

Interreg



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FRACTAL

Deliverable 1.3.1

The state of the art of local GI implementation in the Alps.

**FRACTAL – FosteRing green infrAstruCTure
in the ALps**



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**TRIGLAVSKI
NARODNI PARK**

Deliverable 1.3.1 The state of the art of local GI implementation in the Alps.

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1. FRACTAL - FosteRing green infrAstruCTure in the ALps

In the last century, human population growth and industrial development have been leading to the depletion of natural resources, to ecosystem degradation and to a worrying change in the global climatic conditions. One of the most striking forms of degradation is the fragmentation of ecosystems and habitats because of land use change, which poses a serious threat to biodiversity. A fragmented ecosystem cannot provide the human population with the fundamental ecosystem services (so-called ES hereafter), such as pollination, food, air quality, carbon sequestration, flood management, water treatment, local climate regulation, soil erosion prevention and so on. As the negative impacts of fragmentation have become apparent, the importance of maintaining ecological connectivity within ecosystems and landscapes at different levels of naturalness, including between protected areas and at the rural-urban interface, has been increasingly recognised.

Due to the sensitive inner condition of alpine ecosystems, the impact of climate change could be more severe in the Alps, having harsh effects on the vulnerability of natural capital and consequently on that of local communities. The Alps are characterised by a variety of natural, agricultural, and small urban areas, where the connectivity between natural and semi-natural ecosystems is not always ensured. One of the most effective ways to support ES is implementing Green Infrastructure (GI) at local scale. Unfortunately, the practical implementation of GI at local scale in the Alps is still limited. This is because of a lack of communication and knowledge transfer at community level, both on the political and on the educational sectors. Building on the solutions developed by the LUIGI (Linking Urban and Inner-Alpine Green Infrastructure - Multifunctional Ecosystem Services for more liveable territories) project, FRACTAL involves local stakeholders in the implementation of GI. The goal is to standardise the requirements to plan GI at municipality level, as well as to develop an educational toolkit in order to raise awareness among citizens and pupils.

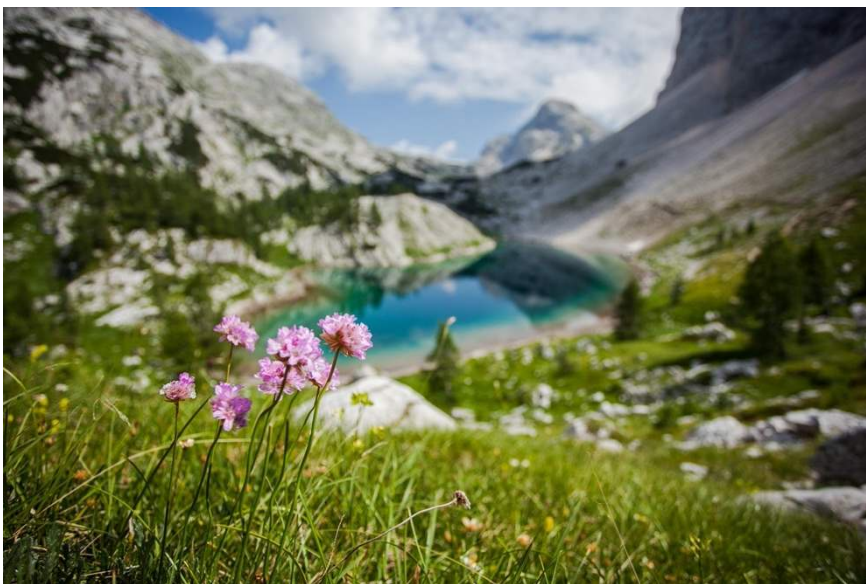


Figure 1: Delicate balance: A glimpse into the alpine ecosystem, where even the smallest changes resonate through the mountains, highlighting the fragility of this environment.



2. The concept of Green Infrastructure

Green Infrastructure (GI) refers to a network of interconnected natural and semi-natural features that provide a wide array of ecosystem services. These services encompass functions such as water purification, air quality improvement, habitat provision, climate regulation, and opportunities for recreation. The core concept revolves around the strategic incorporation of these natural elements into land use planning and development, recognizing their role in maintaining ecological balance and promoting human well-being. In the Alpine context, GI encompasses the diverse components of the natural environment, blending seamlessly with the cultural and urban fabric of the region.



Figure 2: Rural Resilience: A glimpse into Green Infrastructure in rural landscapes, where nature and sustainable management harmonise to enhance environmental health and community well-being.

2.1 Importance of Green Infrastructure in the Alps

The relevance of GI for the Alps is manifold:



1. **Biodiversity conservation:** The Alps host a wide range of ecosystems and a rich tapestry of plant and animal species. These diverse habitats are vital



for preserving both common and endangered species. The region's GI, including its forests, meadows, and water bodies, provides essential habitats for a variety of flora and fauna.



2. **Climate regulation:** GI, particularly the vast Alpine forests, plays a vital role in mitigating climate change. These forests sequester carbon dioxide, helping to regulate global carbon cycles. Additionally, the natural landscapes contribute to local climate regulation, reducing temperature extremes and supporting weather patterns.



3. **Water management:** The Alpine region is known for its extensive water resources, including rivers, lakes, and glaciers. These water bodies are critical components of GI, regulating water flow, providing clean drinking water to downstream communities, and supporting aquatic ecosystems.



4. **Human well-being:** GI enhances the quality of life for Alpine residents and visitors alike. It offers numerous recreational opportunities, stimulates the regional economy through tourism, improves air and water quality, and provides protection against natural disasters such as landslides and floods.

2.2 Key elements of Green Infrastructure in the Alps

GI comprises various key elements, each contributing to the preservation and enhancement of the natural environment through the provision of ecosystem services. GI elements can be of both natural or anthropogenic origin and can be categorised as shown in Figure 3. While core areas and natural connectivity features are mainly of natural origin, artificial connectivity features, green urban and peri-urban areas, restoration zones and anthropogenic use zones are strongly influenced or created by humans. Regardless of their origin, GI can take a wide variety of shapes each contributing unique benefits to their respective environments. Outlined below are examples of essential GI elements and the corresponding benefits they provide:



1. **Forests:** Forests cover approximately 40% of the Alpine region, making them a fundamental element of GI. These forests provide carbon sequestration, habitat for wildlife, and crucially contribute to water regulation, avalanche risk reduction, and slope stabilisation.



2. **Urban forests:** Within Alpine cities and towns, urban forests are essential for enhancing the quality of life. These green spaces improve air quality, reduce noise pollution, offer recreational opportunities, and establish a vital connection between urban environments and the natural world.



3. **Meadows:** Alpine meadows support a rich diversity of plant species and provide essential habitat for pollinators. These semi-natural areas contribute to the



preservation of local plant species and support traditional agricultural practices like grazing.



4. Water bodies: Alpine rivers, lakes, and glaciers are integral components of GI. They play a vital role in regulating water flow, providing flood protection, and supplying clean drinking water to communities downstream. These aquatic ecosystems are essential for biodiversity.



5. Green roofs and green walls: In urban environments, green roofs and green walls represent innovative elements of GI. They enhance urban biodiversity, improve air quality, and reduce energy consumption in buildings through insulation.



6. Rain gardens: To facilitate water infiltration into deep soils in urban environments, rain gardens are designed as sunken garden spaces treating stormwater runoff from impervious surfaces, such as roofs, roads and parking lots. The benefits of rain gardens include their ability to temporarily store runoff during small or medium sized storm events, effectively remove pollutants, reduce erosion and contribute to groundwater recharge. They can also help reduce heat pollution in water bodies.



7. Green corridors: Green corridors are linear open spaces, such as agricultural areas, parks or (semi-) natural areas, within urban settings building networks of interconnected landscape elements. They offer cultural, recreational, and ecological benefits to communities including for example the provision of space for non-motorized transportation, wildlife habitat and aesthetic quality.

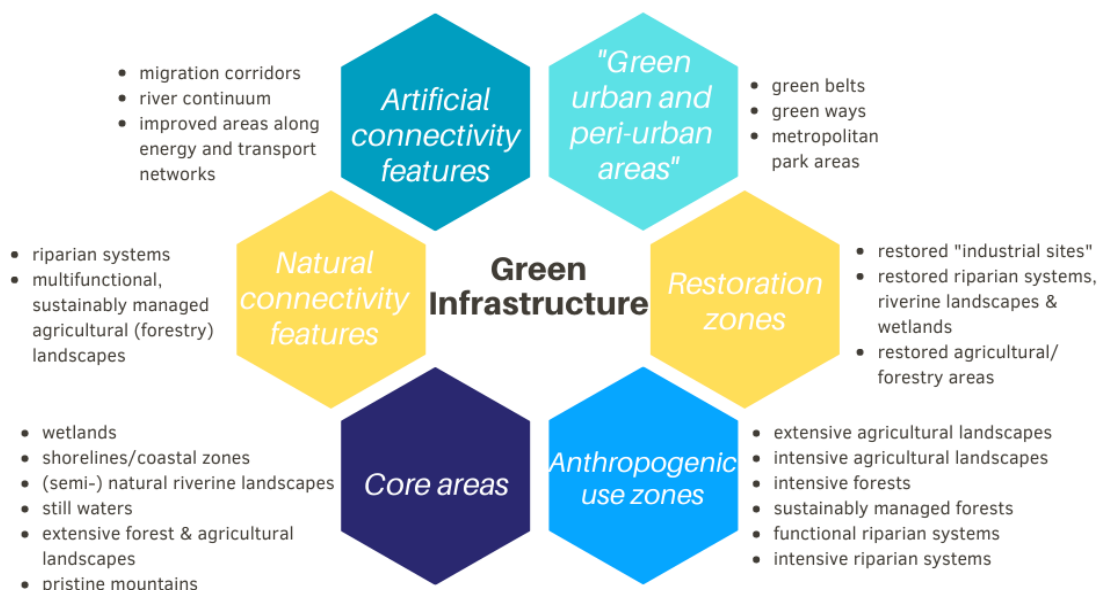


Figure 3: Grouped key elements of GI in the Alpine Space (Source: Schoßleitner et al., 2022).



2.3 Challenges in maintaining Green Infrastructure

Despite its critical importance, maintaining GI in the Alps is challenging, because of different factors. The Alps are experiencing the impacts of **climate change**, which can affect the health and resilience of GI. Changes in temperature, precipitation patterns, and the spread of invasive species can disrupt ecosystems and their services. Human activities, including agriculture, tourism, urbanisation, and other **land use pressures** put pressure on GI. Deforestation, habitat fragmentation, and land development can threaten the integrity of natural ecosystems. The introduction of non-native species can disrupt native ecosystems, affecting both biodiversity and ecosystem services. Effective management strategies are needed to control **invasive species** and protect native habitats. As climate change alters precipitation patterns, **managing water resources** in the Alps becomes increasingly challenging. Floods, droughts, and changes in glacier runoff can impact water availability and quality. **Raising awareness about the importance of GI** and fostering a sense of responsibility among local communities and stakeholders is crucial for its long-term preservation.



3. Strategies for Green Infrastructure in the Alps

The European Union prioritises GI through initiatives like Natura 2000 and the Biodiversity Strategy. The European Green Deal focuses on climate neutrality, and the EU Green Infrastructure Strategy underscores protection and restoration. Member states, including Austria, Italy, and Slovenia, align with these strategies for biodiversity and ecological sustainability within the broader EU framework.

3.1 EU strategies

The European Union has published several key documents and strategies that address GI and its related environmental, biodiversity, and sustainability goals, for instance:

- **Natura 2000 Network:** The Natura 2000 network is a cornerstone of the EU's nature conservation efforts. It consists of protected areas designated under the Birds Directive and the Habitats Directive and is a significant component of GI for preserving biodiversity and ecosystems.
- **EU Biodiversity Strategy for 2030:** This strategy outlines the EU's commitment to addressing the biodiversity crisis and emphasises the importance of GI in conserving and restoring ecosystems. It sets specific targets, including the restoration of at least 30% of degraded ecosystems and the integration of GI into urban planning.
- **European Green Deal:** The European Green Deal is a comprehensive framework that includes various initiatives and strategies aimed at achieving climate neutrality by 2050 and fostering sustainable development.
- **Nature Restoration Plan:** The Nature Restoration Plan is a strategy for restoring and enhancing natural ecosystems, including GI elements. This plan is part of the EU's efforts to halt and reverse biodiversity loss.
- **EU Strategy for the Alpine Region (EUSALP):** EUSALP is based on three general action-oriented thematic policy areas, one of which is Environment and Energy. Its core at the implementation level are nine Action Groups (AGs). AG7 is active in the Environment and Energy policy area and focuses specifically on the development of ecological connectivity across the EUSALP area and is therefore directly linked to the development of GI in the Alps.
- **EU Green Infrastructure Strategy:** The EU Green Infrastructure Strategy, implemented in 2013, is committed to the protection, restoration, creation and enhancement of GI. It emphasises the benefits of GI in various policy areas such as climate change, agriculture, maritime affairs and urban planning. The strategy focuses on promoting GI in key policy areas, improving information and knowledge, facilitating access to finance and supporting GI projects at EU level. Another priority is the development of a trans-European network to promote GI and green corridors on a large spatial scale. Ongoing reviews and guidance by the Commission will ensure the effective implementation of the strategy.



3.2 National Strategies for the countries involved in FRACTAL

Austria

Austria does not have its own strategy on the topic of GI. Approaches can be found in the current biodiversity strategy. The Biodiversity Strategy Austria 2030+ takes up the objectives and measures formulated by the European Union and at international level for the preservation of biodiversity. A ten-point program provides national quantitative and qualitative goals and the necessary conditions for the preservation of biological diversity in all habitats in Austria. These goals and the corresponding measures are aimed at protecting biological diversity in Austria, thus preventing further losses and also creating the appropriate framework conditions for the following aspects:

- Improvement of the status and trends of species and habitats,
- Effective protection and networking of all ecologically valuable habitats,
- Restoration of ecosystems that are particularly important for biodiversity and climate protection,
- Decisive reduction of land use and fragmentation,
- Initiating transformative change in society and integrating biodiversity into all sectors - “mainstreaming”,
- Strengthening global commitment,
- Improving the legal framework for biodiversity conservation,
- Ensuring the financing of biodiversity conservation and support for biodiversity-promoting activities,
- Valuing biodiversity in society and the economy,
- Improving the scientific basis for achieving and evaluating biodiversity goals.

The implementation of the Austria 2030+ biodiversity strategy is also intended to contribute to comprehensive, transformative change in our society. To this end, it is important to include biodiversity more closely in all areas of life, economic and use sectors and political decisions. In any case, the prerequisite for successful implementation is to recognize the preservation of biodiversity and sustainable use as a common task of our society and to act accordingly. The Biodiversity Strategy Austria 2030+ formulates over 300 concrete measures for this purpose (ÖSTRAT, 2010).

Italy

Although an omni-comprehensive strategy for GI is not yet available, Italy has adopted national regulations for GI-related topics, including protected areas, biodiversity protection, ecosystems and Natura 2000 sites. Starting from the ecological perspective on GI, for more than a decade ISPRA (Istituto Superiore per la Protezione e Ricerca Ambientale) has been studying the issue of ecological



connectivity and habitat fragmentation. In 1997 the institute had launched the research initiative “Reti ecologiche, piano pluriennale di attività per la definizione di strumenti per la continuità ecologica del territorio” (Ecological networks, a pluriannual activity plan for the definition of tools for the ecological continuity of the territory) with the aim of promoting and supporting the implementation of the EU Habitats Directive. 10 years after, the publication of the “Guidelines for the management of functional ecological linkage areas” (APAT, 2003) provided practice-oriented guidance for the planning and management of green corridors in land management policies. Unfortunately, Italy does not have comprehensive and well-defined national legislation on spatial planning and urban development, a fact that hinders the development of a common approach to GIs.

In 2013, Italy enacted Law 10/2013, the main national law on urban green spaces, which focuses exclusively on the urban level. This led to the creation of the National Committee for the Development of Public Green Spaces which oversees the implementation of the law and provides guidance to local administrations. The committee has defined the National Strategy for Urban Green Spaces and a set of guidelines that provide criteria and tools for the planning, construction and management of green spaces in urban and peri-urban contexts (OECD, 2023).

The protection of the environment and ecosystems is subject to the legislative power of the state, while territorial planning is coordinated between the state and the regions. At regional level, the Regional Ecological Network (REN) is an important regulatory instrument specific to GI. Italian regions integrate GI in the definition of their RENs in accordance with the European framework on Biodiversity Protection. Certain Regional Territorial Plans (RTPs) designate RENs as priority infrastructure and a key tool for regional and local spatial planning. Moreover, there exist some regional initiatives that further integrate GI in spatial planning (OECD, 2023).

At the national policy level, it is worth mentioning the “Quarto Rapporto sullo Stato del Capitale Naturale” (2021), which highlighted how GIs can help reduce environmental impact and halt the loss of biodiversity, restore and enhance ecosystem services and improve the quality of life in urban and peri-urban areas. GIs have also a key role in the “Strategia nazionale per la biodiversità al 2030”: the strategy requires all cities with at least 20,000 inhabitants to develop an urban greening plan and to integrate nature-based solutions in urban planning (e.g. green roofs and walls, phytoremediation, parks, green corridors, trees, vegetable gardens, urban gardens, grassy canals and ditches for drainage, making paved surfaces permeable, etc.) (OECD, 2023).

Further national strategies in tight connection with GI are:

- “Strategia nazionale per lo sviluppo sostenibile” (2017)
- “Strategia Nazionale di Adattamento ai Cambiamenti Climatici” (2015)

The 2021 National Recovery and Resilience Plan (PNRR) also considers GI, even if just to a limited extent. The PNRR dedicated a total of €6 billion to the GIs, around the strategic axes for ecological transition, under cluster 6, for contributing to the objectives of the European Green Deal related to the Biodiversity Strategy to 2030. In particular, the PNRR allocates €300 million to the GIs in urban areas by planting of 6.6 million trees (at least 1.6 million trees by 2022 and 6.6 million of trees within 2024) in the 14 Italian Metropolitan Cities, some of them within the Alpine Space area (Torino, Milano, Venezia).



Slovenia

Slovenia does not have a specific national strategy exclusively focused on GI. Slovenia's approach to GI is embedded within broader environmental and sustainability strategies. These strategies include components related to biodiversity conservation, forest management, water resource management, and urban planning, all of which contribute to GI goals. However, there are strategies at the local level, e.g. strategy of the city of Ljubljana.



4. Projects and other activities related to GI

Across Austria, Italy, and Slovenia, innovative initiatives are shaping the landscape of GI, showcasing a collective commitment to combating climate change and enhancing urban well-being.

4.1 International projects on GI outside the Alpine Space programme

PERFECT: Planning for Environment and Resource eFFiciency in European Cities and Towns (Interreg Europe)

The overall objective of the PERFECT project was the identification, analysis, dissemination and transfer of good practices and policy experiences in the multiuse of GI into mainstream Structural Funds programmes. PERFECT aimed to demonstrate how the protection, development and exploitation of natural heritage can deliver sustainable, smart and inclusive growth through the exchange of good practice on new uses of GI to blend with, and enhance existing uses.

ENGREEN 2: Capitalising on the strengthening of green infrastructure in the cultural landscape cross-border IT-SI

The project's main goal is to increase cross-border collaboration in order to better conserve and protect nature, biodiversity, and GI in the IT-SI program area. This will be accomplished by utilising the Engreen project's outputs and results and transferring them to new areas, partners, and stakeholders. The inclusion of best practices in public policies and assisting in consolidating and replicating the same results through pilot projects and a communication campaign, will thereby improve the current state. The project is novel because it restores various forms of GI with the goal of preserving biodiversity and natural ecosystems. It carries out equally creative environmental interpretation initiatives that highlight biodiversity and GI as critical components of sustainable spatial development and increase their public awareness.

Since distinct ecosystems and habitats exist on both sides of the border and their adequate protection can only be ensured by fostering synergies, cross-border cooperation is essential.

GREVISLIN: Green infrastructures for the conservation and improvement of the condition of habitats and protected species along the rivers

GREVISLIN's primary goals were to increase awareness of and take action for sustainable cross-border development, as well as to create a coherent, integrated, and sustainable cross-border area with a clear long-term strategy in the management of GI. The program's goal is strengthening integrated ecosystem management for sustainable development—which includes GI planning, water monitoring and pilot projects.

In order to create and preserve GI, it was necessary to establish long-term cross-border strategic planning, monitor water and habitats, carry out pilot projects and investments for the



development of GI in NATURA 2000, and increase public awareness on the goals of sustainability of water resources, protected areas, forest land, and agricultural land.

The goal was to create a cross-border cooperation area with a well-defined, long-term, all-encompassing, and sustainable strategy in the field of GI, awareness-raising, and actions for cross-border development that is sustainable. This was accomplished by identifying best practices and conducting pilot projects that increased local community, agricultural, and protected area visitors' understanding of the value and effectiveness of ecosystem services.

MaGICLandscapes Managing Green Infrastructure in Central European Landscapes (Interreg Central Europe)

The main focus of MaGICLandscapes was on the benefits of GI and GI in EU regulations and national laws in five countries in Central Europe (AT, CZ, DE, IT, PL) with nine project partners. One of the main activities was the production of nine Green Infrastructure Strategies and associated action plans in the case study areas in close collaboration with local and regional stakeholders. Furthermore, they produced transnational and regional GI maps and GI functionality maps, a booklet on supporting the benefits of GI, a GI Handbook, different manuals on GI assessment and strategies, and filmed five documentaries on the history of near-natural green spaces and their present use by people in the pilot regions. The project was running from 2017 to 2020 and was funded by Interreg CENTRAL EUROPE 2014-2020.

4.2 Interreg Alpine Space projects on GI

In the last decade several international projects on GI in the Alps were, like FRACTAL, carried out as part of the Interreg Alpine Space programme co-funded by the European Union. The Alpine Space programme promotes cooperation on transnational challenges among seven Alpine countries (Austria, France, Germany, Italy, Liechtenstein, Slovenia, Switzerland) and contributes to the goals of EUSALP. Five recent Alpine Space projects supporting EUSALP's AG7 and focused on GI are summarised in table 1.

One Alpine Space project specifically related to the goals of FRACTAL is **LOS DAMA!**. This project built a transnational cooperation network with the goal of preserving and enhancing the landscapes and open spaces in and around the Alpine cities as GI. Recognizing the value of their attributes and functions for both urban areas and the Alpine region overall, cities and metropolitan authorities in the region worked to enhance the development, design, and upkeep of peri-urban green spaces and landscapes. They pledged in a memorandum to establish a long-term foundation for cooperation amongst the aforementioned stakeholders in the endeavour to preserve, improve, and manage our open spaces and landscapes as GI. As a publication that is ready for use, the LOS_DAMA! toolkit offers practitioners adaptable methods to improve GI in areas surrounding peri-urban cities. Within LOS_DAMA!, seven cities, institutions, and metropolitan areas—Munich, Salzburg, Vienna, Ljubljana, Trento, Turin, and Grenoble—developed and carried out local experimental initiatives. In order to improve GI in peri-urban city areas, 38 unofficial instruments were created. The developed tools have distinct goals and were grouped into the following areas because the primary challenges differed depending on the city region: 1) Increasing awareness through instruments 2) Analytical instruments 3) Tools for facilitating collaboration 4) Tools for the plan, planning, and execution; and



5) Tools for supporting the process. The tools are easily adaptable to various circumstances and include application advice and experiences.

Table 1: List of the most recent (last 10 years) Interreg Alpine Space projects focusing on the topic of GI.

Project Name & Duration	Main Focus	Countries involved	Outputs and Products	Local Engagement and Adoption of Outputs	GI Mapping
AlpES 2015 - 2018	Alpine ecosystem services (ES) concept	AT, DE, FR, IT, LI, SI	Reports, booklet, film, wikiAlps	Development of one-day training sessions for decision makers, workshop, and e-learning platform	ES map (WebGIS) (not available)
ALPBIONET 2030 2016 - 2019	Ecological connectivity and wildlife management	AT, CH, DE, FR, IT, SI	Policy recommendation, handbook, Alpatlas (spatial analysis), wildlife management report, conflict management toolkit	Workshops	Strategic Alpine Connectivity Areas (SACA) map
LOS DAMA! 2016 - 2019	Green and open spaces in peri-urban landscapes (practice-oriented)	AT, DE, FR, IT, SI	Compendium, alpine city network, toolbox, public synthesis report, policy recommendations	Dialogues, field trips, workshops, conferences, expositions, autumn school, ...	Different thematic maps on GI developed in workshops for pilot regions



<p>LUIGI</p> <p>2019 - 2022</p>	<p>Link between mountain ecosystems and urban centres; benefits deriving from GI</p>	<p>AT, CH, DE, FR, IT, SI</p>	<p>State of the art and guidelines, ES stock exchange model, education and training, knowledge transfer</p>	<p>Modules for participatory GI maintenance implemented in the pilot regions, 'Massive Open Online Course', workshops, survey on GI- related educational landscape</p>	<p>Ecological connectivity, ES-based multifunctionality, GI networks (building on SACA from ALPBIONET 2030)</p>
<p>OpenSpace-Alps</p> <p>2019 - 2022</p>	<p>Improving local and regional planning processes for open spaces</p>	<p>AT, DE, FR, IT, SI</p>	<p>Report, planning handbook, strategic recommendations, video, story map</p>	<p>Establishment of 'AlpPlanNetwork' (transnational cooperation), AlpPlan workshop</p>	<p>Interactive web map</p>

4.3 National or local projects on GI

Austria

[Care4GREEN](#) – Participatory maintenance of green infrastructure

The negative effects of climate change are increasingly being countered by the use of GI. They are seen as efficient measures to counteract urban heat. Good, high-quality open spaces must be closely maintained and developed. The usual maintenance intervals of contracted external companies are usually not sufficient. In practice, there are frequent breakdowns and the green spaces are not maintained in the long term. The desired cooling effects do not occur, and biodiversity is greatly reduced. A promising approach can be the participatory involvement of committed residents in the maintenance and management of green spaces (inner courtyards, green facades, green roofs etc.). For property management companies, legal uncertainties and the complexity of liability, risk, and warranty still represent high barriers to the involvement of private users; attractive incentive models are also lacking. Care4GREEN is developing solutions for this and for the first time is creating an interface between property developers, property management companies and residents to optimise the maintenance process of GI by involving users in and providing incentives for active green space maintenance. Legal certainty for property management companies and apartment owners and residents will be created and the necessary model contracts will be developed. The goal is to enable house communities in municipal and private housing to green their open spaces (high-quality and sustainable), to expand the green stock and to become actively and permanently involved in the care of the green spaces. On the



basis of two to three case studies, interested residents are to be involved in the maintenance of GI through innovative co-creation methods and workshops. Suitable incentives (monetary/non-monetary incentives) and care concepts will be developed and tested in the show cases (SmartCitiesInitiative, 2022).

BlueGreenCities: Blue-Green Infrastructure for Improving Resilience to Floods and Droughts in Alpine Cities

The BlueGreenCities project investigates the consequences of uncertain water variability and the resulting impact on adaptation measures such as blue-green infrastructures to improve the resilience of our cities under future climate change scenarios. The aim is to optimise climate change adaptation measures, including nature-based and technical solutions, to improve both the water and energy balance, increase evaporative cooling through water availability, reduce runoff peaks and thus reduce the risk of heat and flooding in cities (Kleidorfer et al., 2022).

GREeNvaluation: Real-time monitoring and performance evaluation

The aim of the project was to develop the GREeNvaluation toolkit to pave the way for the realisation of green and liveable cities. By visualising and balancing (costs/benefits) the benefits of GI, the benefits become more tangible and easier to understand. The GREeNvaluation toolkit is intended to create awareness far beyond the target areas by means of target group-specific communication formats (M. Kogler et al., 2023).

Association Austrian Nature Parks – On the surface, ready, go!

The "Ready, steady, go!" initiative focuses on small public and private areas, such as school gardens, roadsides, field margins and riverbanks. With the help of various structural improvements, these can become an attractive habitat for many insects. Training videos and information material have been compiled based on the experience gained in pilot regions. These are intended to help other nature parks and municipalities to protect insects with very simple measures. Creating small habitats for insects is often very simple and does not require extensive maintenance. You can find detailed instructions and tips for creating small areas in our manual (VNÖ, 2023).

Stepping stone biotopes Nature Conservation Association Burgenland

The NGO Naturschutzbund Burgenland looks after 120 areas which are special because of their high species diversity. They include different biotope types like dry grass areas, wetlands and forests protected by the FFH Directive. To protect the biodiversity of these habitat types a new project was created to develop management plans for every individual area. One protects what one values! We want to create awareness in local communities by organising excursions with different emphases - like botany, entomology, herpetology or ornithology – to show nature's diversity. The Citizen Science platform „naturbeobachtung.at“ of Naturschutzbund Austria helps beginners to identify all sorts of species. Hands on mentality! Together in a network of motivated and interested people we take actions to maintain the habitats sustainably. The main target of



the project is to raise the awareness of special areas and species diversity and to protect them. We want to generate a regional green network in collaboration with other organisations and the government (Michalek, 2021).

Nature in the garden

"Nature in the Garden" is a movement supported by the province of Lower Austria that promotes the "ecologisation" of gardens and green spaces in Lower Austria and beyond its borders. The movement's core criteria stipulate that gardens and green spaces should be designed and maintained without pesticides, synthetic chemical fertilisers or peat. Great importance is attached to biological diversity and design with native and ecologically valuable plants (Movement "Nature in the garden", 1999).

Regionale Gehölzvermehrung

For over 20 years, the members of the Regional Grove Propagation Association have been collecting native wild shrubs, extracting high-quality seed from the fruit and growing vital young plants. Together with collectors, partner tree nurseries, experts and project partners, over 5 million native wild shrubs have already been propagated and replanted in their regions of origin through campaigns such as the Hedge Day (RGV, 2020).

Unser Dorf- wunderbar naturnah

As part of the "Burgenland BeeFit" project, municipalities are committed to preserving biodiversity and promoting habitats in their municipalities, as the importance of public green spaces as important micro-ecosystems and habitats for insects and small mammals is constantly increasing! Green spaces in municipalities - if they are designed in a natural and diverse way - will become important retreats for animals and plants, valuable habitats and food sources for many important insects such as wild bees and butterflies. With the certification as a "wonderful nature-oriented municipality", the municipality undertakes on the one hand to refrain from the use of harmful substances on municipal land and on the other hand to take various measures to actively promote biodiversity in the local area (Verein UNSER DORF, 2022).

ÖGREEN: Das Österreichische Grüne Infrastruktur Netzwerk

ÖGREEN brings together the leading associations in Austria's green sector and, as an umbrella organisation, is the leading platform for information, development, technology, services and awards relating to the green sector. ÖGREEN's aim is to make "green infrastructure" mainstream in Austria and to revitalise the entire sector. This objective is pursued through the provision of specialised information and competent services, targeted lobbying work with politicians and the public sector, as well as partnerships with private investors (first movers). Ultimately, of course, private individuals should also benefit from the new green mainstream (ÖGREEN, 2017).



Alpen Karpaten corridor

Cross-border spatial planning and habitat management measures in the Alps-Carpathians passage aimed at creating and preserving a coherent 120-km wide ecological corridor from the Alps to the Carpathians. The mountain ranges of the Alps and the Carpathians, which straddle the border of Austria and Slovakia, are the largest sources of biodiversity in Central Europe. The Alps-Carpathians Corridor between these mountains has historically been a major migration route for wildlife crossing the Danube and has been disrupted by economic development. The project brought together various institutions, NGOs, universities, as well as highway companies and regional and federal authorities from Austria and Slovakia to create a common cross-border platform facilitating the migration and genetic exchange of wild animal populations. The project also aimed to increase the recreational attractiveness of the region and improve the environmental awareness of the population (EEA, 2020).

Italy (only regions part of the Alpine Space programme)

Rete Ecologica Regionale Plan, Lombardy

Lombardy Region manages GI measures for ecological connectivity and the creation of ecosystems that ensure continuity between the Alps and the Po Valley (Pianura Padana) and the urban environments in the area, which is ensured by the *Plan Rete Ecologica Regionale* (regional ecological network plan). The Lombardy Region manages a funding scheme for “GI for ecological connectivity and ecosystem enhancement” (Regulation D.d.u.o. 22 Dicembre 2016 - n. 13767). Individuals and legal entities - public or private - can apply for funding. Eligible measures include the creation of green spaces, focusing mainly on the development of forest ecosystems, soil restoration or conversion. Funding for the acquisition of land is reserved for public bodies (municipalities, parks, regional reserves). In the period of 2007-2013, the Lombardy region invested a total of EUR 61.2 million, around half of which (EUR 28 million) came from EU funds (Life+, European Agricultural Fund for Rural Development, European Regional Development Fund) and the rest (EUR 31.6 million) from regional funds (Gusti & Masperi, n.d.). Two examples of implementation can be found in Gorla Maggiore and the city of Milan:

- **[Gorla Maggiore water park](#): Constructed wetlands as a multipurpose Green Infrastructure**

The aim of the project was to test the feasibility of GI instead of traditional grey infrastructure for the treatment of wastewater overflows and to investigate the multiple benefits of GI and its importance for water management. The first example of this kind of GI in Italy was the Gorla Maggiore water park that was inaugurated in March 2013. The implemented GI consisted of a set of constructed wetlands surrounded by a park on the banks of the Olona River in an area previously used for poplar plantations. They found that with similar costs GI provided additional benefits like wildlife support and recreation while performing equal or better than the grey alternative (Liquete et al., 2016).



Corona Verde (Green Crown) of Turin

Corona Verde is a project implemented in the urban area and hilly surroundings of Turin including 93 municipalities by the Piemonte Region and the “Politecnico di Torino” University. It is focused at creating a GI that integrates the *Corona di Delitie* (Crown of Delights), a system of royal residences from the 16th and 17th centuries spread across the city of Turin, with the city's green belt encompassing urban parks, rivers and rural areas. The project covers an area of 164,883 hectares, including 1,865 hectares of special protection areas and about EUR 13 million were invested by various parties, including the European Union. *Corona Verde* aims to bring numerous social, environmental and economic benefits to the greater Turin area in a cost-effective way for the city and its population. Examples are the protection against soil erosion, reduction of the negative impact of grey infrastructure projects, promotion of tourism and, above all, reduction of pollution, as Italian cities are among the most polluted in Europe (EEA, 2023).

Blühende Städte (Blossoming Cities) Project in Bruneck-Brunico, South Tyrol

The *Blühende Städte* project is about increasing biodiversity in the municipality of Bruneck-Brunico through targeted strategies and measures in green space design and maintenance. The focus was on supporting urban greenery and trees for climate-friendly urban development, as a habitat for a variety of living creatures and as a decisive factor for the quality of life of residents. Therefore, several stakeholders and interest groups were involved in the project development. In addition, work was carried out to raise awareness and public relations for the topic of biodiversity. The project ran from 2020 to 2022 in the municipalities of Bruneck-Brunico and Lienz and was funded by the Interreg CLLD Dolomiti Live program (Kuttig, 2019).

En-Route City Lab in Trento

In the past years the city of Trento has been part of several projects on GI co-funded by the European Union. In particular, the city was involved in an Alpine Space project on GI in peri-urban areas (LOS_DAMA!) and started activities to create the new urban plan. Furthermore, university researchers had contributed to the MAES (Mapping and Assessment of Ecosystems and their Services) Urban Pilot and were involved in the ESMEALDA (Enhancing ecoSystem sERVICES mApping for poLicy and Decision mAKing) project on the mapping and assessment of ecosystem services. Most recently the EnRoute (Enhancing Resilience of urban ecosystems through GI) project of the European Commission in the framework of the EU Biodiversity Strategy and the Green Infrastructure Strategy was running in Trento until 2019. The EnRoute City Lab, which involved both researchers and city officials, has therefore benefited from several other initiatives since its creation. Key results of the project were presented in maps of the current green and blue infrastructure of the city, Ecosystem Service hotspots, the cooling effect produced by GI, and the city's Recreation Opportunity Spectrum. It was shown how the analysis of the supply of ecosystem services can be combined with the analysis of demand in order to compare planning options and develop innovative approaches for urban planning and green space management (Cortinovic, n.d.).



Slovenia

Green Ljubljana

Ljubljana, the capital of Slovenia, has been actively promoting GI within the city through its "Green Capital" initiative. The project includes the development of green roofs, green walls, urban parks, and green spaces in the city to improve air quality, reduce the urban heat island effect, and enhance the overall urban environment.

VrH Julijcev: The “Improving the status of species and habitat types in Triglav National Park - VrH Julijcev”

VrH Julijcev is a partnership between nature conservation, traditional agriculture and forestry, mountaineering and tourism with a common objective: to preserve nature in Triglav National Park. The implemented conservation measures of nine project partners are improving or preserving the conservation status of endangered wild animal and plant species and their habitats by reducing harmful impacts of human activities.

LIFE NATURAVIVA: Biodiversity – Art of Life

Biodiversity in Slovenia and its promotion was the central topic of the project. The main goal was to increase awareness about biodiversity (including GI) among different target groups of the public and to emphasise the need for its conservation through information, communication and education. The most important target groups were children, pupils and students, farmers, urban and rural inhabitants, inhabitants of and visitors to nature-protected areas.

EIP KROTA: Improving the nature conservation effects of agricultural production systems in Slovenia (Rural Development Programme 2014–2020)

The project is aimed to establish or improve the conservation status of grassland habitat types and breeding and feeding conditions for selected species of amphibians, reptiles, butterflies and small mammals that live in or otherwise depend on the agricultural landscape. Special attention is given to practical approaches in agriculture that are not only mutually beneficial, but also locally specific, to get best results at establishing better conditions for biodiversity. Some of these practices include creating ponds or other smaller bodies of water, rockeries, grassland belts around fields and hedgerows, areas without the use of phytopharmaceuticals, as well as restoration of grassland habitats.

EIP SOOS: Fruit Growers for pollinators and pollinators for fruit growers (Rural Development Programme 2014–2020)

Project aim was to establish better conditions for pollinators in orchards, as well as educating farmers, especially fruitgrowers, of the importance of wild pollinators and what positive effects they could have on their farming. Within the project there was developed a special type of wild bee nesting box and practical protocol, that allows for cleaning the nests in between the seasons, without harming the wild bees. In total, 24 of such nesting sites were built at locations of six fruit



growing partners. Additionally, grassland and honey plant surfaces were established on the same locations, and educational training was organised on themes about creating better conditions for biodiversity in orchards.

EIP POMOP: Supporting pollinators in intensive agricultural landscapes to promote biodiversity

The project contributes to solutions and practices that will improve conditions for biodiversity, especially pollinators, in the agricultural landscape, by using cover crops and ground nesting sites for wild bees.



Figure 4: Pollinator Paradise: Flourishing flowering patches in urban Green Infrastructure become vital habitats for pollinators.

5. Final Remarks

The current state of local GI implementation in the Alps reflects a commitment to sustainable development, with Austria, Italy, and Slovenia actively embracing innovative practices. However, amidst this progress, significant challenges persist, demanding thoughtful consideration and strategic solutions.

The implementation of GI, like urban forests, urban parks, and green roofs, marked by initiatives indicates a collective understanding of the need to balance development with environmental preservation. These efforts underscore a shared commitment to creating resilient, eco-friendly communities within the unique Alpine landscape.

Challenges such as the encroachment of urbanisation and the escalating impacts of climate change cast a shadow on these advancements. Striking a harmonious balance between development imperatives and the delicate Alpine ecosystem remains a complex undertaking. Urban planning must navigate these challenges while ensuring the long-term viability and ecological health of the region.

The European Union has developed important documents and strategies, including the Natura 2000 Network, EU Biodiversity Strategy for 2030, European Green Deal, Nature Restoration Plan, EU Strategy for the Alpine Region, and EU Green Infrastructure Strategy, to address GI in Europe.

While none of the three countries involved in FRACAL has a specific national GI strategy, GI is addressed in several related local, regional and national strategies and plans. Austria integrates GI principles into its Biodiversity Strategy Austria 2030+, focusing on the preservation of biological diversity in all habitats in Austria. In Italy, various national regulations acknowledge GI, but the lack of a comprehensive national legislation on spatial planning and urban development hinders the development of a common approach. However, Law 10/2013, the main national law on urban green spaces, lead to the definition of the National Strategy for Urban Green Spaces, the “Strategia nazionale per la biodiversità al 2030” requires Italian cities to develop an urban greening plan integrating nature-based solutions, and regional initiatives like the Regional Ecological Network (REN) integrate GI into spatial planning. Slovenia incorporates GI into broader environmental and sustainability strategies dealing with biodiversity, forest management, water resources and urban planning, with local strategies also taking GI into account.

In Austria, Italy and Slovenia, various innovative projects and initiatives at local scale contribute to the development of GI, jointly addressing climate change and the improvement of urban well-being. They emphasise the importance of transnational cooperation, the preservation of natural landscapes and the development of tools and strategies to improve GI in urban and peri-urban areas. Several international projects illustrate the efforts and successes of cooperation in this regard. Transnational collaborations offer avenues for shared learning and coordinated action. Recognizing that environmental issues transcend national borders, these collaborative efforts are crucial for addressing challenges that require a unified approach.



As the Alps progress toward a greener future, continuous innovation, adaptive strategies, and a holistic understanding of the interconnectedness of social, economic, and environmental factors will be paramount. The challenges ahead serve as catalysts for refining and expanding the implementation of GI, ensuring that the Alpine region remains a good example of sustainable development in the face of evolving global pressures.



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