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RESEARCH

Marcello Modica

Alpine Industrial Landscapes

Towards a New Approach for Brownfield Redevelopment in Mountain Regions

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In the course of the “spatial turn” of the social sciences and humanities, the number of scientific researches in this field has increased significantly. With the series “RaumFragen: Stadt – Region – Landschaft” scientists are offered a forum to present innovative approaches in anthropogeography and social space research. The series focuses on fundamental questions of the social understanding of space. The aim is to integrate different theoretical approaches of anthropogeographical and social-scientific urban and regional research. Spatial references should be on a micro- and mesoscale level in particular. The series comprises theoretical and theory-based empirical work. These include monographs and anthologies, but also introductions to some aspects of urban and regional geographical and social science research. In addition, conference proceedings and qualification papers (dissertations, postdoctoral theses) are also published.

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The present text is a copy of a doctoral dissertation submitted to the Technical University of Munich in March 2021, with the title “Alpine Industrial Landscapes. Towards a New Approach for Brownfield Redevelopment in Mountain Regions”. The dissertation was successfully defended on 9th July 2021 in front of a commission composed by: Prof. Dr. Sören Schöbel (head), Prof. Dr. Udo Weilacher (first supervisor), Prof. Dr. Stefan Siedentop (second supervisor). The open access publication was funded by the Dr. Marschall Stiftung (Technical University of Munich, Department of Architecture).

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"A man sets out to draw the world. As the years go by, he peoples a space with images of provinces, kingdoms, mountains, bays, ships, islands, fishes, rooms, instruments, stars, horses, and individuals. A short time before he dies, he discovers that the patient labyrinth of lines traces the lineaments of his own face."

Jorge Luis Borges, The Aleph and Other Stories

"Each city receives its form from the desert it opposes."

Italo Calvino, Invisible Cities

Firmly Embeded and Transformed

A foreword by Udo Weilacher

The Alps are characterized by specific natural conditions with a far-reaching impact on the lives of 14 Million inhabitants within the Alpine Convention area[1]. In the course of the Anthropocene, the impact of man is getting increasingly powerful, also on the so-called "Green Heart of Europe". Since in the middle of the 19th century, the change of the Alpine environment was accelerated due to the increasing industrialization of all areas of life and manufacturing. When the heavy industries invaded the main valleys of the Alps, the ecologic, economic and social structures were transformed dramatically and new cultural landscape patterns occurred: Alpine industrial landscapes.

Marcello Modica in this publication clearly points out, that there is a need to carefully investigate the transformation of Alpine industrial landscapes. Since the 1980s the structural change in global industrial production resulted in a crisis that hit the peripheral mountain regions particularly hard. Many spatial planning disciplines, amongst them landscape architects, are actively dealing with the question of how to possibly (re)integrate brownfields sustainably into the landscape. This work is based on a very specific understanding of the term landscape: "Landscape is not a natural feature of the environment but a synthetic space, a manmade system of spaces superimposed on the face of the land, functioning and evolving not according to natural laws but to serve a community."[2]

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[1] Permanent Secretariat of the Alpine Convention, (Ed.). (2017). Greening the Economy in the Alpine Region. Report on the state of the Alps, Insbruck, p. 21

[2] Jackson, J. B. & Horowitz, H. L. (Eds.). (1997). Landscape in Sight. Looking at America, New Haven, pp. 304–305.

Every “manmade system of spaces”, its topography, specific soil, water and climate conditions has a decisive influence on all human life. It is therefore obvious that industrial conversion in the Alpine context has to follow different rules than in densely populated metropolitan lowland regions. Marcello Modica is developing crucial components for these rules and clearly illustrates, that the industry in the Alps is firmly embeded into a complex landscape structure in spatial proximity to smaller municipalities. These communities are almost always overextended with the conversion of large industrial wastelands, and the researcher therefore introduces sustainable planning strategies that can be used by local and regional actors to start the conversion of brownfields.

Such a complex task cannot be mastered by a single professional group alone. Therefore, it is very foresighted, that Marcello Modica takes up an interdisciplinary position, supported by the International Doctoral College “Spatial Research Lab” of which he was a member between 2017 and 2020. Modica also profits from his experiences as the project manager of a 3-year interdisciplinary research project, led by the Technical University of Munich from 2018 until 2021. Regional project partners in Austria, France, Italy and Slovenia, as well as many renowned researchers from five universities worked on the transformation of Alpine industrial landscapes (trAILs), funded by Interreg Alpine Space programme of the European Union. Committed scientists like Marcello Modica will play an important role in complex transformation projects in the future. I am personally very pleased that my team at the TUM chair for Landschape Architecture and Transformation and I were able to support him in making his professional career and I personally congratulate him very much on this important publication.

Acknowledgments

This work is the result of an intense, challenging and truly exciting journey. Therefore, I take this opportunity to thank all those who contributed to make this achievement possible.

First, I would like to express my deepest gratitude to my main supervisor Prof. Dr. Udo Weilacher, for genuinely grasping my initial research interest and for giving me the opportunity to concretely realise this potential. His remarkable commitment as critical reviewer, his openness to confrontation and his constant scientific support were essential to foster my progress and to reach this final result. A special thanks goes also to my second supervisor Prof. Dr. Stefan Siedentop, whose constructive interest for my research topic was a great source of motivation and innovation as well.

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This dissertation was largely developed and completed within the framework of the EU-funded Interreg Alpine Space project *trAILs—Alpine Industrial Landscapes Transformation*, which run from 2018 to 2021 under the supervision and coordination of Prof. Weilacher and me. In this respect, I would like to acknowledge all the friends and colleagues from partners institutions in Italy, Austria, France and Slovenia for having enabled this outstanding, mutual learning process.

I would like to express my gratitude to the many stakeholders from the Alpine region who shared with me their valuable expertise, dedicating time for interviews and exchanges. In particular, I would like to thank personally the ‘gatekeepers’ of my case studies, for their outstanding support to my fieldwork activities across Italy, France, Austria and Switzerland during summer 2018: Alessandra Pellegrini (Comune di Ponte Nossa), Mario Balduzzi (Comunità Montana Valle Seriana), Eugenio Seghezzi (Comune di Premolo), Mathieu Janin (SLS sas), Roger Cohard and Alain Daramy (Mairie Le Cheylas), Tonis Antzoulatos (Communauté de Communes Le Grésivaudan), Hintner Heinz and Josef Blößl (Rohrdorfer SPZ GmbH), Josef Dillersberger (Gemeinde Schwoich), Tamar Hosennen (Regions- und Wirtschaftszentrum Oberwallis), Renzo Theler (Theler AG), Raphael Matter (Constellium Valais).

A doctorate is first and foremost a life achievement. In this respect, my utmost gratitude goes to my mother Maria and my father Giovanni, who always encouraged and supported me in following and realising my dreams, nourishing my life with passion, creativity and ambition. I dedicate this work to them.

Summary

The Alps, often labelled as the green heart of Europe, are in fact a complex living environment, as well as an economic region undergoing profound transformation. For some decades now, a widespread deindustrialisation process is leading to the decline and disappearance of traditional resource- and energy-intensive mountain industries. Still largely underestimated by both research and practice, this process is producing an ever-increasing number of brownfield sites of relevant size and complexity. Their physical and functional transformation represents, for many mountain communities, a unique opportunity to improve socio-economic and environmental conditions both locally and regionally. However, the structural limitations of the mountain context prevent, in most cases, to initiate and successfully achieve a sustainable brownfield redevelopment. A possible way to overcome this planning challenge is to re-consider Alpine brownfields as a territorial infrastructure, that is, to emphasise their spatial embedment into a wider landscape structure, rather than just focusing on the functional disconnection from the context. In this perspective, the former industrial site becomes to all effects a structuring element of a complex system of relations—physical and functional, existing and potential—capable of informing the future transformation. By means of a holistic landscape approach, which integrates structuralism and systemic design in brownfield transformation, this hypothesis is concretised into an operative model. The latter is developed, implemented and tested on four case study sites in Austria, France, Italy and Switzerland, highly representative of the different brownfield typologies and contextual conditions across the Alpine region. Explored and rendered through intensive fieldwork and remote mapping and design, the proposed landscape approach to brownfield redevelopment in mountain regions holds a twofold potential. By fostering an inclusive, incremental and flexible site transformation, it enhances the feasibility of the overall process. In addition, being easily adaptable to a variety of situations and contexts, it ensures a very high transferability within the Alps and beyond.

Kurzfassung

Die Alpen, die oft als das grüne Herz Europas bezeichnet werden, sind in Realität ein komplexes Lebensumfeld sowie eine Wirtschaftsregion, die sich in einem tiefgreifenden Wandel befindet. Seit einigen Jahrzehnten führt ein weit verbreiteter Deindustrialisierungsprozess zum Niedergang und Verschwinden traditioneller Grundstoffindustrien und energieintensiver Branchen in Bergregionen. Dieser Prozess, der von Forschung und Praxis stark unterschätzt wird, führt zu einer immer größeren Zahl von Industriebrachen von relevanter Größe und Komplexität. Ihre physische und funktionale Transformation stellt für viele Berggemeinden eine einzigartige Gelegenheit dar, die sozioökonomischen und ökologischen Bedingungen sowohl auf lokaler als auch auf regionaler Ebene zu verbessern. Die strukturellen Einschränkungen des montanen Kontextes verhindern jedoch in den meisten Fällen, dass eine nachhaltige Revitalisierung von Industriebrachen eingeleitet und erfolgreich durchzuführen. Ein möglicher Weg, um diese Planungsherausforderung zu bewältigen, besteht darin, die alpinen Industriebrachen als Teil der Infrastruktur zu betrachten und ihre räumliche Einbettung in eine breitere Landschaftsstruktur zu betonen, anstatt sich nur auf die funktionale Trennung vom Kontext zu konzentrieren. In dieser Perspektive wird der ehemalige Industriestandort auf allen Ebenen zu einem strukturierenden Element eines komplexen Beziehungssystems – physischer und funktional, auf den Bestand bezogen wie auch in die Zukunft weisend –, dass in der Lage ist, die zukünftige Transformation zu beeinflussen. Durch einen ganzheitlichen landschaftlichen Aftsansatz, der Strukturalismus und systemisches Design in die Transformation von Industriebrachen integriert, wird diese Hypothese zu einem operativen Modell konkretisiert. An vier Fallstudienstandorten in Österreich, Frankreich, Italien und der Schweiz, die für die unterschiedlichen Typologien von Industriebrachen und Kontextbedingungen im gesamten Alpenraum sehr repräsentativ sind, wird

dieses Modell entwickelt, implementiert und getestet. Der vorgeschlagene landschaftliche Ansatz zur Revitalisierung von Industriebrachen in Bergregionen, der durch intensive Feldarbeit sowie Fernkartierung und -Gestaltung erforscht und umgesetzt wird, birgt ein zweifaches Potenzial. Durch die Förderung einer integrativen, inkrementellen und flexiblen Standorttransformation wird die Machbarkeit des Gesamtprozesses verbessert. Da es leicht an eine Vielzahl von Situationen und Kontexten anpassbar ist, gewährleistet es außerdem eine sehr hohe Übertragbarkeit innerhalb der Alpen und darüber hinaus.

Riassunto

Le Alpi, spesso rappresentate come il cuore verde d'Europa, sono in realtà un ambiente di vita complesso, oltre che una regione economica in profonda trasformazione. Da alcuni decenni, un processo generalizzato di deindustrializzazione sta causando il declino e la scomparsa delle industrie montane tradizionali, energivore e consumatrici di risorse. Questo cambiamento strutturale, ancora ampiamente sottovalutato sia dalla ricerca che dalla pratica, sta generando un numero sempre maggiore di siti industriali dismessi di dimensioni e complessità rilevanti. La trasformazione fisica e funzionale di queste aree rappresenta, per molte comunità montane, un'opportunità unica per migliorare le condizioni socioeconomiche e ambientali, sia a livello locale che regionale. Tuttavia, i limiti strutturali del contesto montano impediscono, nella maggior parte dei casi, di avviare e perseguire efficacemente una riqualificazione sostenibile dei siti ex industriali. Una possibile risposta a questa domanda progettuale e pianificatoria sta nel riconsiderare le aree dismesse alpine come un'infrastruttura territoriale, ovvero enfatizzandone l'integrazione fisica in una più ampia struttura paesaggistica, piuttosto che concentrarsi esclusivamente sulla disconnessione funzionale dal contesto. In questa prospettiva, il sito ex industriale diventa a tutti gli effetti elemento strutturante di un complesso sistema di relazioni – fisiche e funzionali, esistenti e potenziali – in grado di informare la trasformazione futura. Attraverso un approccio olistico al paesaggio, che integra strutturalismo e progettazione sistemica nella trasformazione delle aree dismesse, questa ipotesi trova concretizzazione in un modello operativo. Quest'ultimo è sviluppato, implementato e testato su quattro casi studio in Austria, Francia, Italia e Svizzera, altamente rappresentativi delle diverse tipologie di siti e contesti riscontrabili

nella regione alpina. Esplorato e reso attraverso un intenso lavoro sul campo e di mappatura e progettazione da remoto, l'approccio paesaggistico proposto per la riqualificazione delle aree ex industriali alpine ha un duplice potenziale. Promuovendo una trasformazione inclusiva, incrementale e flessibile, migliora la fattibilità dell'intero processo. Inoltre, essendo facilmente adattabile a una varietà di situazioni e contesti, assicura un'elevata trasferibilità entro e oltre le Alpi.

Resumé

Les Alpes, couramment représentées comme un cœur vert de l'Europe, sont un milieu de vie complexe, ainsi qu'une région économique en profonde mutation. Depuis des nombreuses décennies, les processus de désindustrialisation généralisée ont conduit au déclin et à la disparition des industries lourde de montagne, à forte intensité de ressources et d'énergie. Encore largement sous-estimé tant par la recherche que dans les pratiques, ce processus produit un nombre croissant de friches industrielles de taille et de complexité conséquentes. Leur transformation physique et fonctionnelle représente, pour de nombreuses communautés de montagne, une vraie opportunité pour améliorer les conditions socio-économiques et environnementales à la fois localement et régionalement. Cependant, les limites structurelles du contexte montagnard empêchent, dans la plupart des cas, d'initier et de réussir un réaménagement durable des friches industrielles. Une manière possible de surmonter ce défi de planification est de reconsidérer les friches industrielles alpines comme une infrastructure territoriale, c'est-à-dire de souligner leur ancrage spatial dans une structure paysagère plus large, plutôt que de se concentrer uniquement sur leur déconnexion fonctionnelle du contexte. Dans cette perspective, l'ancien site industriel devient, dans tous les sens du terme, un élément structurant d'un système complexe de relations – physiques et fonctionnelles, existantes et potentielles – capables d'informer la transformation future. Au moyen d'une approche holistique du paysage, qui intègre le structuralisme et la conception systémique dans la transformation des friches industrielles. Cette hypothèse se concrétise en un modèle opérationnel. Ce dernier est développé, mis en œuvre et testé sur quatre sites d'études de cas en Autriche, en France, en Italie et en Suisse, très représentatifs des différentes typologies de friches industrielles et de contextes de la région alpine. Explorée au travers de travaux de terrain intensifs, d'une production cartographique et d'études de conception à distance, l'approche paysagère proposée pour le réaménagement des friches industrielles dans ces régions de montagne présente un double interêt. En favorisant une transformation de site inclusive, progressive et flexible, elle améliore la faisabilité du processus global. De plus, étant facilement adaptable à une grande diversité de situations, elle permet sa bonne transférabilité dans les Alpes et au-delà.

Contents

Part I

Framework

1 Research Interest

Since the late 1970s, many European urban areas have embarked on a complex process of physical and functional restructuring following extensive deindustrialization phenomena. In this context, the revitalisation of local and regional economies, as well as the improvement of social and environmental conditions, have found a common ground in the transformation of brownfields, i.e. "derelict or underused sites that have been affected by the former [industrial] uses of the site and surrounding land; may have real or perceived contamination problems; are mainly [found] in developed urban areas; and require intervention to bring them back to beneficial use" (Oliver et al. 2005). To tackle the unprecedented challenge of brownfield redevelopment, and to effectively highlight its multi-scalar and interdisciplinary character, new planning and design strategies have been since then developed and widely adopted (Hauser 2001; Baum and Christiaanse 2012; Braae 2015). The rehabilitation of disused industrial sites has thus become increasingly relevant in many regional, national and EU policies addressing sustainable territorial development, especially due to its notable contribution to sustainable urban growth and large-scale regeneration processes (Ferber et al. 2006).

The often central location of most brownfields in respect to large urban systems, as well as their proximity to key infrastructural nodes, make their redevelopment strategically relevant to sustain land recycling processes at the regional scale (European Environment Agency 2016). This is particularly evident in major urban agglomerations, where the structural transition to post-Fordism has fostered the territorial 'explosion' of the city through the intertwined processes of urban sprawl (Couch, Petschel-Held, and Leontidou 2008) and urban shrinking (Oswalt and Rieniets 2006). Here, vacant industrial land and redundant infrastructural

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spaces—often so well integrated into the urban fabric to be referred as ’voids’—are offering a better alternative in terms of available and accessible built land to undeveloped greenfields and semi-natural spaces in the outskirts (Schulze Baing 2010). Depending on the specific framework conditions, brownfield redevelopment can support urban densification—either by adaptively reusing the existing built heritage or building anew—as well as helping to improve the ecological conditions of deprived urban areas—through the creation of green infrastructures, recreational spaces and, in some extreme cases, also by bringing ‘back-to-nature’ former built or contaminated areas. Accordingly, brownfield redevelopment is capable of influencing the spatial form and the environmental impact of urban settlements.

At the same time, the recycling of derelict industrial land helps to improve the socioeconomic conditions of deindustrialising and transitional urban contexts, by fostering a localised functional diversification/upgrade (Couch, Fraser, and Percy 2003). The physical transformation of the inherited, former industrial ‘topographies’ always carries on a functional program, which in turn has to mirror in the new layout and appearance of the site itself. This is an incredibly complex challenge, as it brings together often conflicting perspectives and aims such as heritage conservation and architectural production, economic and real estate development and social inclusion and identity (Mieg and Oevermann 2015). In this respect, the planning concept of ’mixed-use development’ has gained particular success in relation to brownfield revitalisation projects, as its functional inclusiveness perfectly matches the physical and programmatic flexibility of disused industrial land. Over time, this matching has proved to work out good not only for what concerns traditional urban functions, such as housing, business and services, but also and especially for catalyst functions with a truly regenerative power such as art and culture, education, recreation and leisure (Hospers 2004; Dixon et al. 2007). In this way, brownfield transformation as (also) an act of innovative functional regeneration can trigger long-term socio-economic restructuring and urban renewal processes.

1.1 Brownfields in Mountain Regions

The interwoven occurrence of industry, deindustrialisation and brownfields in mainstream urban settings, such as inner cities and urban-industrial agglomerations, is widely acknowledged. Most of the scientific as well as practical knowledge gained so far—including challenges, opportunities and conversion strategies—is based on case studies and experiences derived exactly from these contexts. However, many relevant and context-specific industrial activities have developed, to a certain extent, also in peripheral urban and semi-urban regions, either in mature or restructuring and developing economies (Ian Hamilton 1986). European mountain ranges are highly indicative in this sense, not only because of their historically documented industrial development (Kopp 1969; Raffestin and Crivelli 1988; Muller 1995; Collantes 2003), but also because today these regions are still showing a proportion of secondary sector employment similar or even higher than in the adjoining lowlands (Nordregio 2004). Nevertheless, the common tendency to overrepresent mountain contexts as predominantly rural and recreational regions, sparsely populated and economically relying on agro-forestry, wilderness and tourism, leaves industry, and especially the presence of brownfield sites, out of the debate on the contemporary mountain socio-economic landscape. Some studies have however highlighted how a structural change in industry is occurring also in peripheral mountain regions across central, eastern and southern Europe (Müller, Finka, and Lintz 2006; Dalmasso 2007; Bonomi 2012; Weissenbacher 2014), and in particular how this decline is imputable to the scarce resilience inherent to most of the industrial activities there existing—resource-intensive sectors, low added value chains, poor competitiveness.

In this regard, the Alps[1] can be assumed as an exemplary case of deindustrialising mountain areas due to their 'advanced' socio-economic development—compared to other mountain regions in Europe and worldwide—and a rather high level of industrial maturity. The strategic location at the crossroads of European trade routes and dynamic metropolises and agglomerations has favoured, throughout the 20th century, the increasing economic integration of the Alpine region into national and global networks, thus fostering also here a widespread yet spatially uneven transition from primary and secondary sectors to services (Perlik 2019). However, while most of the non-Alpine regions of France, Italy, Switzerland, Germany and Austria have largely completed their post-industrial conversion—having thus assimilated the related socioeconomic and spatial impacts—, in the Alps the same process is still ongoing (Modica 2019), being relented by the inherent structural shortcomings of a developed yet still peripheral economy (Bätzing 2015). As evidenced in Fig. 1.1, between 1975 and 2000 the employment rate in the secondary sector shifted from 50% to 36% in Alpine regions[2] and from 41% to 20% in Alpine countries entirely considered (France, Italy, Switzerland, Austria, Germany, Slovenia). Alpine regions experienced in this first phase a more

[1] Identified as the mountainous area within the perimeter of the Alpine Convention.

[2] Statistical regions (NUTS-Nomenclature of Territorial Units for Statistics) of level 2 and 3 fully or partially lying within the perimeter of the Alpine Convention.

contained decrease of manufacturing jobs (–14) compared to national averages (–21), revealing therefore a still stronger presence of industry in the regional economy—although with significant local variations. In the following fifteen years (2001–2016), however, this declining trend almost flattened at the national level, reaching an average of 18% (−2), while keeping lowering down with the same intensity in the Alpine regions, reaching 23% (–13). The economic crisis of 2008–2010 has significantly contributed to the late speedup of Alpine deindustrialization (Brozzi et al. 2015), clearly revealing the inherent structural weaknesses of mountain industry.

As evidenced by Werner Bätzing in his influential research on the Alpine cultural landscape, heavy and manufacturing industries have settled in mountainous rural regions primarily to take advantage of key ‘environmental’ conditions, such as the availability of mineral resources, the on-site use of hydropower, abundant low wage workforce as well as political/financial incentives (Bätzing 2015). The resulting industrial mono-structure, firmly attached to specific locational factors and thus highly dependent on external framework conditions, is extremely vulnerable to macro-economic changes and technological shifts as well. The deindustrialisation of the Alps, and mountain and peripheral economic regions in general, can be then explained as the passive reaction of traditional, resource-intensive industries to the new global geography of raw materials and energy sources, which entails the relocation of associated production chains in highly accessible locations (even regionally) or in developing countries (Gebhardt 1990; Perlik 2007; Bartaletti 2011). In this context, and having the Alps as remarkable example, it is reasonable to expect a moderate if not locally relevant presence of industrial brownfield sites in mountain areas too; a presence that will probably increase in the forthcoming years, due to the temporal delay accumulated in comparison to lowland industrial and urban agglomerations. As evidenced by Grimski and Ferber, “rural areas within the EU also contain individual derelict sites […] that may be very significant for the relevant local government authorities concerned, [who] are often unable to solve the problems involved and so do not develop any area revitalisation activities” (Grimski and Ferber 2001: 144). Indeed, the redevelopment of brownfield sites already is, or will soon constitute, a key challenge for the affected mountain territories. The acquisition of a sound scientific knowledge on brownfield transformation in mountain contexts, and its transfer into practice as well, is therefore essential to support the local and regional communities in this complex process. The fact that brownfield sites are confronted, in the mountain context, with radically different socioeconomic, environmental and spatial conditions than in lowland urban areas, underlines the relevance and the urgency of finding appropriate solutions to this challenge.

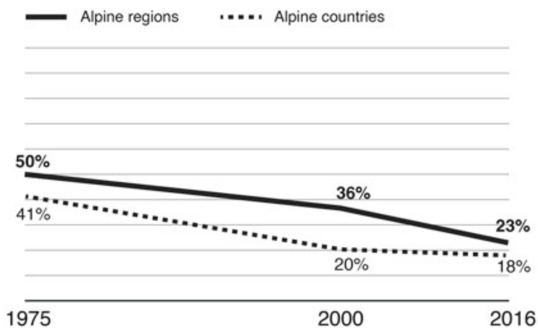

Fig. 1.1 Employment rate in the secondary sector in Alpine regions and Alpine countries. (Source: author's own representation. Data: European Commission, Alpine Convention, OECD, Swiss Federal Statistics Office)

1.2 Context, rather than Content

The background processes that have originated and shaped brownfields are generally similar by industrial typologies, that is, derived from specific production processes and 'represented' by certain standard facilities. In this respect, what seems to be determinant for understanding the actual condition of brownfields in mountain regions is more the influence of the context of the site itself, rather than simply its content (Fig. 1.2 and 1.3). Given two brownfield sites with a similar productive background, one in a peripheral mountain setting and the other in a central urban location, the main differences are supposed not to lay within the site itself, within its spatial structure and builtscape, but mostly on the edges of it and in the immediate surroundings, i.e. on a wider space which coincides with the landscape (footprint) the site itself generates. The complex and dual relationship between the brownfield site and its context can be certainly interpreted in terms of space (physical, 'environmental'), but also indirectly assessed by assuming as context the social, cultural and economic features of the hosting territory. Both these perspectives are extremely relevant, and worth equal attention, when dealing with brownfield transformation and redevelopment, as learned during the Interreg Alpine Space project "trAILs—Alpine Industrial Landscape Transformation"[3], and in particular during the development of the assessment and test-design activities in the four partner regions (Weilacher and Modica 2021).

The physical conditions of mountain brownfields are clearly determined by the spatial structure of mountain landscapes, which is in turn influenced by very different land uses, settlement patterns, topographic and environmental features than lowland urban areas. In mountain areas, land uses are characterised by a net prevalence of the 'unbuilt' over built spaces. While this apparently fosters the

[3] See www.alpine-space.eu/projects/trails.

physical and visual detachment of the site from the surroundings, it actually blurs the edges of the site itself, especially in case of large-scale brownfields with high proportion of unbuilt land within the perimeter. This condition is crucial to plan a future redevelopment that takes into account the real footprint of the site, and thus the wider impacts of transformation. The variable topographical harshness, from hilly to mountainous, determines a scarcity of available land for settlements in these contexts. At the local level, brownfields usually occupy a relevant portion of the little suitable land for settlements, either of natural or artificial origin. This increases a lot the strategic role these sites for local spatial development, especially when the brownfield location intercepts key infrastructural corridors. Furthermore, the 'absence' of the city[4] determined by a scattered and fragmented urban fabric challenges the traditional contextualisation of brownfields as voids within dense urban patchworks. If only considering building footprint and infrastructural complexity, industrial sites in mountain regions are indeed 'thicker' than the surroundings—an aspect which makes of brownfields a key structural element of the dispersed urbanity of mountain regions. Last but not least, mountain areas are well known for their extensive and biologically rich ecological networks, where vast semi-natural environments, preserved habitats and cross-regional biodiversity corridors are the rule. In most cases, due to the specific location of industry close to resources hotspots (water courses, mineral deposits, forests, etc.), brownfield sites are directly interfaced with the nodes of ecological networks. This is relevant not only in terms of landscape and environmental mitigation, but also and mostly in relation to the management of potential contamination impacts. The hazardous content of abandoned and polluted industrial sites can easily reach considerable distances if accidentally 'introduced' in the environmental network, thus affecting the ecological equilibriums on a very large scale (e.g. river systems). This aspect betrays a higher 'environmental sensitivity' in scarcely urbanised mountain regions than in most of built-up, core urban areas. An issue which strongly influences (not to say limits) brownfield redevelopment in these particular contexts.

The non-physical conditions, to which mountain brownfields are also but indirectly confronted, are equally relevant and to some extent even more influential for the redevelopment process than the spatial constraints. These mainly refer to the regional socio-economic structure and the local management capabilities, i.e. to the framework conditions that enable or prevent brownfields revitalisation

[4] The urbanised landscape of peripheral regions can be associated to forms of dispersed urbanisation, such as those evidenced with the neologisms of *Zwischenstadt* (Sieverts 2003), *territories-in-between/TiB* (Wandl 2020) and *horizontal metropolis* (Viganò, Cavalieri, and Barcelloni Corte 2018).

to take place. The first condition to which mountain brownfields are generally confronted is the economic system, often less dynamic and structurally weak compared to that of urban regions. Middle-mountain regions bordering large metropolitan regions, for example, are mostly relying on activities 'expelled' from fast-developing cores (but often complementary), such as agriculture and forestry, low added value manufacturing, leisure and tourism. Technology-based activities, advanced education, research and financial services are by contrary very limited. The absence of a dynamic and expanding market reduces considerably the economic opportunities connected to brownfield revitalisation, thus calling local and regional public institutions for action in replacement. And then the second problematic condition is reached, that is, the lack of powerful institutional and socio-economic actors and management capacities at the local level. This directly relates to the administrative and demographic fragmentation of mountain regions, where heterogeneous and vast territories are indeed covered by several small and sparse municipalities without a dominant urban or metropolitan area. The redevelopment of large and complex brownfield sites requires, in these specific contexts, a very good coordination among the different administrative levels, possibly under the 'planning' supervision of a regional authority. In many cases, however, the burdening issue of brownfield revitalisation actually remains for large part in the hand of the affected small communities, with the consequence that only a few concrete actions are occasionally undertaken. Last but not least, the successful redevelopment of mountain brownfields is also strongly determined by demographic trends and redevelopment pressure at the regional and local level. Many mountain areas, for example, are experiencing continuous depopulation in favour of more attracting metropolitan cores. This phenomenon is however highly differentiated at the local level, where a demographic and socio-economic polarisation can be observed between concentration poles (main urban centres, regional capitals or highly urbanised valleys) and leftover marginal areas (rural regions or formerly industrial valleys). The localisation of brownfields in one or the other context is therefore extremely influential on the redevelopment process: while in the first case the demand might be average to high, although with a limited associated economic potential, in the second case it is generally low and limited to environmental concerns[5]. These aspects, together with the aforementioned spatial conditions, make of brownfield redevelopment in mountain contexts an undoubtedly complex challenge.

[5] With regards to the pilot sites involved in the trAILs project, a clear difference in the future redevelopment perspective could be seen between 'centrally' located sites such as in L'Argentière-la-Bessée and Tržič, and isolated sites such as in Eisenerz.

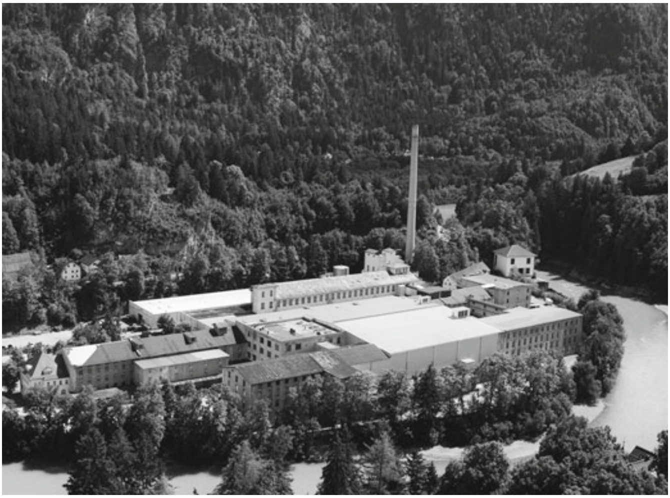

Fig. 1.2 The former Hanfwerke (hemp spinning mill) in Füssen, Ostallgäu

Fig. 1.3 The former Kammgarnspinnerei (worsted spinning mill) in Augsburg, being redeveloped

1.3 Incomplete Transformations

In geo-economic peripheries, such as mountain regions and the Alps in particular, the closure and dismantling of even one single industrial site can become a serious concern as well as a decisive matter for regional development. The urgency to make the site socially and economically profitable again leads to approach the complexity of brownfield redevelopment from solely an economic perspective, that is, to prioritise the short-term employment returns. To this end, a 'simplified' transformation process, which completely or largely ignores the physical and non-physical contextual conditions, actually takes place. This leads in turn to incomplete, imbalanced and, on the long-term, problematic outcomes, as demonstrated by many unsuccessful brownfield redevelopment stories across the Alpine region. Two main strategies are identifiable as representative of this situation: building recycling and land recycling.

The first one aims at the economic relaunch of the site by prioritising the low-budget and low-profile adaptive reuse (literally recycling) of main buildings and other built structures over the site in its totality. Motivated by the possibility to quickly accommodate small-scale business and activities in disused industrial spaces, the building recycling strategy is characterized by the absence of long-term redevelopment plans, either regarding environmental remediation or the future spatial organisation of the site. The reuse of the existing buildings and surrounding open spaces takes place as an incremental, unregulated and spatially fragmented process, having the goal of functionality and usability as the main driver. This leads on the one hand to the temporary or permanent reactivation of those indoor/outdoor spaces in better conditions—often through minimal structural interventions which ignore the existing architectural and/or ecological values—while on the other hand the most polluted, derelict and generally challenging buildings/areas are left to inexorable decay. The partial dismantling of a closed or closing down site over an extended period of time might facilitate the building recycling strategy, as portions of the former industrial site become progressively available to new ownerships. An exemplary case of that is the former Münichtal ironworks (Fig. 1.4) in the historical mining centre of Eisenerz, in the Austrian Upper Styria region (Modica and Weilacher 2020). After the early shut down of the blast furnaces in 1945 and the following slow disassembling until the early 1980s, the derelict and partially emptied site has been used in variable intensity by different companies dealing with scrap metal recycling—linked to the regional steelmaking sector. Most of these activities ceased after some time due to failure or relocation, thus challenging the economic future of the site and its relevance for the deprived local community (Migliorati and Veronesi 2020). At the same time, significant environmental issues have made their appearance on the scene, such as the reclamation of the former blast furnace area as well as of the huge, abandoned slag

Fig. 1.4 The Münichtal site in Eisenerz, partially occupied by scrap recycling businesses

heap, yet unresolved. A similar story is that of the former Pechiney aluminium smelter in L'Argentière-la-Bessée (Fig. 1.5), in the upper Durance valley not far from Briançon, Hautes Alpes (Combal 2018). After eighty years of aluminium production, the smelter closed down for good in 1985, leaving the entire valley community deprived of the only significant industrial activity in the region. The less ecologically compromised portion of the site has been roughly repurposed, through a public-financed consortium, for small-scale and low-profile businesses, while most of the existing productive halls were recycled to host a foundry and smelting facility. As the latter eventually closed down in turn in 2011, the acquisition of the derelict and polluted land became the goal of the regional community, which only succeeded in late 2019. If a comprehensive and organic development plan for the site will ever be outlined (and possibly implemented), it would be the chance to address the many still open issues such as land reclamation, the management of river flooding and the valorisation of industrial heritage.

Fig. 1.5 The former Pechiney site in L'Argentière-la-Bessée

When the incremental, yet uncertain, recycling of existing buildings and infrastructures is not foreseeable, a 'clearing out' strategy is set out instead. The content of the site in terms of buildings, structures and open spaces is entirely or to a great extent removed, so that after soil and groundwater remediation the land can be prepared to host new developments. In the best case, which is indeed very rare, the reclamation process is largely completed but the establishment of new activities struggles to take place on the long-term, due to the lack of investors and/or locational difficulties in attracting firms or developers. It was the case of the former SEFE carbide and ferroalloys factory in Sellero, in the Camonica Valley (Lombardian Alps), where it took around ten years from the five-hectares site clearing to its commercial and productive redevelopment. Or that of the former HCB-Holcim cement factory site in Roche, in the Rhone valley (Swiss Vaud), which was closed down in 1994, demolished in 2002, then sold to the municipality and, nevertheless, to date only half redeveloped as industrial estate. In the worst-case scenario, quite common, the reclamation process stops after the

Fig. 1.6 Overview of the Atofina brownfield in Brignoud (Villard-Bonnot)

first stages (e.g. the removal of building) due to the high costs of environmental remediation and the related financial, technical or legal uncertainties. The polluted site remains then derelict and empty for long time, causing a potential loss to the regional economy—especially if the social cost of remediation and redevelopment has burdened mostly on public authorities. It is the case of the Atofina brownfield in Brignoud, not far from Grenoble, a twelve-hectares heavily polluted site resulted from the complete demolition of the previous chemical factory in 2004 (Fig. 1.6), whose environmental reclamation is lagging behind due to legal controversies and uncertain future plans. A similar story is that of the former Falck ferrochromium factory in Novate Mezzola (Fig. 1.7), in the Valchiavenna region, where after the closure in 1990 and the clearing of the site three different owners have succeeded without being able to complete the necessary and urgent remediation.

Both the aforementioned strategies seem to hide a deep conflict between economic and environmental goals—with social advantages associated to one or the other according to the specific situation. In the land recycling strategies, the site clearing as the precondition to and the result of ecological rehabilitation turns

Fig. 1.7 The former Falck site in Novate Mezzola, cleared yet unreclaimed

into an obstacle for the economic redevelopment, actually impeding the establishment of new activities for long time. At the same time, the precarious reuse of existing spaces in the building recycling strategy succeeds into fostering a partial economic-oriented site redevelopment while leaving environmental and ecological issues mostly unsolved. In the specific context of mountain regions, the balancing between economic development and environmental regeneration goals represents a major planning challenge in the complex management of brownfield sites. The high environmental sensitivity of these contexts, united to the fragile socio-economic structure, are clearly 'feeding' this challenge.

1.4 A Different Approach

Considering the structural limits of brownfield redevelopment in mountain regions, well expressed through the specific contextual conditions and the usually applied transformation strategies in the Alps, it seems reasonable to call for a conceptual shift on the 'nature' of mountain brownfields themselves. A successful reconversion strategy, able to equally meet environmental, economic and social development goals in the given framework conditions, cannot avoid, in this specific context, to consider the complex relationships established between the site and its 'breeding' environment. Instead of a self-standing and enclosed area, an isolated object in the landscape, the brownfield site should be more realistically perceived as a 'hub' of relational systems reaching out on the territory. The brownfield site is indeed an integral part of a wider landscape, with which it establishes physical and functional relationships, generating recognisable topographies and specific environments mutually influencing the site actual conditions as well as its future transformation (Fig. 1.8). Practically, this means to replace the classical 'inward' approach used in the redevelopment of urban brownfields with an outward orientation, in which the physical and programmatic dialogue between the site and its context is essential to fully realise the transformation potential. These considerations are not entirely brand new, but they are freely inspired by one of the first definitions of industrial landscape provided by the architectural historian Franco Borsi back in the 1970s, on the basis of empirical evidence in declining mining and heavy industry regions of north-western Europe (Borsi 1975, 1978). Among the first to extend the emerging discourse on industrial archaeology beyond the mere architectural/building scale, Borsi noticed indeed how the 'modelling force' of industry "[…] left behind not only a series of architectural ruins but also a veritable change in the landscape […]" (Borsi 1975: 38). Accordingly, "[…] the factory cannot be considered by itself, as architectural typology or in its historic-technological aspects, but has to be seen as the barycentre of a system to which, in close functional connection, belong houses, roads, leisure places and services, landscape aspects and so on and so forth. Only in this way it can be identified a structure that is clearly located within a territorial area—having therefore influences and relations induced with the area itself—, of which it constitutes a factor of physical transformation"[6] (Borsi 1978: 43). Fed by dynamic cultural, economic and environmental forces, the organic complexity of this landscape survives to the decline and disappearance of industry forming then the conceptual and formal context of the transformation of the site itself.

[6] Translated by the author.

Fig. 1.8 The proposed conceptual shift on the understanding of brownfield sites, from functionless enclave (left) in central urban contexts to territorial infrastructure (right) in mountain areas

Based on these premises and considering once more the aforementioned physical and non-physical special conditions, a re-contextualisation of brownfield sites in mountain regions as ‘territorial infrastructures’ is then proposed. The term ‘infrastructure’ is here understood both in terms of design/form—the site is strongly embedded in the landscape, of which it represents a key structural element to be physically reorganised—and program/function—the site as a functionally devoid space, whose transformation will influence the development of a wider territorial context. The ecological rehabilitation and the economic revitalisation of the site take place therefore through the ‘reactivation’ of the infrastructure itself, that is, through the update/upgrade of the relational systems established between the site and its surroundings. In other words, it means to address an extensive but integrated adaptive reuse of the landscape which belongs to the site and in which the site is immersed, rather than just of the site itself.

Given this challenging framework and task, traditional architecture and urban planning strategies normally used in the redevelopment of well-located, central brownfields, rather static if not ‘hyper-designed’, do not seem adequate for the purpose. On the contrary, the hybridised architectural-planning principles of landscape urbanism seem to hold a greater potential in this sense, especially for the proposed use of ‘landscape’ as both a conceptual and performative medium to address transformative processes in a context of lacking or weak urbanity (Waldheim 2016). Furthermore, a specifically designed transformation approach for brownfields in mountain contexts can take great advantage from the emphasis given by landscape urbanism theories and models to the infrastructural (or ecological) qualities of landscape (Bélanger 2016). The challenge of using such an approach is to combine the ‘structural significance’ of landscape (Weller 2006), or the ‘relational structuring’ of its composing elements (Marot 1999), with the systemic, ‘ecologic’ functioning of landscape *as* infrastructure (Berger 2009).

The added value of such an approach lies in its broad-spectrum applicability, that is, in the ability to address the transformation and redevelopment of individual brownfield sites and, hence, of wider territorial contexts. While at first glance this broadening of perspective may seem to tend to increase the complexity of an already demanding challenge, it holds actually the key to learn to consciously manage the emerging issue of mountain brownfield redevelopment. It is a matter of shifting the view and the scale, to focus on interdependencies rather than objects, on performances rather than forms. An holistic understanding of landscape as an interdisciplinary action field (Antrop 2017), a matching ground of many interests, practices and dynamics, is believed to be an essential prerequisite to the successful development of the proposed approach.

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2 Research Design

As evidenced, the existence of industrial brownfield sites in the Alps, and in mountain regions in general, is a relevant yet largely underestimated issue, worth to be explored. The fact that most of the previous research on the topic, as well as the practical experiences, have a strong local character—in terms of geography, culture and even language—, translates into a substantial lack of comprehensive and comparative international studies. This research gap can be indeed articulated through the analytical and operative stages of knowledge generation. A first 'analytical' gap concerns the identification, mapping and characterisation of brownfields in the Alpine region. Identification and mapping deal with quantitative aspects and represent a necessary preliminary step in the investigation of new territorial and spatial phenomena. Although many local and regional databases of brownfield sites are already existing (Modica 2019), developed for either scientific or administrative purposes, their wide differences in methodology and spatial/temporal coverage make any reliable comparative and 'sampling' study extremely difficult to be achieved. Characterisation, in turn, should highlight the qualitative aspects of mountain brownfields, that is, focusing on their specific features and structural conditions. The lack of a proper analytical base—distribution and characteristics—leads logically to the second 'operative' gap: the development, testing and implementation of specific brownfield transformation strategies in these contexts. The already evidenced shortcomings in planning and design approaches there used—clearly reflected in the prevailing orientation to building or land recycling, without considering spatial and aspatial contextual conditions—are the cause behind the failure to achieve long-term, sustainable redevelopment results. This second gap can be ideally addressed by means of explorative research-by-design methods, capable of integrating the analytical

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M. Modica, *Alpine Industrial Landscapes*,
RaumFragen: Stadt – Region – Landschaft,
https://doi.org/10.1007/978-3-658-37681-9_2

findings into a new procedural model for mountain brownfield transformation. Although extendable to mountain regions in general, the aforementioned research gaps are specifically investigated and addressed, in the framework of the present research, with reference to the Alpine region.

2.1 Aims and Hypothesis

Given the interwoven analytical-operative structure of the identified knowledge gaps, and considering the arguments introduced in the previous introductory chapter, the research proposes to:

- quantify and characterise Alpine industrial brownfield sites, providing a first, necessary overview on the 'size' and the 'shape' of the problem. Through the quantification and characterisation aims, the research will identify the recurring typologies of mountain brownfields, as well as assess their impact in terms of geographical distribution, spatial structure and landscape footprint. The nature of this first aim is therefore purely analytical;
- develop and test a context-based, reliable and transferable transformation approach, capable of effectively sustaining the complex redevelopment process of Alpine brownfields. This aimed transformation approach will incorporate the already mentioned 'infrastructural' understanding of landscape, providing to be sufficiently adaptable (replicable) to a variety of specific situations—as emerging from the quantification and characterisation. According to this second aim, the research is expected to generate an operative 'planning' model, as well as the premises for its possible future implementation. The nature of this second aim is explorative and strongly interpretative.

The first aim—quantification and characterisation of Alpine brownfields—is considered as a precondition to the achievement of the second aim—development and testing of a new transformation approach. In turn, the achievement of the second aim validates and sustains the evidence resulting from the first. This mutual relationship between the two main research aims is synthesised and expressed through the following hypothesis, which constitutes indeed the logical basement of the entire research:

The challenging redevelopment process of complex brownfield sites in mountain regions can only be successfully managed through an inclusive, adaptable and affordable landscape approach based on structural-systemic principles.

The effectiveness (usability and transferability) of such an approach is directly related to its capacity of integrating, in a structured but flexible way, the typological site specificity with the given environmental, economic and social contextual conditions.

To favour a clear and immediate understanding of the aforesaid hypothesis, the following key terms are provided:

- **complex brownfield sites**: industrial sites which have lost their original function and are currently unused, underused or derelict; with at least two of the following characteristics: most of the original spatial layout and built structures still present, large size/footprint compared to the surrounding built/open fabric, proved contamination issues, proved socioeconomic relevance at the regional scale.
- **mountain regions**: geo-economic peripheral regions and enclaves characterised by mountainous topography (reliefs from 1000 m upwards) and overlapping spatial (land use patterns, scattered urbanisation, environmental sensitivity) and aspatial (economic mono-structures, administrative fragmentation, weak market forces) conditions.
- **landscape approach**: to consider brownfield sites as infrastructural elements of a wider cultural (man-made) landscape; to adopt an outward perspective on the site, i.e. focusing on the spatial, functional, ecological and visual relationships between the site and the context, rather than just on the content of the site itself; to consider landscape as a medium to analyse the site and its surroundings as well as to spatially implement transformation; to equally consider built and open spaces, as well as vertical/plan/detached and horizontal/view/attached analytical and design perspectives.
- **inclusive**: the *transformation area* has to include the core site (industrial plant) and those surrounding spaces having a direct or indirect functional connection to the core site.
- **adaptable**: the *transformation process* has to be structured in a way that the same results can be achieved independently from the site typology and conditions as well as contextual circumstances.
- **affordable**: the *transformation process* has to be structured in a way that its activation and further progress are made possible even with limited technical and financial efforts.

2.2 Methodology

As stated in the hypothesis, the research aims to understand and deepen the actual physical condition of mountain (Alpine) brownfields, as a precondition to outline and test their (potential) transformation in the framework of complex redevelopment processes. This dual analytic-operative structuring of the research invokes the integration of different levels and methods of knowledge generation, from the review of existing theories, concepts and facts towards more explorative and interpretative research-by-design approaches (de Jong and Van der Voordt 2002). The construction of the research methodology is derived directly from the hypothesis, which functions as ‘synthesising collector’ of research questions and thus provides the methodological vocabulary.

The first part of the hypothesis statement incorporates the problem and the proposed solution respectively in the beginning and the end of the sentence. The problem is “the challenging redevelopment process of complex brownfield sites in mountain regions”, while the solution is “an inclusive, adaptable and affordable landscape approach based on structural-systemic principles”. Accordingly, the first research step towards validating the hypothesis is to define and study both the problem and the prospected solution. In other words, it means to ‘extend’ the relative parts of the sentence into a wider, more articulated discourse. This process constitutes indeed the theoretical framework of the research, in which the background of both the problem and the solution is investigated and unearthed by means of reviewing previous works and findings. However, this reviewing process is not a linear, flat enumeration of theories, but rather a highly constructive and ‘oriented’ assembling of selected and relevant sources. In addition, given the multifaceted and cross-disciplinary character of the issue under investigation, this reviewing process has necessarily to integrate literature and findings from different scientific fields, although afferent to planning and landscape studies.

Concerning the aforementioned ‘problem’ sentence, the complex redevelopment process of brownfield sites in mountain regions is broadened and signified through the description of the overall contextual conditions that affect former industrial sites in the Alps, based on existing literature and previous research. The Alps as context of brownfield redevelopment means to understand why brownfields can be found there, what are their originating causes, and how their transformation is challenged by specific economic, environmental and social conditions. The theoretical research aims here therefore to set the ‘territory’ of the identified problem.

Similarly, the ‘solution’ sentence is addressed by means of existing theories and approaches that understand and treat brownfield transformation from the perspective of landscape. As for in the problem section, the argumentations in favour of this particular focus are not existing *per se*, but they have to be detected, integrated and partially re-interpreted. Issues such the codification of brownfields as transitional landscapes, the derived transformation approaches and their inherent semantics, the use of structuralist and systemic principles in the transformation practice, are therefore considered and discussed. Both these theoretical inquiries on problem and solution are producing, as preliminary conclusion, an interpretative image of the object of the research (i.e. Alpine brownfields), that is, a functional add-on to the testing of the hypothesis.

The second part of the hypothesis statement explains the causal link between the problem and the proposed solution, or how the solution will ensure the “successful management” of the problem. All the key elements are included in the sentence: the effectiveness of the proposed approach, which entails its usability and transferability as well; the required ‘functioning’ of the proposed approach, i.e. the “structure but flexible” integration of the “site typological specificity” with the “given environmental, economic and social contextual conditions”. The complex unfolding of this second hypothesis statement constitutes the explorative and interpretative content of the research, that is, the empirical work. In order to approach the latter logically, i.e. by following the argumentation line within the hypothesis, the empirical analysis is performed through different stages, consequential yet independent. Being strongly spatially defined, these stages are indeed scales of analysis, which progression develops as a sort of zooming-in process from big to small, from the overview to the details. The first scale aims to quantify and qualify the brownfield issue in the Alpine region, that is, to identify how many sites are existing and where are these located. The second scale performs a typological analysis on representative categories of sites, with the aim to highlight recurrent landscape structures and the attached transformation potential. The third and last scale, finally, concretely and actively explores a selection of case study sites, condensing in this process the elements of knowledge accumulated so far in the research—both theoretically and analytically. As highly explorative and interpretative procedures, all the three scales encompass a vast set of methods and techniques of analysis, from desk research and focused literature review to interviews, from remote geo-surveying to photographic field documentation, from virtual mapping to explorative design. Due to the density and complexity of the empirical work, the detailed methodology for each stage/scale is explained in each respective introductions, rather than in the current section. This allows to better frame and understand the preliminary results of each stage, as well as to clearly link them to the previous or upcoming ones.

In conclusion, the empirical results are critically and comparatively evaluated according to the previously established theoretical framework, with the aim to read the hypothesis anew and check for its (eventual) validity. So described, the 'method-o-logical' construction of the research is clearly reproduced in the structure of the work itself.

2.3 Structure

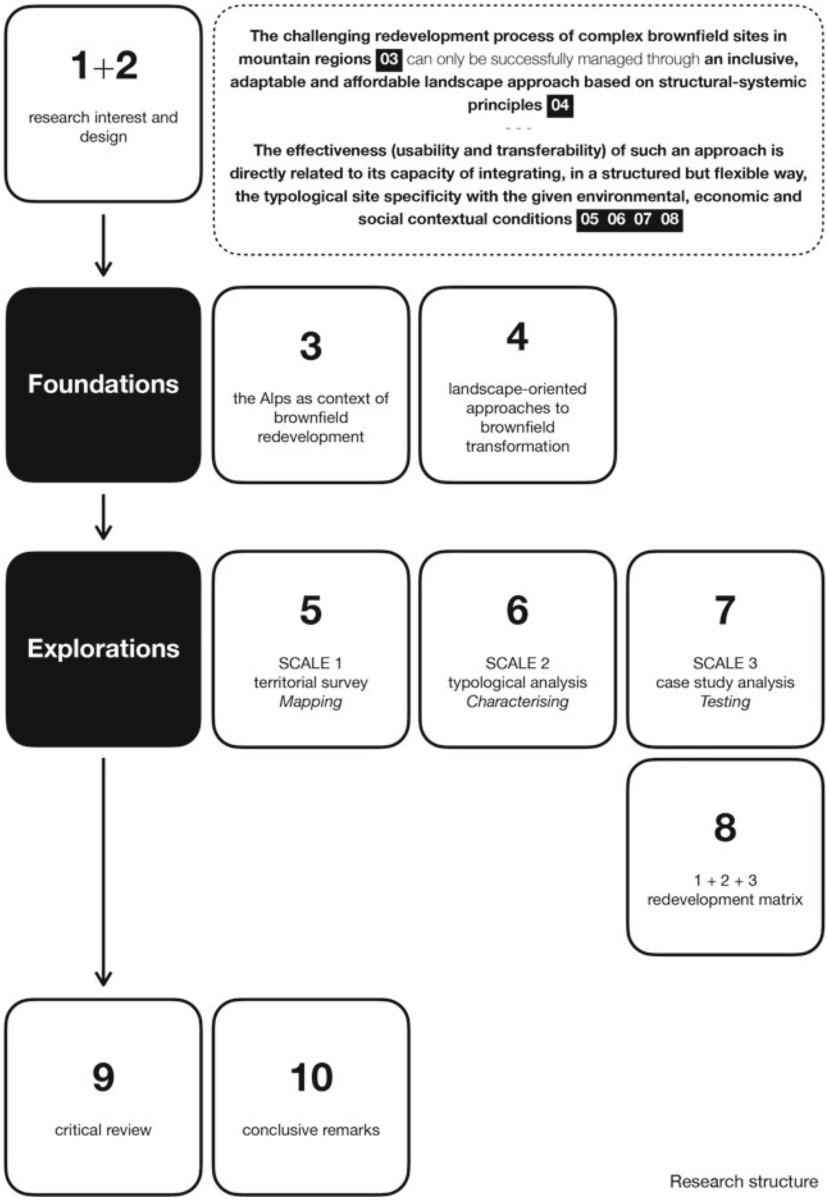
According to the research aims and methodology, the work is structured around two main sections and six chapters, besides the present introductory framework (chapters 1 and 2) and the conclusive part (chapters 9 and 10).

The first section, Foundations, sets the theoretical base of the research, while providing the key arguments for the final critical discussion. Its structural organisation is based on a careful selection and integration of sedimented as well as emerging theories and concepts from diverse yet adjacent disciplinary fields.

Chapter 3, "The Alps as context", introduces the issue of brownfield redevelopment in Alpine region according to consequential perspectives. An overview on industrialisation and deindustrialisation processes in the Alps provides first the background causes and the reasons for the presence of brownfields (origin). A review of the contextual economic, social and environmental conditions influencing the redevelopment of Alpine brownfields provides then the elements to shape this latter challenge. Accordingly, a description of mountain brownfields as territorial infrastructure is put forward.

Chapter 4, "Brownfields as landscapes", presents a methodological excursus on landscape-oriented approaches to brownfield redevelopment, illustrated through the most relevant thinking patterns as well as concrete reconversion experiences. According to a holistic understanding of landscape, structuralist and systemic approaches to brownfield revitalisation are identified and discussed, especially with regards to their potential useful application in the Alpine context.

The second section, *Explorations*, constitutes the empirical part of the research, logically organized and developed on the basis of data collection, presentation, analysis and discussion phases. As already mentioned, the empirical analysis is presented through a multi-scalar perspective, which allows a gradual and closer approaching to the investigation of the main research questions.



Research structure

Chapter 5, “Mapping”, unveils the first analytical scale, which provides a comprehensive overview of the brownfield issue in the Alps by means of a territorial census of sites as well as a survey among key regional stakeholders. As preliminary result, four regional types are identified based on territorial aggregation.

Chapter 6, “Characterising”, describes the typological specificity of the most representative Alpine industries, by focusing on the associated landscape structures—inherited by the related brownfields. As preliminary result, recurring and recognisable landscape structures are identified in association to specific site typologies.

Chapter 7, “Testing”, contains the rich and detailed analysis performed on the four international case study sites, for which a prospected transformation is outlined, developed and visually represented. As preliminary result, a taxonomy of transformative interventions is identified.

Chapter 8, “Matching”, assembles and systematise the three previous preliminary results into an operative tool, the matrix of redevelopment.

The conclusive section of the research, *Findings*, critically evaluates the results and, in particular, it defines a specific landscape approach for the transformation of Alpine brownfield and for its transferability.

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Part II

Foundations

3 The Alps as context

“The Alps are the symbol of the complex interactions that characterise modern life. Being the most industrialised and urbanised mountain territory worldwide, they represent a challenge for the whole planet, but also a great opportunity. In these regions, in fact, almost all the major global issues are concentrated: from the excess of development to environmental pollution, from the extinction of species to cultural impoverishment and the irrational management of resources. Nevertheless, right in the Alpine territory there are the resources to effectively address these problems.”[1]
S. Aga Khan

These few words perfectly address the relevance of the Alps as an outstanding laboratory for investigating contemporary societal, environmental and economic changes in mountain regions, as well as to develop innovative and sustainable development solutions. This is also and especially valid for what concerns the rising challenge of brownfield redevelopment in mountain regions, a crucial yet underestimated planning issue whose influence extends far beyond the mere physical transformation of disused sites. The Alps provide indeed all the necessary conditions for deepening and grounding the study of mountain brownfields. First, the well-developed socio-economic structure of the Alpine region—identifiable with a rather high degree of ‘industrial maturity’ compared to other European mountain areas—implies that brownfield sites are not only being ‘naturally’ generated, thus growing by number and diffusion, but also that their perception as a strategic asset for future territorial development is being established. At the same time, and exactly because of the rapidly evolving socio-economic dynam-

[1] (Alpenschutzkommission 1998: 24) Translation by the author.

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M. Modica, *Alpine Industrial Landscapes*,
RaumFragen: Stadt – Region – Landschaft,
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ics, the Alps are increasingly subject to an extremely high development pressure, which translates into more and more selective land uses as well as in the dual process of erosion/emergence of cultural landscapes. In this context, brownfield sites are often occupying a key position in terms of both physical constituents of the changing mountain landscape and available ‘space of possibility’, suitable for new uses and interpretations. Through these arguments, the chapter outlines the Alps as the context of brownfield redevelopment, highlighting in particular the connections between macroeconomic processes behind brownfield existence and the actual challenges inscribed in the contemporary Alpine landscape.

3.1 Industrialising mountains: landscape as resource

The functional dualism industrialisation-urbanisation, well documented in Europe’s modern urban history, leads often to consider industry as an exclusive feature of densely urbanised regions. Peripheral areas characterised by scarce urbanisation and a strong yet stereotyped rural appearance, such as mountain regions, are rarely considered as territories of mainstream industrial development. However, in many cases the mountain resources and their primary processing have constituted the fuel to the intensive and successful industrialisation of the surrounding lowlands and the hosting regional and national contexts (Nordregio 2004; Perlik 2019). In the first half of the XX century, the Alps have not only supported the industrial growth of nearby regions and national states by providing the necessary energy sources, but also through the local establishment of key production chains with regards to iron and steelmaking in Austria, Italy and France, electrochemistry and electrometallurgy in Switzerland and France, and textile manufacturing in Italy, Switzerland and Slovenia. Similar developments occurred in many other European mountain ranges, such as the Pyrenees in France (metalworking, electrochemistry) and Spain (metalworking, cement, textile), the Cantabrian Mountains in Spain (coal mining, ironmaking), the Vosges in France (textile industry), the Apennines in Italy (textile industry, electrochemistry), the Erzgebirge between Germany and Czech Republic (ore and coal mining, ironmaking), the Carpathians in Slovakia (coal and ore mining, ironmaking, chemical industry), Hungary (ore mining, ironmaking) and Romania (coal mining, ironmaking, chemical industry), the Balkans in Bulgaria (coal mining, metalworking, textile industry), the Caucasus Range in Armenia (metalworking, chemical industry) and Georgia (coal mining)[2]. Beyond Europe, on a far bigger scale, the Urals in Russia as well as the Appalachians and the Rocky Mountains in North America have also fostered a regional and nationwide economic growth.

Despite the geographical and socio-economic diversity, in all of the aforementioned mountain ranges the growth and development of industry followed the common path of 'dependent industrialization', proper of economic marginal regions (Kopp 1969; Ian Hamilton 1986). As a form of exogenous development, this model suggests that key production factors such as technologies, investments and intellectual/human resources are to be mostly introduced in the region from the outside. At the same time, the added value generated locally by the newly established manufacturing activities is transferred partially or entirely out of the region, where decision-making centres and end markets are located. Behind this approach stands a clear logic of "hetero-centred" (or outer-oriented) appropriation of resources (Puttilli 2010), which is shared by industry with many other modern economic activities developed in mountain areas, such as mass tourism and energy production. The structural dependency of mountain industry can be also read through the lens of technological progress and innovation. In many cases, mountain regions have always chased technological development without being able to dominate it, constituting instead a mere and temporary test-field for innovations developed elsewhere (Raffestin and Crivelli 1988). Again, as the testing phase reached its completion, the achieved innovation and its related productive infrastructure are transferred and implemented elsewhere—exemplary is the case of aluminium industry in the Western Alps (Dalmasso 2007; Combal 2018). With the sole exception of specialised SMEs, which can be found in small amounts only in certain highly developed mountain contexts, mountain industry is basically a raw industry, strongly tied to the exploitation of natural resources such as minerals, water, energy and wood or often a combination of those. In this sense, the industrialisation of mountain regions can be understood as a large-scale, intensive and time-wise process of landscape exploitation, which entails

[2] A clear distinction must be made, however, between mountain regions in Western and Eastern Europe. In the former, industry developed earlier in a context of market economy and driven mostly by private initiative—with notable exceptions in the period 1925–1945. In Eastern Europe, the intensive industrial exploitation of mountain resources did not occur until the half of the XX century, thus in a context of planned economy. These differences can still be traced in the form, scale and impact of the existing industries.

its transformation and 're-ordering' through different forms and cycles of utilisation of the embodied resources[3]. The cases of mining and hydropower-based industries are self-explanatory of this resource-intensive development. The mining sector and its related primary processing did and still constitute a key industry in most of the European mountain regions (Nordregio 2004), although significantly downsized, as well as in many other mountain ranges worldwide (Perlik 2019). The 'exploiting' character of mountain industry is perfectly depicted by branches of mining industry such as metal smelting (copper, lead, zinc, etc.) and building material production (cement, refractories, etc.), which are characterized by rather volatile socio-economic benefits and a burdening environmental and landscape impact (Josephson 2007; Modica and Weilacher 2020). Another abundant resource of mountain areas, water, has been intensively used since the early phases of industrialisation at first to provide hydraulic power to textile mills (Fig. 3.1), paper mills and iron forges, and later to obtain hydroelectric energy for large-scale heavy chemical and metallurgical industries (Veyret and Veyret 1970; Muller 1995; Collantes 2003). In terms of human resources, the industrial development in economically disadvantaged rural and mountain regions did also profit considerably from the cheap and abundant workforce 'expelled' from the modernising agricultural sector (Salstrom 1994; Bätzing 2015). Until the mid-XX century, the figure of the 'farmer-worker' half employed in rising heavy industries and half running his family agricultural business was central to the industrial growth of many Alpine areas—and it still is in less developed or developing mountain regions worldwide.

[3] Not surprisingly, in the specific context of the Alps industrialisation is often associated, in its 'utilitarian' approach to the mountain landscape, with the modern development of tourism (Bätzing 2015).

Fig. 3.1 Wool mills along the Cervo river in Biella, 1898

Being strongly resource-based, exploitation-oriented and externally dependent, mountain industry is indeed extremely weak, if no literally ‘ephemeral’ (Weissenbacher 2014). It relies mostly on a few core activities in mature and low added value sectors, i.e. basic industries characterized by low degrees of technological resilience and thus scarcely adaptable to change. On a long-term perspective, and in absence of economic diversification measures, the inevitable decline of such an industrial mono-structure will negatively affect the development of entire territories which previously invested on it—as in the case of the many inner valleys of the Alps once relying on hydropower-based industries (Dalmasso 2007). At the same time, however, the strong ‘functional’ dependency of industry from the mountain landscape and its resources has fostered in many cases a ‘reverse’ adaption process, thus establishing powerful cultural identities and territorial relationships able to survive long after the end of industrial production (Lorenzetti and Valsangiacomo 2016).

3.2 Growth and decline of Alpine industries

The Alpine region has reached the current industrial maturity though a complex, often nonlinear superimposition of different phases of industrial development. The temporal discontinuities between these phases are interpreted differently by economic historians and geographers, depending on the relevance assigned to the main drivers of industrialisation. Traditional manufacturing and heavy industries have developed roughly between 1850 and 1945 (Kopp 1969), having main discontinuities or shifts between 1880 and 1900—introduction of hydroelectric energy (Veyret and Veyret 1970; Raffestin and Crivelli 1988; Gebhardt 1990)—and between 1920 and 1945—war industry and forced modernisation in authoritarian states (Gebhardt 1990; Bätzing, Bartaletti, and Gubetti 2005). A further, radical turn can be identified in the post-war period (1945–1960), in coincidence with the rapid transition from Alpine heavy industry to small-scale, flexible and clustered light industries (Gebhardt 1990). By considering as main discontinuities the introduction and diffusion of hydropower (ca. 1880–1900) and the shift to light and specialised industry (ca. 1950–1960), three main ‘layers’[4] of industrial development can be identified across the XIX and XX centuries.

[4] The term ‘layer’ perfectly underlines the complexity and non-linearity of these developments, as to each single phase corresponded the growth of specific sectors or sub-sectors—as either newly introduced industries or upgrade ones—as well as the decline of others.

The upgrade of proto industries (1850–1900)

The first phase of industrialisation comes along as result of the joint action of two interwoven processes. On the one hand, the gradual introduction and diffusion of new technologies—developed outside the Alps—causes a deep transformation of pre-industrial manufacturing systems, fostering their modernisation through competitive upgrade as well as a functional relocation (Raffestin and Crivelli 1988). Two manufacturing activities once widely diffused in mountain valleys, i.e. metal smelting and domestic textile production, are first and heavily affected by this radical transformation. In the case of metal smelting, the increasing extra-Alpine concurrence of coal-based metallurgy (i.e. iron production in coke-fired blast furnaces) pushes the local smelting sector for a quick abandonment of the rudimental charcoal-based process. The structural conditions for the growth of a modern metallurgical industry are changed. The abundance of wood and water loses fast its relevance, replaced by the proximity to high quality and profitable ore deposits—able to compensate the lack of major hard coal deposits in the Alps (Kopp 1969). The cases of Donawitz (coke blast furnaces established in 1889) and Eisenerz (1901), both located in Upper Styria nearby the Erzberg ore deposit, are exemplary of this transition (Fig. 3.2). A similar process occurs also in the textile sector, whose shift from a craft activity to an industry turns successful in some Alpine regions thanks to the integration between existing resources, new technologies and availability of skilled workforce. A great advantage for the local textile craftsman systems is provided by the introduction, in the first half of the XIX century, of automatic spinning machines and pulley-belt systems for waterpower transmission—the latter allowing the intensive (industrial) exploitation of very small water courses. In this process, the initial extra-Alpine dependency of the local textile industry is gradually replaced by the rise of local entrepreneurship, both in terms of investments and technical improvements. Two of the most exemplary and early cases of the transition experienced by the Alpine textile sector are the Glarus cotton industry in Switzerland and the wool district of Biella in Piedmont. A second, crucial input to the first industrialization of the Alps is provided by the rapid expansion of the railway network, and to the new geography of trades and transport which follows (Gebhardt 1990). In the time frame here considered, the opening of major transalpine railway lines[5], as well as of many lines of regional or national importance along the main outer and inner valleys[6] takes place. The resulting new

[5] Semmering 1854, Brenner 1867, Frejus 1871, Gotthard 1882, Arlberg 1884, Simplon 1906, Karawanken 1906.

[6] E.g. Grenoble-Montmélian 1864, Lindau-Bludenz 1872, Linthal/Glarnerland 1879, Veynes-Briançon 1884, Bergamo-Clusone 1884, Ivrea-Aosta 1886, Tarentaise 1893, Brescia-Edolo 1907.

accessibility pattern fosters the spatial reorganisation of the existing and developing industrial activities. To better link the production sites to the railway network, industry relocates from its birthplaces in side valleys or remote areas to the flat valley floors acting as transit corridors. For example, the late XIX century relocation of the Austrian iron and steel industry from the mountainous Eisenwurzen region to the Mur-Mürz valley is largely due to the opening of the Vienna-Trieste railway (Südbahn) via the Semmering pass. At the turn of the century, the first industrial regions of the Alps are already formed: Upper Styria and Vorarlberg in Austria, Glarus and St. Gallen in Switzerland, Grenoble and the Arve valley in France, the prealpine arc from Turin to Brescia in Italy.

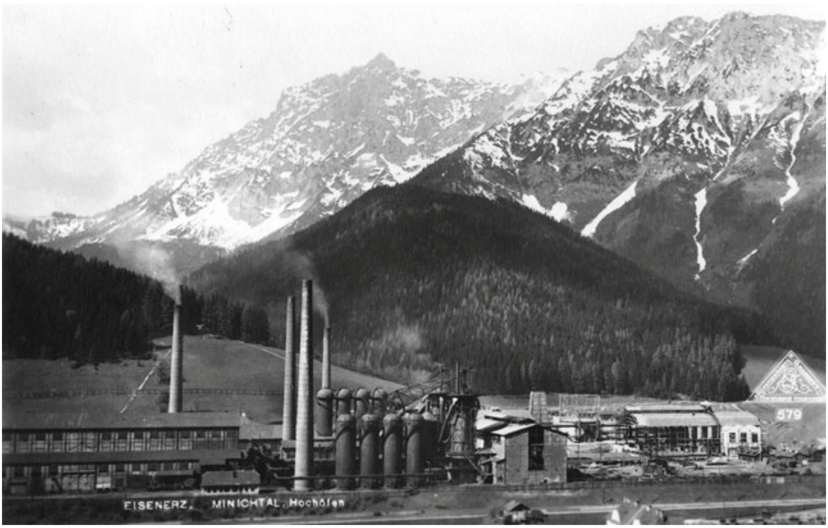

Fig. 3.2 The ÖAMG blast furnaces in Eisenerz, 1921

Hydropower and heavy industries (1900–1960)

The second industrialisation phase coincides with the large-scale exploitation of the Alpine hydroelectric potential. Besides the establishment of a new and specifically 'alpine' energy sector (Bonoldi and Leonardi 2004; Dalmasso, Gouy-Gilbert, and Jakob 2011), the spread of hydropower leads to the rapid development of new energy-intensive heavy industries, as well as to the upgrade of the existing ones. However, this process does not occur with the same intensity everywhere in the Alps—despite the similar geological and hydrogeological conditions –, but it affects first and especially those regions where national and political interests, flows of capitals and skills from nearby scientific centres and local entrepreneurial initiative successfully merge together (Kopp 1969). It is the case of e.g. Savoie (France) and Valais/Wallis (Switzerland), where the great impulse given to the promising sectors of electrometallurgy and electrochemistry leads to the establishment of several big-sized production facilities in the span of just a decade (Fig. 3.3). Based on innovative, energy-intensive industrial processes such as electric arc smelting[7] and electrolysis[8], the Alpine heavy industry is now able to cover several key production chains such as secondary steelmaking, ferroalloys, aluminium, calcium carbide and derivates (acetylene, nitrogen, ammonia, fertilisers), chlorine and derivates (caustic soda). In the first twenty years of the XX century, the lack of cost-efficient technologies for energy transport obliges most of these new industries to settle in proximity to hydropower production sites, thus mainly in upper valleys and remote rural regions (Veyret and Veyret 1970). Soon, however, the increase of size and capacity of hydropower installations leads production to exceed the needs of local industries. In addition, the gradual improvement of long-distance energy transport goes now in favour of the outer areas and the peri-Alpine lowlands, where the major industrial agglomerations are located. These new conditions foster the optimisation of industrial production in the Alps, often resulting in alliances between energy producers and industrial companies aiming at the creation of larger production facilities in which hydropower generation is fully integrated—either on- and off-site. A further, relevant impulse to the intensive industrialization of inner Alpine regions is provided, during the 1930 s, by political arguments and national strategic interests. In Fascist Italy, for example, several energy-intensive heavy industries are established in the multi-cultural 'border' provinces of Aosta Valley—steelworks in Aosta, combining local ore deposits and hydropower, and chemical industries in Châtillon and Verrès—and South Tyrol—steelworks, aluminium industries and chemical plants between Bolzano and Merano, all hydropower-based (Gebhardt 1990). A significant growth is also registered in the pre-war years by national relevant sectors such as the mining and steelmaking industry of Upper Styria (Austria) and Upper Carniola (Slovenia), as well as by electrochemistry (chlorine and derivates) around Grenoble. The Western Alps are in general much more affected by this second wave of industrialization than the Eastern Alps, mostly because of the early and more developed energy infrastructure and the better accessibility to lowland industrial centres (De Rossi 2016).

[7] The prototype of the first electric act furnace for steel production in history was developed by Ernesto Stassano in 1898 at his electro-steelworks in Darfo, near Lake Iseo, in the Lombardian Alps.

[8] The first industrial application of electrolysis in Europe was due to Paul Héroult, who developed in 1888 a hydropower-based process for aluminium production at his pilot smelter in Froges, near Grenoble.

Energy-intensive industries are established especially in the Northern French Alps—Maurienne and Tarentaise valleys in Savoie, Grésivaudan and Romanche valleys in Isère –, in south-western Switzerland—Rhone valley in Valais, in the Lepontine Alps between Ticino and Grigioni –, and in north-western Italy—Aosta valley and Ossola in Piemonte. In the Eastern Alps, a punctual development characterized by few isolated facilities disconnected from the regional industrial structure takes place in Trentino, North- and South-Tyrol, Salzburg, Carinthia and partially Slovenia. The advantages of hydropower are also successfully adopted by already established and well-developed sectors, often leading to a substantial upgrade of local production systems and facilities. It is the case of textile industry in the Bergamo valleys and in Kranj, or steel industry in the Brescia valleys, in the upper Sava valley in Slovenia and in the Styrian district of Liezen. Between 1945 and 1960, the rapid change of framework conditions (resources, energy, productive models, political situation, etc.) slowly brings this long and complex industrialisation phase to an end.

Fig. 3.3 Overview of the Lonza electrochemical works in Visp, ca. 1930

Light industries (1960–1980)

The third and last phase is that of light industries, whose rapid and geographically uniform development brings the secondary sector at the top of employment shares in the whole Alpine region[9]. In the post-war phase, the positive economic conjuncture characterised by market liberalisation and flexible manufacturing systems (as response to the increased international competition) favours an unprecedented industrial growth in all the Alpine countries, especially in Western Europe. The related Alpine regions also profits largely from these developments. The regional industrial system, until then based on resource-intensive heavy industries, is expanded and empowered through the widespread development of SMEs, i.e. small-scale industries highly specialised but mostly focused on low added value sectors (mechanics, electric appliances, apparels, food, etc.). This process occurs mainly in two forms: branch plants and industrial districts. In the former, secondary production sites without management and R&D departments are established by mother companies through a process of externalisation of production chains, or part of them. In the Alps, branch plants of this kind are usually opened in low-cost labour areas and/or border regions, either with a strong industrial background (e.g. Vorarlberg) or not (e.g. South-Tyrol and Ticino). According to the location of the mother company, the establishment of branch plants can be inner-oriented (if both the headquarters and the branch plant are located within the same region) or outer-oriented (if the headquarters are located elsewhere) (Gebhardt 1990). In opposition to externally developed branch plants, the rise of industrial districts is mostly fed by internal (or local) factors, such as the private initiative, the entrepreneurial capacity and cohesive local community. Developed as an innovative response to the dissolution of Fordist production models, industrial districts make use of flexible specialization to replace the existing vertically oriented production (one large plant incorporating all production phases) with a horizontally oriented version (a density of small-sized plants specialised in one specific phase). Hence, the key characteristics of industrial districts which differentiate them from branch plants are the local origin of firms, their territorial and relational proximity (clustering) and the close relationship with locally-relevant social and institutional structures (Becattini 1991). Starting from the 1970s, similar developments occur along the southern prealpine rim in Italy (Fortis 1999) and in Haut-Savoie (Courlet 2002), but also in eastern Switzerland, Vorarlberg

[9] By 1975, industry accounts for around 50% of the total employment across the Alps (Bätzing 2015).

and Tyrol. A significant example of the influence of branch plants and industrial districts on the existing Alpine industrial system is provided by old textile manufacturing regions, which gradually convert their raw textile production into specialised sub- or side-sectors such as apparel industry (e.g. Biella, Vorarlberg and St. Gallen, Annecy) or textile engineering (Bergamo, Vorarlberg). Another Alpine dated industrial sector, steelmaking, also experiences a similar transformation/diversification, with big differences however between private-oriented systems (e.g. Brescia district) and state-funded ones (e.g. Upper Styria). The ubiquitous development of light, clustered industries across the Alps is also due to the increased road accessibility of many core and side areas. A substantial difference between these new industries and the previous traditional ones is indeed in the meant of transport and accessibility: while the latter required the railway to be productively efficient, the former prefer capillary road networks, able to sustain spatially fragmented production systems and high production flexibility. As a consequence, light industry tends to concentrate along the prealpine fringe, at the entrance of main valleys or along transnational transit corridors, thus leaving the innermost regions of previous industrialization (Chabert 1978). At the same time, traditional heavy industries are challenged by the fast changing global economic framework conditions, among which the 1960s nationalization of energy markets and the rising energy, transport and labour costs (Veyret and Veyret 1970; Raffestin and Crivelli 1988). As response, many energy- and labour-intensive Alpine industries try to increase their competitiveness by specialising in niche sectors (e.g. chemical and pharmaceutical industry) or through concentration and restructuring (e.g. steelmaking, metal smelting industries, cement production).


1850-1900
+ growth
1. Grésivaudan
2. Vallée de l'Arve
3. Valli Torinesi
4. Biellese
5. Lario
6. Valli Bergamasche e Bresciane
7. Alto Vicentino
8. Glarus
9. Alpenrheintal
10. Tiroler Oberinntal
11. Tiroler Unterland
12. Salzkammergut
13. Eisenwurzen
14. Mur-Mürz-Furche
15. Murtal
16. Villach-Raibl
17. Gorenjska
DE
FR
CH
AT
SI
IT
München
Zürich
Wien
Lyon
Milano
Torino
Genova
Marseille


1900 - 1960
+ growth
+ stable
- decline
DE
FR
CH
AT
SI
IT
München
Zürich
Wien
Lyon
Milano
Torino
Genova
Marseille


1960 - 1980
growth
stable
decline
sharp decline
DE
FR
AT
CH
SI
IT
München
Zürich
Wien
Lyon
Milano
Torino
Genova
Marseille
N
0
50
100 Km


1980+
growth
stable
decline
sharp decline
DE
FR
AT
CH
SI
IT
München
Zürich
Wien
Lyon
Milano
Torino
Genova
Marseille
N
0
50
100 Km

Widespread decline and concentrated growth after 1980
After 1980, the changes already visible at the end of the previous phase become structural. These transformations partially reflect, or follow, the current trends and ongoing processes in European western economies, such as the increasing tertiarization and the replacement of resource- and labour-intensive industries with knowledge-based ones[10]. In the Alps, those sectors and activities established in the early phases of industrialization—heavy and manufacturing industries strongly attached to exclusive location advantages (raw materials, energy, transport, workforce, etc.)—are particularly hit by the new economic framework conditions at the global scale (Fig. 3.4). The relocation of raw material extraction industries from developed to developing countries causes the decline of the related processing industries, once widely present across inner mountainous regions (Modica and Weilacher 2020). It is the case of mining-based metal industries—lead, zinc and copper smelting in the southern and eastern Alps –, ore-based steelmaking—which only survives, heavily downsized, in Upper Styria—and cement industry—that, in reverse, maintains most of the extraction activities in the mountains while moving production facilities in the forelands, due to better accessibility, space availability and improved long-distance transport. Electrochemical and electrometallurgical industries, which made the economic fortune of many Alpine regions at the turn of the century, are also severely affected by the deep transformations within the energy sector. The increasing competition of fossil fuels and nuclear power, as well as the influence of state monopolies on energy pricing, bring quickly to an end those location advantages connected to the self-generation of cheap hydropower (Raffestin and Crivelli 1988). Consequently, many energy-intensive industries (aluminium, alloys and raw chemicals) are delocalised from the inner Alps to the new energy production and distribution hubs, such as seaports or gas/oil pipeline terminals—e.g. aluminium industry moved from Trentino and South Tyrol to the industrial harbour of Venice-Marghera, carbon industries from inner Savoie to the zone industrielle

[10] According to Rowthorn and Ramaswamy (Rowthorn and Ramaswamy 1997), deindustrialisation as structural change can be explained with at least three hypotheses. The first is economic maturity, in which a high GPD per capita leads to the growth of services at the expenses of manufacturing. The second one is specialisation, as response to the increasing global trade and the competition directly generated from that. The third one is failure, or the inherent structural weakness in certain manufacturing systems (obsolescence or monostructures). Considering the particular case of the Alpine region, these three hypotheses seem to be overlapping.

et portuaire (ZIP) of Fos-sur-Mer and Port-de-Bouc, near Marseille. In terms of accessibility, the scale-up and speed-up of transport and trade at the global scale lead also to the selective decline of rail freight transport across many Alpine valleys—while favouring only the few key European corridors (Brenner, Gotthard, etc.). For traditional Alpine industries, this meant the disappearance of the previously competitive advantage of being connected to the railway network, and thus to halve the high transportation costs in favour of on-site resource exploitation. The dismantling or downgrading of many inner Alpine railway lines acts either as a cause for and an effect of the abandonment of certain industrial activities, e.g. in the cases of the Aosta valley, the Tarentaise and Durance valleys, the Seriana and Camonica valleys, or the Erzbergbahn in Upper Styria. In a few cases, the pursuing of cutting-edge specialization and relevant investments in technological and structural upgrade allow a successful restructuring and thus the survival of some basic industries—e.g. aluminium industry in Saint-Jean-de-Maurienne and Sierre, chemical industry in Villadossola. Light industrial districts and SMEs cluster developed in the 1960 s and 1970 s are also pushed through a process of adaptive specialization, to face the increasing global competition. Within the districts, the horizontal distribution of production chains among single-phase small firms is inversely replaced by concentration in few, larger firms (district leaders), able to better sustain the spread of innovations as well as to reach a stronger international placement (De Marchi and Grandinetti 2012). In the Italian Alps, a successful example of the latter transition is that of the eyewear district of Belluno-Cadore, whose downsizing in terms of number of firms is balanced by increasing exports (around 80% in 2008) and the development/integration of design, prototyping and branding phases (Bramanti and Gambarotto 2009).

Fig. 3.4 The carbide silos of the former Rhodiatoce-Montedison chemical plant in Villadossola, 2007

Parallel to the restructuring and/or decline of the existing traditional industrial activities, the Alpine region experiences from the late 1980 s a significant growth of advanced industries in knowledge-intensive sectors such electronics, nanotech, biotech, and ICT (Bartaletti 2011). Driven by the increasing functional and economic integration of the Alpine region with the surrounding metropolitan areas and global networks, this process is locally sustained by the successful interaction between higher education and research institutions, dynamic entrepreneurial networks and innovation-oriented policies. Not by chance, these new industries tend to concentrate within or around the major inner- and pre-Alpine cities and agglomerations, highly accessible and equipped with a critical mass of knowledge and political institutions as well as urban amenities and services (Perlik and Messerli 2004). In a few notable cases, the collaborative coexistence of medium-large university campuses (5.000–20.000 students), research centres and business incubators (e.g. science and technology parks[11]) supports the development of highly innovative and specialised clusters, often regarded as "Alpine Silicon Valleys" in regional promotion activities. Among the most relevant innovative clusters there are the Grenoble-Chambery metropolitan area (nanotech, microelectronics, molecular biology, ICT), which is the second innovation centre in France after Paris/Île-de-France, the Insubria Region between the Lombardian provinces of Varese and Como and the Swiss canton of Ticino (biotech, life sciences), the Rhine valley between St. Gallen and Dornbirn (nanotech), the Inn valley from Innsbruck to Kufstein (biotech, life sciences), the Adige valley with centres in Trento-Rovereto and Bolzano (microelectronics, ICT, greentech, foodtech) and the Klagenfurt-Villach conurbation (microelectronics).

In the first decade of the new millennium, the spatial and development polarisation between 'quaternary' industry poles (including successful SMEs districts) and declining old industrial regions becomes clearly evident. In the context of the heavily industrialised Northern French Alps, Anne Dalmasso (2009) distinguishes between "territories of continues industrialisation" (the former) and "territories of deindustrialisation" (the latter). In the first case, ancient industrial regions such as the Grenoble area, Annecy and the Arve valley have successfully managed the transition from the existing industrial mono-structure (replaced or partially upgraded) to a more diverse, innovative and specialised productive system. In the case of deindustrialising regions, which are mainly found in inner Tarentaise,

[11] Among the most important science and technology parks in the Alps there are *Minatec* and *Inovallée* in Grenoble, *Savoie Technolac* nearby Chambery, *Sophia Antipolis* in Nice-Valbonne, *Tecnopolo Ticino* in Lugano-Manno, *Trentino Sviluppo* in Rovereto, *NOI Tech Park* in Bolzano, *Lakeside Science & Technology Park* near Klagenfurt and *Technologiepark Villach.*

Maurienne and Romanche valleys, the decline of energy-intensive heavy industries is not counterbalanced by any further development in the industrial sector, nor by tourism or the service sector—which indeed remains very limited in these contexts. The territorial divergence between upgrading and shrinking industrial regions also implies a delocalisation, or shift, of industrial activities and related services from the innermost areas to the outer borders of the Alps (Modica 2019). Besides the French Savoie and Isére, this process can be observed in Valais (from the mid-upper to the lower Rhone valley and the Métropole lémanique), in the Lombardian Prealps (from the uppermost valleys to the foreland gateways in Varese, Lecco, Bergamo and Brescia provinces), in Styria (from Leoben and the Mur-Mürz valley to Graz in the south and Wiener Neustadt in the west), in the Tyrol (from the upper to the lower Inn valley), in the Salzburg region and in north-western Slovenia (from the upper Sava valley to the urban area of Ljubljana).

3.3 An economic challenge

In such a strongly polarised context, where to the emergence of a few successful economic clusters it opposes a widespread decline of traditional industrial activities, brownfield redevelopment 'naturally' assumes a strategic economic relevance, both locally and regionally. Yet, the transformation and reuse of derelict industrial sites is confronted, in the specificity of the Alpine context, with rapidly changing economic conditions and emerging new paradigms of territorial development. It can be noticed, just as an example, how two of the activities traditionally associated to mountain landscapes, agriculture and tourism, are steadily losing their traditional 'economic' relevance due to external socio-economic factors (e.g. the market predominance of intensive food production or the globalisation of the travel industry) and environmental transformations as well (e.g. the impact of climate change on soils, vegetation and precipitations) (Bartaletti 2011; Bätzing 2015). At the same time, new promising sectors are emerging, such as distribution logistics in relation to expanding transnational trade and transport corridors (Convention 2007), while others are being revived, such as small-scale hydropower production fostered by the renewables transition (Svadlenak-Gomez, Tramberend, and Walzer 2015). The spatial distribution and thus the territorial influence of these economic activities are also extremely uneven, being closely linked to specific environmental and socio-cultural conditions such as morphology, climate, demography, accessibility, cultural landscapes and level of urbanisation, legal and policy frameworks. As an economic space, the contemporary Alps are indeed a complex patchwork of obsolete and innovative, growing and declining economic activities, whose relative fate is strongly determined by both local conditions and global trends and dynamics (Boesch 2005)—as demonstrated by the specific case of industry itself, previously discussed.

In this scenario, the overall and long-term sustainability of this heterogeneous yet strongly 'localised' mountain economy depends on the capacity to overcome the regional mono-structures[12] (inherited but also emerging), by pursuing an innovative and integrated use of the existing territorial capital (Camagni and Capello 2013). Defined as the sum of biophysical and human factors, of given environmental conditions and socio-cultural capabilities of a certain territory, the concept of territorial capital is particularly meaningful in setting future economic perspectives for fragile mountain regions, especially since it implies a shift in meaning and usage of what can be considered a resource. Traditional mountain economic activities, at the base of the aforementioned weak mono-structures, relied mostly on natural resources, on their direct exploitation and even on the commodification of those (e.g. in winter tourism). Instead, future mountain economies, sustainable and self-assured, are expected to take increasingly into consideration the local and regional human capital—the networks of stakeholders, capabilities and know-how—and especially to foster its development in connection to a wise use of given environmental resources (Perlik 2019). To realise this change, and to make its achievements durable, it is essential to ensure that locally generated innovation (supported by adequate education and knowledge structures) is transferred to the regional economic and productive system. While this growth-through-innovation process works smoothly in economically advanced and dynamic regions, such as global cities and core metropolitan areas, in marginal regions such as inner Alpine areas, lacking significant knowledge hubs and innovation transfer systems, it does not (Convention 2017). An alternative approach, suitable for mountain contexts where the territorial capital is significantly shaped by environmental resources[13], is that of territorial innovation (Zanon 2018). Based

[12] The regional dominance of one specific economic sector is quite common in mountain and peripheral areas, as result of externally induced development (Perlik 2019). The most diffused mountain mono-structures are farming and forestry (traditional), intensive tourism and industry/energy production. Although forms of regional-based coexistence are possible in principle, the growth in economic relevance of one specific sector normally implies the decline or marginalisation of the others (Bätzing 2015).

[13] Environmental resources are here broadly understood, including 'actual' natural resources but also habitats (as living environments) and especially (cultural) landscapes (Lehmann, Steiger, and Weber 2007).

on Raffestin's TDR model (Raffestin 2012), which explains how collectivities constantly transform space to their own needs and purposes through cyclical processes of territorialisation-deterritorialisation-reterritorialisation, the territorial innovation approach postulates that innovation can occur in socially and economically weak contexts only through the "activation (or re-activation) of strong links between the local communities and the space involved" (Zanon 2018: 5). With the support of three concrete cases from the Alpine region of Trentino (Italy), Zanon explains how a revived interaction between local actors and specific territorial features[14], fuelled by proximity-based learning processes, has fostered innovative and alternative economic developments in previously 'critical' contexts. Although the effects of these new developments are still limited in terms of GDP, the resulting increase of local networking, mutual learning and capacity-building is definitely strengthening the future perspective of once marginal areas.

In this framework, mountain brownfield sites gain their position as an actual territorial resource, a 'latent' yet promising one, capable of supporting innovative territorial developments both in terms of 'immaterial' networking and 'material' available space (Fig. 3.5). Depending on the sites conditions, location and accessibility, and highly influenced by the regional economic structure and the spatial planning system too, Alpine brownfields can be proactively turned into experimental platforms for setting-up new 'productive ecologies' (Sega 2017) at the local and regional scale. As a concrete 'space of opportunity', former industrial sites can indeed support the emerging mountain green economy (Convention 2017), foster the 'smart specialisation' of regional clusters (Dax 2019) and even contribute to shape new 'brandscaping' strategies for regional development (Boesch, Renner, and Siegrist 2008). The perspective of mountain brownfields as an economically productive resource finds a fertile ground in Aldo Bonomi's concept of 'Alpine productive platform' (Bonomi 2010), a polycentric and integrated system of innovative micro-economies based on the specificity of the mountain territory, on its environmental and socio-cultural infrastructures, capable of "repositioning the Alpine territory […] beyond the idea of touristic resort or green oasis of well-being at the edges of the metropolitan model"[15] (Bonomi and Masiero 2014). A productive-oriented reuse of brownfields can embrace, in this sense, a wide range of programmatic options, from 'traditional' regional business parks hosting locally based activities to more innovative business incubators connected with existing and emerging clusters at the regional scale. Also, industrial architectural ensembles having a particular historic or symbolic value can be creatively

[14] Some of which 'latent' or ignored until then, though tangible and visible (Corrado 2010).
[15] Translated by the author.

repurposed as cultural and artistic production centres, thus contributing to foster multi-seasonal tourism through a diversified cultural offer[16].

Fig. 3.5 Empty halls of the former SISMA steelworks in Villadossola, 2016

From an economic perspective, the challenge of brownfield redevelopment in mountain regions is therefore linked to the re-integration of the physical, spatial and 'built' resource within the wider network of territorial development, i.e. the system of local/regional social and economic actors and assets. In other words, it means to 'capitalise' the already there through a process of territorial, community-led re-appropriation (Zanon 2014). Especially in the mountain context, characterised by extensive geographies yet a very high human proximity, the economic challenge of brownfield redevelopment and transformation is, certainly, also a social and environmental question.

[16] A few successful experiences of cultural-led reuse of small-scale Alpine brownfields, worth to be mentioned, are Centrale Fies in Drò/IT (www.centralefies.it), Sass Muss near Belluno/IT (www.dolomiticontemporanee.net/DCi/sass-muss) and La Fabbrica del Cioccolato in Blenio/CH (www.lafabbricadelcioccolato.ch).

3.4 A social challenge

In geo-economic peripheries such as the Alpine region, the social and cultural impact of deindustrialisation can be extremely significative and hardly manageable on the long-term. Since the number of regionally relevant industrial sites is very limited there, the closure and dismantling of just one single site usually bears social consequences on a larger scale, triggering socio-demographic processes that largely exceeds the mere 'brownfield problem'. This is especially true for those mountain contexts long characterised by the aforementioned monostructures, where entire valley communities used to rely on industry as the main economic source, thus having shaped their societal structures accordingly (Combal 2018). Compared to the early replacement of mountain farming with modern industry and energy production—a rapid transition, widely accepted by Alpine people as an alternative and promising future –, the recent withdrawal of the same industry, meanwhile turned obsolete, often leaves these territories without a concrete perspective of long-term habitability. In many documented cases, industrial decline is the reason for continuous depopulation of mountain communities (Migliorati and Veronesi 2020), increasing disparities at the regional level (Bätzing, Perlik, and Dekleva 1996) and the worsening of already existing conditions of socio-economic marginality (Čede et al. 2018). At the same time, however, the end of the "golden age" of Alpine industrialisation and the following transition to an uncertain post-industrial phase activates, in the affected local communities, a process of review and/or redefinition of their own social identity (Migliorati 2021). Brownfields, as the most significant and tangible legacy of the previous industrialisation, are often directly involved in this collective appraisal. Rediscovered and reinterpreted as material cultural heritage, these sites or at least part of those, are charged with strong identity-related meanings, thus paving the way, in the best cases, for a long-term cultural-oriented reuse. In the mountain context, however, this 'heritagisation' process is not so immediate, but instead rather difficult in its actualisation. Two main reasons can be found for that. At first, Alpine communities often perceive brownfields very pragmatically as an open economic and social question, a concrete problem whose solution entails the survival of the community itself. In the framework of the already mentioned Interreg project "trAILs", the majority of local inhabitants interviewed on the meanings associated to their own brownfield have clearly underlined the dysfunctionality of the site—related to the current state of abandonment or underuse—over its potential value as cultural heritage[17] (Migliorati and Veronesi 2020; Migliorati 2021). This lack of cultural acceptance of industrial leftovers can be somehow explained with the difficult coexistence between industry and the mountain context, fostered by the recent origin and the transient presence of heavy industrial activities as well as by a certain 'culturally-established' view on the mountain realm (Fig. 3.6). On the one hand, and as already seen, the industrialisation of the Alps was mainly fostered by exogenous economic processes. The disruptive introduction of industry into a traditional and closed socio-cultural environment, shaped by centuries of human adaption to the mountains, has impeded in many cases its acknowledgement as an integral part of the mountain culture (Lorenzetti and Valsangiacomo 2016). This cultural detachment was largely sustained, also, by the historical yet persistent Romantic view over the mountains as natural and pastoral idyll, a picturesque leisure landscape in which industry clearly stands out as a true 'atypical object'. The local inhabitants, although conscious of their industrial past and the origins of their everyday landscapes, are often influenced by this view. In the context of the current deindustrialisation of mountain regions, the vestiges of industry, and especially of heavy and 'modern' industries (Combal 2018), are usually questioned and evaluated as less relevant (less useful) than other, more 'Alpine' cultural and natural heritage (Lorenzetti and Valsangiacomo 2016). The collective assessment of local industrial heritage has a direct influence on brownfield transformation, as it can enable or block potential conversion strategies and development pathways.

[17] An exception, among the investigated cases, was that of Eisenerz, where the ancient mining industry united to the geographical isolation have fostered a higher sense of belonging to the industrial past. However, heritage values were more associated with the huge open cast mine (Erzberg) rather than the Münichtal brownfield, which have lost indeed its character of authenticity after decades of transformations.

Fig. 3.6 The old Italcementi cement factory overlooking the town of Albino, 2014

Tied to the issue of social identity and heritage, which mostly deals with the present view over the past, there is also a future-oriented perspective on social cohesion at the local and regional scale. It is now widely acknowledged, and widely documented, that the contemporary Alpine space is anything but homogeneous from a social, cultural and especially economic point of view. Driven by global dynamics, several processes of regionalisation are sharpening the spatial polarisation between growth areas, highly accessible and capable of building functional relationships outside their own territory, and marginal areas, economically uncompetitive and socially in decline (Perlik 2010, 2019). This scenario, by many considered as extremely problematic for the sustainable development of the Alpine region (Price et al. 2011; Bätzing 2015), is directly reflected in the social matrix of the territory. The growth areas, i.e. the Alpine edges in close contact with the nearby lowland metropolitan regions as well as the main valleys acting as transit corridors, attract social groups such as young creatives, skilled workers and multi-locality residents that, by transferring urban social structures and lifestyles into the mountains, foster Alpine gentrification (Perlik 2011). Marginal areas, characterised either by geographical remoteness or poor economic competitiveness[18], are not only failing in attracting such innovative social groups, but especially they keep losing those segments of local population (youngsters, working age groups) capable of keeping the territory socially and economically alive (Corrado 2010). The impacts of these profound societal transformations reach out on the territory itself, on its economic performance as well as on its environmental character, including the land use structure and the landscape appearance too (Pfefferkorn, Egli, and Massarutto 2005). In this context, former industrial sites make their appearance as sites of transformation. Considering the regional relevance of mountain brownfields, their redevelopment can directly influence social and territorial cohesion at the local and regional scale, exactly by managing, on a long-term perspective, the flow of certain social groups. Depending on the specific location and the socioeconomic contextual conditions, brownfield redevelopment can help to prevent depopulation and social desertification in marginal areas as well as addressing a more sustainable 'gentrification' in growth areas. This particular issue is worth to be investigated, as most of the current research on the link between the reactivation of disused spaces and the improvement of social cohesion in mountain regions is solely focusing on deprived rural contexts.

Either seen from the perspective of social and territorial cohesion or considered in terms of identity and heritage, the social relevance of Alpine brownfields is a complex and disputable matter. From a socio-cultural point of view, the challenge connected to the transformation of mountain brownfields seems to lie in the equilibrium between the expected performance of redevelopment in terms of social cohesion (i.e. how the site conversion responds to social and territorial dynamics) on one hand, and the preservation of social and cultural identity connected to the material and immaterial legacy of industry. Facing this challenge calls definitely for the direct involvement of local communities in the site transformation.

3.5 An environmental challenge

The social and economic issues connected to the redevelopment of Alpine brownfields cannot be properly addressed without considering the specificity of the living environment to which these sites are interfaced. Mountains are dynamic natural

[18] Across the Alps, the condition of territorial marginality is not just related to geographical remoteness, or scarce accessibility, but it is more influenced by a functional 'disconnection' from neighbouring regions and networks. In this sense, the concept of 'inner periphery' perfectly applies to these situations (Copus, Mantino, and Noguera 2017).

ecosystems, characterised by an outstanding biodiversity and a rich ecological stratification due to morphological and bio-climatic factors. But being also inhabited territories, mountain regions and their complex yet vulnerable ecosystems are constantly subject to various forms of anthropogenic influence. In the Alps, the scale and the impact of human-driven transformations have dramatically increased in the last one hundred and fifty years, as result of the combined action of local and global processes (Bätzing 2015; Perlik 2019). In the first case, the new intensive economic uses of mountain natural resources, such as water, wood, rocks and soil, have strongly impacted on existing and well established eco-cultural equilibriums. Locally, the effects can be seen in biodiversity degradation due to extreme land uses (overuse versus abandonment) or in the permanent fragmentation of large-scale ecological networks due to mobility, tourism and energy infrastructure development (Chemini and Rizzoli 2003). As highly dynamic natural systems, mountain environments are also reacting very sharply to global processes such as climate change (Grabherr, Gottfried, and Pauli 2010; Cherisch et al. 2015). The effects of global warming are already visible and well documented in mountain regions. The occurring and prospected significant changes in yearly temperatures and precipitation are causing permafrost retreat, the rise of snow line and the increase of drought frequency, with cascade effects on freshwater supply, vegetation types and coverage as well as habitats. Furthermore, natural disastrous events such as floods, landslides and avalanches are also directly associable to changing climate conditions, though in many cases these are 'empowered' by environmental-unfriendly land uses and urbanisation models (Kruse and Pütz 2014). Under these changing environmental conditions, the human-nature equilibrium which allows the habitability of these Alpine territories is increasingly put under pressure, thus also negatively influencing the availability and the quality of ecosystem services provided by mountains to the surrounding regions.

In this dynamic environmental context, industrial brownfield sites obviously represent a problematic condition. At the same time, however, their transformation does also advance potentially valuable solutions for large-scale environmental regeneration (Fig. 3.7). A first dimension to consider is that of the former industrial site itself, an abandoned or underused portion of already developed land resulting from a prolonged and intensive production activity. Depending on the previous industrial activities, the environmental impact of Alpine brownfields can be extremely significant and challenging to be addressed: it can include soil and underground water contamination (e.g. chemical industries, paper industries, steelworks, etc.), increased geo-morphological instability due to uncontrolled erosion (e.g. mining industries, cement production) and the fragmentation or permanent loss of habitats due to deforestation, soil sealing and land degradation (common to most brownfields). In certain cases, some of these processes have already emerged during the previous industrial activity, as in the infamous cases of heavy mercury pollution from aluminium smelting in Martigny/CH, Mori/I and Saint-Jean-de-Maurienne/F, the DDT outflow into Lake Maggiore from chlorine industries in Pieve Vergonte/I, or the accumulation of heavy metals around the lead and zinc smelting complex of Arnoldstein/A. But more often, exactly the condition of prolonged and uncontrolled abandonment of previously industrial sites let these critical ecological situations to emerge. In this case, the ecological rehabilitation of brownfields is the only way to be able to implement, later on, a transformation process and thus enabling the reuse and redevelopment of the site itself. However, as a costly and time-wise operation, the reclamation of contaminated industrial sites can be only achieved, in the specific context of mountain regions, if financial and technical support is provided to affected regional and local communities by higher level institutions—as occurred in some of the previously mentioned cases[19].

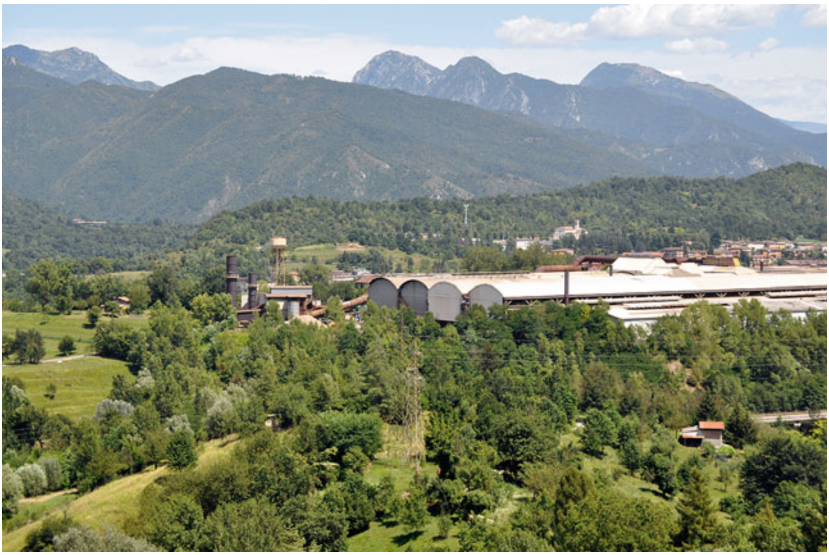

Fig. 3.7 The IRO steelworks in Odolo, 2010

[19] A less costly and sustainable alternative for the ecological rehabilitation of contaminated brownfield sites is that of phytoremediation, whose utilisation in the specific context of the Alps is still very limited and experimental, yet promising (Schwitzguébel et al. 2011).

The management of the site-specific environmental impact of Alpine brownfields is without any doubt a problematic and challenging issue, yet rarely tackled 'holistically' through a wider ecosystem service (ES) -based approach (Grêt-Regamey, Walz, and Bebi 2008; Schirpke, Tappeiner, and Tasser 2019). In most cases, mountain brownfields are located at critical nodes of the regional ecological network, that is, at the confluence of water streams into larger rivers or even directly into riverbeds, on alluvial fans at the narrow intersection of mountain slope and valley ecosystems, in the centre of ecologically impoverished valley floors or at the edges of vast biotopes. These locational conditions are not sufficiently considered when dealing with the environmental regeneration of brownfields, with the result that major environmental and ecological concerns are not tackled at all. However, right the integration of these contextual aspects with the aforementioned site-specific issues can foster an appropriate environmental framing of mountain brownfields, thus improving the effectiveness of their transformation. By 'ecologically' consider brownfields as key nodes of hybrid artificial-natural mountain ecosystems, as they actually are, their transformation and redevelopment can be also understood as a way to increase the environmental resilience of mountain areas by providing (or enhancing the provision) of relevant ES (Mathey et al. 2015; Cortinovis and Geneletti 2018). In this way, the transformation of a brownfield site intercepting (also negatively) a regionally relevant river ecological corridor represents the occasion to implement a large-scale restoration of the same, or at least of those sections ecologically compromised as within the brownfield itself. Or, again, a disused industrial site interlaced with extensive former mining surfaces or waste deposits can serve as starting point for a vast operation of reclamation and ecological rehabilitation, leading to significant positive impacts on mountain biodiversity at the regional scale or even beyond. In synthesis, it seems useful to consider, during the transformation and redevelopment process, the potential benefits of brownfield transformation for the wider mountain environmental context, that is, to highlight and enhance the ecological value of the site for the intercepting ecosystems.

Considering this latter perspective, the environmental challenge for Alpine brownfield redevelopment does not only lie in their ecological rehabilitation, in fact unavoidable, but more and especially it embraces their ecological relevance for the hosting territorial ecosystem (Svadlenak-Gomez et al. 2014). In this regard, the environmental regeneration of mountain brownfields needs to be considered and implemented necessarily beyond the mere site perimeter. Only in this way brownfield transformation can substantially contribute to increase the resilience of highly vulnerable and rapidly changing mountain living environments.

3.6 Deindustrialising mountains: landscape as infrastructure

For over a century, the Alps have constituted the breeding ground for a certain form of exogenous industrialisation, one aimed at taking advantage of the mountain environment and its precious resources. A multitude of heavy and manufacturing industries began to multiply in once remote rural regions, deeply and permanently transforming rooted regional economies and societal structures as well as cultural landscapes (Crivelli 1998; Dalmasso 2007). From around the 1980s many of these industries entered in crisis, as the changing economic conditions at the regional and global level suddenly turned the previous location advantages in inner Alpine areas obsolete and counterproductive. However, compared to other European regions of old industrialisation, the Alps never experienced such a dramatic decline, due to the much lower industrial density and the regionally diverse economic structure (Bätzing 2015). The ongoing structural change is causing the emergence of many brownfields, derelict or underused former industrial sites that, while telling the epic yet controversial story of Alpine industrialisation, are posing an enormous challenge for the future sustainable development of mountain communities and regions (Fig. 3.8). The redevelopment of these sites, their physical and functional transformation, is undoubtedly a complex planning task, strongly influenced by the framework economic, social and environmental conditions of the contemporary Alpine space. From an economic point of view, mountain brownfields can be considered as an outstanding space of opportunity, an emerging type of territorial capital requiring innovative cooperation models to be successfully (re)developed and reintegrated in regional economic networks. With regards to the Alpine society, brownfields as material legacy of the past industrial age are bearing a certain social and cultural identity, whose preservation has to meet the expected contribute of the site transformation to social and territorial cohesion. In terms of environment, finally, the mandatory ecological rehabilitation of heavily compromised derelict sites might be the chance to foster an extensive reclamation of altered mountain ecosystems, and thus to improve the environmental resilience of the Alps, or at least of their mostly inhabited parts.

Fig. 3.8 The former INDEL ferrosilicium factory in Domodossola, 2007

Based on these arguments, Alpine brownfields can be realistically and proactively viewed as supporting infrastructures for their own economic, social and environmental contexts. This aspect, still largely undervalued, is determinant when it comes to deal with the challenging redevelopment of these sites. As already advanced in the introduction, and further clarified in this chapter, these mountain brownfields are indeed at the centre of complex territorial systems under deep transformation. Originated and developed along industry, these deindustrialising mountain territories are now questioning the role of its material and immaterial legacy in view of an alternative, sustainable future (Migliorati and Veronesi 2020). Such a strong yet underrated condition of territorial centrality—shared especially by those large-scale brownfields derived from traditional resource-intensive heavy industries—is particularly striking while considering the strategic relevance of most of these sites in terms of regional development. As a long-term spatial planning challenge, the physical and functional transformation of mountain brownfields should then take advantage of this specific infrastructural quality, enhancing its potential in terms of territorial spillover on economy, society and environment too. In doing so, this condition of territorial centrality of brownfields has to be evidently transposed into the physical space, i.e. underlining also the spatial centrality of these sites with regards to their own related landscapes. Alpine brownfields are indeed strongly influenced by their dual condition of strong spatial embedness in the context on one hand, and a total functional disconnection from the same on the other hand. The brownfield site is the fulcrum of a specific mountain landscape altered by the historical presence of industry, an environmental, economic and social presence that due to deindustrialisation becomes ‘negative’—not meant as problematic (it obviously is), but more in terms of a leftover, redundant superstructure. The disused industrial site exists and persists embedded into its own territorial structure, yet it is increasingly disconnecting from the social and economic dynamics that occur within the same territory, flowing through the same space, regardless of the site itself. Yet, in the previous pages it was clearly evidenced how the brownfield site, as a highly receptive ‘awaiting space’, does actually constitute a unique opportunity to intercept and concretely influence these new territorial flows and dynamics. The interpretation of spatially well-integrated yet functionally disconnected sites leads to advance the image of Alpine brownfields as true territorial infrastructures: a very special form of ‘territorial capital’ whose biophysical component already exist—the brownfield site as an architectural ensemble at the centre of a vast, altered ecosystem to be regenerated—while the human one has yet to be (re)formed—by means of interacting cultural identity, economic development and social cohesion -related issues. The real challenge lies therefore in rendering in space and time this potential role of Alpine brownfields as platforms for development, that is, to enable their transformation and redevelopment.

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Brownfields as Landscapes

4

The planning perspective of Alpine brownfields as a territorial infrastructure, emerged in the previous chapter, is essentially based on the mutual association—physical and functional, even before than conceptual—between the former industrial site and the cultural landscape to which it belongs. Out of the specific Alpine context, in those old-established and heavily industrialised regions of Europe where the redevelopment of brownfield sites is representing a key challenge since decades, this particular association is everything but new. In these contexts, the progressive yet nonlinear convergence between spatial and ecological interpretations of derelict industrial land has fostered a cultural re-shaping of the 'nature' of urban brownfields, from discarded fragments of previous cultural landscapes to key infrastructural elements of emerging eco-cultural landscapes (Höfer and Vicenzotti 2014; Braae 2015). Driven by design- and planning-afferent disciplinary fields, while being also strongly influenced by socio-cultural studies[1] and environmental sciences[2], this cultural breakthrough in the interpretation of brownfield sites has produced an ever-expanding set of conceptual models and operative tools that can be ideally transferred, though carefully adapted, to very different contexts and situations. Although it is very difficult to talk about a specific and widely recognised landscape-oriented understanding of brownfields—as the concept of landscape itself is highly interpretable—, it is actually possible

[1] Worth to be mentioned are the researches on post-industrial landscapes by human geographers Tim Edensor (Edensor 2005) and Anna Storm (Storm 2016).

[2] Particularly relevant, the discovery of brownfields as biodiversity-rich environments (Rebele and Dettmar 1996; Kowarik 2005) and the positive valuation of the related ecosystem alteration (Kirkwood 2001).

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to identify which aspects of 'landscape' are influencing brownfield transformation as a complex socio-economic and spatial process. In doing so, this chapter moves temporarily away from the Alpine context, reaching out to the wider European and North American contexts as cultural breeding grounds for approaching brownfields as landscapes. In describing how this factual association took place and developed, the chapter puts a major emphasis on the structural and systemic paradigms emerged in the practice of brownfield redevelopment. These two paradigms, as epitomes of the inherent transformative qualities of landscape, constitute indeed the theoretical base for further developing a context-based landscape approach for Alpine brownfields, that is, the aim of this research.

4.1 Intensive/extensive

The many experiences of brownfield redevelopment so far completed reveal that there is no single way to deal with industrial remnants. Given the strong multidisciplinary character of the brownfield challenge (Genske and Hauser 2003; Ferber et al. 2006), what seems to be determinant for the physical and programmatic outcome of transformation is not the scale nor the purpose of it, but rather the intensity of transformative actions and their temporal horizon (Braae 2015). Accordingly, the multitude of redevelopment approaches developed and applied up until now can be basically differentiated between intensive and extensive ones, with a variable degree of intermediate steps. The first are those focused on rapid, radical but rather 'static' changes, either concerning the form or the function or both, while extensive ones privilege a slower, subtle and progressive change. On a general principle, intensive redevelopment approaches are strongly market-oriented and rendered through traditional architectural production and urban regeneration strategies, while extensive ones are more suitable for low or no market situations and mostly relying on ecologically-driven interpretations (Grimski and Ferber 2001). However, this dualism should not be automatically reduced to a question of conservation and/or authenticity of leftovers: while some conservative transformations (such as the 'musealisation' of industrial objects) are radical in the sense that they impose a totally new meaning and function to what exists, other 'deconstructivist' transformations (such as the progressive recultivation of industrial fallow lands) integrate change in space and time very discreetly.

The intensive/extensive dichotomy in reading, interpreting and transforming brownfields can be traced back in the avant-garde studies on 'industrial-archaeological' landscapes by Franco Borsi (Borsi 1975, 1978). In a time when the conversion of derelict industrial sites was still an emerging—if not a marginal—issue, Borsi proposed two main interpretations of these transitional landscapes and, derived from the latter, four conceptual and programmatic strategies. On the one hand, and from a purely architectural perspective, the derelict industrial landscape can be perceived as a 'monument', an historicised cultural in(ter)vention[3] encasing precise meanings, memories and identities. Transformation can be aesthetic-driven and temporally-neutral, if addressed to the preservation/restoration of built heritage and even to the pure contemplation of ruins, or technology-driven and temporally-active, if what exists is made intelligible through footnotes interventions—not necessarily implying a total conservation. On the other hand, the transitional industrial landscape can be also interpreted as *natura artificialis*, a hybrid and man-made status which ideally replaced the previous *natura naturalis*. In this case, transformation can also act as a temporally neutral intervention, if the removal of environmental alteration is programmed, or as a temporally active one, if a certain form of cultivation of this status is foreseen. The interpretation of disused industrial sites as either monument or altered nature, or even a mix of both, is the theoretical and conceptual breeding ground for the aforementioned intensive and extensive guiding approaches (Hauser 2001; Douet 2012). On a general basis, the 'monument' concept is associated to the manipulation of built heritage and building fabric, and thus in the focus of architectural production and urban planning strategies, while the 'nature' one brings forward ecological dynamics and human-nature interactions, being therefore mostly addressed by landscape architecture and open space planning strategies.

Intensive 'built' transformation approaches on brownfields are widely diffused and rather old in their origin, though subject to continuous evolution. The cultural background of this approach can be traced in the urban regeneration experiences developed in the UK starting from the mid 1970s, and later transposed to Western Europe. Specific policies and programmes, such as the Liverpool Initiative or the Urban Development Corporation established in 1980 to support the regeneration of docklands and inner-city areas, were developed with the aim to attract and involve private investors in the complex process of physical and socio-economic upgrade of run-down urban and industrial centres (Stratton 2000). Parallel to that, the English Heritage Trust introduced the Conservation Area Partnership, a funding scheme addressed to communities undergoing regeneration and aimed to

[3] The industrial landscape perceived as such is indeed a 'projection' of the past into the present, an 'invention' in the sense that its existence is founded on an idealisation of industry and its transposition onto the leftover land and built structures (Ganser 1999; Höfer and Vicenzotti 2014).

preserve key heritage buildings—among which mostly of industrial origin—and integrate them into the new urban developments. The nonlinear and sometimes difficult alliance of heritage conservationism and urban regeneration programmes has however provided the breeding ground for a wide appreciation of industrial leftovers as 'new heritage' (Braae 2015) or even 'heritage for re-activation' (Mieg and Oevermann 2015). In many declining industrial cities, from Manchester to Turin, from Bilbao to Tampere, the conservation of industrial built heritage has indeed proved to be "a key to unlocking their potential in both economics and culture" (Stratton 2000: 25). The successful integration of industrial leftovers into wider urban regeneration strategies was accompanied and sustained by a ground-breaking cultural shift in the understanding of heritage (Fairclough 2009), whose meaning exceeded that of 'monument' in the narrow sense towards comprising the ordinary, "the environment in the widest sense of the word" (Kolen 2006: 50). In this way, not only historically relevant industrial buildings and architectures could be preserved, but also the multitude of apparently anonymous industrial objects of which post-industrial urban landscapes are mostly made of. This democratic approach to industrial heritage has fostered the development of architectural and planning 'adaptive reuse' strategies, in which the conservation of historic, aesthetic and atmospheric characters of formerly industrial spaces coexists with the social, economic and cultural demand for new uses and practices (Baum and Christiaanse 2012; Fragner 2012). Old industrial buildings, in fact, "can accept both programmatic and semantic changes […] With their generous size and open ground plans, the buildings can be used extremely flexibly and can be adapted to whatever needs arise. The architectural structures are interpretable" (Baum and Christiaanse 2012: 8). Adaptive reuse does not apply to single buildings only, but it has successfully also become a planning strategy for large-scale site redevelopments or district regeneration. The careful retaining of both representative and marginal objects, or even of underlying spatial structures, provides the logic of the intervention while producing attractiveness in terms of identity and image (Fig. 4.1). Evidence of that can be found in famous contemporary regeneration cases, such as London's King Cross, Vienna's Gasometers, the Aker Brygge in Oslo, the Rotermann Quarter in Tallin, the Île de Nantes project in Nantes and the Escher Wyss-Industriequartier in Zurich, to cite some, but also in much smaller and ordinary transformations.

An alternative yet complementary approach to these intensive models has gradually developed starting from the 1980s, as the increasing complexity and size of the brownfield issue matched with the rise of ecological thinking and

Fig. 4.1 Heritage-led real estate development in the former industrial district of Battersea, London. In the picture, the iconic Battersea Power Station being renovated, at the centre of the homonymous urban redevelopment project

especially with the emergence of urban ecology studies[4]. The tidal wave of deindustrialisation which invested Europe at the very end of the century not only did leave behind numerous abandoned buildings and independent sites, but in many cases it caused the emergence of vast and intricate networks of sites and infrastructures (Smets 1990; Hauser 2001). A prominent case of the latter was represented at that time by the Ruhr basin, once the largest heavy industry region in Germany and Europe as well, which turned into a crisis area after being severely hit by the decline of the local coal and steelmaking industry[5].

[4] The 'prototype' of this new approach to brownfield transformation is often considered the Seattle's Gas Works Park by Richard Haag, inaugurated in 1975 as result of the reconversion of a former gasification plant into a public park. However, the rather traditional and 'monumental' interpretation of industrial leftovers, preserved and fenced as a derelict landmark surrounded by lawns, makes this project quite distant from the forthcoming 'ecological' understanding of brownfields.

[5] To give a glimpse of the crisis, it can be said that in the span of just two decades, between 1960 and 1980, the active coal mines in the region shrunk from 125 to 29, while the workforce in mining and steel industry dropped by 50%.

Between 1989 and 1999, however, the Ruhr district became the set of a pioneering experience of regional restructuring within the framework of the International Building Exhibition (Internationale Bauausstellung, IBA) Emscher Park. Under the lead of Karl Ganser, the challenging transformation of around eight thousand hectares of abandoned and contaminated industrial land was innovatively and 'extensively' addressed by means of a hybrid ecological-cultural reinterpretation of the altered post-industrial landscape (Dettmar, Ganser, and Latz 1999; Ganser and Höber 1999; Weilacher 2008). The stagnant economic and market situation in the region—which prevented a real-estate 'intensive' redevelopment for all the existing large and small brownfields to take place—as well as the complexity of the restructuring on stake—called to jointly manage serious environmental damage and social and economic deprivation—have contributed to the development of a unique 'change without growth model' (Reicher, Dahlheimer, and Uttke 2008), of which the cultivation of the existing industrial topographies became the planning leitmotiv. Central to this new 'eco-cultural' approach to brownfield transformation is the acknowledgment and the appreciation of the 'uncontrolled' ecological developments occurring on the site—which, together with the industrial built heritage and the underlying infrastructural network, form the basis of an 'unfinished' and constantly evolving new cultural landscape (Dettmar, Ganser, and Latz 1999; Weilacher and Dettmar 2003). The overgrown abandoned industrial spaces are mostly retained as such and further enhanced by means of minimal interventions (Fig. 4.2), e.g. to stabilise the new ecosystems or improve the public accessibility. In this way, a positive reconciliation with the industrial legacy (as also environmental alteration) can be gradually achieved, one in which the "fear of historical contamination has given way to a calm acceptance of the structures" (Latz 2001: 151). From here onwards, the ecological, cultural and even aesthetic potential of spontaneous renaturation on brownfields and residual urban spaces in general has been highlighted and similarly interpreted by landscape architects and urban ecologists as 'industrial nature' (Dettmar et al. 1999), 'new wilderness' (Kowarik 2005) or 'third landscape' (Clément 2004). Extremely influential in the European contemporary planning debate on sustainable urbanisation, these concepts and the related extensive transformation models have proved to be particularly successful in problematic contexts such as deindustrialising mining regions—notably, the IBA Fürst-Pückler-Land (2000–2010) in Lower Lusatia and various 'spot' projects in Pas-de-Calais and Limburg regions—but also in shrinking or porous cities—from the Berlin's classic Schöneberger Südgelände to the 'perforation' strategy implemented in Leipzig.

Fig. 4.2 Ruinous heavy industrial sites reinterpreted as new eco-cultural landscapes, in the Ruhr region. In the picture, the Landscape Park Duisburg Nord by Peter Latz, one of the flagship projects of the IBA Emscher Park

The aforementioned intensive and extensive transformation models are not mutually exclusive, nor they embody perfect solutions. Although possible in theory and highly desirable in practice, their full functional integration has been so far rarely achieved in concrete situations. This is not just because of the difference in scale—intensive models on dense, compact sites and extensive ones on permeable, fragmented networks—but mostly due to the diverging source of commitments as well as the framework conditions. Concerning the former, intensive transformations relying on adaptive reuse and urban development strategies are normally addressed by private investors such as real estate companies or private-public partnerships, while extensive transformations based on the cultivation of altered topographies are often addressed by public planning bodies and regional institutions—which usually already own the land[6]. The contexts are also very different, and determinant for the choice of the approach, as intensive transformations take place in dynamic inner-city areas, particularly fertile to the real estate market, while extensive transformations usually occur in economically weak contexts and in fringe or intermediate urban areas, where the redevelopment pressure is lower or absent.

4.2 Total Landscape

The original definition of industrial landscape provided by Borsi[7], in which architectural objects and altered environments are seen as interwoven components of a larger, inclusive and constantly evolving 'territorial structure', was somehow downplayed by the intensive-extensive dichotomy emerged in the practice of brownfield transformation. The term 'landscape' has been in fact associated to derelict industrial sites mostly in the context of extensive approaches, following the interpretation of hybrid human-nature landforms and processes provided by the disciplinary and professional fields of landscape architecture and urban ecology. Those large and complex brownfields managed through intensive approaches, in which the built prevails over the unbuilt (physically and conceptually), are not equally referred as 'transformed industrial landscapes' due to the absence of (visible) natural elements and ecological dynamics. This professionally 'authorised' way of defining (and thus approaching) transitional industrial landscapes shows many shortcomings and limitations, and especially it conflicts with the contemporary understanding of landscape as "a holistic, dynamic and hierarchical system" (Antrop 2017: 6), "a man-made system of spaces superimposed on the face of the land, functioning and evolving not according to natural laws but to serve a community […] a composition of man-modified spaces to serve as infrastructure or background for our collective existence" (Jackson 1984: 8). These ambitious and far-reaching statements, which indeed come from two landscape geographers—respectively Marc Antrop (1946-) and John Brinckerhoff Jackson (1909–1996)—rather than architects and planners, highlight very precisely the

[6] The "A-B-C Model", developed within the framework of the CABERNET Project, similarly classifies brownfields according to their economic status: A-sites are highly economically viable and thus self-developing with private funding, B-sites are intermediate, and C-sites are not profitable and thus redeveloped only with substantial public investments or planning frameworks (Ferber et al. 2006).

[7] See Chapter 1, p. 20.

integrative and unifying nature of landscape. The use of the term 'system' in association to landscape is particularly striking in this sense, as it evokes a complex, pluralistic and networked spatial entity, whose organisational patterns[8] are evolving according to historical, economic and ecological dynamics (Antrop 2013). The continuous superimposition of human- and natural-driven processes and the related topographies, their cyclical sedimentation and transformation as source of the landscape itself, are well conveyed by Corboz's metaphor of palimpsest (Corboz 1983) and Marot's hypertext/hyper-landscape (Marot 2003), which share indeed a similar 'historiographic' view on the 'already existing' as supporting structure for design and transformation. On these premises are also based the principles of the European Landscape Convention (ELC), which fully recognises the holistic nature of landscape both in terms of forming process—"an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe 2000 [Art. 1])—and spatial wholeness—"[it] covers natural, rural, urban and peri-urban areas […] outstanding as well as everyday or degraded landscapes" (Ibid.).

Considering the multifaceted understanding of the material and territorial legacy of industry so far elaborated, it makes sense to ask how and where do brownfields and especially their transformation locate themselves in this 'total landscape'. As previously seen, the redevelopment, reuse and recycling of former industrial sites is a complex and highly trans-disciplinary action field—as it is the management of contemporary urbanisation processes, of which disused industrial spaces incorporate many traits and dynamics. To approach brownfield transformation with a holistic landscape approach is a challenge itself, given the many cultural interpretations and disciplinary and professional ways-of-acting. A promising path, worth to be followed, is the one being traced by landscape urbanism, an urban planning theory established in the late twentieth and early twentieth-first centuries as alternative to traditional planning and design—which failed in addressing complex urban transformations in a post-Fordist economy. In conceiving landscape as a conceptual as well as performative medium for contemporary urbanization (Waldheim 2016), landscape urbanism operates a radical transformation in the meaning and use of 'landscape'. Liberated from its binding aesthetic and pictorial tradition, landscape is thus re-coded as a key urban infrastructure, "a live index and indeterminate interface of hard technological systems and soft biophysical processes" (Bélanger 2016: 38) and capable "to absorb and in some ways mitigate various impacts associate with social, environmental and economic crises" (Waldheim 2016: 4). The boundless horizontal dimension of

[8] The underlying structure of Borsi's industrial landscapes.

landscape, and especially of the contemporary urbanised landscape[9], is recovered in its deep geographical meaning through a work of/on surface, in which the ground plane as palimpsest becomes the real 'field of action' (Corner 2006), "an active surface capable of accommodating temporary programmes and on-going changes to promote the diversification that has always represented the meaning of urbanity as well as of landscape" (Marini 2009: 254). As landscape becomes an organising device for space, for the complex and interwoven system of human and natural environments, the design of it is aimed therefore at reconfiguring these systems and their supportive spatial structures. Accordingly, the transformation of run-down industrial sites as 'landscape reconfiguration' exceeds the simplistic yet established dichotomy between architectural-intensive and ecological-extensive approaches, thus pushing for their relative principles, methods and tools to merge in a different, unifying perspective.

This 'infrastructural' understanding of landscape can be easily detected in many ground-breaking experiences of brownfield transformation, some of which dating back prior to the emergence of landscape urbanism theories. In many of these experiences, the physical and programmatic re-arrangement of derelict industrial sites and discarded landscapes relies, according to the aforementioned holistic approach, on clear structuralist and systemic principles, often borrowed from scientific areas 'alien' to the architectural and planning field.

4.3 Structures

The linkage between structuralism and brownfield transformation is not immediate, nor completely acknowledged. As a design theory and concept, structuralism was introduced in architecture and urban planning from anthropology and linguistics in the 1960s, mainly through the work of Japanese and Dutch architects and planners such as Kenzo Tange, Aldo van Eyck and Herman Herzberger. By shifting the orientation from functional to spatial organisation, from uniformity to flexibility and modularity, structuralism developed as "a complete set of relationships, in which elements change, but in such a way that these remain dependent on the whole and retain their meaning. The whole is independent of its relationships to the elements" (Lüchinger 1981: 16). The particular focus on formal

[9] Referring to the European context in particular, the study of the emerging forms of dispersed urbanisation and hybridised urban-rural territories are increasingly supporting the infrastructural and ecological 'role' of landscape addressed in landscape urbanism (Viganò, Cavalieri, and Barcelloni Corte 2018; Wandl 2020).

relationships within the underlaying structure of a built space is indeed recognisable in several, later projects dealing with the complex redevelopment of disused industrial sites.

A pioneering experience in this sense can be traced back in the ambitious yet unrealised Potteries Thinkbelt Project (1964–66) by Cedric Price. In his proposal, the vast, derelict and 'peripheral' industrial landscape of North Staffordshire had to be transformed into an open and widespread university and innovation campus, following his idea of architecture as social (development) instrument. The radicalness of change in terms of function—from obsolete and polluting clay industries to higher education and knowledge sector—was counterbalanced by an intelligently conservative approach for the existing landscape structures, whose qualities were maintained and enhanced to fulfil the new purposes (Price 1984). The comprehensive approach towards the industrial landscape, perceived by Price as a complex relational system of used and unused spaces, solids and voids, infrastructures and nodes—very close to Borsi's understanding (see introduction)—was ground-breaking at the time, especially in relation to vast-scale disused industrial land. Adaptive reuse strategies were not just limited to old industrial buildings, but also and especially they embraced the redundant infrastructures as well as the scattered, undefined open spaces (Fig. 4.3). Most striking was the recycling of the extensive industrial railway network as the main infrastructural backbone of the new campus, on which 'educational railbuses' consisting of prefabricated modules could be moved around and docked at certain transfer facilities. The recolonisation of empty wastelands, in addition, had to be tactically fulfilled through the development of modular housing units adaptable to the unstable and complex topography. In this way, the flexibility of the structural elements—built, open, linear—composing the industrial landscape was first and clearly highlighted and valued as an outstanding quality of the 'already there'.

From here onwards, the underlying landscape structure of derelict industrial sites or network of sites has been variously interpreted according to the contextual conditions of transformation—site layout and typology, site conditions at the closure, market pressure, site location within the urban fabric, etc. Based on the transformative intensity applied to the existing structure, three main approaches can be identified: conservative, radical and intermediate.

In handling the transformation of complex industrial sites, the conservative structuralist approach is that which aims to retain as much as possible of the existing structural layout, using it as a 'porous bed' for new interpretations and functions. Two are the requirements for the success and viability of such an 'extreme' approach: first the site conditions at the beginning of the transformation process, that is, its formal integrity; second, the economic and ownership

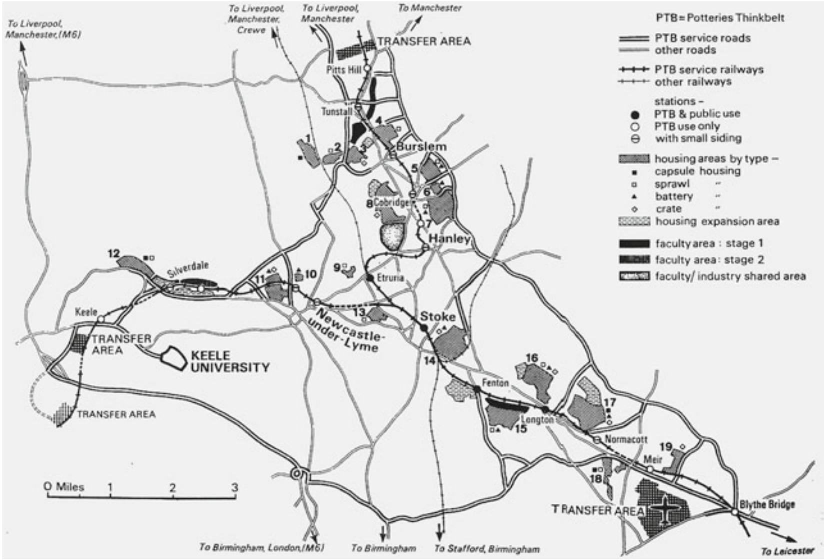

Fig. 4.3 Map of the Potteries Thinkbelt project (1966)

framework conditions, which have to fully support the feasibility of the operation. One of the best and most complete experiences of conservative structuralism is provided by the already mentioned Landschaftspark Duisburg-Nord project by Peter Lazt, part as well as highlight of the wider IBA Emscher Park regeneration program for the Ruhr basin. In the latter framework, the will to turn the 230 hectares disused Thyssen Meiderich steel mill into a public park was concretised first through the acquisition of the site by the regional land development authority and then by launching an international competition in 1990. Awarded with the first prize, Latz's proposal was based on a wide acceptance of both the industrial heritage—represented by the blast furnaces and related infrastructures—and the dramatically altered environmental conditions as resulting from heavy industry activities and following abandonment. The complex technological and spatial structures of the steel mill are not only entirely preserved (Fig. 4.4 and 4.5), but they are integrated and enriched with new information layers by means of nature-based design (including formal and informal nature reproduction), and thus deeply reinterpreted (Weilacher 2008). Based on acceptance and creativity, such a 'syntactical design' approach allows Latz to initiate and address both a material and conceptual metamorphosis of the industrial landscape, in which technological and natural systems, preserved as well as designed, are functionally and aesthetically interwoven to "celebrate the site's history" while "develop fantastic images of the future" (Latz 2001). Although widely assumed as a most representative case of post-industrial landscape transformation, the Duisburg project actually represents a *unicum* in its structural integrity. This is evident just by looking at other XL brownfield reconversions still in the Ruhr area, such as the Zollverein complex in Essen—whose heritage-based 'upgrading' transformation is prefigured by OMA's ring masterplan—and the Phoenix-West site in Dortmund-Hörde—whose economy-driven transformation into a business park responds to a different, younger regional development concept than that of IBA. Beyond the Ruhr district, a 'weak' reply of the Duisburg project can be found in Ostrava, in Czech Silesia, on the former Dolní Vítkovice steelworks site (Volf, Švácha, and Souček 2013). Despite the initial contextual conditions between the two cases were very similar, though temporally distanced by 20 years, the approach used in Ostrava by the Czech architect Josef Pleskot is largely missing that 'ground project'[10] which allowed, in Duisburg, a comprehensive recognition and thus reuse of the existing site structure. Deprived of their relational 'basement', the overwhelming Vítkovice blast furnaces and the attached Hlubina colliery are therefore fluctuating on a carpet of two-lane boulevards, golf-like lawns and cosy pocket gardens. In favour of such a (ongoing) transformation, it might be said, however, that the site foreseen development as a hybrid heritage-technology park requires an infrastructural upgrade to be able to accommodate, through the time, a wide range of activities, from public events to small business.

Opposite to conservative approaches stand radical ones, which are basically imposing a complete or almost completely new structure on the site, with the retaining of just a few industrial objects (stand-alone buildings or landmarks) as landscape anchors. The starting conditions, as well as the specific goals of redevelopment, are indeed influencing considerably the use of such a structural radicalness. The transformation of a brownfield site can start 'too late', when most of the existing buildings and infrastructures are already gone, and thus it requires a new spatial organisation to be implemented. Or the uncertain framework conditions (economy, investments, etc.) call for high spatial flexibility in the redevelopment process (e.g. progressive occupation of the site, adaptable building footprints, etc.), while the previous industrial layout is too binding for that. The

[10] In the words of Bernardo Secchi (Secchi 1986), a *progetto di suolo* (land/ground project) implies the necessary consideration, in every urban transformation, of the site topography and the system of open spaces on which existing and new buildings are grafted.

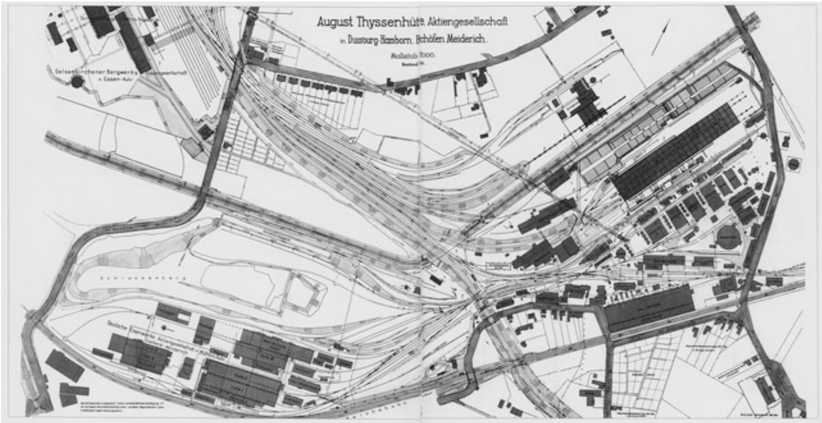

Fig. 4.4 Plan of the August Thyssen steelworks in Duisburg-Meiderich (1934)

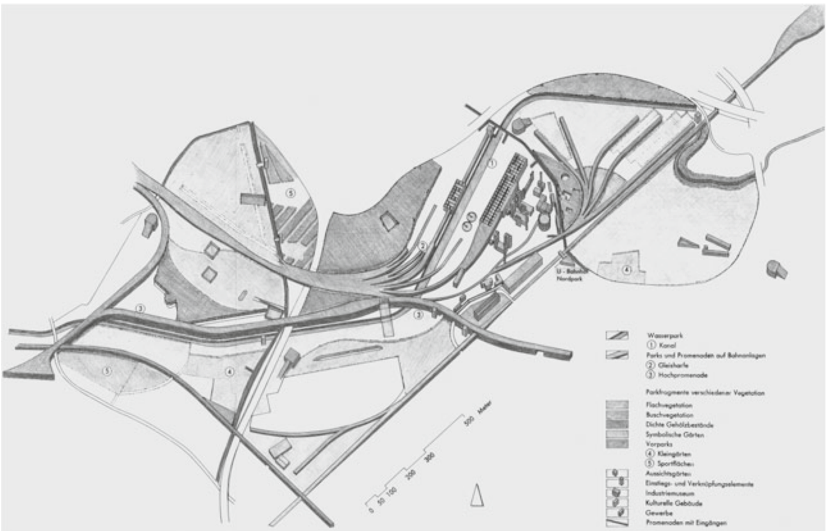

Fig. 4.5 Structural concept plan of the landscape park proposed by Peter Latz on the same site (1991)

often-unified question of physical and functional reprogramming of vast brownfield sites supports radical or quasi-radical approaches. A leading experience in this sense was the redevelopment proposal for the SMN/Unimetal brownfield in Caen, Normandy, by Dominque Perrault. As result of the closure of the integrated steel complex in 1993 and the following transfer of most of the facilities to China, a 230 hectares wide empty area suddenly appeared on the eastern edge of the city. To cope with such a gigantic *terrain vague*, with the “excess of ground”, Perrault opted for a *prépaysagement* (preparatory landscaping) strategy. A 100×100 meter grid, superimposed on the site and temporarily cultivated/planted, allowed at the same time to link the three ‘environments’ around the site—city, riverscape and agricultural fields—and to provide an infrastructural backdrop to future developments, which had to take place within the one-hectare lots (Fig. 4.6 and 4.7). In this way, a new and flexible spatial order was to be found, as well as a sort of reconciliation of the brownfield with its context. Due to the changed conditions years later, namely the absence of enough redevelopment pressure to sustain such a strong concept, the project was never realised. Around half of the site—the most accessible area—has been so far turned into a business and technology park.

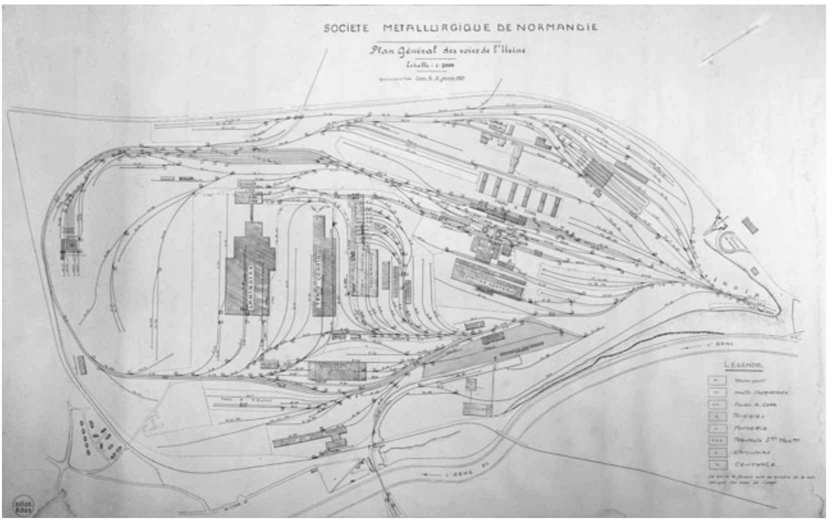

Fig. 4.6 Plan of the SMN-Unimetal steelworks in Caen (1925)

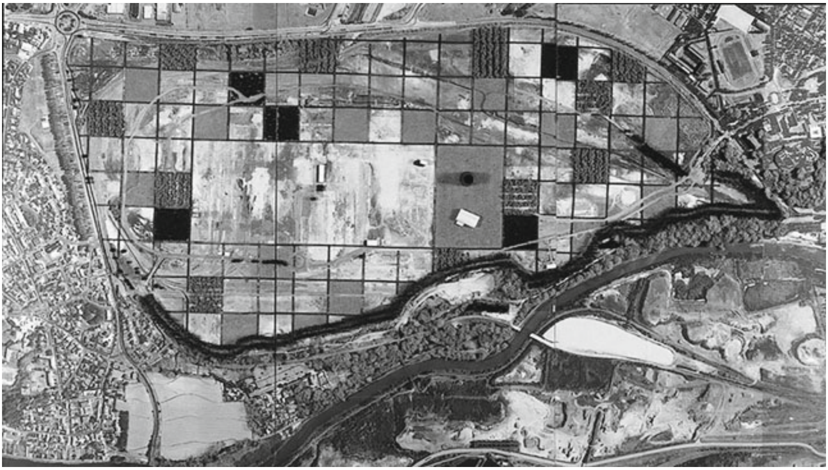

Fig. 4.7 The urban recolonisation grid proposed by Dominique Perrault on the same site (1996)

A similar and almost contemporary experience was the long-term transformation proposed by Florian Beigel for the disused Brikettfabrik Witznitz site in Borna, Sachsen, a fragment of the vast post-mining landscape around Leipzig. The 're-structuring' approach is here driven by the spatial indeterminacy of the site on the one hand—as the original topography is only visible in the few leftover buildings—, and the contextual uncertainty on the other hand—due to the missing economic conditions for redevelopment. Conceived as "an architectural landscape of activity fields" (Beigel and Christou 1996), the post-mining, altered topography is recovered through a temporary recultivation in forms of gardens, orchards and ecological zones, whose layouts are designed in a way that they can be quickly and adaptively urbanised in the future. The project was never realised as planned: part of the old industrial buildings has been renovated to host small businesses, while the foreseen housing development has been realised only partially and with a far less 'structured' layout than in Beigel's concept. These two examples—Borna and Caen—are 'theoretical' models for the radical structuralist approach, whose overall feasibility is indeed questioned by the missed realization (or mis-realization, leading a different result). More recent examples in continuity with such a trajectory—the Bagnoli steelworks regeneration in Naples (masterplan by Francesco Cellini, 2006) as well as the Uckange blast furnace park (Agence TER, 2014)—are also showing several difficulties in the realization, mostly because of the inherent imbalance between costs/efforts and benefits. Radical structuralist approaches deal with almost completely cleared sites, sort of 'evolved brownfields' in which the original structure is missing while being replaced in the meantime with undefined and rewilded surfaces—often hiding severe contamination problems never tackled before. To take advantage from the existing situation, the proposed redevelopment usually introduces a new landscape structure acting as 'mat of possibilities', which works fine in principle but miss to align with the contextual economic forces when put in practice.

A further approach, halfway between conservative and radical ones, is that of intermediate structuralism. As a much more pragmatic and thus viable solution than its two extremes, this approach aims to establish a new spatial organisation of the site on the basis of a few, determinant features of the existing structure, such as the infrastructural system and the built/open pattern. The 'structural identity' of the site is therefore retained, remodelled and reinterpreted according to both planning and design principles, forming the conceptual as well as concrete basis for the site transformation and future development. The search for a new urban order, a renewed *principio insediativo* (settlement principle) in Vittorio Gregotti's view, moves here from the consideration of "industrial topography as a logical grid" (Wünschmann 2016), thus valuing its inherent structural potential. Widely applied in several brownfield conversion projects, this approach has so far resulted particularly successful in addressing the transformation of large scale, autonomous industrial sites (so-called 'city-within-city') embedded in well-developed, dense urban contexts. An exemplary case of intermediate structuralist approach is represented by Gregotti's masterplan for the redevelopment of the former Pirelli tyre factory in Milan (1985), at the time one of the largest and most complex brownfield transformation projects in Europe. The conversion of the 70 hectares industrial area—largely built-up and well-integrated into the surrounding early XX century urban fabric—was approached by Gregotti through a careful reinterpretation of the spatial structure within the 'factory enclose'[11] as a flexible matrix of public spaces, able to accommodate in/on/within it a wide range of incoming urban functions and uses (Fig. 4.4 and 4.9). According to Gregotti, "the new design has to measure itself with the historical and geographical context in its structural aspects and not in stylistic ones. Precisely the discovery of these structural aspects will reveal the unknown which is often the way of

[11] The factory enclose (*recinto di fabbrica*) underlines the physical and functional separation of the industrial site from the surrounding urban fabric. To break the enclose and reconnect the internal structure with the urban outer one is a key objective in Gregotti's plan.

being of the permanent"[12] (Gregotti 1990: 5). The underlying structure of the vast industrial site is therefore perceived as a 'device' to bring together what exists, the historical tensions within the site, and what will or can be, the outcome of transformation as a new, added layer of permanence. Besides the open space network and the road grid, also several factory buildings and structures (e.g. the cooling tower) are retained as 'above-ground' structural anchor points. The complex transformation of the former mono-functional industrial site into a mixed-use urban district—including a new university and research campus, Pirelli's and other multinationals headquarters, an opera house and housing—has been completed in a span of twenty years, with some minor parts still under development.

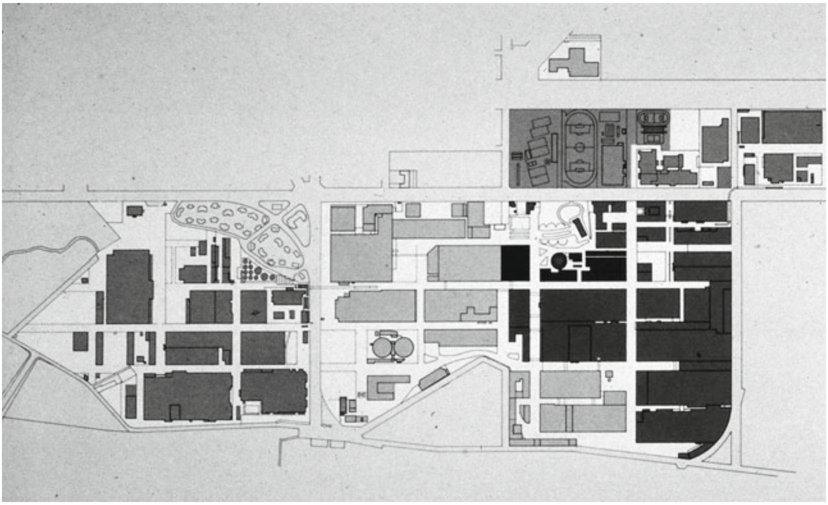

Fig. 4.8 Layout plan of Pirelli's tyre factory in Milan's neighbour of Bicocca (1985)

[12] Translated by the author.

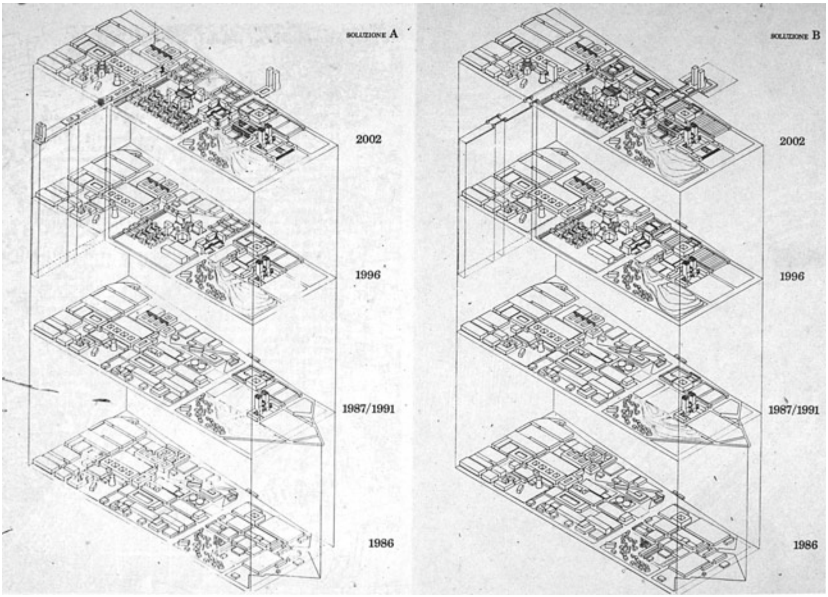

Fig. 4.9 The structural of the same site between 1986 and 2002, as outlined in the masterplan by Vittorio Gregotti (1986)

A similar case, also a good example of intermediate structuralism, is the already mentioned Belval megaproject in Esch-sur-Alzette, which concerned the redevelopment of a former 650 hectares wide brownfield into a mixed-use urban and research district for 20000 employees and 5000 residents. Managed by a development agency created in private-public partnership between site owner Arbed/Arcelor Mittal and the State of Luxembourg, the complex transformation was (and still is) guided by the masterplan of Jo Coenen, who won the competition launched in 2002. Structuralist principles are particularly noticeable in the eastern portion of the site, those where the 'hot side' of the steel complex was located. Not the system of public spaces nor the infrastructural grid, but "the pattern of the earlier industrial facilities, which was due to the technological processes, determined the development of the new quarter. It is both an inscribed pattern of memory and a structuring element for the new development"[13] (Wünschmann 2016: 16). The new spatial organisation of the area is in fact centred on

[13] Translated by the author.

and structured around the two giant blast furnaces—survived to the site clearing and preserved as cultural heritage—, whose complex footprint and outstanding elevation are reinterpreted not as mere landmarks, but as a true 'metric' for the surrounding emerging urban landscape. Although different in timing, transformation purposes and contextual conditions, the two cases of Milan and Esch-Belval are both configured as a successful urban redevelopment of large-scale, former industrial sites. Intermediate structuralist approaches prove to be extremely pragmatic when it comes to organise decades-long transformations. Two conditions seem to be at the base of these experiences of intermediate structuralism. The first is the strong private-public commitment, expressed through effective partnership schemes and planning cooperation between the site owning companies and key planning authorities. The second condition, very crucial, is the status of the industrial site at the beginning of the transformation process, which is not derelict nor an 'evolved brownfield', but rather a closing down machine whose signs and traces are still fully readable, and thus easily 'transferred' into the redevelopment project.

4.4 Systems

Since Geddes' early definition of the city as a living organism (Geddes 1915), systemic thinking has been increasingly used to understand and define the 'organised complexity' of urbanised territories (Lynch 1960; Jacobs 1961). It was not until the mid-late twentieth century, however, that the rise of environmental concerns on the impacts of unsustainable urban growth led to upgrade the 'organic' understanding of the urban phenomena in association to ecological and biological processes. In this context, systemic thinking began to be concretely applied to urbanisation in what American engineer Abel Wolman called 'urban metabolism' (Wolman 1965), that is, "the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste" (Kennedy, Cuddihy, and Engel-Yan 2007: 1). According to this view, urbanisation has to be seen as a spatially projected system of material flows, i.e. the materialisation of these flows occurring as these intercept a specific physical context in determinate socio-economic conditions. Assumed as biological systems, "cities are not static objects, but active arenas marked by continuous energy flows and transformations of which landscapes and buildings and other hard parts are not permanent structures but transitional manifestations" (Berger 2006b: 239). This transient condition represents therefore the perfect ground for brownfield sites and similar disregarded urban spaces to embody that 'positive waste' addressed by Kevin Lynch in his seminal 'Wasting Away' (Lynch 1990), that is, “a normal stage in the cycling of material and activity, a stage in itself fascinating and full of potential” (Lynch 1972: 233). As a category of ‘waste landscapes’[14], former industrial sites are at all the effects and purposes a material by-product of complex urban metabolic systems, naturally suitable for recycling and in the best cases even for up-cycling[15].

The specific influence of systemic thinking and urban metabolism on the transformation of industrial landscapes can be roughly traced in landscape urbanism theories and models developed in the context of North American deindustrialising urban territories. The planning question posed by industrial change and the resulting accumulation of disused and often contaminated industrial sites has been intuitively addressed by landscape urbanist Alan Berger through its ground-breaking concept of ‘drosscape’ (Berger 2006a, 2006b). Assuming an investigative approach towards the causal and formal relationships between landscape and urbanisation, Berger identifies as drosscapes those “inevitable waste landscapes” produced by the healthy economic growth of developed urban systems—either as actual brownfields, derived from regressive/shrinking economic trends in older/inner city areas[16], or as extensively ‘dissipated’ landscapes emerging from suburban sprawl. In this view, which assumes “the city as […] a huge ecological envelope of systematically productive *and* wasteful landscapes” (Berger 2006a: 202), disused industrial sites as a category of drosscape, or waste landscape, are to be ‘resurfaced’ and thus ‘reinscribed’ into productive urban cycles by means of new landscape design practices. These, according to Berger, have to satisfy two basic criteria: one of scale, by “shift a good amount of attention away from small-scale site design in order to consider howe we can improve regional landscape deficiencies of the urban realm” (Berger 2006a: 209), and one of structure, being “capable of adapting to changing circumstances while at the same time avoiding being too open-ended as to succumb to future schemes that are better organised” (Berger 2006a: 209). To this purpose, and to deal with

[14] According to Alan Berger (Berger 2006a), waste landscapes are either related to a) storage and processing of actual waste such as municipal waste, sewage, scrap metal etc., b) leftover, abandoned and/or contaminated sites or c) extensive and superfluous land uses for commercial and infrastructural purposes (e.g. oversized parking lots, shopping malls).

[15] Differently from pure recycling, in which discarded materials (and spaces) are processed and re-processed to make products resembling the originals, though often qualitatively poorer, up-cycling entails a creative upgrade of the original products (McDonough and Braungart 2013).

[16] Concerning industrial brownfield sites in particular, Berger states that these “accumulate in the wake of the socio- and spatio-economic processes of deindustrialisation, post-Fordism and technological innovation [and] are located in the declining, neglected and deindustrialising areas of cities” (Berger 2006b: 239).

drosscapes 'productively', Berger has developed a "systemic design" approach as well as the design-based strategy of "integrative reclamation". At the base of both methods stands the commitment for contemporary designers to involve the communities that 'inhabit' these landscapes in transition, and to guide them through the re-scaping process. Following the concept of "large scale logic in smaller scale proposals", systemic design proposes itself as a bottom-up procedural model aiming to integrate the existing economic, environmental and programmatic needs at the regional scale with site-based transformations (Berger 2009). To do that, the designer is required to understand first the underlying dynamics in the built environment as the context of transformation, by "conducting fieldwork while collecting and interpreting large-scale trends, data and phenomena" (Berger 2006a: 210), to cluster this information in so-called 'systemic bundles' and then to identify which of the identified territorial systemic flows are 'projecting' themselves as transformation issues on the site at stake (Fig. 4.10). The transformative design of altered or waste landscapes does not start at the end of this 'systemic relational' process, but *is* the process itself. The understanding of how natural and artificial systems dynamically operate in the landscape, across its regional and local scales, is central in Alan Berger's approach. Particularly striking in this sense is his work on post-mining landscapes in the US Intermountain West—the mountainous region shared between the States of Idaho, Wyoming, Colorado, Nevada, Utah, Arizona, and New Mexico –, an operative research aimed to outline reclamation as a design strategy for recovering altered landscapes (Berger 2002). Moving from Lynch's 'rehabilitation' as a way to "return entire complex sites to a productive status or at least to an open and ecologically stable condition that permits future development" (Lynch 1972: 234), Berger proposes reclamation as a permanent landscape alteration, a reordering of ecological situations that "autonomously adjust to altered site conditions, thus forming new landscapes that emerge out of the original landscape" (Berger 2002: 181). Through experimental projects dealing with vast post-mining landscapes, such as the French Gulch concept plan in Breckenridge, Colorado, reclamation proved to be an integrative device (Berger 2008): it is capable of integrating through design the ecological, social and economic needs of the site with that of the (regional) community, and, at the same time, to integrate physical entities (materials, ecologies, flows) with non-physical ones (perceptions, histories, values). With this set of arguments, Berger puts forward that in reclaiming, recovering and reusing of brownfields, either as urban drosscapes or post-mining topographies, landscape should be always "treated more as a system than a form and more as an infrastructure than an object" (Berger 2008: 181)—a key principle in landscape urbanism.

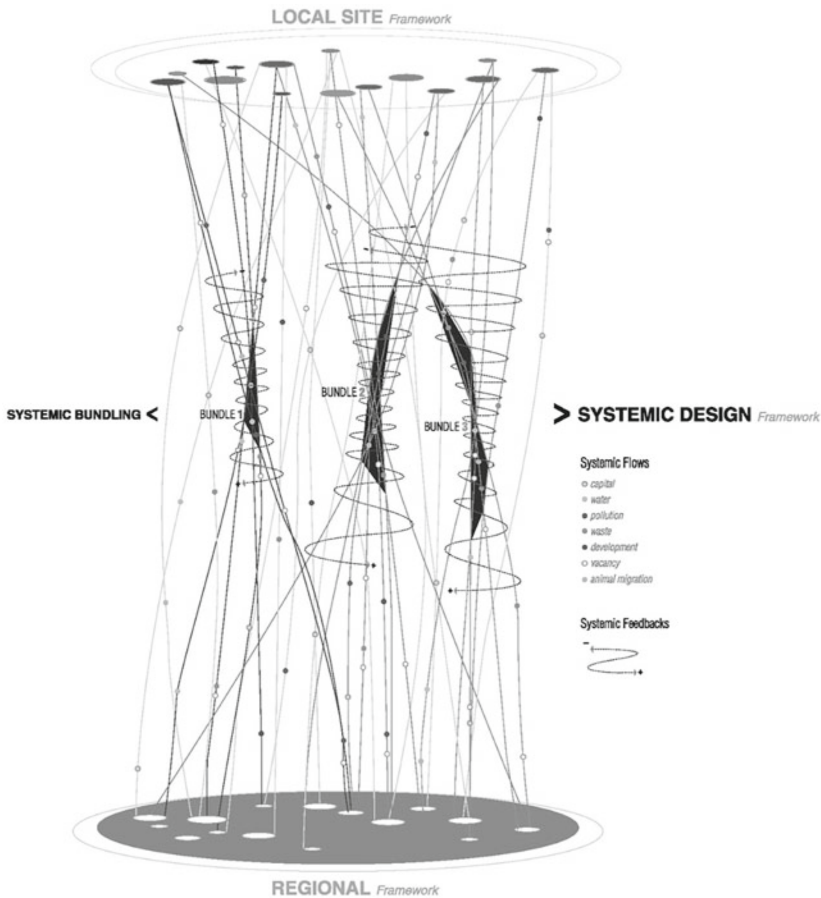

Fig. 4.10 Systemic design as interface between site and regional flows, according to Alan Berger (2009)

The processing capacity of landscape in addressing contemporary 'waste ecologies'—among which discarded industrial sites holds a key position—is particularly evident in the way of thinking and acting of landscape architect James Corner, the founder of Field Operations and co-author of renowned infrastructural conversion projects such as the New York based High Line and especially the Fresh Kills Park. As for Berger, Corner also believes that "the processes of urbanisation […] are much more significant for the shaping of urban relationships than are the spatial forms of urbanism in and of themselves" (Corner 2006: 28), thus calling for the planners and designers involved in the transformation of complex urban landscapes to shift the attention "away from the object qualities of space (whether formal or scenic) to the systems that condition the distribution and density of urban form" (Corner 2006: 28). In his 'manifesto' writing *Terra Fluxus* (Corner 2006), Corner proposes four themes (to be) assumed as central to the contemporary landscape urbanism project: process over time, the staging of surfaces, the operational or working method, and the imaginary. The first two are particularly relevant in connection to the 'ecological' understanding of brownfields and of their transformation/remodelling. With their 'incremental', 'cumulative' and 'systemic' nature, ecological processes can be assumed as a realistic reference for describing urbanisation as a type of environment, a man-made one, which constantly evolves through the time adjusting to the actual conditions. The spatial order in the urbanised landscape, central to the modernist architectural and planning tradition and aimed at 'controlling-through-form', must be therefore re-envisioned as a "spatio-temporal production", that is, a dynamic process involving "all forces and agents working in the urban field [in] continuous networks of inter-relationships" (Corner 2006: 30). If 'process' explains the temporal dimension of Corner's approach, 'surface' indicates the role of space in it. The surface as the 'ground plane', and not just the open, unbuilt space, constitutes the uniforming topography on which systemic flows and interactions take place, or 'perform'. In this way, the horizontal surface becomes the 'field of action' of landscape urbanism, assuming the active role of urban infrastructure, one that "unlike architecture, which consumes the potential of a site in order to project […] sows the seeds of future possibility, staging the ground for both uncertainty and promise" (Corner 2006: 31). The surface as infrastructure has nothing to share with compositional design, but instead it supports and enhance the 'operational logic' of urban landscapes. The process and the surface are recurring in the already mentioned Fresh Kills project, the complex reclamation of the world's largest landfill site on Staten Island, New York, of which Corner was committed after having won the international competition launched in 2003. The former landfill, 930 hectares of suburban wasteland interwoven with damaged fluvial and coastal ecosystems, is reclaimed spatially and temporally by means of a 30-years long phasing plan, whose development stages are rendered on and through an infrastructural matrix of 'threads', 'maths' and 'islands' bounding together biological processes and public usability in the emerging "lifescape" (Fig. 4.11). Though different in scale and scope, similarities can be found between Fresh Kills and the earlier IBA Emscher Park experience, as both (re)conceived the urban-regional landscape as infrastructure, one capable to deal with the current 'logistics of disassembling' (Bélanger 2007) through the twofold recovery of discarded sites and compromised ecologies.

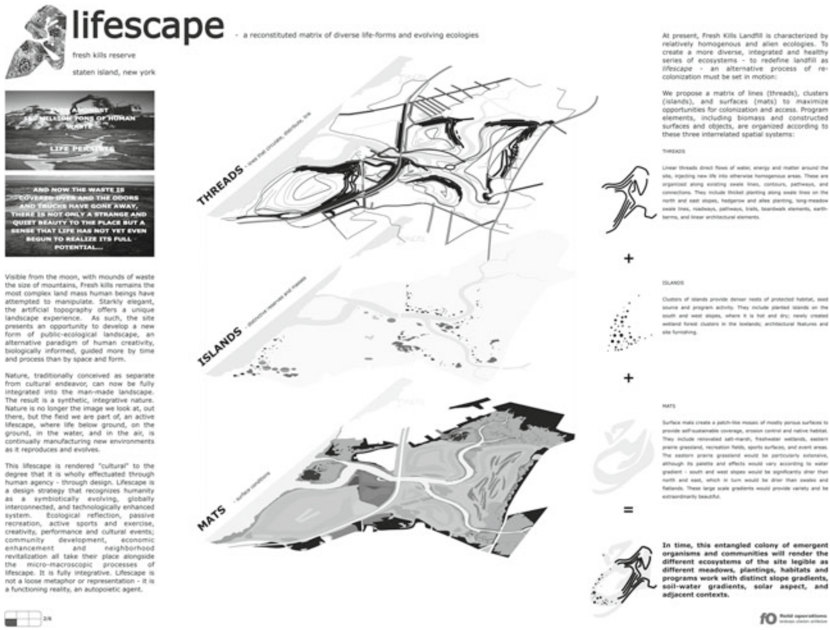

Fig. 4.11 The system-based 'synthetic ecologies' in the Fresh Kill project by Field Operations (2001)

4.5 Infrastructure for/of Transformation

Despite their conceptual and sometimes cultural diversity, structuralist and systemic approaches share to all effects the same landscape holistic view on that *terra incognita* produced by industrial decline. In dealing with brownfields and discarded urban-industrial landscapes, structuralist models bring forward the underlying spatial organisation and rearrange it for future programmes, while systemic approaches address the material flows that intercept the area into new designed ecologies. What both strategies have in common is the willing to remodel, reshape, reclaim, recover these post-industrial landscape scars (Storm

2016), rather than remove them. In other words, they both deal with transformation, with the continuous rearrangement and improvement of what exists, that is, departing from and confronting with the 'as found' (Braae 2015). This holds no big surprise, however, as landscape *is* transformation by itself, no matter if interpreted as a layered sequence of spaces (structuralism) or as ecological processes (systemic design). Brownfield redevelopment as a planning practice incorporates transformation only when the already existing is processed and reprocessed multiple times, by means of a design that incorporates 'unmeasurable' landscape features such as indeterminacy and adaptability. In this way, by 'intercepting time' and rendering it in space, transformed brownfield sites "are manifesting as intermediate landscapes whose only lasting quality is the permanence of change"[17] (Weilacher and Dettmar 2003: 81). Brownfields as landscapes, therefore, means to grasp the transient character of these spaces and to cultivate their change as an integral part of that 'total landscape' to which they belong, belonged and will belong too.

In addition to that, structuralist and systemic approaches have proved how the deep infrastructural significance of landscape is capable, when applied to brownfield redevelopment in particular, of generating many adaptable futures out of one single, given site. Whether considering as infrastructure the elementary networks and the formal relationships (structures) or the performative, functional linkages between the parts (systems), a holistic landscape approach to discarded industrial sites allows them to keep, yet to renew, their original centrality within the urbanised space. Infrastructure supports transformation, as much as transformation requires an infrastructure to take place. If such a space-time exchange worked out properly in the context of complex urban systems, such as metropolitan regions and urban-industrial agglomerations—where brownfield sites are indeed a relevant though not exclusive infrastructure for development –, it can be expected that, in infrastructurally-weak marginal contexts such as mountain areas, the same could be even more successful. The scattered and fragmented settlement pattern, the undefined urban-rural landscape interwoven with complex topographies, and the predominance of vast semi-natural, unbuilt spaces emphasises, in the mountain context, the structural/structuring relevance of brownfields as 'heavy', grounded elements. Transformation, therefore, should aim to enhance the future-oriented role of brownfields as systemic 'anchor points' of these wider, complex living environments. With its 'infrastructural' power and the natural inclination to 'adaptability' over time, a holistic landscape-based approach does represent a valid solution to deal with the challenging redevelopment and transformation of Alpine brownfield sites.

[17] Translated by the author.

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Part III

Explorations

Mapping

5

How many brownfield sites are actually existing in the Alpine region? Where precisely are these located? To which previous industries they belong to? How the challenges connected to their redevelopment are perceived and addresses by spatial and landscape planning institutions, at the local and regional level? Is it possible to assign a certain relevance to brownfield redevelopment according to specific regional contexts? To answer these questions, the first scale of analysis sets to outline a comprehensive and actual overview of Alpine brownfields. To this purpose, a quantitative territorial census of current and potentially future sites was first developed and then integrated by a qualitative stakeholder survey, addressed to national, regional and local planning institutions in brownfield-affected contexts. So conceived, the emerging geography of Alpine brownfields provides first-ever transnational, concrete insights on the territorial incidence of industrial decline in a mountain context, while also suggesting how to 'translate' the redevelopment challenge in the different regional contexts.

5.1 Framework

Focus

To date, a reliable and comprehensive quantification of former industrial sites in the Alpine region is not existing yet. The only available territorial surveys and

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Supplementary Information The online version contains supplementary material available at (https://doi.org/10.1007/978-3-658-37681-9_5).

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M. Modica, *Alpine Industrial Landscapes*,
RaumFragen: Stadt – Region – Landschaft,
https://doi.org/10.1007/978-3-658-37681-9_5

databases—MTES/F 1998[1], Umweltbundesamt/A 2004/2008[2], USI/CH 2007[3], Regione Lombardia/I 2008–2010[4], ARE/CH 2008[5], Kanton Glarus/CH 2013[6]—have a limited time and geographic coverage, besides being too heterogeneous in terms of classification criteria and thematic focuses (e.g. from contaminated sites to vacant buildings). Although these inventories represent a good starting point for reflection, they are hardly comparable and thus not useful for implementing an Alpine-wide survey. In addition, since most of the existing databases have been compiled before 2010, the impact of the 2008–2009 economic crisis in terms of site closures and/or decommissioning is inevitably ignored. To overcome this lack of a proper analytical data base, a two-step mapping procedure has been therefore developed by integrating a first quantitative census of sites (on territorial basis) with a qualitative survey among key regional stakeholders. The whole procedure has been designed and oriented according to the research framework, and especially taking in consideration the issues discussed in Chapter 3 ("the Alps as context"). In this regard, the mapping procedure focuses only and exclusively on complex sites in traditional heavy and manufacturing mountain industries. As evidenced in Chapter 3, these are not only the sectors most affected by the current structural changes, but also, they provide the brownfields whose redevelopment and transformation are the most challenging, yet strategic, for the Alpine context. This sector/typology-oriented approach follows a clear 'anticipatory' logic, as it allows to map not only the existing brownfield sites, but also potentially future ones, i.e. sites with similar features and subject to similar trends, yet not completely closed or dismantled. This point is particularly relevant, as long as the replicability and transferability of the research outcomes are concerned. At the same time, rather 'irrelevant' sites in traditional sectors as well as rather 'young' sites in newer sectors (i.e. established after 1960–1970) are excluded from the mapping target. This is motivated by the fact that most of these sites are lacking the complexity which makes their transformation challenging and heavily

[1] Available at https://basol.developpement-durable.gouv.fr/recherche.php

[2] Available at https://www.altlasten.gv.at/flaechenrecycling/Flaechenrecycling.html

[3] Available at https://ssl.lu.usi.ch/entityws/Allegati/brochure_prog420_it.pdf

[4] Available at https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioPubblicazione/servizi-e-informazioni/Enti-e-Operatori/territorio/sistema-informativo-territoriale-sit/aree-dismesse/aree-dismesse.

[5] Available at https://www.are.admin.ch/are/de/home/medien-und-publikationen/publikationen/grundlagen/die-brachen-der-schweiz-reporting-2008.html.

[6] Available at https://www.gl.ch/public/upload/assets/8516/Industriebrachen_GL_07_2013_30.08.13.pdf.

impacting on the context, being also subject to different decline/recycling dynamics compared to traditional heavy and manufacturing industrial sites. Small-sized sites, often relatable with mountain pre-industrialisation (e.g. textile mills in Glarus, Vorarlberg and Biella or mining facilities in South Tyrol and Carinthia), are indeed profiting a lot from a stronger heritage-led perception and a higher economic feasibility of transformation (Fäh 2013; Natoli and Ramello 2017). On the other hand, brownfield sites generated from the decline and abandonment of recently established industries in light manufacturing sectors have often a very specific spatial and landscape impact—connected to the clustering condition in which these industries have developed –, which largely differs from that of traditional heavy industries and usually calls for public-driven recycling strategies based on financial compensation tools (Lanzani, Merlini, and Zanfi 2013).

Criteria

To facilitate the identification of industrial sites corresponding to the mapping target—complex sites in traditional heavy and manufacturing mountain industries—a set of essential criteria was established in advance as ‘guidance’. These criteria can be synthesised as following:

- **territorial coverage**: the area within the perimeter of the Alpine Convention, which corresponds roughly to the orographic boundaries of the Alpine range. In some cases, also part of the Alpine forelands has been included, especially where the origin of targeted industrial sites is strongly related to the mountain resources (e.g. Bavarian plateau south of Munich, Lombardian foothills between Varese and Bergamo, Traunviertel south of Linz, etc.);
- **industrial sectors**: heavy and manufacturing industry belonging to the first two cycles of Alpine industrialisation, i.e. originated roughly between 1850 and 1960. In particular, the following industrial sectors have been identified as key sub-categories: ferrous metallurgy (primary and secondary iron and steel -making), nonferrous metallurgy (aluminium, zinc, lead, copper and other metals smelting, including alloys), chemical industry (partially including petrochemical and pharmaceutical industry), building material industry (manufacturing of cement, lime and refractories), textile industry (primary processing only, no clothing/apparel), paper industry (including large-scale timber industry);
- **site size**: an area equal to or greater than 5 hectares. This threshold is motivated by the fact that, especially in the Alpine context, the gap between small and micro sites and medium-to-large sites is quite significant. To increase productivity and efficiency as compensation for the peripheral location, traditional

heavy and manufacturing industries tend, in mountain areas, to pursue a high concentration of activities on one single site. This is why sites above 5 hectares can be considered at all the effects large and complex sites, i.e. sites with a relevant spatial, environmental and socioeconomic impact in terms of decline and transformation and thus with a greater influence on regional development;
- **site current status**: either active or closed/downsized sites which fulfil all the previous criteria. The grouping of fully closed (no more active) and partially closed (downsized) sites in a single category is motivated by the fact that brownfields are generated in both cases—although in partially closed sites these are usually limited by size and interwoven with active/used spaces. As explained before, active sites with the same characteristics are also included, to allow a complete overview of actual as well as potentially future brownfield sites.

Methods

Guided by these criteria, the interwoven search, identification and classification of sites has been conducted by means of integrating secondary data with a virtual land survey performed on Google Earth—and other land visualisation systems, where necessary. The secondary data as input were collected from different sources, mainly existing literature on Alpine industry (cf. Chapter 3), sectoral studies at the national and regional level, secondary sector statistics and even company profiles/websites. Based on the available information, the actual presence of industrial sites and the corresponding characteristics was then verified—one by one—by patiently surfing through most recent aerial or satellite images. As said, Google Earth was chosen as the preferred platform to perform this virtual land survey, due to the highly updated content in terms of images and because it offers very useful tools, such as the temporal comparison between images (to detect downsized sites), the option to add coloured placemarks for easy and immediate classification and the area measuring tools. At the end of this long and complex procedure, a georeferenced database became available, including the exact location, typology, name, size, status and municipality of each site. This is the first, ever made attempt at the scale of the entire Alpine region.

5.2 Sites Census

The first stage of the mapping process consisted in the territorial census of large and complex industrial sites in the Alpine region. Based on the aforementioned focus, criteria and method, the census was completed in the course of 2017, and reviewed/updated twice in the beginning of 2018 and mid 2019. The results are here presented and commented with reference to the industrial sectors investigated and the sites distribution among Alpine countries and regions.

In total, 302 industrial sites have been identified, of which 159 are completely closed or downsized—for an overview, see the attached map *Territorial census of large and complex industrial sites* (Fig. 5.1), while details are contained in the *Annex 1 Territorial census, list of sites*. In terms of sector relative share, building material industry holds the top with 70 (38) sites, followed by ferrous metallurgy with 64 (32) sites, paper and pulp industry with 49 (13), chemical industry with 46 (25), nonferrous metallurgy with 37 (22) and textile industry with 36 (29). With less than 25% of the sites already closed or downsized, paper and pulp industry is the most 'resilient' traditional industrial activity in the Alps. This might be related to the fact that paper industry, although subject to process innovation, is basically depending on natural resources such as water and timber, largely available in mountain areas and thus able to compensate the scarce accessibility of many facilities. The connection to timber industry seems to be particularly relevant, as most of the active paper and pulp factories are located in the Eastern Alps, where the abundance of extensive forests at lower altitudes largely sustains this sector. In opposition to paper industry stands the 'twin' textile industry, the fastest declining Alpine sector with almost 80% of the sites closed or downsized. This number, which is already impressive by itself, can easily increase if all the existing, closed down micro-mills (sites covering an area far below 5 hectares) are included. While in the case of many other industrial sectors the size threshold of 5 hectares largely includes most of the sites, in the case of textile industry it tends to exclude, in fact, a lot of small and small-medium sites—which have, however, a very limited impact in terms of redevelopment and transformation. Alpine former textile regions such as those of Glarus, Biella, the western Vorarlberg and Upper Tyrol, are actually characterized by a high density of micro sites, which are ignored by the present census according the already mentioned criteria. The other analysed sectors—ferrous and nonferrous metallurgy, chemical industry and building material industry—show a rather balanced situation, with a relative rate of closed/downsized sites around 50–60%. The internal composition of these numbers differs however from sector to sector. In the case of building material industry, the amount of fully closed sites largely exceeds that of downsized sites, especially concerning cement production. This can be related to the fact that the process-based functionality of cement-making facilities does not allow partial dismantling, otherwise the overall economic sustainability of the production cycle is over. Chemical industry and ferrous/nonferrous metallurgy are heavy Alpine industries characterized by extensive facilities and a rather high adaptability/resilience in terms of production cycles and footprint. In these sectors, the relative share of fully and partially closed sites is in fact almost equal. While the complete closure of one site often depends on site-specific conditions, ranging from the ownership to the location, downsizing is mostly connected to sectoral restructuring (e.g. previous steel-making sites 'shrunk' to manufacturing of semi-finished products). The average size of sites is also a good indicator of the different impact that closed and downsized sites might have at the territorial level. The largest sites are found not by chance in chemical industry (32,6 hectares on average) and ferrous metallurgy (23,5). Intermediate sites are those of paper industry (18,6), building material industry (16,8) and nonferrous metallurgy (14,5), while the smallest sites are indeed within textile industry (9,1).

In terms of spatial distribution, it should be distinguished between purely geographic and national/country levels. Concerning the first, it is noticeable how the majority of complex industrial sites in traditional sectors are located along the edges of the Alps, in the transition zone between the inner rural (and sometimes touristic) highlands and the urbanised forelands. In particular, the highest concentration of sites is found in proximity to peri-Alpine cities and metropolitan regions (e.g. Milan, Lyon, Vienna, Munich, etc.), clearly indicating the historical dependency of mountain industries from peri-Alpine economic centres. In general, three main distribution patterns can be identified:

- dense agglomerations on the Alpine fringe, such as in the Savoie Prealps, along the southern foothills between Turin and Brescia, on the south-east of Munich and between Graz and Vienna;
- linear sequences along major inner valleys (and transit corridors), such as the Rhone valley in Valais, the Ossola valley in Piedmont, the Aosta valley, the Maurienne in Savoie, the lower Inn valley and the Mur-Mürz valley in Styria;
- widespread networks in both outer and inner regions, such as Provence, central-eastern Switzerland towards Vorarlberg and Allgäu, Salzkammergut-Traunviertel and in the south-eastern Alps from Trentino to Carinthia through Veneto, Friuli and Slovenia.
- In addition, a significant presence of heavy industrial sites (chemical industry and metallurgy) can be also noticed in inner mountainous regions of the Western Alps (Savoie, Valais, Piedmont), clearly indicating the much stronger

role played here, in comparison to the Eastern Alps, by hydroelectric energy in fostering this kind of industrial development.

At country level, the distribution of large and complex sites (with closed/downsized sites in brackets) is rather unequal, although it follows to some extent the national shares of Alpine territory: Italy counts 133 (73) sites, followed by Austria with 74 (31) sites, France with 43 (28) sites, Switzerland with 23 (13) sites, Germany with 15 (5) sites and Slovenia with 14 (9) sites. The relative share of closed/downsized sites on the country's total shows Italy and Switzerland in equilibrium (slightly above 50%), Slovenia and France with a prevalence of closed sites (around 65%), Austria slightly below the equilibrium (42%) and Germany positively performing (33%). In the case of Italy, the majority of declining sites are distributed across all the sectors, with significant shares in earlier established ones such as textile industry (Biella, Bergamo and Vicenza old textile regions) and cement industry (once widely diffused in the prealpine areas). Former electro-chemical and electro-metallurgical industries once connected to hydropower are also declining, especially in the central-western Italian Alps. In Austria, most of the closed/downsized sites are found also in building material industry (cement industry in Tyrol and refractories in Styria) and especially in ferrous metallurgy (Styria), which experienced a significant downsizing in the last forty to fifty years. In France, most of the declining or closed sites are belonging to former hydropower-based heavy industries such as chemical industry (calcium carbide in Savoie, chlorine in the Grenoble region) and electrometallurgy (metal smelting in Savoie, steelmaking in Isère), but also to cement industry (Grenoble-Chambery region). Similarly, Switzerland has also a prevalence of closed sites in former energy-intensive industries, with high shares in nonferrous metallurgy (aluminium industry in Valais) and some significant cases in chemical industry (e.g. TAMOIL refinery in Collombey) and ferrous metallurgy (e.g. Monteforno in Bodio). The case of Slovenia is instead very heterogeneous, counting few closed or downsized sites yet equally distributed among all the sectors (and generally related to former state-run large facilities). In Germany, the few closed sites are mostly related to old textile and paper industries.

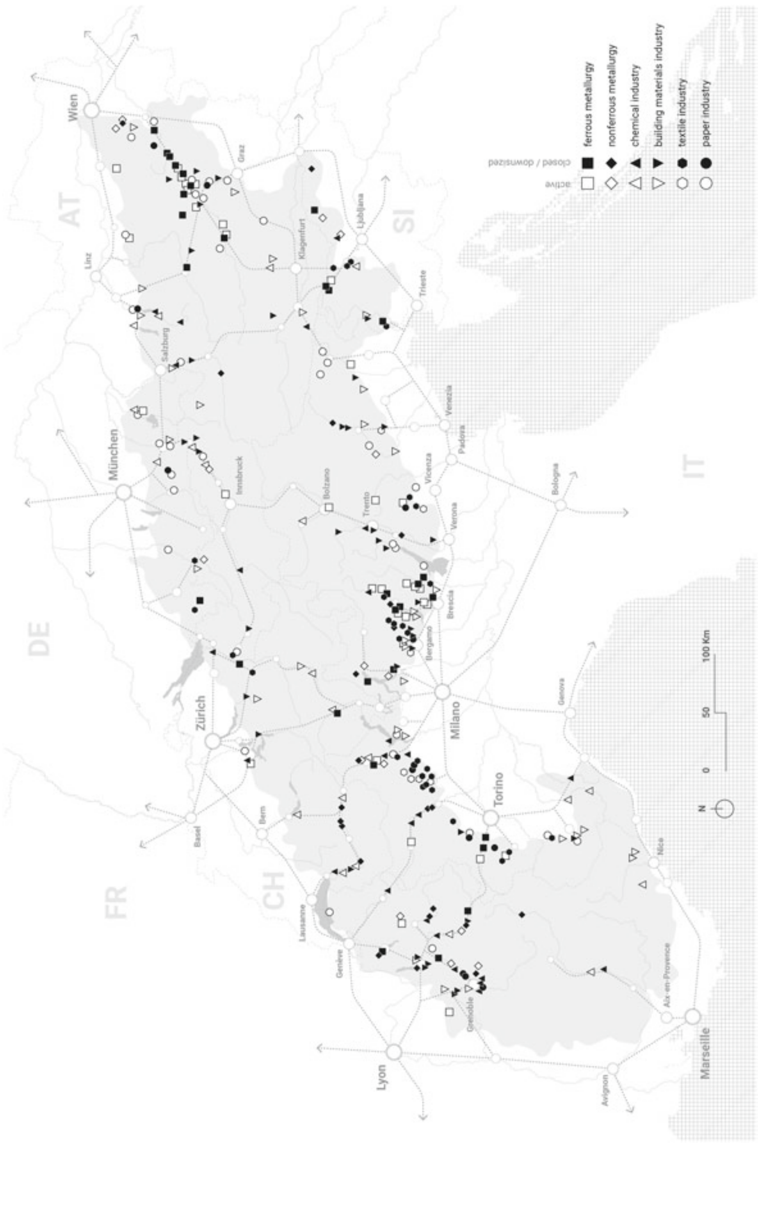

Fig. 5.1 Territorial census of large and complex industrial sites. Actual brownfields are black-filled shapes

5.3 Stakeholder Survey

The territorial census of large and complex industrial sites clearly shows that, although transnational and Alpine-wide in principle, the issue of brownfield revitalisation is affecting certain regions or even valleys much more than others. This can be explained through the above-average spatial concentration of critical sites, as well as in terms of a local overrepresentation of declining sectors. To get an insight about how (and if) the challenge of brownfield redevelopment is perceived and managed in the affected Alpine territories, a survey among relevant stakeholders from planning-afferent sectors at different administrative levels was therefore developed (see Annex 2). The selection of the right institutions to contact was related to the regional distribution of brownfields and declining sites in general, specifically focusing on spatial planning expertise with integrations from 'side' environmental and economic fields where required. The survey was conducted between March 2018 and October 2019.

In order to collect the requested information, a structured questionnaire was distributed electronically to the stakeholders upon a first, successful contact. The questionnaire (see Annex 3) included a short introduction to the research and five open-ended questions:

1) *With reference to your own region, is there a real and concrete perception of the presence of disused industrial sites? If yes, in which way is this usually brought to the view of the public? If not, to which causes this lack of perception can be ascribed, despite the evidence of disused industrial sites in the area?*
2) *With reference to your own region, is there existing a specific approach towards the reuse/transformation of disused industrial sites? If yes, in which way is it formally conveyed?*
3) *According to your own experience and knowledge, which are the main difficulties encountered in the process of reuse/transformation of disused industrial sites in the Alpine context?*
4) *With reference to your own region, which are the main opportunities and/or expectations related to the transformation of disused industrial sites, in terms of economic development, environmental regeneration and socio-cultural growth?*
5) *According to your own experience and with reference to your own region, is it desirable the development of a specific transformation strategy for disused industrial sites in the Alpine space? If yes, which should be the key issues to be tackled by such strategy?*

The answers to the first two questions reveal indeed many differences at the regional and national level regarding the perception, identification and management of disused industrial sites, which are mainly ascribable to the cultural background of each country and the adopted planning system. Concerning the first question, the prevailing perception of the presence of disused industrial sites is associated to the negative impacts on the landscape and the environment (abandonment, degradation, contamination). Further on, less tangible and more expert-oriented perceptions are also mentioned in connection to sustainable land use (soil consumption) and economic changes (job loss and need for restructuring).

The answers to the second question show that the issue of brownfield transformation is tackled and/or addressed in many ways and by using different programmatic and planning tools, including local and regional land use plans, financial incentives for revitalisation, intra-level cooperation frameworks, and others.

Concerning the following third and fourth questions (difficulties and opportunities of transformation), a homogenising tendency in the answers can be clearly noticed compared to the previous questions. In particular, the difficulties in the transformation of mountain industrial brownfields are, in order of recurrence/importance: a) lack of financial resources at the local level (municipalities) to influence or address the site revitalisation process, especially concerning the high costs of remediation in the initial phase; b) lack of strategic planning approaches (resource seeking, process management, long-term vision) and coordination between different administrative levels as well as between public and private stakeholders (PPP, private-public-partnerships); c) lack of potential investors with sound financial background and commitment, especially due to the marginal location of sites (low attractiveness and thus unprofitability) and the development uncertainties (lack of perspectives); d) lack of technical expertise and political capacity at the local level, which limits the chances to initiate, address and manage the transformation of complex brownfield sites (also in terms of promoting new development models); e) lack of available data and reliable information regarding the actual situation of disused sites both at the regional level (census/database) and the local level (site characterisation).

Concerning the eventual lack of pressure for the site redevelopment, which is actually expectable in these peripheral mountain contexts, it must be said that surprisingly this is rarely mentioned as a real difficulty. What seems to be problematic for the redevelopment process is not the pressure itself, which is vividly expressed, but more the framework conditions to enable the process to take place (administrative, financial and legal issues, e.g. on contamination and reclamation).

On the other hand, there is a common understanding between all the interviewed stakeholders on the main opportunities and expectations of brownfield redevelopment. Listed by recurrence/importance and thematically clustered, these are: a) economic development and/or diversification at both local and regional level, mainly through the establishment of new and profitable economic activities on the sites (new industries or leisure/recreation, depending on location and context). This will allow the creation of new jobs and thus increase the life/work attractiveness of municipalities and regions; b) environmental regeneration, in terms of compensation (renaturation, reforestation) and also, indirectly, by limiting further land take through the sustainable reuse of already used/urbanised areas; c) socio-cultural development and/or regeneration, especially through active heritage management and identity-building.

As noticeable, the economic issues gain most of the attention among the interviewed stakeholders. This might be related to the fact that in average Alpine regions without significant shares in tourism and agriculture, manufacturing and related services still hold a key role in the local economic system. In contexts where long-established industry has profoundly shaped the local labour and skills system, or where accessibility bottlenecks limit intra-regional daily commuting, the loss of core industrial activities, as it can be the closure or downsizing of one or more large industrial sites, makes therefore the creation of new jobs and business a key priority. Some of the interviewed addressed, in addition, that the economic-related opportunities connected to brownfield revitalisation are strongly influenced by the location of the sites. In this perspective, the most favoured sites are those located within or in proximity to urban areas, while more isolated sites have a lower relevance in economic terms. Various opportunities connected to environmental and social regeneration are also mentioned by the interviewees, but somehow these are perceived as a second priority, something that can be taken into consideration if the economic objectives of revitalisation are already achieved. It is interesting to notice how the potential contribution of brownfield redevelopment in limiting further soil consumption is especially felt, or addressed, in those local contexts with long industrial tradition and thus densely urbanised (e.g. Valle Camonica/I and Leoben-Obersteiermark Ost/A). Concerning the last question, the need for a specific transformation approach for Alpine brownfields is generally perceived as real and concrete by all the interviewees. In particular, the aspects that such approach must necessarily address can be grouped in three main ‘clusters’: process management (alternative or temporary uses for the transition phase and improvement of site resilience in the view of future changes), improve framework conditions (cooperation scheme, legal and financial support tools, scenario-building) and sharing knowledge (including best practices and mutual learning).

5.4 Regional Types

The distribution pattern of complex industrial sites derived from the territorial census, integrated by the arguments and knowledge from institutional stakeholders and experts, provides enough elements for a comprehensive yet detailed overview on the current situation. What emerges from the overall mapping procedure, in particular, is the recurrence of specific geo-economic contextual conditions in which the majority of Alpine brownfield sites are found—and have to deal with. Through the comparative analysis and synthesis of the mapping outcomes it is possible therefore to outline an 'interpretative' geography of Alpine brownfields, that is, a qualitative distribution pattern. The latter recognises four regional types as the main territorial frameworks for analysing the presence of complex industrial sites in traditional sectors (including related brownfields)—for an overview, see the attached map *Regional types* (Fig. 5.2). These are described as follow:

- **old industrial regions**, characterized by a high density of industrial sites in declining sectors (textile industry, steel industry, former branches of electrometallurgy and electrochemistry) and a substantial lack of more advanced industrial activities in leading sectors. These regions can be mainly found in inner Savoie (lower Tarentaise and Maurienne valleys), Piedmont (Turin valleys, Biella foothills and Ossola), Lombardy (Bergamo-Brescia valleys) and Upper Styria (Mur-Mürz valley). Due to the outdated industrial monostructure, old industrial regions are those where brownfield recycling is mostly associated to economic restructuring and diversification. This latter achievement is however blocked or relented by structural limitations such as a constantly growing number of complex brownfields to deal with, a rather high administrative fragmentation and capacity (lack of major urban poles) and the low pressure for site redevelopment (due to out-migration and social marginalization). The strong attachment of local communities to industry (in terms of identity, employment and skills) makes the perspective of re-industrialization a highly desirable one, although the proper conditions for its realisation (investors, knowledge generation and transfer institutions, etc.) are usually lacking in these contexts. Therefore, different strategies and alternative development pathways have to be identified. A good way could be to

Fig. 5.2 Regional types

consider at first all the existing and potentially future brownfields as a single territorial system (sharing the same infrastructures, spatial patterns as wells as environmental and socioeconomic challenges), thus developing a strategic coordination at the regional level able to address a successful large-scale transformation program. Furthermore, other activities than manufacturing can also be considered to foster economic diversification at the regional level. It might be the case of the touristic- and cultural-oriented reuse of disused industrial sites, which can be rather successful in mountain contexts due to the potential linkages with unique landscape and environmental assets.

- **industrial-tertiary regions of type 1**, characterized by a significant presence of old industrial sites in traditional sectors (in sharp decline) as well as a high density of recently developed light industry clusters related to tertiary-based production cycles (tourism, services, logistics, higher education and research). These 'restructured' old industrial regions are mostly found in the Western Alps—e.g. the southern Sillon Alpin (Grenoble-Chambéry agglomeration), the Rhone valley from Visp to Lake Geneva, the Rhine Valley between Chur and Bregenz, the Ivrea and Cuneo foothills—but also, to a minor extent, on the eastern edge of the Alps—e.g. the Sava valley north-west to Ljubljana, the Mur valley north to Graz and the Industrieviertel. In most of these contexts, the recycling of brownfield sites is usually confronted with a developed and dynamic economic system, a high accessibility and also a significant population growth. But also, with an increasing soil consumption, rising conflicts between competing economic activities and urban functions and landscape preservation. In reason of their size, location and accessibility, large brownfield sites constitute here valuable land reserves for the expanding regional productive system, under the principles of land recycling and densification. This means that concrete strategies towards the redevelopment of brownfield sites as e.g. business parks are prioritised, such as in Valais—where 7 industrial sites of Cantonal relevance, among which 3 former aluminium smelters, are identified as *Pôles de développement économique* (PDE)—and in the *Communauté de communes du Grésivaudan*—where the existing brownfield sites are converted in *Zones d'activités intercommunales* (ZA).
- **industrial-tertiary regions of type 2**, characterized by a rather young and dynamic economic structure mostly developed after 1970, often as side-effect of inner-alpine suburbanisation and/or peri-alpine metropolisation processes. Here, highly specialized clusters of light industry often connected to regional innovation hubs largely exceed, by size and relevance in terms of employee and output, the few existing traditional industrial sites. These regions are generally found in proximity or around major urban centres and agglomerations,

such as Nice-Cannes, Annecy-Geneva (including the Arve valley), Lucerne-Schwyz, Lugano-Varese-Como (Ticino-Insubria), the lower Inn valley from Innsbruck to Rosenheim, the Adige valley including Bolzano-Merano and Trento-Rovereto poles, Belluno, Salzburg and Klagenfurt-Villach. In these contexts, the transformation of the few existing brownfield sites is strongly influenced by their location and, specifically, by the proximity to urban poles and regional transport-hubs. Most favoured sites are of course those located in major cities (e.g. Michelin/Trento, Alumix/Bolzano) and relative agglomerations (e.g. Vetrotex/Chambéry, Viscose Suisse/Emmen-Lucerne), which are suitable for mixed-use and inward urban development. Less favoured sites are those located in peripheral areas or outside urban cores (e.g. Papierfabrik Baum/Miesbach, Alumetal/Mori), which are usually left apart due to the scarce competitiveness in terms of reuse and investments. However, within expanding inner-Alpine agglomerations the recycle of less-favoured peripheral brownfields might represent a potentially valuable chance for decentralising urban functions, which means to avoid urban sprawl and suburbanisation by pursuing a more sustainable, polycentric development at the regional or valley scale.
- **rural-industrial regions**, characterized by a very limited presence of old industrial sites within predominantly rural (or scarcely urbanised) contexts, sometimes with a relevant tourism-based economy. Mostly found in the Eastern Alps, these regions can be roughly identified with the Allgäu-Außerfern, the Salzkammergut-Traunviertel, the southern Eisenwurzen, the Slovenian Carinthia and the Carnia in Friuli. In the Western Alps, similar regions with much lower extension are the Moyenne Durance and part of the Ligurian Alps. The lack of pressure in terms of urban land reuse makes the reconversion of brownfields, in these contexts, mainly oriented towards environmental and landscape regeneration, thus favouring ecological restoration and renaturation strategies. The economic potential connected to brownfield redevelopment is not always fully understood and/or perceived, although good opportunities to develop ‘green’ economic activities linked to local natural resources are existing.

The regional types so identified, supported and integrated by the outcomes of the territorial census and the stakeholders survey as well, provide a rather heterogeneous, mixed quantitative-qualitative overview of the current situation of Alpine brownfields. This constitutes indeed a valid basis for the implementation and development of the following characterisation and testing phases.

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Characterising

6

How to scale-down (sampling) the vast Alpine brownfield geography resulted from the mapping? Which are the most representative brownfield typologies, based on recurrence and status? What is the basic landscape structure of these representative brownfields? Is it really possible to identify a common structure per site typology? And also, is it possible to associate a certain transformation potential to a specific landscape structure? Based on the mapping results, the characterisation phase focuses on the most representative site typologies of Alpine brownfields. These are identified and analysed according to a structural criterion, which emphasises the role of previous industry-environment interactions as generator of a specific and recurring landscape structure. Through a comparative analysis of aerial views and self-generated figure-ground diagrams, four representative site typologies are selected and described on the basis of their recognisable structural features and their inherent transformation potential.

6.1 Framework

Focus

To proceed towards the further analytical level, the geography of Alpine brownfields resulting from the mapping phase needs to be scaled down through a sampling process. This is oriented according to the research framework and hypothesis, thus considering the landscape structure of mountain brownfields (both the object and the field of investigation) as the formal result of the functional interaction between the site and the surroundings. A reasonable way to proceed, in decoding the mapping result according to this principle, is to consider

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M. Modica, *Alpine Industrial Landscapes*,
RaumFragen: Stadt – Region – Landschaft,
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the originating function at the base of industrial production in the mountain context. The function always relates, in fact, to a specific industrial process, whose requirements in terms of location, raw materials, technology and production lead to a recognisable, recurring spatial form of related industrial activities. The way in which this spatial form relates to the mountain environment[1]—or how the latter influences the 'spatiality' of industrial sites—is the focus of the characterisation phase. Through the typological analysis of the most representative categories of Alpine industries, the specific landscape structure of related brownfields is identified through the assignment of recognisable spatial/physical characters (form). However, the characterisation process is not limited to the description of landscape structure typologies, but it attempts also to outline the transformation potential inherent to each specific structure. This latter result represents indeed the base for the following phase, in which a foreseeable transformation is developed and tested on real-world case study sites.

Criteria

The shift from the industrial sectors emerged in the mapping process to the most representative landscape structures of Alpine industries is not immediate. The identification and selection of the latter typologies was developed through a two-step procedure and guided by specific criteria. In the first step, the six industrial sectors identified in the mapping, i.e. those covering Alpine heavy and manufacturing industries developed approximately between 1850 and 1960, have been reconsidered according to the following criteria:

- **technological development** (process-related), i.e. by focusing on the main technologies at the base of traditional mountain industry. Already identified in Chapter 3, these technologies can be either old (mineral extraction and waterpower) or new (railway and hydropower), depending on the temporal introduction in the mountain context;
- **declining trend**, i.e. by considering the overall performance of these sectors, with the aim to ensure a good coverage of the different forms/impacts of industrial decline in the Alpine context.

Accordingly, four sectors have been selected among the previous six:

- **building material industry** (mineral-based with occasional energy integration, moderate decline with approx. 50% closed/downsized sites);

[1] Always considered in the broad sense, as integration of cultural and natural features.

- **ferrous metallurgy** (integrated mineral-energy-railway, moderate decline with 50% closed/downsized sites);
- **textile industry** (integrated water-energy, heavy decline with 80% closed/downsized sites);
- **nonferrous metallurgy** (integrated energy-railway, moderate-to-heavy decline with approx. 60% of closed/downsized sites).

Paper industry and chemical industry have been excluded. Concerning the first, this is due to the very low rate of closed/downsized sites (thus not representing a potential source of brownfields) as well as because of the functional and typological resembling of textile industry—both united and shaped by the exploitation of waterpower. In the case of chemical industry, the exclusion is mainly due to the very high heterogeneity of sub-sectors, sites and declining trends/paths, which makes difficult if not useless to focus on a common landscape structure. In addition, chemical industry has in general a high process-related resilience, which makes the few relevant brownfields almost self-standing situations.

Given the aforementioned four sectors, the second selection step aimed at identifying a specific, highly representative site typology within each of them. As said, the site typology is directly related to the production process, being its formal (spatial) outcome. The identification of the right site typologies was done based on:

- higher recurrence (quantitative criteria);
- good representativeness of the sector technological background (qualitative criteria).

The resulting selected typologies are, therefore:

- **cement plants** (building material industry): 42 sites of which 23 closed/downsized;
- **EAF steelworks**[2] (ferrous metallurgy): 28 sites of which 11 closed/downsized;

[2] Electric arc furnace (EAF) constitutes the majority of primary steelmaking in the Alps, due to the availability of hydropower and the natural lack of ore deposits. Integrated steelmaking from iron ore (i.e. pig-iron production in blast furnaces) was carried on, during the XX century, only in four sites: Eisenerz/A, Donawitz/A, Aosta/I and Jesenice/SI. The Donawitz plant (today owned by Voestalpine) is the only one still operating.

- **spinning mills**[3] (textile industry): 35 sites of which 28 closed/downsized;
- **aluminium smelters**[4] (nonferrous metallurgy): 10 sites of which 9 closed/downsized;

Together, these four site typologies are able to cover, in a concise yet diverse way, the wide range of traditional heavy and manufacturing mountain industries (Fig. 6.1). The heterogeneity of this selection is considered an essential prerequisite to ensure a valid and realistic test-base for the research hypothesis.

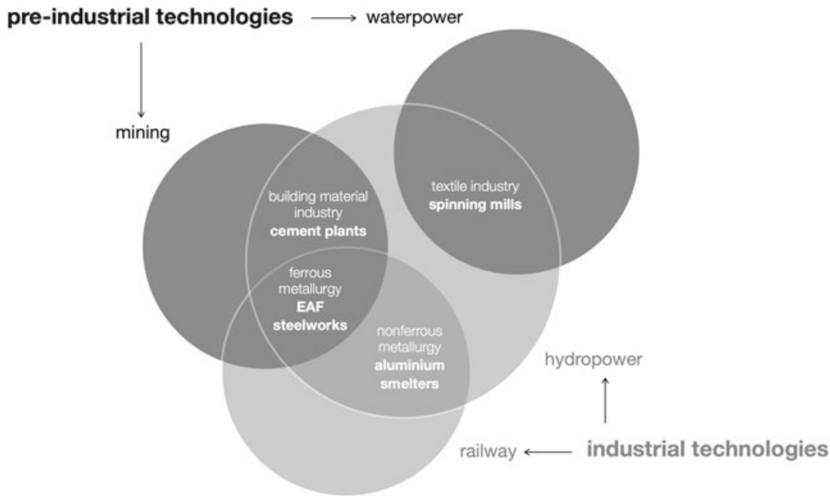

Fig. 6.1 Mountain industries, technology-based taxonomy

[3] Spinning mills are the key facilities for primary textile processing (regardless the used raw material or the processed textile). In the Alps, spinning mills refers to natural fibres only (cotton, wool, hemp), as man-made fibres (e.g. viscose, acetate) are classified under chemical industry.

[4] Aluminium smelting is the energy-intensive process in which aluminium is extracted from alumina (aluminium oxide) via electrolysis. The steps before and after aluminium smelting, respectively the production of alumina from bauxite (ore) and the manufacturing of end-use products, are usually developed in different, separate facilities (mostly located outside the Alps).

Methods
Based on these criteria, a common base for the typological analysis has been generated by selecting six existing industrial sites within each identified site typology. To ensure enough diversity both in terms of context (both regional and national) and status (including, among the six, at least one active site and one completely closed[5]), a heterogeneous set of sites was identified. For each site, a most recent and same-scale aerial photography was at first collected from either Google Earth or national/sectoral geoportals. Based on that, a simple figure-ground diagram is then 'automatically' generated, considering site-related main buildings, infrastructures as well as basic topographical elements (main water bodies and slope-plain junction lines). Through the comparative analysis of the aerial views and the related figure-ground diagrams, a detailed typological description can be then outlined, using both a textual and a diagrammatic form. While the text describes and comments essential aspects of the typology-specific landscape structure—such as the size and spatial footprint of sites, the topography, the builtscape composition, the open space pattern, the attached infrastructural network –, the three-dimensional landscape structure diagram shows, through and abstract isometric projection, the simplified spatial interrelations between the constitutive elements and their specific reuse potential (low, medium, high, with attached short description). Supported by these materials—aerial views and related figure-ground diagrams, textual description, ideogrammatic landscape scheme—the four representative site typologies of Alpine industries (cement plants, EAF steelworks, spinning mills and aluminium smelters) are analysed in the following section.

6.2 Typological Analysis

Cement plants
Analysed sites (Fig. 6.2 and 6.3): Zementwerk Eiberg, Schwoich/A (C)—Colacem, Gemonio/I (A)—Wietersdorfer & Peggauer Zementwerke, Peggau/A (D)—Ciment Vicat, Montagnole/F (C)—Salonit Anhovo, Deskle/SI (D)—Italcementi, Albino/I (C).

The driving force behind cement production landscapes is mineral extraction and processing. Cement production is organised around a cement production site (the cement plant) and one or more related quarries for the extraction of raw

[5] The status of selected sites is indicated next to the site name: A = active, C = closed, D = downsized.

Fig. 6.2 cement plants 1 of 2

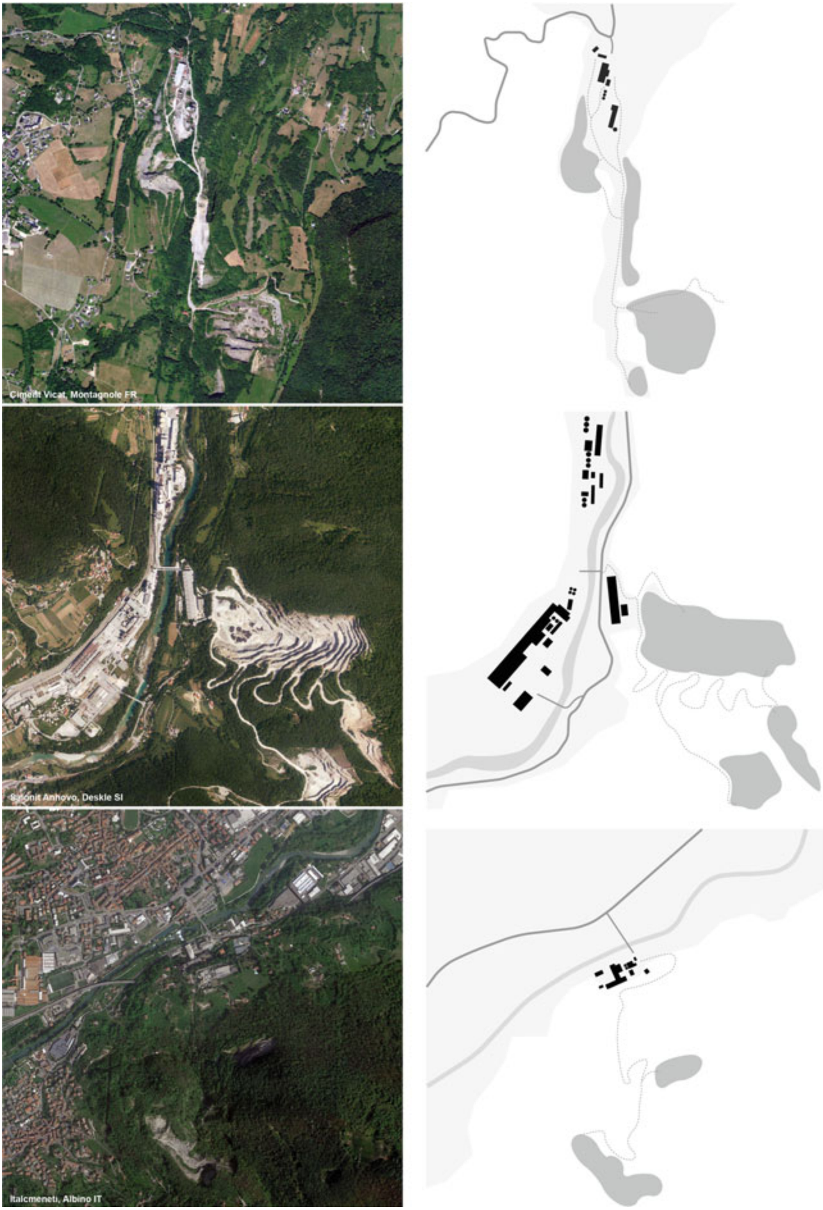

Fig. 6.3 cement plants 2 of 2

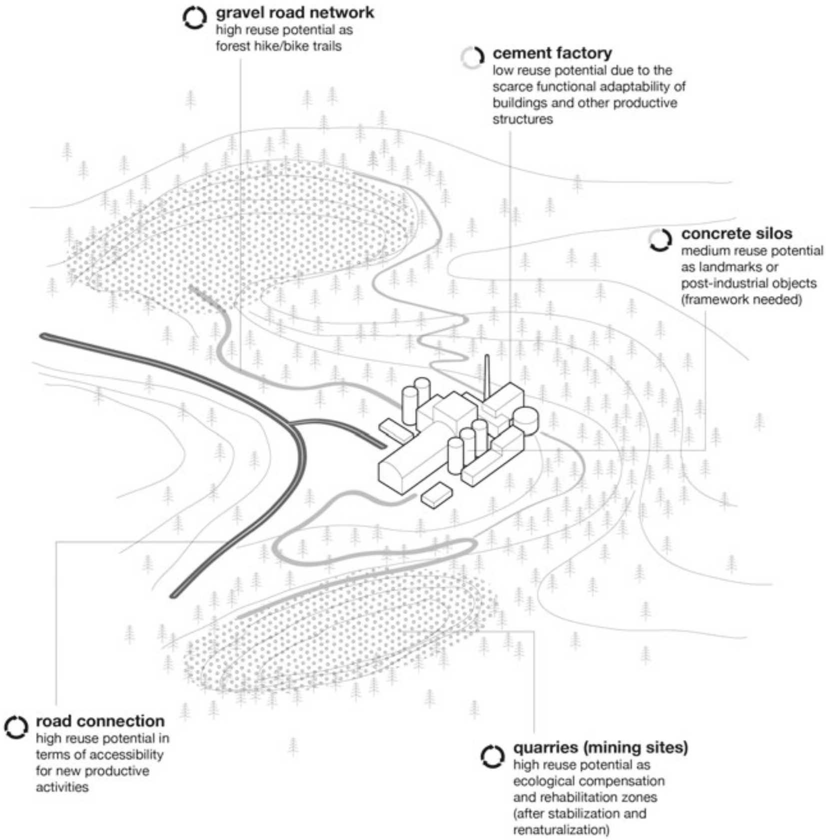

Fig. 6.4 cement plants, typlogical model

materials (limestone, marlstone, clay). The average spatial footprint of cement plants is rather small and compact, though fragmented in several buildings and stand-alone structures (silos). By including the surrounding quarries and related infrastructures, however, the footprint extends considerably. The topography is often complex and uneven: due to the location and nature of cement production, cement plants have a strong relationship with both natural topographic features (mountain slopes, depressions/canyons, etc.) and artificial ones (quarrying-related surface alteration). The cement plant itself is usually located in flat sites adjacent to the slope-plain junction line (Gemonio, Peggau, Deskle), but it can also be integrated in foothill plateaus (Schwoich, Montagnole) or, more rarely, directly in the mountain slope through terracing (Albino). According to the excavation methods and the natural topography, quarries can be either flat (Schwoich, Gemonio, Montagnole) or slope attached (Schwoich, Peggau, Deskle, Albino), although in both cases these are developed in layers. Built structures are concentrated in the cement production site and usually consist of reinforced-concrete buildings suited for production (kilns, mills, etc.) or storage (silos) activities, with a relatively limited building footprint and an expectably relevant height (vertical-developed builtscape). The open spaces are generally consisting of mineral surfaces in and around production facilities and areas—extensive hard/paved surfaces in the cement plant and its premises and soft/unpaved surfaces in quarries and quarries-to-factory white roads—as well as natural/green surfaces in and around quarrying areas—interstitial spaces of quarry-to-factory road network, leftover/abandoned mining surfaces spontaneously rewilded and artificially renatured slopes. Since cement industry is a typical dry industry,[6] no significant functional relation with water systems can be identified—though, in some cases, the proximity to rivers and water courses is due to topographical constraints (Schwoich, Peggau, Deskle, Albino). In terms of transport systems, cement production complexes are strongly relying on grey infrastructures (road systems) due to their high flexibility in facing topographic constraints and also because of their adaptability to constantly changing production landscapes (quarries form and location, and quarries-to-plant connections). Indeed, cement production landscapes are characterized by an extensive and complex network of gravel roads connecting the production site to the quarries, and even the quarries together. This network often intercepts, on purpose or not, extensive natural/green 'unused' spaces, such as abandoned quarrying sites and interstitial forested areas, thus fostering the integration of these altered landscapes into the semi-natural surroundings. The resulting complexity of this landscape typology is at the same time a major challenge and opportunity with regards to transformation (Fig. 6.4). It is a challenge in relation to its large footprint, whose management often requires a multi-scalar and multi-sectoral planning approach. But it is also an opportunity due to the already existing high level of integration of the (former) productive landscape into a wider environmental context. More than on the cement plant site and the existing buildings, the reuse potential of this typology lies in fact on the extensive landscape alteration caused by mining activities, which can be turned, through nature-based

[6] The use of water is marginal in the production process. However, some of the older processes made use of water in preparing the slurry for the kilns (so-called wet process).

remediation, selective renaturation and increased fruition, into a new and valuable component of the regional ecosystem network.

EAF steelworks

Analysed sites (Fig. 6.5 and 6.6): Ugitech, Ugine/F (A)—Monteforno Acciaierie e Laminatoi, Bodio/CH (C)—Ascometal, Le Cheylas/F (C)—Voestalpine Böhler, Kapfenberg/A (A)—Breitenfeld Edelstahl, St. Barbara im Mürztal/A (A)—SIJ/Acroni, Jesenice/SI (D).

The driving force of mountain iron and steelmaking landscapes shifted through the time from mineral extraction (iron ore) to the large-scale exploitation of hydropower, with the necessary support/inclusion of railway infrastructures. EAF steelworks, which belong to the last and more recent version of mountain steelmaking, are generally organised around a core production area (EAF plant with casting house and one or more rolling mills) and additional 'service' spaces for pre and post -production activities. On average, the spatial footprint of EAF steelworks is rather large, although the functional proximity between the production phases makes it also very compact and dense. Due to the size of productive sites and the particular requirements of heavy production processes, the topography of EAF steelworks is always totally flat and detached from reliefs—though in some cases the proximity to slopes is unavoidable, e.g. in narrow valley floors (Ugine, Bodio) or for transport/energy reasons (Le Cheylas, Kapfenberg). In case of very large and early established steelworks (Ugine, Kapfenberg), the inclusion of natural topographic elements such as rivers and slopes and their modification according to production purposes has influenced the spatial organisation of the site itself, which is indeed much more complex and chaotic than average. In terms of built structures, it can be clearly distinguished between production-related structures, i.e. huge steel-framed halls with extensive building footprints, and small-scale service buildings located at the margins of the site. The system of open spaces can be also clearly distinguished by function and form between inner and outer spaces. Within the core productive site, the open spaces are normally acting as mere functional 'extensions' of buildings, while also integrating handling/transport infrastructures, thus being concrete paved aprons, roads and parking areas. On the edges of the site and around it, the open spaces are more fragmented and blended into the semi-natural surroundings. These mainly include infrastructural and open-air storage areas, with many interstitial leftover green spaces. A characterising feature of EAF steelworks are temporary or permanent waste and by-product storage areas such as dust landfills or slag heaps, which can be located within (Bodio, Jesenice) or in the proximity of the site (Ugine, Le

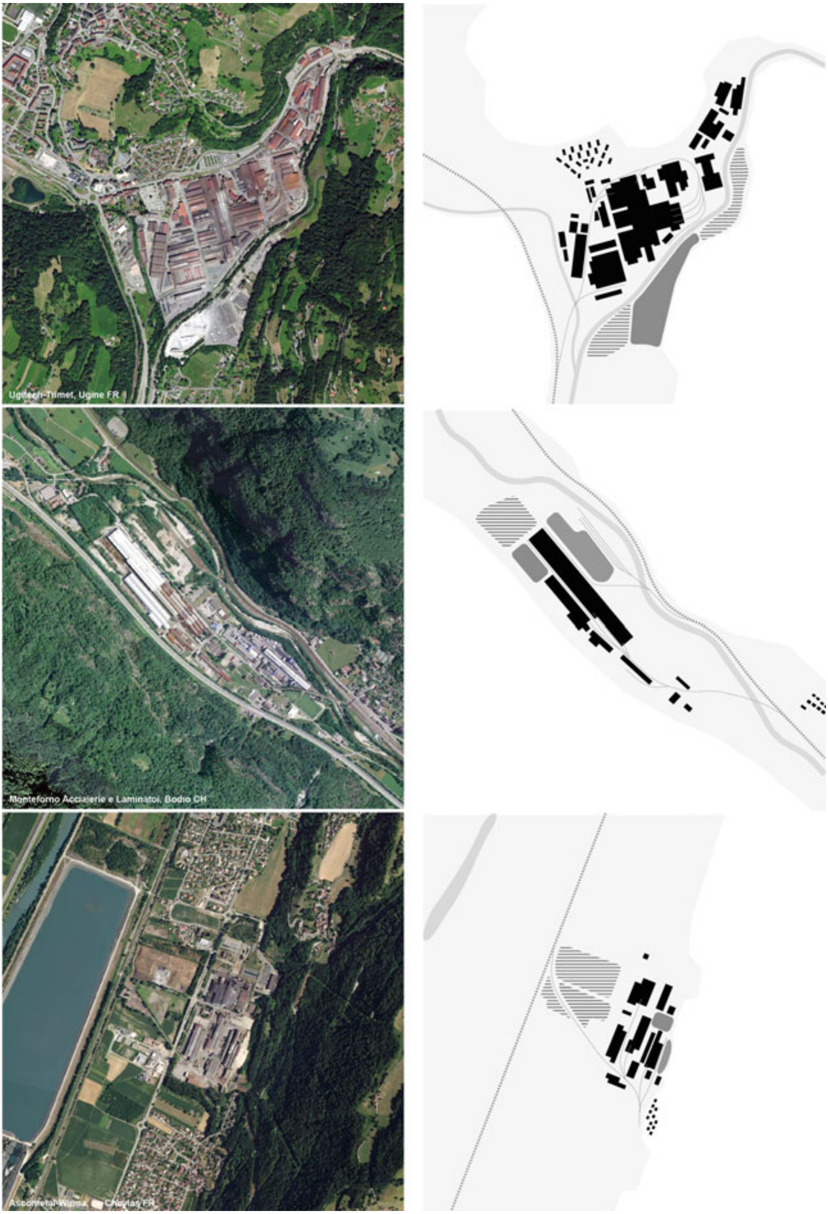

Fig. 6.5 EAF steelworks 1 of 2

Fig. 6.6 EAF steelworks 2 of 2

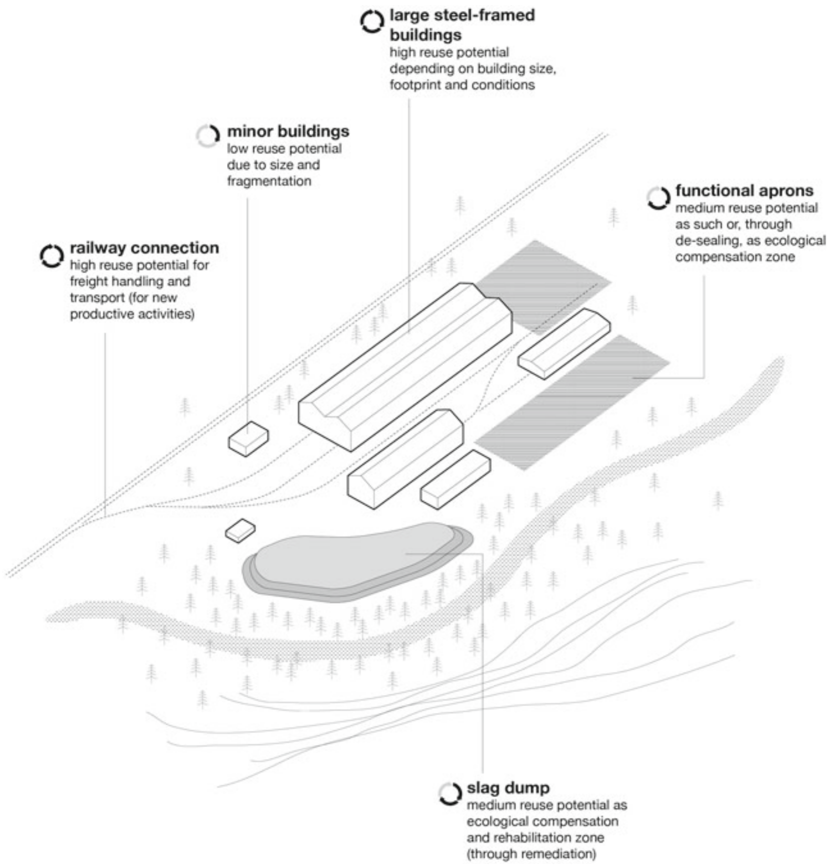

Fig. 6.7 EAF steelworks, typological model

Cheylas, St. Barbara im Mürztal and, not visible, Kapfenberg). The stop of production activities and the closure of the site causes the progressive abandonment of these peripheral open spaces, which are often subject to rewilding processes and thus camouflaged with the surroundings (especially nearby forested areas). Natural and artificial water infrastructures do not have a strong relevance within EAF steelmaking landscapes, apart from an historically induced proximity for ancient waterpower uses (e.g. hammer mills in Kapfenberg). Hydropower is in fact mostly generated in off-site facilities, such as power station located elsewhere in upper and side valleys, although in a few cases it can also take place within the productive site (Le Cheylas). A strong attachment and influence of railway infrastructures can be instead noticed, as all EAF steelworks are located along railway lines of regional, national and even international importance. The site is usually connected to the main railway line through one or more secondary tracks, which then split up in several sub-tracks within the site ending up into large production halls or in functional aprons (raw material storage areas, finished products storage areas, etc.). In all cases, and clearly in the most complex and larger plants (Ugine, Bodio, Le Cheylas, Jesenice), the internal railway network turns the EAF steelworks site into almost an appendix of the main (external) railway line. This makes the existing infrastructural system represented by the in–out railway network a major asset in terms of reuse potential for EAF steelworks (Fig. 6.7). Linked to the high reuse flexibility of large steel-framed halls (quick and low-cost structural refurbishment and indoor parcelling out), the railway network can be reused as such and thus allow the site to be redeveloped to host other railway-based activities, such as logistic platforms or SME business-industrial parks.

Spinning mills
Analysed sites (Fig. 6.8 and 6.9): Cantoni ITC, Ponte Nossa/I (C)—Zegna Baruffa Lane Borgosesia, Borgosesia/I (A)—Seilerwarenfabrik, Füssen/D (C)—Linificio Canapificio Nazionale, Villa d'Almè/I (A)—Bombažna Predilnica in Tkalnica, Tržič/SI (C)—Spinnerei Hämmerle, Feldkirchen/A (C).

The driving force behind textile industry landscapes is water, initially used for hydraulic energy production and then for (small-scale) hydroelectric generation too. The required high proximity of all the production phases (spinning, weaving, dyeing, etc.), as well as the scale of facilities and spaces, makes the built footprint of textile spinning mill rather compact and limited, especially if compared to other mountain industries. However, since many water-related infrastructures of different size and footprint (catchment systems, deviations, power canals, etc.) are usually integrated into the productive site, the overall spatial footprint of textile spinning mills can be, in some cases, quite significant. Although not clearly evident at a first glance, topography also plays a key role in shaping the footprint of textile mills, especially in connection to water flows. Many old textile spinning mills are in fact located in direct contact to river courses, either where the latter form strong meanders (Füssen, Tržič) or wider turns (Ponte Nossa, Borgosesia, Villa d'Almè). Such locations are preferred as the difference in height between the upper and lower river course provides faster water flows, suitable for easy catchment and/or direct use. Topographically difficult locations such as gorges (Füssen, Tržič) or very narrow valley floors (Ponte Nossa) can be also linked to the water flow issue. Within the core productive site, built structures largely prevail by footprint and prominence on open spaces, leaving to the latter just the minimum required space to separate buildings and support small-scale handling and pedestrian mobility. The dense builtscape of spinning mills is usually composed by a mixture of stone/brick-made horizontal-developed shed halls and vertical-oriented multi-storey building, often bounded together in a layered ensemble without significant interruptions. In many cases, the ancient origin and the forms of existing buildings leads to a relatively high architectural value, compared to other typologies. On the site edges and surroundings, the prevailing open spaces are often involuntarily created/shaped by site-related water infrastructures, both natural and man-made. This is the case of power canals and other artificial derivations from natural rivers nearby, which are designed to catch water upstream the mill and canalise it directly through the factory (often underneath the buildings, in the underground), bring it back afterwards to the river downstream. Resulting open spaces between the river and the canal system usually host semi-natural environments with spontaneous reforestation on the river shores, grassland and small-scale crops. Such a waterscape makes textile mills to be somehow anchored to the river course via canals, and thus being integrated to different extents into the river landscape. Depending on the topography, the available space and the water required (mill size and capacity), this structural 'anchoring' can be relatively extended (Ponte Nossa, Borgosesia, Villa d'Almè, Feldkirchen) or even quite short and compact (Füssen, Tržič). Due to the relatively small size of plants and manufactured outputs, no functional link was established with railway systems, which are indeed often missing in the proximity. On the other hand, textile mills are often located in the vicinity of old town centres and historical settlement, making their location somehow more 'urban' than other Alpine industrial typologies. These location advantages, connected to the valuable builtscape and especially the waterscapes, lead textile mills to have a rather complete and equally distributed reuse potential (Fig. 6.10). The symbiotic combination of built and natural heritage characterising textile mills can be enhanced and linked, through adaptive reuse and conservative transformation, to larger processes/projects of cultural landscape valorisation. Furthermore, small-scale hydropower production inherited from the previous industrial cycle can support the establishment of green and creative businesses, which can also profit from existing indoor spaces of high flexibility and architectural value.

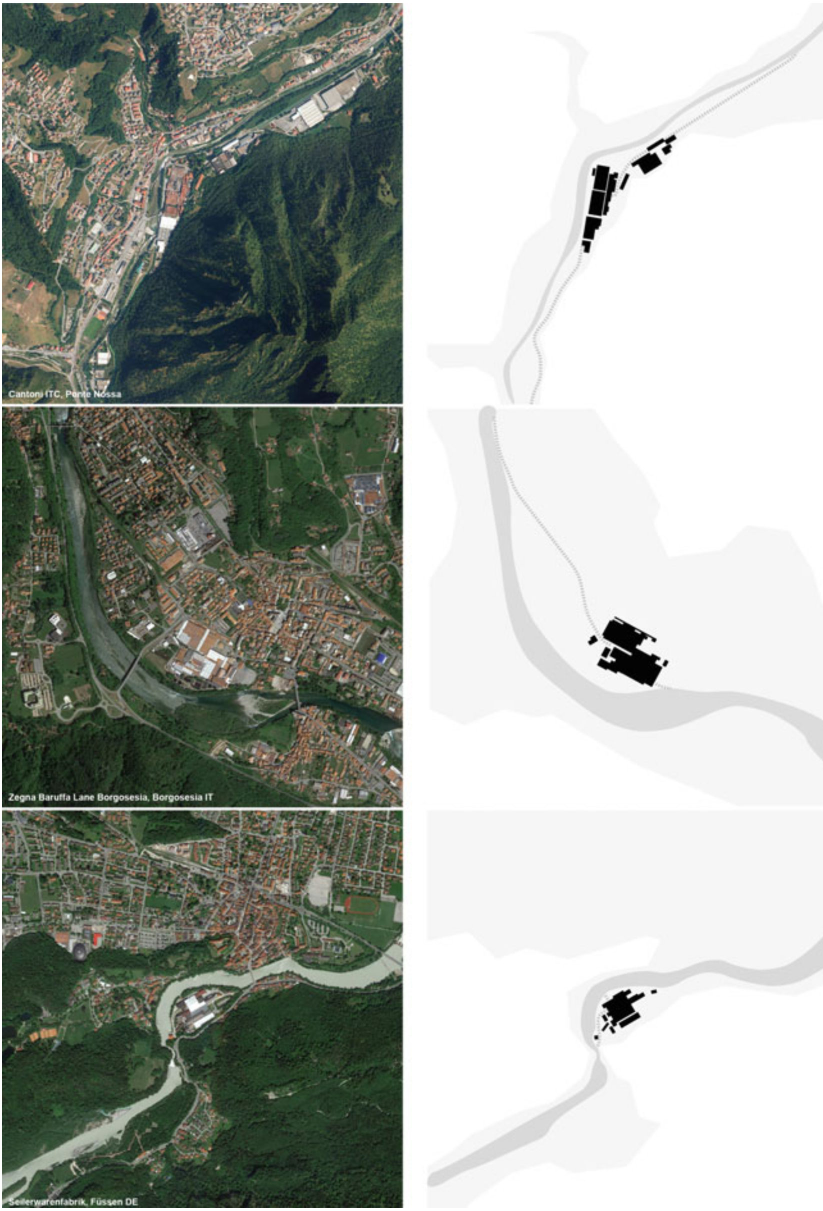

Fig. 6.8 Spinning mills 1 of 2

Fig. 6.9 Spinning mills 2 of 2

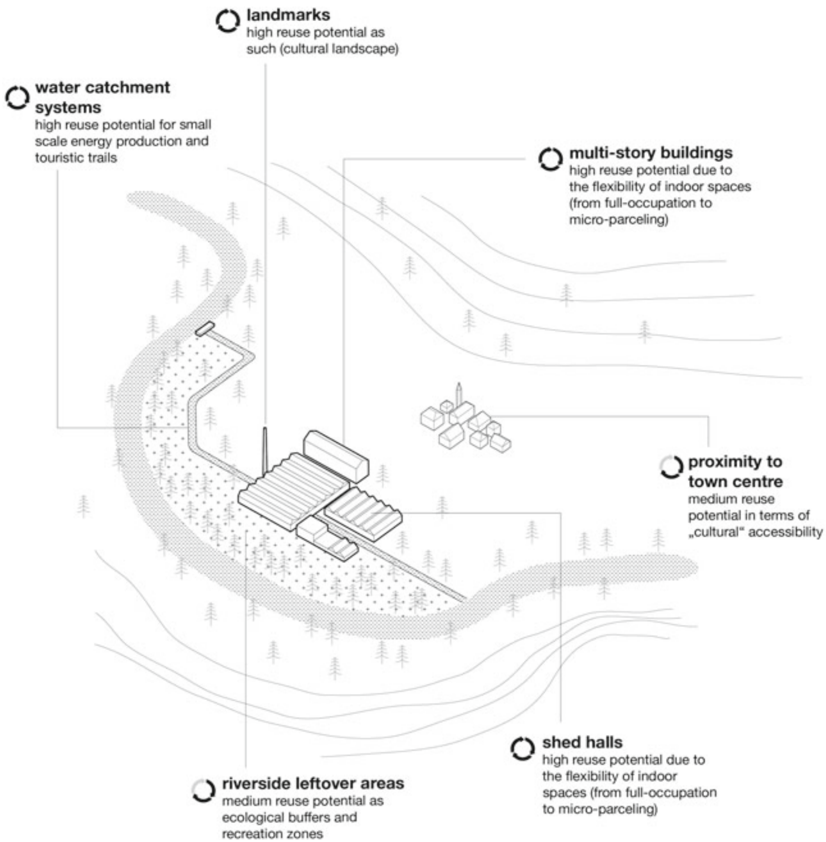

Fig. 6.10 Spinning mills, typological model

Aluminium smelters
Analysed sites (Fig. 6.11 and 6.12): Constellium, Steg-Hohtenn/CH (C)—Trimet, St. Jean de Maurienne/F (A)—Novelis, Borgofranco d'Ivrea/I (C)—Montecatini-Alumetal, Mori/I (C)—Pechiney, L'Argentière-la-Bessée/F (C)—Salzburger Aluminium, Lend/A (C).

The location and thus the size of aluminium smelters are therefore strongly influenced by either energy sources and railway accessibility, or better by their relationship. Medium-sized sites (Steg-Hohtenn, Borgofranco d'Ivrea, Mori, L'Argentière-la-Bessée) are the rule, but large (St. Jean de Maurienne) or even

Fig. 6.11 Aluminium smelters 1 of 2

Fig. 6.12 Aluminium smelters 2 of 2

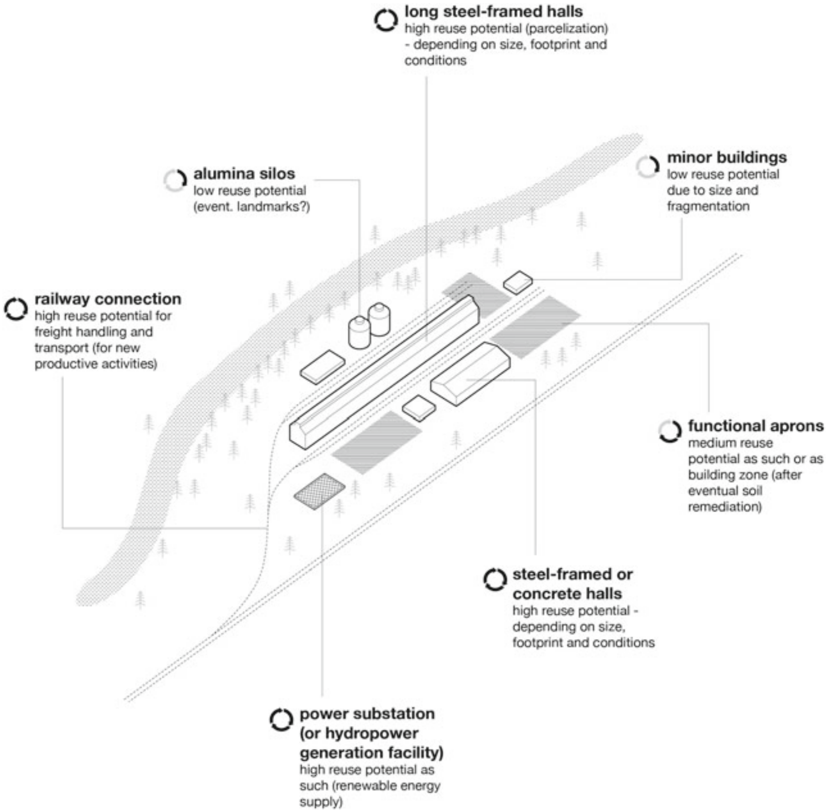

Fig. 6.13 Aluminium smelters, typological model

rather small sites (Lend) are also existing. The spatial footprint is quite diverse and relates to the site size: very small sites are usually rather compact, recalling in some way textile mills or cement factories, while medium-large sites are generally more fragmented, such as steelworks. On the other hand, topographic features play a key role only in relation to energy production. Smelters with detached energy generation facilities (e.g. hydropower stations in side valleys at high altitudes) are usually located in the centre of flat valley floors (Steg-Hohtenn, St. Jean de Maurienne), while smelters with in-house hydropower generation facilities, and thus including water catchment systems (canals, pipelines), shows a significant proximity to steep slopes (Lend, Mori) and/or river courses

(L'Argentière-la-Bessée, Borgofranco d'Ivrea). The builtscape of aluminium smelters is also highly heterogeneous and somehow related to each site background (origin, energy source, capacity). A common feature of all smelters is the presence of one or more long-shaped, thin buildings (either with steel-frame or concrete structure) with variable extension, which hosted the electrolysis furnaces. In addition, medium-sized working halls in steel frame for side processing (foundries, casting), concrete silos for alumina storage and minor concrete buildings for various purposes (workshops, administration) are usually present. The open spaces within the site perimeter are normally consisting of extensive paved surfaces functionally organised for internal transport and storage purposes, often integrating a basic railway network for in–out goods transfer. Along the site borders or on unused areas the mineral surfaces leave space to spontaneous and/or leftover green surfaces—in case of prolonged closure even to woodlands (Mori). As previously said, the relationship with water is really variable and mostly dependent on the location of hydropower production (in-house or external), but basically most of the smelters are more or less closely located to water courses. Road and railway connections are essential, with the latter being a constituting element of aluminium smelting and surroundings. The facilities are connected to the nearby railway lines through a single or double tracks with variable extensions depending on the railway proximity. In case of long-time closed down sites the external railway link might have disappeared or even removed (L'Argentière-la-Bessée, Mori, partially Borgofranco d'Ivrea). Compared to the other typologies, the reuse potential of aluminium smelters is not always easy to identify, especially due to the high heterogeneity of sites and facilities (Fig. 6.13). In general, the good adaptability/flexibility of existing buildings (especially of electrolysis halls) make them easily reusable for small-scale production activities and other purposes. At the same time, the existing infrastructural system (transport and energy) might provide in the best cases a ready-made "platform" for the implementation of new built structures. Redundant open and paved surfaces can also be de-sealed, eventually decontaminated, and renatured to function as ecological compensation zones.

6.3 Landscape Structures

The typological analysis has revealed how each site typology, shaped around a specific production process, generates its own recognisable landscape. The latter can be considered as the layered result of direct and indirect impacts of a certain industrial activity on the mountain environment. Indirect influences relate to the adaptive process occurred/occurring in the surroundings (the hosting environment), while direct impacts derive from the industrial facility itself and its functional composition. The landscape structure shared by many different sites within the same productive typology is influenced by the past and present functional purposes of industrial production, thus resulting in a specific and distinguishable mix of buildings, open spaces and infrastructures. These three categories of spatial elements are arranged everywhere according to the same logic, no matter of the site background, status and context. The complexity of the industrial landscape seems not to be related to the size of industrial facilities, but more to the spatial extent of industry-related infrastructures within the surroundings. Rather huge site typologies, such as EAF steelworks, are almost isolated or detached from the surroundings, as all activities and infrastructures are concentrated within the same, large and circumscribed, area. On the contrary, those typologies with a compact and small-sized footprint, such as spinning mills and cement factories, are far more entrenched with the surrounding topography due to a stronger relation with material resources (e.g. water catchment and quarrying). Since this structural complexity is not limited to the site boundaries, but indeed linked to the site-context influences, the landscapes of early industries are clearly exceeding in this sense those of more 'recent' heavy industries. The comparison between sites belonging to the same typology, but differing by their status, shows also how the landscape structure can change during the 'turn-to-brownfield' process. Built structures, open spaces and infrastructure cease their original function while acquiring new meanings and purposes in the view of transformation. The attempt to identify, or measure, the reuse potential of the landscape typologies under investigation clearly addresses this issue. A first, interesting finding is that the reuse potential of built structures is connected to their efficient re-usability, which means that reuse is privileged where existing buildings can be easily reconverted for other purposes (especially productive ones). Winning typologies in this sense are those with vast and flexible built spaces, from the large metal-frame halls of EAF steelworks and aluminium smelters to the rational shed halls of spinning mills. If the existing built structures are too strictly related to a specific production purpose, such as in the case of cement plants, a too low functional adaptability can prevent a quick and economically sustainable reuse. With regards to the open spaces, which have equal if not greater relevance compared to built structures, it can be generally noticed that in all the typologies these have a medium-to-high reuse potential as either ecological compensation areas (e.g. former quarries in cement industries, slag dumps in EAF steelworks, riverside areas in spinning mills) and building/densification zones (e.g. large aprons in aluminium smelters and EAF steelworks). The infrastructures, finally, are those with the higher reuse potential in all the investigated typologies. Transport infrastructures such as railway connections and internal networks in heavy industries (EAF steelworks and aluminium smelters) as well as extensive gravel road networks in mining industries (cement plants) can be refurbished for the same purpose or reconverted to different uses. Energy infrastructures connected to hydropower, such as the extensive water catchment systems and energy production facilities as those of spinning mills and aluminium smelters, can also be refurbished for the same purpose (especially in the case of micro-hydropower stations) or converted to recreational and/or touristic scopes (e.g. water cultural landscapes). The characterisation process, conducted by means of a simplified comparative analysis of several sites within specific typologies, has revealed that: a) a certain landscape structure does exist across seemingly different sites; b) this landscape structure is subject to changes over time, being also highly influenced by the contextual 'environmental' conditions; c) this landscape structure holds already a transformation potential. In the following chapter, these findings will be concretely tested on four case study sites, selected from the aforementioned 'characterisation' typologies.

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7 Testing

How to manage the complex redevelopment process of Alpine brownfields through a landscape-based transformation approach? In how far does the actual landscape structure of Alpine brownfields influence the site transformation? How to strategically integrate the different expectations/needs expressed by the local community and the brownfield contextual conditions in an operative model based on structuralist-systemic principles? Can such a model be equally applied (transferred) to different mountain brownfield typologies as well as function in different regional contexts? To help answering these questions, the third analytical phase involves four real-world case study sites, selected from the previously outlined geography of Alpine brownfields as a 'test base' for developing a landscape-based transformation approach. By means of a detailed research protocol, which includes and integrates intensive fieldwork activities and interpretative background analysis, the four sites are gradually 'unveiled' as highly representative situations of the vast case systems already identified. The 'virtual' testing of transformation—though based on concrete, realistic insights from local stakeholders and affected communities—allows to outline not only a methodological approach for redeveloping Alpine brownfields, to be later discussed, but more specifically it helps to identify and categorise the possible interventions that can actually take place. In this sense, the Testing phase is the most operative-oriented phase of the analysis.

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7.1 Framework

Focus

The territorial survey has provided a general overview of Alpine brownfields in terms of geographical distribution and regional-based challenges, while the typological landscape study has highlighted the characteristics and inherent transformation potential of the most representative Alpine brownfields. At this point, a shift in both scale and methodology is required to concretely test the research hypothesis on the analytical base so far outlined. With regards to the scale, the Testing phase zooms-in the Alpine brownfield geography and identifies a few, representative case study sites to work with. In this way, the 'numbers' of Mapping and the structural 'typologies' of Characterisation are given a concrete representation, an exemplary form and constitution. At the same time, the methodological approach shifts from a detached, data-based approach towards a more operative, field-based one, in which the collection and interpretation of data largely depends on the direct experience with the site itself, as physical, built entity. For the purpose of working with the same methodology on different yet comparable sites, case study research is identified as the most suitable methodological framework. The nature of case studies is descriptive, as it addresses the description of a phenomenon in a real-world context, but also exploratory, as it aims to increase the knowledge of the same phenomenon while developing (or testing) the hypothesis. The goal of the Testing phase is therefore to describe, through direct and on-site analysis, the reality of representative Alpine brownfield sites, as well as to approach and test their transformation by means of design-oriented approaches. The selection of the case study sites, and the construction of the appropriate methodological toolbox are therefore aimed at providing a well-grounded, empirically assessable insight on mountain brownfields, thus fostering the generation of new and useful knowledge on their complex redevelopment process.

Criteria

According to the research hypothesis and aims, as well as considering the analytical process developed so far in Mapping and Characterising phases, the selection of the case study sites was based on two main criteria: representativeness (relevance) and heterogeneity of situations. The relevance of potential case studies was first defined according to the results of the previous phases, which means that the selected case studies had to match either a) the landscape structural typologies (cement plant, EAF steelworks, textile spinning mill, aluminium smelter)[1] and b) the regional types (old industrial regions, industrial-tertiary regions of type 1 and type 2)[2]. A cross comparison between potentially suitable sites within the four identified landscape typologies (based on the mapping results) and the three regional types led, at first, to circumscribe the set of cases. On this latter, the second macro-criterion (heterogeneity) was then applied. Having as main reference the aforementioned four identified site typologies, the heterogeneity criteria can be expressed through:

- the site status quo, or degree of 'brownfieldisation'. This implies that the case studies have to cover different stages of industrial decline, from underused/downsized sites to completely closed down sites, as well as closing down or partially re-activated sites. This 'staging' criteria is essential to understand how the process of turning into brownfield influences transformation and redevelopment, i.e. which challenges and opportunities are there existing in each of the different stages. In addition, working with sites in different conditions might help to learn how to anticipate (prevent) certain situations and to develop, accordingly, specific transformative interventions;
- the site regional and national context, meant in the broad sense (geography, economy, environment, spatial development policies, etc.). Different socioeconomic and cultural contexts from the Alpine countries have to be then taken into account, to ensure the widest possible reach-out of results. This does not only refer to the fact that in different countries the brownfield issue might be tackled in different ways, but also, and mostly, to the possibility of developing a concrete and transferable methodological approach for Alpine brownfields, regardless the specific socioeconomic context and cultural background.

According to the representativeness and heterogeneity criteria, four case study sites have been therefore selected for the testing phase:

[1] The six sites per typology already used in the typological study have been prioritised in the selection of potential case study sites.

[2] Rural-industrial regions have been totally excluded from the range of suitable regional types due to the limited number and impact of brownfield sites in this specific context. This makes the potential trajectories of reuse and transformation rather different from the other regional types, which are indeed characterized by higher densities of sites and more pressure for redevelopment.

- **SPZ Zementwerk Eiberg** (Schwoich, Land Tyrol/Austria): cement plant, recently closed (1865–2018), industrial-tertiary region of type 2;
- **Ascometal-Winoa** (Le Cheylas, Département de l'Isère/France): EAF steelworks, partly closed (1921–2015), industrial-tertiary region of type 1 (peri-Alpine location);
- **Cantoni ITC** (Ponte Nossa, Provincia di Bergamo/Italy): cotton spinning mill, long closed (1870–2004), old industrial region;
- **Constellium** (Steg-Hohtenn, Kanton Wallis—Canton Valais/Switzerland): aluminium smelter, downsized (1962–2006), industrial-tertiary region of type 1 (inner-Alpine location).

The Italian case study well represents those old Alpine industries in steady decline, for which redevelopment is difficult to achieve due to long status of abandonment and the fragile economic context. The Austrian case study deals with early-established industrial typologies too, although characterized by a dynamic decline trend strongly related to the socioeconomic context—which, in this particular case, is rather well developed and growing. On the contrary, the French and the Swiss case studies are both focused on Alpine heavy industries once based on hydropower, also sharing the same regional type. However, the specific socioeconomic context (urban agglomeration versus inner valley) and the background and current use of the two sites are very different, thus giving rise to diverse, alternative questions.

Methods

To ensure a common analytical framework and procedures for such a heterogeneous set of sites, a detailed case study protocol has been defined in advance (Fig. 7.1). The protocol not only serves as "a standardised agenda for the investigator's line of inquiry for a single case" (Yin 2014), thus allowing its straightforward replication on all the selected cases/sites, but it also helps to integrate in a logic sequence the multiple units of analysis through which each case study is investigated (so-called 'embedded design'). Indeed, a protocol so conceived is essential to ensure a later, well-documented and transparent comparability of results. The approach behind the protocol structuring is derived by carefully mixing quantitative and qualitative research methods in planning and social sciences (Silva et al. 2014) with those referring to geographical or 'territorial' landscape analysis (Turri 2002; Antrop 2013). The protocol integrates and organises the different selected methods and tools in a three-step procedure, developed according to the author's own interpretation of the outsider/insider dualism in experiencing and studying landscapes (Cosgrove 1985). The procedure encompasses the following temporarily ordered phases.

phase	focus/aim	methods	results	descriptive outcome
desk research 1 preliminary analysis	• to identify the regional context of the site and to get a clear, complete and exhaustive overview of the economic, social and environmental situation • to get a clear, complete and exhaustive overview of the site historical development, current state and future challenges, in relation to the regional context • to get a first, detached overview of the site and surroundings in terms of spatial development and landscape structure	• collection and review of data from existing written documentation (regional/local planning documents, sectoral studies, literature, local newspapers) • interviews to regional/local stakeholders (distance/face-to-face) • collection and comparison of historical images of the site and surroundings • collection and comparison of aerial photographs covering at least the last 50-70 years	• a regional overview including region identification (boundaries, location), geography and accessibility, socio-demographic data and issues, economic data and issues, environmental issues, spatial development trends and challenges • a site overview including site location, historical background, recent developments (post closure or post-downsizing), future plans and expectations • a preliminary site analysis based on the comparison of aerial/plain pictures from different time frames	• **regional profile** (text + infographics) • **site profile**(text + images) • **preliminary site study** (sequence of commented aerial views)
field research fieldwork	• to visit the site and the surroundings to get a real-based impression • to document the site and the surroundings and the spatial, visual and landscape interactions through them using photography • to gain further knowledge on the situation from local/regional stakeholders	• prolonged site visit including direct observation and photographic documentation of site and surroundings (selection of representative photographs focused on: overview, site, landscape structure(s)) • on-site sketches and drawn impressions • meetings/interviews to relevant stakeholders (face-to-face)	• a set of actual and detailed photographies of the site and surroundings • notes, sketches and impressions gained on site • integrative data/information from interviews/meetings	• **photographic study** (24 photographies)
desk research 2 advanced analysis	• to outline a comprehensive and realistic overview of the site spatial and landscape structure • to provide a suggestion for the site transformation, based on the outlined overview, inputs and framework	• critical review of fieldwork material (selection, description, integration) • computer-based graphic representation of the study area including relevant information previously collected as well as proposed interventions	• a map describing the spatial and landscape structure of the site at the current state, based on field research • a set of planning schemes showing the transformation process (landscape systems with toolkits and phases)	• **landscape structure** (1 map 1:10.000) • **transformation systems** (6 panels)

Fig. 7.1 Case study protocol

The **preliminary analysis** *(type of research: desk research; role of researcher: outsider)* aims to establish the 'territorial' framework for the site in-depth study. This includes an exhaustive overview of the regional context—described through its geography, accessibility, socio-demography, economy, environment and spatial development trends—as well as a description of the brownfield site itself—location, background, current use and future plans. The information and data for the regional and site profiles are gathered from existing and available documentation (mainly planning documents and reports, sectoral studies, literature but also local newspapers) and eventually further integrated by face-to-face or phone/mail interviews to relevant stakeholders (e.g. site owners and local/regional administrative planning institutions). The content of the regional and site profiles constitutes therefore the 'operational perimeter' within which the site analysis has to be performed, and to which the testing of transformation has necessarily to confront with (i.e. programmatic guidelines). Subsequently, the site and its contextual conditions are assessed by means of a diachronic landscape analysis, in which a set of historical aerial views of the contextualised site are compared to evidence and record the landscape change—or the current landscape structure as result of layered processes. This fundamental operation—which borrows from cultural geography the understanding of landscape as palimpsest (Meining 1979) and uses the historical-geographic analytical approaches of territorial studies (Turri 2002, 2001)—allows to objectively assess the present situation by assigning a specific relevance and meaning to the existing spatial structural elements. In this sense, the diachronic landscape analysis constitutes at all the effects and purposes a preliminary 'operative' step, as it sets the ground for the following field-based investigation of the site, either in terms of content (what to do/see) and planning (where to go).

The **fieldwork analysis** *(type of research: field research, role of researcher: insider)* aims to acquire qualitative spatial information through the direct experience of the landscape. The fieldwork analysis is performed through a one week-long excursion, in which the site and its surroundings are thoroughly explored and carefully documented by means of photography. Differently from the typical site visits to transformation sites performed in the architectural and planning fields, this way of documenting involves a longer time span, minimum 5 days, which allows an experiential deepening of the site and its context. Furthermore, the intermediate positioning of the documentary fieldwork between the precedent purely analytical phase and the following deductive and design-oriented one, fully enables a critical involvement in the situation of study. The operative principles of the field visit, such as prolonged stays (familiarity), the use of mental mapping (orientation) and slow-motion field exploration (observation), are based on place-engagement and 'environmental perception' techniques already developed and tested in ground-breaking 'psychogeographic' experiences of the 1960 s–1980 s (Lynch 1960; Debord 2006; Burckhardt 2015). To document the direct experience of landscape and thus the actual spatial forms and relationships, a photographic study is developed throughout the field visit, as also the main descriptive outcome. The photographic approach used in the fieldwork analysis builds on the author's own experience in documenting industrial landscapes (Modica 2012, 2018; Modica and Infussi 2017), combined with key elements and techniques from contemporary landscape photography (Alexander 2015). The industrial site and its surroundings are documented according to the 'topographic style' (Bertho 2015) developed by ground-breaking collaborative photographic projects such as the New Topographics (1975) in the US (Jenkins 1975; Foster-Rice and Rohrbach 2010), Luigi Ghirri's collective Viaggio in Italia in the early 1980 s (Ghirri 1989; Ghirri, Leone, and Velati 1984) and the French Mission photographique de la DATAR in 1984–88 (Latarjet and Hers 1985). By pursuing a pure, aesthetics-free documentation of indeterminate yet familiar landscapes—thus including environmental concerns on human intervention on nature—these works have introduced Western societies to a new, objective and critical, approach to landscape representation, far opposite to traditional romantic and idealised conceptions. The photographer assumes here a neutral position toward the landscape, though being conscious of its own position and view, aiming to reproduce it through 'natural' framing and depth of field[3] as in a sort of visual mapping process. Due to the specific typology of landscape in the focus, i.e. industrial or industry-altered landscapes, additional references in terms of techniques and representation are borrowed from the field of industrial photography. These encompass artistic works from the German Neue Sachlichkeit tradition, such as those of Albert Renger-Patzsch (Renger-Patzsch and Honnef 1977) and the Becher's (Becher and Becher 2002), as well as commissioned corporate works mainly from the Italian context (Desole 2015). The photographic approach used in the fieldwork responds to specific criteria, among which highest possible level of objectivity in representation and multi-perspective observation. An essential prerequisite to the fulfilment of these criteria is the preparatory work of the field visit, which includes the identification of preferred viewpoints and elements/spaces to document according to the outcomes of the precedent diachronic landscape analysis. The overall photography study is then presented through a selection of 24 pictures, focusing either on the site contextualisation, on the spatial qualities of the site and surroundings and, most important, on the physical and visual relationships between the site and its context. Each photography is briefly commented, with the purpose to increase the 'geographical' readability of the included elements.

The **advanced analysis** *(type of research: design-based desk research; role of the researcher: experienced outsider)* aims to outline and test the transformation potential of the brownfield site through a design-oriented approach. Differently from the previous two phases, the advanced analysis is not meant to collect further data or information on the site and its context, but instead to process what has been gathered so far in the view of generating new knowledge on the site future transformation. The methods used in this processing are referrable to the wide methodological approach of 'study-by-design' (de Jong and Van der Voordt

[3] For example, 50 mm lens are preferred as they most closely resemble the human eye perspective and depth of field.

2002), and in particular to the so-called 'scenario design', in which "a scenario does not only contain the extension of empirically established probable developments perspective, but also […] possible spatial interventions" (de Jong and Engel 2002: 457). For each site, its physical and functional transformation is prefigured according to a sequence of two clearly identifiable steps (Fig. 7.2). At first, the bunch of information collected in the diachronic landscape analysis (phase 1) and during the field visit (phase 2) are reviewed and transposed into a landscape structural map. The landscape structure is here conceived as the composition of spatial elements on the land defined according to their actual characteristics and interdependencies, which means the whole built/open and linear/areal elements of which the site and its surroundings are made of[4]. The landscape structure represents therefore the status quo, the 'canvas' of transformation. On this basis, and with the territorial framework (preliminary analysis) as main reference for what concerns the content/inputs, the physical and functional transformation of the site and its premises (context) is gradually outlined and described according to three 'landscape systems': backbone, borders, and core. These systems can be defined as infra-structural (i.e. within / based on the landscape structure) configurations of spatial elements sharing the same performances (aims) and transformative interactions (functions). The three systems may include different spatial elements depending on the landscape structure, but essentially:

- the backbone deals with the characterising structural elements (either buildings, open spaces or infrastructures, often mixed);
- the borders focus on the edges of the site (including mainly open spaces within and beyond the side perimeter);
- the core includes the inner productive area with higher densities of built spaces, often subject to most radical changes.

[4] Such definition of landscape structure has been developed by the author by integrating different understandings of the same concept from landscape ecology (Farina 2000) and geographical studies (Turri 2001), as well as by considering the definition of "industrial landscape" based on functional interactions provided by Borsi (1975, 1978).

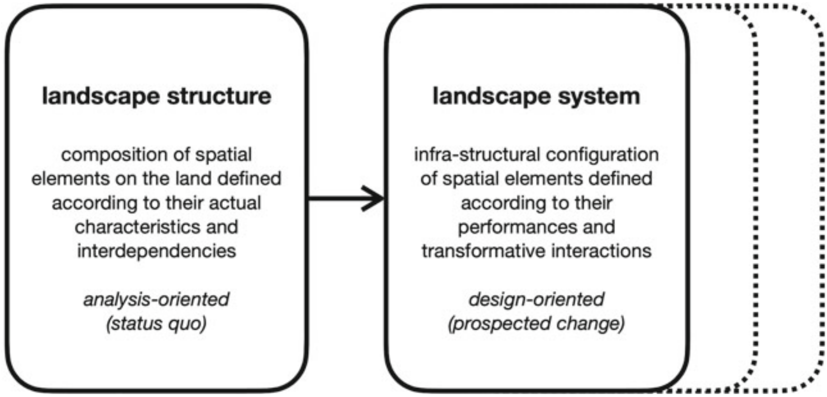


Fig. 7.2 Landscape structure and landscape systems

The identification of these systems and their sequential development are strongly related to the spatial characteristics of mountain brownfield sites (detachment, open surroundings, built density, etc.), addressing in particular the relationships between the site and its context in a transformative way. Each system is visually described to ideogrammatic maps, including a general overview (to show the extent of spatial elements involved), a toolkit (actions or 'rules' to be applied on the spaces involved) and four transformation phases (to illustrate the process, including the involved stakeholders). The flexible integration of 'material reality' (i.e. the site as given) and 'social inputs' (the program for the site as expressed by its socioeconomic context) that occurs within the three systems recalls somehow the already mentioned systemic design approach developed by Alan Berger, and applied to the reclamation of industrial wastelands at different scales (Berger 2008, 2009).

In the following amply illustrated pages, the four case studies are described in detail through the aforementioned protocol and phases. To test the protocol, the Italian case study (Cantoni ITC, Ponte Nossa) was chosen as pilot site due to the immediate accessibility of information and the already accumulated (partial) knowledge of the site itself.

7.2 Case Study I: SPZ Zementwerk Eiberg/A

7.2.1 Regional Overview

Identification
Cultural region: Northern Limestone Alps (Nördliche Kalkalpen) > North Tyrol Limestone Alps (SOIUSA[5] 21), Bavarian Alps (SOIUSA 22) and Tyrol Schistose Alps (SOIUSA 23) > Tiroler Unterland.

Administrative region: Land Tirol (NUTS[6] 2) > Tiroler Unterland (NUTS 3) > Bezirk Kufstein (30 municipalities).

Geography
The region is located along the northern fringe of the Alps, between the Bavarian Alps, the North Tyrol Limestone Alps and the Tyrol Schistose Alps. The lower Inn Valley between Jenbach (Tyrol) and Rosenheim (Bavaria) is the topographic and hydrographic backbone of the Tyrol Unterland. The large valley bed (1,5–3 km width) is flanked on the west side by rough and wooded reliefs of the Brandenberger Alps (Hochiss 2.299 m, Pendling 1.563 m) and the Bavarian Prealps (Hinteres Sonnwendjoch 1.986 m, Wendelstein 1.838 m), while on the east it gradually fades into the rolling foothills of the Chiemgauer Alps (Geigelstein, 1.808 m) and the Kitzbühel Alps (Hohe Salve, 1.828 m), with the remarkable interruption of the Kaisergebirge massif (Ellmauer Halt 2.344 m). The regional valley system is rather complex, including a few side valleys of the Inn valley (Achental and Thierseetal on the orographic left, Zillertal and Brixental on the right) as well as valley-seemingly extensive plateaus around the Kaisergebirge (Sölllandl to the south and Kaiserwinkl to the north). In addition, the Tyrolean section of the Inn valley between Kufstein and Brixlegg is characterized by the presence of morainic terraces (Mittelgebirgsterrassen) on both sides, such as the Angerberg close to Wörgl and the Bad Häring plateau at the foot of the Pölven massif (1.595 m). The river system is shaped around the Inn, to which several stream-like tributaries are connected (Jennbach, Kaiserbach, Weißache, Brixentaler Ache on the right, Brandenberger Ache, Thierseer Ache, Auerbach on the left). Small lakes of karst and glacial origin are also present, among which the Hintersteinersee and the Walchsee near the Kaisergebirge and the Thiersee in the Thierseetal.

[5] Acronym of *Suddivisione Orografica Internazionale Unificata del Sistema Alpino* (International Standardised Mountain Subdivision of the Alps), an updated classification system of the Alps based on transnational geographic and toponomastic principles, designed and proposed by Sergio Marazzi (Marazzi 2005).

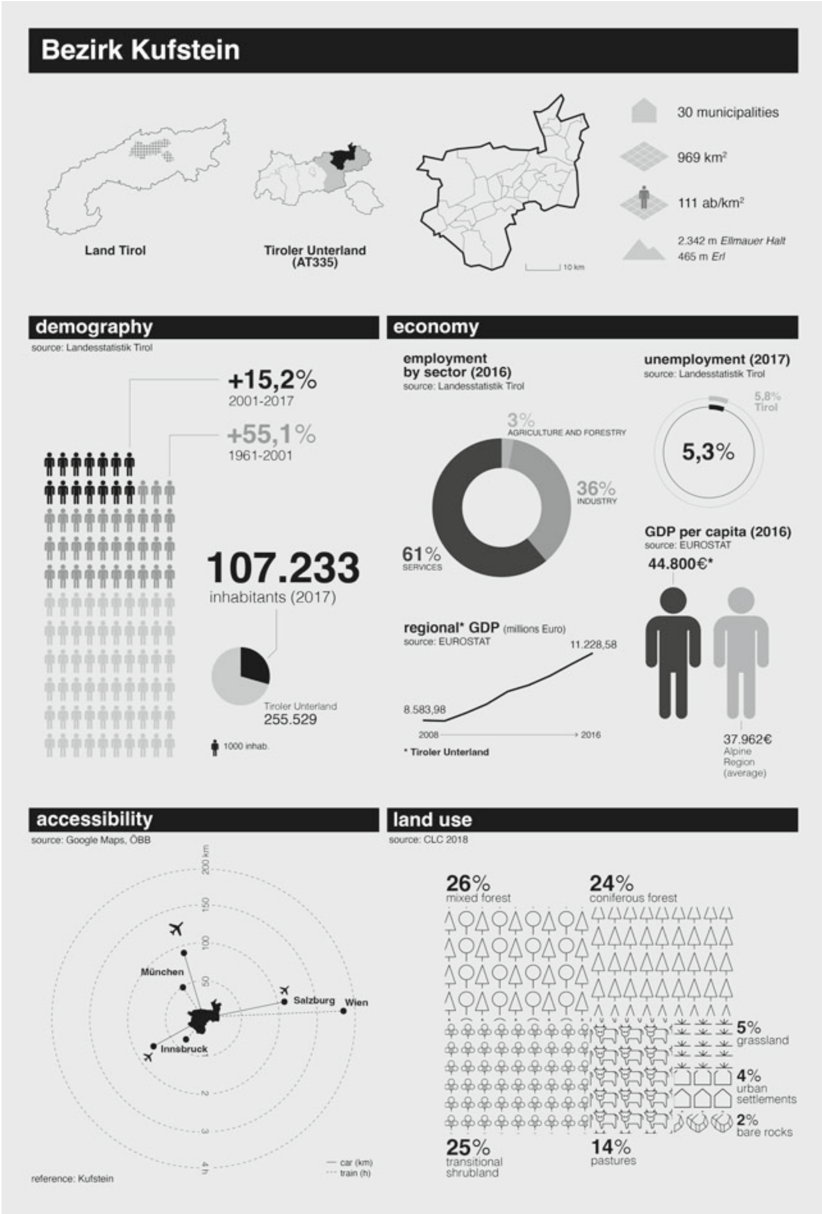
[6] Acronym of *Nomenclature des unités territoriales statistiques* (Nomenclature of Territorial Units for Statistics), the EU standard for referencing the subdivision of countries for statistical purposes.


Pyramidenspitze
(Zahmer Kaiser)
1.997 m
Ellmauer Halt
(Wilder Kaiser)
2.344 m
Ellmau
Kiefersfelden
Kufstein
47°33'02.8"N
12°10'04.9"E
Pölven
1.595 m
Pendling
1.563 m
Kirchbichl
Wörgl

Accessibility
The favourable location of the Kufstein region along the Brenner transalpine corridor (Munich-Innsbruck-Bolzano-Trento-Verona) leads to an extremely high accessibility in comparison to average Alpine regions. The most accessible area is the lower Inn valley floor, which is crossed by two major transport infrastructures: the Innsbruck-Kufstein-Rosenheim railway (a section of the Munich-Verona axis) and the motorway A12 Inntal between Innsbruck and Rosenheim. The train connections are well developed and quite fast: from Kufstein, the urban and administrative centre of the region, Innsbruck can be reached in just 40' and Munich in around 1h. Much more time is needed to get to Vienna (via Salzburg), around 3h30'. The Kufstein region is also well connected to the inner Alpine regions via the regional railway Salzburg-Tirol, which departs from the Inn valley in Wörgl towards Salzburg and intercepts several touristic centres of national and international relevance (Brixetnal, Kitzbühel, St. Johan in Tirol, Zell am See). Favoured by the soft topography, the road system is also well developed. By car, Innsbruck can be reached from Kufstein in around 1h30, while Munich and Salzburg both in around 2h (via motorway). Minor airports in the vicinity are Innsbruck (1h30') and Salzburg (2h), while the larger Munich airport is around 2h30' away. By far, the south-eastern side of the Inn valley towards the Pinzgau touristic district is more accessible than the north-west.

Socio-demographic profile
The Kufstein district (Bezirk) includes 30 municipalities covering an area of 969 km^2, with 107.233 inhabitants (2017). The district is the 3rd most populated in Tyrol after Innsbruck city and its urban area, hosting 14% of the whole Tyrol population and 42% of the Tiroler Unterland. The average population density is $111/km^2$, far above the average of the Alpine region (76,4) and the Austrian Alps too (60,8). Due to its particular location on the border between Tyrol and Bavaria, at the crossroads of dynamic inner- and peri-Alpine urban agglomerations such as Innsbruck, Munich and even Salzburg, the Kufstein district is experiencing since the 1960 s an impressive and constant population growth: + 55% between 1961 (60.022) and 2001 (93.702), + 15% between 2001 and 2017 and even + 13,3 foreseen for 2030. However, this growth is strongly polarised in favour of the city of Kustein—the second largest city of Tyrol after Innsbruck with around 20.000 inhabitants—and the Inn valley bed, including the surrounding plateaus. Less accessible side valleys with no intensive tourism, mostly located on the left side of the Inn valley corridor (e.g. Walchsee, Brandenberg), are indeed registering a steady decrease of population. A significant impulse to the recent population growth was given by immigration, mostly from bordering regions and

countries (Germany and Italy at first). The current 21% share of foreigners on the whole district population (second only to Innsbruck) is expected to increase in the upcoming year, and thus to contribute significantly to the overall population growth (both in terms of births and youngsters below 19 y.o.). Most affected areas will be the urban agglomerations of Kufstein and Wörgl. The positive demographic development is also reflected in the ageing trend, as in 2015 21,1% of the population was below 19 y.o., 62,1% between 20–64 and just 18,8% above 65. The forecast for 2030 shows only minimal variations in terms of increase of the + 65 y.o. group, mainly occurring in communities along the Inn urban corridor.


Bezirk Kufstein
Land Tirol
Tiroler Unterland (AT335)
10 km
30 municipalities
969 km²
111 ab/km²
2.342 m Ellmauer Halt
465 m Erl
demography
source: Landesstatistik Tirol
+15,2%
2001-2017
+55,1%
1961-2001
107.233
inhabitants (2017)
Tiroler Unterland
255.529
1000 inhab.
economy
employment by sector (2016)
source: Landesstatistik Tirol
3%
AGRICULTURE AND FORESTRY
36%
INDUSTRY
61%
SERVICES
unemployment (2017)
source: Landesstatistik Tirol
5,8% Tirol
5,3%
GDP per capita (2016)
source: EUROSTAT
44.800€*
37.962€
Alpine Region (average)
regional* GDP (millions Euro)
source: EUROSTAT
11.228,58
8.583,98
2008
2016
* Tiroler Unterland
accessibility
source: Google Maps, ÖBB
200 km
150
100
50
München
Salzburg
Wien
Innsbruck
2
3
4 h
car (km)
train (h)
reference: Kufstein
land use
source: CLC 2018
26%
mixed forest
24%
coniferous forest
5%
grassland
4%
urban settlements
2%
bare rocks
25%
transitional shrubland
14%
pastures

Economic profile

The Kufstein district is characterized by a developed and mixed economic base oriented towards industry, trade and tourism. With a GDP per capita of 44.800 Euro (2016)—far above the average of Austria (40.800 Euro) and the Alpine region (37.962 Euro)—and unemployment at 5,3% (2017)—lower than Tyrol (5,8%) —, the Kufstein region is the second economic pole of Tyrol after Innsbruck. The wider Tiroler Unterland, in which the Kufstein district is included, is the 9th most productive (gross regional product per employed person) NUTS 3 region in Austria (2015), coming after mainly large cities and lowland agglomerations. The district economic geography is quite polarised, with industry, trade and related services mainly concentrated in the narrow Inn valley floor and tourism in side valleys and peripheral areas. The regional economic repartition among the sectors (2015–2016) shows a prevalence of the service sector (63% gross value added, 61% employment) and a rather high relevance of industry and manufacturing (36% both gross value added and employment), while the primary sector lies far behind (1% gross value added, 3% employment). Compared to the Tyrolean and Austrian average values, the Kufstein region and the Tiroler Unterland in general shows a significantly higher importance of the industrial sector (36% of employment in front of, respectively, 25% and 28%). The latter is mostly based on small-scale businesses (28% of industrial activities are indeed micro-enterprises with 1 employee), but also includes 13 large companies with more than 250 employees, among which Sandoz (two large sites focused on pharmaceutical industry and biochemistry), Hans Bodner Bauges (constructions and civil engineering), Coveris Flexbiles (plastic films), STHIL (agro-machineries), Pirlo (metal and plastic packaging) and Berger Logistik (trade and logistics). Most of these industries developed in the second half of the XX century, often as location-based investment by extra-regional multinational enterprises. Anciently established industrial activities such as cement production, cellulose and timber industries and metal smelting are almost completely disappeared, with just a few exceptions (e.g. Montanwerke Brixlegg, copper smelting). The region is also a knowledge and innovation hub, ranking second after Innsbruck as the most innovative region in Tyrol (376 new start-ups registered in 2016). The Kufstein University of Applied Sciences (Fachhochschule) largely support the regional innovation system and business development. The service sector, which dominates the regional economy, includes many trade and industry -related services (e.g. IT, consulting, logistics, etc.) but also the tourism industry, which holds a relevant position within Tyrol and the Kufstein region too—although slightly less in the latter. The main touristic resorts (including infrastructures and accommodation facilities) are found in side valleys and plateaus on the right side of the Inn, such as the Kaiserwinkl, the Wilder Kaiser and the nearby Söllland, the Alpbachtal. The recent trend (1971–2016) in terms of overnight stays shows an exceptional growth (+160%) of winter tourism (e.g. the Wilder Kaiser ski area) and a significant decrease

(−48%) of summer tourism. However, since 2001 both winter and summer tourism are experiencing stagnation or slight decline, mainly due to the decrease of overnight stays connected to the increase of short stays (daily trips or weekends) from nearby metropolitan regions (e.g. Munich). Last but not least, the agriculture and forestry sector is nowadays far less important in economic terms than in the past, as almost everywhere in the Alpine region. In the Kufstein region, the primary sector experienced a sharp decline between 1960 and 1980, with the employment share shifting from 29% in 1961 to the current 3%. Livestock farming and forestry are mainly present on hillsides and plateaus, while intensive crop farming is concentrated in the Inn valley floor. Around 60% of the existing farms are run part-time and, instead of economic output, they contribute more to landscape maintenance.

Environmental profile

Despite the high human pressure, both in terms of urbanisation and intensive agricultural uses, the Kufstein region has still a rich and diverse environmental profile, including several biodiversity hotspots. On the west side, the region is bordered by the Naturpark Karwendel, the oldest and largest protected area in Tyrol (727 km^2) and the largest natural park of Austria. As home to 1300 plant species and 3000 animal species (among which the highest density of golden eagles in the Alps), the Karwendel park has been identified by the Alpine Convention as a priority conservation area for Alpine biodiversity. A second, relevant protected area is the Naturschutzgebiet Kaisergebirge (102 km^2), created in 1963 to prevent the pristine ecosystems from being over-exploited and compromised by mass tourism. The reserve is home of around 940 flowering plant species, 38 fern species and 400 moss species, and covered with extensive forests of northern alpine spruce-fir-beech, sycamore-ash and mixed beech. Meadows and natural grasslands are also included within the perimeter of the reserve, as well as wetlands and micro-environments which have survived the ice age. Last but not least, the course of the river Brandenberger Ache, which runs from the Mangfall mountains (in Bavaria) through the wild Brandenberger Alps towards the Inn, has been declared regional 'natural heritage' in 1988. Its gorges and riparian forests are home to several bird species as well as endangered butterfly species. Besides these valuable natural reserves, minor biodiversity hotspots are existing across the intensively cultivated landscape of the lower foothills and the valley beds. In particular, it needs to be mentioned the "Kufsteiner and Langkampfener Innauen" nature reserve area (17 hectares), which includes the few still existing riparian forests and wetlands along the Inn, between Kufstein and Langkampfen. These ancient alluvial habitats are composed of semi-natural to near-natural woodlands, home of native and rare bird species and plant communities (silver pasture, break pasture, grey alder, black poplar). More to the south, the Söller Wiesen reserve

(44 hectares) includes a vast remnant of the original wetland which used to cover most part of the Inn valley floor. In general, a high level of ecological diversity is ensured throughout the region, even outside these protected areas, due to the small-scale landscape pattern, which integrates meadows and pastures at different altitudes with coniferous and mixed forests of variable extension.

Spatial development trends and challenges
The spatial development trends of the Kufstein region are strongly influenced by an increasing and somehow problematic concentration of settlements and economic activities in the Inn valley bed. The recent growth of major urban centres such as Kufstein, Kirchbichl and Wörgl, as well as the 'suburbanisation' of small villages in between, has led in fact to the creation of an almost uninterrupted urban belt along the main road and railway infrastructures. The sunny plateaus overlooking the valley floor have been also subject to an increasing urbanisation, mainly for residential and recreational purposes (e.g. the case of Bad Häring). As an economically dynamic region with very limited available space, the Kufstein district is facing a very high pressure in terms of urban development. The Tiroler Unterland—which includes Kufstein, the lower Inn valley and the touristic agglomerations of Kitzbuhel and Sankt Johan in Tirol—has currently the lowest rates of land reserves in the whole Tyrol (15–20%). Furthermore, it is expected that by 2030 the population of Tyrol will increase of 50.000 inhabitants, mostly concentrated in the Inn valley urban axis. Given these forecasts and the current space limitations, the key challenges for future spatial development in the Kufstein region are: a) to foster soil-saving forms of urban development, including either inner development in major centres, land recycling in outer zones and/or industrial areas and building restrictions in mountain (environmentally fragile) areas; b) to address spatial panning concepts based on short distances, able to limit commuting and to overcome functional segregation; c) to take into account the economic benefits of nature and landscape and their contribution to the quality of life, i.e. to carefully manage environmental and landscape accessibility in urban development processes; d) to enhance a climate-resilient urban development, by pursuing energy efficiency in all urban functions and activities, changing the mobility pattern and develop adaptive solutions to natural hazards (e.g. de-sealing, flood management, protection forests). These challenges are affecting in one way or another all the regional economic sectors, from intensive land-use activities such as industry and tourism to extensive ones such as agriculture and forestry. Concerning 'land eaters', the main efforts should be addressed to identify in advance the optimal location for new economic activities, taking into account accessibility, conflicting land-uses and environmental impacts. Recycling of vacant or underused land should be prioritised for commercial and industrial activities, while for touristic infrastructures a good level of integration within the

Fig. 7.3 The cement pant flanked by the Eibergstraße, 1965

Fig. 7.4 Excavation layers being dig at the Matzing quarry site, 1965

existing natural and cultural landscapes is recommended. The Kufstein region incorporates, in a smaller scale, all these Tyrol-wide spatial development challenges. The current functional segregation between the industrial-commercial Inn valley floor, the residential plateaus and the touristic inner valleys and highlands can be superseded by better balancing the distribution of the different urban functions and activities on the territory.

7.2.2 Site Overview

Location

The cement plant site is located within the Eiberger Becken, a depression on the north-eastern edge of the Häring rolling plateau, surrounded by the forested foothills of the Kaisergebirge, the Pölven massif and the Kufsteiner Wald hills. Concerning topography, the cement plant stands right at the bottom of a Y-shaped deep canyon generated by the confluence of the Gaisbach stream into the Weißache river, below the height of the cultivated plateau floor. The three slices of the plateau around the canyon (namely Egerbach, Eiberg and Amberg) host the quarrying sites belonging to the cement plant, which are fully embedded in the plateau morphology. Due to the complex topography, the cement plant and the quarries are rather isolated from the nearby sparse urban settlements (mainly residential hamlets of Schwoich municipality), thus being surrounded mostly by dense forested areas alternated to open pastures. Along the course of the Weißache, down in the canyon, runs the Eibergstraße (1912), which links the site to the centre of Kufstein (4 km) and thus to the Inn valley on the north, and to the Söll-Ellmau touristic resorts (6,5 km) to the south-east.

Background

The Kufstein region is renowned to be the home of the Austrian cement industry. In 1857, the local entrepreneur Alois Kraft receives the imperial privilege for the exclusive production of hydraulic cement. Through a self-developed process adapted from Portland cement manufacturing, Kraft introduced natural cement production in Austria for the first time, being thus acknowledged as the founding father of Austrian cement industry. A first experimental production site is established in the calcareous Häring plateau. Given the successful results, in 1865 A. Kraft decides to found, together with Michael Egger, a new factory for Roman-type cement (natural cement based on a mixture of clay and limestone) in the Eiberg gorge. Initially, the cement factory is equipped with 6 top-charging kilns and the raw materials excavated right nearby, on the Haberg and Eiberg slopes. In 1879, after the death of A. Kraft, the cement plant is taken over by his son Ing. Karl Kraft. To overcome the physical isolation of the factory, K. Kraft promotes, also financially, the realization of two major infrastructures: an aerial ropeway (1889) for clinker shipping, running over the top of the Winterkopf mountain to link the cement plant to the Kufstein railway station; the Eibergstrasse (1913), a concrete-paved road running through the Eiberg gorge for almost 10 km, from Kufstein to Söll (Fig. 7.3). The improved accessibility of the cement plant is unfortunately not enough to avoid the impact of the economic recession of the late 1920 s. In 1930, production is suspended and the Eiberg cement plant is mothballed. A few years later, in 1938, the existing facilities are taken over by the

Fig. 7.5 The cement plant seen from the entrance on the Eibergstraße, 1962. The four shaft kilns are clearly visible in the background

Fig. 7.6 Aerial view of the cement plant down in the Eiberger Becken, 1974

local entrepreneur Bartl Lechner and gradually reconverted into a larger, modern Portland cement plant. Due to war circumstances, the construction works lasts for several years, leading to achieve full production only in 1946. The new plant is equipped with a couple of shaft kilns (increased to four in 1955), a raw mill and an integrated grinding plant with a reinforced-concrete clinker silo. Since the existing quarrying sites in the vicinity of the plant are not able to satisfy the new production needs, a search for new limestone deposits is developed in the surroundings of the Eiberg gorge. In 1948, the Schmiedl limestone quarry begins to be excavated and exploited through an open pit. As the quarry expanded, a tunnel was excavated at the bottom of the pit to drain water and allow, through a narrow-gauge railway, a direct and flat connection between the cement plant and the mining site. A second large quarry named Matzing is then opened on the northern slopes of Pölven foothills (Fig. 7.4), later also reached by the Schmiedl railway tunnel (final length 780 m). In 1950 the production capacity of the Eiberg cement plant is 60.000 tons of clinker per year, far below the average of other Austrian facilities. A major upgrade takes place in the mid 1960 s, as a new rotating kiln with pre-heating plant (dry process) is installed to replace the obsolete shaft kilns (Fig. 7.5). A larger grinding plant and an automatic packaging line are also added to support the increased production capacity, which reaches 320.000 tons/year. The completion comes in the 1970 s (Fig. 7.6) with the exploitation of rich marlstone surface deposits in the newly opened Neuschwendt quarry. In 1995, the Eiberg cement plant and its three large quarries, with a capacity of around 400.000 tons/year, are taken over by the Bavarian company Rohrdorfer Zement, and thus included in the Südbayerisches Portland-Zementwerk group (becoming SPZ Zementwerk Eiberg). The restructuring process that follows leads to the stop of clinker production at Eiberg, leaving just the mining activities and the grinding plant in operation. The Matzing and Neuschwendt quarries are gradually abandoned and partially reclaimed, while the older Schmiedl quarry is kept open to supply limestone to the Rohrdorfer cement plant in Rohrdorf, Bavaria. In 2010 the useless rotating kiln facility and the first grinding plant are demolished. All remaining activities ceased definitively in November 2018.

Current use and future plans
Since early 2019 the cement plant and the quarries are completely inactive. The site owning company, Rohrdorfer, has planned the removal of leftover machineries and equipment until 2020. After that, in 2020–2021, the existing buildings will be demolished. The plan of Rohrdorfer, in fact, is to transform the site into a new production facility to manufacture concrete blocks and paving stones. Due to the expected creation of new jobs, the site re-industrialization is perceived by the owners, as well as by the community, as a realistic and desirable one. The plan is also supported by the Land Tirol (Spatial planning department), as due to the limited availability of suitable land for industry, craft or trade, the sustainable reuse of already used sites is favoured. Among the issues to be solved prior to the set-up of the new facility there are, according to Rohrdorfer, the management of flooding (as the riverbanks next to the site are currently sealed and built-up) and the flattening of the site topography (at least of its central part, to allow a one-level production facility). On the other side, the future of the former quarries is still open and unclear. The Schmiedl quarry will be probably kept partially in operation for a few more years, to supply the company's other cement plants. The Neuschwendt quarry will be instead filled-in with building rubble and similar waste from all over Tyrol (serving as regional waste dump), as publicly announced by Rohrdorfer in late 2018. However, such a plan has immediately raised massive protests by local inhabitants in early 2019, who are worried that the besides concrete rubble the quarry will be filled with contaminated materials too, such as sludge from cement factories, asphalt and even asbestos. Although an agreement signed in August 2019 between Rohrdorfer and Land Tirol has excluded contaminated material from the dump content, the protests continued and future developments remain unclear. Through the Gesteinsabbaukonzept Tirol 2013 (quarrying/mining plan), the spatial planning department of Land Tirol has set goals and requirements for the post-mining management of quarrying sites. The preferred solution is, according to the guidelines, the recultivation or landscaping (soil stabilisation and renaturation) of abandoned open pits, also possibly oriented to recreation and tourism purposes. Due to the proximity to touristic centres and the natural reserve of Kaisergebirge mountains, this solution is highly recommended for all the quarries on the Härig plateau, including the Eiberg ones.

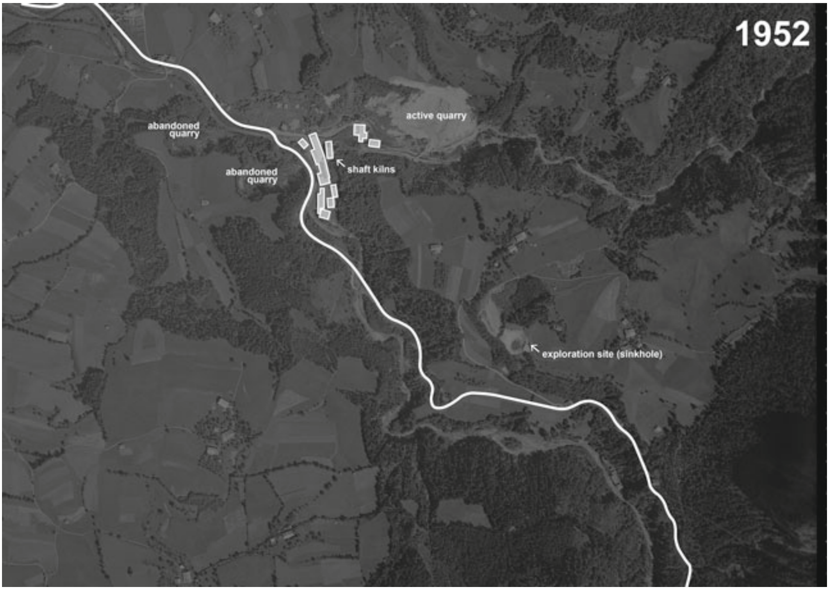
Main sources of information for the regional and site profiles:

- email interview (questionnaire) with Christian Drechsler and Martin Sailer (spatial planning dep. Land Tirol), 8.03.2018

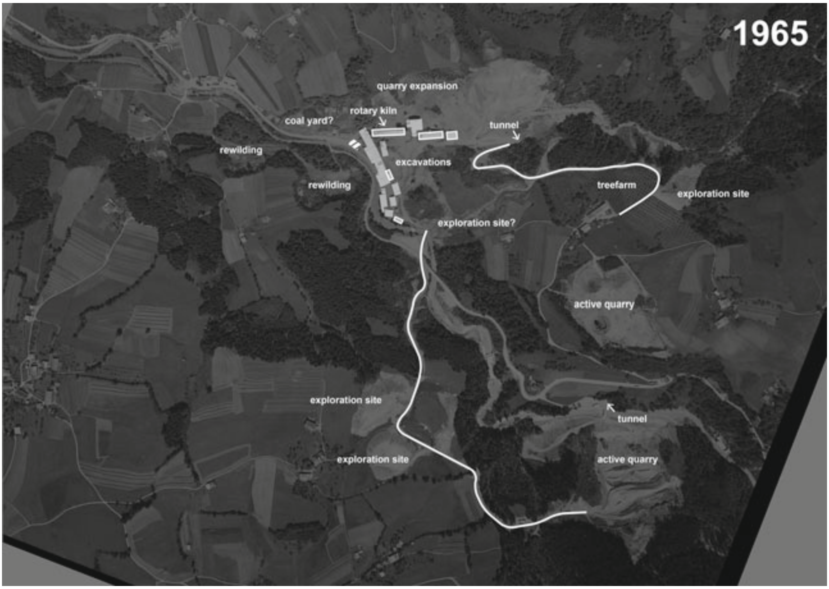
- face-to-face interview with Hintner Heinz (CEO Rohrdorfer Sand und Kies), 3.08.2018
- face-to-face interview with Josef Blößl (production manager SPZ Zementwerk Eiberg), 5.08.2018
- email interview and exchange with Josef Dillersberger (Mayor of Schwoich), 26.02.2019
- Bezirk Kufstein—Regionsprofil Statistik 2019 (tirol.gov)—regional data BK
- Leader region KUUSK (Kufstein-Umgebung / Untere Schranne-Kaiserwinkl)—Lokale Entwicklungsstrategie 2014–2020—regional development strategy KUUSK
- Integrierte Wirtschaftsförderung in Kufstein (MPRA Paper 88284, 2018)—regional economic profile BK
- ZukunftsRaum Tirol_2011 Strategien zur Landesentwicklung—territorial development strategy Tirol 2011
- Lebensraum Tirol_Agenda 2030 (Raumordnungsplan)—spatial development plan Tirol 2030
- Gesteinsabbaukonzept Tirol 2013—quarrying/mining plan 2013
- Treichl H. (2014). *In jeder Hinsicht bindend. Zementerzeugung im Bezirk Kufstein.* Rohrdorfer.
- Kirchmair F. (1988). *Schwoicher Dorfbuch.* Schwoich Gemeinde.

7.2.3 Site Preliminary Study

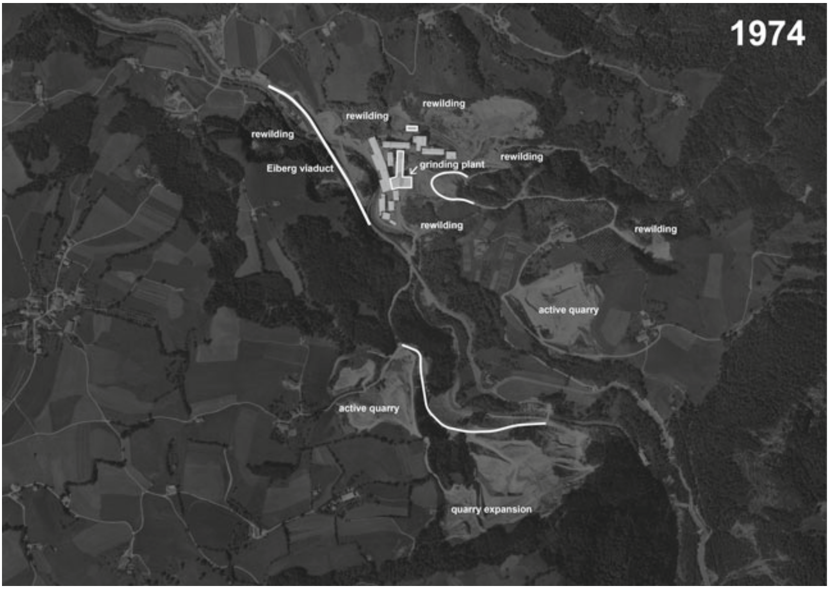
The following site preliminary study is based on both single and comparative analysis of six corrected aerial photographs (orthophotos) covering the time frame 1952–2015. The selection of suitable photos has been done by considering a temporal distance among each other of approximately 10–15 years, although this was not always possible due to the limited availability of the material. The selected orthophotos refers to the following years (source in brackets): 1952 (BEV), 1965 (BEV), 1974 (Luftbildatlas Tirol), 1990 (Luftbildatlas Tirol), 2004 (Luftbildatlas Tirol), 2015 (Luftbildatlas Tirol). The collected material provides a good and detailed coverage of both the cement plant site and the surrounding landscape, thus allowing an easy recognition of temporal changes. The cement plant as represented in the first available picture (1952) is the result of the 1940 s radical refurbishment. Before that date, the only available visual material of the previous cement plant structure is a panoramic overview dating back to early 1900 s.



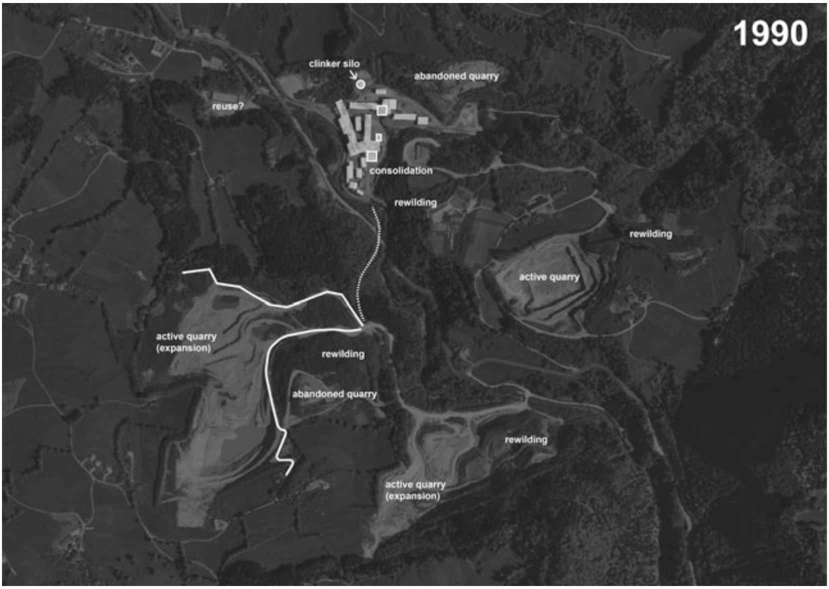
1952—The cement plant is located on a tiny strip of land at the bottom of a narrow canyon formed by the confluence of the Glaisbach and the Weißache. The plant's built structures are organised on a dense north-south axis, with just the grinding plant standing separate on the east side. Several quarrying sites can be spotted in the vicinity. A first, large operating quarry is located right to the east of the cement plant, beyond the grinding plant, on the right shore of the Glaisbach. A second quarry can be spotted on the south, far distanced from the previous one and the cement plant too. A funnel-type open pit is clearly visible, which indicates that the quarry is still being explored. Two abandoned (older?) quarrying sites of limited size are also existing on the west side of the plant, beyond the Weißache and the Eibergstraße. The surrounding landscape is predominantly shaped by agricultural fields and woodlands.



1965—The cement plant is expanding towards the quarrying site on the west side. New buildings are then visible, among which the rotary kiln facility. The west edges of the cement plant are now merged completely into the expanding quarrying site, which includes new excavations on the area behind the shaft kilns. The quarrying landscape on the south of the cement plant has expanded considerably. Two active quarries are now existing on both sides of the Weißache canyon, the northern one including two funnel pits and the southern one with slope terracing. Several exploration sites (small-scale excavations) are also visible. To connect the distanced quarries and exploration sites with the cement plant, two new roads have been built, as well as an underground tunnel (whose entrances are clearly visible). Next to the cement plant, the two little abandoned quarries are rapidly rewilding.



1974—The cement plant is further expanding with the addition of a new grinding plant next to the kilns and other minor buildings. The immediate surroundings of the cement plant are also being gradually transformed by further excavations on the south-east and the progressive abandonment of the first quarrying site, now with visible rewilding areas. Major landscape transformations are also occurring on the west side of the cement plant, especially after the construction of the new Eiberg viaduct—to replace the old Eibergstraße road along the Weißache (the section next to the cement plant). The southern quarries have significantly expanded, with many new excavation layers clearly visible. Some of the previous exploration sites are now being fully exploited, while others (Glaisbach side) are instead abandoned and rewilding. New roads have also been created to connect the quarrying site among each other.



1990—The cement plant builtscape is almost unchanged, with the sole exception of a few new buildings (noticeably the clinker silo). The surroundings of the plant are instead rapidly rewilding as result of ceased excavation activities. Just a few bare mineral surfaces are now visible in the early quarrying sites. The complex mining landscape on the south of the plant has also many visible changes. The funnel pit quarry is expanding and deepening through massive terracing. The southernmost quarry is also expanding (to the west), but a large portion of it is already abandoned. The westernmost quarry has undergone a significant expansion, with many lots of farmland now being excavated. At the same time, previous excavation areas have been abandoned and thus rewilding. New road sections have been created to support this latter expansion, while old sections are abandoned.

2004—The cement plant and dense reforestation can be noticed all around the cement plant, especially in the Glaisbach canyon, as well as across the whole related mining landscape. The active quarrying area on the south is also undergoing a significant shrinkage, with just the funnel pit quarry and the northern portion of the western quarry currently being exploited. The southern part of the latter is now abandoned, as early succession and the formation of a small lake clearly indicates. Similar developments are occurring within the southernmost quarry, where the activities are completely ceased. On the far east side of the mining area, a former exploration site seems to have been transformed into a dump site, which is linked to the cement plant through a road passing next to the funnel pit. The built core is shrinking as result of some punctual demolitions, e.g. the old shaft kilns. Widespread rewilding.

2015—The rotary kiln facility and the nearby grinding plant have been demolished, thus generating a significant change in spatial organisation of the easternmost part of the cement plant site. The downsizing of production activities at the plant can be also noticed by the little presence of maintained open spaces compared to vast underused surfaces. In a few spots (lower levels of the first abandoned quarry, clinker silo area, roadside south-east of the plant) the clearing of vegetation suggests a reuse of such spaces, though not significant and probably just temporary (e.g. open storage of raw materials or debris). The only active quarry is now the funnel pit, while the two other large southern quarries being completely abandoned—though cleared in the inner parts, probably due to the filling with waste material from other excavation sites. The waste dump is expanding to the south-east on nearby grassland.

7.2.4 Photographic (field) Study

The field trip took place on 2–8.08.2018. At first, a “guided” tour of the cement plant and the quarries by car (with stops) was provided by Mr. Heinz Hintner (CEO Rohrdorfer Sand und Kies). The owner gave the permission to freely access the site (gate keys provided) for the entire field trip, with the exception of night time and Sundays. The photographic study took place on several days, shifting between the cement plant site and the surroundings, with much time spent for the extensive mining landscape. The field exploration mainly occurred on foot, but driving was often necessary to cover long distances between different “spots” and to grasp a quick overview on the landscape. A second meeting with the site owners (including Mr. Hintner and the cement plant director) was held in the meantime, to collect more material about the site and to clarify further points/questions. Selected photographs include overviews of the cement plant from the surrounding reliefs (at different distances) as well as “inward” views of the cement plant site (buildings and open spaces) and the quarries landscape. The keymap below provides the exact location and orientation of each image (Fig. 7.7–7.30).

Fig. 7.7 The cement plant nestled at the bottom of the Eiberger Becken, surrounded by the rolling Häring plateau. In the background, the Brandenberg Alps facing the Inn valley

Fig. 7.8 Overview of the cement plant from north, towards the Pölven massif

Fig. 7.9 The cement plant seen from the B 173 (Eibergstraße) viaduct, framed by the Eibergkopf (right) and the Scheffauer (left) mountains

Fig. 7.10 Overview from Eiberg top, with the ancient sawmill buildings on the left (reconverted in workshops and offices) and the silo building on the right

Fig. 7.11 The clinker silo seen from the Eiberg top

Fig. 7.12 The Weißache flowing next to the cement factory

Fig. 7.13 The former packaging halls and the old silo building facing the entrance of the site. On the right side, beyond the barriers, runs the Weißache

Fig. 7.14 The 'courtyard' in the centre of the cement plant created after the demolition of the old shaft kilns, surrounded by silos (right) and the grinding plant (left)

Fig. 7.15 The huge silo building towering the workshops and offices hosted in ancient sawmill buildings

Fig. 7.16 An aerial conveyor belt connecting the disused production halls to the clinker silo

Fig. 7.17 The massive clinker silo standing next to the bare rocks in the ancient Haberg quarry site

Fig. 7.18 The unfinished silo building facing the terraced Eiberg quarrying site, long abandoned

Fig. 7.19 Partial overview of the former Haberg quarry, now almost completely camouflaged by secondary succession

Fig. 7.20 The upper entrance to the Schmiedl open pit quarry

Fig. 7.21 Overview of the still active Schmiedl quarry, overlooked by the Scheffauer

Fig. 7.22 Tailings and wastelands near the Schmiedl quarry. In the background, the bulky Eibergkopf profile

Fig. 7.23 The southern part of the abandoned Neuschwendt quarry. In the background, the Winterkopf (left), the Scheffauer (centre) and the Eibergkopf (right)

Fig. 7.24 The sterile wasteland at the bottom of the Neuschwendt quarry, towards the Pölven massif

Fig. 7.25 Tailings and secondary succession on the southern edge of the Neuschwendt quarry

Fig. 7.26 The abandoned Matzing quarry at the foot of the Pölven

Fig. 7.27 The bare slopes and bottom of the Matzing quarry partially covered by secondary succession. In the background, the towering Eibergkopf

Fig. 7.28 Long abandoned quarrying slopes covered by spontaneous woodlands

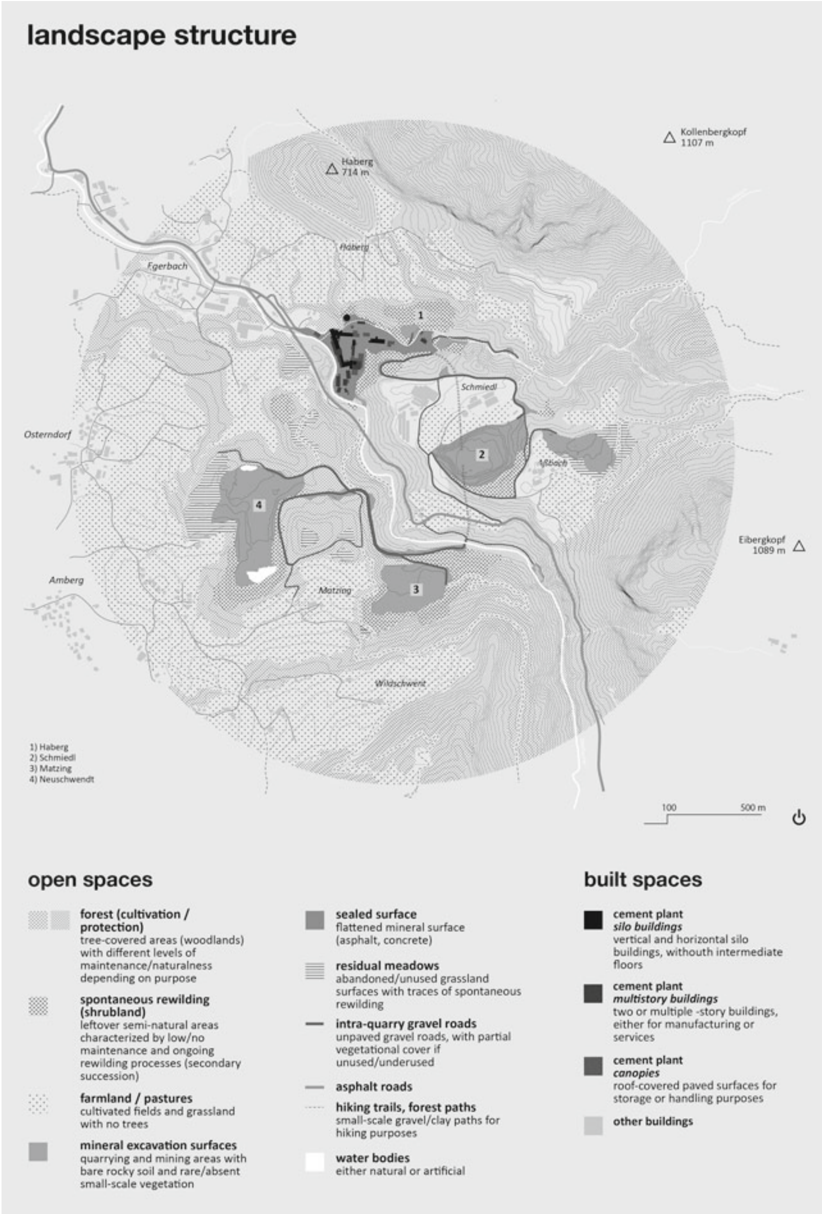
Fig. 7.29 A crossroad between gravel roads connecting the Matzing and Neuschwendt quarries, surrounded by either managed or secondary succession forests

Fig. 7.30 A gravel road near the Neuschwendt quarry, surrounded by secondary succession forest

7.2.5 Site Advanced Study

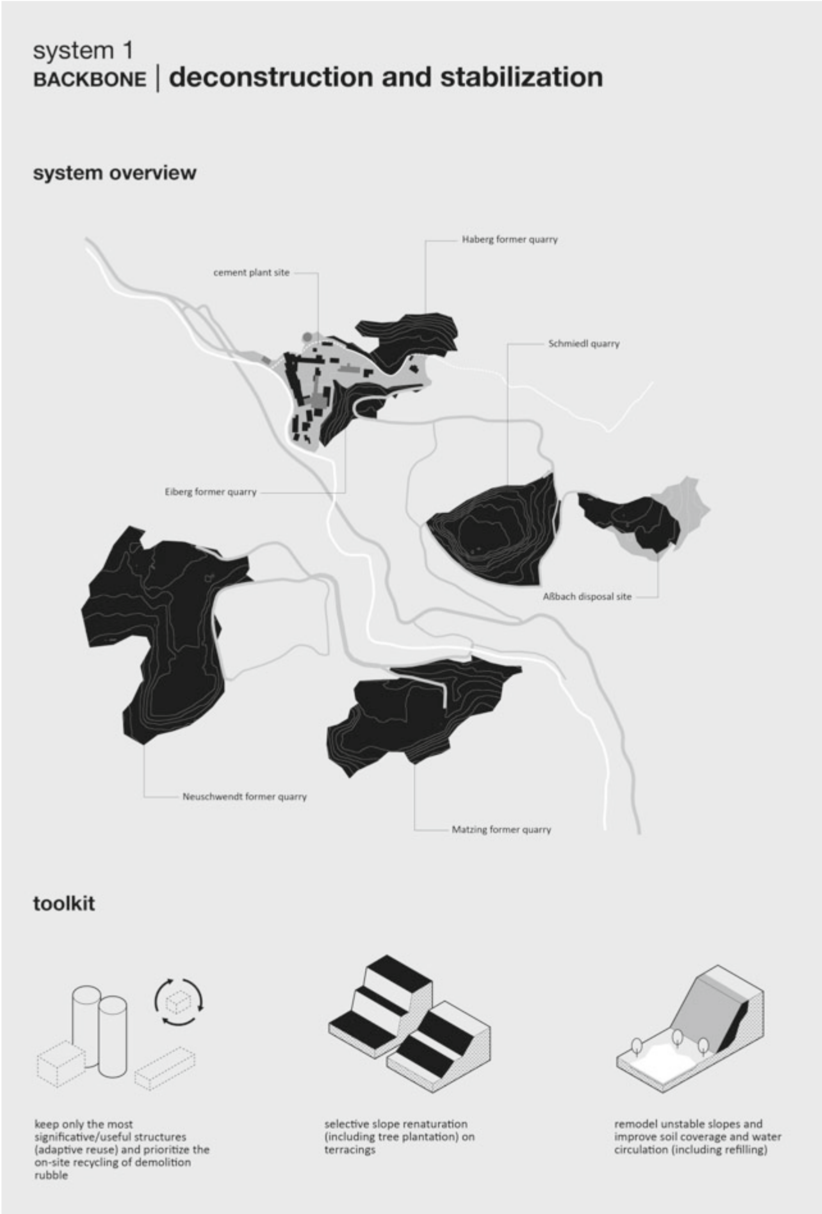
Landscape structure

The landscape structure of the cement plant, which necessarily includes the quarries and attached infrastructures and spaces, is strongly determined by the topography of the area. This makes the overall structure rather complex, at a first glance undefined in its key elements and perimeters. However, at a closer look it can be noticed the presence of some 'hard' elements, such as the cement plant site—with its sealed-off surface and the very high building density—and the mineral excavations surfaces within the quarrying sites, as well as 'connecting' or linear elements, such as the gravel roads between the quarries and the cement plant site, the water system and the minimal but extensive network of small roads and paths within and all around the site. A patchwork of 'soft' elements, including the variety of semi-natural spaces (forests, shrublands, farmlands, etc.) around the site, increases the thickness of the landscape structure. In particular, a system of woodlands, either protection/cultivation forests or spontaneously rewilding shrublands on the perimeter of excavation sites, enhances the physical integration of all the constituting elements of the industrial (altered) landscape.


landscape structure
Kollenbergkopf
1107 m
Haberg
714 m
Haberg
Egerbach
1
Schmiedl
Osterndorf
2
4
Eibergkopf
1089 m
Amberg
Matzing
3
Wildschwent
1) Haberg
2) Schmiedl
3) Matzing
4) Neuschwendt
100
500 m
open spaces
forest (cultivation / protection)
tree-covered areas (woodlands) with different levels of maintenance/naturalness depending on purpose
spontaneous rewilding (shrubland)
leftover semi-natural areas characterized by low/no maintenance and ongoing rewilding processes (secondary succession)
farmland / pastures
cultivated fields and grassland with no trees
mineral excavation surfaces
quarrying and mining areas with bare rocky soil and rare/absent small-scale vegetation
sealed surface
flattened mineral surface (asphalt, concrete)
residual meadows
abandoned/unused grassland surfaces with traces of spontaneous rewilding
intra-quarry gravel roads
unpaved gravel roads, with partial vegetational cover if unused/underused
asphalt roads
hiking trails, forest paths
small-scale gravel/clay paths for hiking purposes
water bodies
either natural or artificial
built spaces
cement plant
silo buildings
vertical and horizontal silo buildings, withouth intermediate floors
cement plant
multistory buildings
two or multiple -story buildings, either for manufacturing or services
cement plant
canopies
roof-covered paved surfaces for storage or handling purposes
other buildings

Landscape transformation systems

The proposed site transformation follows and integrates the indications of existing plans and regulations, as expressed by the site owning company and the local/regional institutions. The transformation is therefore addressed to the productive-oriented reuse of the cement plant site on the one hand, and to the reclamation and recultivation of the post-mining landscape of the quarries on the other hand. In the transformation process, the cement plant site and the quarries are always considered together, as mutually dependent interacting spaces/objects. The transformation process is structured on the three identified systems: the "backbone", which focuses on first priority actions such as the cement plant deconstruction and the stabilisation of quarries; the "borders", which deals with the refurbishment of the extensive gravel road network and surrounding semi-natural spaces; the "core", which aims to the cement plant site reactivation for new purposes. As such, the process will allow a gradual reconversion of the entire industrial landscape generated by the cement plant activities as well as its environmental and economic re-integration into the context. The cement plant site is radically transformed through the removal of 90% of the existing buildings and key ecological measures (river shore renaturation, de-sealing, uncover of natural water flows, etc.) and prepared to host new productive activities. The quarries and the attached gravel road network are reclaimed and turned, mostly through minimal interventions, into new functional components of the local and regional network of green spaces and recreational infrastructures.


system 1
BACKBONE | deconstruction and stabilization
system overview
Haberg former quarry
cement plant site
Schmiedl quarry
Eiberg former quarry
Aßbach disposal site
Neuschwendt former quarry
Matzing former quarry
toolkit
keep only the most significative/useful structures (adaptive reuse) and prioritize the on-site recycling of demolition rubble
selective slope renaturation (including tree plantation) on terracings
remodel unstable slopes and improve soil coverage and water circulation (including refilling)

system 1
transformation phases

1 / sites and buildings identification

The working site includes four main quarries (Haberg, Schmiedl, Matzing, Neuschwendt) characterized by a different topography, usage and abandonment status, as well as the those built structures most difficult to reuse due to status/layout (old silos along the Weissache, sparse small buildings and canopies). *SHs: Rohrdorfer, Land Tirol (Raumordnung), Schwoich/Söll municipalities.*

2 / hard stabilization + selective demolition

The quarries with unstable topography, steep slopes and precarious conditions (Haberg north, Matzing and Neuschwendt south sides) are stabilized and landscaped. These include slope remodeling and partial refilling with demolition rubble. For this purpose, the massive concrete buildings along the river are demolished and the material is processed (filtered and crushed) in the existing grinding plant. *SHs: Rohrdorfer, Land Tirol (Raumordnung, Umwelt - Landschaft).*

3 / soft stabilization

The leftover quarrying sites (Haberg south, Schmiedl funnel, Matzing and Neuschwendt central flat area) are gradually stabilized through site-specific soil remodeling operations (flattening). The remaining cement plant buildings (mostly concrete canopies and isolated redundant structures) are demolished and the material also processed and eventually used in the quarries stabilization. *SHs: Rohrdorfer, Land Tirol (Raumordnung, Umwelt - Landschaft).*

4 / renaturation and recultivation

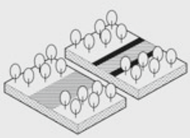
Once stabilization is concluded, renaturation and recultivation can take place: slope dense reforestation (south side of Matzing and Neuschwendt, Schmiedl terracings, Haberg north and south sides), flat sparse reforestation (Neuschwendt and Matzing centre, Schmiedl top, including the Aßbach deponie) and wetland restoration (Neuschwendt depressions and Schmiedl bottom). *SHs: Rohrdorfer , Land Tirol (Raumordnung, Umwelt - Landschaft, Land - Forstwirschaft).*

system 2

BORDERS | infrastructural conversion

system overview

toolkit

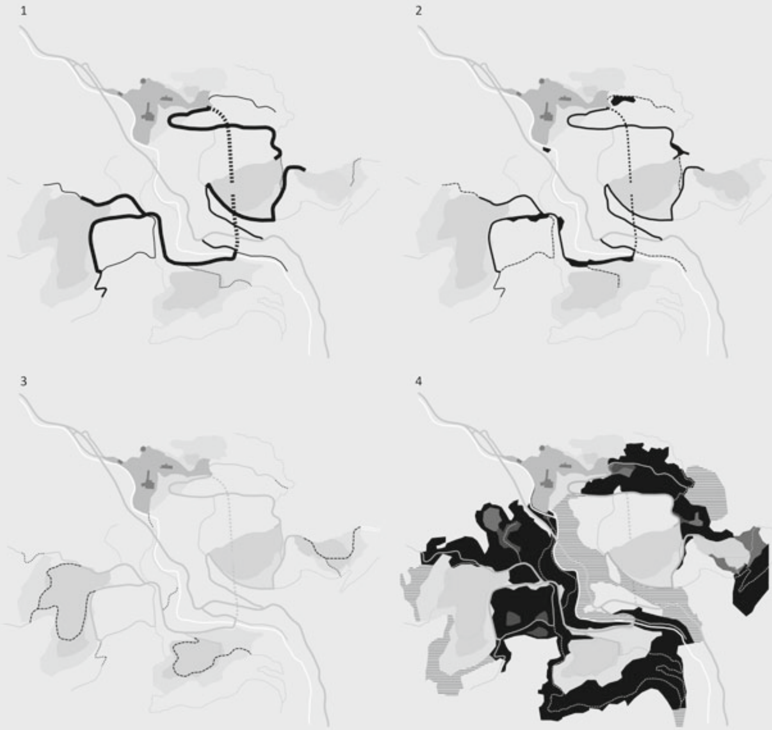


reduction by size of main gravel road section, including greening on the margins (buffer zone between forest and road)

equip the newly developed hiking paths and trails with basic services and infrastructures (water collection systems, rest areas, indications, etc.)

improve accessibility to existing and potential recreation areas (restored quarries, forests) and habitats (wetlands, meadows)

system 2
transformation phases



1 / network hierarchization

The existing network of gravel roads is divided in four typologies on the basis of the relative importance within the system: 1) main roads, connecting quarries among each other and the cement plant; 2) secondary roads, conencting main roads with public roads; 3) dead-end roads, ending up in forested areas and thus used also as servitude; 4) minor paths. *SHs: Rohrdorfer, Schwoich/Söll municipalities.*

2 / network refurbishment

The existing network is restored through minimal interventions (holes flattening, water collection systems, sideways adjustment), including the creation of small rest areas on the roadside where there is available space. For those sections of the network which are also used as forestry servitudes, a flexible use should be taken into account. *SHs: Rohrdorfer, Schwoich/Söll municipalities.*

3 / gap filling

The missing sections of the network are identified and recovered, either by the refurbishment of abandoned paths or by creating new ones. Two typologies of gaps are identified and treated accordingly: missing sections on the borders of the network, connecting the site network with the regional network of paths, and cross-quarry paths, to be designed or highlighted. *SHs: Rohrdorfer, Schwoich/Söll municipalities, private land owners.*

4 / buffers and interstices

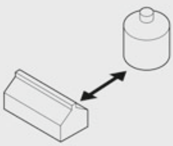
The open and semi-natural spaces within and around the road network, usually consisting of protection and/or spontaenous forests and wetlands, are enhanced through ecological measures (selective renaturation and wetland management) and further integrated into the network by means of easy and clear accessibility. *SHs: Rohrdorfer, Schwoich/Söll municipalities, land owners, Land Tirol (Umwelt/Landschaft).*

system 3

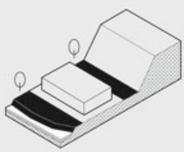
CORE | site preparation

system overview

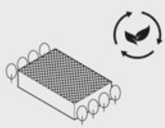
toolkit



connect visually and phisically the leftover buildings/structures by mean of artificial and natural infrastructures



keep a mitigation buffer between the new development in the site and the surrounding water bodies and steep slopes



ensure a low environmental and visual impact for all the new industrial buildings and structures

system 3
transformation phases

1 / sites and buildings identification

The cement plant site is freed from the remaining bulky buildings, such as the grinding plant and the attached silos, which are demolished and possibly recycled on the site premises. Other buildings and structures with good reuse potential due to architectural space and location are instead kept, such as the clinker silo and the raw material bunkers. *SHs: Rohrdorfer.*

2 / re-definition of edges

The actual site edges are re-defined and adjusted according to the existing topography. The eastern edge is traced on the baseline of the terraced slope of the former Eiberg quarrying site. The south-western edge, now corresponding to the Weissache riverbed, is drawn back to allow more space to the river. The northern edge is also drawn back from the current problematic baseline of the Haberg slope to the southern side of the Glaisbach. *SHs: Rohrdorfer, Schwoich/Söll municipalities.*

3 / de-sealing and ecological restoration

The areas enclosed between the old and new site edges are de-sealed as much as possible and returned to a seemingly-natural state. The Weissbach edge is turned into a green buffer zone between the site and the river. The larger Glaisbach edge is transformed into a multifunctional wetland park, including the re-opening of the Glasibach underground section and the inclusion of the preserved buildings. *SHs: Rohrdorfer, Schwoich/Söll municipalities, Land Tirol (Umwelt/Landschaft).*

4 / building zones and occupancy

The resized inner area is prepared to host new buildings through the definition of building zones and maximal footprint. These should take into account the proper distance from the Eiberg (renaturalized) slope as well as from the newer ecological edges. The main access remains the same of the cement plant, already equipped with a recently built gatehouse. *SHs: Rohrdorfer, Schwoich/Söll municipalities.*

7.3 Case Study II: Ascometal-Winoa, Le Cheylas / F

7.3.1 Regional Overview

Identification

Cultural region: Northern French Alps (Alpes du Nord) > Savoy Prealps (SOIUSA 8) and Graian Alps (SIOUSA 7) > Moyen-Grésivaudan.

Administrative region: NUTS 2: Région Auvergne-Rhône-Alpes > NUTS 3: Isère (FR714) > Communauté de communes Le Grésivaudan (43 municipalities).

Geography

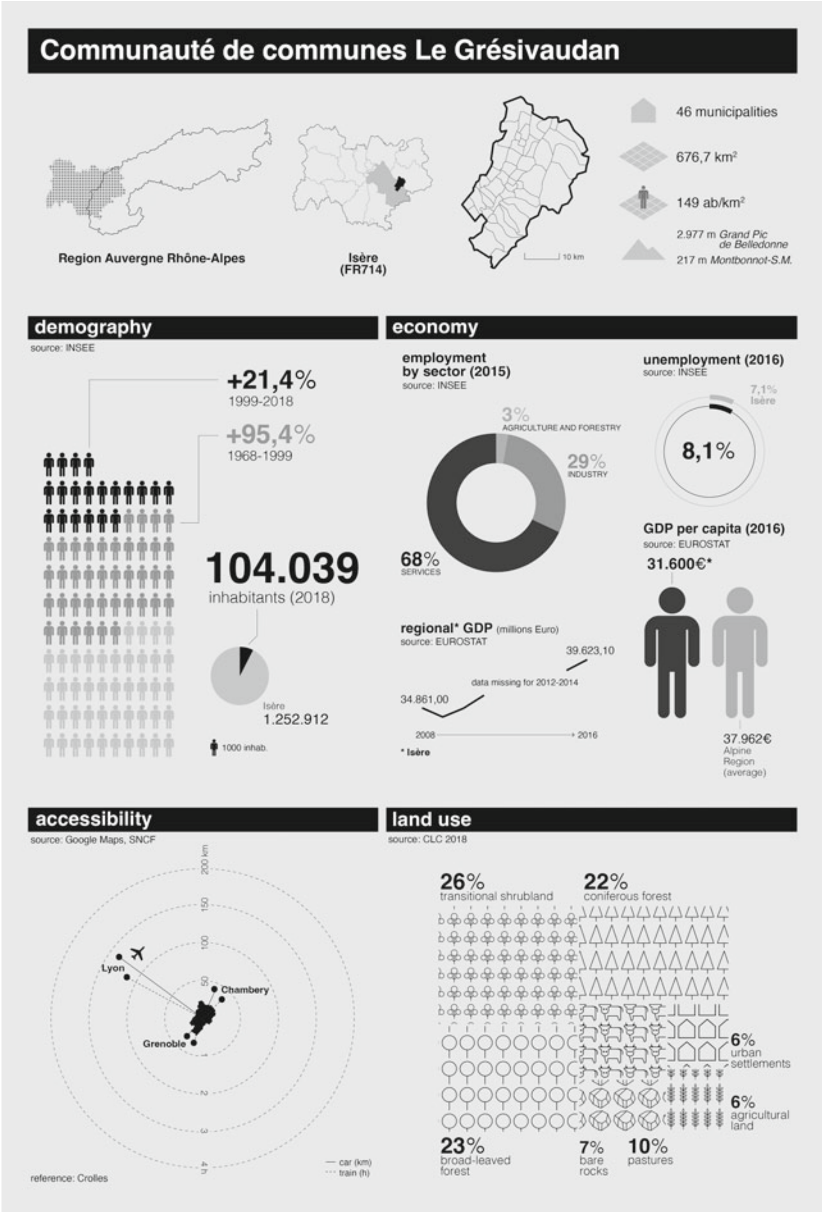
The region is located in the Northern French Alps, part of the Western Alps, and in particular it lays in the transition zone between the inner upper ridges of the Dauphine Alps (Alpes du Dauphiné) and the outer Savoy Prealps (Préalpes de Savoie). The Moyen-Grésivaudan identifies the middle section of the valley of the Isère river (Grésivaudan), roughly comprised between Grenoble in the south and Pontcharra in the north. This is part of a wider valley system known as Sillon Alpin, a glacial groove stretching from the Voreppe gorge towards the junction between the Isère and the Arly in Albertville, today hosting the largest urban agglomeration in the whole Alpine region (which includes the cities of Grenoble, Chambéry and to some extent also Annecy). The wide and flat valley floor between Grenoble and Pontcharra, which constitutes the geographical and socio-economic backbone of the region, is bordered on the west by the crystalline reliefs of the Belledonne range (Grand Pic de Belledonne, 2.977 m) and on the east by the rough, calcareous Chartreuse massif (Chamechaude, 2.082 m). The physical 'compression' of the valley floor between the two mountain ranges is softened by a sequence of terraces and plateaus on both sides: the "Balcon de Belledonne" (Allevard, Theys, Saint-Martin-d'Uriage) on the Belledonne side and the "Plateau des Petites Roches" (Saint-Hilaire-du-Touvet, Sainte-Marie-du-Mont) on the Chartreuse side. The topography of the valley floor is therefore defined by several deep gorges generated by small streams, instead of true side valleys. The same applies to the river system, which is dominated by the rectified course of the Isère and a few minor tributaries, such as the Breda flowing down from the Belledonne massif.


Le Grand Morétan
(Belledonne)
2,775 m
La Rochette
Allevard
Brame Farine
1,210 m
Pontcharra
45°22'54.8"N
5°59'55.4"E
Goncelin
Sommet du Pinet
(Chartreuse)
1,867 m
Lances de Malissard
(Chartreuse)
2,045 m

Accessibility
The favourable location of the Moyen-Grésivaudan on the western border of the Alps, at the crossroads of north-south (Geneva-Marseille) an east-west (Turin-Lyon) corridors, makes its accessibility very high compared to the other French Alpine regions. As part of the Sillon Alpin urban agglomeration, and in particular due to its function as transit corridor between the urban poles of Grenoble and Chambéry, the valley hosts primary infrastructures among which the motorway A41 Grenoble-Geneve and the Grenoble–Montmélian railway. Furthermore, the valley is crossed by the parallel-running departmental roads RD523/923 (left side of the Isère, from Grenoble to Montmélian) and RD 1090 (right side of the Isére, from Grenoble to Bourg-Saint-Maurice and the Petit-Saint-Bernard pass). From either Chambéry and Grenoble, Lyon can be reached in less than 100 km respectively with the motorways A43 and A48. The Lyon and Geneve international airports can be reached in around 1h30' from the centre of the Moyen-Grésivaudan by car, and 2h15' or 3h respectively by train. Other airports in the vicinity are the regional ones of Grenoble and Chambéry. Another relevant connection is towards Italy, as Chambéry is intercepted by the historical Frejus railway line between Turin and Lyon, which runs through the Susa (Italy) and Maurienne (France) inner Alpine valleys. As part of the EU TEN-T Mediterranean Corridor, the Turin-Lyon railway is interested since the early 2000 s by major refurbishment and update projects, among which the ambitious high-speed line whose completion (foreseen for 2030) is relented by financial problems and socio-political frictions. The high-speed line is expected to cross the upper ridges of the Graian Alps with a 57,7 km -long base tunnel (between Susa and St. Jean de Maurienne) and, further towards Lyon, to cut the Grésivaudan valley between Pontcharra and Montmélian. Once completed, this will allow an extremely high accessibility to the Grésivaudan valley and to the Grenoble-Chambéry agglomeration too. Compared to the "corridor" represented by the Isére valley floor, side valleys and plateaus are much less accessible, as reached by small local roads only.

Socio-demographic profile
The Communauté de communes Le Grésivaudan (CC Grésivaudan) includes 46 municipalities covering an area of 676,7 km^2, with a population of 104.039 inhabitants (2018). After the Grenoble urban area and the Porte de l'Isère agglomeration (part of Lyon metropolitan area), the CC Grésivaudan is the third most populated region within the Isère department (8% of the total department population). This is the result of an impressive population growth experienced by

the Grésivaudan region in the past fifty years, mainly as result of the expanding urban agglomerations of Grenoble and Chambery. The regional population registered an increase of + 95% in the period 1968–1999 (with peaks in the 1980 s–1990 s) and a further + 21% in 1999–2018. The average population density of 149/km^2 is indeed higher in comparison to either that of the French Alps (65,8/km^2) and the Alpine region too (76,4/km^2), but slightly lower than the Isère department (168,4/km^2)—which is half flat and half mountainous. The distribution and composition of the population are rather unequal within the region. In terms of distribution, most of the population is concentrated in the flat and wide Isère valley floor (i.e. the Grésivaudan valley), while the surrounding plateaus and side valleys are sparsely populated. In recent years, however, the highest rates of population growth were registered mostly in 'mountain' municipalities in peripheral areas (e.g. Allevard). In terms of composition, the unequal territorial distribution is more between south and north rather than between lowlands and mountains. The south-western part of the region, which is close to Grenoble and falls partially within its urban area, is characterized by a majority of young, qualified and high-income inhabitants (due to the local presence of many high-tech firms and high-profile activities), while the north-eastern part, close to Chambery and the Combe du Savoye, has higher rates of older and less skilled inhabitants. The internal migration of young families (30–40 y.o.) from the urban area of Grenoble is a major cause of the population growth in the CC Grésivaudan territory, as well as of the age composition. In fact, 31% (2006) of the regional population is between 35–54 y.o. (28% in Isére), followed by a high proportion of children below 15 y.o. and youngsters of 20–29 y.o., while just 6% is above 75 y.o. The socio-demographic profile of the CC Grésivaudan is typically that of suburban areas of inner-Alpine agglomerations.


Communauté de communes Le Grésivaudan
Region Auvergne Rhône-Alpes
Isère (FR714)
10 km
46 municipalities
676,7 km²
149 ab/km²
2.977 m Grand Pic de Belledonne
217 m Montbonnot-S.M.
demography
source: INSEE
+21,4%
1999-2018
+95,4%
1968-1999
104.039
inhabitants (2018)
Isère
1.252.912
1000 inhab.
economy
employment by sector (2015)
source: INSEE
3% AGRICULTURE AND FORESTRY
29% INDUSTRY
68% SERVICES
unemployment (2016)
source: INSEE
7,1% Isère
8,1%
GDP per capita (2016)
source: EUROSTAT
31.600€*
37.962€ Alpine Region (average)
regional* GDP (millions Euro)
source: EUROSTAT
39.623,10
data missing for 2012-2014
34.861,00
2008
2016
* Isère
accessibility
source: Google Maps, SNCF
Lyon
Chambery
Grenoble
200 km
150
100
50
1
2
3
4 h
car (km)
train (h)
reference: Crolles
land use
source: CLC 2018
26% transitional shrubland
22% coniferous forest
6% urban settlements
6% agricultural land
23% broad-leaved forest
7% bare rocks
10% pastures

Economic profile
The CC Gresivaudan territory is characterized by a productive-oriented advanced economy, fostered by the spatial and relational proximity to Grenoble and its metropolitan area. The hosting region, the Isère department, has a GPD per capita of 31.600 Euro (2016), which is in line with that of the larger Auvergne Rhône-Alpes (31.639 Euro) but lower than the Alpine average (37.962 Euro). On the contrary, unemployment is slightly higher in the Gresivaudan area (8,1%, 2016) than in Isère (7,1%). The economic geography and structure of the Gresivaudan resembles that of polycentric urban agglomerations, with a spatial concentration (clustering) of the most significant activities along a few key transport axes and a large share of services (68%) and industry (29%). Most of the services are indeed business services, strongly related to and integrated within the regional industrial system. The aggregation of workplaces in industry and services to industry makes the overall share of industry-related employment equal to 58%, a much higher value than the average of Isère (41%). Under the positive influence of the international knowledge and innovation hub of Grenoble (2 universities, national and international research campuses such as CNRS, ESRF and the Polygone Scientifique), the regional industrial system of Gresivaudan developed from the 1970 s towards cutting-edge, highly specialised sectors such as electronics, nanotech and IT. Several multinational enterprises with more than 1000 employees and own R&D facilities are based in the region, among which STMicroelectronics (nanotech), Soitec (semiconductors), Schneider Electric (electrical equipment) and Capgemini (IT consulting). In addition, 362 small and medium-sized companies with 11.174 employees (2014) are currently hosted in the Innovallée science park of Montbonnot-Saint-Martin, specialised on information and communication technology. The relevance of high-tech industries within the regional productive system is also well represented by the high proportion of top-skilled professionals (28%) compared to Isère (20%). On the other side, traditional heavy industries once based on hydropower are gradually disappearing since the 1980 s. The few still operating plants are mainly belonging to metalworking (Winoa, Almeco, Amcor Flexibles) and paper industry (Cascades RDM, Ahlstrom). The geographical distribution of industrial activities is strongly polarised between the south and the north of the region, as well as between the left and right sides of the Isère river. Most innovative and high-tech industries are located on the south-west of the region, at the border of the Grenoble metropolis, while traditional industries are (used to be) located mostly on the north-eastern side, due to the presence of the railway line and abundant water sources. The commuting flows between the Gresivaudan and Grenoble are well expressing the powerful economic integration between the core city and its agglomeration: 42% of CC Gresivaudan inhabitants work in Grenoble, while 29% of the regional jobs are occupied by Grenoble-based employees (2014). Besides industry and business services, other economic sectors are less developed

and little influential. Tourism is locally relevant in mountain areas (29.000 beds in 2006), and especially on the eastern plateaus at the foot of the Belledonne massif, where some renowned ski resorts are located (Sept-Laux, Prapoutel, Chamrousse, Collet d'Allevard). With only 400 farms currently active (providing around 500 jobs, 45% in mountain areas), agriculture is a rather marginal economic activity compared to the past. The recent creation of a regional agri-food pole with its own branding strategy (Alpes Is(h)ere) supports the high-quality development of the local agricultural sector towards specialization in organic products (e.g. Grenoble nuts).

Environmental profile

The environment of the mid Gresivaudan valley is highly heterogeneous, characterized by relevant differences between the mountain areas and highlands and the wide, flat valley floor. Despite the proximity to large urban areas, the reliefs on the west (Chartreuse massif) and the east (Belledonne chain) sides of the valley have high quality natural and semi-natural environments, most of which are classified as zones of ecological value (ZNIEFF) of priority 1 (highlands) and 2 (foothills). The calcareous Chartreuse mountains and their foothills are entirely included into a regional natural park established in 1995, which covers an area of 76.700 ha and an altitude range of 200–2.082 m. With 2/3 of mountain forest cover, 2000 flora species and 3 Natura2000 sites, the park constitutes, together with the nearby Bauges and Vercors regional parks, the most significant protected natural area in the northern French Prealps. The same protection status does not exist for the higher Belledonne mountain range, mostly because of the far lower urban pressure and the extensive highlands environment. Differently from the reliefs, the environment down in the Isère valley bed is much more affected by the widespread urbanisation and the infrastructural density. Biodiversity hotspots are nevertheless present, although highly fragmented. Among them, the ENS (natural sensible areas) of "le bois de la Bâtie" in St. Ismier, the "Marais de Montfort" in Crolles and the "Marais du Col du Coq" in Saint Pancrasse. Along the Isère an almost continuous system of alluvial forests is also existing, which includes several ZNIEFF areas and around 1200 wetlands (e.g. Biotope la Frette or le Mas des Essart). Such a valuable lowland ecological system is being gradually eroded and harmed by intensive agriculture, gravel pits along the river, infrastructural corridors and expanding urbanisation. A second relevant issue in terms of ecological connectivity, affecting the whole Gresivaudan valley system, is the lack of transversal or cross -linkages between the three main ecological corridors, i.e. the Chartreuse mountains on the west, the Isère alluvial forests and wetlands in the middle and the Belledonne mountains on the east. In terms of vegetation pattern, an equal distribution between broadleaves and coniferous forests can be noticed. With regards to the broadleaves, these are mainly concentrated in the warmer valley bed (mostly oak and elm trees, with relevant presence of black poplars and ash trees) and the foothills on both sides (oak and chestnut trees mixed with birch and beech trees). The reliefs are mostly covered by coniferous forests of mixed spruce-fir, beech, mugo pine (especially on the Chartreuse massif) and Swiss pine. Extensive shrublands can be found on the foothills, especially on the plateaus and terraces of Belledonne (at higher elevations) and Chartreuse (at lower elevations), as result of the shrinkage of used agricultural surface.

Spatial development trends and challenges
The Gresivaudan valley has experienced since the 1980 s a widespread and intensive suburbanisation process, fostered by the nearby growing metropolitan pole of Grenoble and the particular location along a major urban corridor (the Sillon Alpin formed by Grenoble, Chambery and Annecy regions). In the Gresivaudan, the share of urbanised land (including infrastructures) increased of + 7% between 1998 and 2003 only, and of a lower + 3,5% between 2003 and 2009. New residential areas accounted for around 2/3 of such urban development increase, while industrial and commercial zones for the remaining 1/3. However, the recent trend shows a little but significant decrease in urbanised land for housing—from 66,3% in 2003 to 61% in 2009—and an equal increase for industrial-commercial areas—from 33,7% in 2003 to 39% in 2009. Around 75% of these new urban developments occurred in the Isère flat and wide valley floor, with a spatial concentration in the south and north extremes, i.e. closer to the urban poles of Grenoble and Chambery/Savoie. The Gresivaudan can be clearly identified as an inner-Alpine suburban region, characterized by a recent and significant urban growth fostered by residential and recreational functions instead of workplaces. Faced with the topographic and spatial constraints provided by the surrounding reliefs, such an urban growth model usually gives rise to conflicts in land use. The little available space suitable for settlements, i.e. the valley bed, is shared mainly between urban areas (including transport and energy infrastructures) and intensive agricultural surfaces. Since 1990, around 95% of the newly urbanised land in the valley floor was previously used for cultivation and agriculture purposes. The abandonment of agricultural land in the Isère valley floor is not due to scarce accessibility and profitability, as usually occurs on mountain slopes and inner valleys, but it is mainly caused by expanding urban centres and lot forced 'isolation'. This process is not only harming (intensive) agriculture as an economic sector, but also indirectly it erodes open spaces and seals greenfields. The key spatial development challenges for the Gresivaudan territory can be synthesised in the need to overcome a suburban development model characterized by unsustainable land consumption and scarce functional resilience. An alternative development, able to reduce the economic, mobility and spatial dependency from the Grenoble metropolitan core, should be therefore addressed through: a) the diversification of

the functional uses of the urban land, in particular the limitation of further housing developments and the increase of attractive economic activities (workplaces); b) a better balancing of urban services across the whole territory, which means to improve the actual polycentric character of the urban system (no core city) and concentrate the key regional services in few strategic poles, instead of distributing them everywhere; c) the reduction of private mobility, an objective which can be indirectly reached through the previous strategies. In addition, an already operative strategy to limit land consumption while creating space for new economic activities is that one developed by the economic department of the CC Gresivaudan, which aims to recycle underused and/or abandoned industrial sites and facilities for new productive purposes (creation of Parc d'activités-PA, or activity zones). The CC usually acquires the sites, realises basic infrastructures and then promotes the establishment of new businesses through financial incentives and rent/sale frameworks. Currently, 14 PA are already existing (some of them hosting innovation clusters) and 3 brownfields are being recycled (among which the former paper mill in Lancey, turned into a co-working cluster for IT-companies).

7.3.2 Site Overview

Location

The site is located in the mid Gresivaudan valley, approx. 34 km from Grenoble (south) and 30 km from Chambéry (north). In particular, the site is located on the eastern margin of the large and flat valley floor, which reaches in this point the width of 3,5 km. On the east, the site is bordered by the soft-descending forested slope of the Bramefarine massif (1210 m), while on the north, west and south it is surrounded by the urban-agricultural landscape of the valley floor. The RN523 road axis and the parallel Grenoble-Montmélian railway divides the eastern half of the valley floor in three parallel strips, of which two are occupied by the site itself and its premises (waste dump and scrap yard) and the last one, next to the river course, by the huge artificial basin belonging to the EDF hydroelectric power station located next to the steelworks. In terms of urbanisation, the site is surrounded (but not directly flanked) by a few low-density settlements belonging to the municipality of Le Cheylas, namely Le Merciers on the south, La Gare and Le Villard on the north side. The accessibility to the site is extremely high due to the RN523 running nearby and the railway connection to the main line (currently out of use).

Background

The history of Le Cheylas steelworks dates back to the very beginning of the XX century, having its roots in the ancient Allevard ironworks. The latter, located in a gorge within the Belledonne massif, was running since 1873 a sophisticated transport infrastructure to link the production site to the new railway line running down in the Gresivaudan valley. In the vicinity of Le Cheylas, the upper section of that infrastructure, a narrow-gauge railway, was connected to the lower normal railway line through an inclined plane of around 500 m length. The flat land nearby the lower station of the inclined plane, next to the railway junction, was chosen in the late 1910 s to establish a modern electric steelwork. This decision represented a key step in the transition process from mineral-based ironmaking to hydropower-based steelmaking undergone by the former Allevard company—meanwhile reorganised and renamed as Société des Hauts Fourneaux et Forges d'Allevard (SHFA). The new factory and its related hydropower-generation network were completed between 1919 and 1921 (Fig. 7.31), initially producing ferroalloys through a 2000 kW electric arc furnace (EAF). Some years later, an agreement between SHFA and the metallurgical division of the French Ministry of Armaments led to the extension of the plant with the addition of a steelworks section, equipped with a new EAF fed with iron scrap. By 1943, most of the production previously carried on at Allevard was transferred definitively to Le Cheylas (Fig. 7.32). After the war, the production process was improved with the implementation, in 1955, of a continuous casting plant, the first of its kind in whole France. Another record was set in 1960, as the first plant for steel shot abrasives in Europe was opened just next to the steelworks by Wheelabrator-Allevard (WA), a joint-venture between Forges d'Alleverd and the American Wheelabrator Corporation, holder of the patent for this kind of production. To support the continuous casting as well as the steel abrasives plant, a new 20-tons EAF was installed in 1963, increased up to 40-tons in 1965 and further to 100-tons in 1971. To pursue a better vertical integration of the complete production process, the owning company decided to concentrate all the activities in the site of Le Cheylas between 1970 and 1974, thus leading to the definitive closure of older and smaller sites such as that of Allevard and Saint-Pierre. As result, the steelworks site was expanded with the addition of two large rolling mills (1972–78), while a new hydroelectric power station was also built in Pinsot, in the upper Bréda valley (1973–74). Despite the world steel crisis of the early 1980 s, the steelworks of Le Cheylas recorded good performances while pursing increasing specialization (Fig. 7.33). The former Forges d'Allevard company was dismantled and the two integrated facilities transferred to the new holding Allevard Industries, with the steelworks being controlled by the subsidiary Aciers d'Allevard and the steel abrasives plant still managed by WA. In mid 1980 s, the steel abrasives plant of Le Cheylas was among the largest of its kind worldwide, employing 150 people and producing around 150.000 tons of steel shots per year. A major corporate transformation led to the split, in 1986, of the two facilities, as the steelworks (Aciers d'Allevard) was sold to Valeo Group while the steel abrasives plant remained in the hands of WA—from 1991 onwards 100% owned by the French CGIP (Compagnie Générale d'Industrie et de Participations). In the 1990 s the steelworks, which employed around 600 people producing mainly steel components for the car industry, was transferred from Valeo to USINOR Group subsidiary Ascometal (1992) and then to the Italian steelmaking company Lucchini (1999). The economic crisis of 2008 and the related troubles in the global steel market forced Lucchini to stop some of its facilities, among which the EAF steelworks of Le Cheylas (2010). To get rid of the 360 million Euro of debts accumulated by Ascometal, Lucchini sold the company to the American investment fund Apollo Global Management in 2011, who proceed to the gradual stop of activities. The first rolling mill was dismantled soon in 2011, followed by the second one in 2013 and, after the dismissal of the remaining 108 workers, the complete closure of the site in 2015. One year later, the former steelworks property, including the attached railway network and other facilities, was acquired by STS real estate company, aiming to redevelop the site as a logistic and multi-firm industrial park. The WA steel abrasives plant, meanwhile renamed WINOA, continued and improved instead the production becoming a world leader in its niche sector.

Fig. 7.31 The steelworks in the first years of activity, around mid 1920 s

Current use and future plans

The former Ascometal property, owned by the real estate developer STS, covers around 30 ha (70% of the whole site) of which 30.000 m^2 built-up. The property includes the core steelworks area (EAF plant, rolling mills, etc.), part of the forested slope on the backside (up to Rue de Bramefarine) and the waste dump site next to the railway line. The original plan of STS after the acquisition was to transform the site into a logistic platform, taking advantage of the existing railway infrastructure and the strategic proximity (10 linear km) to the future Turin-Lyon high-speed railway. However, due to technical and bureaucratic problems (missing authorisation) and uncertainty about the future railway corridor, this plan was put aside and replaced with an incremental and flexible transformation strategy based on turnkey rental of existing spaces. Some of the buildings not requiring significative structural refurbishment, such as the rolling mill 2 and the workshop halls 1–5, have been internally subdivided in "cells" of 100 to 500 m^2 and rented to interested local small and medium -sized firms. In a couple of years, 15 firms with 45 employees were already established, active in the fields

Fig. 7.32 The steelworks and the attached workers settlements, immersed into the agricultural landscape of the upper Gresivaudan, ca. 1950

Fig. 7.33 Overview of the expanding industrial site from the Brame Farine slopes, in 1974. In the background, the EDF basin being created

of green technologies (coated recycled carton-board, wood recycling construction materials), industrial supplying (heating/cooling equipment, food transformation) and even industrial services (e-commerce, small-scale logistics). For the oldest and most derelict buildings of the former steelworks, such as the EAF plant and the ancient casting halls, STS has planned the complete demolition and replacement with new industrial buildings. In this way, the former Ascometal site is expected to be transformed into a multi-firm industrial park within 3–5 years. The existing railway network, currently out of use, is also planned to be integrated in the industrial park infrastructural system, although no detailed plan has been prepared yet. The re-industrialization plan of STS for the Ascometal site is sustained by the community of Le Cheylas (as expressed in the municipal PADD, Project d'Aménagement et de Développement Durable) as well as by the Community of Municipalities of Gresivaudan—as it fits into the regional strategy of reusing brownfield sites for productive purposes. The environmental recovery of the heavy polluted EAF dust landfill and the nearby scrap yard (8 hectares in total) is still an open issue for STS and the community too, as the funding for such an expensive procedure are currently missing. Preliminary recovery measures were already taken by Ascometal back in 2010–2011, such as the removal of 5500 tons of soil substrate contaminated with heavy metals and the partial coverage of the excavated area with concrete slabs. However, further analysis revealed a rather extended contamination on the whole area. STS does not have a clear strategy for the landfill reclamation, although the aim is to reuse the area in the future for photovoltaic energy production. The WINOA and STEELMAG facilities are still operating and will continue to do so in the future, so at the moment there's no reuse/transformation plan for that portion of the site. The Plan Local d'Urbanisme of Le Cheylas confirms and address the industrial and productive use of the former steelworks site, including the core built site and the surrounding infrastructural spaces (such as the landfill and the nearby crafts-industry zone). Furthermore, the same plan also expresses the necessity of reinforcing the green infrastructural network between the mountain side and the river through ecological corridors of proximity, of which several running next the site.

Main sources of information for the regional and site profiles:

- face-to-face interview with Mathieu Janin (CEO MJSTONES, site owner since 2017), 13.06.2018 + phone interview 18.07.2019
- face-to-face interview with Roger Cohard (Mayor Le Chelyas) and Alain Daramy (chief spatial planning Le Cheylas), 14.06.2018

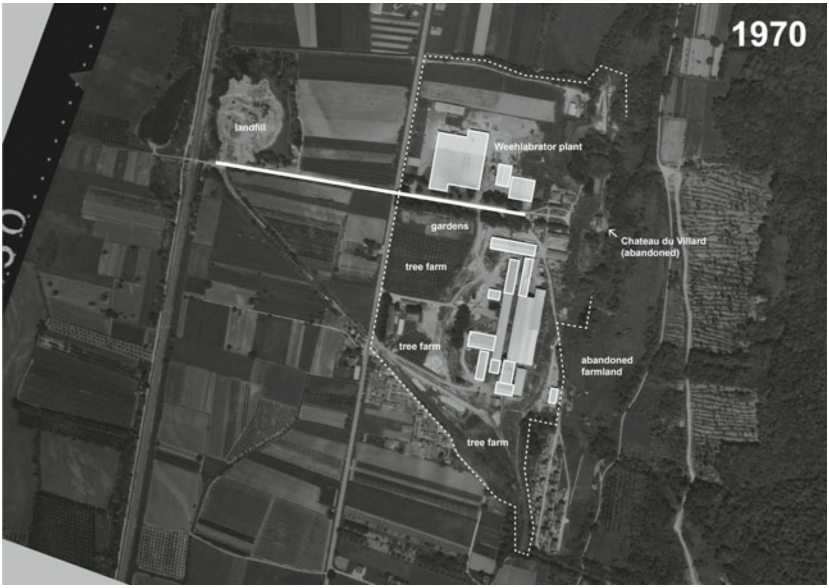
- face-to-face interview with Tonis Antzoulatos (chief economic development CC Gresivaudan), 15.06.2018
- PAAD Le Cheylas (strategic territorial development plan)
- PLU Le Cheylas (local urban development plan)
- PHL Gresivaudan (urbanism and housing plan CC Gresivaudan) + Project du Territoire Gresivaudan (strategic plan)
- Le pays de Grésivaudan: un territoire périurbain qui attire les cadres, mais avec de notables disparités internes (regional analysis by INSEE Rhone-Alpes)
- CC Le Gresivaudan—Portraits des EPCI Isérois, Emploi—Chômage (economic statistical profile CC Gresivaudan)
- Kouchner J., Ricard. P. *Allevard, coeurs d'acier*, Ed. Thetys 1996
- local newspapers (2013–2016)
- BASOL (database of polluted sites by the French Ministry for Sustainable and Ecological Transition), basol.developpement-durable.gouv.fr/

7.3.3 Site Preliminary Study

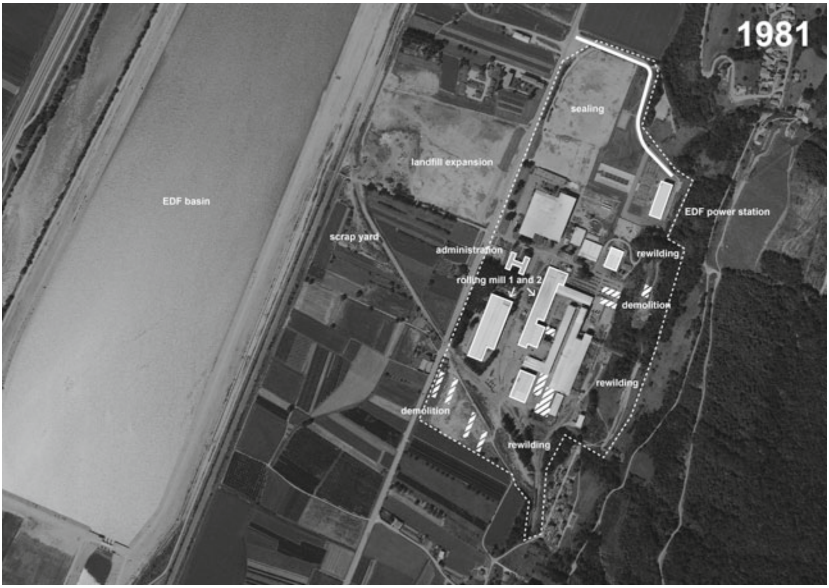
The attached site preliminary study is based on both single and comparative analysis of six corrected aerial photographs (orthophotos), covering the time frame 1939–2003. The selection of suitable photos has been done by considering a temporal distance among each others of approximately 10–15 years, although this was not always possible due to the limited availability of the material. The selected orthophotos refers to the following years (source in brackets): 1939 (IGN), 1948 (IGN), 1970 (IGN), 1981 (IGN), 1989 (IGN), 2003 (IGN). The collected material provides a spatially detailed and temporarily complete coverage of the site and its surroundings. The fact that the first available year (1939) dates around 20 years later than the factory opening gave the valuable chance to follow the evolution of the site from almost the beginning. Furthermore, the high resolution common to all the photographs was extremely helpful in the identification of many small-scale landscape changes.

1939—The steelworks stand halfway between the RD 523 valley road axis and the forested slopes of the Brame Farine massif. The productive site, which consists of three parallel casting halls and few additional buildings, is located next to—and somehow integrated into—a large railway yard stretching NW-SE. The latter is part of the transport infrastructure developed by the old Allevard steelworks, which links the main railway line down in the valley to the upper narrow-gauge railway via an inclined ropeway. Along the perimeter of the site there are a couple of small-sized workers settlements (cité ouvrière) with terraced houses and gardens. The surroundings are mainly occupied by cultivated fields, interrupted by tree rows, ponds, farms and country estates—among which the Chateau du Villard, north to the steelworks.

1948—The factory site is slowly expanding, as suggested by the northward extension of the casting halls and the gradual conversion of the surroundings to industrial purposes. The agricultural fields between the industrial buildings and the road RD 523 are now included within the factory site, and partially used as temporary by-product waste dump site. The inclined ropeway is out of use and already partially hidden by the growing forest. The dismantling of the railway-ropeway infrastructure is leading the railway yard site to be used mainly by the steelworks, both as transport infrastructure and raw materials storage area. No other significant changes can be noticed in the surroundings.



1970—The steelworks have doubled its size through the extension of the casting, the addition of new service buildings and the construction of the new Wheelabrator steel abrasives plant, on the northern edge of the site. Such expansion has caused the incorporation of the old Chateau du Villard estate into the industrial site, thus causing its decay and abandonment. The boulevard once connecting the estate to the route 523 has become the main access to the industrial site, as well as the direct link between this and the newly created landfill on the former pond. The farmland behind the Chateau, on the slope, is abandoned and subject to rewilding. Within the industrial site, the internal railway network has been upgraded and expanded with new tracks, to reach the abrasives plant. Many unbuilt greenfields within the site perimeter, including the disused railway yard, have been turned into tree farms.



1981—Major changes within and around the factory site can be noticed. Among new additions there are two rolling mills, located between the old casting halls and the route 523, the ‘H’ shaped administration building and the new EDF hydroelectric power station on the north-eastern edge of the site. Connected to the power station (a pump-storage type) there is the huge water basin created next to the railway line. The old buildings of the Chateau have been demolished, as also the lower workers settlement and some of the oldest factory buildings. As result, the open space pattern within the factory perimeter is enriched with many paved aprons for storage of raw materials or finished products. Some of these open spaces are however not used and undergoing rewilding. The landfill is rapidly expanding on surrounding agricultural fields, while a scrap yard has been added nearby.

1989—No significant changes within and around the factory site are noticeable. A few additional buildings are increasing the built footprint of the site, while inner open spaces are now cleared from trees and vegetation and sealed to host storage areas and parking lots. On the contrary, the outer open spaces along the south-eastern perimeter are left apart and thus rewilding into shrublands and forested areas. In particular, the slope side behind the old casting halls, once occupied by the Chateau estate, is turning into a dense forested area. The same rewilding process is visible on the previously sealed surface on the northern edge of the site, as it is not yet used for any purpose. The landfill is increasing in content but not expanding in size. A sort of green buffer seems to divide the landfill from the route 523.

2003—The factory site is rather unchanged, although many new small-scale buildings have been added to the existing ones, especially on the southern edge. The former railway yard is now partially occupied by these new buildings and partially turned into a woodland. Only a few railway tracks are in use. In general, a widespread process of rewilding can be noticed along the site perimeter, with high tree densities on the less usable areas (slopes, borders). A system of green buffers, spontaneous or planned, is also emerging around the site and its detached extensions. Around the landfill and the scrap yard, for example, a continuous system of shrublands and tree buffers has been created, probably to mitigate the negative impact of these activities on the surroundings. On the northern edge of the site a new administration building has been built, surrounded by shrublands.

7.3.4 Photographic (field) Study

The field trip took place on 11–17.06.2018. At first, a "guided" tour of the site by foot was done together with Mr. Mathieu Janin (CEO MJSTONES and main site owner). Full permission for site access and visit was provided by Mr. Janin, who informed the site gatehouse. This allowed complete freedom for the upcoming days. The site exploration took place mostly by foot, with car used only to reach distant spots for overviews. The field visit was integrated by two more meetings, both occurring on 15.06: one with Mr. Tonis Antzoulatos (director Economic Development, CC Le Grésivaudan) and the other one with Mr. Roger Cohard and Mr. Alain Daramy (Mayor and director urban development dep., Le Cheylas municipality). Selected photographs include overviews of the former steelworks from surrounding reliefs (at different distances) as well as detailed views of the site core (active and disused buildings, open spaces) and immediate surroundings (including waste dump sites and the EDF basin) (Fig. 7.34–7.57).

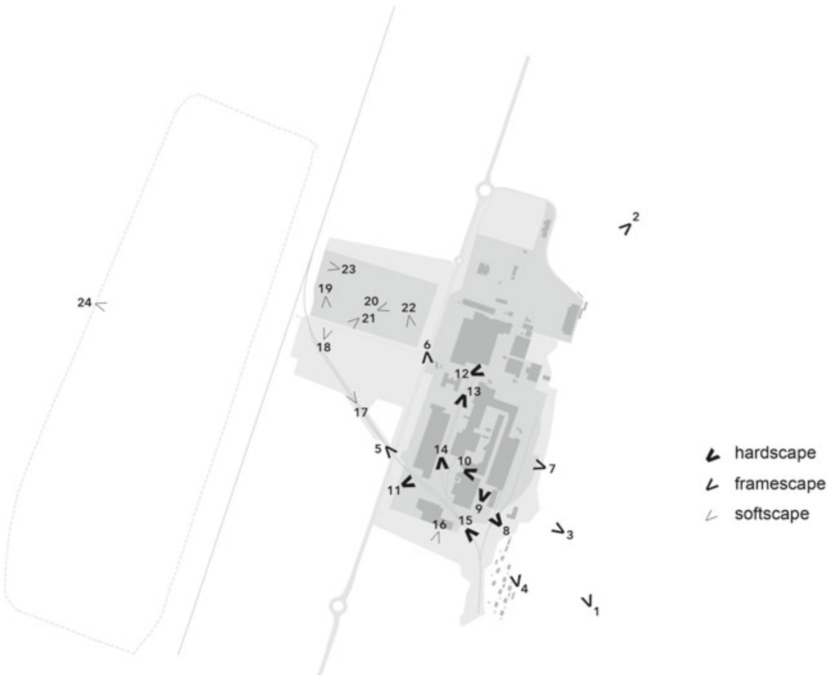


Fig. 7.34 Overview of the steelworks site and the wide Grésivaudan valley bed, from the western slope of the Bramefarine massif

Fig. 7.35 The Winoa steel abrasives factory (foreground) and the disused Ascometal steel mill (background)

Fig. 7.36 Closer view of the Ascometal site from the Bramefarine slope

Fig. 7.37 Houses and playground in the old workers village (Cité Haut). The steel mill can be seen in the background

Fig. 7.38 The railway track crossing the regional road D 523 before entering into the site

Fig. 7.39 The rolling mill 2 seen from the regional road D 523. The sign says "space available"

Fig. 7.40 The former scrap yard currently used as open-air storage of gravel and sand. In the background, the derelict casting halls

Fig. 7.41 The oldest existing building on the site (dating back to 1921, as written on the facade), a former power substation

Fig. 7.42 A large apron surrounded by disused buildings, among which the casting halls (centre)

Fig. 7.43 Former workshops and warehouses. In the background, a glimpse of the casting halls

Fig. 7.44 The southern edge of the rolling mill 2 overlooking overgrown railway tracks and polluted wastelands

Fig. 7.45 The still active WINOA steel abrasives plant, on the northern edge of the site, framed by the forested slopes of the Bramefarine

Fig. 7.46 Abandoned railway tracks running south, flanked by the two rolling mills

Fig. 7.47 A formerly multifunctional apron now disused. The buildings on the right background are currently occupied by small businesses

Fig. 7.48 Overgrown railway tracks towards the old workers village

Fig. 7.49 On the southern edge of the site the spontaneous woodlands have been partially cleared for unknown purpose

Fig. 7.50 The abandoned railway yard on the western, outer side of the steelworks. In the background, the imposing Chartreuse massif

Fig. 7.51 The exposed EAF dust landfill along the former agricultural path called Chemin de l ' Articol. The signs says "private property, entry forbidden"

Fig. 7.52 View over the landfill bare top

Fig. 7.53 Part of the landfill has been roughly secured through drainage containment and spontaneous renaturation

Fig. 7.54 Slag dump next to the landfill

Fig. 7.55 Overview from the top of the landfill. In the foreground, a polluted tar and exhausted oil dump site, on the background the steel mill and the Bramefarine woodlands

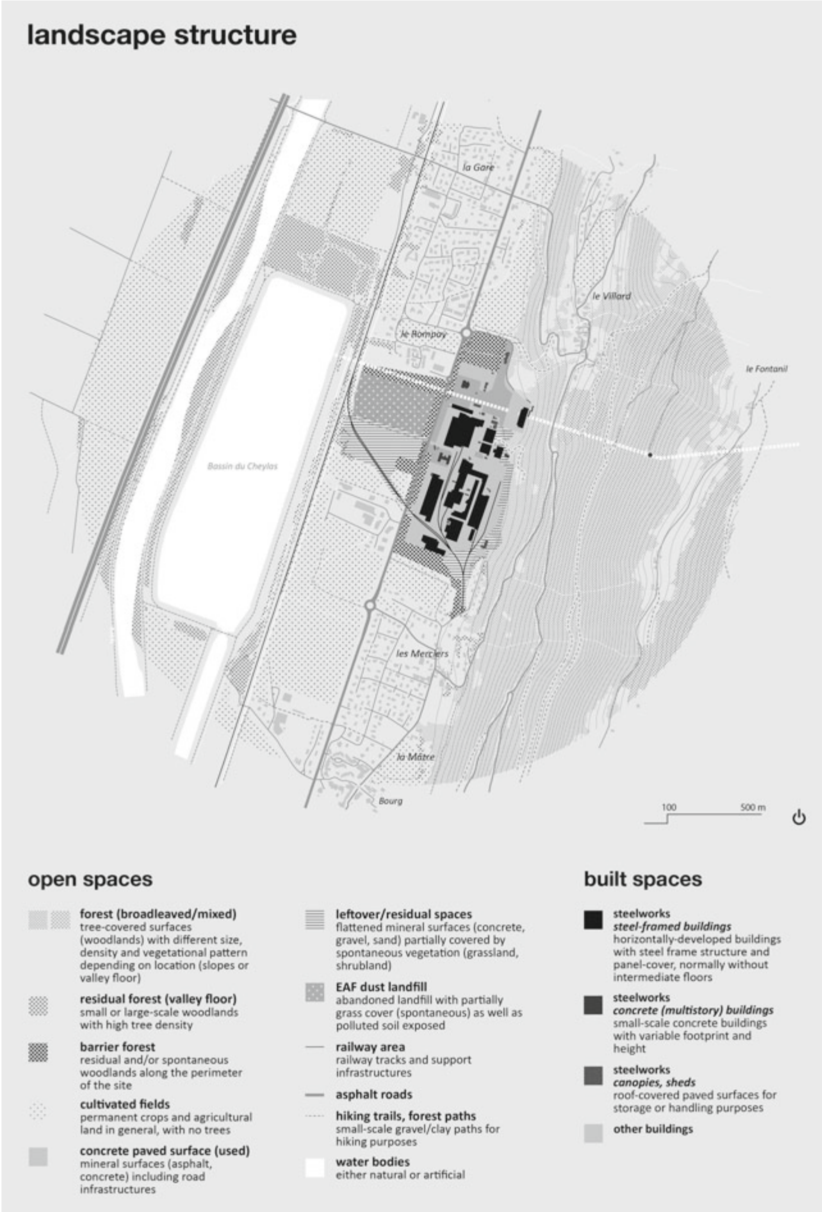
Fig. 7.56 The EDF basin seen from the top of the landfill

Fig. 7.57 The EDF basin towards the Bramefarine. The WINOA plant and the EAF dust landfill can be seen in the middle background

7.3.5 Site Advanced Study

Landscape structure

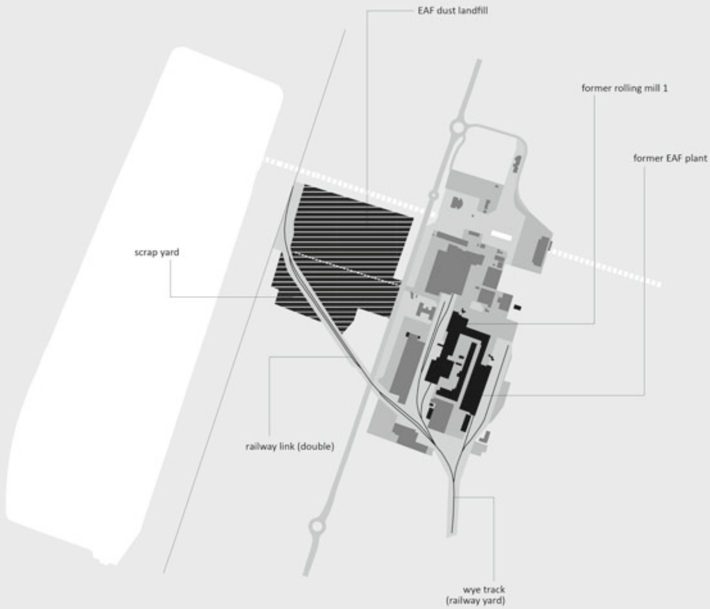
The landscape structure of the steelworks is characterized by the strong counter position between a dense and compact ‘hard’ built core and an extensive ‘soft’ buffer ring of artificial and/or semi-natural open spaces. The proximity to the mountain slope has just little influence on the landscape structure, which is instead shaped by the interactions between grey and blue linear infrastructural elements in the flat valley bed. The complex infrastructural grid of roads, railway tracks and water bodies (on which the steelworks has gradually developed) creates, in fact, a casual patchwork of ‘allotments’ which are ‘filled’ either with industry-related functions or leftover and/or used for other purposes. On the one hand, this particular landscape structure leads to a successful spatial and visual integration of the industrial site into the surroundings, but on the other hand it strongly limits the possibilities of interchanging different functions and land uses when it comes to transformation. The core site and its built system are structured according to the external/internal road and railway accessibility, almost functioning as a landscape ‘room’ with specific access points and borders. The same occurs for outer site-related facilities such as the dust landfill and the scrap yard, as well as the EDF water basin far beyond. All these ‘functional’ rooms are, in fact, strongly circumscribed and delimited by green buffers of mixed woodlands and shrublands developed on leftover open spaces, beyond which agricultural fields and low-density urban settlements extend. The sequence of industrial core and outer areas, green buffers and infrastructures creates somehow a direct but fragmented landscape ‘corridor’ between the Brame Farine mountain on the east and the Isère river axis on the west.


landscape structure
la Gare
le Villard
le Rompay
le Fontanil
Bassin du Cheylas
les Merciers
la Mâtre
Bourg
100
500 m
open spaces
forest (broadleaved/mixed)
tree-covered surfaces (woodlands) with different size, density and vegetational pattern depending on location (slopes or valley floor)
residual forest (valley floor)
small or large-scale woodlands with high tree density
barrier forest
residual and/or spontaneous woodlands along the perimeter of the site
cultivated fields
permanent crops and agricultural land in general, with no trees
concrete paved surface (used)
mineral surfaces (asphalt, concrete) including road infrastructures
leftover/residual spaces
flattened mineral surfaces (concrete, gravel, sand) partially covered by spontaneous vegetation (grassland, shrubland)
EAF dust landfill
abandoned landfill with partially grass cover (spontaneous) as well as polluted soil exposed
railway area
railway tracks and support infrastructures
asphalt roads
hiking trails, forest paths
small-scale gravel/clay paths for hiking purposes
water bodies
either natural or artificial
built spaces
steelworks
steel-framed buildings
horizontally-developed buildings with steel frame structure and panel-cover, normally without intermediate floors
steelworks
concrete (multistory) buildings
small-scale concrete buildings with variable footprint and height
steelworks
canopies, sheds
roof-covered paved surfaces for storage or handling purposes
other buildings

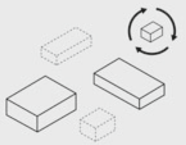
Landscape transformation systems
The proposed site transformation follows and integrates the indications of existing local and regional plans and regulations, as expressed by the site owning company and local planning institutions. On one hand, the transformation addresses the functional reuse of the former steelworks core area, keeping into account the existing productive infrastructure (railway network and available buildings/spaces) as well as the needs of the ongoing activity of the Winoa plant, which shares the northern half of the site. On the other hand, the transformation enhances the buffering effect of semi-natural spaces around the core site through their reclamation, improvement and inter-connection, as part of a wider local green infrastructure already identified in the PADD of Le Cheylas. The transformation process is structured on the three identified systems: the "backbone", which focuses on first priority developments such as the site clearing, the adaptive refurbishment of the railway network and the landfill reclamation; the "borders", which deals with the improvement and extension of the ecological buffers, including the renaturation of reclaimed areas; the "core", which addresses the functional redevelopment of the central area into a multi-firm industrial park. So conceived, the three systems are strongly interrelated in terms of space but highly flexible and somehow independent as it concerns the temporal development. This is essential to ensure a gradual but complete transformation of the whole site without harming the many existing activities already developed on it.

system 1
BACKBONE | preliminary reclamation

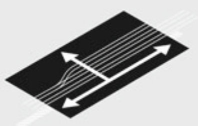
system overview



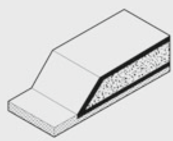
toolkit



keep only those buildings in good structural conditions and suitable for productive reuse (including already used ones)

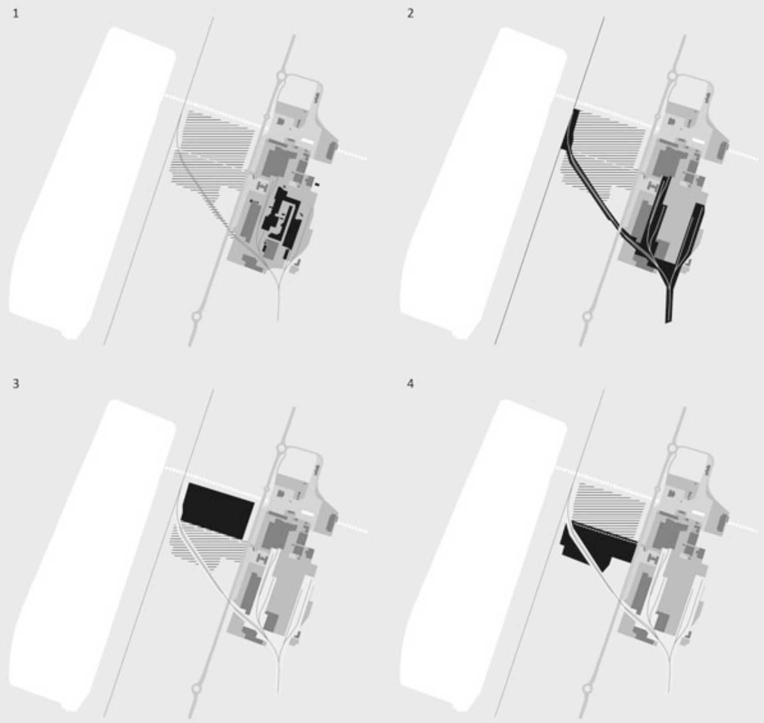


adaptive refurbishment of railway area as industry-oriented shared space



landfill reclamation through encapsulation and landscaping (including water drainage)

system 1
transformation phases



1 / steel mill buildings removal

The buildings not suitable for productive refurbishment and reuse, due to their size and/or structural conditions, are removed. These are the long-shaped concrete-steel buildings belonging to the casting house (oldest built core, now derelict), the billets halls (also derelict), the rolling mill 1 and several micro-buildings and additional structures. *SHs: MJ Stones, Le Cheylas municipality, CC Le Grésivaudan.*

2 / railway area refurbishment

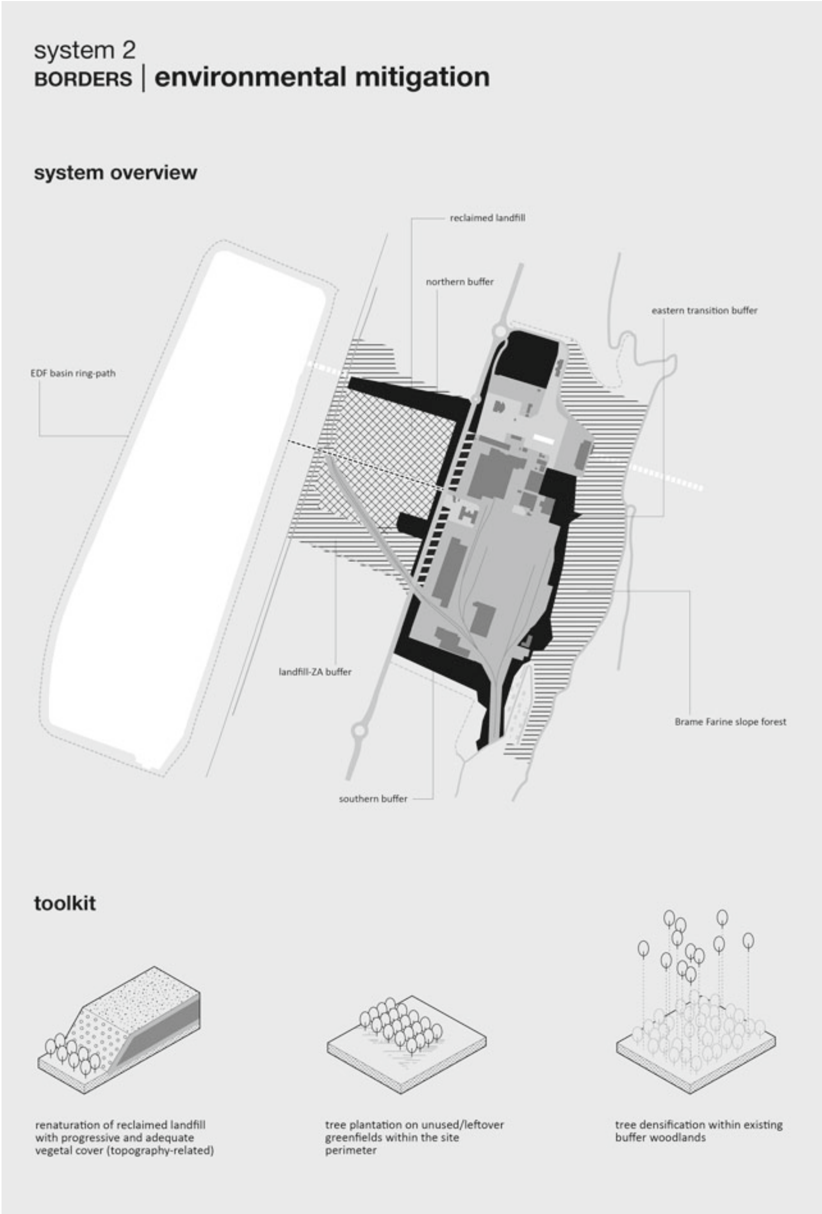
The existing railway network consists of a double-track link to the main railway line and an Y-shaped internal system with wye track. The railway area (including support infrastructures) is clearly delimited to favor the internal re-organization of built and open spaces. The inner zone is refurbished as productive shared space (street-running railway), while the rest is de-sealed and left green (link tracks, wye track). *SHs: MJ Stones, SNCF, WINOA, Le Cheylas municipality, CC Le Grésivaudan.*

3 / landfill reclamation (phase 1)

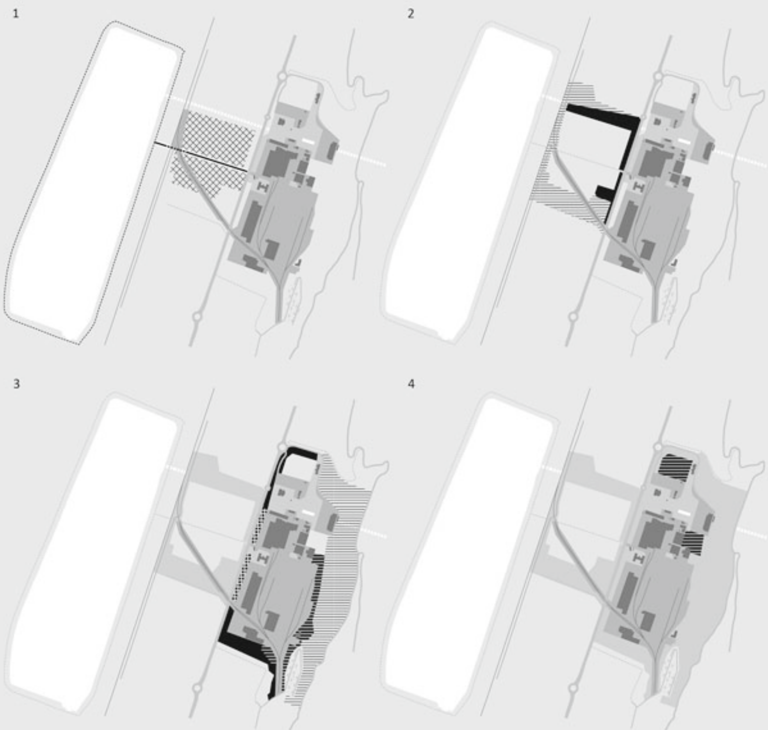
The first priority reclamation site is the EAF dust landfill, located between the regional railway line and the road D523. Given the size and the material already accumulated, the reclamation is done on-site with containment measures (encapsulation). These include forming, underground and above ground sealing (securing water drainage) and final landscaping. As a result, a 10m trapezoidal hill is formed. *SHs: MJ Stones, DREAL AURA, Le Cheylas municipality, CC Le Grésivaudan.*

4 / scrap yard clearing and reclamation

The second priority reclamation site is the former scrap yard, located south-west to the landfill and crossed by the railway link. The site includes areas with contaminated soil currently under spontaneous renaturation and abandoned agricultural fields. The reclaimed site will keep the original flat topography and have a permeable soil cover suitable for recultivation. *SHs: MJ Stones, DREAL AURA, Le Cheylas municipality, CC Le Grésivaudan.*


system 2
BORDERS | environmental mitigation
system overview
reclaimed landfill
northern buffer
eastern transition buffer
EDF basin ring-path
landfill-ZA buffer
Brame Farine slope forest
southern buffer
toolkit
renaturation of reclaimed landfill with progressive and adequate vegetal cover (topography-related)
tree plantation on unused/leftover greenfields within the site perimeter
tree densification within existing buffer woodlands

system 2
transformation phases



1 / renaturation of reclaimed areas

Once reclaimed, the EAF landfill and scrap yard sites are gradually renaturated through addition of topsoil, restoration of surface vegetal layer and tree plantation. The landfill top and slopes are covered with grass and shrubs. The ecological compensation zone provided by the two reclaimed site is completed with the refurbishment of the access road (Chemin de l'Articol) towards the EDF basin ring-path. *SHs: MJ Stones, DREAL AURA, Le Cheylas municipality, CC Le Grésivaudan, EDF.*

2 / buffer zone 1 (landfill)

The semi-natural spaces surrounding the reclamation area are turned into an ecological buffer zone of variable thickness and appareance. Along the north-eastern edges the existing mixed shrubland-woodland is densified and improved where necessary. On the southern and western edges the buffer zone is created brand new through tree plantation and/or punctual densification. *SHs: Le Cheylas municipality, affected land owners, CC Le Grésivaudan.*

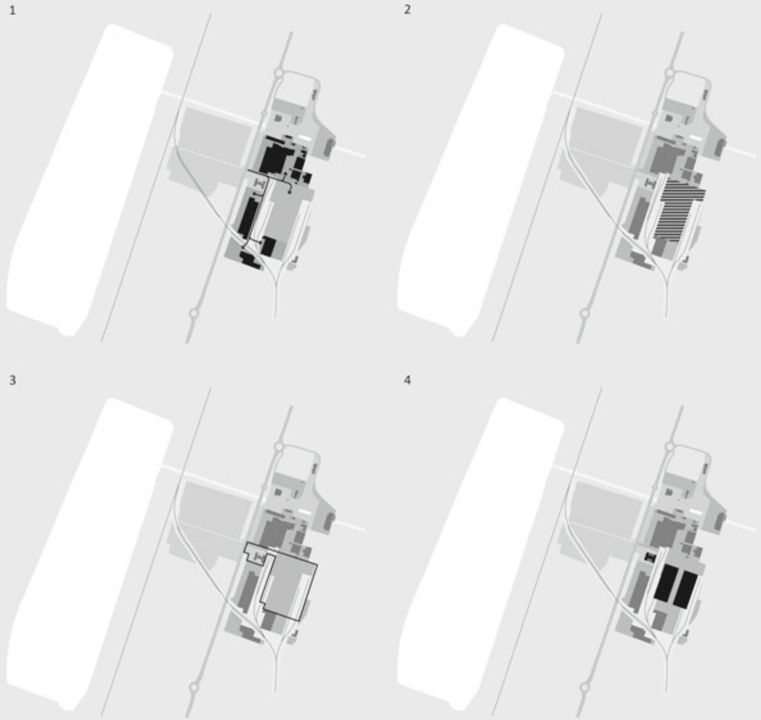
3 / buffer zone 2 (steelworks)

The semi-natural and leftover spaces surrounding the steelworks site are also turned into an ecological buffer zone. Tailored environmental measures are taken according to the different conditions and expected performance of the areas composing the buffer zone: tree densification on the western and eastern sides, tree plantation on unused greenfields along the site perimter. *SHs: MJ Stones, WINOA, EDF, Le Cheylas municipality, CC Le Grésivaudan, affected land owners (forest).*

4 / greening of land reserves

The ecological performance of unused and leftover green spaces within the site perimeter (land reserves) is improved through temporary tree plantation. *SHs: MJ Stones, WINOA, EDF.*

system 3
transformation phases



1 / lots and access

Four areas concering the lots and access of the buildings already in use are identified and defined: the WINOA plant north of the main internal road axis and three minor sites on the former Ascometal site (former rolling mill 2 and workshops, currently occupied by small-scale businesses). Accessibility in ensured through the main axis and a secondary north-south axis, partially already existing. *SHs: MJ Stones, WINOA, other small business onwers.*

2 / inward soil remediation

The inner area previously occupied by old steelworks buildings (demolished) is subject to on-site soil remediation. The contaminated soil is removed, processed and replaced with new subsoil. The re-sealing is then completed taking into account environmental issues (water driainage, heat) and future uses and/or constructions. *SHs: MJ Stones, DREAL AURA.*

3 / building zone definition

After remediation and site preparation, the new building zone is defined. This necessarily takes into account the existing buildings and related servitudes, as well as the internal infrstructural system. The new building zone includes the site entrace and nearby administration building (with surrounding open spaces), the main axis (south of the WINOA plant) and the remediated zone with related railway tracks. *SHs: MJ Stones, Le Cheylas municipality.*

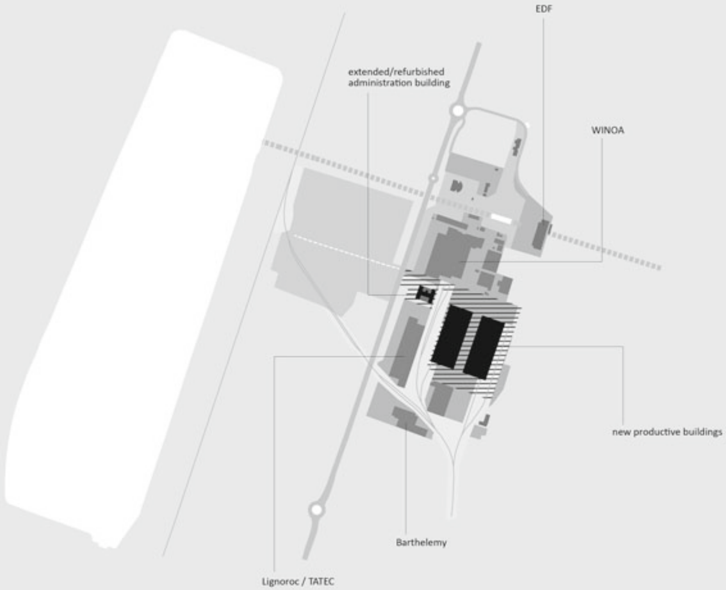
4 / new buildings

After remediation and site preparation, the new building zone is defined. This has to take necessarily into account the existing buildings and lots, as well as the internal infrstructural system. The new building zone includes the site entrace and nearby administration building (with surrounding open spaces), the main axis (south of the WINOA plant) and the remediated zone with related railway tracks. *SHs: MJ Stones, Le Cheylas municipality.*

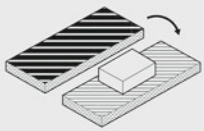
system 3

CORE | site redevelopment

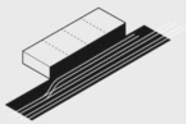
system overview



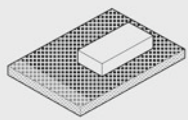
toolkit



subsoil remediation and environmentally friendly re-sealing before new constructions



prioritize new buildings (single or multi -property) with direct access to the the existing railway tracks



ensure enough space around existing and new buildings for necessary infrastructures (aprons and handling areas for trucks too)

7.4 Case Study III: Cantoni ITC, Ponte Nossa / I

7.4.1 Regional Overview

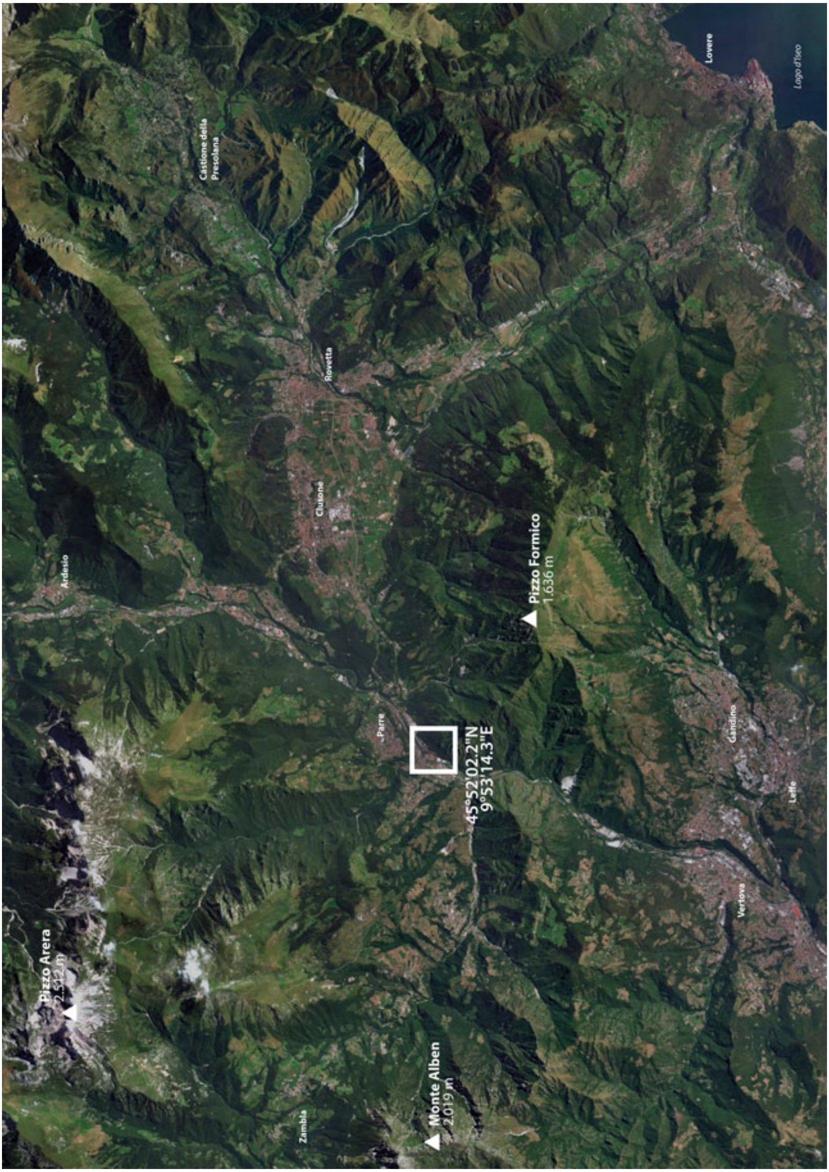
Identification

Cultural region: Lombardian Alps and Prealps (Alpi e Prealpi Lombarde) > Bergamasque Alps and Prealps (SOIUSA 29) > Valle Seriana.

Administrative region: NUTS 2: Regione Lombardia > NUTS 3: Provincia di Bergamo (ITC46) > Comunità Montana Valle Seriana(38 municipalities).

Geography

The region is entirely located within the Bergamasque Alps and Prealps (Alpi Orobie), a section of the Southern Eastern Alps bordered on the west by Lake Como, on the north by Valtelline, on the east by Valcamonica and Lake Iseo and on the south by the Bergamo plain (part of the Po Valley). The Bergamasque Alps are characterized by a clear sequence of mountain systems: a northern range of high crystalline reliefs (highest peak: Pizzo di Coca 3.050 m), a complex system of calcareous reliefs in the middle, which include impressive stand-alone massifs (Grigne 2.410 m, Pizzo Arera 2.512 m, Presolana 2.521 m, Pizzo Camino 2.492 m, Concarena 2.549 m), and lower and softer wooded reliefs towards the foreland. The main valleys Valsassina, Brembana, Seriana and Cavallina are all north-south oriented and connected to each other by minor transversal valleys and passes. The Seriana valley, approximately 50 km long, is named after the river Serio, which originates from the northern range of the Bergamasque Alps (Monte Torena, 2.911 m) and runs to the south for 127 km, leaving the Alps in the eastern outskirts of Bergamo and joining the Adda river near Crema. According to its orography, the Seriana valley is usually divided in upper and lower valley: the point of divide is the Costone gorge, where the river Serio is the only physical separation between the steep slopes of Pizzo Formico massif (1.636 m) and those of Pizzo Frol (part of the Alben massif, 2.019 m). The lower valley is characterized by a large and flat valley floor surrounded by modest reliefs and forested hills, while the upper valley has a narrower valley section and it is surrounded by higher mountains and steep slopes. Two large plateaus are attached to the valley axis on the east site: the Gandino-Leffe plateau in the lower valley, south to the Pizzo Formico massif, and the Clusone plateau in the upper valley, between the Formico and Presolana massifs, connecting the Seriana valley to Scalve and Borlezza valleys and then to Valcamonica (Lago d'Iseo).


Pizzo Arera
2.512 m
Monte Alben
2.019 m
Zambla
Ardesio
Parre
45°52'02.2"N
9°53'14.3"E
Clusone
Rovetta
Castione della Presolana
Pizzo Formico
1.636 m
Gandino
Leffe
Vertova
Lovere
Lago d'Iseo

Accessibility

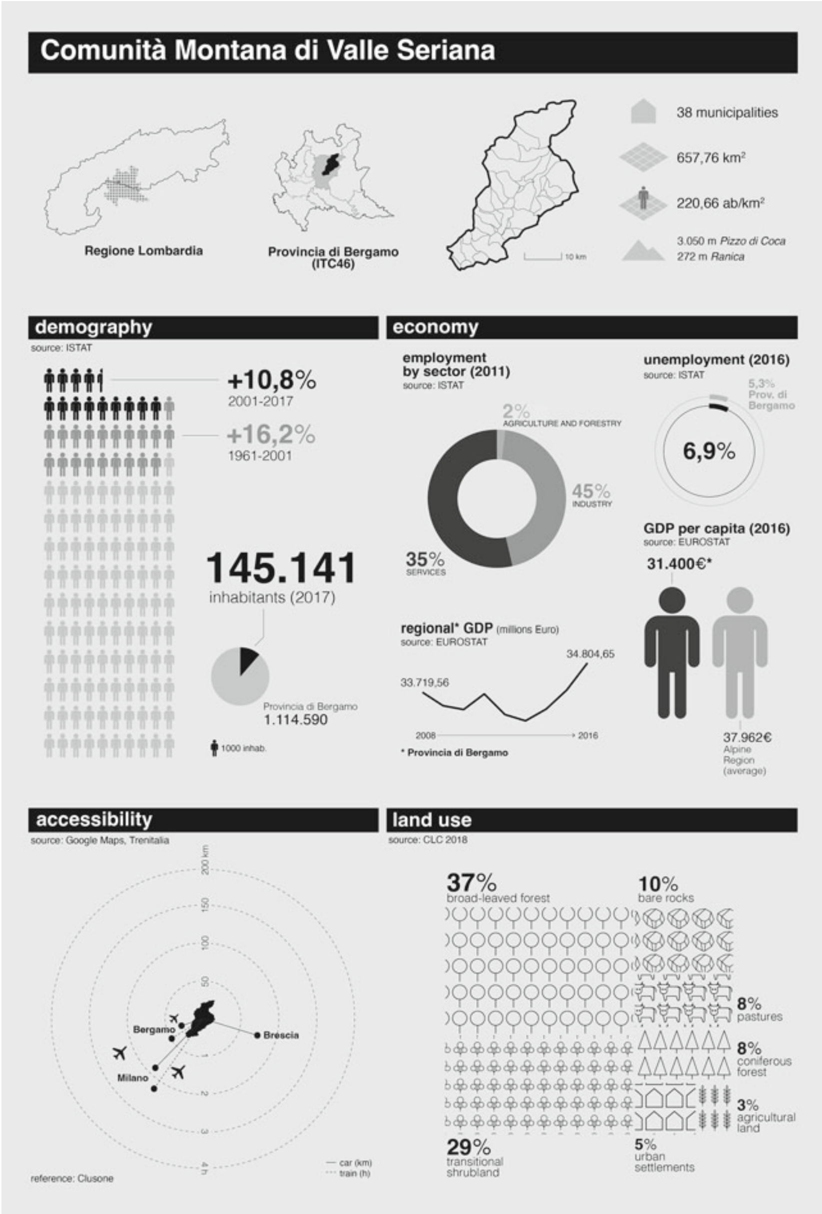
Due to its location on the southern border of the Alps, the Seriana valley is highly accessible from Bergamo and the Milan metropolitan region. Bergamo, which is located right at the entrance of the valley in the foreland, is a key regional transport hub including railway connections to Milan (50') and Venice (2h45'), A4 Turin-Venice motorway and Orio al Serio international airport (part of the Milan metropolitan region airport system and third in Italy for passengers after Rome and Milan-Malpensa). All these facilities, and in particular the airport, can be easily reached from the mid-lower Seriana valley through the expressway SP671 Seriate-Cene (completed in 2007) and the new suburban tramway Bergamo-Albino (opened in 2009 after the reconversion of the former Seriana valley railway line, dismantled in 1967). The upper valley from the Costone gorge upwards is less accessible, with the SP671 normal road running to Clusone and the Scalve valley (and then to Darfo Boario Terme in Valcamonica) and the dead-end SP49 road reaching Valbondione, the last centre in the upper Seriana valley. A network of bus run by SAB covers the whole valley and especially the touristic centres in the higher locations (Castione della Presolana, Schilpario, etc.). Major future plans are the extensions of the tramway from Albino to Vertova and the realization of the tunnel under the Pizzo Formico near Ponte Nossa to extend the expressway SP671 from Cene to Clusone. Lastly, it needs to be also mentioned the Ciclovia Valle Seriana, a 47 km long bike route connecting Bergamo (Torre Boldone) and Clusone developed in the early 2000 s by reusing the site old Seriana valley railway line and part of the embankments of the Serio river.

Socio-demographic profile

The Comunità Montana di Valle Seriana (Seriana valley mountain community) includes 38 municipalities covering an area of 657,76 km^2, with a population of 145.141 inhabitants (2017). The average population density is 221/km^2, pretty high if compared to the average of the Alpine region (76,4) and the Italian Alps (83,9) too, but far lower than that of the Province of Bergamo (403,99). Like other mountain regions located on the margin of the Alpine arc and close to highly dynamic metropolitan regions, the Seriana valley has experienced in the last decades a significant population growth: + 29% between 1961 (112.699) and 2001 (130.960) and even + 11% between 2001 and 2017. However, the population dynamics within the region are pretty in favour of the lower valley, where most of the population and the economic activities are located. The lower valley has in fact 9,8% of population and 9,1% of employees in industry (the main economic sector) of the whole Bergamo province, while the upper valley has only the 4% of population and 3% of employees in industry. In terms of ageing population, the region is affected by moderate trends in this sense similarly to other valleys in the Bergamo Alps, but not as dramatic as in other Italian Alpine areas (e.g. Piemonte and Friuli). In 2000 around 50% of the population of the Seriana valley was 30–64 y.o., while only the 20% above 64 y.o. Immigration is quite relevant in the region due to the density of available jobs in manufacturing, with a higher presence of foreign population in the municipalities of the lower valley (average 5%). In general, the Seriana valley community shows overall positive demographic dynamics if compared to the average of the Italian Alps. This can be clearly linked to a rather developed economic system and especially to the high accessibility and proximity to Bergamo and Milan metropolitan centres.

Economic profile
The economy of the Seriana valley is strongly based on industry and manufacturing (45% of employees, 2011), as it is in the wider context of the Bergamo Province (46,2% of employees in the secondary sector, 2010) and also in most of the Italian Prealpine Arc (Provinces of Biella, Como, Lecco, Bergamo, Brescia, Vicenza, Belluno, Pordenone). The Seriana valley region is in fact to one of the 21 officially recognised industrial districts of Lombardy, with high specialization in textile machinery and mechanical engineering for textile industry. Other key industries of the region, developed in the 1960 s–70 s in connection to the original textile production, are fine mechanics, polymers and plastics materials. Several niche leading companies such as ITEMA (advanced weaving solutions), Radici Group (engineering fibres and plastics), LAMIFLEX (technical composite materials) and SCAME (electrical engineering) are rooted in the region, having their HQs in the Seriana Valley. More traditional industrial sectors, such as primary textile industry and non-ferrous mining and metallurgy are today almost completely disappeared. Agriculture represents a marginal activity in the Seriana Valley region as in the whole Bergamo Province, where it employs only 2% of the working population and contributes to the regional GDP for only 1,4%. In the Seriana Valley, and in mountain areas of Bergamo in general, agriculture is in sharp decline since several decades: as an example, between 1990 and 2000 the number of farms has decreased in the whole province of −53% and in mountain areas even of −61%. In the latter, agriculture is mainly related to hillside grazing and livestock farming, both usually managed as a part-time activity aside main jobs in industry and services. Tourism is a developing activity. The strong industrial-oriented economy has led to ignore, in the past decades, the potentials of tourism development in the Seriana Valley region. Between the 1960 s and 1980 s a significant tourist development occurred only in relation to skiing and

winter sports, with the establishment of a few tourist resorts of regional importance (Castione della Presolana, Spiazzi di Gromo, Zambla) and the proliferation of second homes. However, the location at modest altitudes (1200–1600 m) plus the effects of climate change (increasing lack of snow) are causing a sharp decline of these locations. In recent years a different perspective has been assumed by the valley community, which actively contributed to the definition of a regional framework for sustainable tourism development (Patto Territoriale per le Orobie), in connection with the valuable environmental and landscape resources represented by the Orobie Natural Park (70.000 hectares in the upper valley), and the foundation in 2010 of the Promoserio regional development agency for tourism promotion and territorial marketing. As result, the summer season is favoured and thus expanding in the Seriana Valley, with a constantly increasing number of visitors (+20% of national visitors and + 19% of foreign visitors between 2010 and 2017).



Comunità Montana di Valle Seriana
Regione Lombardia
Provincia di Bergamo (ITC46)
10 km
38 municipalities
657,76 km²
220,66 ab/km²
3.050 m Pizzo di Coca
272 m Ranica
demography
source: ISTAT
+10,8%
2001-2017
+16,2%
1961-2001
145.141
inhabitants (2017)
Provincia di Bergamo
1.114.590
1000 inhab.
economy
employment by sector (2011)
source: ISTAT
2%
AGRICULTURE AND FORESTRY
45%
INDUSTRY
35%
SERVICES
unemployment (2016)
source: ISTAT
5,3%
Prov. di Bergamo
6,9%
GDP per capita (2016)
source: EUROSTAT
31.400€*
37.962€
Alpine Region (average)
regional* GDP (millions Euro)
source: EUROSTAT
33.719,56
34.804,65
2008
2016
* Provincia di Bergamo
accessibility
source: Google Maps, Trenitalia
200 km
150
100
50
Bergamo
Brescia
Milano
1
2
3
4 h
car (km)
train (h)
reference: Clusone
land use
source: CLC 2018
37%
broad-leaved forest
10%
bare rocks
8%
pastures
8%
coniferous forest
3%
agricultural land
29%
transitional shrubland
5%
urban settlements

Environmental profile

The environment of the Valle Seriana and the Bergamasque Alps and Prealps is very diverse, due to the location along the transition zone between inner Alpine areas (upper valleys and main chains) and outer Alpine forelands (foothills and plains). A particular feature of the region is the incredibly high biodiversity, which is due to the fact that in the Miocene the glacial coverage was pretty lower here than elsewhere in the Alps. Hundreds of endemic flora and fauna species can be found only here, thus making of the Bergamasque Alps a biodiversity hotspot and one of the 9 priority areas for Alpine biodiversity conservation (cf. Alpine Convention). The main mountain range and most of the upper Seriana Valley are included in the perimeter of the Regional Nature Park "Orobie Bergamasche", created in 1989 on 70.000 hectares of forests, pastures and grasslands and including around 100 natural mountain lakes, waterfalls and several peaks between 2000 and 3000 mt. In addition, the Presolana and Grem massifs are included in two Natura 2000 sites (SIC Val Nossana and SIC Val Sedornia). In the lower valley there no such protected areas due to the less outstanding biodiversity, but anyway some PLIS (Parco Locale di Interesse Sovracomunale, transl. Local Park of Regional Interest) have been created, among all the PLIS Naturalserio, which covers a section of the Serio river and surrounding wetlands not yet interested by urbanisation and soil sealing. In fact, a major environmental problem of the mid-lower section of the Seriana Valley is the missing communication between the ecosystems of the mountain slopes (forests, pastures) and those of the river (wetlands, fields). Due to the gradual abandonment of agricultural surfaces, the forest is rapidly expanding and today it covers most of the lower calcareous reliefs of the lower valley. In terms of vegetational pattern, broadleaves are predominant, with oak and chestnut (formerly cultivated) forests covering the lower valley slopes and mixed beech and spruce fir forests in the upper valley. Noticeable exceptions are birch trees, growing fast in rewilding grasslands at 1000–1200 mt, and scots pine, which are mainly located in the Clusone Pine Forest (the result of a massive reforestation occurred in the mid XIX century). Water ecosystems are in general under significant pressure due to the high level of anthropisation of the valley. In particular, the Serio river has been subject in the past to the dam/sealing of banks and to several water catchment systems (for agricultural and hydroelectric purposes) which have impoverished its ecosystem, especially in the mid-lower valley.

Spatial development trends and challenges

Spatial development trends in the Bergamasque Alps and in particular in the Seriana Valley region can be ascribed a two main processes: increasing urbanisation of the flatland and soft slopes in the valley floor and progressive abandonment of farmland at the higher altitudes and in unfavourable areas (e.g. steep slopes). In the last decades, these two processes have radically changed the landscape of the valley and also the stability of the ecosystem, thus increasing the risk of natural disasters (flooding, landslides, etc.). With regards to urbanisation, the Seriana Valley ranks among the most urbanised valleys of the Lombardian Alps with a percentage of urbanised soil over the available usable land equal to 43,5% (2011). The lower valley is the most problematic in this sense, since the higher accessibility, the larger valley section and the proximity to Bergamo and the plains have favoured in recent times an intense urbanisation connected to small-scale industrial development (industrial district) and housing development (metropolisation effect). In the upper valley, significant urbanisation has occurred in relation to industry and especially tourism development (second homes). The challenge of limiting further soil consumption is already assumed as a key priority by regional and local administrations, although it often conflicts with the economic needs expressed by the communities. In this sense, the Mountain Community of Valle Seriana and other regional actors are strongly promoting the reindustrialisation of former industrial sites (of which the valley is extremely rich) to avoid the establishment of new industries on the few remaining flat greenfields. This also applies to tourist resorts, such as Castione della Presolana, where the 80% of houses are second homes built in the 1970 s–80 s which are now empty due to the decline of this type of tourism. The second process already mentioned is the progressive abandonment of farmland and the uncontrolled expansion of the forest. This process is of course related to the vitality of mountain agriculture and thus to the economic relevance of this sector. Therefore, the hyper-urbanised and industrialised lower valley and prealpine areas are generally more affected by the abandonment of agricultural surfaces than the upper valley. As an example, in the decade 1990–2000 the lower valley has experienced a decrease of the UUA (utilised agricultural area) of 37%, while the upper valley of 29% (which is still relevant). Although this process can hardly be reversed, the regional authorities and the Mountain Community are trying to sustain and promote agricultural training and the development of new farms able to take care of critical semi-natural spaces (new forests).

7.4.2 Site Overview

Location
The site is located ca. 2 km north to the Costone gorge, at the entrance of the upper Seriana Valley and at the crossroads of the Clusone plateau and the Rise valley (both leading to the touristic locations of Castione della Presolana and Zambla respectively). In particular, the site is located on the orographic left side of the Serio river, close to the watercourse, on a triangle-shaped alluvial fan at the base of Corno Guazza (1270 m, NW extremity of Pizzo Formico massif). Indeed, the site is "compressed" between the river and the steep mountain slope, extending on a curve from NE to S. On the right side of the river, facing the site, at the confluence between the Serio and the smaller Nossa stream, there is old town of Ponte Nossa (Italian for 'Nossa bridge'), crossed by the main valley road SS 671 and overlooked by Premolo and Parre centres, developed over the soft and terraced sunny slopes of Pizzo Arera massif. The site is visually and spatially embedded in the densely urbanised floor and slopes of this particular valley section, of which constitutes a relevant structural element. The accessibility to the site is really high due to the presence of three bridges (of which two pedestrians, including the former railway bridge) in just 250 m of river section, connecting the lower half of the site to the town centre on the opposite side of the Serio.

Background
The cotton mill was established in 1870 by the Swiss-Italian entrepreneurs Giacomo Trumpy and Alfredo Zopfi, who moved from Schwanden (Glarus) to Bergamo to invest their capital and know-how in the promising business of textile industry. The location in the mid Seriana valley was chosen for the abundant water supply and the skilled workforce in textile manufacturing. The industrial complex consisted, at the beginning, of a shed building with 6 working halls (small spinning mill and large weaving, 400 weaving machines), hydraulic-power facilities including an artificial canal, a villa for the owner's family and a few housing blocks for the workers (Fig. 7.58). In 1899 the cotton mill was sold by Trumpy to the newborn company Società Anonima Cotonificio Bergamasco, founded by a group of Swiss and Italian entrepreneurs based in Milan, among which Federico Mylius, Edoardo Amman, Giuseppe Frua, Paolo Muggiani, Emilio Wepfer and the same Giacomo Trumpy and Alfredo Zopfi. Further expanded, the mill had at time 10.000 fuses and 520 weaving machines (most of them Northrop automatic) and employed around 650 workers. A financial crisis hit the company in 1909 and, at the same time, a vast fire destroyed mostly of

the weaving section. Close to bankruptcy, the company and the factory of Ponte Nossa were then taken over by a growing and already leading textile company at the time, De Angeli-Frua, Società per l'industria dei tessuti stampati S.p.A., based in Milan and founded by Ernesto De Angeli and Giuseppe Frua. Under the new ownership, the factory was incredibly expanded with the addition of a new spinning section (50.000 fuses) in a multi-story luminous building and the upgrade of weaving (700 machines) and printing, dying and bleaching sections. In the late 1910 s, the factory was able to produce 20 million of meters of textiles per year and employed around 1600 workers. Several social and housing services were also established in Ponte Nossa, such as workers houses (on a terrace above the old town, right side of the Serio), nursery and schools, and also a boarding school for incoming female workers (1917). In 1924 two hydroelectric power stations were built in the upper valley (Ardesio and Gromo) by the De Angeli-Frua subsidiary Società impianti idroelettrici alto Serio, which served not only the Ponte Nossa cotton mill (already provided with two power stations, one internal and one downstream in Casnigo-Costone) but also other companies plants in the lowlands. Within De Angeli-Frua productive network, the cotton mill of Ponte Nossa developed rapidly becoming one of the leading production sites (Fig. 7.59) (Fig. 7.60). Several years later, in 1968, De Angeli-Frua was taken over by Cotonificio Cantoni, an historical and renowned textile company based in Milan leader in the cotton manufacturing business. The cotton mill was updated and partially refurbished with the addition of new weaving section (replacing the old one), although the new ownership began soon to consider this plant (as all those sites inherited from De Angeli-Frua) a non-profitable business. In 1972 the cotton mill employed around 1000 workers and had 49.528 active fuses and 748 weaving machines. In 1984 Cantoni was then taken over by Inghirami Textile Company, part of the financial holding of Inghirami, thus becoming Cantoni ITC. The activities in Ponte Nossa were gradually reduced and some unused buildings were taken over by local SMEs (Lamiflex and Officine Meccaniche) and refurbished for their production purposes. In early 2000 s most of the raw cotton manufacturing of Inghirami group was moved from Italy to developing countries. In this context, the cotton mill of Ponte Nossa, almost inactive, was definitively closed in 2004. Soon after, the Municipality of Ponte Nossa and the Mountain Community of Valle Seriana promoted the creation of a STU-Società di Trasformazione Urbana (a public-private joint-stock urban development company) named "Kilometro Verde" (transl. green mile). The aim of the STU was the reactivation of the site through the functional reuse of the existing structures for small scale industry and new businesses focused on green economy. However, despite the financial support of the Lombardy Region authority and Fondazione Cariplo (a charitable foundation active in economic and cultural development projects), the compulsory purchase of the site (=esproprio) could not be completed due to the too high costs and the missing sponsorship of Inghirami Group, the site owner. In 2010, a feasibility study following the same orientation of the STU goals was commissioned by Inghirami to the Bergamo-based architectural office Studio Pievani. The preliminary project included the reuse of several existing buildings and environmental mitigation works on the mountain backside. In 2012 the Municipality of Ponte Nossa approved the new PGT (town plan) in which the productive reuse of the site is confirmed, including further details on the functional use of specific buildings and areas within the property and considering architectural heritage values in the process of transformation. In 2015, after the formal dissolution of the STU "Kilometro Verde", the Municipality together with the Mountain Community of Valle Seriana presented again to Lombardy Region and Fondazione Cariplo a new project proposal for co-funding called "La comunità sostenibile—Green sul Serio", which aims to support green economy in the valley through the reuse of former industrial sites. In particular, two sites are included in the project: the Cantoni site in Ponte Nossa and the former Pigna paper mill in Alzano Lombardo. With regards to Ponte Nossa, the project mentioned the will to proceed through an Accordo di Programma, i.e. a cooperation between all administrative levels (region, province, municipality) to ensure a stronger public framework for relevant spatial planning projects. Within the new project proposal, the start-up phase is tied to the establishment of a business incubator (PCUBE) on the site, in a former industrial building of 900 m^2 which, on the basis of the Accordo di Programma, has to be transferred free of charge from the owner to the Municipality. Overall cost of the reuse operation is estimated in 1.5 million Euro. Following these last developments, an updated and economically lighter version of the feasibility study is again commissioned by Inghirami to Studio Pievani, in which the percentage of reused spaces is lowered down and replaced with brand new buildings, still with productive use. In 2017 the company Officine Meccaniche, which already occupied some of the former cotton mills buildings since the 1980 s after having bought and refurbished them, took over the upper part of the former industrial sites (former spinning mill block) with the aim to expand its production surfaces. In 2018, finally, Inghirami presented a concrete proposal of Piano Attuativo which integrates the last feasibility study (2015) with the prescriptions of the Municipal town plan (2012). The official adoption of the Piano Attuativo occurred in late 2019.

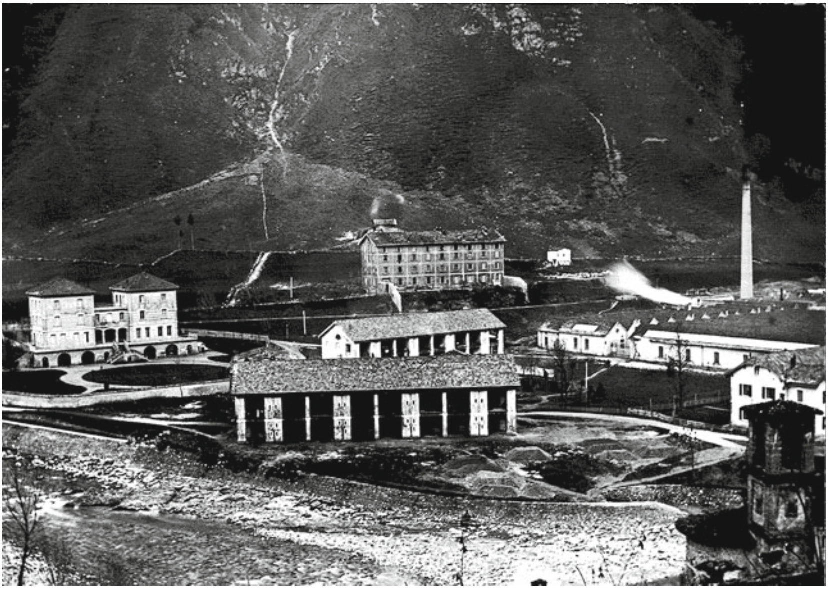


Fig. 7.58 A rare view from 1902, showing the first shed halls (right side) as well as the director's villa (left side) and the boarding-houses in between. The embankment of the Serio river is also clearly visible

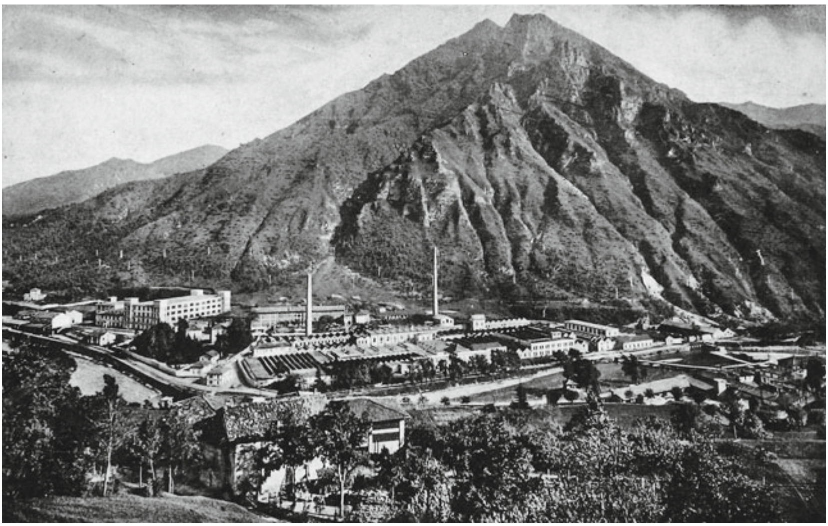


Fig. 7.59 The cotton mill extending at the foot of Corno Guazza (Pizzo Formico massif), 1941

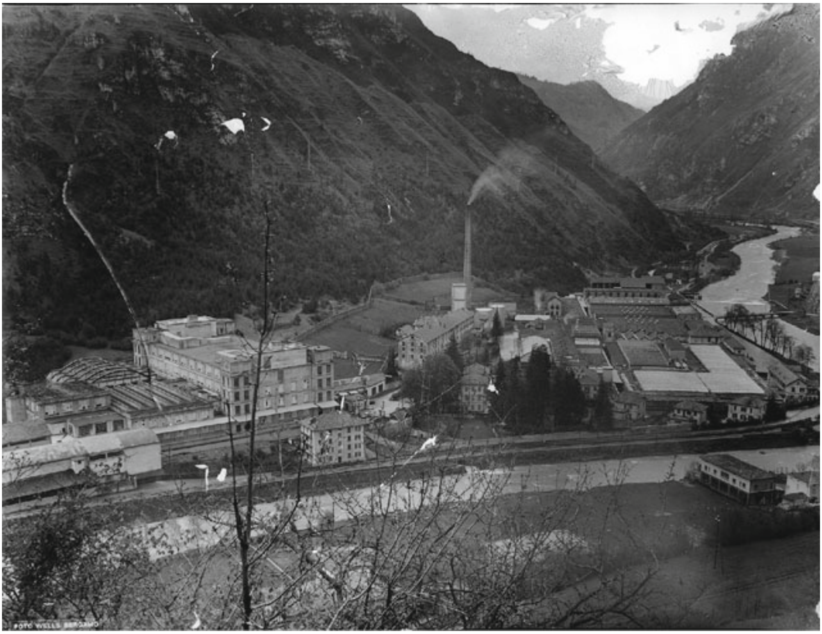


Fig. 7.60 Overview of the cotton mill in 1967. The Serio river, the railway and the hydropower canal are all clearly visible

Current use and future plans
The main expectations of the local and valley community are connected to the concrete reactivation of the site for productive purposes, and this way seems to be already seriously taken due to the recent agreements. The takeover of the former spinning mill block by Officine Meccaniche is perceived as a good sign towards the site reactivation, although the interested portion of the site is still very limited. The lower part of the site, larger and in worst conditions due to the earlier abandonment of the spaces, is still waiting for an investor, which is quite difficult to find (because there are restrictions on the transformation of buildings due to industrial heritage value). The fear that a coherent transformation of the whole site might not happen due to the different timing and the lack of a single investor is true. The municipality and the valley community are not able to acquire the remaining parts of the sites or even less, and to transform it, but at least through the local development plan their aims are expressed and made clear. Some upcoming projects are believed to foster the transformation of the site, such as the realization of a new larger bridge to connect the left and right shores of

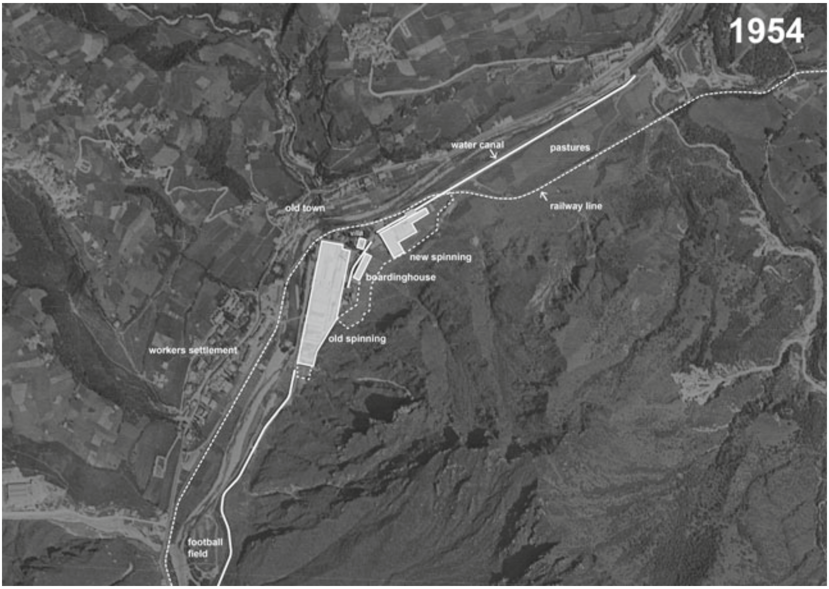
the river in the proximity of the site (required by industrial activities on the left side which needs to move goods). Potentially, the site redevelopment is seen by the valley community as also a chance to improve the problematic environmental conditions of the surroundings (impermeable river shores, landslides due to low maintenance of the slopes, etc.) and also to foster a more sustainable and diffused mountain tourism.

Main sources of information for the regional and site profiles:

- face-to-face interview with Mario Balduzzi (spatial planning and cultural heritage dep. Comunità Montana Valle Seriana), 23.01.2018
- face-to-face interview with Alessandra Pellegrini (chief of urban planning Ponte Nossa), 01.06.2018
- email exchange with Roberta Ripa (Inghirami Group, site owner), 17.05.2019
- telephone interview with Matteo Pievani (architect and owner of Studio Pievani), 25.09.2018
- PGT Ponte Nossa (local urban development plan)
- Piano Attuativo ADT 4 "Polo Produttivo Comprensoriale" via De Angeli (site development plan)
- PTCP Provincia di Bergamo (territorial development plan, Bergamo Province)
- ISTAT statistics (elaborated)
- "La comunità sostenibile _ Green sul Serio" (progetto N48)
- Gelfi M. (1995), Capitali svizzeri e nascita dell'industria cotoniera a Bergamo, in Archivio Storico Bergamasco, 15, 3, pp. 4–40.
- Archivio Storico Mediobanca (1973), Cotonificio Cantoni, in Ricerche & Studi.
- "Il territorio di Clusone. Evoluzione geologica e paesaggio vegetale", AAVV, Comune di Clusone 2004
- local newspapers (2012–2019)

7.4.3 Site Preliminary Study

The attached site preliminary study is based on both single and comparative analysis of six corrected aerial photographs (orthophotos), covering the time frame 1954–2015. The selection of suitable photos has been done by considering a temporal distance among each other of approximately 10–15 years, although this was not always possible due to the limited availability of the material. The selected orthophotos refers to the following years (source in brackets): 1954 (IGM), 1962 (IGM), 1975 (Regione Lombardia), 1988 (Regione Lombardia), 1998 (Regione Lombardia), 2015 (Regione Lombardia). The collected material provides a good coverage of the recent temporal development of the site and its surroundings. However, since the industrial site was already formed in the first available year (1954), thus no more subject to major transformations, the temporal series provides more elements with regards to the landscape change in the surroundings rather than the site itself.



1954—The cotton mill is divided in three distinct areas: the old spinning mill as huge and compact built-on block on the south, an intermediate area including the director 's villa and the boarding house, and the new spinning mill on the north-east end. On the left side, the site is bordered by the river Serio on the south and the railway line on the north. The complex intercepts a long water canal derived from the Serio, which runs through the site (underneath buildings and inner roads) and continues far to the south. The canal, the railway and the river create a fragmented flat landscape around the site, whose open spaces are mainly made of grassland used for pastures or other activities (e.g. football field). On the backside, at the foot of the mountain slope, the site is delimited by a wall. On the other side of the river it is possible to distinguish the old town and the newer workers settlement.

1962—The factory site looks almost unchanged, with just a few small additions next to the new spinning mill plant. The distinction between inner and outer factory areas is much clearer, as beyond the factory wall a growing shrubland is covering the lower part of the mountain slope. The density and regularity of the shrubs might suggest that part of it is the result of a plantation (reforestation?). Along the water canal, north and south to the factory site, the same growing shrubland can be spotted too, but much more fragmented and chaotic (probably spontaneous rewilding of inaccessible areas for pastures). Within the factory perimeter, it can be noticed the appearance of small paths connecting the new spinning mill with the other buildings, which run across maintained grassland and orchard gardens around the boarding-house.

1975—Relevant changed within and around the site perimeter can be detected. Some ancient buildings in the core site (including the old director's villa) have been demolished, while on the north and south edges of the site there are some new additions as well as replacements (the new weaving mill). A power substation has been also added on the backside, next to the boarding-house. The railway once running through the valley and crossing the river Serio in front of the mill is now abandoned. Reforestation and rewilding processes are evidently occurring on the mountain slope, out of the factory wall, along the canal and on residual land between the canal and the river. In addition, new small-scale industries have been established on former pastures next to the river and the canal, both on the north-east side of the mill and further to the south—provided with new roads for accessibility.

1988—The factory site is almost unchanged. On the southern edge, some small old buildings are demolished and replaced with a new modern one, next to the weaving plant. On the northern edge, a section of the spinning plant has been demolished. The most relevant issue is again the fast-rewilding process, which is superimposing to the existing reforestation on the backside of the mill, thus leading to a dense tree pattern beyond the factory wall. Some rewilding spots can be also detected within the factory perimeter, on unused/leftover open spaces (e.g. near the new spinning mill and around the boarding-house). Similar developments can be also seen along the abandoned railway line as well as the water canal, towards the mountain slope. The recently established industries are expanding, while a new road is created on the north side of the mill (refurbishing an existing agricultural pathway).

1998—No major changes occurred on the factory site. A new building has been added on the northern edge, close to the newer spinning mill. The factory wall can barely contain the expanding and growing forest on the mountain slopes, which is now surrounding the factory site from all sides except the riverfront. The river shores are increasingly subject to rewilding and tree-coverage densification too, especially on the north and south sides of the cotton mill area. New industrial and commercial buildings are now occupying the flat land between the river and the former railway line, on what used to be (partially) a railway yard. Urbanisation on the valley floor and sunny slopes is expanding with new mixed industrial, residential and leisure zones.

2015—The factory builtscape is unchanged, although most of the open spaces within the factory site are now fully rewilded—as consequence of the factory closure and abandonment. An impressive continuity of tree pattern can be seen between the mountain slope and the inner courtyards of the cotton mill, such as around the boarding-house, on the former director's villa site (previously a private garden) and next to the newer spinning mill. A new building added on the northern edge of the site suggests that this part of the factory has been reused for other purposes. The former railway line has been transformed into a bike path. On the southern edge of the site, the fallow land (former pastures) between the river and the canal now hosts a riverside public park. New industrial buildings have filled the leftover meadows on the north-east, between the canal and the former railway line.

7.4.4 Photographic (field) Study

The field trip took place on 31.05–6.06.2018. Due to the restrictions imposed by the site owner and the general conditions of the structures, only one full day was dedicated to the site visit—including access to some relevant buildings. The fact that the site was already visited by the author back in 2008 eased the on-site operations. Beside the cotton mill site, however, most of the field study was dedicated to exploring and documenting the surroundings, with particular attention towards the extensive water infrastructure connected to hydropower generation (partially still in use). Selected photographs include overviews of the cotton mill from different distances and point of view (reliefs, plateaus, valley floor), detailed views of the site internal structure (including overviews from rooftops) and the related 'water landscape' along the valley bed. In addition, during the field work a fruitful meeting with architect Alessandra Pellegrini (urban planning chief at Ponte Nossa municipality) and her team took place, which allowed to gather useful information and insights on the current state of the site and plans (Fig. 7.61–7.84).

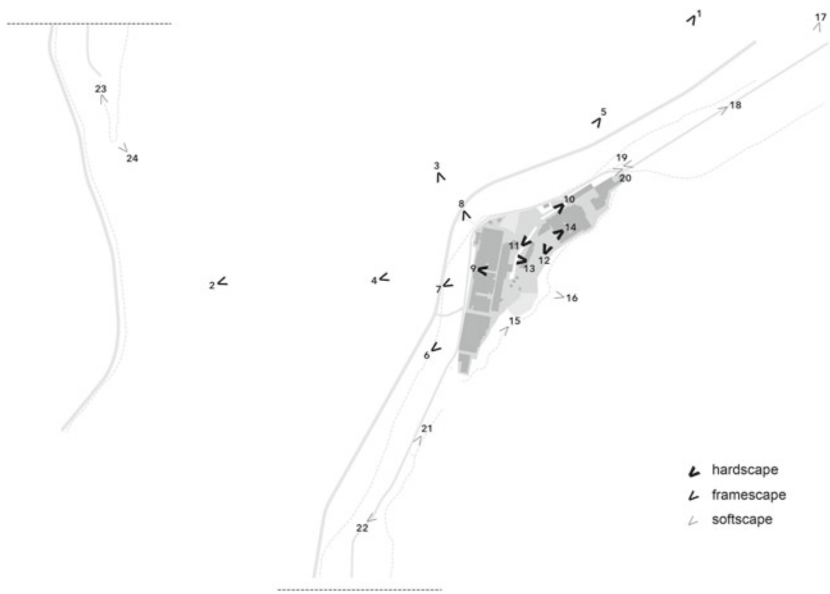


Fig. 7.61 Overview from Parre. The Cantoni cotton occupies the narrow valley floor at the foot of Pizzo Formico massif

Fig. 7.62 Overview from Premolo. Stretched along the valley, the former cotton mill is composed of many different sections immersed in a dense vegetational pattern

Fig. 7.63 The ancient core of the cotton mill, with the typical shed halls, is separated from the nearby old town of Ponte Nossa by the Serio river

Fig. 7.64 Although partially hidden by overgrown vegetation, the cotton mill is still a prominent constitutive element of the urbanised landscape of the valley

Fig. 7.65 The new spinning mill seen from Sottocorna

Fig. 7.66 The Serio river flowing next to the southern part of the cotton mill site (now occupied by Lamiflex industries). On the right, the water catchment dam

Fig. 7.67 A tiny strip of trees separates the factory from the Serio river

Fig. 7.68 The medieval bridge crossing the Serio river in the vicinity of the old cotton mill entrance

Fig. 7.69 The older section of the site is characterised by high building density and narrow roads. The area is completely unused except for the hydropower station (centre-right)

Fig. 7.70 The hydropower canal runs through the entire site to bring water to the power station and production halls. On the left, the imposing new spinning mill

Fig. 7.71 The water canal section between the old and the new spinning mills, crossing overgrown factory gardens

Fig. 7.72 The new spinning mill surrounded by spontaneous woodlands and shrublands

Fig. 7.73 Overview of the old spinning mill with the typical shed roofs seen from the boarding house. In the background, the recent expansion of Ponte Nossa

Fig. 7.74 A few buildings and structures barely emerge from the fully overgrown gardens and courtyards. In the background, the Pizzo Frol and the Alben massif (far right)

Fig. 7.75 The forest path along the backside wall of the site, on the western side of Corno Guazza

Fig. 7.76 The only left chimney of the cotton mill seen from the pine forest on the Corno Guazza slopes

Fig. 7.77 The catchment point of the mill's hydropower canal, 800 m upstream on the Serio river

Fig. 7.78 The canal running next to an industrial zone developed in the 1970 s on former lowland pastures

Fig. 7.79 The canal running north to the cotton mill, between industrial areas and residual woodlands. The larger bridge in the right foreground used to serve a railway line

Fig. 7.80 The same old railway bridge looking south, where the canal enters the factory site passing underneath a renovated building

Fig. 7.81 The second section of the canal proceeding south, out of the cotton mill site. In the background, the imposing Pizzo Frol

Fig. 7.82 As the valley bed decreases in height, the water canal keeps the same elevation for the purpose of hydropower generation

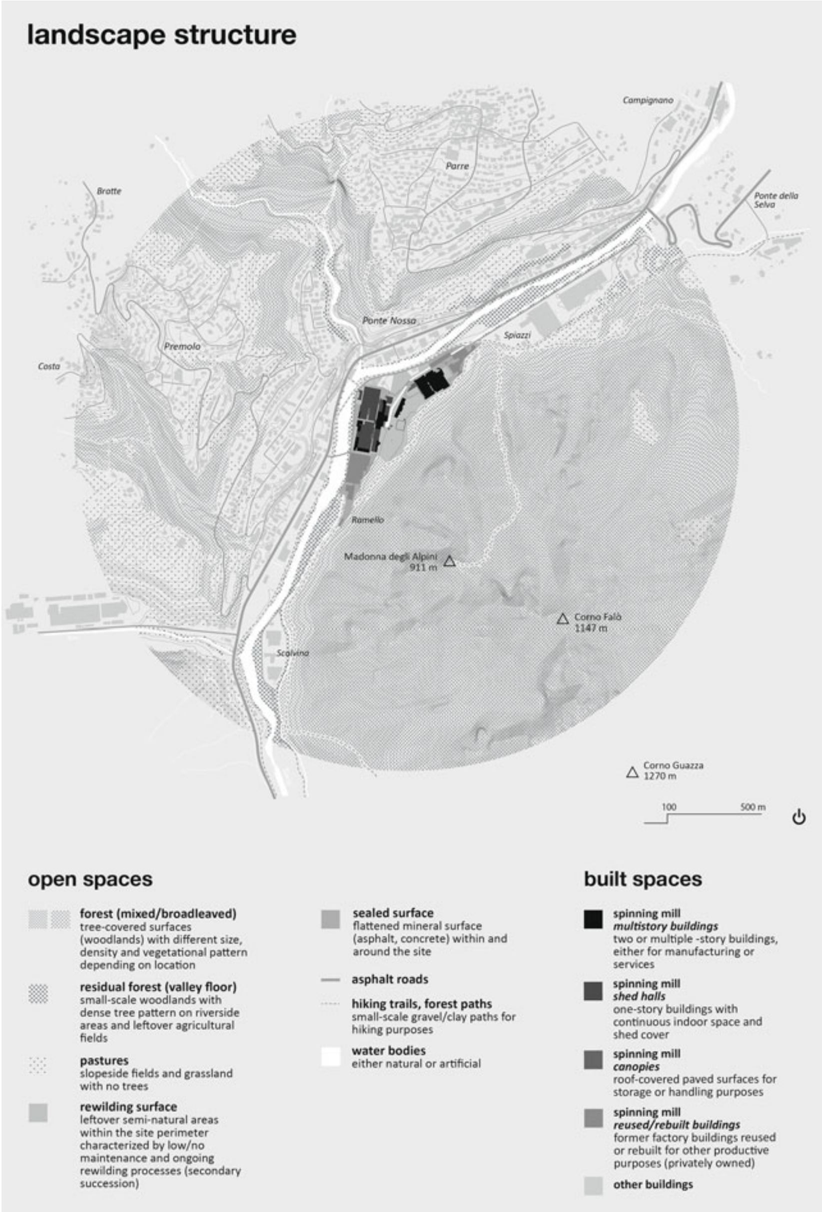
Fig. 7.83 A controlled waterfall near a small wetland allows to get rid of the exceeding water in the canal

Fig. 7.84 The canal beyond the Costone gorge, in the vicinity of the southern hydropower station. In the background, the ridge of Corno Guazza

7.4.5 Site Advanced Study

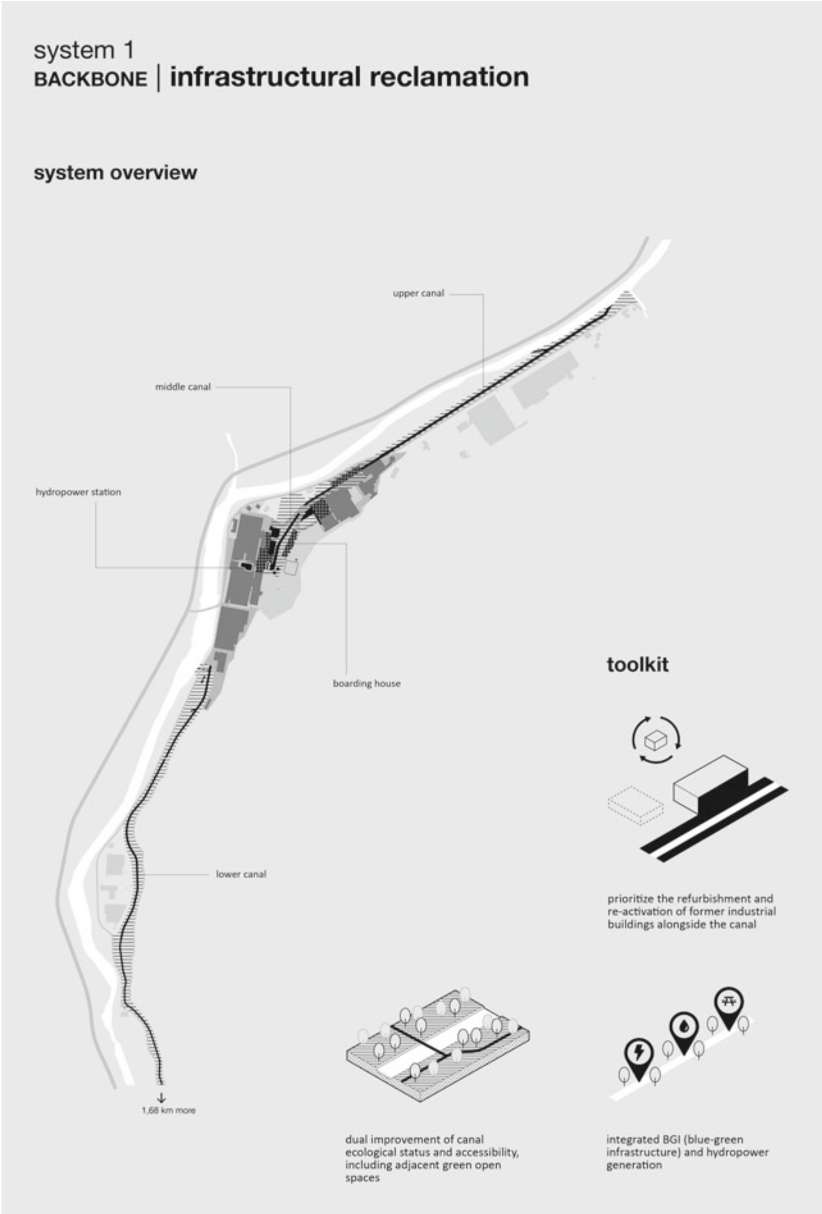
Landscape structure

The landscape structure of the former cotton mill is strongly characterised by the linearity of the Serio river and the parallel-running hydropower canal. The two water courses, although different by width and footprint, are interwoven into a complex and irregular waterscape. The cotton mill site is totally integrated in this waterscape, of which it occupies a key intermediate section. Due to the fact the hydropower canal literally crosses the industrial site, entering from upstream the river Serio and leaving that downstream, the position and orientation of most of the existing factory buildings are strongly influenced by the course of the canal itself. The oldest part of the site is aligned to a south-oriented section of the Serio, directly facing the old town of Ponte Nossa at the junction between Serio and Nossana rivers. The newest part extends further upwards, organised around a linear section of the hydropower canal, and thus having a less binding spatial relationship with the river. The internal structure of the site is characterised by the clear distinction between the two built-up parts, which are indeed separated by a vast open green space mostly covered by spontaneous vegetation due to long abandonment. On the backside of the former industrial site, where the mountain slope rises rapidly in altitude, the layered complexity of the built-up industrial landscape fades away into a homogenous forest-covered rugged terrain. From a wider perspective, the cotton mill site can be figuratively seen as a big knot in a rope, where the latter is represented by the water infrastructure. The same situation, i.e. little flatlands compressed between the river system and the harsh mountain slopes, can be found both upstream and downstream of the site, where other (more recent) industrial areas are also existing.

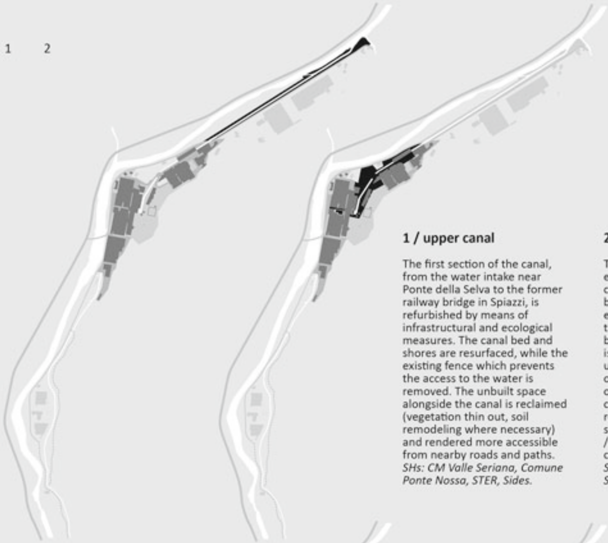

landscape structure
Campignano
Parre
Brotte
Ponte della Selva
Ponte Nossa
Spiazzi
Premolo
Costa
Ramello
Madonna degli Alpini
911 m
Corno Falò
1147 m
Scalvino
Corno Guazza
1270 m
100
500 m
open spaces
forest (mixed/broadleaved)
tree-covered surfaces (woodlands) with different size, density and vegetational pattern depending on location
residual forest (valley floor)
small-scale woodlands with dense tree pattern on riverside areas and leftover agricultural fields
pastures
slopeside fields and grassland with no trees
rewilding surface
leftover semi-natural areas within the site perimeter characterized by low/no maintenance and ongoing rewilding processes (secondary succession)
sealed surface
flattened mineral surface (asphalt, concrete) within and around the site
asphalt roads
hiking trails, forest paths
small-scale gravel/clay paths for hiking purposes
water bodies
either natural or artificial
built spaces
spinning mill
multistory buildings
two or multiple -story buildings, either for manufacturing or services
spinning mill
shed halls
one-story buildings with continuous indoor space and shed cover
spinning mill
canopies
roof-covered paved surfaces for storage or handling purposes
spinning mill
reused/rebuilt buildings
former factory buildings reused or rebuilt for other productive purposes (privately owned)
other buildings

Landscape systems

The outlined site transformation follows and integrates the indications of existing local and regional plans and regulations, as expressed by the different site owners and planning institutions. In particular, the transformation strongly enhances the site potential in connection to the wider river landscape system, of which the former cotton mill is an integral and relevant part. The complexity of the site, well expressed by the layered composition of many different built and open spaces, is tackled by means of gradual refurbishment and reactivation process. The latter is centred on and driven by the infrastructural reclamation of the hydropower canal and its adjacent spaces, as well as founded on the valorisation of the architectural and spatial qualities of the old industrial buildings there existing. The transformation process is structured on the three identified systems: the "backbone", which focuses on the complex waterscape designed by the canal and its functional 'encounter' with the former industrial site; the "borders", which deals with the stratified sequence of liminal spaces in the narrow valley floor, resulting from the interaction between the river, the canal, the mountain slope and the industrial site; the "core", which addresses the adaptive reuse of the long abandoned old industrial buildings and adjacent open spaces, developing their potential for productive, cultural and service activities. So conceived, the three systems advance a fully integrated site redevelopment, which takes into account the many existing infrastructures while improving their multi-functionality through a progressive, highly adaptive approach.


system 1
BACKBONE | infrastructural reclamation
system overview
upper canal
middle canal
hydropower station
boarding house
lower canal
1,68 km more
toolkit
prioritize the refurbishment and re-activation of former industrial buildings alongside the canal
dual improvement of canal ecological status and accessibility, including adjacent green open spaces
integrated BGI (blue-green infrastructure) and hydropower generation

system 1
transformation phases



1 / upper canal

The first section of the canal, from the water intake near Ponte della Selva to the former railway bridge in Spiazzi, is refurbished by means of infrastructural and ecological measures. The canal bed and shores are resurfaced, while the existing fence which prevents the access to the water is removed. The unbuilt space alongside the canal is reclaimed (vegetation thin out, soil remodeling where necessary) and rendered more accessible from nearby roads and paths. *SHs: CM Valle Seriana, Comune Ponte Nossa, STER, Sides.*

2 / middle canal (site)

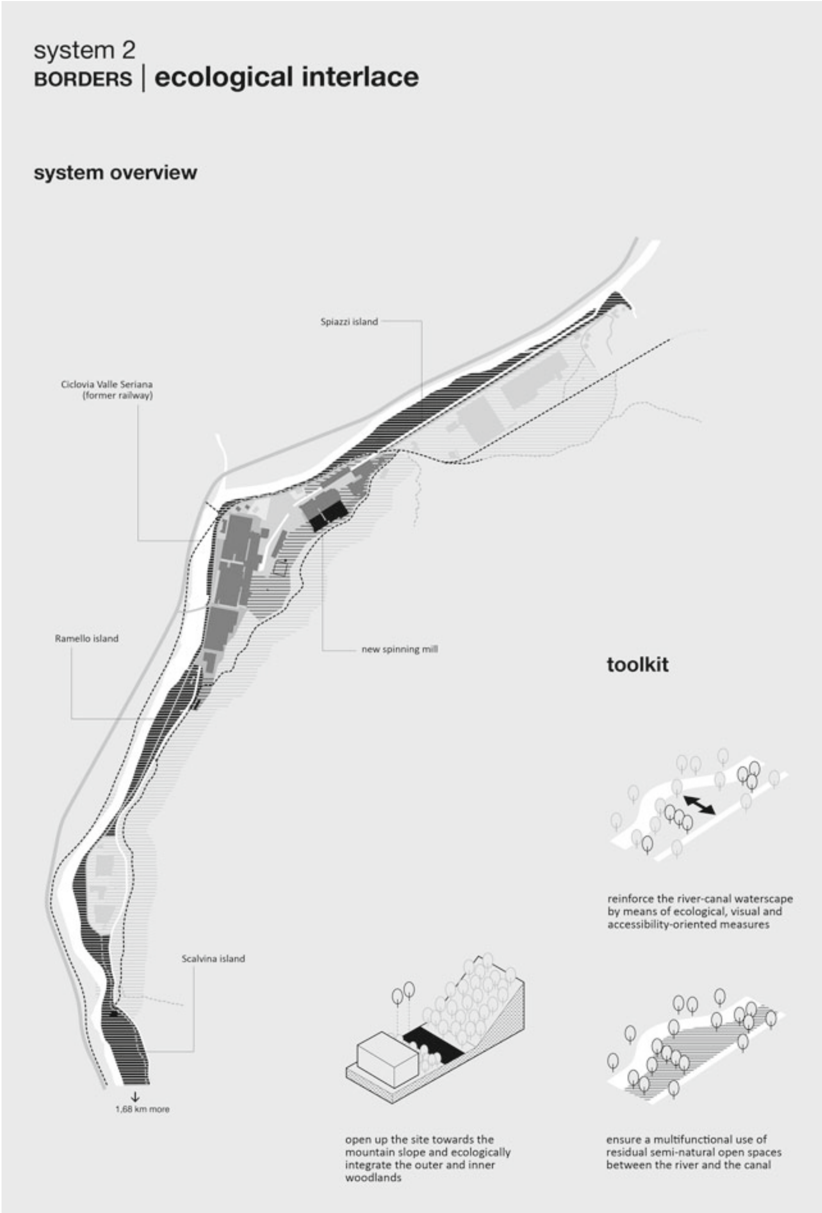
The middle section of the canal, entirely located within the cotton mill site, is refurbished by means of infrastructural and ecological measures. Besides the resurfacing of visible canal bed and shores, refurbishment is also addressed to underground sections as well as on the bridges. The unbuilt open spaces adjacent to the canal are reclaimed through reconfiguration of permeable surfaces and vegetation thin out / increase (e.g. the former courtyard-park). *SHs: CM Valle Seriana, Comune Ponte Nossa, STER, Sides, Inghirami, OM.*

3 / adaptive clearing and refurbishment

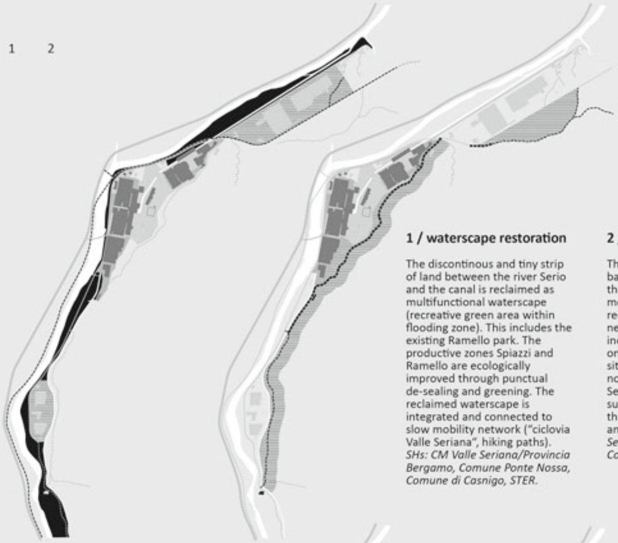
Those industrial buildings, either used or unused, that intercept the middle canal section are subject to clearing or refurbishment depending on specific location, structural relevance, status and architectural quality. Those buildings suitable for refurbishment are the northern half of the new spinning mill, the boarding house and multi-story shed halls in the lower half of the site. Demolished ones are minor add-ons and redundant structures. *SHs: CM Valle Seriana, Comune Ponte Nossa, STER, Inghirami, OM.*

4 / lower canal

The third and last section of the canal, running for 3 km from the southern edge of the cotton mill site (Lamiflex industries) to the Costone power plant in Casnigo, is refurbished by means of infrastructural and ecological measures. The canal bed and shores are resurfaced, while the existing fence along the shores is maintained only in proximity of dangerous terrain situations. The adjacent spaces are made accessible. *SHs: CM Valle Seriana, Comune Ponte Nossa, Comune di Casnigo, STER, Sides, Lamiflex.*


system 2
BORDERS | ecological interlace
system overview
Spiazzi island
Ciclovia Valle Seriana (former railway)
Ramello island
new spinning mill
Scalvina island
1,68 km more
toolkit
reinforce the river-canal waterscape by means of ecological, visual and accessibility-oriented measures
open up the site towards the mountain slope and ecologically integrate the outer and inner woodlands
ensure a multifunctional use of residual semi-natural open spaces between the river and the canal

system 2
transformation phases

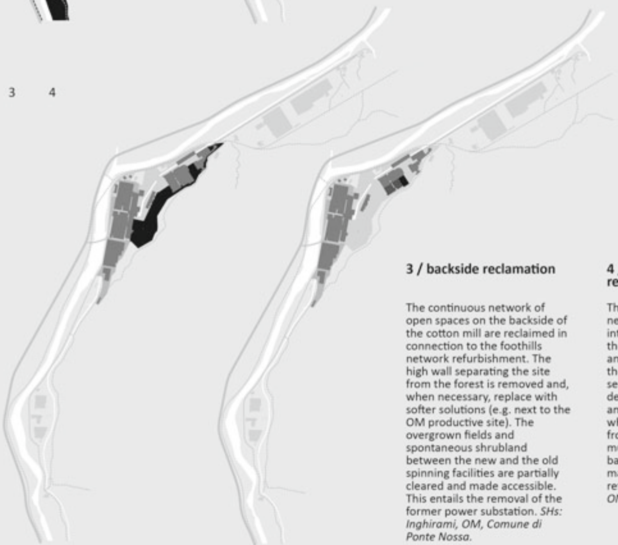


1 / waterscape restoration

The discontinous and tiny strip of land between the river Serio and the canal is reclaimed as multifunctional waterscape (recreative green area within flooding zone). This includes the existing Ramello park. The productive zones Spiazzi and Ramello are ecologically improved through punctual de-sealing and greening. The reclaimed waterscape is integrated and connected to slow mobility network ("ciclovia Valle Seriana", hiking paths). *SHs: CM Valle Seriana/Provincia Bergamo, Comune Ponte Nossa, Comune di Casnigo, STER.*

2 / foothills network

The hiking path network on the backside of the cotton mill, at the foot of the Corno Guazza mountain, is restored and reconnected to the existing network. The restoration includes the path prolongations on the south of the cotton mill site, towards Ramello, and the north, towards Ponte della Selva. The overgrown forested surroundings of the paths are thin out to allow accessibility and safe fruition. *SHs: CM Valle Seriana/Provincia Bergamo, Comune Ponte Nossa.*

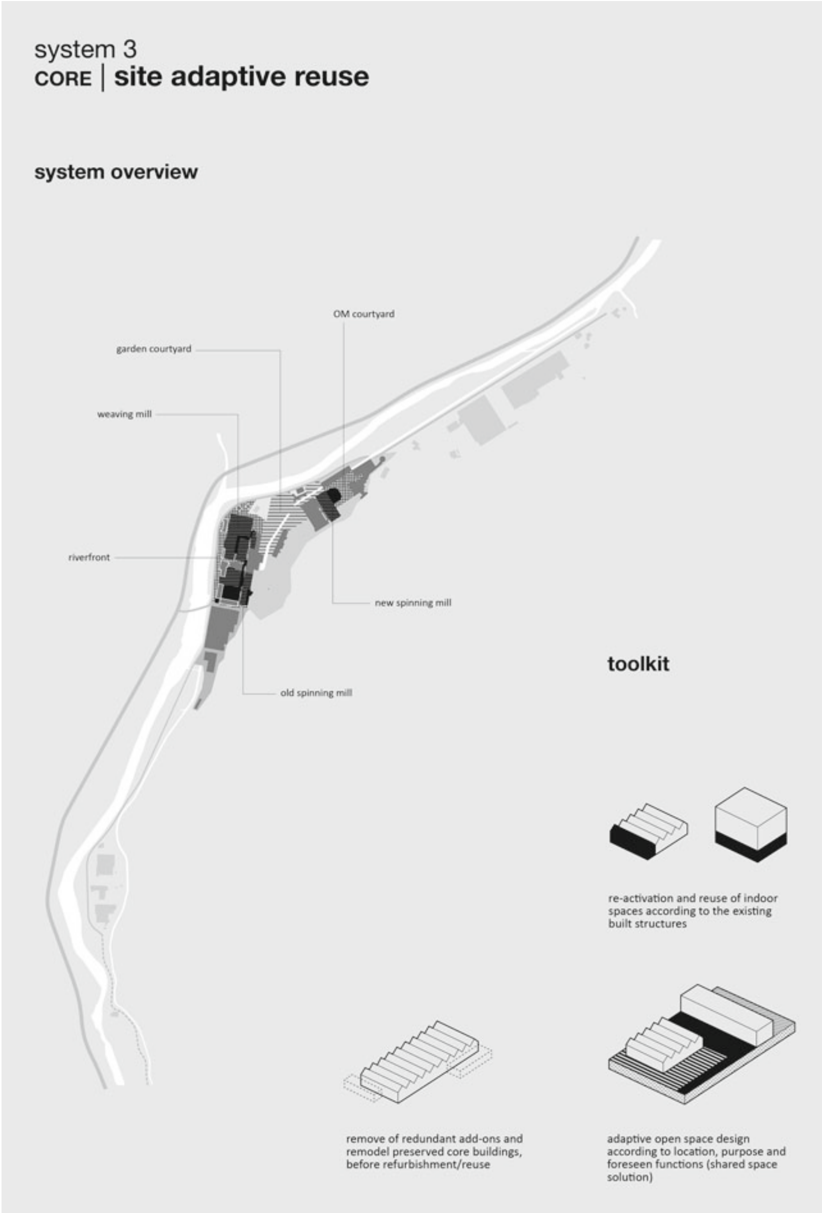


3 / backside reclamation

The continuous network of open spaces on the backside of the cotton mill are reclaimed in connection to the foothills network refurbishment. The high wall separating the site from the forest is removed and, when necessary, replace with softer solutions (e.g. next to the OM productive site). The overgrown fields and spontaneous shrubland between the new and the old spinning facilities are partially cleared and made accessible. This entails the removal of the former power substation. *SHs: Inghirami, OM, Comune di Ponte Nossa.*

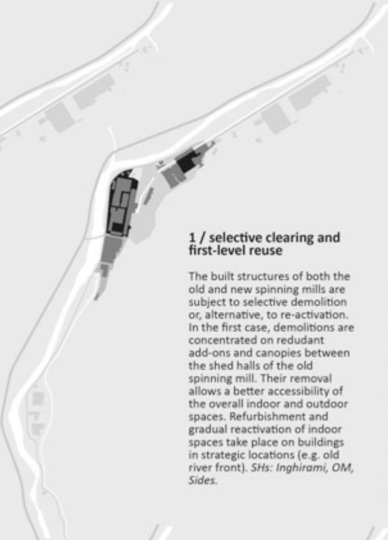
4 / adaptive clearing and refurbishment

The rear-side buildings of the new spinning mill block are interested by the reclamation of the surrounding open spaces and the foothills network. Of the three separate building sections, the eastmost one is demolished (hardly reusable and of low architectural value), while the other two (a shed hall from the 1950s and part of the multi-story spinning unit dating back to the 1920s) are maintained and gradually refurbished. *SHs: Inghirami, OM, Comune di Ponte Nossa.*


system 3
CORE | site adaptive reuse
system overview
OM courtyard
garden courtyard
weaving mill
riverfront
new spinning mill
old spinning mill
toolkit
re-activation and reuse of indoor spaces according to the existing built structures
remove of redundant add-ons and remodel preserved core buildings, before refurbishment/reuse
adaptive open space design according to location, purpose and foreseen functions (shared space solution)

system 3
transformation phases

1 2



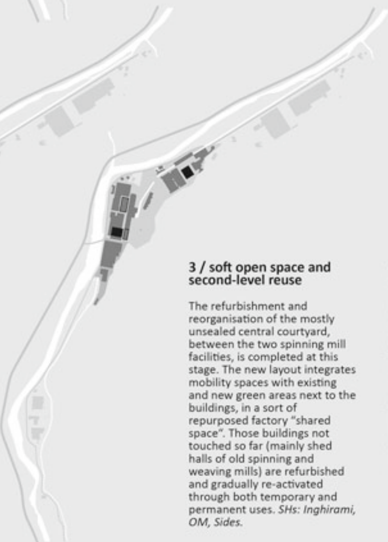
1 / selective clearing and first-level reuse

The built structures of both the old and new spinning mills are subject to selective demolition or, alternative, to re-activation. In the first case, demolitions are concentrated on redudant add-ons and canopies between the shed halls of the old spinning mill. Their removal allows a better accessibility of the overall indoor and outdoor spaces. Refurbishment and gradual reactivation of indoor spaces take place on buildings in strategic locations (e.g. old river front). *SHs: Inghirami, OM, Sides.*

2 / hard open space

The hard open space in-between and around the buildings of the old spinning mill is reorganised according to the built fabric. Different layouts, pavings and ratio of permeable/sealed surface are foreseen on the basis of the specific use of the open space (e.g. difference between riverfront and internal alleys). A similar refurbishment takes place also in the courtyard of the new spinning mill, between the already reused buildings by OM and the former spinning facility. *SHs: Inghirami, OM, Sides.*

3 4



3 / soft open space and second-level reuse

The refurbishment and reorganisation of the mostly unsealed central courtyard, between the two spinning mill facilities, is completed at this stage. The new layout integrates mobility spaces with existing and new green areas next to the buildings, in a sort of repurposed factory "shared space". Those buildings not touched so far (mainly shed halls of old spinning and weaving mills) are refurbished and gradually re-activated through both temporary and permanent uses. *SHs: Inghirami, OM, Sides.*

4 / completion and densification

For those former industrial buildings where the removal of add-ons left incomplete/open footprints, a completion is forseen. This has to match the new layout of the adjacent open spaces and allow the highest reusability of the indoor spaces too. In a few cases, specific empty areas/lots are identified as new building zones, for future densificatio (new developments). *SHs: Inghirami, OM.*

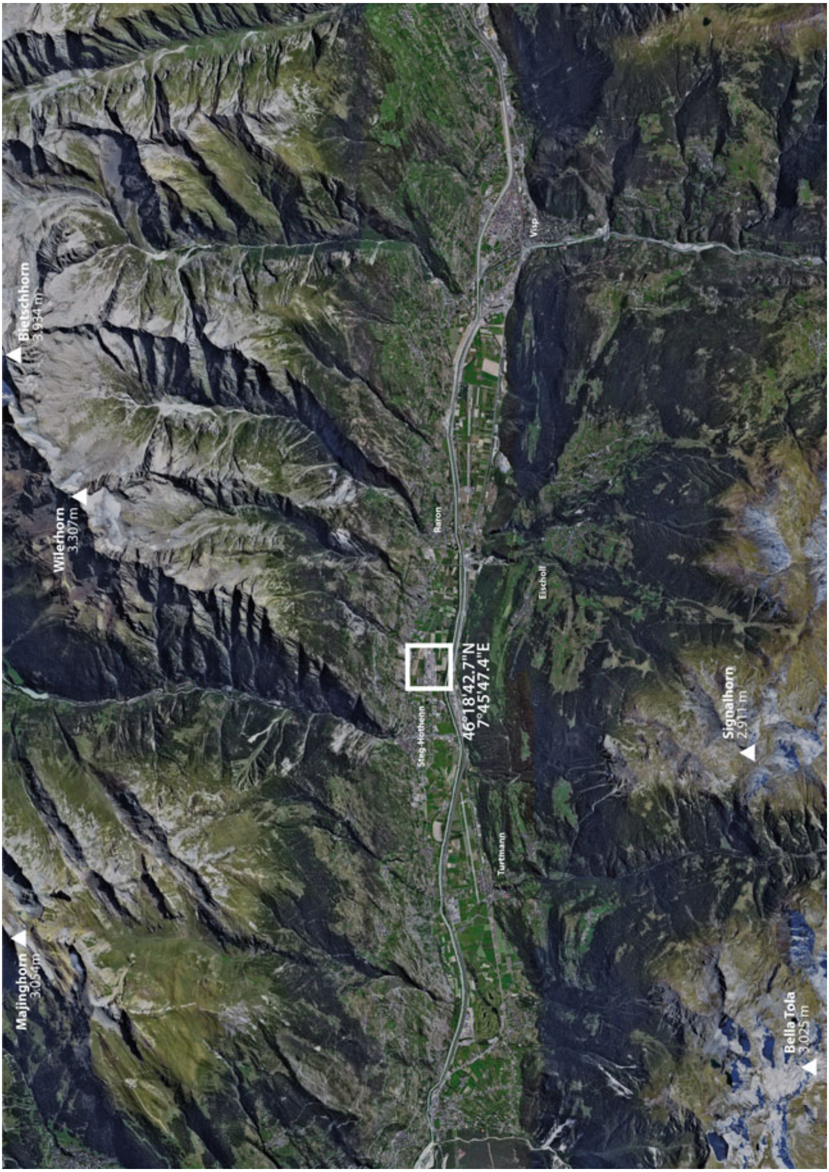
7.5 Case Study IV: Constellium, Steg-Hohtenn / CH

7.5.1 Regional Overview

Identification
Cultural region: Swiss Western Central Alps (Westliche Zentralalpen) > Bernese Alps (SOIUSA 12) and Pennine Alps (SIOUSA 9) > Oberwallis.

Administrative region: NUTS 2: Région Lémanique/Genferseeregion > NUTS 3: Canton Valais/Kanton Wallis (CH012) > Region Oberwallis (socio-economic aggregation of Goms, Östlich Raron, Brig, Visp, Westlich Raron, Leuk administrative districts: 63 municipalities).

Geography
The region corresponds to the hydrographic basin of the upper Rhone, centred on the upper Rhone valley and including several side valleys on both the right (Leukertal, Lötschental) and left (Turtmanntal, Mattertal, Saastal, Binntal) bank. The orographic system is typically inner-Alpine, i.e. strongly characterized by impressively high and complex crystalline massifs which physically isolate the enclosed valleys from the surrounding regions. The northern edge of the region is defined by the Bernese Alps, which include several renowned Swiss 4000 + peaks (Jungfrau 4.158 m, Mönch 4.099 m, Finsteraarhorn 4.274 m, Aletschhorn 4.195 m) and the largest European glacier (Aletschgletscher), while the southern border towards Italy is dominated by the equally impressive and even higher Pennine Alps (Matterhorn/Cervino 4.478 m, Weisshorn 4.506 m, Mischabel-Dom 4.545 m, Monte Rosa-Dufourspitze 4.633 m). The eastern part of the region is partly occupied by the Lepontine Alps (Monte Leone 3.553 m, Blinnenhorn 3.373 m) and, towards north-east, the Uri Alps (Dammastock 3.630 m). The western side is instead the continuation of the mid Rhone course with surrounding valleys and peaks, which form the adjacent central Valais. In the upper Valais, the Rhone course and the related valley shape can be clearly distinguished between a lower and an upper section. The lower section, ca. 28 km from Leuk to Brig, is characterized by an EW orientation and a relatively large and flat valley floor of maximum width 1,2 km, surrounded by steep slopes on both the north and the south side (in this last case, some plateaus and terraces at high altitude are also present). The upper section, ca. 37 km from Brig to Obergoms, has a narrower valley floor (almost a gorge) which in the last section, above 1.300, opens up into a long-shaped, cultivated plateau.


Bietschhorn
3,934 m
Wilerhorn
3,307 m
Majinghorn
3,054m
Visp
Raron
Eischoll
Steg-Hohtenn
Turtmann
46°18'42.7"N
7°45'47.4"E
Signalhorn
2,911 m
Bella Tola
3,025 m

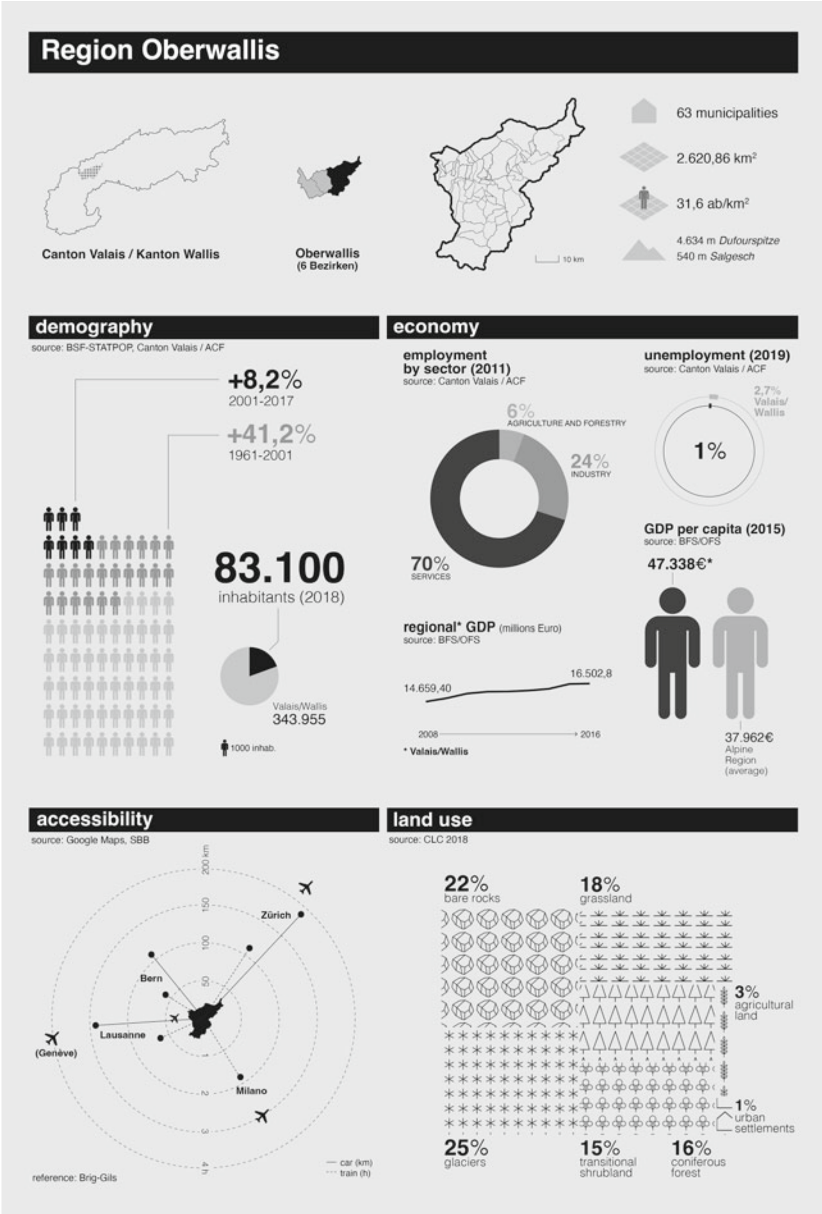
Accessibility

Despite the inward Alpine location, the region Oberwallis has a rather high level of accessibility in comparison to similar regions. This is mainly due to the unique position at the crossroads of French, Swiss and Italian Alpine regions, which makes of the upper Valais a key node in the transalpine transport network. The latter particularly applies to the railway system, which intercepts between Brig and Visp the historical Simplon-Lötschberg axis (connecting Milan to Bern-Basel, as part of the EU Rhine-Alpine Corridor). The completion in 2007 of the new Lötschberg basis tunnel (34,6 km), as part of the Swiss AlpTransit project, has largely improved the connections between the region and the major urban poles on the Swiss plateau (1h Brig-Bern, around 2h Brig-Zurich). On the southern side, the Simplon tunnel (20 km) allows to reach Milan in around 2h. Along the Rhone valley, towards west, another important railway line connects Brig-Visp to Lausanne (1h30') and Genève (2h20'). The narrow gauge Furka-Oberalp railway, on the eastern highlands, connects the region to Andermatt and Disentis/Mustér, though it is mainly used for touristic purposes and local commuting. Another narrow-gauge railway of mainly touristic relevance is the Visp-Zermatt line, climbing up through the Mattertal. The out-reaching road system is far less developed than railways, consisting mainly of single carriageways of historical importance but low capacity, often dealing with considerable elevations (Simplonpass towards Domodossola 2.005 m, Furkapass towards Andermatt 2.431 m, Grimselpass towards Brienz 2.165 m, Nufenenpass towards Airolo 2.478 m). Along the Rhone valley floor, downstream to Brig, the main road axis is represented by the H9 cantonal road (which includes the Simplon Road towards Italy). A major upgrade of the H9 is represented by the motorway A9, whose last section between Sierre and Brig (31,8 km) is expected to be completed by 2025. In terms of airport accessibility, the region is clearly disadvantaged, as the closest ones are indeed quite distant (Zurich and Genève around 200 km, Milan-Malpensa 150 km).

Socio-demographic profile

The Oberwallis region includes 63 municipalities grouped in 6 administrative districts, covering an area of 2.620,86 km^2 and hosting 83.100 inhabitants (2018). With an average population density of 31,6/km^2, the Oberwallis stands far below the averages of Canton Valais (65), the Swiss Alps too (76,5) and the whole Alpine region (74,6) too. However, due to the harsh topography, the regional population is mainly concentrated in the Rhone valley floor between Brig and Leuk, where significant densities up to 500–700/km^2 are normally reached into and around the main urban centres (Visp, Brig). Urban dwellers constitute, in fact, the majority of the population (78,7%). In quantitative terms, the Oberwallis contributes with its population for around one fourth to the overall Canton Valais

(343.955 inhab. in 2018), thus matching the 24,9% of German-speaking population of Valais here residing. The region experienced an outstanding population growth (+41,2%) between 1961 (54.276 inhab.) and 2000 (76.625 inhab.), while in more recent years (2000–2017) this trend has relented significantly, although remaining positive (+8,2%). With regards to the age composition of the population, the Oberwallis is experiencing a moderate ageing trend as the share of >65 y.o. inhabitants increased from 16,5% in 1990 to 19,3% in 2017 (21,4% at the cantonal level). The majority of the regional population (60,8%) is indeed active population between 20–64 y.o. With regards to the foreign population, the Oberwallis has a relatively lower share (15%) compared to the whole Valais (23,2%). However, in major industrial and touristic poles such as Visp and Zermatt the same rises up to 21–22%. In general, the Oberwallis shows a rather dynamic demographic trend but strongly polarised between central locations (high growth rates, more active population and many foreigners) and peripheral areas (low growth rates, more elderly people and less foreigners).


Region Oberwallis
Canton Valais / Kanton Wallis
Oberwallis (6 Bezirken)
10 km
63 municipalities
2.620,86 km²
31,6 ab/km²
4.634 m Dufourspitze
540 m Salgesch
demography
source: BSF-STATPOP, Canton Valais / ACF
+8,2% 2001-2017
+41,2% 1961-2001
83.100 inhabitants (2018)
Valais/Wallis 343.955
1000 inhab.
economy
employment by sector (2011)
source: Canton Valais / ACF
6% AGRICULTURE AND FORESTRY
24% INDUSTRY
70% SERVICES
unemployment (2019)
source: Canton Valais / ACF
2,7% Valais/Wallis
1%
GDP per capita (2015)
source: BFS/OFS
47.338€*
37.962€ Alpine Region (average)
regional* GDP (millions Euro)
source: BFS/OFS
14.659,40
16.502,8
2008
2016
* Valais/Wallis
accessibility
source: Google Maps, SBB
200 km
150
100
50
Zürich
Bern
Lausanne
(Genève)
Milano
1
2
3
4 h
car (km)
train (h)
reference: Brig-Gils
land use
source: CLC 2018
22% bare rocks
18% grassland
3% agricultural land
1% urban settlements
25% glaciers
15% transitional shrubland
16% coniferous forest

Economic profile

The Oberwallis is an economically dynamic inner Alpine region, characterized by a well-established industrial base and a strong orientation towards the service sector and especially intensive tourism. The employment figures of Oberwallis are matching those of the hosting region Valais/Wallis, although the latter is slightly more pronounced towards the service sector (72% of employment compared to 79% in Oberwallis, 2015) while the first is stronger in industry (24% of employment compared to 22% in Valais, 2015). In terms of unemployment, Oberwallis exceeds the canton with 1% against 2,7%. However, the contribution of the regional economy to the cantonal GDP is limited to 26% (2016), thus suggesting a rather marginal role of the region compared to those in the central and lower Rhone valley—more accessible and thus more developed. The industrial sector in Oberwallis is particularly well developed, as its specific contribution to the regional GDP exceeds the employment (respectively 27% and 24%). The main driver of the regional industrial sector is the multinational chemicals and biotechnology company Lonza AG, founded in the region in the late XIX century and running since 1909 a large chemical plant in Visp (90 ha, 2600 employees, 70 labs and R&D departments). In the whole canton, Lonza and the other few multinational enterprises (Constellium, BASF, Syngenta) occupy 16% of the industry employees, while the rest is employed in around 300 SMEs—90% of which have less than 100 employees. Halfway between industry and services (but accounting for the latter), energy production is also a major economic activity in the region as it is in the whole canton: with 10 billions of kWh per year, the Valais/Wallis accounts for around 30% of the total hydropower generation of Switzerland. With regards to the proper service sector, a key role is played by trade and transport businesses (due to the strategic location on the Basel-Milan railway axis) as well as by tourism-related activities (35% of regional employment) such as accommodation, catering, retail and healthcare/well-being. Tourism, in particular, is a well-established and high-profile activity in the region since more than one century, with world famous top-class destinations for winter tourism such as Zermatt and Sass-Fee and wellness resorts such as Leukerbad. The high relevance of tourism is a common feature of the whole canton Valais/Wallis, which holds the second place as the most visited Swiss Alpine region after the Grisons with around 12 millions of nights (2014). The share of foreign arrivals is rather high (40%) compared to other tourism-based Alpine regions, with higher proportions of visitors from Asia and North America. However, a significant difference there exists between high-profile destinations such as those mentioned before, which are mainly based on international tourism and strongly focused on the winter season, and less relevant destinations of “extensive”, domestic and mostly summer-based tourism (such as the Lötschental and the Goms district). As regards to agriculture, a general declining trend can be observed in Oberwallis too. Although the employment share in agriculture is a bit higher here than the Alpine average (respectively 6% and 3%), its contribution to the regional GDP is limited to just 2%. Around 60% of the utilised agricultural area (UUA) of the region is still concentrated in mountain areas, where extensive cattle farming is the most diffused activity.

Environmental profile

The inner location of Oberwallis, stretched between two of the widest and highest mountain ranges of the Alps, makes the quality as well as the role of natural environment particularly relevant, much more than in middle and lower Valais. However, the environment is here strongly influenced by "extremes" uses (or lack of) of the land, from the densely urbanised Rhone valley floor to the vast inhabited highlands above 3000 m. These extremes are also readable in terms of climate, as the Rhone valley and the surrounding slopes are characterized by a warm and dry climate—almost Mediterranean and common to many inner valleys in the south-western Alps—while the narrow side valleys and the highlands are subject to a cold Alpine climate. The resulting great diversity of ecosystems and landscapes is widely recognised and partially protected through extensive nature reserves. The northern part of the region, i.e. the mountainous area on the right side of the Rhone, is almost entirely included within the UNESCO Natural World Heritage site "Swiss Alps Jungfrau-Aletsch-Bietschhorn". Established in 2011, the protected area covers 824 km^2 of Alpine highlands of high ecological and geological importance, including the largest glaciated area in western Eurasia and the largest glacier in the Alps, the Aletsch Glacier. A second, national-relevant protected area is the Naturpark Pfyn-Finges, a regional park of 276 km^2 located between Gampel and Sierre, stretching from the Rhone valley bed (500 m) up to the Weisshorn massif (4100 m). The core zone of the nature reserve is the Pfynwald or Bois de Finges, a 20 km^2 wide scots pine forest, the largest contiguous of its kind in both Switzerland and the Alps too. The ancient cultural landscape of the rural highlands in the upper Rhone valley is partially included in the Landschaftspark Binntal, a regional park of 181 km^2 first "informally" established by local inhabitants in 1964 and officials recognised and protected since 2002. Besides these protected areas, a network of small-sized and widespread nature reserves of national relevance can be also found, especially in or nearby the Rhone valley floor. For what concerns Oberwallis, around 80% of these reserves are dry meadows and pastures located on sunny and harsh slopes at medium altitudes, mostly on the right side of the Rhone, while the remaining 20% is constituted by glacier forelands. The vegetation pattern reflects the ecosystem and climate diversity in the region, with broadleaves such as oak and birch trees concentrated in the Rhone valley floor and on lower sunny slopes and coniferous at higher altitudes. With regards to coniferous, a particular feature of the region is the extensive presence of scots pines at medium altitudes, between

500 m (valley bed) and 1500 m). However, most of these scots pine forests are highly threatened by climate change, as it has been observed in the last three to four decades an increasing mortality rate with spontaneous replacement by broadleaves.

Spatial development trends and challenges

In Valais/Wallis, and in particular in the inner Oberwallis, spatial development is strongly influenced by the harsh topography and the lack of flatland suitable for settlements and economic activities. The Cantonal Spatial Development Concept Plan (CCDT) distinguishes among different types of spaces across the region, such as urban spaces (either small settlements and agglomerations, including transport nodes), the multifunctional space in the Rhone valley bed (devoted to intensive agriculture and de-centralised, inter-municipal industrial zones), hillsides (cultural landscapes of rural matrix, with hamlets and limited touristic offer) and alpine resorts (intensively used highlands, including ski station and touristic centres). The most critical area with regards to spatial development is certainly the flatland along the Rhone valley bed, which does represent around 6% of the cantonal territory but hosts 70% of the population as well as most of the economic activities in the industrial and service sector. The management of land use conflicts generated by the overlapping of aforementioned urban spaces and multifunctional spaces does represent, therefore, a key challenge not only for the spatial development of the Rhone valley flatland, but for the whole region. Different land uses are indeed concentrated and compressed in the tiny flatland strip along the Rhone, among which urbanisation and peri-urbanisation (including commercial and industrial zones), intensive agriculture requiring wide and continuous surfaces, few ecological corridors to be preserved and the necessary flooding zones along the Rhone and tributaries. Many of the strategies identified by the CCDT with regards to spatial development in the Rhone valley floor are directed towards the containment of urbanisation through optimisation of the existing spaces/possibilities. In major urban centres and agglomerations such as the Brig-Visp-Naters agglomeration, the main economic engine of Oberwallis, inner development is considered a key priority to limit further land take and preserve the not yet urbanised spaces in the valley. Either in agglomerations and minor centres, as well as in de-centralised commercial and industrial zones, densification through infilling, renovation or brownfield reuse have to be prioritised. Financial incentives and planning measures are implemented to help municipalities to use and properly manage the land reserves and building zones. A particular relevance is assigned to the further development and optimisation of the so-called poles of economic development (PDE), i.e. existing economic clusters or new activity zones to be implemented on brownfield sites. Seven PDEs have been identified along the Rhone valley: Monthey-Collombey, Martigny, Sion, Sierre, Steg, Visp and Brig-Gils (the last three in Oberwallis). The establishment of new industrial and commercial activities in these PDEs should be done at first through densification of the available reserves, while the extension of building zones is only possible under specific circumstances and requires adequate ecological compensation measures. The improvement of the existing ecological network, especially in semi-natural spaces under pressure by growing urbanisation as well as intensive agricultural uses, is also considered as a key objective in a well-balanced spatial development of the urban and economic backbone of the region.

7.5.2 Site Overview

*Location*The aluminium smelter is located in the upper Rhone valley, roughly halfway between the regional centres of Visp and Leuk. In particular, the site lies in the middle of the flat valley floor along the orographic right of the Rhone, 300–400 meters away from the steep slopes of the surrounding mountains on both northern (Chistehorn 2700 m) and southern sides (Signalhorn 2910 m). Physically detached from the nearby villages of Gampel-Steg and Niedergesteln, the site is thus fully embedded into the intensive agricultural landscape of the valley floor, right in the centre of the cultivated flatland known as Stegerfeld, bordered by the Galdi canal on the north and the Rhone on the south. In terms of topography, the site has no direct relationship with the surrounding reliefs, but its specific location is instead indirectly influenced by the spatial constraints provided by the mountains—i.e. the functional proximity and density in the valley floor. A rather good accessibly to the industrial site is provided by either regional road corridors, such as the H9 cantonal road running parallel to the Rhone (currently being upgraded as motorway), and local roads, such as the A509 towards the touristic Lötsch valley. The site is also located nearby and directly connected with the international railway line Geneva-Lausanne-Milan, which runs along the Rhone valley from Brig (Simplon tunnel) to Villeneuve (Fig. 7.85).

Background
The aluminium smelter of Steg was established in 1961–62 by the Swiss Aluminium-Industrie AG (AIAG). That company was at the time a major aluminium manufacturer in Switzerland, with roots in the Valais/Wallis region. Founded in 1887 in Zurich by a group of entrepreneurs, among which Paul-Luis Toussaint Héroult, one of the key figures behind the modern electrolysis process, AIAG began its activities in 1888 in Neuhausen am Rheinfall, near Schaffhausen. The transfer of production to the inner Alpine region of Valais/Wallis occurred in 1908 through the set-up of a large aluminium smelter in Chippis, motivated

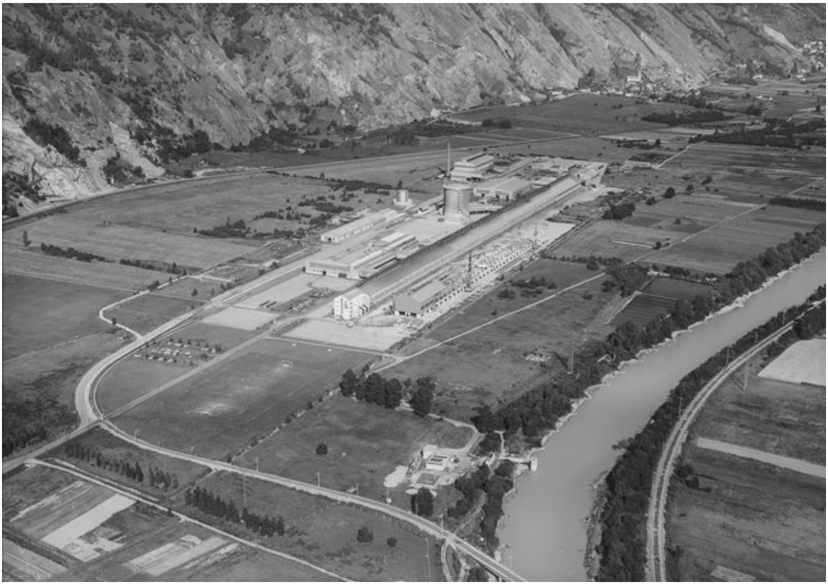


Fig. 7.85 Overview of the Alusuisse smelter in 1969. The second electrolysis hall is under construction

by the local availability of cheap hydropower from the Rhone and its glacial tributaries. A second facility with rolling mills was then established in 1928 in the nearby centre of Sierre. In late 1950 s it became clear the Chippis smelter was not able alone to sustain the growing market demand of aluminium finished products, and especially the lack of available space around the site was limiting any further expansion. The Stegerfeld agricultural plain in the upper Rhone valley, near the twin villages of Steg and Gampel, was thus identified as a suitable area for the establishment of a new smelter facility, which came in operation in spring 1962 (Fig. 7.85). The strategic location at the crossroads of transalpine railway corridors between France, central Switzerland and Italy allowed the smelter to be constantly supplied with essential raw materials, such as aluminium oxide (from Italy and France), cryolite and fluorides (from Swiss chemical industries) and anodes (from Italy in the first years, then manufactured directly on-site). The huge amount of energy needed for the electrolysis process was generated within the region through seven hydropower station managed by AIAG subsidiaries Rhonewerke AG and Ernen-Illsee-Turtmann. The smelter was supplied via a 65 kV powerline, and the energy converted (rectified) on-site into a direct current of 475 V and 100.000 A, to be used in the electrolysis process. At first, 96 electrolysis furnaces of 100.000 A were installed, each with a capacity of 260 t/y of molten aluminium. As a brand-new facility, though small-sized compared to similar ones built in the same period, the Steg smelter was designed according to the very modern criteria, such as automation and full interconnection of the different working spaces/phases. In 1963 the owning company AIAG is transformed into Alusuisse-Schweizerische Aluminium AG. A plan to further expand the Steg smelter was then developed, leading to the addition of a second electrolysis hall and the subsequent upgrade of the plant capacity from the original 25.000 t/y to 45.000 t/y. In 1973 Alusuisse proceeded to take over the regional-based Lonza chemical enterprise, with key facilities located just a few km from Steg, in Gampel and Visp. The 1970 s were also, and mostly, signed by the environmental scandal involving Alusuisse known as the "war of fluorine", in which the disastrous effects of pollution due to fluorine emissions were publicly reported by workers, farmers and local communities. Especially the orchards and vineyards in the Rhone valley, as well as the local water sources, were severely polluted by aluminium smelting. After the company's reached its peak of production of 800.000 t in 1980, a restructuring and modernisation program was set up. Outdated plants had to be closed and/or downsized, while semi-finished aluminium production facilities had to be modernised and privileged. According to this program, the Steg smelter was refurbished and upgraded to 48–50.000 t/y in the view of the upcoming stop of primary aluminium production at the older Chippis plant. In 1990 Alusuisse is transformed into Alusisse-Lonza Holding AG, a group with 30.000 employees, of which 5.800 in Switzerland only. However, soon in 1998 the chemical activities of Lonza were spin off and the aluminium branch was renamed Algroup and, already in 2000, taken over by the Canadian multinational Alcan, a worldwide leading aluminium producer. The Swiss plants of Steg, Sierre and Chippis were then assigned to a subsidiary called Alcan Aluminium Valais. In 2004, after the acquisition of the France-based Pechiney Group, Alcan became the first aluminium producer worldwide. Optimisation through concentration and restructuring became thus essential to ensure an efficient production worldwide. Many of the smelters managed by Alcan around the globe produced aluminium at a cost 70% lower than the factories in Valais. The rising energy costs in the region, as well as the expiration of the energy supply contract, led Alcan to decide for the definitive stop of primary aluminium production (electrolysis plant) at Steg in 2006. Following the takeover of Alcan by the British-Australian multinational Rio Tinto in 2007, the still operating foundry in Steg (130 workers) as well as the rolling mills in Sierre were transferred in 2011 to Constellium, the former Alcan Engineered Product division. As result, around 70% of the Steg site became unused and wasted. The Canton of Valais and Constellium agreed upon regeneration measures for the former smelter site and, together with the Rio Tinto subsidiary Metallwerke Refonda AG, set up a plan for the site reclamation and rehabilitation in 2015. Heavy soil pollution with fluorine (13 t accumulated) and polycyclic aromatic hydrocarbons (around 1 t) became the focus of first reclamation measures, especially on the area occupied by the former electrolysis plant and the anodes factory.

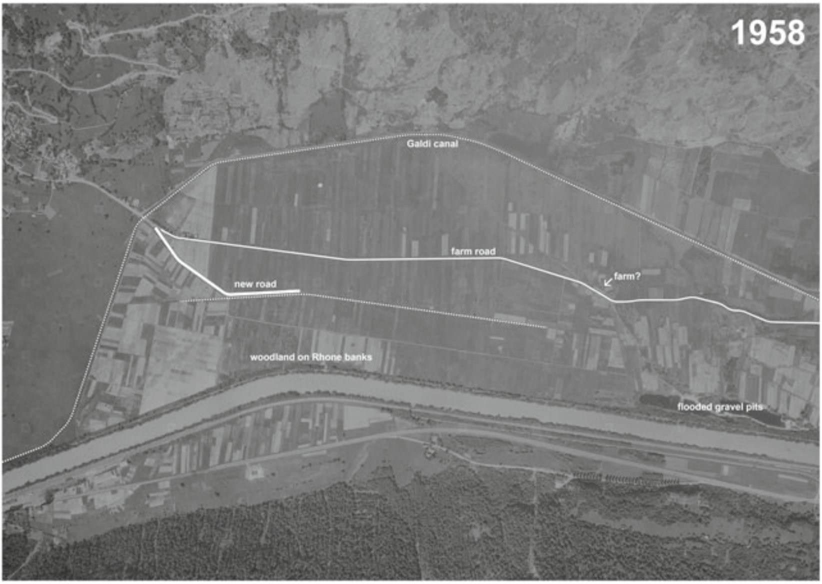
Current use and future plans
Besides necessary depolluting measures, the agreement between the Canton and Rio Tinto also included the sell and/or rent of land (lots) and cleaned-up buildings to local small and medium businesses and property developers. The functional and adaptive reuse of as much as possible of the existing structures and spaces was considered by the two parties as a key priority. To date, a few companies already moved on the reclaimed brownfield site, among which Theler AG (20 employees), Swissredux (30), Plasco (25) and Schollglas (40). Theler AG, in particular, has occupied most of the former electrolysis halls and related aprons and is planning to extend its activities over the greenfield (partially already reclaimed) on the north of the site. Other companies are instead hosted in renovated former industrial buildings (workshops and warehouses) or newly built structures (e.g. Schollglas). The many vacant lots and buildings within the site perimeter are still owned by Metallwerke Refonda, while the remaining aluminium production (foundry and finishing) and related infrastructures (railway yard, road network and site access) are property of Constellium. The fragmentation of the site ownership as well as of the current uses (or not) of buildings and lots make the perspective of a complete transformation of the site still wide open. The aim of the different owners, as well as of the local and regional institutions, is to foster the gradual and productive-oriented redevelopment of the brownfield site (21 ha) and, eventually, of the adjoining greenfields (14 ha). This approach follows and complies with the Cantonal strategy of developing a few key PDEs through the improvement of existing industrial platforms (e.g. Visp, Monthey) as well as the productive recycling of large-scale brownfield sites—among which the former aluminium factories in Steg, Sierre, Chippis, Martigny and the disused oil refinery in Collombey-Muraz. The long-term management of the Steg site reactivation process, including a plan to attract new investors and developers, is currently in the hand of the regional development company RW Oberwallis.

Main sources of information for the regional and site profiles:

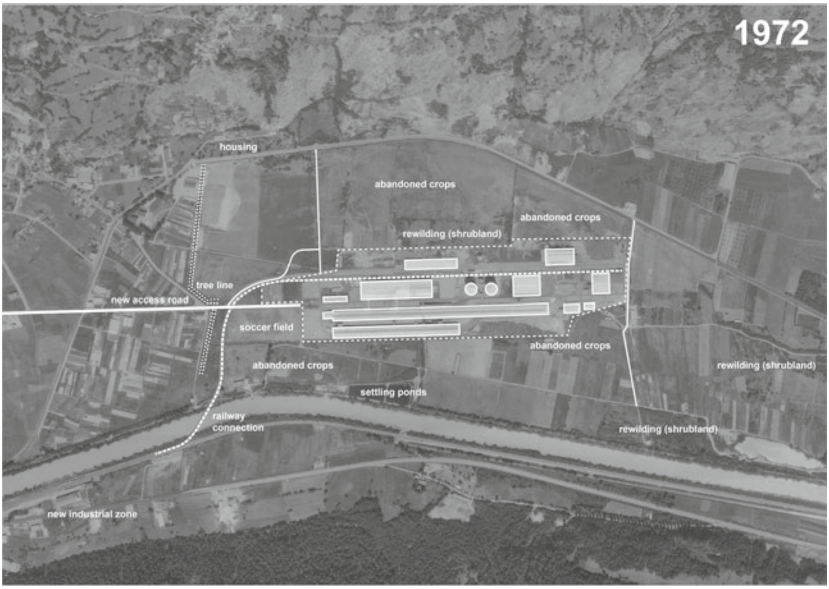
- Skype interview with *Tamar Hosennen* (project manager RW Oberwallis, regional development), 12.06.2018
- face-to-face interview with *Renzo Theler* (project manager Theler AG), 13.08.2018
- face-to-face interview with *Raphael Matter* (production manager Constellium Valais SA), 14.08.2018
- CCDT Valais/Wallis (canton territorial development plan)
- "L'économie valaisanne" (regional economic profile, 2014)
- Praxisbeispiele «Kohärente Raumentwicklung»—Region Oberwallis (paper by Regiosuisse, 2018)
- "Entwicklung Industriegebiet SteNiGa" (site development plan by RW Oberwallis, 2016)
- "Steg aluminium smelter, Valais Switzerland" (document by Rio Tinto—Legacy Management case study, 2013)
- Wipf H., Oehler R. (1964), "Die Aluminium-Hütte der Schweizerischen Aluminium AG in Steg (Wallis): Ueberblick", in Schweizerische Bauzeitung, 82 (6), 85–94.
- BFS/Cantonal statistics (elaborated)
- local newspapers (2016–2018)

7.5.3 Site Preliminary Study

The attached site preliminary study is based on both single and comparative analysis of six corrected aerial photographs (orthophotos), covering the time frame 1958–2014. The selection of suitable photos has been done by considering a temporal distance among each others of approximately 10 years, although this was not always possible due to the limited availability of the material. The selected orthophotos refers to the following years (source in brackets): 1958 (swisstopo), 1972 (swisstopo), 1981 (swisstopo), 1993 (swisstopo), 2005 (swisstopo), 2015 (swisstopo). The collected material provides a spatially detailed and temporarily complete coverage of the site and its surroundings. In particular, since the first selected year (1958) shows the area prior to the establishment of the industrial site, the complete series allowed to understand to a great detail the impact of industry on the surrounding landscape. Indeed, the most relevant changes occurred in the surroundings rather than on the site itself—due to the recent origin.



1958—The aluminium smelter is not existing yet. The flat valley floor on the north side of the river Rhone is occupied by cultivated fields and small farms. The few relevant linear infrastructures are the canalised Rhone in the south, the curved Galdi canal and an irregular farm road crossing the fields from west to east. At the intersection of the Galdi canal and the farm road, a newly built road ending up in the fields suggests that the site preparation for the smelter is already started. Woodlands are only present along the Rhone banks and around some flooded (abandoned?) gravel pits along the river.



1972—The smelter has been built in the middle of the flat valley floor. It consists of several buildings with different footprints, among which the long electrolysis halls stand out. New infrastructures have been also created for the purpose of the factory, such as the railway line crossing the Rhone (departing from the Simplon railway line on the south) and a large access road on the site west side. Other smelter-related structures added in the surroundings are the settling ponds next to the Rhone, a soccer field (for workers?) and some workers houses along the Galdi canal. It can be noticed a gradual abandonment of those cultivated fields and crops attached to the factory perimeter, as well as some rewilding spots (shrublands) on the northern edge of the site and on the eastern side (abandoned farms?). Some agricultural roads have been created to support the changed crops accessibility.

1981—The industrial site is almost unchanged, except for a small building addition on the east side and the extension of paved open surfaces along towards the site edges. The abandonment process affecting the agricultural fields and crops around the site is ongoing, which suggests that part of this land has been probably taken over by the smelter too (but not yet developed). However, while extensive fallow land including rewilding spots can be noticed on the north and south-east of the site, some "regenerated" crops are now visible on the south and north-east edges, thus indicating a temporary use of agricultural surfaces. Many shrublands and woodlands are emerging around the site, on abandoned fields and along the water infrastructures (Rhone and Galdi).

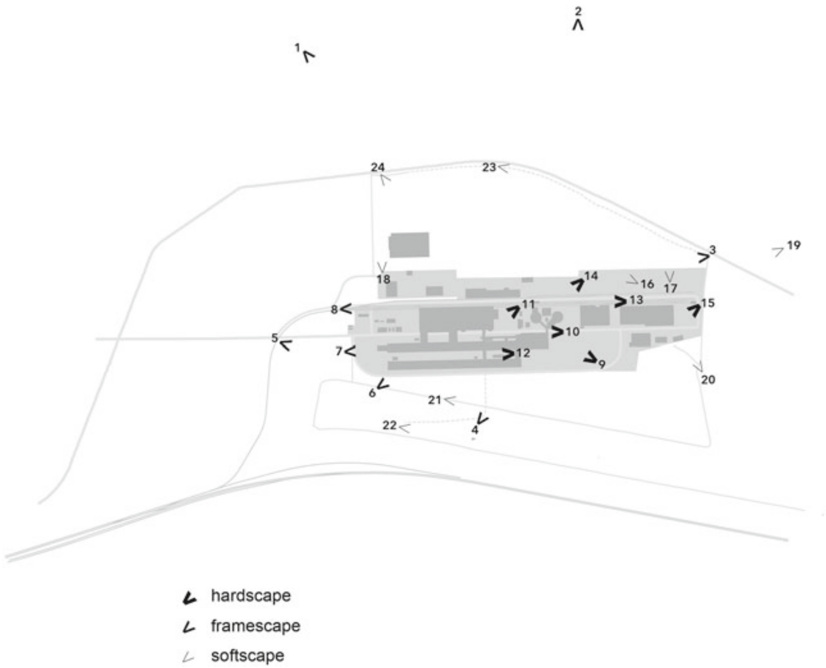
1993—The factory site is still unchanged, especially concerning the builtscape. Several leftover green spaces along the factory perimeter are gradually turning in shrubland/woodland through spontaneous rewilding. The location and pattern of such spaces creates a sort of unintentional green belt around the factory core, thus separating it from the surrounding agricultural fields. The process of crops regeneration, already started in the previous phase, is expanding towards fallow land previously used for agriculture. New crops can be observed on the northern side of the smelter, towards the Galdi canal, as well as on the south-east side. A clear demarcation between intensively used or reused agricultural surfaces (crops) and leftover rewilding woodlands is increasingly visible. Around the smelter, new industrial zones are gradually developing former agricultural land.

2005—The agricultural fields on the north side of the smelter are turned into a large construction site, which relates to the opening of the Niedergesteln side portal within the Lötschberg-Basistunnel project. The construction site extends from the foot of the mountain slope on the north-east of the smelter towards the railway curve near the entrance of it. Besides that, no significant changes can be observed in the surroundings. Within and along the factory perimeter, however, a couple of small-scale industrial buildings have been added on a previously fallow land. The spontaneous and discontinuous green belt grown on leftover spaces within the site perimeter is subject to some kind of maintenance, looking therefore as a green buffer to mitigate the impact of the plant on the surrounding landscape.

2014—As the construction works for the Niedergesteln portal are suspended for economic reasons, the massive construction site is dismantled and the land turned to the former use. Crops are recreated (for the third time!) and a narrow strip of discontinuous woodland is kept to separate the crops from the factory site. Major changes have occurred also within the site perimeter, as many key buildings have been completely or partially demolished (electrolysis hall and anode plant), while some others have been expanded through add-ons. The downsizing of activities on the site has also led to the partial abandonment of some inner open spaces, such as a large portion of the eastern edge. The green buffer established in the previous phase is then less effective. The small industrial zones around the site are growing by size and density.

7.5.4 Photographic (field) Study

The field trip took place on 11–17.08.2018. Two different permissions for the site access were provided in advance by the two major owners: Theler AG, which holds the former electrolysis hall and most of the eastern portion of the site, and Constellium, which manages the still partially active aluminium casting plant and its premises. With regards to Theler (around 80% of the site), complete freedom of movement was ensured except for building interiors, while Constellium provided a guided tour of the area with photographic restriction to the interiors. During the multiple-day site visit, the representatives of the two owning companies were also interviewed: Mr. Renzo Theler for Theler AG and Mr. Raphael Matter for Constellium. The site exploration occurred mostly on foot, due to the limited size, while for the surroundings (and especially the high viewpoints) the car had to be necessarily used. Selected photographs include overviews of the aluminium smelter from both the mountains and the valley floor, detailed views of the builtscape within the site (including open spaces and infrastructures) and views of the surrounding agricultural and urban landscape (Fig. 7.86–7.109).



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hardscape
framescape
softscape

Fig. 7.86 Overview of the former aluminium smelter, which lays in the centre of the Rhone valley bed surrounded by monocultures

Fig. 7.87 The unused twin silos stand out as a landmark within the site. In the background, runs the Rhone. On the upper terraces, top left, the village of Eischoll

Fig. 7.88 Corn fields and residual woodlands around the site

Fig. 7.89 One of the former electrolysis hall, partially renovated, stands next to a rusted gas washing tower. View from the connecting road to the settling basins

Fig. 7.90 The western edge of the two electrolysis halls overlooking a football field

Fig. 7.91 The former electrolysis halls, now empty and derelict, in close contact with agricultural land

Fig. 7.92 The power substation (for power rectification) on the western edge of the first electrolysis hall, seen from the new site ring road

Fig. 7.93 The railway yard within the site, partially still used by the Constellium foundry (centre, background)

Fig. 7.94 A large concrete apron (owned by Theler AG) surround by former industrial objects. Left to right: a gas washing tower, the first electrolysis hall and the alumina silo

Fig. 7.95 The main road axis running through the site E-W, overpassed by the aerial structures connecting the former smelter buildings

Fig. 7.96 The Constellium foundry (right) and the disused electrolysis hall in the background

Fig. 7.97 The open space between the two electrolysis halls has been partially renovated and used as storage and parking space by Theler AG

Fig. 7.98 Freight cars parked on a track in the site railway yard, partially unused

Fig. 7.99 The twin alumina silos seen from the abandoned area previously occupied by the anode plant

Fig. 7.100 Empty and unused aprons on the east end of the site. New buildings are being constructed next to former smelter ones

Fig. 7.101 The polluted area previously occupied by the anode plant is currently under reclamation. In the background, on the slope, the church of St. Barbara (Hohtenn)

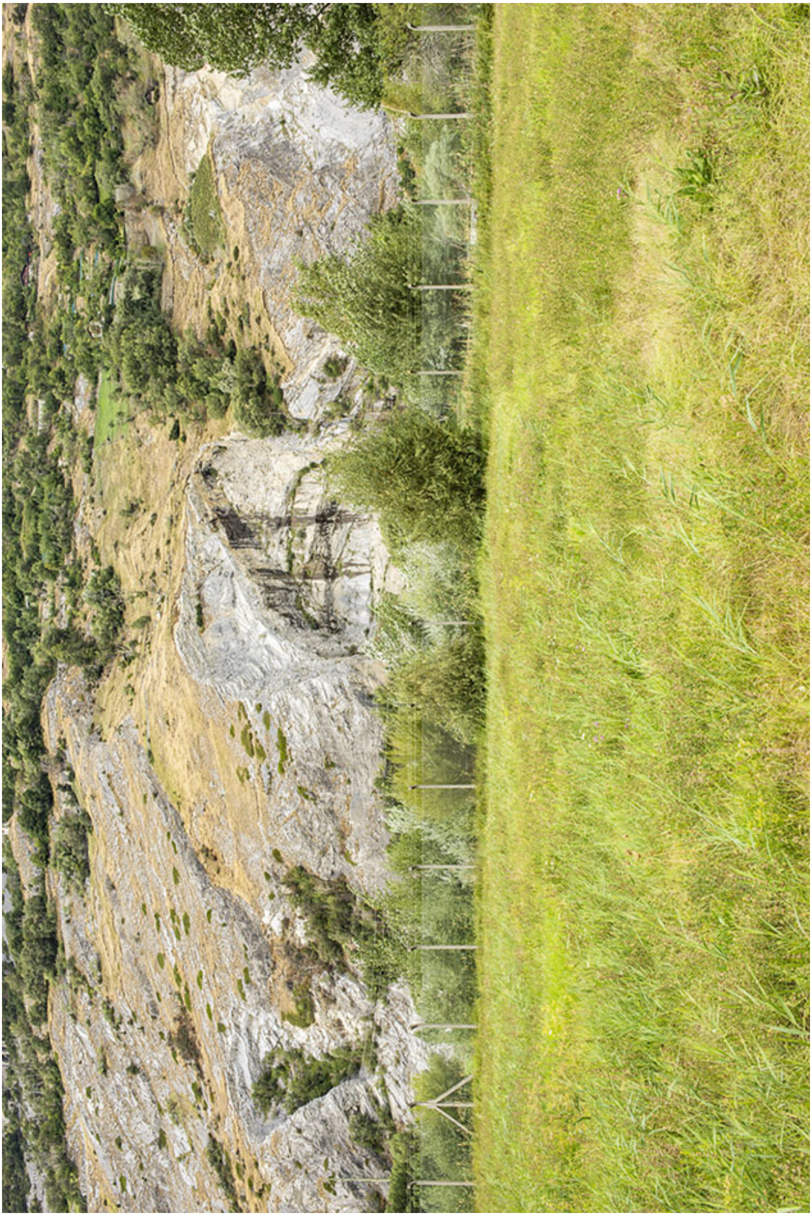


Fig. 7.102 Leftover greenfields and shrublands along the site northern border

Fig. 7.103 The Schollglas factory, established in 2013 next to the former smelter site. The village of Hohtenn, above the rocky slopes, overlooks the valley

Fig. 7.104 The concrete silos are clearly visible from the small industrial zone of Niedergesteln

Fig. 7.105 Old farmhouses along the eastern border of the site, whose structures can be seen in the background

Fig. 7.106 The Gravistrasse country road running south to the site, between crops and scattered woodlands

Fig. 7.107 The former settling basins of the aluminium smelter

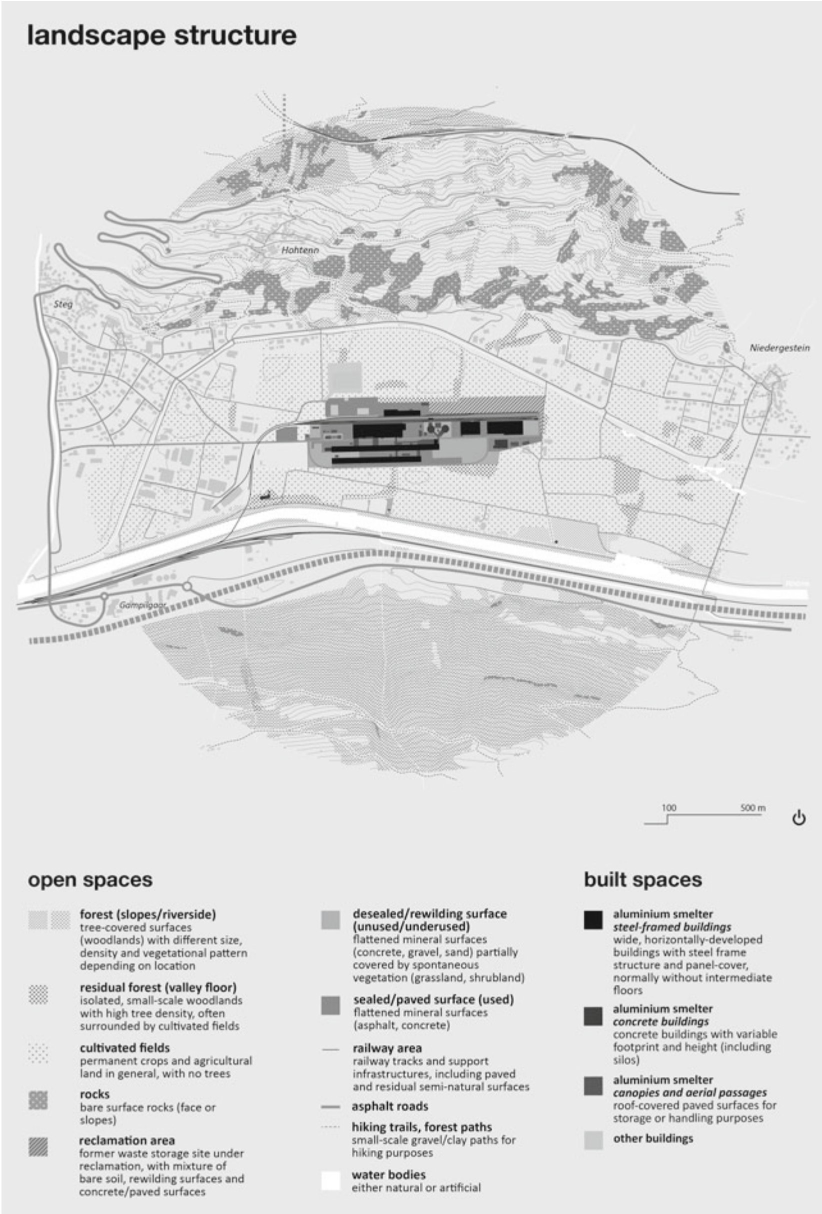
Fig. 7.108 The footpath along the Galdi canal filled up with reeds

Fig. 7.109 Crops and fields on the NW of the site, with the silos clearly visible in the background

7.5.5 Site Advanced Study

Landscape structure

The landscape structure of the aluminium smelter is rather simple in its components and their relationships, mainly because of the site recent origin as well as due to its particular location along the median axis of the valley floor. The latter makes topography less relevant, as reliefs are quite distanced from the core site. What really influences the overall structure is instead the detachment of the industrial site structure from the underlying, previous agricultural landscape. The smelter, originally designed as an autonomous productive platform connected to nearby infrastructures by minimal functional links (e.g. railway), has become gradually more permeable to the surroundings, especially after its downsizing. The hard paved surfaces are only limited to the main buildings and adjacent lots, while many previously hard surfaces are now softer thanks to underuse and/or abandonment and related rewilding processes (front and back ends of the electrolysis halls, silos area, former anodes plant site). Along the site borders and beyond, fragmented small-scale woodlands and shrublands are contributing to blur the structural contrast between the site and its surroundings. Accordingly, the linear water infrastructures running along the valley floor—i.e. the Rhone on the south of the site and the Galdi canal forming an arch on the north—do represent the 'real' edges, within which a developing landscape structure can be identified.

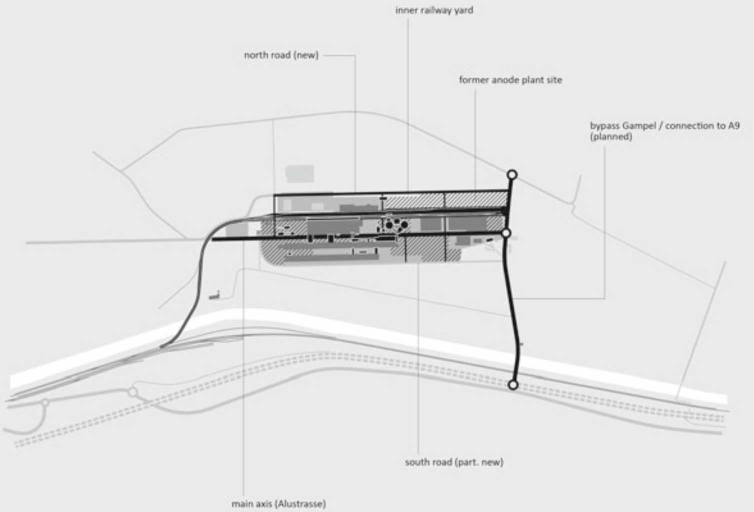

landscape structure
Hohtenn
Steg
Niedergestein
Gampilgaar
100
500 m
open spaces
forest (slopes/riverside)
tree-covered surfaces (woodlands) with different size, density and vegetational pattern depending on location
residual forest (valley floor)
isolated, small-scale woodlands with high tree density, often surrounded by cultivated fields
cultivated fields
permanent crops and agricultural land in general, with no trees
rocks
bare surface rocks (face or slopes)
reclamation area
former waste storage site under reclamation, with mixture of bare soil, rewilding surfaces and concrete/paved surfaces
desealed/rewilding surface (unused/underused)
flattened mineral surfaces (concrete, gravel, sand) partially covered by spontaneous vegetation (grassland, shrubland)
sealed/paved surface (used)
flattened mineral surfaces (asphalt, concrete)
railway area
railway tracks and support infrastructures, including paved and residual semi-natural surfaces
asphalt roads
hiking trails, forest paths
small-scale gravel/clay paths for hiking purposes
water bodies
either natural or artificial
built spaces
aluminium smelter
steel-framed buildings
wide, horizontally-developed buildings with steel frame structure and panel-cover, normally without intermediate floors
aluminium smelter
concrete buildings
concrete buildings with variable footprint and height (including silos)
aluminium smelter
canopies and aerial passages
roof-covered paved surfaces for storage or handling purposes
other buildings

Landscape systems
The outlined site transformation follows and integrates the indications of existing local and regional plans and regulations, as expressed by the different site owners and planning institutions. In particular, the transformation takes into account the site strategic development guidelines developed by RM Oberwallis, which identify both the former smelter site and the agricultural surroundings as industrial development zone. The functional adaption and refurbishment of the core productive site is therefore integrated with a flexible management strategy for the surrounding areas, including temporary nature-oriented land uses and increased permanent ecological connectivity. The transformation process is structured on three systems: the "backbone", which addresses the infrastructural upgrade of the core site through punctual demolitions and the development of a new mobility grid; the "borders", which increases the functionality of outer areas, including ecological compensation zones and large-scale connectivity between blue and green infrastructures; the "core", which focuses on the productive densification of the former smelter area and its immediate surroundings. By integrating and enhancing the functional relationships between the former industrial site and its surroundings, the proposed transformation is able to generate a highly flexible productive landscape in which different activities and uses are coexisting (either temporarily or permanently), while taking advantage of relational proximity.

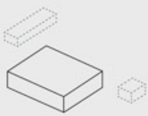
system 1

BACKBONE | site infrastructural upgrade

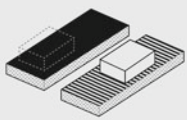
system overview



toolkit



keep buildings and structure with high reuse potential of indoor spaces for production purposes

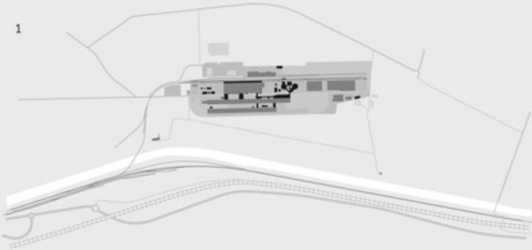


adaptive soil remediation according to built/unbuilt areas and current/planned use

adaptive upgrade and refurbishment of existing mobility infrastructures

system 1
transformation phases

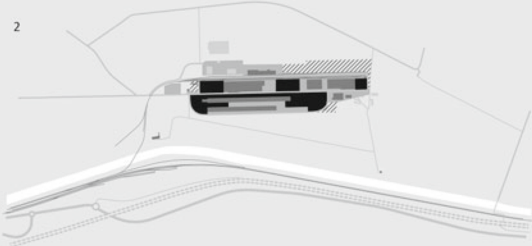
1



1 / selective demolition of redundant buildings

All the unused buildings and redundant structures belonging to the former aluminium smelter are removed. These include the two alumina silos, the many aerial passages and minor buildings (gatehouse, services, various canopies, etc.) *SHs: Alcan Alluminium, Metallwerke Refonda, Theler AG, RW Oberwallis, Steg-Hohtenn municipality.*

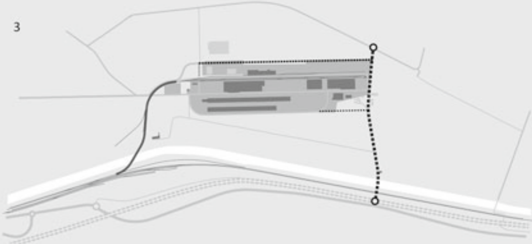
2



2 / soil de-sealing and punctual remediation

Unused paved surfaces beneath demolished buildings are de-sealed and the soil underneath remediated (where necessary). Further remediation takes place (or is completed) in sensible areas (e.g. former anode plant site). *SHs: Alcan Alluminium, Metallwerke Refonda, Canton Valais (Environment, Territorial Development).*

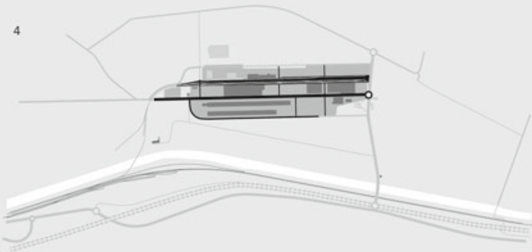
3



3 / external infrastructural grid

The external infrastructural grid is completed with north and south roads and connected to the A9 motorway through a bypass on the east side. The railway link between the site internal yard and the main line is refurbished and ameliorated. *SHs: Steg-Hohtenn and Niedergesteln municipalities, SBB, RW Oberwallis, Canton Valais (Mobility, Territorial Development).*

4



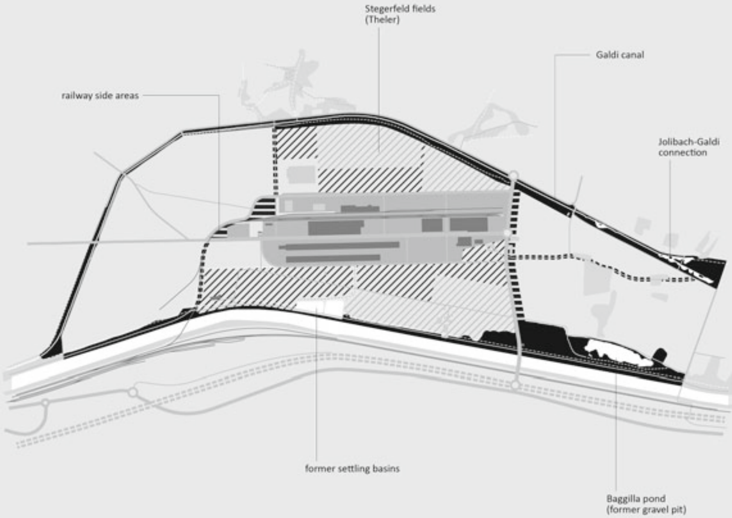
4 / internal infrastructural grid

The existing internal infrastructural grid is refurbished and completed. The main axis (Alustrasse) is connected to the bypass road, while a system of transversal minor roads is implemented taking into account the existing buildings. The internal railway yard is refurbished. *SHs: RW Oberwallis, SBB, Alcan Alluminium, Metallwerke Refonda, Theler, other firms on the site, Steg-Hohtenn and Niedergesteln municipalities.*

system 2

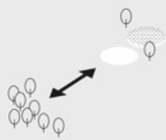
BORDERS | ecological compensation and connectivity

system overview

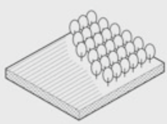


toolkit

integrated improvement of blue and green infrastructures at different scales

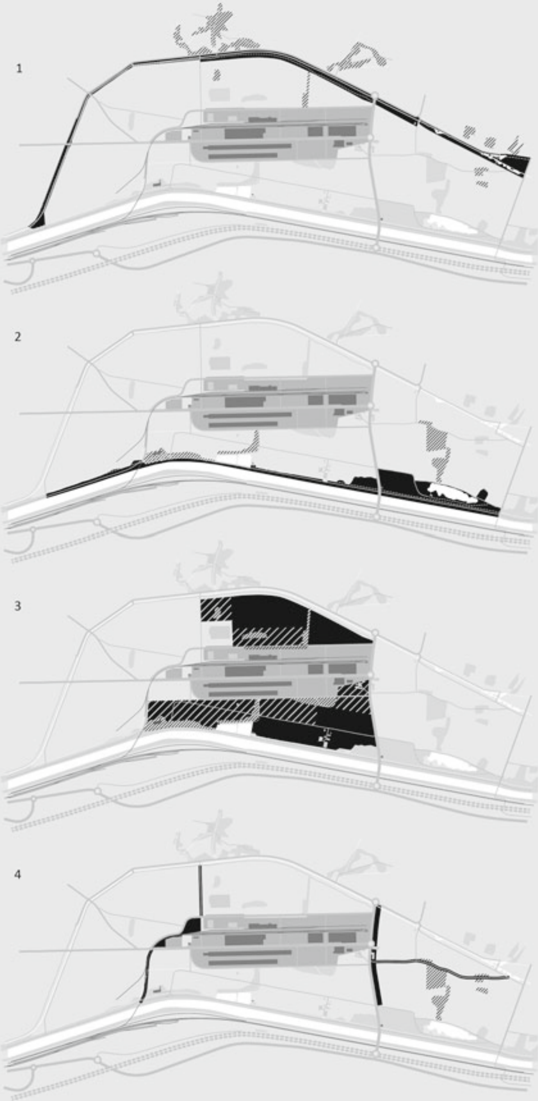


support ecological connectivity between existing and potential new habitats



tree plantation on fallow land and leftover open spaces

system 2
transformation phases



1 / northern buffer (Galdi)

The environmental quality of the Galdi canal is improved through the renaturation of its banks (tree or shrub plantation depending on available space). The existing woodlands and shrublands along the canal are connected to it through ecological micro-corridors. The discontinued walking path is refurbished and completed. *SHs: Steg-Hohtenn and Niedergesteln municipalities, Canton Valais (Water and Landscape, Environment).*

2 / southern buffer (Rhone)

The existing woodlands on the left bank of the Rhone are densified through plantation on leftover greenfields (former pumpstation areas) and connected through ecological micro-corridords and paths to fragmented woodlands (former settling basin area, Baggilla north). *SHs: Canton Valais (Water and Landscape, Environment), Steg-Hohtenn and Niedergesteln municipalities, Metallwerke Refonda, BLS Netz.*

3 / transitional cultivation and planting

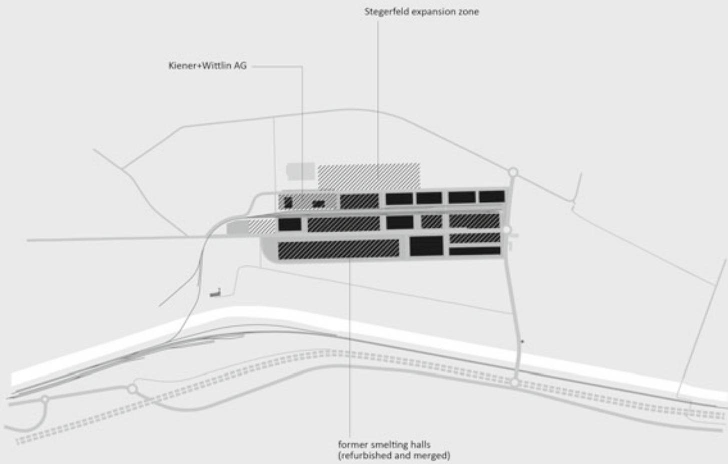
The open fields on the north and south of the site are partially transformed into ecological compensation zones through tree plantation. Agricultural uses (crops) are limited to outer areas, while compensation is foreseen for the site adjacent lots, including existing woodlands. *SHs: Canton Valais (Environment), Steg-Hohtenn and Niedergesteln municipalities, Theler AG, Metallwerke Refonda.*

4 / improve connectivity

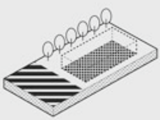
Ecological corridors between Galdi and Rhone buffers are implemented and/or completed on the west (railway - Stegerfeld) and east side (bypass road - Hosandleesser) of the site through tree plantation and building-free zones. *SHs: Canton Valais (Environment), Steg-Hohtenn and Niedergesteln municipalities, Theler AG, Metallwerke Refonda, Alcan Alluminium, Volken Handels.*

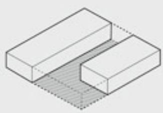
system 3
CORE | development and densification

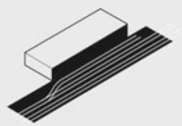
system overview



toolkit







system 3
transformation phases

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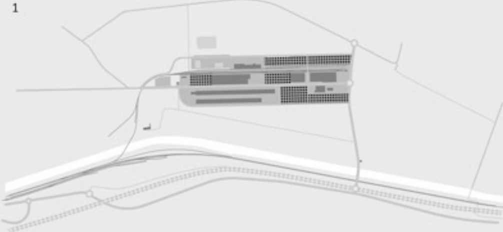
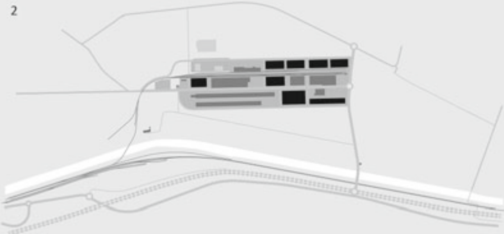


1 / internal building lots

The new building zones are delimited within the site perimeter on unused and reclaimed open spaces, previously occupied by factory buildings. The building zones must have direct access to road and/or railway and secure sufficient space for supporting facilities and infrastructural services. SHs: RW Oberwallis, Theler AG, Alcan Alluminium, Metallwerke Refonda, Steg-Hohtenn municipality.

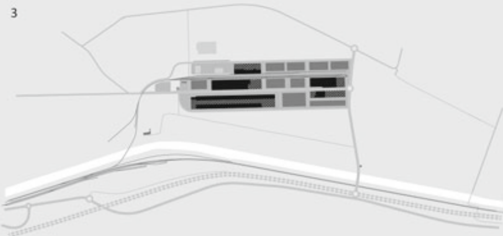
2



2 / lots filling

New building for productive purposes are gradually addedd on identified building zones. In each building zone (plot) the building(s) footprint must take into account open spaces for supporting facilities and infrastructures as well as a minimum quote of permeable/green surface (e.g. water drainage). *SHs: RW Oberwallis, Steg-Hohtenn municipality, companies/owners of new businesses.*

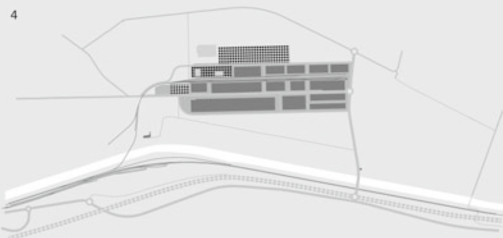
3



3 / expansion of existing buildings

Existing buildings (former electrolysis halls, foundry, workshops) can be extended by size and footprint if needed, keeping into account the built/open space ratio within the related plot and the accessibility system within the site. *SHs: RW Oberwallis, Theler AG, Plasco, Alcan Alluminium, Metallwerke Refonda, Steg-Hohtenn municipality.*

4



4 / external building lots (perimeter)

To plan the future expansions, further building zones are identified and delimited along and beyond the site actual perimeter (former entrance area, Stegerfeld area). *SHs: RW Oberwallis, Theler AG, Alcan Alluminium, Volken Handels, Steg-Hohtenn municipality.*

7.6 Intervention taxonomy

The richness of information so far collected and produced for each case study allows to perform a variety of comparative reviews according to specific questions. To which extent the transformation of a single site is influenced by the regional socioeconomic and spatial development conditions? Key factors such as the state of the site, the current quality of the open spaces and buildings, the ownership and land situation, the location, etc. are they always relevant and/or determinant? What does the resilience of a certain landscape structure depend on? Does the transformative potential depend more on built structures or open spaces? While these and other questions will find their answer in the following conclusive chapters, this last section of Chapter 07 specifically aims to identify and define the common results across the heterogeneous case system investigated, with clear reference to the tested transformation strategies. The two main criteria used to select the case studies, i.e. representativeness and heterogeneity, allowed to work with four very different site typologies and regional contexts as well. For each site, a foreseeable, well-grounded transformation has been outlined through a systemic design model, on the basis of the results of fieldwork analysis and also taking in consideration the programmatic inputs from local stakeholders and the regional and local contextual conditions. Accordingly, a set of concrete interventions has been ‘spontaneously’ generated. Although apparently strongly site-specific, these transformative interventions are indeed shared, yet differently interpreted, among the sites. By comparing the proposed interventions in all the four sites, a taxonomy or classification of interventions can be outlined, a one which includes both physical and functional/programmatic elements. The resulting categories of intervention can be described as:

- **productive refurbishment**, i.e. the adaptive reuse of existing spatial elements (buildings, open spaces, infrastructures) for productive purposes (manufacturing, business-oriented). A common feature of all the case studies is indeed the more or less explicit will by stakeholders and communities to maintain if not improve the productive function of currently underused or abandoned industrial sites. The form in which this productive refurbishment might take place varies according to the site-specific features and conditions. In the case of the former aluminium smelter of Steg-Hothenn, the steelworks of Le Cheylas and, to some extent, the Cantoni cotton mill of Ponte Nossa, the site is gradually reactivated through a process of adaptive fragmentation, in which the setup of new small-scale industrial and commercial firms occurs according to the immediate availability of spaces. In the case of the disused cement plant in

Schwoich, the specific configuration of the site as well as the ownership situation favour instead a reconversion/update of the existing industry—the cement plant is dismantled and ‘returned’ to the quarries while the site is prepared for a new concrete paved stones facility. The productive refurbishment strategy works better when the existing spatial and landscape structure allows greater flexibility, both in terms of space and time. It is the case of heavy industries with ‘platform-like’ productive sites, characterized by large and empty halls with poor but functional architectural quality and key infrastructures such as railway tracks. In both Steg and Le Cheylas sites, most of the former industrial buildings are indeed suitable for a cheap reutilisation and quick parcelling of indoor spaces. With some differences, the same also applies to the Cantoni cotton mill, whose imposing and architecturally valuable buildings are also quite flexible due to the size and continuity of indoor spaces—although requiring more efforts for structural amelioration. Ideally, the final result of such a productive refurbishment should resemble the previous site structure. In the case of heavy industries with high availability of wide open and indoor spaces and (often) railway connection the scenario is more likely that of an industrial business park, i.e. an agglomerate of SMEs sharing key services such as transport, energy, surveillance, etc. In the case of big-scale traditional ‘light’ industries, such as the Cantoni site, the productive refurbishment will probably lead more to a business ‘campus’, i.e. a small-scale business park in which the relational and intellectual proximity between firms is more relevant than infrastructural efficiency;

- **environmental regeneration**, which entails the mitigation of the current impacts of brownfield sites as well as the future integration of related new developments in the surrounding environmental context. A striking aspect that emerges in all the proposed transformations is the high yet hidden potential of ecological upgrade in the specific case of mountain brownfields, mainly due to their permeable/porous landscape structure and spatial footprint. In most of the analysed cases, this upgrade mostly occurs within the ‘borders’ system, i.e. the scattered network of micro and macro spaces which shapes the relations between the core site and its surroundings—or the impacts of the first on the second, assuming an ‘ecological’ perspective. Interventions addressing environmental regeneration rely indeed on the real footprint of the sites, which largely exceeds the builtscape extending over the many seemingly unrelated open spaces around. This aspect is clearly evident especially in sites with an ancient origin and developed in close connection to natural resources and topography, such as the Eiberg cement plant with its extensive (post)mining landscape or the Cantoni cotton mill interwoven with its complex waterscape.

Regenerative interventions do often address different issues and thus different spaces at the same time. A first one, common to all the analysed case study sites, is the improvement of ecological connectivity at either small and big scale, within and around the site. The location of these sites along interrupted or impoverished ecological corridors, such as in the evident cases of Ponte Nossa, Schwoich and Le Cheylas, 'naturally' favours restoration measures in this sense. A second kind of intervention is the environmental repurpose, either temporary or permanent, of wastelands and abandoned/leftover open spaces around the site built core. This is particularly relevant in those sites with evident spatial constraints connected to intensively used surroundings (urban or agricultural), where ecological interventions are necessarily concentrated on tiny strips of land while having a key role in balancing the existing and future land uses. The 'buffering' examples of Steg, Le Cheylas and partially Ponte Nossa goes right in this direction. A third category intervention is the reclamation of polluted or ecologically compromised areas, which occurs both within the productive site itself and, more often, in the altered landscape of the surroundings. Reclamation measures are occurring more frequently in formerly heavy industrial sites, where past industrial activities were responsible for a significant alteration of the soil and water system. It is the case of the EAF dust landfill and slag dump in Le Cheylas, located outside the site perimeter, or the former anode factory area in Steg, located within the site perimeter. Reclamation also applies to extensive ecological alteration without significant pollution presence, such as in the abandoned quarries of Schwoich;

- **cultural reuse**, i.e. the 'cultural reclamation' of existing built and open spaces of industrial origin according to their symbolic, aesthetic or formal qualities. Very popular in dynamic and over-developed urban contexts, the cultural reinterpretation of disused industrial sites is often perceived in the analysed mountain contexts as a plan B for economically weak sites, where productive refurbishment failed or cannot be implemented. The proposed transformation, which always follow and integrate the needs and plans of the local community, have demonstrated that the cultural reuse of Alpine brownfields is more likely to occur where specific contextual conditions meet specific typologies of sites. With regards to the firsts, it is the case of e.g. old industrial regions seeking alternative socioeconomic development paths, such as in Ponte Nossa, or peri-urban touristic and recreation regions where mass tourism will never develop, such as in Schwoich. Not by chance, the typologies of sites more suitable for cultural reuse are those with an ancient origin and a rooted, stronger integration of the existing industrial structures in the surrounding cultural landscape, such as textile mills and pre-1900 cement plants. Cultural reuse interventions might work actively on the creative refurbishment of indoor spaces as well as outer spaces of particular architectonic and landscape values, such as in the former Cantoni cotton mill, or rather playing around the visual integration of imposing industrial landmarks, such as in the case of Eiberg cement pant (e.g. the clinker silo and the raw material bunker included in the Glasibach wetland park). In any case, the cultural-led reinterpretation of existing structures is strongly related to the heritage value assigned to them—not always matching between institutional and local perspectives—or their impact on the landscape. For instance, heavy industries such as those represented by the sites in Steg and Le Cheylas have a far more limited impact on the surrounding landscape than the other two mentioned sites.

These three categories of intervention represent an attempt to group, or classify, the different ways in which transformation has been outlined in/on the previous case study sites. Each category brings a set of specific and easily replicable interventions, which often overlaps and interacts in a single site transformation process, both in space (structure) and time (systems). The most interesting, if not striking, result of the testing phase is indeed the fact that a certain degree of spatial and temporal flexibility has to be ensured, to allow a widest possible range (or mix) of interventions to be implemented. The three landscape transformation systems seem to provide the conceptual space for this to happen. In the following chapter, the results of the case study analysis and the testing phase will be critically compared and merged with those derived from the mapping and characterising phases.

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Matching

8

The previous Mapping, Characterising and Testing analytical phases have provided a comprehensive and multi-scalar description of the complex reality of Alpine brownfields. By means of different methodologies and focused approaches, each of these phases has produced a specific, oriented view on the actual problem. At the first macro scale, the territorial census of Alpine brownfields enriched with the outcomes of the stakeholder survey has led to identify four regional types, i.e. geo-economic aggregations of industrial sites in which the presence of brownfield assumes different weights and roles. The intermediate scale focused on the most representative typologies of mountain brownfields, highlighting their simplified landscape structure and spatial footprint as a recurring feature among sites belonging to the same sector. This step helped to identify how differently large and complex industrial sites relate with the contextual conditions provided by mountain environments, thus leading the resulting brownfields to assume certain common landscape structures. In the third and last analytical scale, finally, it was conducted a reality-based exploration of four Alpine brownfield sites selected accordingly to the previous findings, highlighting and testing their inherent transformation potential on the basis of intensive fieldwork and stakeholders' engagement. As main result, the Testing phase generated a taxonomy (classification) of those interventions that can realistically take place as in a prospected redevelopment process. As already explained in Chapter 2 (Research design), this three-scales structuring of the empirical analysis has been designed not only to get a comprehensive yet detailed overview on the research questions, but also and especially with the aim to provide the right elements for the future transferability of results. In this sense, the 'sectoral' outcomes of Mapping, Characterising and Testing are supposed to be read and interpreted both individually

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and as a whole. For this second purpose, in the following few pages it is proposed a functional and logical integration of these preliminary results by means of a synthesising tool, the redevelopment matrix. The latter has not to be read as an attempt to forcefully frame the future redevelopment perspectives, but rather as a programmatic guidance to the management of the incredible and complex case system of existing and upcoming Alpine brownfield sites. Furthermore, a similar tool can facilitate the comparison, analytical as well as design-oriented, between two or more geographically and culturally distant situations.

8.1 The Redevelopment Matrix

The matrix integrates the preliminary results of the previous analytical-explorative phases. Its logical construction is rather simple. The regional types[1] (Mapping) and landscape structures (Characterisation) are the two fixed parameters, the first placed on the Y-axis while the second on the X-axis. For each of the four-related voices, a brief description is attached to ease the readability. The intervention taxonomy (Testing) is the variable element of the matrix, as it fills the cells with different figures according to the parameters of reference. In other words, the interventions, or better the balancing between different categories of interventions, are generated by the encounter of a specific regional type with a certain landscape structure. In this way, the matrix acts as a tactical device to identify a priori the orientation of redevelopment, using the results from the case study analysis as key reference. Certainly, any concrete site redevelopment is primary influenced by the local needs and involved interest, which have to be always taken into consideration when planning it, but at the same time it depends to some extent to recurring contextual conditions, either regionally or site-specific.

By looking in detail at the elements of the matrix, as well as by considering the relational influences between the different parameters, some general but useful considerations can be outlined.

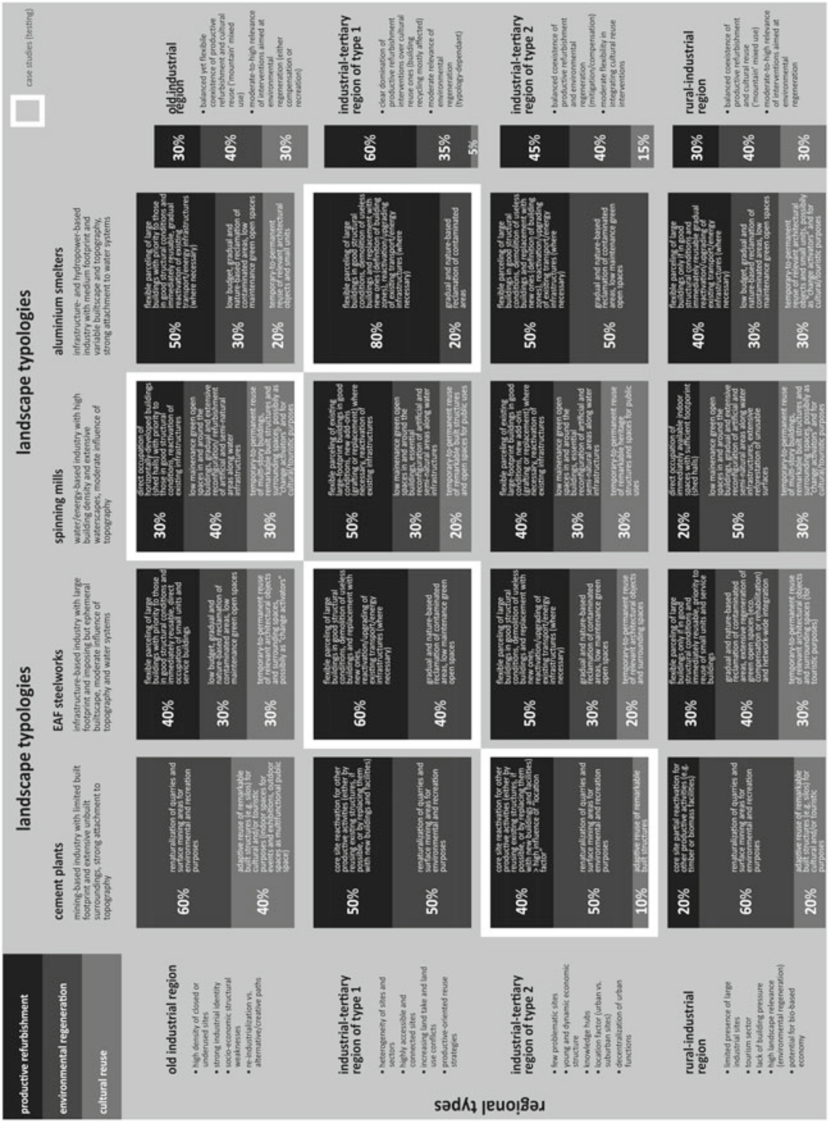
First, the regional context has an extremely high influence on the balancing between categories of intervention, often prevailing over the specific features of a given landscape structure. Regions characterised by fragile socioeconomic conditions and thus with limited chances of efficient and successful redevelopment, such as old industrial regions and rural-industrial ones, are surprisingly

[1] To clarify, it must be mentioned that the fourth regional type, 'rural-industrial regions', has not been analysed in the Testing section (case studies) due to the already mentioned scarce relevance for the Alpine area. In this regard, the associated elements in the matrix are ideally derived and adapted from the previous types.

those characterised by a rather well-balanced equilibrium between the categories of intervention. This indicates that brownfield sites in these contexts, no matter which landscape structure they belong to, are confronted with a higher flexibility in redevelopment purposes compared to sites in more dynamic regions. In particular, besides a 40% average share of interventions addressing environmental regeneration, an interesting balancing of productive refurbishment and cultural reuse interventions (30% each on average) emerges. The successful redevelopment of brownfield sites in these weak contexts relates, therefore, to the capacity of functionally integrating different but complementary 'economic' uses on the area, such as small-scale businesses in local value chains and regionally-relevant, heritage-based cultural activities—a sort of 'mountain' mixed-use development model. On the contrary, for those brownfields located in industrial-tertiary regions a prevailing orientation towards productive refurbishment interventions, with relevant shares of environmental regeneration (often as mitigation and/or compensation), is foreseen.

The landscape structure also highly influences the balancing between the different interventions, providing indeed the physical conditions and the actual space for action. Expectably, those structures more 'anchored' to topographical features are showing higher shares of environment-related interventions, suggesting that the more complex the topography is, the more ecological considerations have to be taken into account. At the same time, landscape structures strongly characterised by infrastructural networks, either relating to transport or energy purposes, are those which accommodate higher shares of productive refurbishment, since these kind interventions can largely profit from existing infrastructures. Again, a rather well-equilibrated coexistence of all the three categories of intervention in each of the four contextual conditions is found only in one specific landscape typology, that of spinning mills. This is characterised by high building density, often with architectural/heritage values, extensive waterscapes (both energy and recreation infrastructure) and a moderate influence of topography. The typological ratio between building density and infrastructural footprint seems to be, according to that, a key influencing factor for the flexibility of transformative interventions. This is valid only partially, however, as other landscape structure typologies with the same ratio (e.g. cement plants and mining-based sites in general) are indeed not showing the same balancing. The quality of buildings, besides the density, is therefore determinant for ensuring that flexibility.

Last but not least, it can be also observed how the specific categories of interventions are variably declined according to the influence of contextual conditions and landscape structures. In the case of productive refurbishment, it can be distinguished between direct measures, such as the reactivation and/or occupation of available spaces, in good conditions and thus ‘ready’, and follow-up interventions, such as add-ons and/or replacement of buildings. The prevalence of either direct or follow-up measures depends mostly on the contextual conditions. For what concerns environmental regeneration, it is also noticeable a difference between adaptive mitigation measures (limited effort and impact) and more extended reclamation/reconfiguration measures (long-term development and variable purposes, from ecological restoration to public use and recreation). Cultural reuse interventions are more homogeneous, as in most cases they address alternative economic uses of the site or parts of it. Nevertheless, in fragile contexts and where the landscape typology allows that, cultural reuse can play the role of temporary ‘change activator’, i.e. catching the attention and thus helping to initiate the transformation.


landscape typologies
regional types
productive refurbishment
environmental regeneration
cultural reuse
cement plants
EAF steelworks
spinning mills
aluminium smelters
old industrial region
industrial-tertiary region of type 1
industrial-tertiary region of type 2
rural-industrial region

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Part IV
Findings

9 Research Outcomes

The dissertation began with questioning the current redevelopment and transformation approaches applied to brownfield sites in the Alpine region. The accent was posed on the fact that brownfield sites in mountain areas present very different contextual conditions, compared to traditional urban brownfields located in densely urbanised and economically developed regions. Exactly the acknowledgement of the higher relevance of the context over the content of the site, and thus the incorporation of the contextual conditions in the redevelopment process itself, was advanced as the conceptual shift required to effectively tackle the brownfield issue in mountain regions. Several examples of incomplete transformations, which leave unsolved either socioeconomic or environmental key questions, were included to support this statement. In response to the underestimated yet emerging challenge of brownfield redevelopment in the Alpine region, it was proposed to assume an outward, context-centred perspective on transformation, in which the brownfield site should be assumed as “a ‘hub’ of relational systems reaching out on the territory […] an integral part of a wider landscape, with which it establishes physical and functional relationships, generating recognisable topographies and specific environments mutually influencing the site actual conditions as well as its future transformation”[1]. Indeed, this view brings forward a strong ‘infrastructural’ understanding of mountain brownfields, in which these are no more seen as isolated (and thus problematic) entities, but rather they are considered as critical nodes of a larger, hosting territorial structure. To sustain and develop this idea, and to facilitate its concrete implementation, it was proposed to assume a

[1] Quoted from Chapter 1.

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holistic landscape approach, capable of integrating nature and culture in the physical (living) environment, as well as space and society in a defined territory. This was assumed as necessary, in particular, to deal with the spatial, visual and especially cultural detachment of industrial brownfield sites from the Alpine context, which is indeed the source of major shortcomings in both research and practice when it comes to identify, define and transform mountain brownfields.

On these premises, the research addressed two causally interrelated questions, here briefly recalled:

(1) quantify and characterise Alpine industrial brownfield sites, providing a first, necessary overview on the 'size' and the 'shape' of the problem;
(2) develop and test a context-based, reliable and transferable transformation approach, capable of effectively sustaining the complex redevelopment process of Alpine brownfields.

The research was not limited to just 'solve' the transformation and development question of mountain brownfield sites, representing indeed the core issue on stake, but was aimed also and specially to frame the problem itself, to measure its significance. The interrelation between these two research objectives was synthesises and expressed by means of the following hypothesis:

The challenging redevelopment process of complex brownfield sites in mountain regions can only be successfully managed through an inclusive, adaptable and affordable landscape approach based on structural-systemic principles.

The effectiveness (usability and transferability) of such an approach is directly related to its capacity of integrating, in a structured but flexible way, the typological site specificity with the given environmental, economic and social contextual conditions.

Based on this hypothesis statement, a research methodology was designed and developed, articulated around two main forms of knowledge production.

A first, theoretical part aimed to deepen the two 'variables' of the hypothesis—"the challenging redevelopment process of complex brownfield sites in mountain regions" and "an inclusive, adaptable and affordable landscape approach based on structural-systemic principles"—by means of existing and available research on the topics. On the one hand, it was analysed in how far the Alps can be considered the context of "complex brownfield sites", meaning to find out why brownfield sites can be found exactly there (a by-product of context-specific industrialisation and deindustrialisation processes) and how their redevelopment is challenged by the current economic, social and environmental conditions of the Alpine region itself. On these basis, Alpine brownfields were given a definition as ‘territorial infrastructures’, a form of territorial capital that is spatially well-integrated and defined (key nodes of a cultural landscape) yet functionally disconnected (temporarily useless yet suitable for reactivation). On the other hand, it was analysed what does it mean to approach brownfield transformation from a landscape-oriented perspective, and especially what does imply to deal with former industrial sites in a landscape ‘infrastructural’ way. In doing so, the focus was moved temporarily away from the Alpine region to review the main approaches to brownfield transformation developed so far, their cultural and disciplinary backgrounds and the influence on concrete planning and design outcomes. Accordingly, ‘structures’ and ‘systems’ were highlighted as key paradigms in approaching brownfields from a holistic landscape perspective, as two distinct yet strongly interwoven ways of interpreting the infrastructural qualities of these particular sites.

Following that, the empirical part of the research was developed with the aim to collect the evidence in support of the hypothesis, and especially in regard to the second hypothesis statement on the requirements of the proposed approach. To approach the complexity of the task, well expressed by the hypothesis and the twofold research aim—quantification/qualification of Alpine brownfields and development/testing of an appropriate transformation strategy—an incremental, multi-scalar analysis was carefully planned, set up and conducted. This encompassed three main scales: a first Alpine-wide territorial census of brownfield sites, an intermediate study of landscape typologies of most representative brownfield sites and a final design-based testing of transformation on four real-world case study sites. As foreseeable, this shifting between scales required the use of many different methods, tools and, generally speaking, it implied a careful handling of phases, related results and their interpretative interlinkages. Concerning the results, in particular, the multi-scalar empirical analysis was conceived in a way that the preliminary outcomes from each single scale could be directly illustrated and discussed immediately after the data collection. In this way, the structuring of the empirical part already partially included some of the conclusion of the research, or at least some of the most relevant key findings. In order to ease the comprehension of the following conclusive sections, these key findings are here briefly recalled:

- the territorial census of Alpine industrial sites in traditional heavy and manufacturing sectors has revealed, through its figures, the extraordinary yet challenging relevance of the brownfield issue in this particular mountain region. Although partially expected, this first result comes actually ‘out of the blue’ if we consider that most of the existing research as well as national and transnational regional policies focusing on the Alpine region are not mentioning the question of brownfields at all, or at least they do superficially and with a too narrow local view;
- attached to the geography of current and potentially future Alpine brownfields, the insights provided by local and regional stakeholders confirmed a general underestimation of the problem, but at the same time they helped to clarify why the redevelopment process is so problematic there. Not only financial, technical and management shortcomings of small-sized municipalities and local networks, but also and especially the limited ‘impulse’ of these fragile socioeconomic systems make the redevelopment of large and complex disused industrial sites very difficult. Furthermore, the stakeholders and representatives of affected communities and regions strongly addressed the economic relevance of these sites for the wider hosting territories, putting in fact in the background other most felt issues such as e.g. environmental and ecological concerns. This specific aspect was quite a surprise at first glance, as it clearly downturned the claim that in mountain regions and rural regions in general there is no pressure (interest) in redeveloping and reusing brownfield sites. The sites are there, and in huge numbers. The pressure is also there, with variable implications from context to context. The difficulty lies, therefore, in conveying this demand on the sites themselves, i.e. on delivering expectations in/through their transformation and ‘re-programming’;
- Alpine brownfields are definitely not isolated entities, or better, not just in terms of site and surroundings. The distribution of the sites across the Alpine space, as emerged from the mapping process, described a geography which is clearly ‘territorialised’, where specific categories of sites (either closed, downsized or still active) are clustered on a regional basis. The spatial concentration of some industries than others, and the ratio between active and closed or downsized sites within the same sector, helped to outline recurring regional types, to which a specific relevance of brownfields was associated. This regional geography proved to be particularly useful to illustrate how each single Alpine brownfield is indeed part of a larger yet very specific territorial system, which is in turn capable of influencing (indirectly) the redevelopment process of every belonging site;

- as resulted from the typological study of the landscape structures of Alpine industries, it was found how apparently different sites—located far from each other and developed in very diverse cultural contexts and environmental conditions—do actually share the same spatial organisation and footprint, thus interacting similarly with the surroundings. Far from wanting to 'flatten' the specificity and singularity of each Alpine brownfield, this remarkable finding clearly demonstrates the need, advanced in the hypothesis, of a transferable approach to transformation and redevelopment. Built architectures may vary by forms and age, as their status does, vegetational patterns and covers may also vary, depending on e.g. the climate conditions, but two disused cement factories located on the opposite sides of the Alps (either north-south or east-west) will always present the same landscape structure, the organisational logic of elements in space. This confirms what was addressed in the first pages of this work, that is, the much greater relevance of the relationships between the site and its surroundings over the content of the site itself. The recognisable landscape structures associated to specific Alpine industries, and thus brownfields, are at the same time the 'common ground' of analysis and the 'variable' of transformation.

These findings were conveyed, re-elaborated and somehow verified in the detailed design-based analysis of the case study sites. Presented as four very different 'brownfield stories', yet united in their analytical processing, the case studies constituted the most relevant empirical work of the entire research. On them and by them, the theoretical and empirical knowledge accumulated before was condensed and tested by means of a specifically designed methodological approach, involving a clear sequence of steps and procedures. At the end of the case study analysis, and through the comparison of the achieved results, different 'evaluation' pathways opened up. Those most immediate, and functional to the research construction, were the outlining of a taxonomy of transformative interventions as well as its further integration into a redevelopment matrix—a way to systematise the three scales of analysis (mapping, characterising and testing). However, the most prominent result of the thorough, field-based case study analysis was indeed that landscape approach already advanced in the hypothesis, now to be defined.

9.1 A Landscape Approach

By considering landscape in its inherent holistic nature, as "a complex whole that is more than the sum of its composing parts" (Antrop 2006: 35) where "all elements in the spatial structure [...] are related to each other and form one complex system" (Ibid.), the landscape itself becomes the conceptual framework as well as the action space for guiding large and small territorial transformations. This principle was established in the beginning of the research, as the source of a potentially useful approach to deal with the complex planning challenge of redeveloping Alpine brownfields. The specific 'environmental' conditions of mountain landscapes—namely the over-relevance of topographical and ecological features, the dispersed yet concentrated urbanisation pattern and the prevalence of semi-natural open spaces over built ones—operate in fact a radical re-contextualisation of former industrial sites here located. As the focus necessarily shifts from the site to the complex relationships established with the surroundings, the mountain brownfield can be rightly perceived as integral part of wider, hosting landscape structure, of which it is not just a key structuring element, but in most cases also the cause behind that specific structure. This was clearly evidenced first in the Characterisation phase (Chapter 7), where the landscape structure of twenty-four Alpine industrial sites showed, in all cases, how their variable spatial footprint is indeed generated from the time-wise interaction between the physical surroundings and the previous industrial activities. Furthermore, the same mutual influencing was confirmed in the Testing phase on the four case studies (Chapter 8), and especially with reference to their diachronic landscape analysis and the on-site photographic study. This specific 'outer-oriented' condition of the brownfield site was considered, since the beginning of the research, as the key to address its problematic transformation. Already advanced in Chapter 3, the view of Alpine brownfields as territorial infrastructures, spatially embedded (already there) in a changing cultural landscape yet functionally disconnected from it, provides the reason for tackling their challenging redevelopment by means of a holistic landscape approach. The latter can be defined as such only if capable of effectively integrating the context into the site transformation process, not as a mere situational background or source of programmatic inputs, but rather as a structural and systemic extension of the site itself. Apparently more challenging than just the single site transformation, this passage is however extremely practical in its purpose. By assuming an holistic landscape view, integrative of all the components of landscape—artificial and natural, built and open, architectural and ecological, designed and accidental, linear and areal –, the complexity underlying the (missed) brownfield transformation can be broken down into minimum factors, enabling therefore their logical and factual ‘placement’ into the main planning process, as well as their functional integration into side-processes not directly related to the specific site (yet influential). In this way, not only the feasibility of the site transformation is substantially improved, but the process itself is finally (and rightly) integrated into those wider territorial dynamics to which it naturally belongs. The re-contextualisation of the brownfield site acts therefore as lever to also re-contextualise (review) its challenging redevelopment as a planning and design process. In this regard, the holistic landscape approach here developed proved to work effectively as both a conceptual framework—brownfield sites in mountain regions as territorial infrastructures, key nodes of a wider landscape structure—and an operative procedure—a system-based and performative guidance to the redevelopment process. These two aspects cannot be separated one from each other: while on the one hand the conceptual redefinition of Alpine brownfields as territorial infrastructure can be only fulfilled through a systemic transformation, on the other hand this procedural design model finds its reason only if these sites are considered as part of a larger context.

Developed and tested on the four case study sites, the holistic landscape approach to brownfield redevelopment in mountain contexts sets out as an iterative analytical-design process. This encompasses at least seven consequential phases, each building on the previous ones, as in a sort of progressive cognitive exploration aimed at outlining and guiding, as result, the overall site transformation (Fig. 9.1). The procedure can be exemplified as such:

1) Acquisition of the necessary knowledge on the regional context (geographic features, accessibility, socio-demographic features, economic features, environmental features, spatial development features).
2) Acquisition of the necessary **knowledge on the site** (historical background including elements on the former productive process, most recent developments including eventual plans and programs, future challenges and expectations).
3) Remote analysis of **landscape change** (diachronic study of the site physical evolution in relation to its surroundings, by means of aerial views and maps), based on (1) (2).
4) On-site analysis of **landscape forms, features and visual interactions** (planned and prolonged fieldwork focusing on the site and its context, to be thoroughly and carefully documented by means of geo-localised photography), based on (1) (2) (3)—Ex-ante evaluation of **landscape transformation**

potential as complementary activity to fieldwork documentation (review of captured images with support of explorative sketches and annotations).

5) Outline of the **landscape structure** (site-centred map describing the composing elements and their spatial organisation), based on (3) (4).
6) Design and development of landscape transformation systems (site-centred diagrammatic maps describing the prospected transformation process through a 3-system strategy—backbone, borders, core), based on (1) (2) (3) (4) (5).
7) Assessment and implementation[2] (feasibility check with interested parties and formalisation into a site redevelopment plan), based on (6) + (1) (2).

The site and its context are clearly distinguished only in the first two phases, which are indeed aimed at setting the knowledge foundations of the entire process by means of collecting specific and relevant information on each of the two 'scales'. From the third phase onwards, the site and the context are merged into a physical, tangible landscape, which constitutes the actual test field of both the following analytical and design activities. This shift in scale and perspective is strongly required in order to face brownfield transformation through a holistic landscape approach, that is, to consider right from the beginning, from the first stages of analysis, the formal and factual integration of the former industrial site into the surrounding landscape. It might sound banal in a way, but the tendency to consider the brownfield site as 'other' than its mountain context is real and common, as demonstrated by the failed redevelopment approaches occurred so far. In order to actualise this fundamental change of view, a highly explorative and photography-based fieldwork has to be introduced and operated. By focusing on the spatial and visual interactions between the site and its surroundings, recording them by means of a georeferenced landscape photographic approach, the differences between the former industrial site and what lays around it are indeed flattened and almost cancelled. Of course, this does not mean that planning-relevant issue such as land ownership or spatial regulatory rights and restrictions are avoided, but indeed during this perceptive and documentary diving into the landscape these are temporarily set aside, to be then recovered during the design phase.

The fourth step constitutes the 'keystone' of the entire process, as it bounds together in space the previous analytical steps with the upcoming design and development ones. Specifically, the placement of this step halfway into the process constitutes one of the most innovative as well as relevant aspects of this

[2] Due to the limited scope of the present research, this last step was not included nor completely tested.

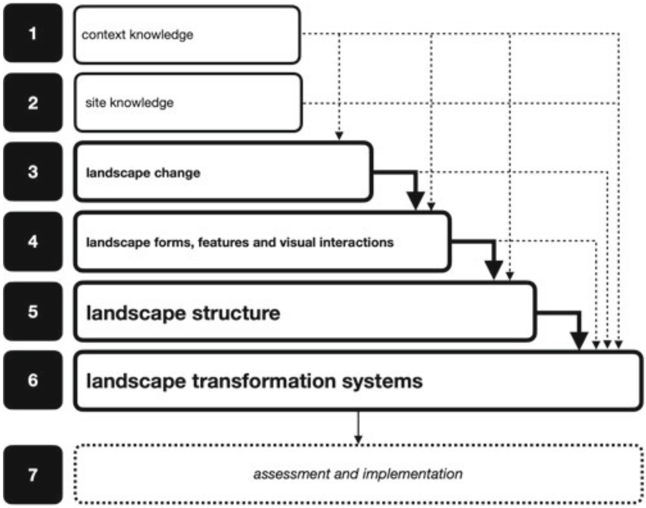

Fig. 9.1 Landscape approach, the procedure

methodology, compared to the usual way of approaching brownfields transformation. On-site analysis and fieldwork activities are normally occurring in the early stages of the process: in regular planning procedures but also in design commitments and competitions as well, the site visit is often perceived as a first, necessary contact with the 'object' of transformation, which is then rapidly explored and documented by means of highly subjective and spontaneous photography—acting as a 'fake' documentation, where to be documented are just the aspects that are interesting for the viewer and for his own view on future transformation. The prolonged fieldwork proposed in this new approach is evidently time- and cost-intensive, but also very democratic, as it does not require at all that the investigator shall be a professional photographer. Exactly the placement of the site visit and fieldwork after three key analytical stages—acquisition of knowledge on the context and the site, and remote analysis of landscape change—makes the investigator well-informed on what to see, to check and to document on-site. Going on site with a clear idea of what to expect and record, almost being already familiar with the site and its 'landscape of embedment', allows the planner-designer investigator to be highly pragmatic in his view and considerations on the future transformation. In other words, the fieldwork turns from being a mere site visit into a preliminary, 'mental' testing of the transformation that will occur. As a complementary, almost parallel activity to photographic documentation, the evaluation of the transformation potential of the site is carried on while visiting it, getting acquainted with the concrete spatial nature of the problems and issues already identified and defined in the previous stages. In this sense, photography acts as both a documentary tool, recording the actual 'state of things', and a design-oriented tool, rendering visible where, what and how change can take place. To allow this latter function of photography, it is necessary, again, to clearly 'inform' the photographic work in advance, i.e. to carefully plan the fieldwork activities according to the previous steps. The site visit, which includes indeed repeated and prolonged explorations of the site and its surroundings, should not be approached as just an aesthetic experience of pure observation, as if letting ourselves being totally absorbed by the landscape as a Romantic flaneur, but more as an objective evaluation practice, aimed at testing our knowledge of the 'already there' and, based on visual verification, prefiguring the change.

The amount of knowledge accumulated until this stage, an interwoven set of background information and direct experience, are then transferred into the last two stages, the design-oriented ones. In this regards, structural and systemic paradigms are introduced to respectively describe and address the complexity of the brownfield site as embedded in its hosting landscape. Although not referring to the Alpine context at all, the structuralist and systemic approaches to brownfield transformation discussed in Chapter 4 are indeed forming the thinking pattern for the development of specifically 'Alpine' structures and systems, useful and used to outline the transformation of brownfields here located. As defined already in the introduction of Chapter 7, before the case study analysis, the landscape structure of mountain brownfields is understood as "the composition of spatial elements on the land, defined according to their actual characteristics and interdependencies", while associated landscape systems are each "the infra-structural configuration of spatial elements defined according to their performances and transformative interactions". The structure is omnipresent, it defines the current conditions and describes the materiality of 'participating' elements as well as their organisation in space. Depicted by a territorial sample of 2,5 km diameter, centred on the brownfield site, the landscape structure shows very clearly how the site and its contexts are indeed fully integrated in the same structural organisation of the land. The site is not emerging as a different entity, as the sole object of transformation, but rather its presence is subtly dissolved in the context, as it is in reality. This way of prefiguring and depicting the landscape structure of mountain brownfields is also quite innovative, if compared to usual planning and design representations marking very strongly the site boundaries and its spatial 'otherness'. In addition, such a different representation of a spatially embedded site can also help to better manage other transformation areas within the same mountain context, not necessarily of industrial origin.

Last but not least, the 'infra-structural' 3-system strategy for organising and representing the site transformation has proved to succeed very well in the challenging incorporation and elaboration of the information collected so far. As in the fieldwork analysis, where the photographic documentation of the site is logically developed through three oriented focuses (*framescape, hardscape and softscape*), also in the transformative design phase the complexity of the task is addressed by means of three landscape systems, i.e. variable configurations of spatial elements: backbone, borders and core (Fig. 9.2). The sequencing is not casual, as it emphasises the infrastructural quality of landscape and especially the key placement of brownfield sites in that one. Depending on the specific landscape structure, in turn related to the site typology and its contextual conditions (location), the three systems act very flexibly as a comprehensive planning device to identify and outline where and how transformation takes place. In other words, the systems so conceived help to set down the whole range of interventions required to reactivate the brownfield site as a territorial infrastructure. The systems orchestrate the interventions 'organically' in space, but not in time, or not at all in time. The latter, in particular, is another key innovative point of the whole approach: the complex redevelopment of brownfield sites is usually a time-wise process, for which a careful phasing is always outlined. While this is correct, necessary and by no means disputable, the landscape approach here developed makes indeed a step backward, prioritising the logical and functional identification of interventions in space over their planning over time. This choice has two main reasons: first, the focus and frame of the research are not meant to provide concrete designs for the case study sites, but instead the aim is, once more, to develop a methodology capable of coping with the 'infrastructural' nature of mountain brownfields; secondly, the phasing of a brownfield transformation can only be developed when the whole set of interventions, i.e. their required effort and its spatial footprint, is extremely clear, otherwise it would just end up in that vague timeline often used to 'thicken' many landscape planning and design projects. Based on the wide range of interventions as described through the 3-system strategy, and after having discussed and evaluated their feasibility with the stakeholders and involved parties, a concrete phasing can be outlined.

So conceived, this structural-systemic approach perfectly fulfils the three main requirements addressed in the introduction, and specifically in the first hypothesis statement:

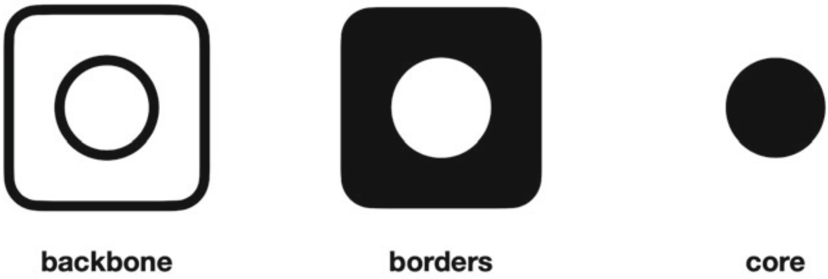

Fig. 9.2 The 3-system strategy (exemplification)

- it is inclusive, as it brings together, in the landscape structure and thus in the derived systems, different spatial elements belonging to both the brownfield site itself and the surroundings, thus generating a highly flexible transformation area whose shape is determined by current and future interactions;
- it is adaptable, as the 3-system strategy can be easily applied to very different brownfield sites and related landscape structures, as clearly demonstrated in the case studies. Depending on the specific landscape structure and contextual conditions, the systems will incorporate different spaces, yet organising them for future transformation with the same logic. The backbone always includes a variable mix of 'structuring' entities, both buildings, open spaces and infrastructures. The borders always deal with the outer frame of the brownfield site, the edges and attached liminal spaces, in some cases reaching out vastly in the surroundings. The core, finally, always focuses on the hardscape of the brownfield site, its built-up inner area, which often corresponds to the effective brownfield site as identified in local and regional planning schemes;
- it is also quite affordable, as it turns the overwhelming initial complexity of the site transformation into micro-interventions and independent little steps. These can be arranged and re-arranged in space and time according to the specific framework conditions (e.g. financial, technical or planning-related ones), as well as easily achieved by means of a joint cooperation of private and public, local and regional stakeholders. The indication of the key stakeholders to be involved in each step of the three systems aims exactly at that programmatic feasibility.

With these characteristics, the holistic landscape approach here developed provides a valuable methodological answer to the complex transformation and redevelopment of mountain brownfield sites. As always required by emerging planning challenges, in addition, this approach merges carefully selected and reinterpreted theoretical arguments with clear operative procedures, contributing therefore to increase the social function of science.

9.2 On Transferability

The transformative methodology previously outlined was developed and tested by means of four representative case study sites. As addressed in the introduction and expressed in the hypothesis, the effectiveness of such a landscape approach is measured not only through its capacity of actually figuring out the redevelopment process, but also and especially in terms of adaptability and replicability on a variety of different Alpine brownfields. The issue of transferability, clearly explained in the second hypothesis statement as the "capacity of integrating, in a structured but flexible way, the typological site specificity with the given environmental, economic and social contextual conditions", was tackled in the empirical research by means of three scales of analysis (mapping, characterising, testing), and especially through the progressive integration of the interpretative findings from each of them. The latter can be achieved by shifting from general to particular, in a 'deductive' scaling-down of the Alpine brownfields' geography into the concrete transformation of a few representative sites, as well as by shifting back from the particular to the general, through an 'inductive' definition of transformation principles and rules potentially valid for all the existing and future Alpine brownfields (Fig. 9.3).

In the first deductive process, the vast case system of Alpine brownfields was functionally broken down to specific types of industries, representing and grouping the majority of traditional heavy and manufacturing Alpine industries mostly affected by the crisis and closures—i.e. the primary 'source' of brownfields. From these sectors of types, a further selection of related industrial facilities served to identify the most relevant (industrial) landscape typologies, as resulting from the interaction between a certain industrial activity and the mountain context. This intermediate passage clearly showed the 'compositional rule' behind the similar types of Alpine brownfields, a determinant issue for what concerns the transferability of results. The typological analysis was then refined through the identification of four highly representative case study sites, resembling the different (common) conditions faced by Alpine brownfields. Approached from a theoretical yet well-grounded planning and design perspective, the transformation of these four sites has produced a set of recurring interventions, categorised into a taxonomy.

Starting from the latter, the inductive application of the case study results to the upper, more general analytical levels, verifies and enables the overall transferability. The transformative interventions outlined and tested on each of the four representative Alpine brownfield—again, very different in terms of actual state, contextual conditions and landscape typology—are theoretically transferable to other brownfields characterised by similar conditions. Of course, this transfer does not happen automatically, but it is rather 'logically' implemented on the basis of few independent variables, basically attributable to the typology-related landscape structure identified in the Characterisation phase. A similar landscape structure, i.e. a clear and recognisable composition of spatial elements on the land, is indeed the key that enables the transferability of transformative interventions to a multitude of other brownfields across the Alps, thus allowing a generalised feasibility of the process itself. In fact, as demonstrated in all the four case study sites, the landscape structure of mountain brownfields acts 'naturally' as the common ground for the programmatic inputs deriving from the regional context (the 'framework' of redevelopment) as well as for the transformative planning- and design-based interventions that the site requires[3]. The further and last step is the transfer of such a landscape-structural logic to the totality of current and potentially future Alpine brownfields, as identified in the Mapping phase. In this sense, 'transformed' landscape structures related to a specific brownfield typology can be almost infinitely replied (re-implemented) across a variety of regional and local contexts: the only changing variable will be in fact the programmatic input from the context, adaptively applied on the same site-related landscape structure.

[3] This exchange between the programmatic inputs from the context and the transformative interventions 'suggested' by the site itself recalls, not by chance, the systemic design approach already mentioned in Chapter 4 (Berger 2009).

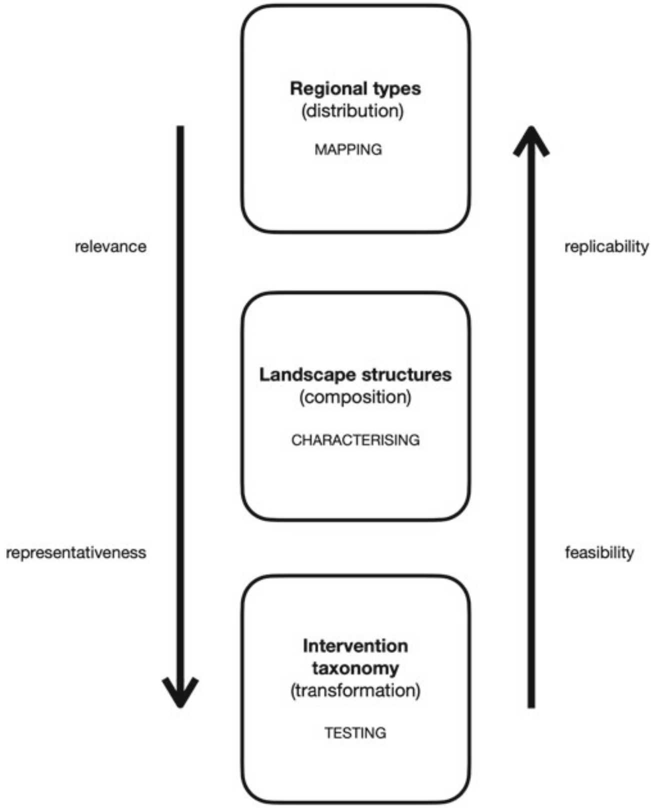

Fig. 9.3 Transferability scheme

This apparently complex transferability scheme is indeed very simple in its functioning logic. In advancing and supporting the feasibility of the holistic landscape approach here developed, this scheme definitely proves the initial argumentation, expressed in the hypothesis, that the inherent infrastructural quality of landscape is the one and only interpretative key to deeply understand Alpine brownfields and to tackle their challenging transformation.

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10 Conclusive Remarks

This work aimed to tackle the unprecedented challenge of brownfield redevelopment in the Alpine region. Still largely underrepresented in research as well as unsolved in practice, the complex transformation of mountain brownfields faces very different conditions compared to mainstream urban contexts. Not only these former industrial sites are here physically interfacing with a completely different landscape—where the human factor is omnipresent but rather subtle, mostly 'unbuilt'—but also their challenging redevelopment is framed into a territorial system with relevant structural limitations—from socioeconomic weaknesses to ecological fragilities, without mentioning institutional, technical and financial shortcomings. The research has first contributed, within its specific scope, to highlight and better define these contextual conditions, with which every brownfield transformation has necessarily to confront. To this purpose, the research collected and gathered 'on-site' the main issues that concur to shape the brownfield challenge in the mountain context: the origins of Alpine brownfields as a result of regional-specific industrialisation/deindustrialisation processes; the economic relevance of these brownfields and the related interpretation as territorial capital; the social and cultural meanings of industrial leftovers in the specific context of the Alps and their integration into a larger framework of social and territorial cohesion; the wide-scale ecological value of ecologically compromised sites, in the context of a rapidly changing mountain environment. Bringing together these different views and arguments required a strongly interpretative attitude, especially because none of those has been already directly associated to disused industrial sites in the specific context of the Alps and mountain areas in general. Through the empirical work, and especially the detailed fieldwork-based analysis of the case studies, these contextual conditions were first personally experienced and then concretely addressed in the reasoning on, outlining and testing the sites physical and functional transformation. This research-by-design approach, entailing a

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fundamental and continuous exchange between facts and things, ideas and spaces, has allowed to define, in the end, an innovative methodology for understanding and addressing the complex transformation of mountain brownfields. At the base of such methodology there is a truly holistic understanding of landscape, meant as the wholeness out there, the sum of human and natural elements and their integration into planned, designed and even accidental superstructures. Similarly to the association between brownfield and mountain regions initially advanced in this research, also the correlation between landscape holism and brownfield transformation required an enormous interpretative effort. A so-called landscape approach to brownfields has been until then used on a highly theoretical level, mainly addressing a few ground-breaking experiences such as those mentioned in this work, not all realised, and thus remaining confined to those only. However, brownfield redevelopment is actually a rather ‘ordinary’ planning issue, applied to hundreds of small and large sites across urbanised territories of the world. This enormous gap between advanced theoretical models and their daily practicability was a motivating issue throughout the whole research, from its initial conception to the last writing phases. With the aim to contribute, at least, to shorten this distance—and driven in that also by the compelling challenge of facing the emerging brownfield issue in the Alps—the research advanced an ‘operative’ reinterpretation of structuralism and systemic approaches used, in a way or another, in the aforementioned ground-breaking experiences of landscape-oriented brownfield transformation. Landscape holism was not just limited, therefore, to the comprehensive view of the ‘out there’, but it was also considered in terms of theoretical and practical wholeness. The idea of landscape as both a conceptual framework and an operative method for brownfield redevelopment in the mountain context, recurring many times throughout these pages, has been rendered active in the empirical ‘climax’ of the research, that is, the four case studies. In testing their transformation, the conceptual understanding of landscape as an implementing structure of a certain territory (Jackson 1984; Turri 2001; Raffestin 2012; Antrop 2017) has been transferred ‘systemically’ into a complex planning process, which often do not consider landscape at all or not so holistically. In this sense, the research has also indirectly contributed to improve the increasingly emerging linkups between spatial planning, urbanism and landscape studies, as indeed required to face the complexity of the contemporary built environment. For what concerns, specifically, the infrastructural qualities of landscape—inherent to a holistic understanding of it—and their application to brownfield transformation, landscape urbanism provided the major source of inspiration in both theories and experiences. Still too vague in its principles and applications, landscape urbanism is not yet fully accepted by traditional planning—as it introduces too much uncertainty—as well as by traditional landscape architecture—as it intends and uses landscape as mainly an engineered design. Nevertheless, exactly this undefined and hybrid character makes of landscape urbanism a potentially valuable thinking and operative framework for complex transformation challenges, such as the one addressed by this research.

Considering the work done and the results achieved so far, especially if compared to the initial 'emptiness' faced while approaching this research topic, it can be said, in the end, that the key research questions have largely found their answers while the hypothesis has been demonstrated, at least on a theoretical basis. But as naturally happens in research, new questions and issues are arising at this point:

- at first, the holistic landscape approach here developed and defined needs certainly to be further refined and especially tested on more, different sites. The methodological basis is there, the sites are also there, as resulted from the mapped geography of Alpine brownfields, so the next step would be to apply and repeat the same procedure both on similar sites (same landscape structures and typologies) and different ones. This can be done either professionally or by means of university teaching, but in all cases (better if interwoven) it necessarily requires a strong supportive scientific framework, which allows the constant assessment of results and thus methodological adjustments. As a planning approach, the structural-systemic method here advanced must be further tested and implemented in cooperation with the relevant local and regional stakeholders. For practical reasons, this aspect could not be directly tackled in the framework of this dissertation, which instead aimed to outline first the method itself, but a next necessary step would be to double-check its feasibility (practicability) with the communities and institutions involved in the redevelopment process. For example, it would be useful to verify whether the identified transformation systems are perceived as realistic by involved stakeholders and, if so, how these can be practically implemented. A valuable help can come, in this sense, from the experience and the outcomes of the already mentioned Interreg "trAILs" project, where for the first time local stakeholders from different Alpine regions were joining together to discuss the future of their own brownfield sites. Following the further testing and implementation with communities, the proposed landscape approach can be transferred, operatively, into a real planning procedure;
- secondly, a further step which needs to be undertaken is to integrate the spatial scales of analysis used in the empirical work with an additional layer focused on the specific landscape contextual conditions of Alpine brownfields. The

three scales used to frame and explore the issue of mountain brownfields—the regional distribution across the whole Alpine space, the typological landscape structure of representative sites, the case study analysis of real-world situations—covered very well the problem on stake, and also responded clearly to the twofold research aim of quantify and qualify Alpine brownfields. However, an intermediate step between the regional geography and the typological landscape structures is now required to better understand the infrastructural relevance of brownfields for contemporary urbanised mountain landscapes (YEAN 2005; Diener et al. 2006; Diamantini 2014). In this regard, an additional focus on the landscape context at the regional scale, that is, on entire valley system, could be one of the most significant follow-ups to this research, almost the 'natural' frame that can legitimise and also empower the landscape approach so conceived;
- lastly, the pioneering nature of this dissertation, both with reference to the topic and the methodology, constitutes alone a reason for its further 'geographic' extension. The specific and emerging conditions of mountain brownfields, here investigated and described with reference to the Alps, can be indeed expanded to all those disused or underused complex industrial sites in mountain and peripheral regions in general, i.e. sharing similar socioeconomic, environmental and urban conditions. As already identified in the first pages of this dissertation, and clearly verified later on, what makes the difference here is not really the content of the brownfield site itself, but more the relationships it established with its surroundings—that, in turn, are very different from the 'usual' context of urban brownfields. For all those former industrial sites located in these specific contexts it can be coined a definition of 'decentralised brownfields', as to underline their outward-oriented location compared those similar sites instead 'squeezed' into central and dense urban patterns. The current situation in the Alps—a rather dynamic mountain region compared to others in Europe and beyond—suggests that the transformation and redevelopment of most of these decentralised brownfields is yet to be defined, before being concretely achieved.

The fact that at the end of such a thorough research there are still many open question and issues on stake is not a sign of failure, but indeed it shows that the work done so far is really promising, and therefore worth to be carried on. In this case, this doctoral dissertation can certainly be considered as a starting point, rather than simply an achievement.

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