrocarbon sectors for the IOCs and investors. Several IOCs have announced their intention to withdraw from Russia's oil and gas industry and to sell their assets; particularly relevant is BP's decision to sell its stake of Rosneft. While in the long-run such political pressure could somehow fade away, in the short and medium-term the MENA upstream could benefit from this situation attracting IOCs thanks to its low-production costs and well-developed history of engagement with IOCs.

MENA oil and gas producers and exporters need to adapt to the energy transition, seeking new business models while implementing fiscal and economic diversification in order to navigate in the future energy geopolitics. Each producer could pursue two strategies: defense of market share and maximization of reserves value. However, these two strategies may still face some challenges in a more decarbonized world. To secure future and further financial revenues, MENA oil and gas exporters may focus on their competitive advantage and increase the resilience of their oil and gas sector.

It may be expected that MENA oil and gas producers will face lower oil revenues in the longer-run (with possibly some temporary increases of oil prices from time to time) and intense competition in a demand-constrained world. This world will be a '*buyers' market*' compared to the previous '*sellers' market*', such as during the last oil price cycle in the period 2000–2014. A major trend will be an ever-growing broad consensus on climate policies and the clean energy transition. However, such a broad consensus may not be translated into a homogenous landscape. Instead, fragmentation and regionalization may be two features of the next global energy system, driven by growing competition among major economic blocs (i.e. USA, Europe, and China). Diverging policies and technological pathways may result in the rise of different market places across the world.

Major consequences will also occur in the geoeconomic sphere, with a growing role of Asian countries. Their influence has been increasing since the 2000s along with the broader realignment of the world's economic centers of gravity. The growing energy demand in Asia has already induced MENA oil and gas producing countries to increasingly focus on these markets to secure export markets and revenues.

Asian countries already import significant hydrocarbon volumes from the MENA oil and gas producers. By 2019, Asian buyers accounted for more than 80% of crude oil and condensates that passed from Gulf ports through the Straits of Hormuz. China (19%), India (16%), Japan (15%), and South Korea (13%) were the largest receivers of Gulf crude exports. If we compare it with the US (6%), the relevance of Gulf-Asian energy relations becomes clear. The same picture is for LNG. In 2019, China, South Korea and Japan were the largest LNG importers. The Asian energy markets are set to become the main area for LNG demand driven by high economic and demographic growth. Regional NOCs have increasingly looked into opportunities to secure and expand their market share in the growing Asian energy markets, considering also the refining and petrochemicals projects. Energy is still a central pillar of the MENA-Asia relations. Any variation of the energy landscape will also reverberate in the broader relations.

Asia–Pacific countries are expected to have fast-growing domestic economies and energy demand, which may prompt further geoeconomic shifts. Fast-growing Asian economies already played an important role in the economic recoveries of Gulf

States following the 2008 financial crisis and the 2014 oil price collapse. The MENA countries and Asian countries have expanded their relations to multiple sectors. In a post-COVID-19 world, Asian countries may increase their economic relevance for MENA countries, which could increasingly look to Asia–Pacific countries as vital economic partners in their diversification efforts. MENA countries (especially Gulf countries) are considering Asian countries as major partners in key sectors, such as digital and trade, as the flourishing economic relations between the UAE and China show. China has connected part of its regional presence and policies to its ambitious Belt and Road Initiative (BRI). The UAE is often considered a pivotal pillar of China's MENA policy. An example is the announcement of a $10 billion investment in May 2019 in the Khalifa Industrial Zone Abu Dhabi (KIZAD) by East Hope Group, one of China's largest companies (Fulton 2019). Moreover, since 2015, Abu Dhabi has used renewals at its most important onshore and offshore oil concessions to bring in a greater diversity of partners and far more Asian companies (Cahill and Tsafos 2020). The first step in UAE's upstream sector occurred with the establishment of the Al-Yasat JV (ADNOC 60%, CNPC 40%) to explore for oil. Production from the field started in March 2018. In 2017, the Chinese presence picked up considerably when CNPC bought 8% in the Adnoc Onshore concession for $1.77 billion (OGJ 2017). The concession has total resources of 20–30 billion boe, and production capacity stands at 2 mn b/d. In July 2020, China's CNOOC became the third Chinese firm in Abu Dhabi's upstream sector, when ADNOC agreed to the transfer of rights in two key offshore concessions from CNPC to CNOOC (Khaleej Times 2020). The two concessions are Lower Zakum and Umm Shaif and Nasr. CNOOC bought 4% of CNPC's former 10% stakes. The latest transfer of concession rights reinforces the strong and bilateral ties between the UAE and China.

With the expansion in scope of Gulf-Asia relations and growing economic interests, Asian players were encouraged to take on a more active security role (Lons et al. 2020). Japan attempted to mediate with Iran at the height of tensions in the Gulf in 2019. In February 2020, Japan dispatched a warship and patrol planes to gather intelligence and protect Japanese ships in the international waters of the Arabian Sea, Bab el-Mandeb Strait and Gulf of Oman. This area is not far from where two Japanese oil tankers were attacked in June 2019 (Lons et al. 2020). However, it seems improbable that Asian countries or others will increase their stake in the security sphere or pick sides in regional disputes to a degree close to that of the US. For example, most of the countries maintained a discreet security profile in the broader region, engaging in specific issues such as counter-piracy naval patrols. Their activities are mainly focused on areas outside the Gulf and do not come close to approximating the network of US bases and force deployments in the area. Indeed, the US is still the major security player in the MENA region, especially in the Gulf. However, the Gulf countries are increasingly evaluating alternative security solutions, underpinned by perceptions that the US are less interested in being involved in their regional affairs. The JCPOA, signed without the direct involvement of the Gulf countries, sparked security concerns in these capitals. But even the Trump Administration failed to provide visible responses to the attacks on Gulf's energy infrastructure (tankers and

Saudi facilities), fostering the reassessment of the nature of the US security guarantee that they had until then taken for granted (Coates Ulrichsen 2020a). The more assertive foreign policies of these countries (e.g. in Syria and Yemen) is the result of such perceptions.

The US, however, is still the main player in the security sphere, with the highest number of troops in the region. However, since 2008, the US is less eager to be involved in regional affairs. This has ignited a steady process in the region, inducing the Gulf countries to consider changes in their foreign policy in order to prepare themselves to a less direct American involvement in the area. A major development is the normalization of relations between some Sunni countries and Israel. In August 2020, the UAE, Bahrain and Israel signed the so-called Abraham Accords. Some Arab countries had already engaged in cooperation before the inception of formal relations. For example, trade between the UAE and Israel has multiplied in recent years via intermediary companies, and it is mainly focused on agricultural and medical technologies as well as security and communication systems (Coates Ulrichsen 2020b).

However, the accord formalizes bilateral cooperation, especially on intelligence and security, which has strengthened in recent years, and it appears to be specifically designed to counter the growing influence of their common enemy, Iran. The agreement may enlarge the regional security architecture aimed at obstructing Iran's proxies in the region. For this reason, Saudi Arabia is also considering the normalization and formalization of its relations with Israel. However, its leadership in the Islam world, as Custodians of the Two Holy Mosques (of Islam), may be an obstacle. The UAE has been freer to express and pursue closer ties than Saudi Arabia (Coates Ulrichsen 2020b).

Two other events emphasize the recent developments and the growing convergence between Arab countries and Israel. In July 2020, Chevron bought Noble Energy, a key player in the East Med gas saga and Israeli offshore operations. This marked the historical entry of an American oil major, Chevron, in the Israeli gas sector. Historically, American majors saw Israel's energy assets as a taboo, motivated by the need to avoid alienating the Gulf Arab countries that are significantly more important for oil and gas reserves. Secondly, the UAE is increasingly enhancing its role and support in the East Med gas saga with the clear intention to counter Turkish expansionism. In this effort, the UAE decided to join as an observer the Eastern Mediterranean Gas Forum (EMGF), an Egypt-led organization (Sabry 2020).

The energy sector is seen as a potential area of further cooperation and collaboration between Arab countries and Israel. In December 2020, a meeting between the energy ministers of Israel, the US, the UAE and Bahrain took place. Its goal was to establish a platform for a comprehensive dialogue on energy issues (Bassist 2020). The countries could exchange ideas for further cooperation and the creation of joint ventures in the energy sector (from natural gas to energy efficiency). This shows that energy cooperation between Israel and the UAE is not limited to fossil fuels. For example, the Masdar investment fund in Abu Dhabi announced the first major UAE investment in renewable energy in Israel in cooperation with EDF Renewables Israel (Zaken 2021).

At the beginning of 2021, another major development occurred in the region. Saudi Arabia and other GCC countries announced the end of their three-year blockade on Qatar, initially agreeing to reopen their land and maritime borders as well as their air space to Qatar on January 4, 2020. The next day, they pledged to restore relations with Qatar. This symbolic episode was mainly motivated by the Saudi need to improve its troubled relationship with its main ally, the United States. With the end of Trump's presidency, Gulf countries may not have the same political support for their aggressive and assertive policy in the region. Despite the lower tension, serious differences between Riyadh and Washington remain, and they will continue to be a source of stress for the two countries. Moreover, even if it ended now, the blockade of Qatar will have long-term impacts that are not going to be resolved easily. Differences on regional issues were present before the 2017 blockade and they are set to remain in place after its end.

A de-escalation of tensions across the region can also be motivated by the countries' need to attract foreign investments. Asia is not the only (geo)political center that may increase its influence in the region amid geopolitical shifts. As the Green Deal advances, Europe may increase its influence in the North African countries. Given the proximity of the two Mediterranean shores, the EU may look into opportunities to foster renewable energy investments in those countries, also aiming at importing some clean energy. As aforementioned, the EU is considering the possibility to import 40 GW of green hydrogen from North African countries. If the European institutions finance significant clean energy projects in the region, they would increase Europe's geoeconomic influence and foster climate policies in those countries. With the election of President Biden, climate policies are back in the US agenda, and this could induce Washington to enhance and change its policies on several issues, affecting the current geopolitical equilibrium of the MENA region. To preserve its relevance in the area, it is crucial for the US and its energy companies to support climate, energy and technological solutions in the MENA region, finding cooperation opportunities with other countries. Otherwise, other players, notably China, will be ready to fill the vacuum. Moreover, the EU has decided to strengthen its cooperation in the energy sector also with the GCC in the wake of Russia's war in Ukraine. In May 2022, the EC released a Joint Communication on a 'Strategic Partnership with the Gulf', envisaging areas of EU-GCC cooperation, among which energy plays a crucial role both in terms of energy security and decarbonization. The EU seeks to increase energy cooperation as the world's energy flows are expected to change due to international sanctions on Russian fossil fuels. The GCC could benefit from the opportunity, and increase their share in the European energy markets. At the same time, the EU is committed to increasing cooperation also on the low-carbon alternatives, such as hydrogen, given the great ambitions of the GCC countries in the field.

Bibliography

ACWA Power (2020) Air products, ACWA Power and Neom sign agreement for $5 billion production facility in Neom powered by renewable energy for production and export of green hydrogen to global markets. News, 9 Jul 2020. Available at: https://www.acwapower.com/news/air-products-acwa-power-and-neom-sign-agreement-for-5-billion--production-facility-in-neom-powered-by-renewable-energy-for-production-and-export-of-green-hydrogen-to-global-markets/

AFC Energy (2021) Altaaqa and AFC Energy to develop zero-emission, hydrogen power generation solutions in Saudi Arabia and the Middle East, AFC Energy. Press Release, 6 Apr 2021. Available at: https://www.afcenergy.com/altaaqa-and-afc-energy-to-develop-zero-emission-hydrogen-power-generation-solutions-in-saudi-arabia-and-the-middle-east/

Al Jazeera (2019) Qatar signs $8bn petrochemical deal with Chevron. Economy, 9 Jul 2019. Available at: https://www.aljazeera.com/economy/2019/7/9/qatar-signs-8bn-petrochemical-deal-with-chevron

Ansari D (2022) The hydrogen ambitions of the Gulf States. Achieving economic diversification while maintaining power, Stiftung Wissenschaft und Politik, SWP Comment 2022/C 44, Jul 2022. https://doi.org/10.18449/2022C44

APICORP (2020) Gas and petrochemicals outlook 2020–2024, Oct 2020

Aramco (2022) Aramco sustainability report details next steps towards operational net-zero ambition, 15 June 2022. https://www.aramco.com/en/news-media/news/2022/aramco-sustainability-report-details-next-steps-towards-operational-net-zero-ambition

Argus Media (2020a) Aramco, Sabic rethink Saudi crude-to-chemical plans, 19 Oct 2020a. Available at: https://www.argusmedia.com/en/news/2151288-aramco-sabic-rethink-saudi-crudetochemical-plans

Argus Media (2020b) BP, Shell and Total agree energy transition principles. News, 17 Dec 2020b. Available at: https://www.argusmedia.com/en/news/2169963-bp-shell-and-total-agree-energy-transition-principles

Bassist R (2020) Israel, US, UAE, Bahrain to cooperate on energy. Al Monitor, 16 Dec 2020. Available at: https://www.al-monitor.com/pulse/originals/2020/12/israel-us-uae-bahrain-greece-cyprus-lebanon-energy-steinitz.html

BBC (2020) Saudi Arabia triples VAT to support coronavirus-hit economy, 11 May 2020. Available at: https://www.bbc.com/news/business-52612785

Bloomberg (2020) Kuwait aims to finish mideast's biggest LNG terminal by March. Business, 15 Sept 2020. Available at: https://www.bloomberg.com/news/articles/2020-09-15/kuwait-aims-to-finish-mideast-s-biggest-lng-terminal-by-march?sref=Du4DnYqC

BNEF (2020) Oil demand from road transport: Covid-19 and beyond. BloombergNEF, 11 June 2020. Available at: https://about.bnef.com/blog/oil-demand-from-road-transport-covid-19-and-beyond/#:~:text=Road%20transport%20consumed%20more%20than,be%20more%20growth%20to%20come

BNEF, IGU and SNAM (2020) Global gas report, 2020

Bortolotti B, Fotak V, Hogg C (2020) Sovereign wealth funds and the COVID-19 shock: economic and financial resilience in resource-rich countries. BAFFI CAREFIN Centre, Research paper no. 2020-147, Aug 2020. Available at: https://doi.org/10.2139/ssrn.3665993

BP (2020a) Energy outlook, London

BP (2020b) Statistical review of world energy. British Petroleum, June 2020b

BP (2020c) From international oil company to integrated energy company: BP sets out strategy for decade of delivery towards net zero ambition. Press Release, 4 Aug 2020c. Available at: https://www.bp.com/en/global/corporate/news-and-insights/press-releases/from-international-oil-company-to-integrated-energy-company-bp-sets-out-strategy-for-decade-of-delivery-towards-net-zero-ambition.html

Cahill B, Tsafos N (2020) Qatar's looming decisions in LNG expansion. CSIS, Commentary, 28 Sept 2020. Available at: https://www.csis.org/analysis/qatars-looming-decisions-lng-expansion

Coates Ulrichsen K (2020a) Rebalancing regional security in The Persian Gulf, Center for the Middle East, Rice University's Baker Institute for Public Policy, Feb 2020a. Available at: https://www.bakerinstitute.org/media/files/files/de9f09e6/cme-pub-persiangulf-022420.pdf

Coates Ulrichsen K (2020b) The Gulf States and the Middle East peace process: considerations, stakes, and options. Center for the Middle East, Issue Brief, Rice University's Baker Institute for Public Policy, 25 Aug 2020b. Available at: https://www.bakerinstitute.org/media/files/files/25b245c0/bi-brief-082520-cme-gulfstates.pdf

Dale S, Fattouh B (2018) Peak oil demand and long-run oil prices. BP, Energy Economics, Jan 2018. Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/bp-peak-oil-demand-and-long-run-oil-prices.pdf

DEME (2020) DEME and partners present Hyport Duqm, a large-scale green hydrogen project in Oman. Latest News, 3 Mar 2020. Available at: https://www.deme-group.com/news/deme-and-partners-present-hyportrduqm-large-scale-green-hydrogen-project-oman-1

Dii Desert Energy (2020) The risks and opportunities of green hydrogen production and export from the MENA region to Europe. DII & Friedrich Ebert Stiftung, Nov 2020. Available at: https://dii-desertenergy.org/wp-content/uploads/2020/12/Green-Hydrogen-from-MENA-to-Europe-Policy-Paper.pdf

DNV GL (2020) Energy transition outlook 2020—oil and gas. A global and regional forecast to 2050

DW (2019) Elmed interconnector aims to bring solar power from the Sahara to Europe, 24 May 2019. Available at: https://www.dw.com/en/elmed-interconnector-aims-to-bring-solar-power-from-the-sahara-to-europe/a-48843725

EIU (2020) Most MENA currencies to weaken in 2020. The EIU Update, 9 Jul 2020. Available at: https://www.eiu.com/n/most-mena-currencies-to-weaken-in-2020/

Energy Intelligence (2021) Is market heading for supply crunch? Petroleum Intell Weekly, 8 Jan 2021. Available at: https://www.energyintel.com/pages/eig_article.aspx?DocId=1093772

Fattouh B (2021) Saudi oil policy: continuity and change in the era of the energy transition. Oxford Institute for Energy Studies and UK Energy Research Centre, OIES PAPER: WPM 81, Jan 2021. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2021/01/Saudi-Oil-Policy-Continuity-and-Change-in-the-Era-of-the-Energy-Transtion-WPM-81.pdf

Fattouh B, Poudineh R (2020) MENA: a fundamental compromise. World Energy, Number 47, Dec 2020. Available at: https://www.eni.com/en-IT/global-energy-scenarios/mena-fundamental-compromise.html

FT (2020) Russia breaks Opec oil alliance as it takes on US shale, 7 Mar 2020. Available at: https://www.ft.com/content/c1b899ec-5fe5-11ea-b0ab-339c2307bcd4

Fulton J (2019) China deepens ties with UAE with industrial investment. Al-Monitor, 10 Jul 2019. Available at: https://www.al-monitor.com/pulse/originals/2019/07/china-investment-uae-kizad-industrial-zone.html

Gulf Business (2021) Mubadala, ADNOC and ADQ form alliance to grow green hydrogen economy in the UAE, 18 Jan 2021. Available at: https://gulfbusiness.com/mubadala-adnoc-and-adq-form-alliance-to-grow-green-hydrogen-economy-in-the-uae/

Hafner M, Tagliapietra S (eds) (2020) The geopolitics of the global energy transition. In: Lecture notes in energy, vol 73. Springer, Cham. Available at: https://doi.org/10.1007/978-3-030-39066-2_6

Hydrogen Economist (2021) Europe eyes North African H_2 imports, 4 Jan 2021. Available at: https://pemedianetwork.com/hydrogen-economist/articles/green-hydrogen/2021/europe-eyes-north-african-hsub2sub-imports

IEA (2020a) The case for energy transitions in major oil- and gas-producing countries. IEA, Paris. Available at: https://www.iea.org/commentaries/the-case-for-energy-transitions-in-major-oil-and-gas-producing-countries

IEA (2020b) World energy outlook 2020b. IEA, Paris. Available at: https://www.iea.org/reports/world-energy-outlook-2020b

IEA (2020c) World investment outlook 2020. IEA, Paris

IEA (2020d) The oil and gas industry in energy transitions. IEA, Paris. Available at: https://www.iea.org/reports/the-oil-and-gas-industry-in-energy-transitions
IEA (2021) World energy outlook 2021. IEA, Paris. Available at: https://www.iea.org/reports/world-energy-outlook-2021
IEF and BCG (2020) Oil and gas investment in the new risk environment, Dec 2020. Available at: https://www.ief.org/news/new-ief-report-warns-oil-and-gas-investment-cuts-will-spur-higher-prices-and-volatility
IRENA (2019) A new world. The geopolitics of the energy transformation. IRENA, Jan 2019. Available at: https://www.irena.org/publications/2019/Jan/A-New-World-The-Geopolitics-of-the-Energy-Transformation
Khaleej Times (2020) Adnoc adds new Chinese partner following transfer of stakes in offshore concessions from CNPC to CNOOC, 27 Jul 2020. Available at: https://www.khaleejtimes.com/business/energy/adnoc-adds-new-chinese-partner-following-transfer-of-stakes-in-offshore-concessions-from-cnpc-to-cnooc
Lons C, Solanki V, Alhasan H (2020) Gulf–Asia relations in the context of COVID-19. In: The strategic and geo-economic implications of the COVID-19 Pandemic. The International Institute for Strategic Studies, IISS Manama Dialogue 2020, Special Publication, Dec 2020. Available at: https://www.iiss.org/blogs/research-paper/2020/12/strategic-geo-economic-implications-covid-19-pandemic
MEES (2020a) QP-singapore deal to hasten rise of green LNG, vol 63, no 46, 13 Nov 2020
MEES (2020b) Jordan moves towards electricity hub role with Saudi, Iraq deals, vol 63, no 34, 21 Aug 2020b
MEES (2021a) Qatar sets 4GW renewables target, vol 64, no 2, 15 Jan 2021a
Mills R (2020a) A fine balance: the geopolitics of the global energy transition in MENA. In: Hafner M, Tagliapietra S (eds) The geopolitics of the global energy transition. Lecture notes in energy, vol 73. Springer, Cham. Available at: https://doi.org/10.1007/978-3-030-39066-2_6
Mills R (2020b) Letter from the Middle East: the UAE and Opec—a problem postponed, not solved. Petroleum Econ, 15 Dec 2020b. Available at: https://pemedianetwork.com/petroleum-economist/articles/geopolitics/2020b/letter-from-the-middle-east-the-uae-and-opec-a-problem-postponed-not-solved
Noussan M, Raimondi PP, Scita R, Hafner M (2021) The role of green and blue hydrogen in the energy transition: a technological and geopolitical perspective. Sustainability 2021(13):298. https://doi.org/10.3390/su13010298
OGJ (2017) ADNOC awards CNPC 8% stake in ADCO onshore concession. Oil Gas J, 20 Feb 2017. Available at: https://www.ogj.com/general-interest/article/17290254/adnoc-awards-cnpc-8-stake-in-adco-onshore-concession
OPEC (2021) World oil outlook, 2021
OPEC (2020) World oil outlook, 2020
O'Sullivan M, Overland I, Sandalow D (2017) The geopolitics of renewable energy, HKS Faculty research working paper series RWP17-027, June 2017. Available at: https://www.hks.harvard.edu/publications/geopolitics-renewable-energy
O'Sullivan ML (2017a) Windfall. Simon & Schuster
O'Sullivan ML (2017b) US energy diplomacy in an age of energy abundance. Oxford Institute for Energy Studies, OIES Forum 111, Nov. Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/01/OEF-111.pdf
Pflugmann F, De Blasio N (2020) Geopolitical and market implications of renewable hydrogen. New dependencies in a low-carbon energy world, Belfer Center for Science and International Affairs, Environment and Natural Resources Program, Report, Mar 2020. Available at: https://www.belfercenter.org/sites/default/files/files/publication/Geopolitical%20and%20Market%20Implications%20of%20Renewable%20Hydrogen.pdf
Reuters (2019) Qatar teams up with Chevron Phillips for petrochemical project. Commodities News, 24 June 2019. Available at: https://www.reuters.com/article/us-qatar-petroleum-petrochemicals/qatar-teams-up-with-chevron-phillips-for-petrochemical-project-idUSKCN1TP0U7

Rystad Energy (2020) Energy transition report, Dec 2020
Saadi D (2020) Insight from Dubai: Middle East seeks refuge in petchems amid bleak oil demand forecasts. S&P Global Platts, 1 Dec 2020. Available at: https://www.spglobal.com/platts/en/market-insights/blogs/petrochemicals/120120-middle-east-petrochemicals-oil-demand-saudi-arabia-egypt
Sabry M (2020) UAE joins Egypt-led eastern med gas forum. Al Monitor, 26 Dec 2020. Available at: https://www.al-monitor.com/pulse/originals/2020/12/egypt-uae-join-east-med-gas-forum-turkey-israel.html
Scholten D (ed) (2018) The geopolitics of renewables. In: Lecture notes in energy, vol 61. Springer
Shabaneh R, Al Suwailem M (2020) The prospect of unconventional gas development in Saudi Arabia. KAPSARC, Instant Insight, KS--2020-II09, 18 Mar 2020
S&P Global Platts (2020a) UAE seen as GCC nation best able to weather oil crash, coronavirus, 26 Mar 2020a. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/oil/032620-uae-seen-as-gcc-nation-best-able-to-weather-oil-crash-coronavirus
S&P Global Platts (2020b) UAE investing in green and blue hydrogen projects as part of clean energy move: official, 19 Oct 2020b. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/101920-uae-investing-in-green-and-blue-hydrogen-projects-as-part-of-clean-energy-move-official
S&P Global Platts (2021) INTERVIEW: Japan eyes Middle East, Australia and N America for ammonia supply chain, 8 Jan 2021. Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/coal/010821-interview-japan-eyes-middle-east-australia-and-n-america-for-ammonia-supply-chain?ite=153248&ito=1447&itq=b540601a-a3ec-455c-abb9-69f6a0e46871&itx%5bidio%5d=2116489359
Tanchum M (2020) Egypt's prospects as an energy export hub across three continents. ISPI, Commentary, 24 Sept 2020. Available at: https://www.ispionline.it/en/pubblicazione/egypts-prospects-energy-export-hub-across-three-continents-27408
UNICEF (2019) MENA GENERATION 2030. Investing in children and youth today to secure a prosperous region tomorrow. Division of Data, Research and Policy, Apr 2019. Available at: https://www.unicef.org/mena/reports/mena-generation-2030
Van Wijk A, Wouters F (2019) Hydrogen. The Bridge between Africa and Europe, Sept 2019. Available at: http://profadvanwijk.com/wp-content/uploads/2019/09/Hydrogen-the-bridge-between-Africa-and-Europe-5-9-2019.pdf
Walton M (2019) Desalinated water affects the energy equation in the Middle East. IEA, Commentaries, 21 Jan 2019. Available at: https://www.iea.org/commentaries/desalinated-water-affects-the-energy-equation-in-the-middle-east
World Bank (2020) Iraq economic monitor. Report, Fall 2020, Nov 2020. Available at: https://openknowledge.worldbank.org/handle/10986/34749
Zaken D (2021) Emirati investors highly interested in Israeli high-tech, agro-tech. Al Monitor, 28 Jan 2021. Available at: https://www.al-monitor.com/pulse/originals/2021/01/israel-united-arab-emirates-abraham-accords-investments.html

Part IV
Overall Conclusions

Chapter 7
Conclusions on the Transformation of the Energy Sector and the Energy Geopolitics

The final chapter of this book draws the main conclusions and key takeaways of the previous chapters, and addresses the still-open issues related to the energy transformation of the MENA region. These concluding remarks also include several considerations regarding the energy and geopolitical developments in 2021/22 that were not properly addressed in the previous chapters of the volume.

Since 2020, Covid-19 and the Ukraine war have had very incisive impacts on global energy markets. After the economic crisis following the health restrictions due to Covid-19 in 2020, and the subsequent economy recovery programmes launched by governments all over the world, economies of consumer countries have struggled with rising energy prices following years of low energy prices and low global investment in oil and gas projects. The energy price increases were initially motivated by market fundamentals (strongly rising demand not matched by a similar quick upward trend on the supply side) and then geopolitical factors (Russia's war in Ukraine, Europe's commitment to phase out Russia's energy imports and Russia cutting off most of its gas supplies to Europe already since summer 2022). In light of this energy crisis, European governments have reiterated their climate commitments and attempted to reconcile them with security concerns. Opposite perspectives over the energy transition have emerged—especially between importing and producing countries. The Middle East and North Africa region has become even more relevant from an energy point of view as western countries are seeking to reduce Russia's energy imports. The MENA region could become a key region in the European quest for non-Russian energy, given its vast hydrocarbon reserves, existing export infrastructure and energy relations, as well as proximity to the European energy markets. The region has always been a cornerstone of the existing European energy system, but it has now gained a newly found strategic value for Europe as it is one of the few world regions capable of filling the energy vacuum caused by the war.

M. Hafner et al., *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad*, Perspectives on Development in the Middle East and North Africa (MENA) Region, https://doi.org/10.1007/978-3-031-30705-8_7

Russia's war in Ukraine has abruptly changed the energy order. The new order may result in a redrawing of global energy flows, with more US and MENA energy volumes coming to Europe compared to the past, and Russian energy volumes moving towards Asian markets. North African countries have always exported most of their hydrocarbons to Europe (about 58% for oil and 78% for gas in 2019), while the Gulf countries traditionally exported mainly to Asia (about 76% for oil and 82% for gas in 2019). The 2022 crisis has also reinvigorated the potential energy cooperation between the EU and the Gulf Cooperation Countries (GCC). The new emphasis on GCC has been illustrated by the recent European communication on "A Strategic Partnership with the Gulf" (EC and EEAS 2022). The Communication, combined with the REPowerEU (EC 2022), aims at forming a renewed partnership based on sustainable energy security. Compared to North African producers, these countries have traditionally been more focused on Asian rather than European markets. Now Europe is courting all MENA countries capable of exporting hydrocarbons to Europe, to increase their supplies to Europe.

Soaring commodity prices since 2021 have produced mixed results for MENA countries. Resource-rich countries in the region have experienced extraordinary windfall revenues—after an almost decade-long slump. The drop in oil prices in 2014 caused major budget and fiscal stress for most of MENA hydrocarbon producers as global oil prices fell below their fiscal breakeven prices. Countries had to reduce their spending and draw down their savings (e.g. foreign currency reserves). Since 2021, global fossil fuel prices have been surging allowing these countries to collect massive amounts of money. Saudi Arabia is expected to be one of the world's fastest-growing economies (with an expected increase of GDP of 7.6% in 2022—the fastest growth in almost a decade) (Mati and Rehman 2022). Conversely, MENA hydrocarbon resource-poor countries (thus importing countries) are struggling with higher energy prices, which put their national budgets under pressure bringing them to the limit, and increasing current-account deficits.

MENA countries should use the hydrocarbon price spike in 2021–22 to boost reforms and prepare their economy, society and energy system to a lower-hydrocarbon demand world (see below).

This chapter is composed of three main sections, which outline the key conclusions related to the three parts of the book:

– Sect. 7.1 presents the conclusions on the multiple challenges that drive (yet, simultaneously hinder) the great energy transformation in the MENA region (part 1 of the book, i.e. Chaps. 1 and 2).
– Sect. 7.2 outlines the key takeaways for the energy sector of the MENA region (part 2 of the book, i.e. Chaps. 3 and 4),
– Sect. 7.3 addresses the key conclusions related to the geopolitical dimension of both hydrocarbons and the energy transition (Part 3 of the book, i.e. Chapts. 5 and 6).

7.1 Multiple Challenges Entail Transformation?

All MENA countries are facing multiple challenges although to a different extent. Demographic growth, economic growth, localization of (energy-intensive) industries, projected increase in water demand and in energy/electricity demand contribute to threatening the economic and socio-political status quo. These developments have put under question the sustainability of the current social contract in place both in the rich and resource-poor countries, characterized by the distribution of wealth generated by the hydrocarbon industry through energy subsidies and employment in the public sector as well as lack of a significant fiscal policy. These factors weigh heavily on the government budget and public finances of the MENA region.

All MENA countries face rising domestic energy (and especially power) consumption which lead to several negative economic and energy consequences. For hydrocarbon-producing countries, the transformation into large consuming countries entails lower export potential. For instance, Algeria is able to export only half of its gas production while Saudi Arabia has to devote roughly one-third of all oil barrels produced for internal consumption. Given the projected growth in population, economy and localization of industries, this trend may worsen. Moreover, resource-rich countries (i.e. KSA, Kuwait) may not continue to depend on oil revenues in the long term to satisfy the implicit population's demands underwritten in their social contract. Indeed, all main international energy agencies (IEA, IRENA, EIA) forecast a significantly lower global oil demand in the coming decades. Difficulties in satisfying the requests of the social contract, mostly translating into high budget deficit and government debt as well as socio-political relative dissatisfaction could be seen in Bahrain and Oman. Indeed, these two countries have considerably lower hydrocarbon reserves and production with respect to other GCC countries, and Bahrain has almost depleted its reserves.

In resource-poor countries, the common denominator regards highly indebted public utilities, which represent a heavy weight on government budget, for instance in Lebanon, Tunisia and Jordan. More broadly, economic hardships, saturation of the public sector, and an inefficient energy sector contribute to increasing socio-political dissatisfactions at various levels. Lastly, regardless of natural endowments, countries like Iran and Palestine show the negative impact of external constraints on economic prosperity and social satisfaction. In both cases, the full exploitation of natural resources (production for Palestine and export for Iran) is hampered or not possible.

A key driver of rising energy consumption is demographic growth. The MENA region has one of the world's fastest growing populations in the world. In 2000, the region comprised 296 million inhabitants. Between 2000 and 2020, around 136 million people were added, almost the same figure (+ 125 million) is expected to be added in the next two decades (2020–2040). Despite slowing growth rates, MENA's population is expected to more than double in size during the first half of the XXI century, passing from around 296 million in 2000 to 650 million in

2060 according to the United Nations' median population scenario. Should demographic growth offset economic growth, it could determine domestic unrest and socioeconomic instability, which may in turn pose a threat to critical operations in the domestic hydrocarbon industry and energy transition in all MENA countries. Population growth influences per capita income and patterns of employment. Two of the largest producers, Iraq and Saudi Arabia, are expected to see an important population growth, + 20 million and + 7.7 million by 2040, respectively. Consequently, they could see a decline in net income from oil rents, calculated on a per-capita basis. By contrast, for producers with relatively smaller populations (e.g. UAE, Qatar and Kuwait) this is less of a concern. On the other hand, hydrocarbon-poor countries are expected to face challenges also from the energy and economic perspectives (i.e. rising energy demand—which is heavily subsidized—affects import bills). Furthermore, oil exporting countries may decide to prioritize the distribution of their oil rents within their borders (as occurred in the second oil supercycle between 2000 and 2014) hence limiting their regional investments, which could lead to higher regional inequality and exacerbate economic fragilities. This outlook could prompt regional instability as happened with the outbreak of the Arab Springs. Conversely, during the first oil supercycle in the 1970s the Gulf monarchies decided to distribute their hydrocarbon rents throughout the entire region, thus contributing to regional economic development, but at the same time encouraging the formation of the rentier mentality also in MENA hydrocarbon-poor countries.

Finally, climate change is adding another challenging layer to the complexity and fragility of the region. Climate change and depletion of natural resources is a threat multiplier in a context of precarious climate balance and high sociopolitical instability. Adverse climate events could drive forced displacement and exacerbate risks of violent conflict, thus further damaging ecosystems and enflaming social unrest due to economic and livelihood loss. The region already experienced rising temperatures, which are expected to become the norm and further increase in a world where global average warming is rising. This yields immediate consequences on precipitation variability, with droughts and floods likely to worsen due to climate change. The World Bank warns that the Mediterranean coasts will receive about 10–20% less rain in a 2 °C world and up to 50% less rain in a 4 °C world (World Bank 2022). MENA is the world's most water-scarce region with 60% of people living in high or extremely high water stressed areas. Water scarcity generates an economic loss in terms of GDP and social unrest, already experienced in countries like Jordan and Iraq.

7.2 Transforming the Energy Sector

The energy transformation of MENA countries begins with the political commitment and transformation capabilities of each country. The region's renewable energy potential is still largely untapped because of several obstacles and challenging features that slow the deployment of renewables. Therefore, this book has assessed the implementation gap for each country. One of the challenges on the financial/investment dimension of some countries (especially oil-importing countries) is their reliance on international investments compared to the hydrocarbon-rich countries in the Gulf. This dependence is substantially affected by the global macroeconomic outlooks.

7.2.1 Growing Ambition of Renewable Energy Targets

Given the urgency to address climate change domestically, coupled with rising international pressure, MENA countries have set different renewable energy targets, which reflect both external circumstances as well as intrinsic peculiarities related to the energy sector, the presence of hydrocarbons and broader economic conditions. Thus, the ambition of a country's renewable target depends on the intersection of different, in some cases diverging, forces, with some prevailing over the rest given a country's characteristics. Since 2021, there have been major developments on climate ambitions in the region, with the UAE announcing its net-zero target by 2050, shortly followed by Saudi Arabia and Bahrain with a net-zero target by 2060, and others likely to follow in the future. There are major differences between hydrocarbon-rich and hydrocarbon-poor countries.

Saudi Arabia has expressed a strong political commitment to transforming its energy sector with very ambitious updated targets with renewables accounting for 50% of power generation by 2030. The UAE's ambitions and objectives are similar to those of Saudi Arabia, while other GCC countries have set lower renewable energy targets due to forces opposing high renewable penetration. For instance, in Kuwait, the political stalemate between the Government and the National Assembly is hindering the required transformation of the country's energy sector. Qatar, being a gas-exporting country, feels less pressured to transform its energy sector, as it considers gas a key element of the global energy and electricity mix also in the medium and long run. Thus, Qatar did not set specific or particularly ambitious renewable targets, instead, it focuses on making the gas process "cleaner" by envisaging carbon capture and sequestration (CCS) technologies.

Similarly to hydrocarbon-rich countries, the renewable energy targets of hydrocarbon net importers (i.e. Jordan, Lebanon, Morocco and partly Tunisia) vary significantly. While a higher level of renewable energy adoption would decrease the high debt of public utilities and enhance energy security, only some countries (i.e. Morocco, Jordan) have set and are on the right track to considerably enhance their renewable installations. Other hydrocarbon-poor countries, instead, are falling considerably behind also in the willingness of stepping up efforts in renewable adoption due to intrinsic peculiarities (i.e. difficulty in finding political consensus in Lebanon).

7.2.2 Common Ambitions but Different Preferences on Low-Carbon Technologies and Solutions

Countries in the MENA region have envisaged a mix of renewable technologies, from solar PV to CSP to wind and hydro depending on their available renewable energy resources, geographic characteristics and the availability of land. Similar to the global trends, hydropower was the first source exploited already in the twentieth century in countries with available water flows (i.e. Iran, Egypt). Regarding the more recent renewable technologies uptake, most countries have primarily focused on solar energy, setting higher targets compared to wind. CSP technology is envisaged or operational in countries that are at the forefront of renewable energy commitment and efforts in the region, such as the UAE and Morocco. Moreover, regarding solar PV, most countries have primarily focused on large-scale projects, also driven by record-low electricity prices in auctions, rather than smaller-scale ones. Exception arises in the case of Bahrain and Palestine, which mostly aim at relying on small-scale solar PV (i.e. solar panels on rooftops). Indeed, land availability in Bahrain and Palestine is limited, plus restrictions in Palestine prevent it from exploiting area C (highest solar potential) and small-scale projects can have the highest potential in enhancing energy security.

Nuclear energy has also been recently adopted by the UAE, with the operationalization of the Barakah nuclear power plant, and it has been discussed in numerous countries, such as Saudi Arabia, Jordan and Egypt, with the possible introduction of Small Modular Reactors (SMRs). All in all, given the water scarcity throughout the MENA region, renewable energy technologies may be coupled with high-energy intensive desalination plants to ensure "cleaner" and higher water security.

7.2.3 Ambition Versus Reality

Most GCC countries have set very ambitious renewable targets. Given the state-of-art of renewable deployment in these countries and assuming a constant adoption rate, many countries may either attain their renewable targets a few years after the planned deadline or they may fall short of such goals. For instance, Saudi Arabia is likely to attain the renewable target set in 2016 in Vision 2030 by 2030 (9.5 GW by 2023, representing the generation of 10% of Saudi total production), whereas conspicuous investments would be needed to attain the updated renewable target (50% of power generation by 2030) in 2021. Similarly, the UAE has highly ambitious targets, however, an "acceleration" in the adoption of renewable capacity would be necessary to attain them. Other countries would need an "acceleration" in the deployment of renewable energy to attain their targets in time. For example, Iran would benefit of a potential ease in international relations and would thus attract new foreign investments in renewable technologies; Oman only needs 1 GW to attain it by 2025; and Kuwait's situation is similar to that of Oman.

The countries which may be able to attain their targets are Bahrein, in the case of large-scale solar projects, and Qatar. The renewable targets set by Qatar, however, are not as ambitious as those of its neighboring countries, most likely because gas is widely considered a “transition” fuel. Thus, it feels righteously less pressured to widely deploy renewable technologies. Moreover, as gas is deemed a key element of the energy transition, diversification both of the economy and of the energy mix is considered less of a priority with respect to other countries.

Also East Mediterranean countries may find it rather challenging to attain their renewable targets, as the current pace of deployment and investments in the renewable field may not be sufficient. Countries such as Jordan and Egypt have set ambitious renewable targets, and have implemented concrete actions and changes in their regulatory and legislative frameworks.

Tunisia and Algeria would also need to step up their efforts to attain their renewable targets by 2030. However, their achievement could be quite challenging given the global macroeconomic contraction since 2020, and the political and regulatory challenges within the two countries. Overall, Morocco represents an exception, because it may be able to attain its 2020 objective as well as its 2030 goal, thanks to the variety of renewable projects commissioned, developed and/or operationalized. Thus, Morocco really seems to be willing to become a key player in renewable energy in North Africa and beyond.

7.2.4 Factors for Slower Implementation

Despite each country facing specific challenges, related to its economic, socio-political and energy characteristics, some obstacles are common to different countries. One of the main challenges regards the numerous bodies and authorities involved in the renewable and power sector, especially in GCC countries, sometimes blurring the responsibilities and the renewable trajectory. Thus, countries should boost cooperation and integration between agencies, companies in the renewable field, promoting synergies and a cohesive renewable strategy. Indeed, in some cases, such as in Kuwait, Saudi Arabia and Oman, different bodies have overlapping responsibilities and tasks. In other countries, such as in Qatar, the distinction between Qatar Petroleum’s strategy and the government’s strategy is not quite clear, as the former sets more specific targets than the latter and the CEO of the NOC is also the Minister of Energy. Lastly, in the case of the UAE, different Emirates had proposed rather diverging energy policies, also concerning the use of coal, hindering the full renewable potential. In early 2022, Dubai announced that its $3.4 billion coal-fired power plant (the Hassyan power plant) would be converted to use gas in line with the UAE wider pledge to have net-zero carbon emissions by 2050.

Another challenge is the insufficient use of cross-border electricity interconnections. Looking forward, it is thus essential to enhance cross-border power interconnections, especially in view of the possible attainment of the ambitious renewable energy targets set by the countries.

High fossil fuel-based energy subsidies are detrimental to the enhancement of renewable energy adoption because they conceal the potential cost advantage of renewables. The region is responsible for almost half of global energy consumption subsidies. Governments experienced major challenges to reform energy subsidies and they traditionally implemented pricing reforms only when fiscal pressure was high due to price volatility (exporting countries when prices are low, and importing countries when prices are high). Energy prices are a key component of the social contract and have underpinned the industrialization in several MENA countries. Nonetheless, they distort energy market and prices and discourage energy efficiency and the deployment of renewables. In order to truly reform energy prices in the region, countries need to pursue a holistic approach, considering several measures such as social safety nets in order to reduce the impact of the reform for the most vulnerable groups.

Moreover, many countries (especially those in North Africa) depend heavily on international investments for the uptake of renewable energy given their domestic financial constraints (compared to their peers in the Gulf). Countries with the largest and highest number of renewable projects—UAE, Egypt, Morocco and Jordan—mostly depend on international organizations (i.e. World Bank) or private investors (i.e. foreign power and energy companies), thanks to record-low power prices at auctions. Conversely, other MENA countries depend on the public sector for investments also in the renewable sector, as they do not quite manage to attract private and international investors, due to inadequate regulatory and/or on-the-ground policies and practices. In many cases, despite having updated and introduced a regulatory framework more favorable to private investments, many countries, such as Algeria and Kuwait, find it still challenging to attract investors.

Countries also face intrinsic economic and/or socio-political challenges that hinder the exploitation of the full renewable potential. For instance, Lebanon's economic collapse and the major structural issues related to its public utility and energy sector represent, without comparison, the greatest obstacle to increasing renewable capacity. Nevertheless, renewable energy would substantially contribute to decreasing the utility's public debt, enhancing energy security (decreasing blackouts), importing less fuel (given also the limited availability of dollars), reducing the population's reliance on expensive, polluting and rather unreliable private diesel generators. In Palestine, renewable energy would considerably enhance energy security, decreasing its reliance on Israel, and the consequent restrictions also in the energy sector (i.e. Israel prevents the fuel from entering Gaza). Nevertheless, the full exploitation of renewable energy, especially solar PV, is possible only, also in this case, by easing the restrictions, allowing full access to area C of the West Bank. Algeria also has to face structural challenges in order to ramp up renewable energy adoption. The country has witnessed numerous protests since 2019, which may lead the government to offer short-term solutions to employment and the economy, instead of addressing structural challenges related to an environment not very conducive to attracting foreign and international investments. Issues related to the political status-quo are also present in Kuwait, with the National Assembly and the government often adopting different standpoints, hindering renewable energy development.

All in all, most countries in the MENA region have fast-paced the willingness and efforts in enhancing renewable energy capacity, with rather ambitious targets. Nevertheless, the attainment of these targets depends on the numerous challenges the countries have to face and overcome, depending on their intrinsic socio-economic and political conditions, the possible presence of hydrocarbons and external circumstances. The transformation of the energy sector in the MENA region is a key condition to remain at the forefront of the global energy system in the medium and long run, especially for hydrocarbon-rich countries, and to overcome numerous obstacles and inefficiencies in the energy and economic field for hydrocarbon-poor countries.

7.2.5 *Energy Transformation Entails Substantial Social and Economic Transformation?*

The energy transformation may entail a substantial social and economic transformation given the strong ties between the energy and sociopolitical spheres. For example, countries may need to implement reforms in order to boost renewable energies and remove barriers to their deployment. Yet, these reforms may change also the long-lasting socioeconomic and political features of the social contract. This is the case for (universal) fossil fuel subsidies, which incentivize inefficient energy consumption. A common social reform, spanning from Morocco to Iran, regards the energy subsidy reform. This scheme was carried out by most countries in the region, independently of natural endowment, with very few exceptions, such as Lebanon, due to a political stalemate. Energy subsidy reforms allow limiting unnecessary energy/electricity consumption as well as budget deficits. Obviously, each country carried out a specific reform, with different attainments (reduction of subsidies to complete phase out) and varying safety net mechanisms. For instance, Iran had one of the most comprehensive reforms, which also entailed cash transfers to the whole population when subsidies were reduced. Egypt also enacted cash transfers, but only to the most vulnerable families in order to limit the negative impact of subsidy reduction. In GCC countries, another social reform regarded the introduction and increase in value-added taxes in a few countries. This scheme was not widespread, as it may entail strong social opposition. The UAE and Saudi Arabia introduced VAT in 2018, with the latter increasing it to 15% in summer 2020. Oman also introduced VAT in Spring 2021. Moreover, diversification is also a key word in this context. It refers to two main situations: diversification of the energy/electricity mix for all countries in the region and economic diversification for mostly oil-rich countries. Economic diversification refers to the attempt and strategy of resource-rich countries to diversify their production, revenues and exports from hydrocarbons. This is why GCC countries, for instance, strive to become aviation, technology and tourism hubs, as clearly expressed in their Visions. Energy/electricity diversification is planned to be carried out mostly by introducing renewable energy sources, primarily solar, given the ideal geographic location of this region allowing the full exploitation of this energy source.

Most MENA countries have published different documents with specific renewable targets.

Another key challenge regards the key role of the public sector in providing employment for the population, investments in renewables and so on. However, the public sector is currently saturated in most countries of the region. Thus, some countries have carried out legislative and regulatory reforms of, for example, the energy sector to attract foreign investments and international organizations in the renewable field (i.e. Jordan, Tunisia and Morocco). Other countries, especially resource-rich ones, view economic diversification as the solution of this challenge, as the localization of high-tech industries could enhance the competitiveness and attractiveness of the private sector also in the domestic labor market. However, in this case, the issue regarding the high reliance on cheap foreign labor should be addressed, as it hinders efforts to shift towards knowledge- and technology-based economies.

As countries need to address several socioeconomic aspects, a key factor in the successful achievement of the energy transformation will be the ability of MENA countries to govern such transformations through reforms. Many MENA countries have launched diversification strategies, but the ability and strength to implement such strategies vary significantly by country. Countries that are experiencing major domestic turmoil may not be able to pursue and implement the strategies required to transform the energy sector and to adapt and adjust to the changing energy landscape. Those countries may thus lag behind in the transition. For example, countries like Algeria, Libya, Iraq, Tunisia and Lebanon face significant domestic instability at different levels. These countries may be tempted to focus their energy policies on the maximization of their reserves, rather than addressing the reforms that will be needed to preserve geoeconomic and geopolitical influence, while countries with more stable and strong governance and institutions could pursue and implement reforms and boost energy transformation.

Another key factor is the ability of MENA countries to finance the transformation, while reducing the short-term negative economic effects of the clean energy transition. In this effort, countries with large foreign exchange reserves are better equipped to offset negative economic consequences in the short term, while financing economic transformation for the next generations. Two groups can be identified related to this issue. On one side, there are MENA oil and gas producers (mainly Gulf countries) with large foreign reserves, supported by other considerable assets that allow these countries to resist the economic crisis caused by decreasing oil prices and/or volumes. On the other side, countries with low levels of foreign reserves and higher debt levels (mainly North African countries) are in a more vulnerable position to preserve their geopolitical role, potentially representing a greater geopolitical risk. Since renewables projects entail high CAPEX (yet low OPEX), hydrocarbon importing countries with few financial reserves will need to rely more on external investors than hydrocarbon-exporting countries. To attract the required investments, hydrocarbon-importing countries will have to put in place favorable conditions and stable regulatory frameworks, removing market and infrastructure barriers.

7.3 Transforming Geopolitical Factors

Hydrocarbon reserves in the MENA region have significantly contributed to shaping energy geopolitics, attracting multiple external powers and interests. The general availability of vast and abundant hydrocarbon reserves makes the MENA region one of the main energy geopolitical blocs. The desire and need to ensure adequate supplies for their own economies have been a key reason in the global actors' engagement with the MENA region. As a result, regional hydrocarbon reserves have been a key factor for several tensions and conflicts which in the past have erupted in the region, whereas in other regional hotspots (e.g. in the East Med gas saga as well as in Syria) hydrocarbons are only a factor of a broader geopolitical competition. Global energy markets have been going through major transformations, altering interests for, and relevance of, the region. For example, Western countries have over the past decade partially reduced their interests in MENA hydrocarbon reserves driven by the American shale oil and gas revolution and European climate policies. Whereas other countries (e.g. China and Russia) have increasingly engaged with key MENA hydrocarbon producers in order to either secure supply (in the case of China and other Asian countries) or enhance global oil policy coordination (in the case of Russia with the OPEC+ deal). The global energy transition will inevitably change energy geopolitics and the relevance of the MENA region. New players and strategies will be pursued by MENA countries to maintain or enhance their geopolitical relevance also in a low-carbon future.

7.3.1 Conflicts and Hydrocarbons

The MENA region has been the stage of several tensions and conflicts over the last decades. In 2011, the entire region was shocked by the Arab Springs, which resulted in the end of long-lasting rulers in North Africa (Libya, Tunisia, Egypt) as well as minor turmoil in the Gulf (e.g. Bahrain). Since 2011, several countries have been experiencing major internal conflicts, exacerbated by external players; the cases of Libya and Syria are particularly illustrative. Moreover, (geo)political tensions and competition have grown also in the Eastern Mediterranean as well as in Iraq and Iran. In some cases, such as Libya, hydrocarbons (mainly oil, but more recently also gas) have been the prize and a key driver of the duels. The two local factions have clashed over the control of hydrocarbon reserves, which are vital for the government's revenues. Moreover, Haftar and his troops used natural resources as a way to undermine the Tripoli-based government legitimacy. On the other end, Syria's conflict is not driven by control and exploitation of its hydrocarbon reserves. They are almost irrelevant in terms of size within the world's hydrocarbons markets to validate this hypothesis, despite the US decision to leave some US troops in defense of Syria's oil fields. The recent geopolitical competition in the East Mediterranean stands in the middle. The discovery of several offshore fields in the area has fueled regional competition and tensions. However, this competition is more related to the broader regional competition on other issues between key regional powers (Turkey, Egypt, Gulf monarchies). What mainly motivates the increasing tensions is maritime boundaries, legal status and regional ambitions, partially caused by the fading role of the US. In this case, energy shapes regional and international relations, consolidating the already existing trends and strategies.

7.3.2 Old and New Players—A Regional and International Realignment?

The region is going through fundamental changes as the world's power, economy and energy balance is shifting. The traditional interest and role of the US in the region, which begun in the aftermath of World War II, has been questioned by a combination of some fatigue related to the engagement with the MENA region also prompted by the rise of the US domestic hydrocarbon production. Despite remaining a fundamental player in the region, the US is perceived as losing its leverages with MENA countries (especially in the Gulf) while new geopolitical powers, China and Russia, have with different approaches enhanced their relevance in the region's affairs.

Throughout the past decades, China has increasingly dominated the fossil fuel demand side, becoming a major market for MENA hydrocarbon exports. Oil exporting countries are interested in strengthening their energy relations with China as well, because of China's growing energy markets. In this sense, China represents a vital source of revenues for exporting countries like Iran and Iraq, while representing one of the major markets for Saudi Arabia's oil exports. Furthermore, China proposes economic and technological partnerships which are crucial in the diversification strategies of several MENA countries. China has prioritized economic relations, without explicitly taking side in conflicts or tensions (e.g. Libya, Qatar embargo). China has proposed and granted significant investments across the region in key sectors, such as infrastructure, energy, telecommunications, as part of its broader strategy under China's Belt and Road Initiative. Indeed, the MENA region is at the crossroads of Asia, Africa and Europe. Several MENA countries hold a strategic relevance within China's Maritime Silk Road.

For Russia, two episodes have marked its return into Middle Eastern affairs. The military intervention in Syria in support of the Assad regime and the OPEC+ agreement in 2016. Russia has increased its presence in the region's affairs, defending its traditional position (e.g. Russia's only naval base in the Mediterranean is located in Syria) by exploiting the political vacuum (e.g. in the post-Qaddafi Libya) in order to restore its reputation as a global power and obtain strategic and tactical gains useful in other negotiations. Since 2016 (and especially after 2020), Russia has cemented its relations with large hydrocarbon producers in the Gulf, primarily Saudi Arabia and the UAE through policy coordination within the OPEC+ deal. These countries decided to preserve their relationship also during 2022, despite major political pressure from Western countries (mainly the US) to isolate Russia in light of Russia's war in Ukraine. These developments highlighted the prioritization of national interests by Gulf countries over those of their traditional allies (the US first and foremost). While energy is a primary driver of cooperation with regional countries for both Russia and China, energy is also a means to strengthen cooperation by MENA countries and to adapt to the changing geopolitical landscape.

7.3.3 Evolving Geopolitics Alongside with the Energy Transition

Meanwhile, there has been a growing consensus on climate policies with an ever-growing number of countries having pledged to net-zero by and around midcentury. These pledges entail significant lower oil and gas demand (even though it will not mean zero demand). As we outlined in Chap. 2, the world's future oil and gas demand is expected to decline albeit at a different pace. Global oil demand, which had reached its record level of 97.6 mb/d in 2019 is expected to reach by 2050 a level of 45 mb/d (− 54% compared to 2019) in the IEA's 2021 Sustainable Development Scenario (SDS) and even down to 21 mb/d (− 78.5%, or compared to 2019) in its "Net Zero carbon Emissions by 2050" (NZE) scenario (IEA 2021). The sharp decline will be mainly driven by significant changes in the transport sector as electric vehicles will gain an increasing market share, especially in countries with net zero pledges. Natural gas demand has a different, yet also challenging, future. The IEA (2021) foresees that in decarbonization global natural gas demand remains roughly stable at around 3860 bcm (the 2020 level) up to 2030 as on the one side it will be challenged by increased energy efficiency in all sectors as well as the strong continuation of renewable energy penetration in the power sector, and on the other side it will partly replace coal for power generation and the industry. After 2030, the global demand for natural gas (in particular for unabated natural gas) should decline rapidly. By 2050, natural gas demand is expected to reach around 2367 bcm (minus 39% compared to 2020) in the SDS and 1686 bcm (− 56% compared to 2020) in the NZE (IEA 2021). In NZE, natural gas demand falls largely in all regions, except those that are currently heavily reliant on coal, where natural gas largely displaces coal. These scenarios may substantially change in light of the energy crisis started in 2021 as prolonged high gas prices may destroy consumption in several countries.

The future geopolitical role of MENA hydrocarbon exporters varies depending on the different outlook of oil and gas demand. Oil producers may encounter challenges and a loss of geopolitical influence earlier than gas producers. Energy demand will become an important feature of the geopolitical equation as countries will need to compete for smaller energy demand and rising energy markets (i.e. Asia). For these reasons, it will be crucial for MENA exporting countries to have a diversified export portfolio in order to be able to hedge declining demand due to climate regulations.

Therefore, those countries that have secured contracts and market shares in growing energy markets like Asia are in a better position to be relevant in the long-term. Historically, Gulf countries export most of their hydrocarbons to Asia (about 76% for oil and 82% for gas in 2019), while North Africa relies more on European energy markets (about 58% for oil and 78% for gas in 2019). Those MENA producers that are more dependent on the energy markets that have higher decarbonization commitments, such as the European Union, will be more exposed to economic and geopolitical loss unless they adapt to the new context. The producers, such as the North African ones, which are unable to diversify their export portfolio, may suffer the most and more rapidly from the energy transition of their key markets. By contrast, those MENA oil and gas producers that export to growing energy markets, like Asian countries, should be able to preserve their geopolitical influence. For such reasons, the export portfolio composition and its diversification are increasingly crucial in the new energy transition. In the medium term, the Ukrainian war has reshaped the world's energy map and flows. All MENA producing countries may increase their exports to Europe. Yet, the EU has reiterated its climate ambitions hence higher exports towards its markets could be temporary.

Future lower hydrocarbon demand may entail higher competition among the largest producers. This could undermine joint and coordinated actions aimed at stabilizing the oil prices, such as within the OPEC countries. Despite the rising energy prices in 2021/22, OPEC countries have managed to preserve the unity of the deal, extended to other non-OPEC countries including Russia. Nonetheless, several MENA countries announced their intention to ramp up production. For example, the UAE aims at increasing production to 5 mb/d before 2030 from 4 mb/d in 2021, while Saudi Arabia seeks to increase its production up to 13 mb/d. While these countries have the financial and natural resources to reach these targets compared to other countries, these plans may shake the unity of OPEC and the OPEC+ deal.

Alongside the decline of fossil fuels, the global energy transition will result in the expansion of clean-energy and low-carbon technologies and solutions, such as renewables, hydrogen, batteries. The geopolitics of energy will become more complex as industrial and technological capabilities will become key factors of the geopolitical equation. The risk for MENA countries (especially hydrocarbon-exporters) is to lose their geopolitical relevance in the energy markets. Therefore, MENA countries need to consider possible solutions to adapt and adjust to the evolving energy markets and the energy transition by strengthening their competitive advantages and investing in new solutions.

7.3.4 Net-Zero does not mean the end of Petrostates—Strengthening the Competitive Advantages

While the net-zero transition certainly puts substantial pressure on hydrocarbon producers' economic and political stability, a net-zero scenario does not imply the end of all petrostates as often wrongly suggested and assumed. This is due to the fact that fossil fuels will not completely disappear from the world's energy mix. Indeed, a net-zero scenario requires a huge decline in the use of fossil fuels, falling from almost 80% of total energy supply today to slightly over 20% by 2050, according to the IEA. However, their use will need to be coupled with technologies, such as carbon capture use and storage (CCUS), in order to be abated. Furthermore, since today's energy transition is mainly a policy-driven process, it is expected to be pursued at different speed and pace across the world's regions. For hydrocarbon-exporting countries, it will be therefore crucial to strengthen their competitive advantages in order to play some role in the future hydrocarbon supplies. In this sense, several players (Qatar, Saudi Arabia and the UAE) have announced their ambitions to develop and deploy CCS projects in order to reduce emissions of their hydrocarbon operations.

In a fossil fuel demand-constrained world, several MENA countries are expected to play the role of the last *barrel* standing as some Gulf countries can benefit from low-cost production. Until now, regional producers have behaved against market rules, leaving higher-cost producers in the market. One of the reasons is that MENA countries need to take into consideration not only production costs but also social costs given the overreliance on oil rents. However, several MENA countries are expected to remain geopolitically relevant along the transitional period and beyond because they can benefit from cheaper production. The key element for them will be to reduce their hydrocarbon consumption, which is expected to grow given rising population, and adapt their socioeconomic model to the upcoming scenario in order to maximize the valorization of their reserves. Another strategy undertaken by hydrocarbon producers is towards downstream segments of value chains both at home and abroad.

In a low-carbon future, hydrocarbon producers need to consider also other competitive advantages in order to preserve their geopolitical role, such as low carbon intensity of their oil and gas production, thanks to a combination of the nature of their reserve base, very low gas flaring rates per barrel and low water volume per unit of oil produced, and heavy investment in infrastructure and technology. Indeed, securing and defending market shares will not be enough as their products would still face climate issues. Production, transportation and use of oil and gas still produce carbon emissions. On this issue, some MENA oil and gas producers are well positioned, having the lowest production carbon intensity, which is set to become more relevant in a high-carbon prices scenario. At low levels of carbon prices, differences in carbon intensity have a relatively low impact on overall costs and competitiveness. Saudi Arabia and the UAE have one of the lowest carbon intensity rates in the world. Saudi Arabia is committed to further improving this condition. Saudi Aramco announced that it aims to reduce its upstream carbon intensity by 15% by 2035 against a 2018 baseline. On the other hand, other MENA oil producers, such as Algeria and Iraq, have higher carbon intensity rates, which could harm their competitiveness in the future energy system. This is also true for gas exporters like Qatar as they try to protect and enhance the role of natural gas within the energy transition. First, Qatar has decided to regain the leading role in the LNG industry by both expanding its production and export capacity (through North Field expansion and the Golden Pass

LNG project in Texas, US) and benefiting from one of the world's lowest carbon intensity rates in LNG supply chains. The small emirate is committed to further improving this condition as it announced to cut its LNG carbon intensity by 35% by 2035 thanks to the further deployment of CCS.

7.3.5 *New Opportunities and Strategies for Geopolitical Relevance for All MENA Countries: Decarbonized Products and International Cooperation*

Besides the key factors determining the future geopolitical role of MENA oil and gas exporters, all MENA countries need to find solutions to gain geopolitical relevance, ensure future revenues, and reduce total emissions in a net-zero scenario. Therefore, MENA countries could decide to focus on decarbonizing products with new, cleaner energy carriers, exploiting their strengths and competitive advantages. This solution becomes feasible also for MENA hydrocarbon importers as they share a similar renewable potential with MENA hydrocarbon exporting countries. North African countries are better positioned to export clean electricity to European markets as they benefit from geographical proximity. However, they will need to expand both domestic renewable generation and cross-border electricity interconnections as today the two shores of the Mediterranean Sea are poorly interlinked through only two cables (1400 MW combined) between Spain and Morocco.

Another strategy could be represented by the production and export of hydrogen. Firstly, a hydrogen economy could fit well in the hydrocarbon economy and management hence not requiring too many industrial structural changes in MENA countries. Then, as the international electricity trade faces several challenges from the efficiency and security standpoint, countries may prioritize hydrogen trade. Concerning large-scale long-distance energy transport, molecules can be transported more easily and cost efficiently than electrons. Hydrogen and its derivatives could play a pivotal role in decarbonizing those sectors where electricity is not feasible such as heavy industries, and the long haul maritime and aviation sectors. This option may forge a new EU-MENA energy cooperation as hydrogen can be transported by existing pipelines with some infrastructural adjustment (i.e. coating). Furthermore, new momentum to a renewed cooperation based on hydrogen is driven by the fact that Europe will not experience self-sufficiency in hydrogen even though in 2022 it updated targets for domestic hydrogen and biomethane production. Thus, the REPowerEU has also set a target of 10 Mt of renewable hydrogen imports by 2030 (EC 2022). Of these imports, 6 Mt are envisaged to be imported by pipeline in the form of hydrogen, while the rest in the form of ammonia or other hydrogen derivates, which can be more easily imported by ship.

The EU is certainly considering importing from least-cost producing regions, such as North Africa, through the support to major hydrogen import corridors. North Africa has the advantage of proximity to European markets and already existing gas pipelines. This, combined with the aspirations of some MENA countries to become lead exporters, will bring new avenues for the EU-MENA cooperation. For these reasons, the European Commission is working on a Mediterranean Green Hydrogen Partnership (MGHP) and will explore with Gulf countries opportunities for concluding Green Hydrogen Partnerships in order to create win–win solutions and establish a new sustainable energy cooperation. The MGHP will start with the EU-Egypt Hydrogen Partnership. Both oil-rich and oil-poor MENA countries, in particular Morocco, Saudi Arabia, the UAE and Oman, have been working on their hydrogen ambitions, considering both blue and green hydrogen projects. Morocco, a traditional energy-importing country, is among the leading hydrogen players in the region as it aims to use its great solar and wind potential to develop hydrogen for export. The country set an ambitious renewable target of 52% of installed electricity capacity by 2030 and has attempted to ensure partnership with European countries, notably Germany, for the development of hydrogen projects. The Gulf countries are committed to exploiting both their hydrocarbon and renewable resources to develop hydrogen. Compared to their peers in North Africa, Gulf countries have more domestic financial capabilities to invest in the development of a hydrogen economy.

Also the Gulf countries have expressed their interests in hydrogen—albeit at some different intensity. For example, Saudi Arabia has initiated major undertakings with no formal framework such as hydrogen strategy, while Oman is creating new structures and introducing various projects. The UAE has announced a policy framework and successfully realized its first ventures. On the other hand of the spectrum, Kuwait and Bahrain remain cautious, and Qatar prioritizes its LNG industry and blue hydrogen production. There are some differences also regarding the hydrogen's color: the UAE and Saudi Arabia are balancing between green and blue, while Oman is focusing on green and Qatar stays with blue. Regarding hydrogen developments, a lack of coordination among Gulf countries is visible.

Despite the great enthusiasm on international hydrogen trade, the option faces several challenges from the economic and efficiency perspectives. Hydrogen is difficult and expensive to transport (especially in the long distances) and turning it into a more easily transportable non-carbon fuel entails further costs. Instead of focusing exclusively on hydrogen exports, MENA countries could develop clean hydrogen production in order to decarbonize (and expand) their domestic heavy industries including to export decarbonized products (steel, chemicals, etc.). It will always be more convenient to utilize renewable energy or blue/green hydrogen locally for the production of carbon-intensive intermediate or final products than to export hydrogen. In this way, MENA countries could overcome logistic and economic barriers and collect higher revenues, albeit lower compared to the oil and gas sector. Throughout the years, MENA countries have traditionally invested in carbon-intensive industries, such as steel, cement, aluminum and chemicals as well as fertilizers. The decision to decarbonize their domestic industrial output through hydrogen could protect a key economic/industrial pillar from potential and rising carbon prices at the borders of consuming countries. Moreover, it could become a competitive advantage vis-à-vis those industrial countries that do not hold a low-cost hydrogen potential. MENA could also pursue an intermediate strategy, which consists in using hydrocarbons locally in energy-intensive transformations coupled with CCUS. For example, in 2022 Emirates Steel Arkan announced its partnership with Japan's ITOCHU Corp and JFE Steel Corporation to consider the construction of a ferrous raw material production facility in Abu Dhabi that would become an integral part of a global low carbon emission iron supply chain initially through natural gas and then through the adoption of renewable energy power sources as well as green hydrogen.

Bibliography

EC and EEAS (2022) A strategic partnership with the gulf, joint communication to the European parliament and the council, JOIN (2022) 13 final, 18 May 2022. https://www.eeas.europa.eu/sites/default/files/documents/Joint%20Communication%20to%20the%20European%20Parliament%20and%20the%20Council%20-%20A%20Strategic%20Partnership%20with%20the%20Gulf.pdf

EC (2022) REPowerEU Plan (COM/2022/230), 18 May 2022, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52022DC0230

IEA (2021) World energy outlook 2021. International Energy Agency, Paris

Mati A, Rehman S (2022) Saudi Arabia to grow at fastest pace in a decade, IMF, 17 Aug 2022. https://www.imf.org/en/News/Articles/2022/08/09/CF-Saudi-Arabia-to-grow-at-fastest-pace

World Bank (2022) Middle East & North Africa Climate Roadmap (2021–2025). Driving transformational climate action and green recovery in MENA, 25 Jan 2022. https://thedocs.worldbank.org/en/doc/6f868d4a875db3ef23ef1dc747fcf2ca-0280012022/original/MENA-Roadmap-Final-01-20.pdf