Interreg

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Alpine Space

PlanToConnect

Technical proposal(s) for implementing GBI connectivity networks in spatial plans and sector instruments

Alpine space

Reference in AF: D2.5.1 including outcomes of D2.2.1, D2.2.2, D2.3.1, D2.4.1

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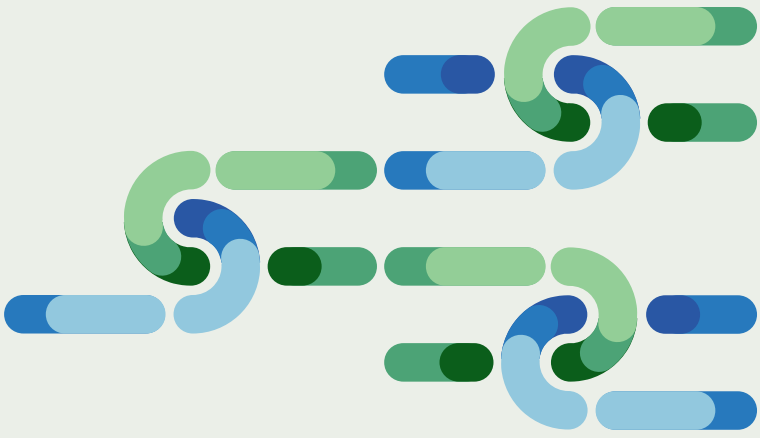

This project is co-funded by the European Union through the Interreg Alpine Space programme.

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Alpine Space

PlanToConnect

Activity 2.5 - Case studies 4th step: Draft a technical proposal integrating the project for a GBI connectivity network into planning tools/sector plans in pilot areas.

D.2.5.1 - Technical proposal for implementing GBI connectivity networks in spatial plans of pilot sites – Alpine space

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Chambéry, 2025

This project is co-funded by the European Union through the Interreg Alpine Space programme.

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Glossary

“Connectivity” (structural and functional)

“*Connectivity comprises two components, structural and functional connectivity. It expresses how landscapes are configurated, allowing species to move. Structural connectivity, equal to habitat continuity, is measured by analysing landscape structure, independent of any attributes of organisms. […]. Functional connectivity is the response of the organism to the landscape elements other than its habitats (i.e. the non-habitat matrix). This definition is often used in the context of landscape ecology. A high degree of connectivity is generally linked to low fragmentation*.” (EUROPEAN COMMISSION - Technical information on Green Infrastructure (GI), 6.5.2013, Glossary)

(Definition of connectivity see also Deliverable 1.1.1, chapter 8)

“GBI – Green and blue infrastructure”

“*Green infrastructure (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings*.” (EUROPEAN COMMISSION - Green Infrastructure (GI) — Enhancing Europe’s Natural Capital, 6.5.2013)

(Definition of connectivity see also Deliverable 1.1.1, chapter 6)

“Ecological corridor”

Landscape component “A linear strip of vegetation that provides a continuous (or near continuous) pathway between two habitats” (Bennett, 2003)

“Landscape fragmentation”

Landscape fragmentation is the result of transforming large habitat patches into smaller, more isolated fragments of habitat… Despite many improvements in legislation to better protect biodiversity, reduce pollution, and improve water quality, urban sprawl is still increasing and the construction of new transport infrastructure is continuing at a rapid pace. As a consequence, fragmentation of landscapes is rising and the remaining ecological network provides less and less connectivity. (European Environment Agency, 2019)

“Ecological Conservation Areas (SACA1)”

According to the ALPBIONET2030 project definition the SACA1 are areas, where ecological connectivity works quite well, that still have considerable space for connectivity with non-fragmented surfaces and where connectivity should be conserved”.

“Ecological intervention areas (SACA2)”

The ALPBIONET2030 project defines the SACA2 as areas that represent important links between SACA1 areas (ecological conservation areas). Connectivity is currently working to some extent but would benefit from enhancements.

Connectivity restoration areas (SACA3)

The ALPBIONET2030 project defines the SACA3 as areas that represent important barriers between SACA1 areas (ecological conservation areas).

Potential Planning Areas for Biodiversity Protection

According to the Alpine Parks 2030 project, these areas are a spatial planning proposal of protected areas, distributed in nine categories combining the criteria of low fragmentation, low spatial development, and a high level of ecologically favourable areas creating the framework, along with the identification of already existing areas with strong protection. This facilitates the determination of further potentials of protected areas within the Alpine space

Executive summary

This report examines ecological connectivity in the Alpine space case study area. It outlines the main pressures affecting connectivity, proposes measures to address them, and reviews the governance structures needed for implementation. The analysis also assesses the current state of connectivity and provides recommendations based on challenges and opportunities identified during the previous stages of analysis of the case study.

The report is distributed in four chapters, the first chapter describes the case study area, the main objectives pursued with the analysis. The second chapter then identifies key pressures and threats to ecological connectivity, including urban expansion, infrastructure development and agricultural changes. These threats are illustrated through maps of fragmentation and main barriers to the development of ecological connectivity identification process.

The report discusses connectivity measures to address these challenges. An overview of the current governance structure in charge on GBI implementation is illustrated, and some recommendations with a focus on cooperation between stakeholders at local, national, and transboundary levels to ensure implementation are described.

Finally, the report reviews the current state of ecological connectivity in the case study area, examining the role of protected areas and cooperation efforts. The report ends with recommendations addressed to improve the integration of ecological connectivity in spatial planning across the Alpine space.

REPORT

1 GBI network project

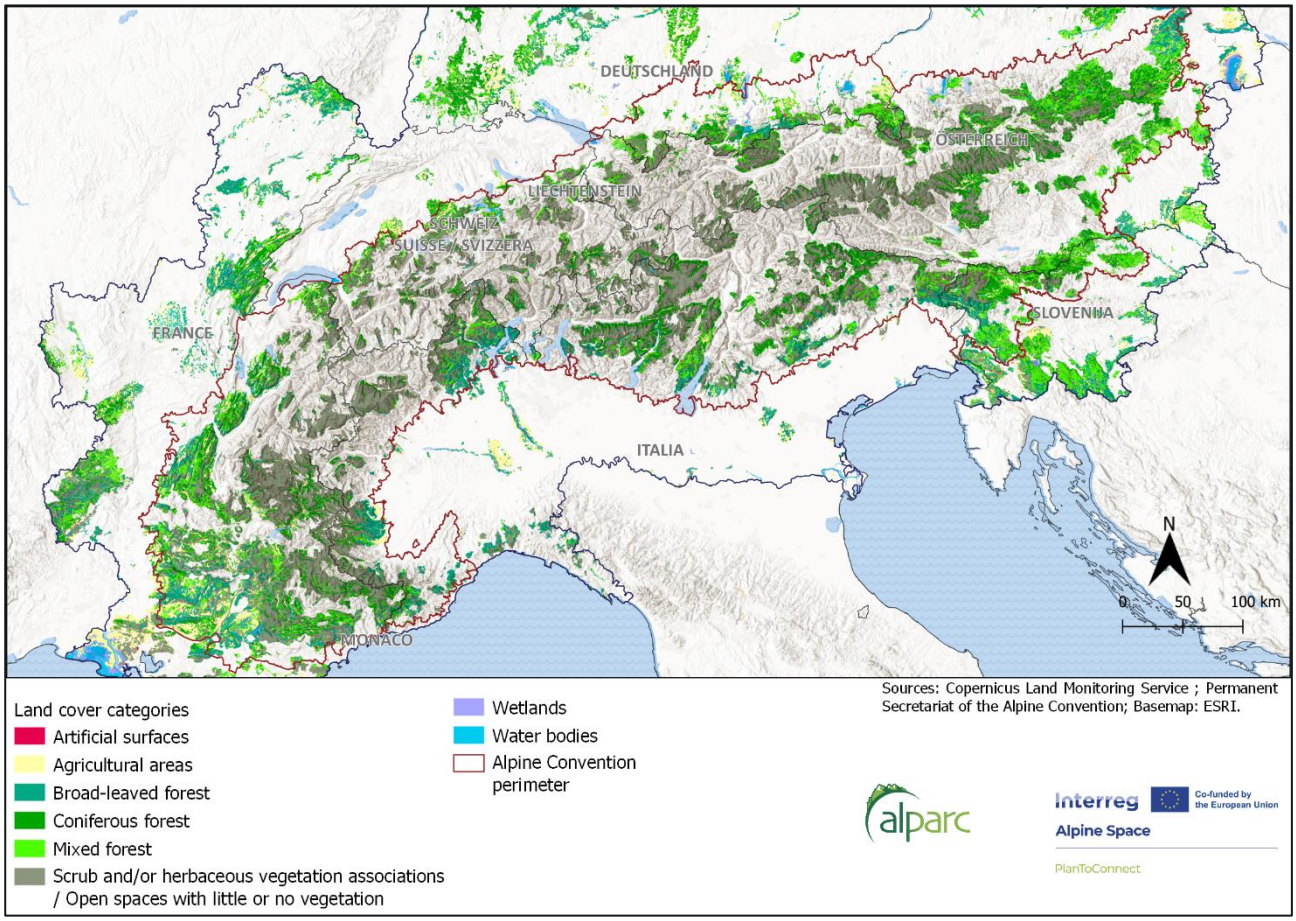
1.1 Alpine space

The Alpine Convention perimeter and the interface with the EUSALP area, constitute an area where multiple land uses are coexisting and sometimes colliding, the progression of different developments is affecting ecological connectivity, and the goal of our analysis is to identify the major barriers and threats to ecological connectivity by focussing on areas with a key value for biodiversity conservation within the Alps.

The selection of the areas is based on different criteria selected by ALPARC in order to elaborate a spatial planning proposal that allows to enhance ecological connectivity among landscapes with high relevance for biodiversity conservation considering the 30% goal. The geographical scope of the case study of ALPARC includes then the potential planning areas, these are described as effectively conserved, ecologically representative, and well-connected areas.

The priority areas integrate both protected and not protected areas, as the biodiversity protection goals wan not be fulfilled depending only on the current network of protected areas and further efforts should be made to connect and remove obstacles impeding the species movement within the Alps.

The analysis focuses on spatial planning areas for biodiversity protection, these are described as effectively conserved, ecologically representative, and well-connected areas. These areas cover around 3.828 municipalities and a surface of 72.048 km^2 inside the Alpine Convention perimeter.



Map 1 Potential Planning Areas for Biodiversity Protection - Alpine space case study

2 Pressures and Threats to connectivity conservation and restoration areas

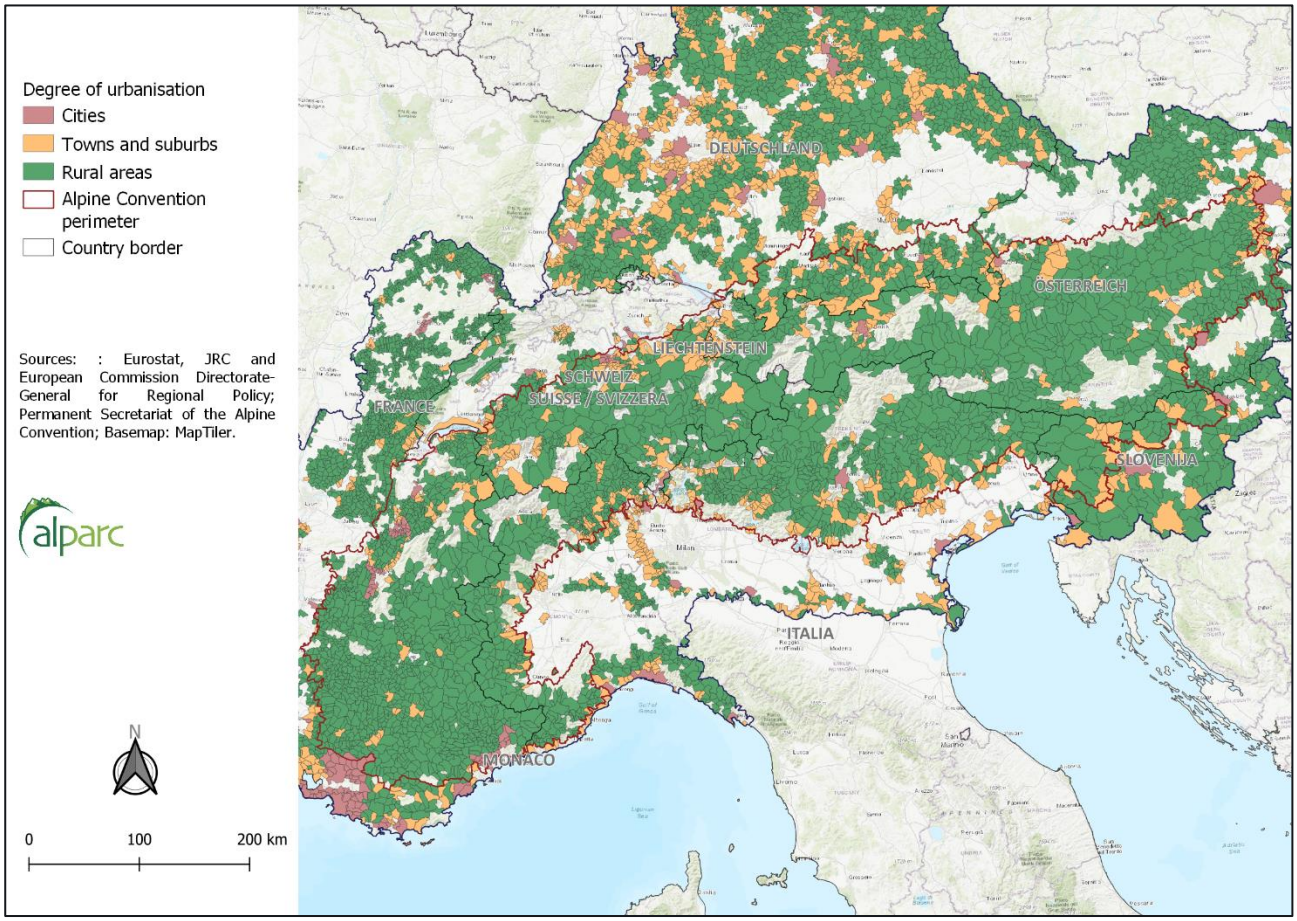
2.1 Main pressures

Alpine biodiversity is threatened by different factors, urban sprawl, land-use changes, infrastructure development, agricultural intensification and other anthropogenic driven factors having major implications on landscape fragmentation and creating obstacles for species movement.

Urbanisation in the Alpine space is mainly characterised by the development of human settlements and major infrastructure in the valleys which complexifies and intensifies the land use conflicts in areas that connect the Alps with the surrounding areas and also increases fragmentation inside the region. (Perrin, Bertrand, & Kohler, 2019)

This fragmentation is evidenced trough different indicators, the degree of fragmentation showed on the following map has three categories of urbanisation, it *"combines the population size and the population density thresholds".* (EUROSTAT, 2018) This indicator allows to have a quick overview of the development of urban infrastructures inside the Alpine space, the map only includes municipalities that overlay with the Spatial Areas for Spatial Development.

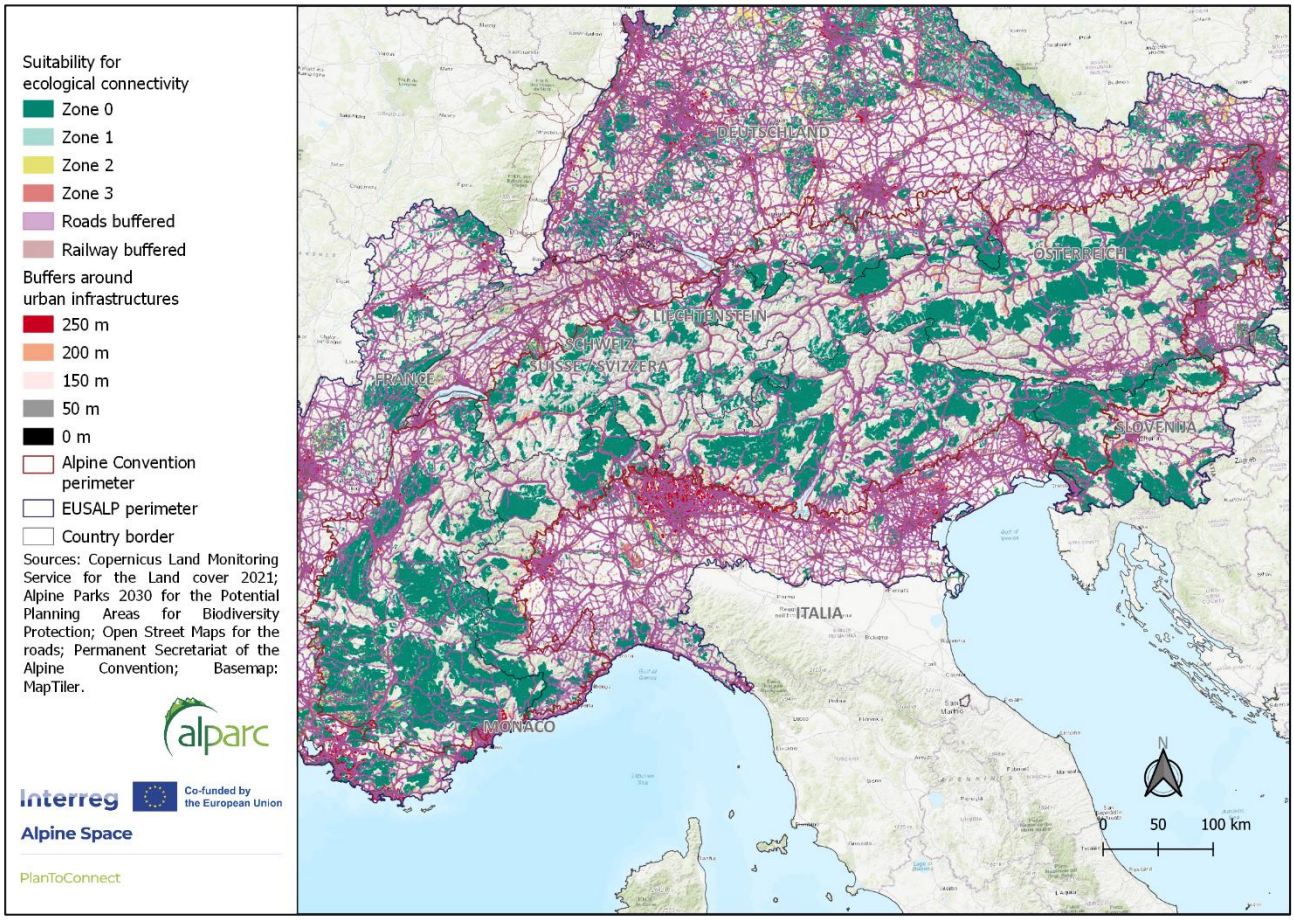
The first signs of fragmentation can be seen mainly around the Alpine Convention perimeter where most of the large cities are located. Another particularity that can be observed on the map is the link between the degree of urbanisation and transboundary areas; this aspect is quite important as most of the areas identified on the case study are also transboundary which explains the importance of international cooperation for the preservation of the Alpine ecological network.



Map 2 Degree of urbanisation Alpine space

Human settlements are often associated with habitat fragmentation, one of the main threats for biodiversity preservation. The negative effects such as reduction of habitat area and quality, species isolation and other disturbances associated with artificialisation, can be addressed by implementing measures to maintain and restore connectivity. (Tabor, et al., 2019)

The following map allows us to visualize both urban infrastructures and population density, the more densely populated municipalities are, the wider will be the buffer zone built around the selection of infrastructure, this procedure is made in order to illustrate the pressure of urban sprawl and how this increases with the variations on population growth.



Map 3 Urban pressure Alpine Convention perimeter

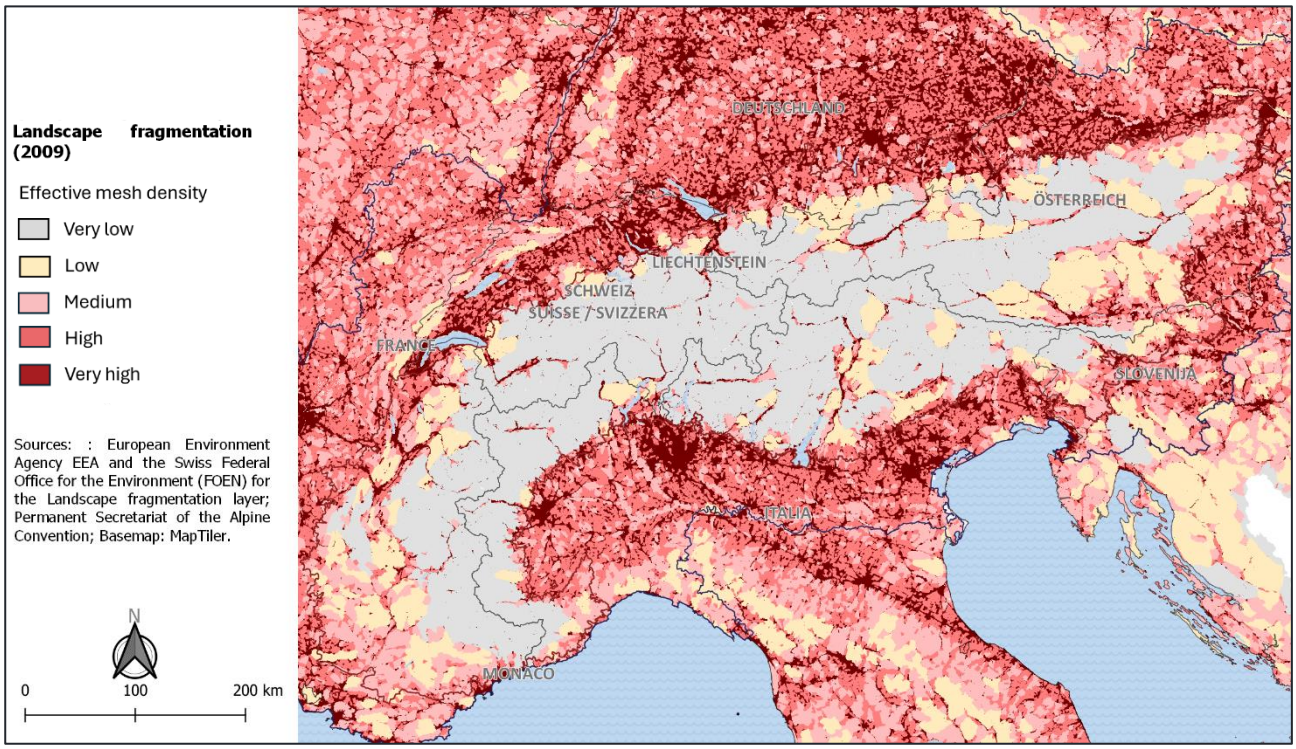
The urban infrastructures selected for the analysis include settlements, zones of economic development and the road infrastructure available on the Landcover dataset, further analysis regarding road and railway infrastructure will be included on the next section.

Buffers with different sizes are built around the infrastructure selection, this allows to identify in an early stage, the areas that may be threatened by the presence of these infrastructures. As evidenced on the map, there are areas with a biodiversity value that are more concerned by this phenomenon.

Landscape fragmentation within the Alps is closely linked to the development of road infrastructures connecting built-up areas. The indicator of landscape fragmentation developed by the European environment agency in 2009 includes different variables representing barriers, the aim of this analysis is to identify the remaining non disturbed patches in the landscape and their extent.

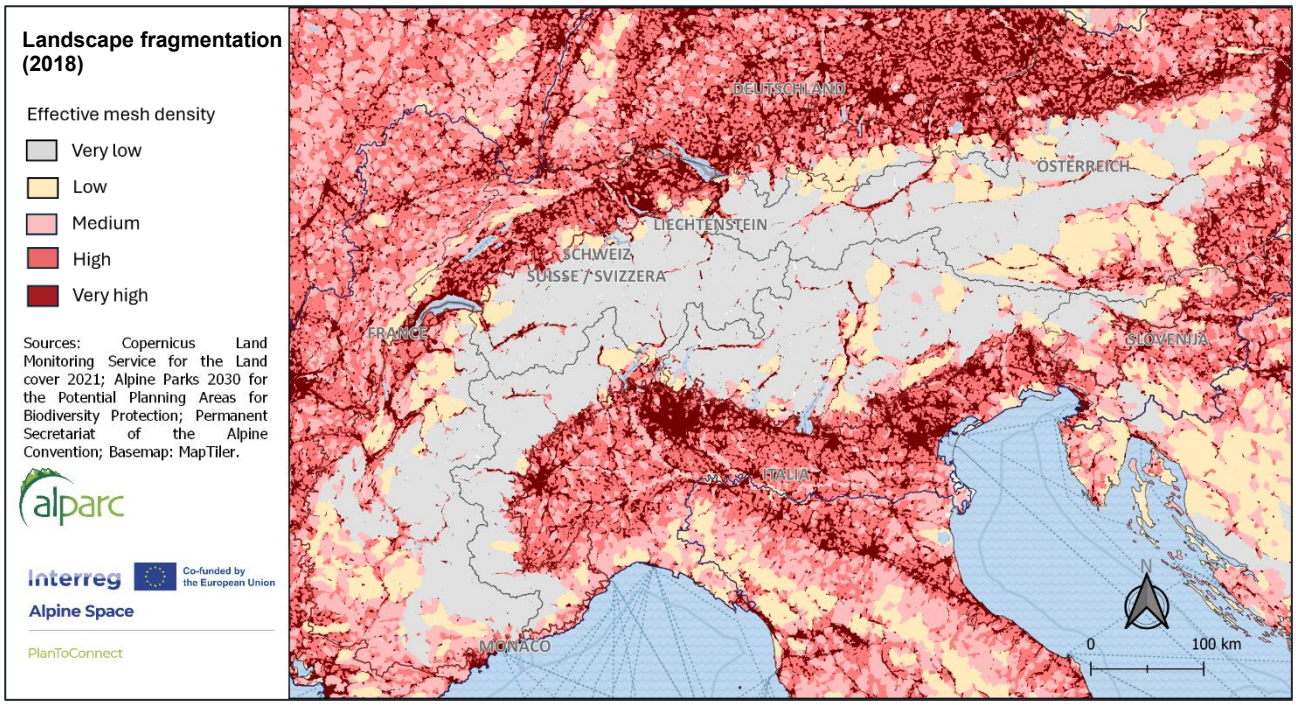
The approach includes both natural and man-made barriers: the roads and built-up areas as sources of anthropogenic fragmentation, while lakes and major rivers were considered

as barriers. The result is a rough overview of the situation of landscape fragmentation in the Alps.



Source: European Environment Agency – Landscape fragmentation indicator 2009

Map 4 Landscape fragmentation Effective Mesh Density 2009



Source: European Environment Agency – Landscape fragmentation indicator 2018

Map 5 Landscape fragmentation Effective Mesh Density 2018

The map of Landscape fragmentation from 2018 shows a slight variation in fragmentation levels. Some already consolidated large urban areas, presenting higher fragmentation in the 2009 map, have expanded to cover a larger surface area. Additionally, the major road barriers identified in parts of the inner Alpine arc remain consistent across both timeframes, this category represent significant obstacles to ecological connectivity and fit with the barriers identified between the Spatial planning areas for biodiversity protection.

2.2 Threats to connectivity conservation and restoration areas

In addition to the pressures reviewed previously, the development of renewable energy sources (particularly solar and wind power) is expanding within the Alpine space. Historically, hydropower has been a dominant renewable energy source across the Alps. The mapping analyses show the existing efforts to accelerate renewable energy production. Although these developments are concentrated in specific locations, and some of them depend on participatory processes, it is essential to establish continuous monitoring systems to track their evolution and assess their impacts on the landscape and ecological connectivity.

The European countries have set different goals for 2030 and 2050 for the development of renewable energy, decarbonization and energy independence. As illustrated in the table

below, each Alpine country starts from a different baseline and have also different potentials for renewable energy development.

Table 1 Share of energy from renewable sources in gross final energy consumption

	2015[1]	2020	Target 2030[2]
Austria	33,49%	36,5%	57%
France	14,8%	19,1%	33%[3]
Germany	14.9%	19,1%	38,1%
Italy	17,5%	20,3%	39,4%
Slovenia	22,79%	25%	33%
Switzerland[4]	2 830,5 GWh (without hydropower)	4 710,2 GWh (without hydropower)	17 000 GWh (Without hydropower - 2035) [5]

The energy and climate strategies proposed by each country include measures to improve efficiency and accelerate the development of renewable energy. These efforts are translated into economic incentives, identification of areas for new developments and the exploration of potential alternatives to deploy renewable energy infrastructure on a larger scale across different landscapes, including mountain areas and, consequently, the Alps.

Currently, hydropower and windpower are the main renewable energy power sources in Europe. For some Alpine countries, hydropower has nearly reached its main potential and windpower presents some major technical challenges for a large-scale implementation.

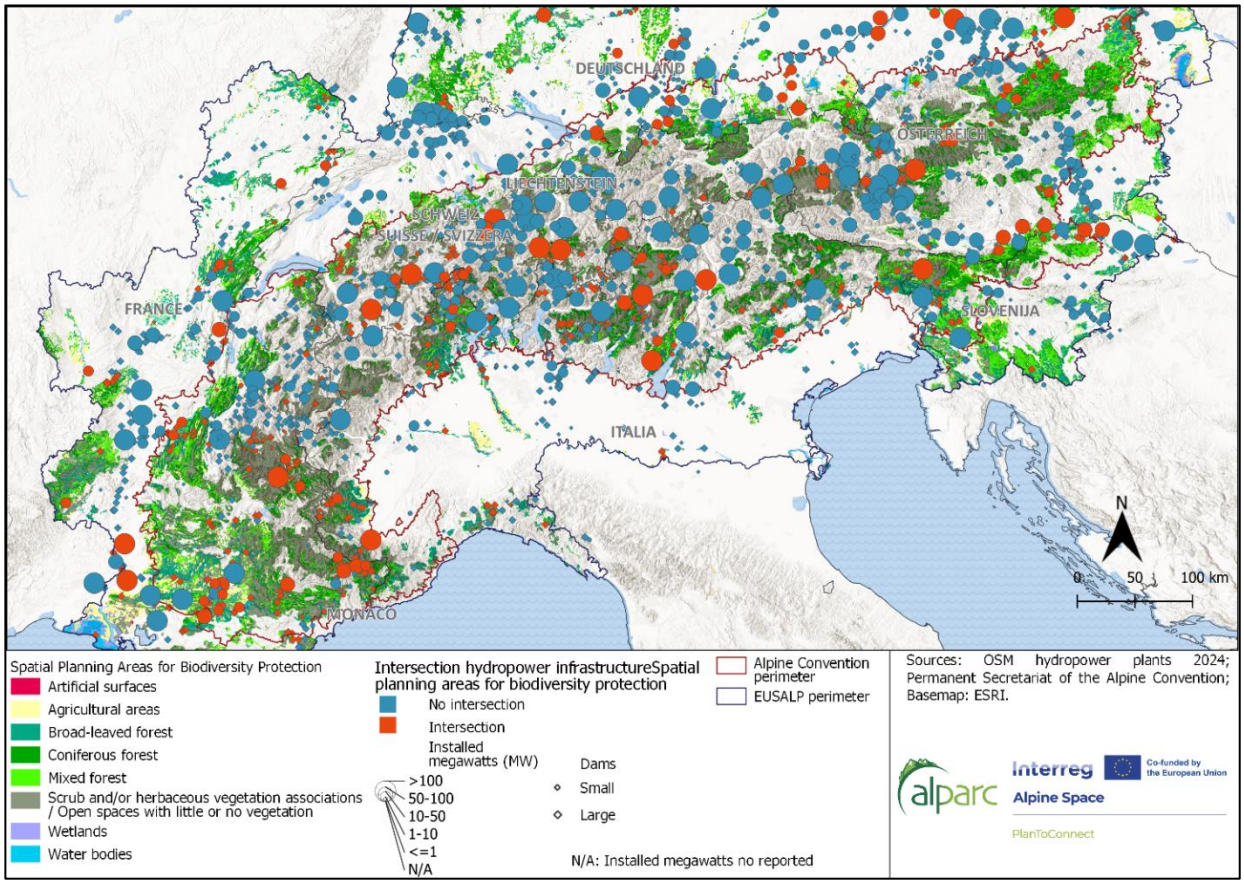
[1] Data from 2015 obtained from the progress report “Towards renewable Alps” (Permanent Secretariat of the Alpine Convention, 2017)

[2] National Energy and Climate plans 2021-2030 - (National energy and climate plans 2021 - 2030 - Austria, Germany, France, Italy and Slovenia)

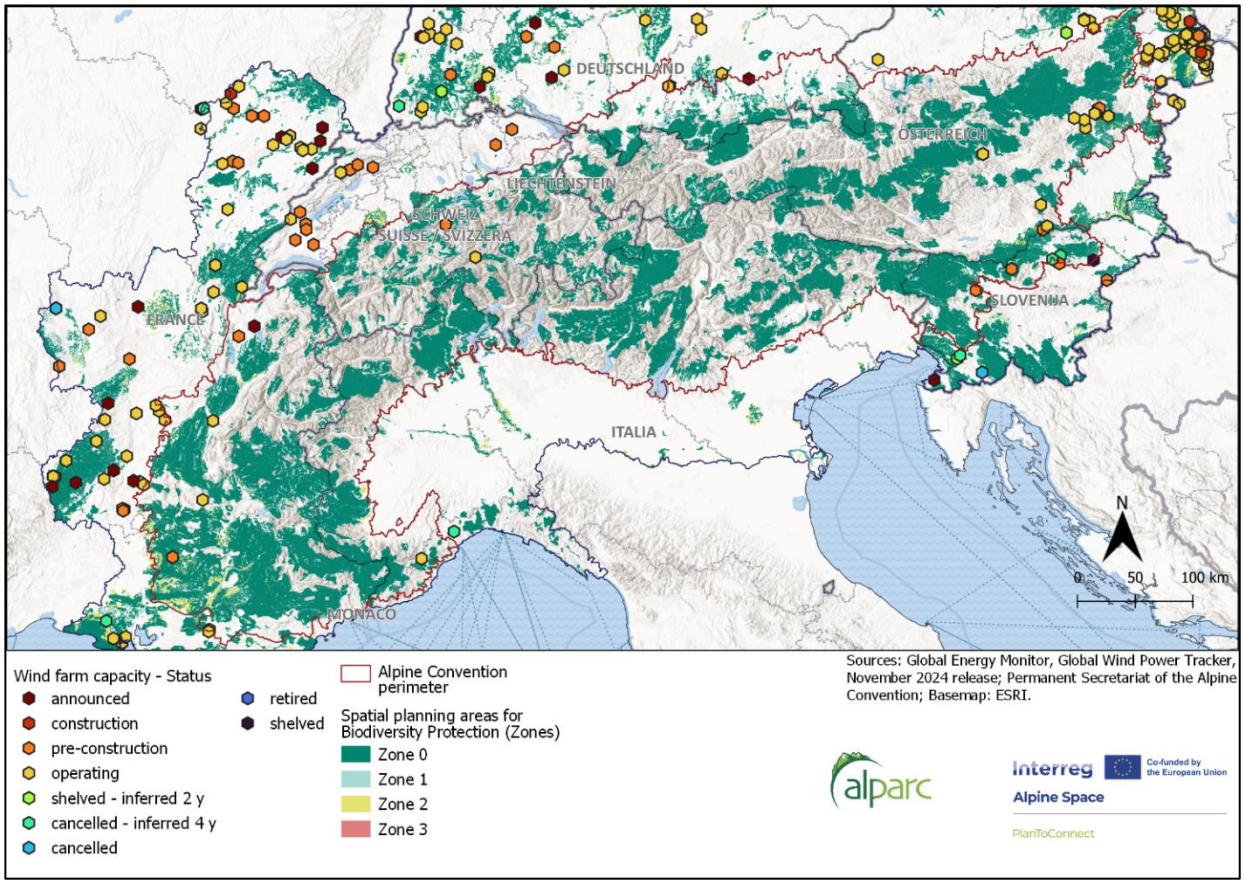
[3] Renewable energies 2030 target France (Ministère de la Transition écologique, de la Biodiversité, de la Forêt, de la Mer et de la Pêche, 2025)

[4] Swiss Renewable Energy Statistic – 1990 – 2023 (Office fédéral de l'énergie OFEN, 2023)

[5] Swiss Renewable Energy Statistic - (Office fédéral de l'énergie OFEN, 2023)



Map 6 Hydropower installations within the Alps



Map 7 Wind power installations within the Alps

Solar power, however, has one of the biggest increases among the renewable sources in the different Alpine countries.

The Alps are an attractive territory for the development of solar plants, as mountain areas benefit from a higher solar irradiance and the current technology developments allow to better capture the solar radiation reflected by snow. There are different types of landscapes that are being targeted and also different types of installations and extensions, for solar energy projects.

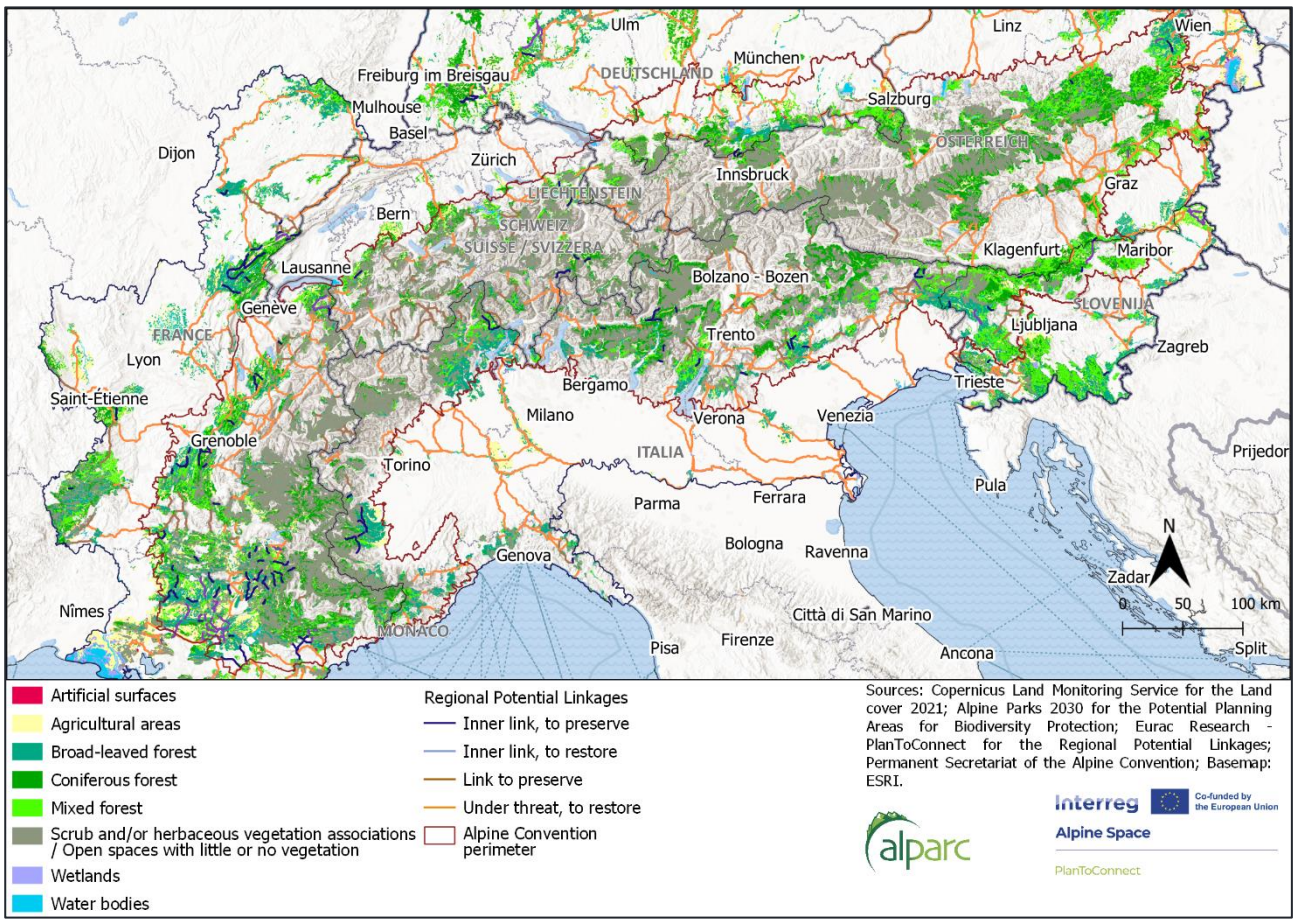
About the possible land use conflicts following the development of solar energy projects. Some of the identified projects in the analysis are in proximity to ski and agricultural areas setting favourable conditions in terms of new development work. Solar energy projects located on already artificialised areas, allow to preserve untouched natural landscapes from new developments and to prevent land use conflicts.

The type of solar installation can vary depending on the location and the project's production goals. Most of the current solar projects within the Alps are either ground-based or installed on dam walls. The first option corresponds to large-scale solar panel systems which involves the modification of a considerable amount of land but a larger production potential. The

second option, the wall-mounted projects, cover a smaller and already in use areas and offer a lower production potential. (Đukan, Gut, Gumber, & Steffen, 2024)

3 Connectivity measures and governance settings

3.1 Connectivity measures / action plan



Map 8 Ecological network Spatial Planning Areas for Biodiversity Protection

The following general measures are recommended in order to fulfil the ecological connectivity objectives inside the Alpine space:

- Protection of Spatial Planning Areas, finding mechanisms to ensure the protection of these landscapes should prioritise the areas integrating Zone 0 and Zone 1.
- Implementation of restauration measures for areas located on Zone 2 and Zone 3.
- Implementation of the potential links to integrate core zones and stepping stones into the ecological connectivity network.

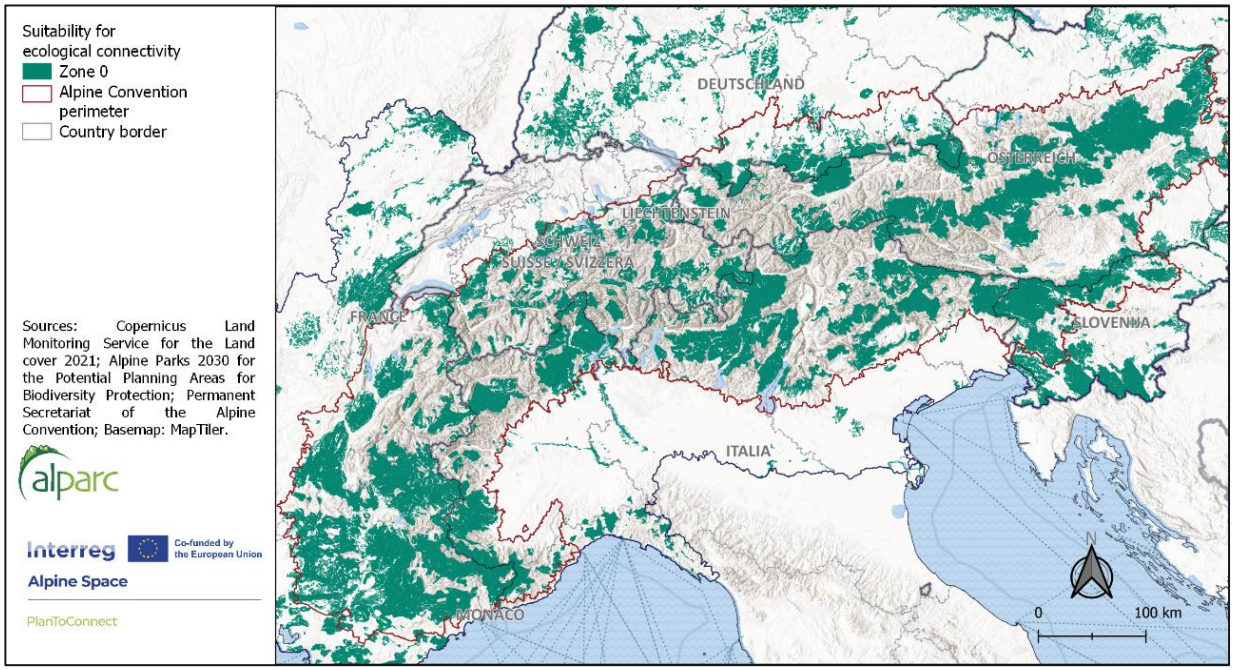
The zonation system is a tool that allows to communicate possible actions to implement in areas that are important to achieve the 30x30 goal within the Alps, these surfaces have an important biodiversity value from a perspective of functional connectivity and the integration of land cover data helps to establish how importance for biodiversity is aligned with current developments.

The zoning proposal in the current analysis, is presented by 4 categories of suitability for ecological connectivity. The suitability for the zone 0 will be higher than the category with more challenges to overcome in order to preserve or restore ecological connectivity, zone 4. The distribution by zones allow to differentiate the territorial challenges for the implementation of a coherent network of key areas for nature conservation and environmental protection.

Zones 0 and 1 cover around 95% of the Spatial planning areas for biodiversity protection, these are less modified landscapes, forests, open spaces, scrub and/or herbaceous vegetations associations. These areas have a considerable potential for ecological connectivity, as they represent continuous, large non-fragmented areas beyond the boundaries of the current protected areas.

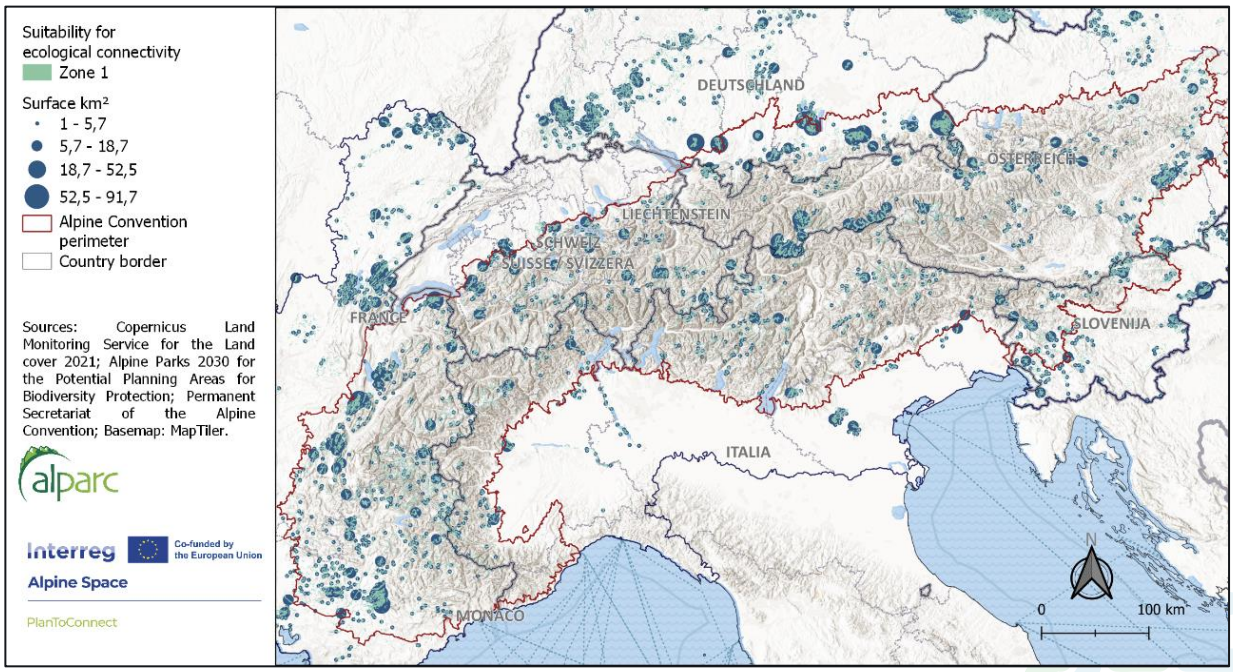
Zones 2 and 3 cover landscapes heavily influenced by anthropogenic transformations. Most of these areas are located in the southwestern part of the Alps, with the presence of intensive agricultural activities. The areas corresponding to these zones include also urban areas located near both natural and near-natural areas. This proximity highlights the importance of studying potential future changes and understanding how the landscape matrix may change over time, particularly if coherent and timely actions to tackle biodiversity loss are implemented.

The zone 0 corresponds to areas more suitable for biodiversity preservation and improvements on connectivity, this category will gather the areas with a high result in ecological favourability, located mostly in forest and semi-natural areas, some categories of the agricultural land are also included. The zone 0 is oriented towards preservation activities.



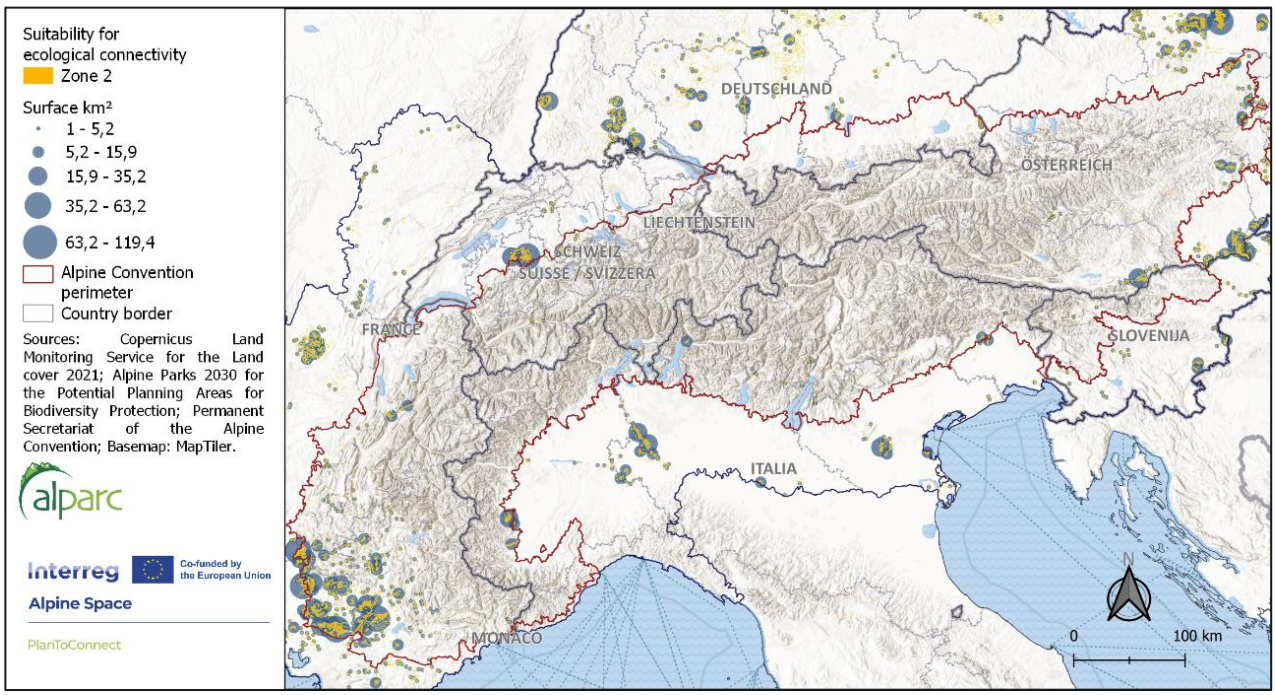
Map 9 Suitability for ecological connectivity - Zone 0

The zone 1 corresponds to areas suitable for biodiversity preservation and improvements on connectivity, this category will gather the areas with a high result in ecological favourability, located in semi-natural areas with low or no vegetation, agricultural land with a more important impact than the categories from the zone 0. The zone 1 is oriented towards preservation and restoration of spaces that might present an early stage of fragmentation.



Map 10 Suitability for ecological connectivity - Zone 1

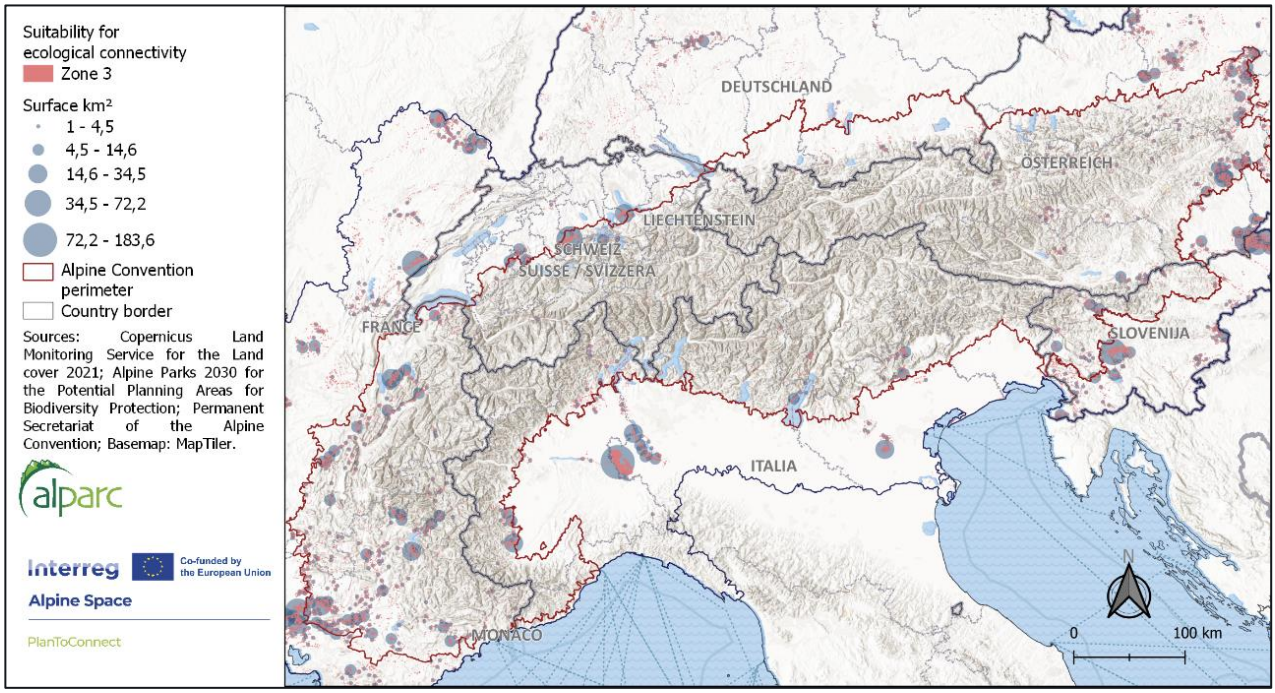
The zone 2 includes a selection of agricultural activities of a significant impact on landscape. Zone 2 is oriented towards adaptation/restoration and is the transition zone between the highly artificialised areas around the natural and semi-natural areas, implementation of actions towards improving ecological connectivity are more challenging as these landscapes are highly modified and are also under the pressure created by the proximity with Zone 3 areas.



Map 11 Suitability for ecological connectivity - Zone 2

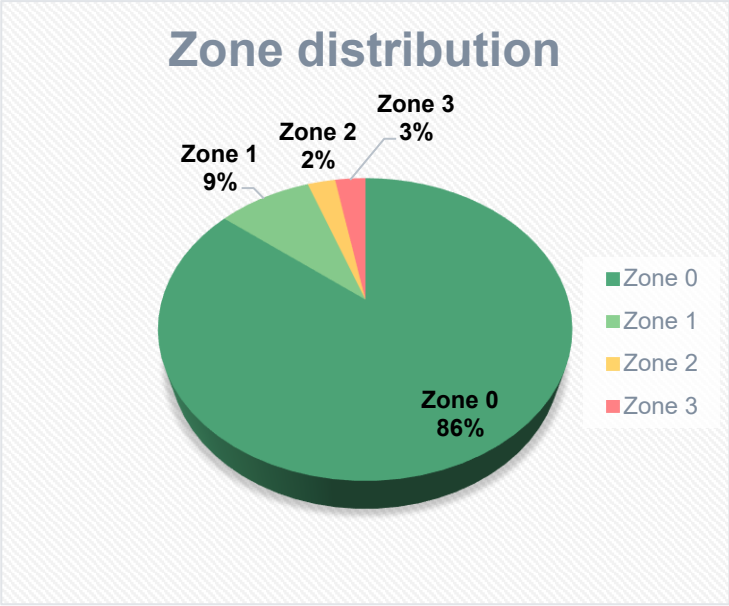
The zone 3 corresponds to more fragmented and artificialised areas, this category will mostly gather the areas with a result <75 in ecological favourability, located mostly in artificial land or with agricultural activities (eg. Rice fields, Complex cultivation patterns) not compatible with nature conservation.

Zone 3 is oriented towards restoration measures, these areas allow to identify the evolution of the threats such as urban sprawl and other infrastructure developments representing a threat for the other 3 zones.



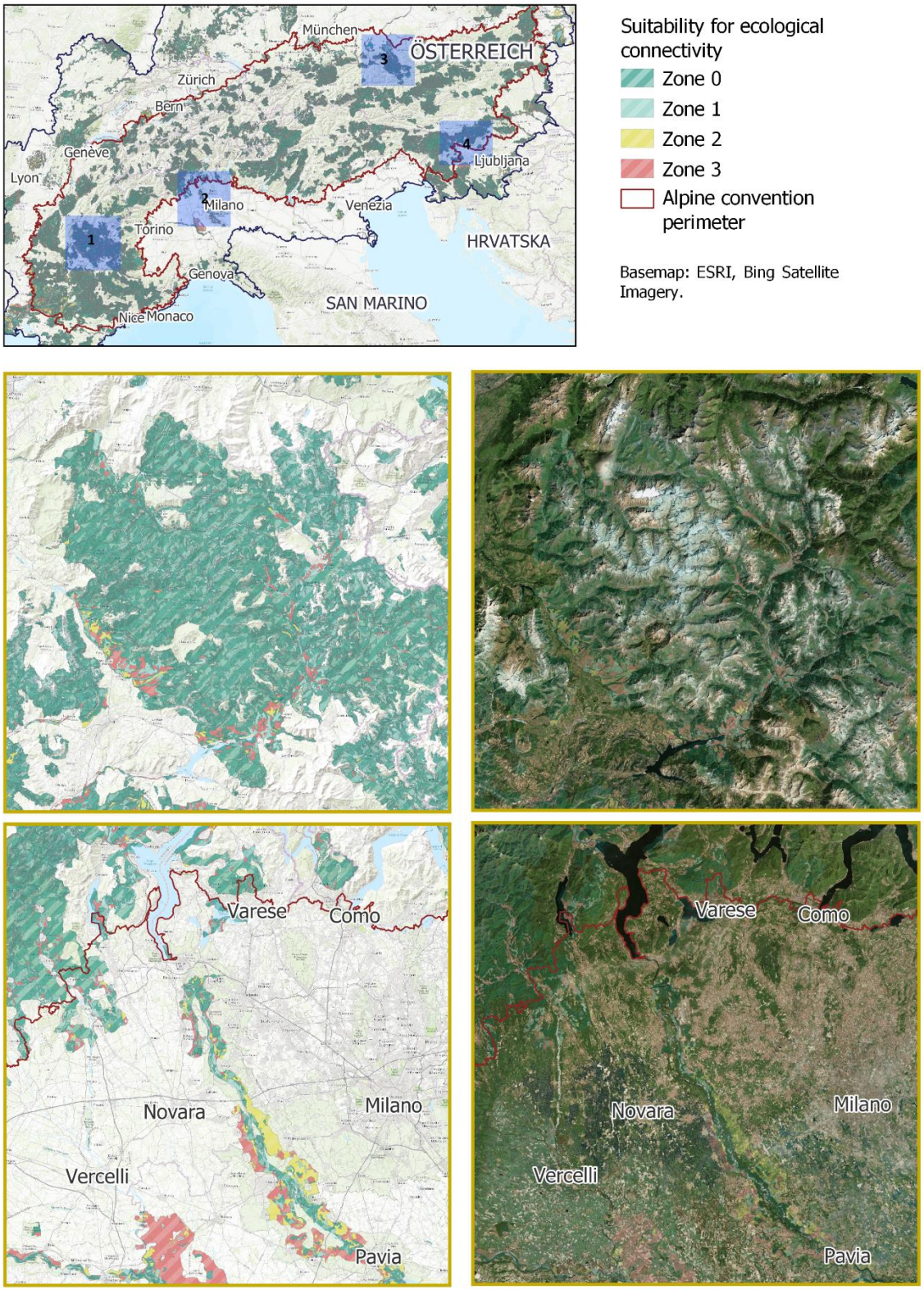
Map 12 Suitability for ecological connectivity - Zone 3

Figure 1 Zone distribution - Alpine Convention perimeter

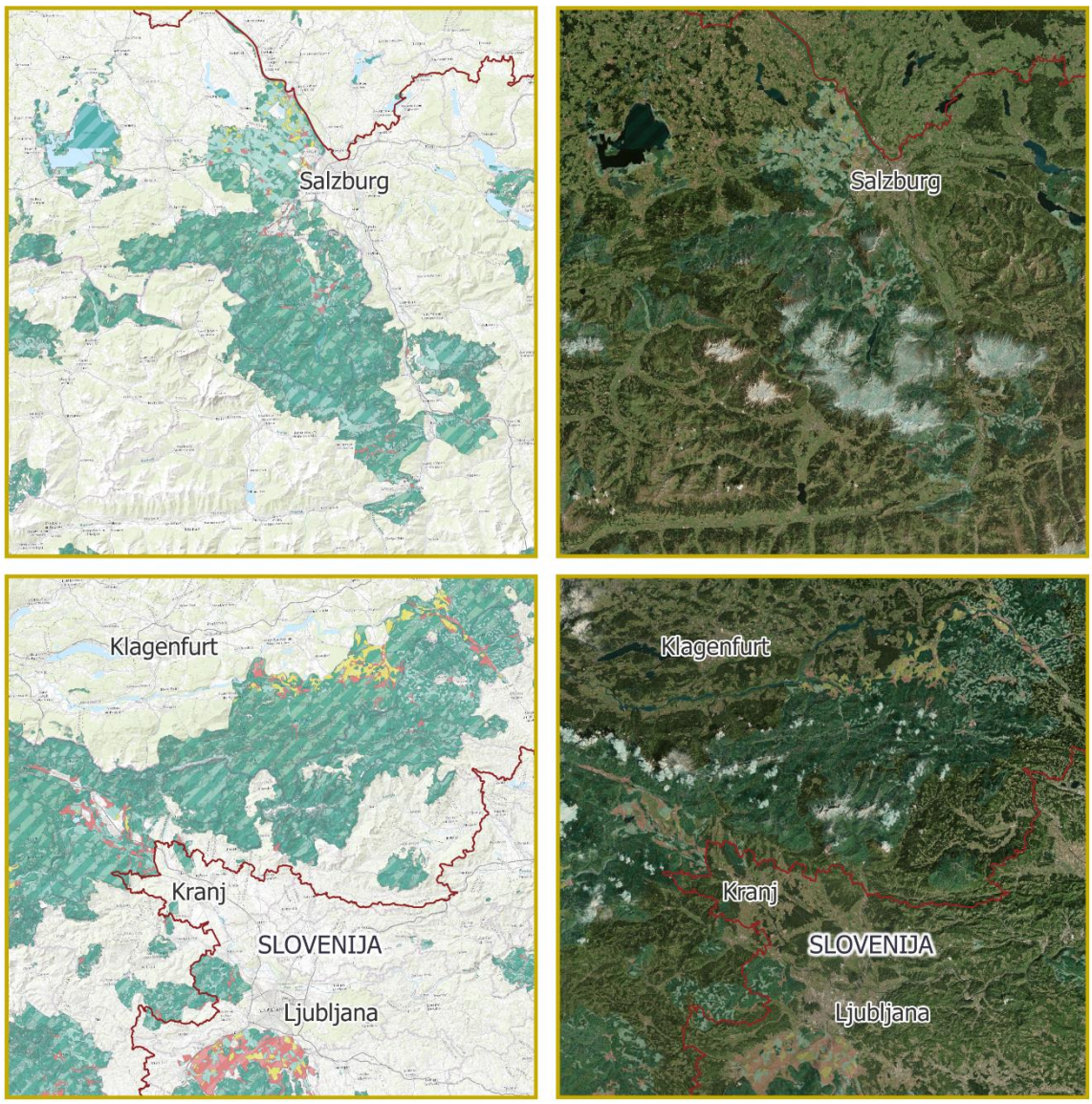


The values in Figure 2 illustrate the proportion of Potential Planning Areas for Biodiversity Protection across different zones within the Alpine Convention's protection perimeter, which collectively cover 37.7% of the protection perimeter.

Most of these areas enter into the criteria defined for the zone 0, as illustrated in map 13 the large extension of the zone 0 areas is at a first sight a positive sign for building large continuities.


München
ÖSTERREICH
Zürich
Bern
Genève
Lyon
Milano
Venezia
Torino
Ljubljana
HRVATSKA
Genova
SAN MARINO
Nice
Monaco
1
2
3
4
Suitability for ecological connectivity
Zone 0
Zone 1
Zone 2
Zone 3
Alpine convention perimeter
Basemap: ESRI, Bing Satellite Imagery.
Varese
Como
Novara
Milano
Vercelli
Pavia

However, the zonation allows also to follow the advancement of fragmentation within these areas in order to protect low modified landscapes (Zoom 1 – France), prevent further landscape modifications in highly artificialised areas (Zoom 2 - Italy), monitor the current and future land uses on patches including protected, no protected landscapes and highly artificialised areas (Zoom 3 – Austria/ Germany and Zoom 4 – Austria/Slovenia).



Restoring, protecting and preserving Spatial Planning Areas for Biodiversity Protection is one aspect of the strategy to guarantee ecological connectivity of natural areas of high ecological value in the Alps. Isolated patches are vulnerable to fragmentation, making it essential to analyse the possible synergies between the identified continuities. To create a

more comprehensive approach, the potential regional linkages were incorporated into the analysis.

Regarding the potential links, the following map shows the Spatial Planning Areas for Biodiversity Protection, categorised by zone, along with the potential corridors proposed on the analysis of the PlanToConnect project.

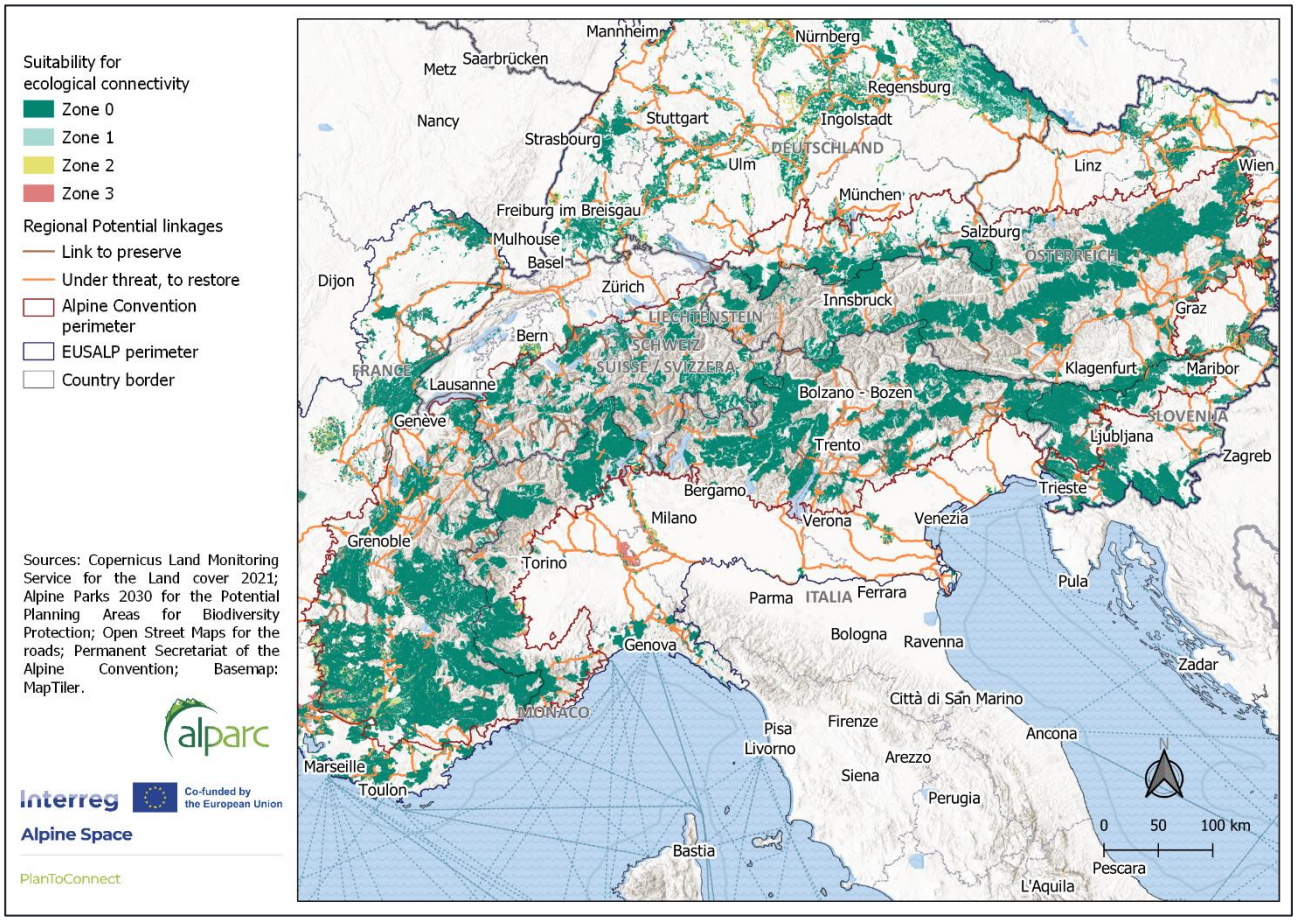
There are 461 potential corridors that overlap with the areas of the case study and are integrated into this analysis. The selection focused on those links that either allow to connect patches or are located within a patch, the links are differentiated accordingly to their potential to support interalpine connections or their relevance for the inner connectivity within the case study areas.

The presence of inner connexions is due to the potential linkage's goal to connect Ecological Conservation Areas (SACA1), these areas are in some cases located within the Spatial Planning Areas for Biodiversity Protection. It is important to remind that Ecological connectivity is one of the criteria integrated to identify these zones. This approach also allows to identify the challenges for ecological connectivity inside larger continuities beyond those identified with the Ecological Conservation Areas.

The surface covered by the Spatial Planning Areas for Biodiversity Protection extends to surfaces at different stages of development concerning ecological connectivity. Identifying internal connections is particularly important, as these links are typically located in near-natural areas with fewer land-use conflicts and often already support actions aimed at nature conservation.

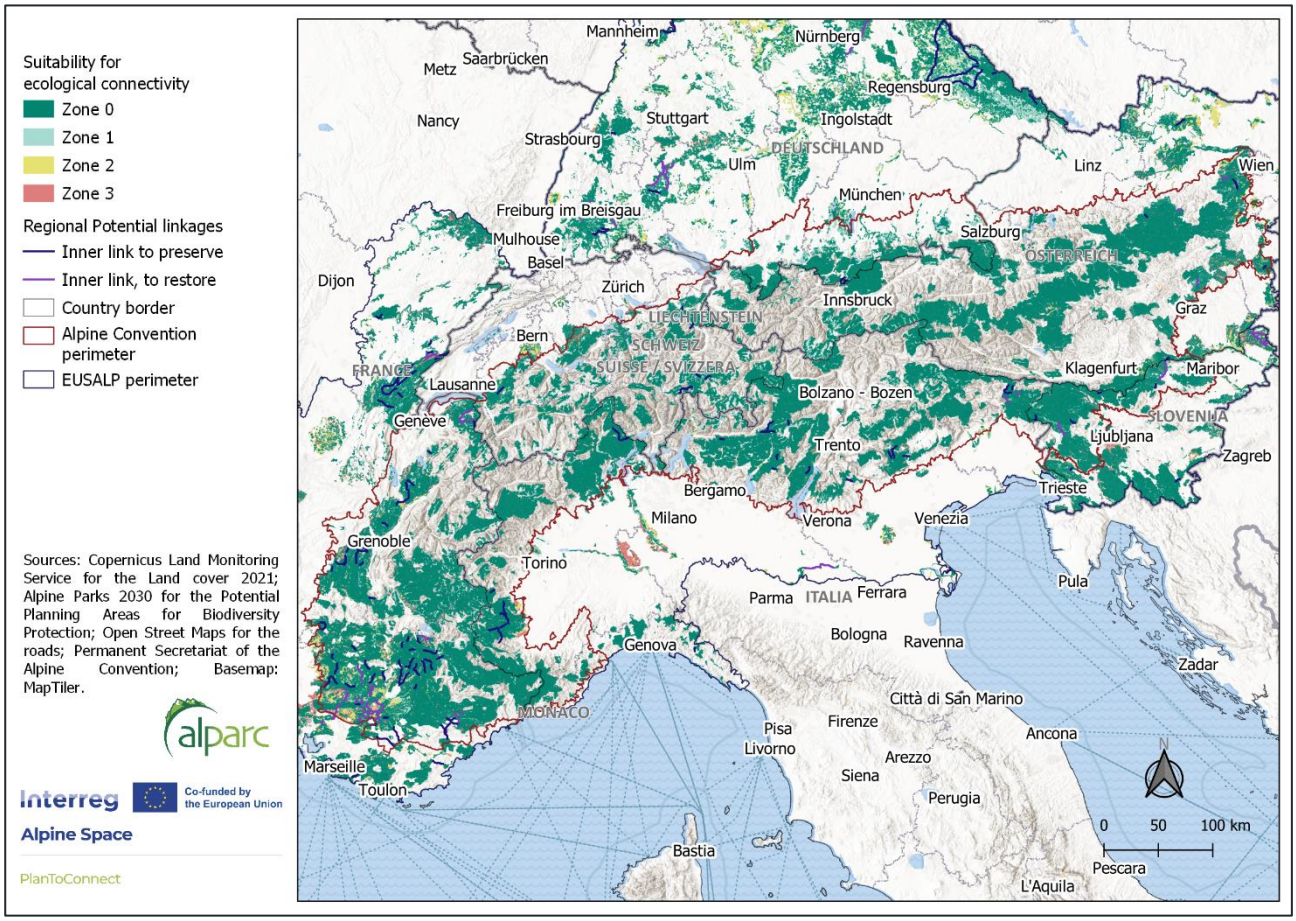
Within these areas, 334 links have been identified as connecting core habitat areas, while 127 are internal links. The identification of the first category, allows to prioritize actions towards preventing the isolation within the Alpine ecological network; Although, the core areas are not always under a protection designation, they are essential for the development of biological processes serving as key habitats within the Alps. Equally important are the corridors between them, as species movement is vital for maintaining biodiversity.

These linkages between core areas are distributed through the entire Alpine arc. However, safeguarding connectivity with other mountain areas as well as peripheral regions requires a broader, more integrated planning approach.



Map 13 Ecological connectivity network - Alpine space

Inner links represent the possible areas to implement improvement efforts to maintain the structure of core areas They also help address the vulnerability of certain core areas that are threatened by the proximity of land uses that are not always compatible with nature conservation.



Map 14 Inner connectivity measures - Alpine space

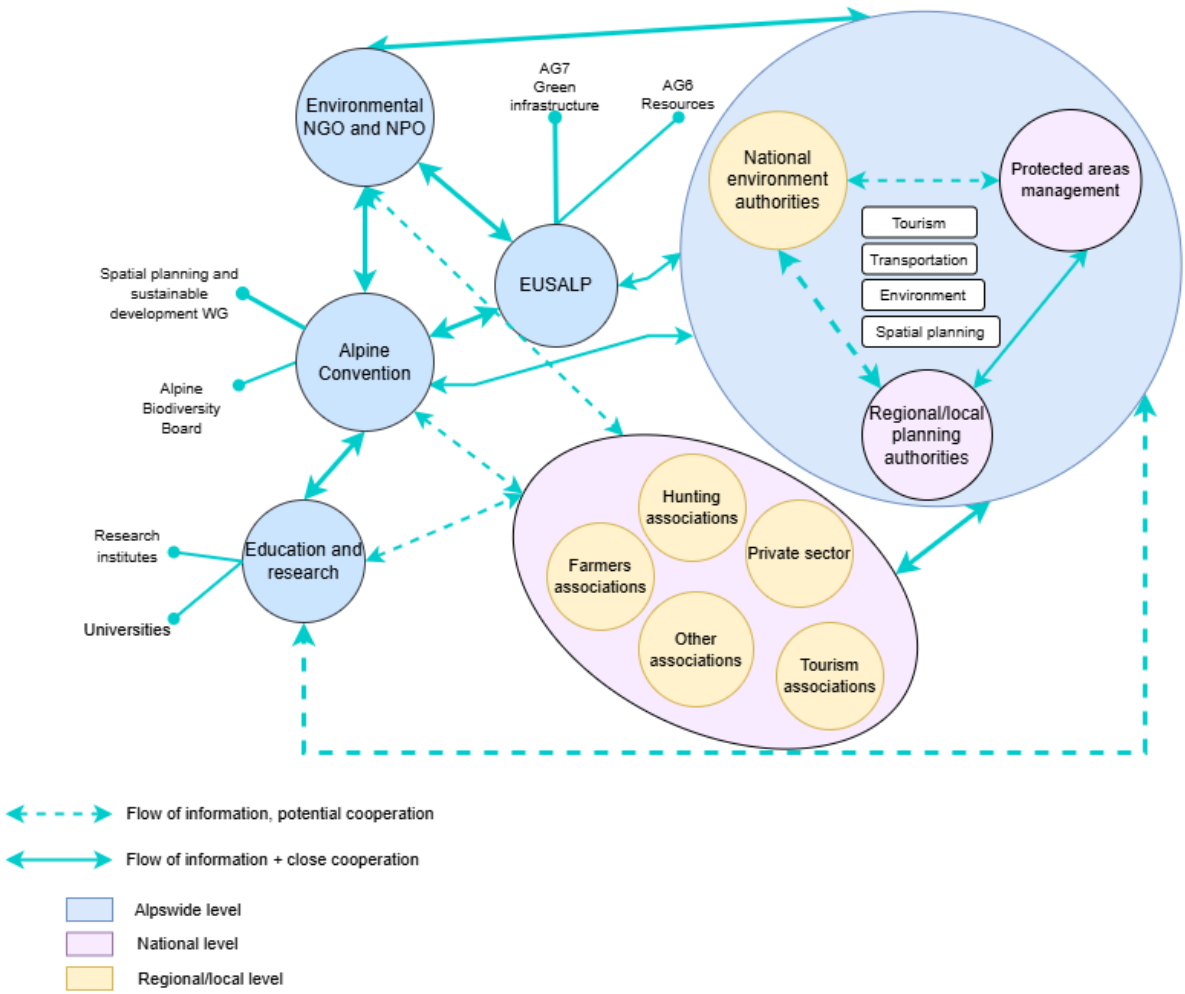
The recommendation of action is given accordingly to the current situation of the corridor taking into account the barriers identified into the analyses, if the link intersects with more than two barriers (urban areas, road or railway infrastructure) a restoration action will be proposed.

The development of a coherent transalpine ecological network requires multi-level and trans sectoral coordination for the implementation of measures in spatial planning. While protected areas are crucial as the core of the Alpine ecological network, the effective conservation of biodiversity across the region depends also on taking meaningful action beyond these areas.

3.2 Key Stakeholders

Many actors are involved in GBI implementation in spatial planning in the Alpine space across different territorial scales and sectors, depending on the nature of the activities developed by each stakeholder.

The diagram below illustrates the main stakeholders involved in the implementation of Green and Blue Infrastructure (GBI) and ecological connectivity within the Alps. The arrows indicate the strength and quality of cooperation between stakeholders, while dashed lines show areas where increased communication and collaboration are needed. The use of color distinguishes three levels of intervention: Alpine-wide, national, and regional/local. Given that the case study covers the entire Alpine space, it is coherent to include all these levels of governance and engagement.



At the Alpswide level, EUSALP and the Alpine Convention along their respective working groups address issues regarding cross-border cooperation on GBI, the development initiatives and guidance both at the macro-regional and Alpine level. Within these frameworks, the implementation of GBI and the creation of transnational ecological networks are recognized as important objectives. The close cooperation between EUSALP and the Alpine Convention facilitates the conceptual alignment of approaches; however, challenges remain in harmonizing implementation across the different Alpine countries.

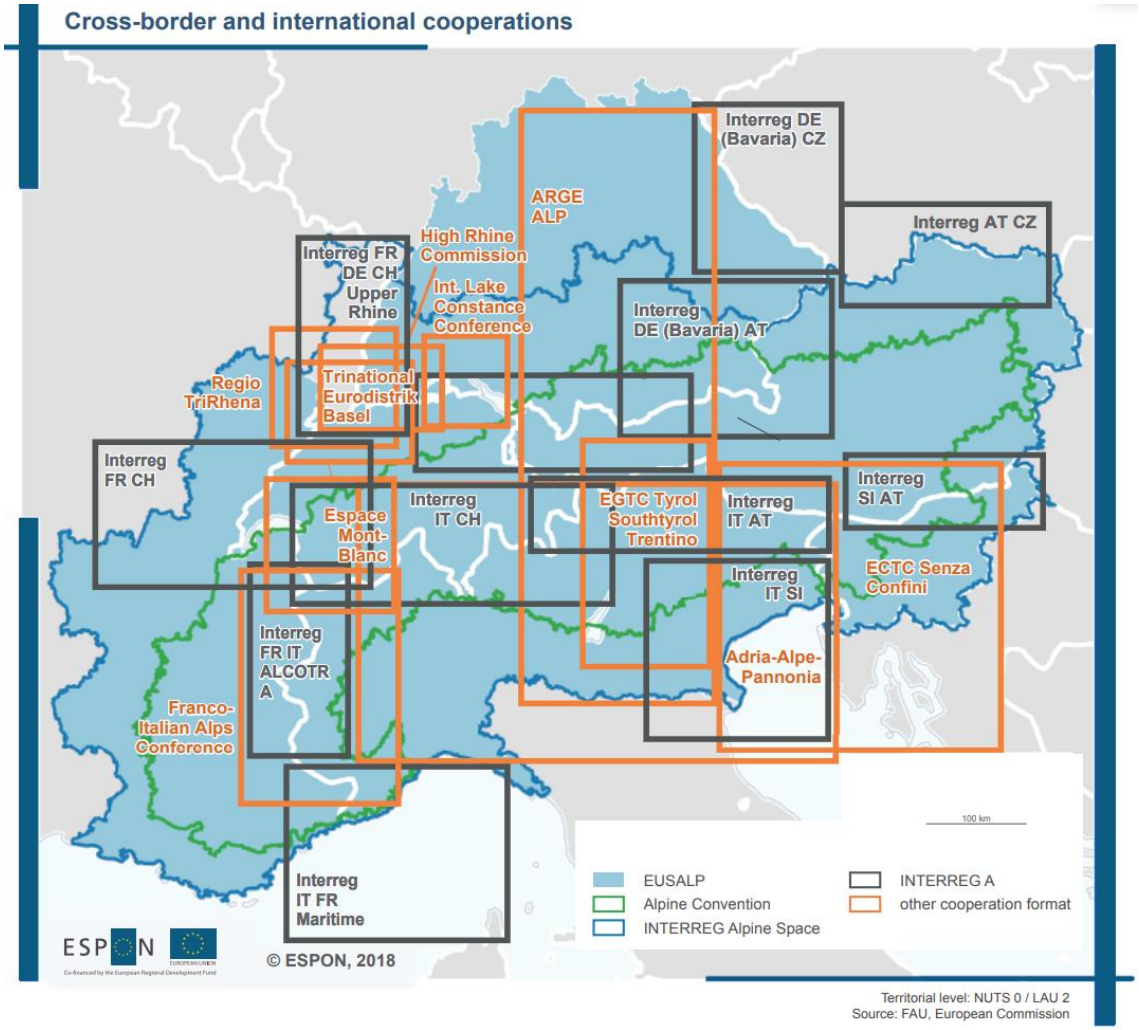
At the national level, environment ministries and other cross-sectoral ministries are responsible for defining strategic orientations for GBI implementation. Nevertheless, as highlighted in the analysis of PlanToConnect project, some countries lack a formal GBI concept in their national frameworks, which complicates implementation at the territorial level. Even among countries that have developed such concepts, differences in definitions and approaches hinder comparability, making cross-border cooperation and coordinated actions more difficult to achieve.

As illustrated on the stakeholder map, different actors are involved on multiple territorial levels the private sector, associations, for instance, are actors involved in the elaboration of national frameworks but also into the implementation of local spatial planning These stakeholders often have overlapping or conflicting interests. Therefore, raising awareness among them, as well as among the general public, is essential to build broad support for implementation and improve effective cooperation.

International cooperation platforms and the education and research stakeholders, have the expertise regarding data, tools and other useful resources that are not always fully utilised or known by local authorities. Strengthening efforts to bridge this gap is essential to improve understanding and to adapt existing mapping, planning, and assessment tools to local contexts more effectively.

3.3 Funding instruments

There are several EU and national funding sources available to support projects that focus on biodiversity, sustainable spatial development, and improving ecological connectivity, are detailed on D2.1.1 report. The most effective instruments for the measures included in this proposal, encourage Alpine cross-border and cross-sectoral cooperation among multiple stakeholders and reinforcing the importance of ecological connectivity for the protection of Alpine biodiversity.



Map 15 Cross-border and international cooperations

Source: The Alps 2050 Atlas ALPS 2050

These funding instruments address the development of strategical vision of the GBI on a larger scale, to reach multiple stakeholders and to mobilise exchange regarding the importance of the introduction of GBI in national frameworks. They also help position ecological connectivity as a key element in Alpine-wide development and nature protection strategies. Local implementation requires the support of dedicated specifical funding adapted to the requirements and priorities identified locally.

The table below resumes some of the main initiatives contributing to GBI developed trough the support of INTERREG Alpine space:

Table 2 Alpine Space projects with relevance for ecological connectivity and GBI

EC project	Description and main tools
Econnect	Protection of biodiversity through the promotion of ecological continuum across the Alpine space, to achieve this objective an analysis of geographical and legal frameworks was elaborated, stakeholder exchanges inside pilot regions were held, serving as an input for political recommendations. Jecami (Joint Ecological Continuum Analysis and Mapping Initiative) was developed as a GIS tool dedicated to the Alps to analyse and assess ecological connectivity through a comprehensive and evolutive geodata catalogue, this tool continues to host cartographic data and useful information concerning alpine ecological connectivity initiatives and projects.
recharge.green	recharge.green aims for a sustainable use of landscapes, the project explored the potential, limits and impacts of the use of renewable energy (wind, hydropower, forest biomass and solar energy) in the Alps.
ALPBIONET2030	Elaboration of Strategic Alpine Connectivity Areas (SACA), this classification of the alpine and EUSALP area in three types of categories offers the possibility to better target actions in favor of ecological connectivity.
OpenSpaceAlps	The project OpenSpaceAlps analysed the current situation of the remaining natural, semi-natural spaces that haven't been disturbed and fragmented or where infrastructure is not yet widely spread, different tools addressed to spatial planners and decision makers were developed, open spaces mapping, political and implementation recommendations to safeguard the spaces with a low spatial development.
PlanToConnect	Expertise of spatial planners, environmental, protected areas and governmental organisations and the knowledge from previous ASP and other ecological connectivity related projects, to delineate transnational natural corridors and habitat linkages critical for preserving the Alpine biodiversity and providing a strategical framework regarding ecological connectivity in the Alps.

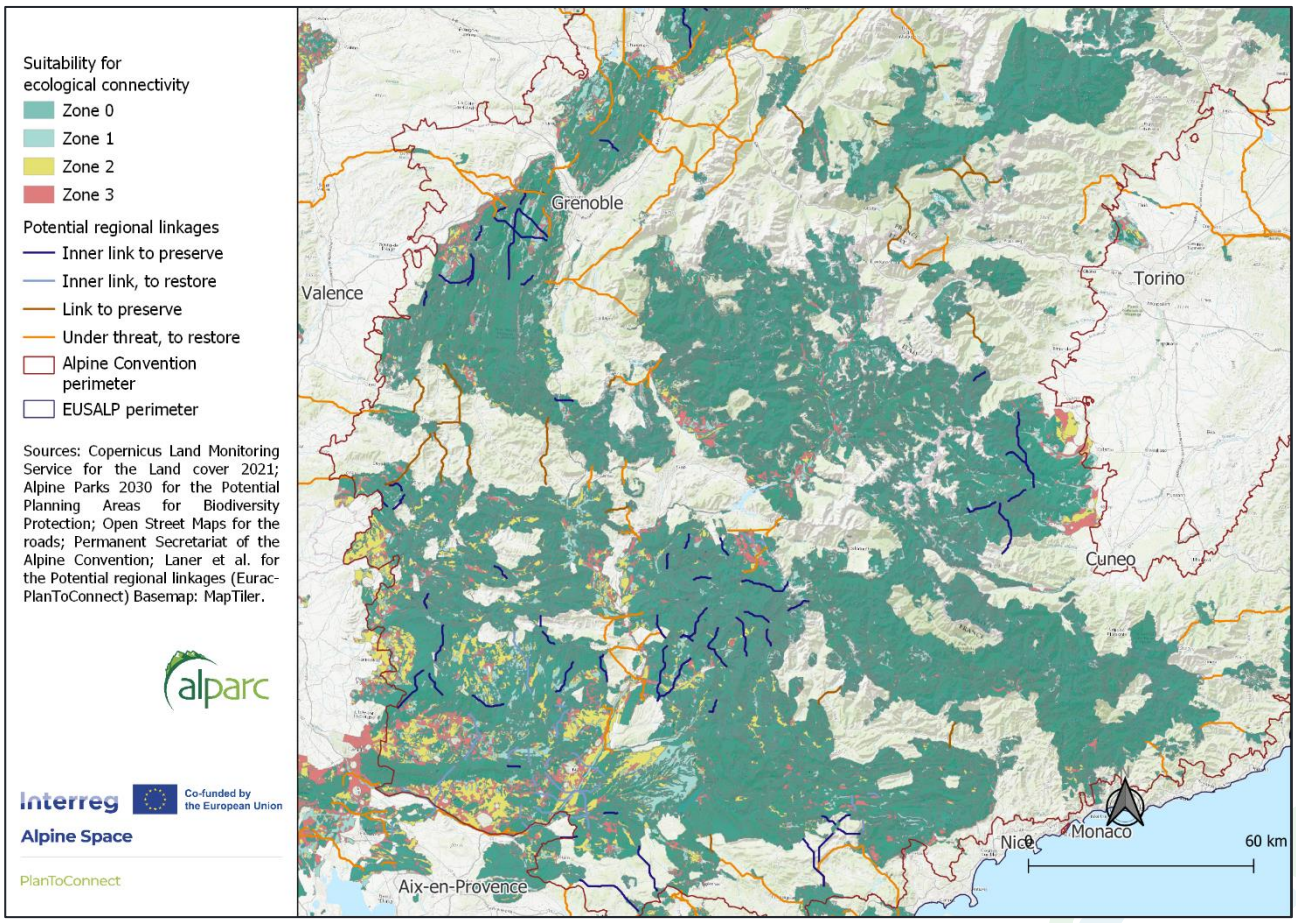
4 Proposal for the implementation of the GBI network plan into spatial and sector planning tools

4.1 State of art of connectivity planning and implementation in the pilot area

The five largest patches within the alpine ecological network have been selected to illustrate the characteristics that contribute to their good performance in terms of ecological connectivity, as well as the potential challenges they face. Detailed analyses and mapping results can be found in report D2.3.1.

1. South Western Alps

With the presence of national parks and other protected areas, the South-Western Alps have the potential to form a large network of natural or near-natural areas. However, special attention must be given to the growing pressure from incompatible agricultural practices and increasing urbanisation.



There are several challenges to address, cross-border coordination between France and Italy is hindered by differences in legal frameworks and administrative structures. There is strong cooperation between neighbouring protected areas.

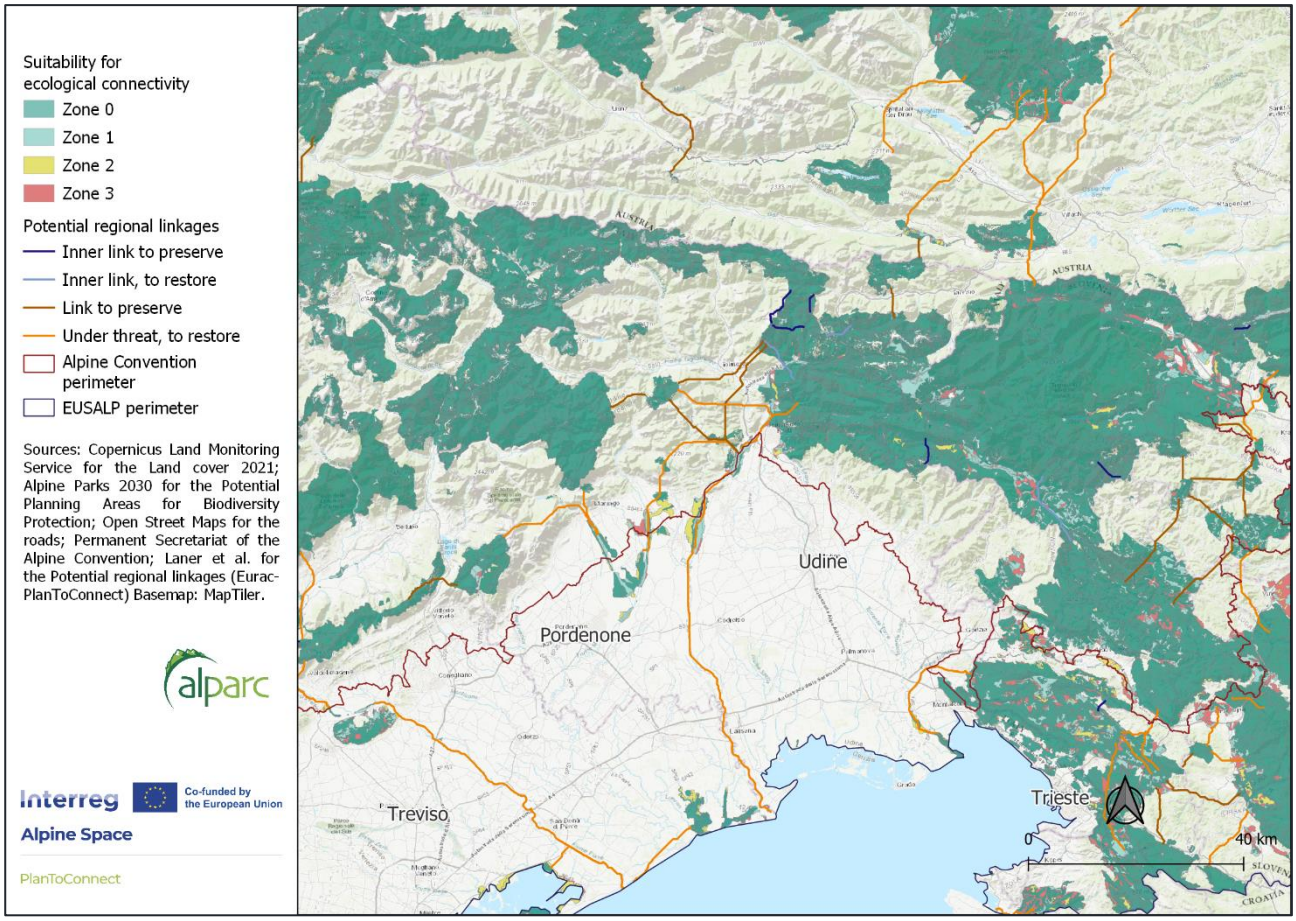
The implementation of ecological connectivity measures by local administrations is still limited. Protection efforts tend to focus primarily on designated protected areas, often overlooking other landscapes that have potential for improving connectivity.

2. Julian Prealps Nature Park –Triglav National Park

The transboundary area shared by these protected areas plays a crucial role in maintaining ecological connectivity within the Alps. However, several factors challenge the effectiveness of this connectivity. The presence of secondary roads and the proximity to major transport infrastructure such as the A2 motorway (Karavanke–Ljubljana), combined with the presence of dispersed urban centers across the region, contribute to landscape fragmentation.

Moreover, the surrounding areas to the protected areas already show advanced levels of fragmentation, which further threatens the potential for ecological corridors to link this region with other parts of the Alpine arc. This challenge is particularly significant given that the area lies in a triple-transboundary zone making it a strategic point for cross-border ecological networks.

Map 16 Implementation - Julian Prealps Nature Park –Triglav National Park

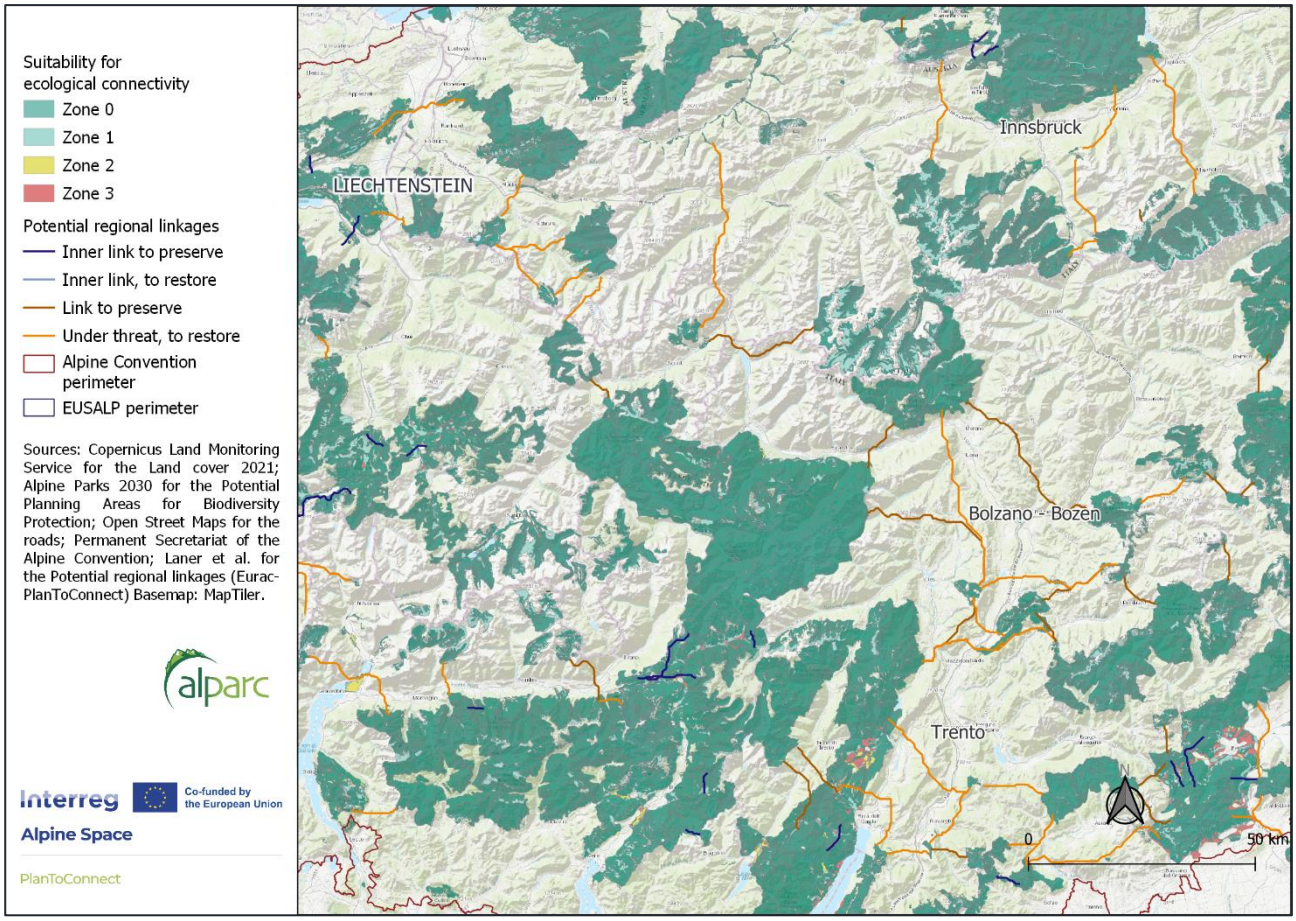


3. Rhaetian triangle

The Rhaetian Triangle has participated in different initiatives addressed to integrate biodiversity and ecological connectivity into spatial planning, serving as a pilot region. As a triple transboundary area, the assessment, development and implementation of connectivity measures vary between countries.

The objectives set by protected area management differ across borders due to the differences about the mission fulfilled by each protection category in the area and governance structures. Despite these differences, the efforts across the region are aligned in promoting functional landscapes, which support and enhance ecological connectivity throughout the area, especially in the face of challenges posed by tourism and related infrastructure development.

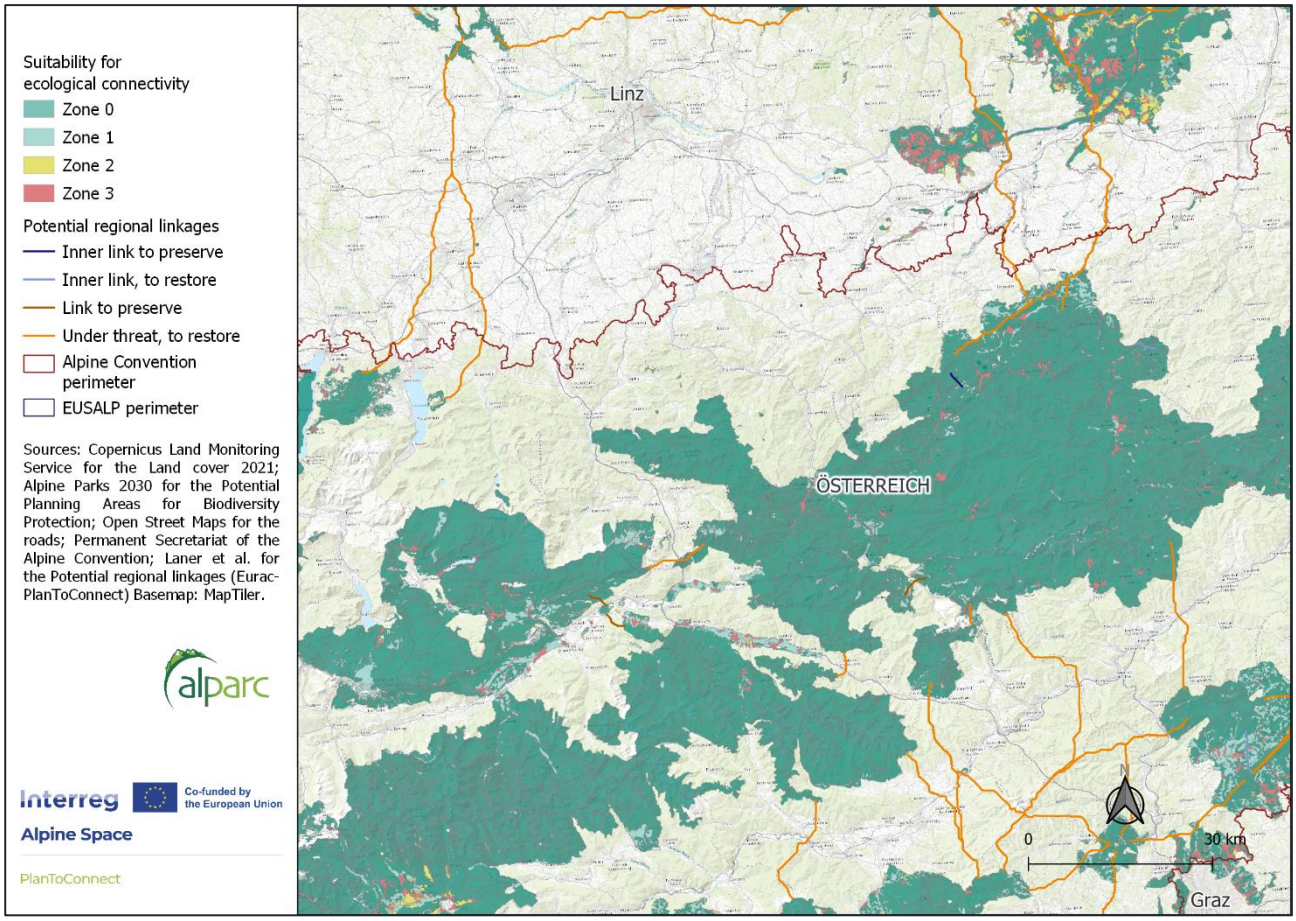
Map 17 Implementation - Raethian triangle



4. Northern Limestone Alps

The presence of the forest patrimony has brought together efforts to safeguard biodiversity and promote connectivity among the protected areas of the region. As in other regions, multiple categories of protected areas work together to ensure ecological connectivity. Since 2011, the *Netzwerk Naturwald*, formed by the Kalkalpen National Park, Gesäuse National Park, and the Dürrenstein Wilderness, was established to contribute to the expansion of wilderness area. The network has since evolved to include six natural areas, aiming to facilitate interaction among wild animals and to create sustainable connections between habitats.

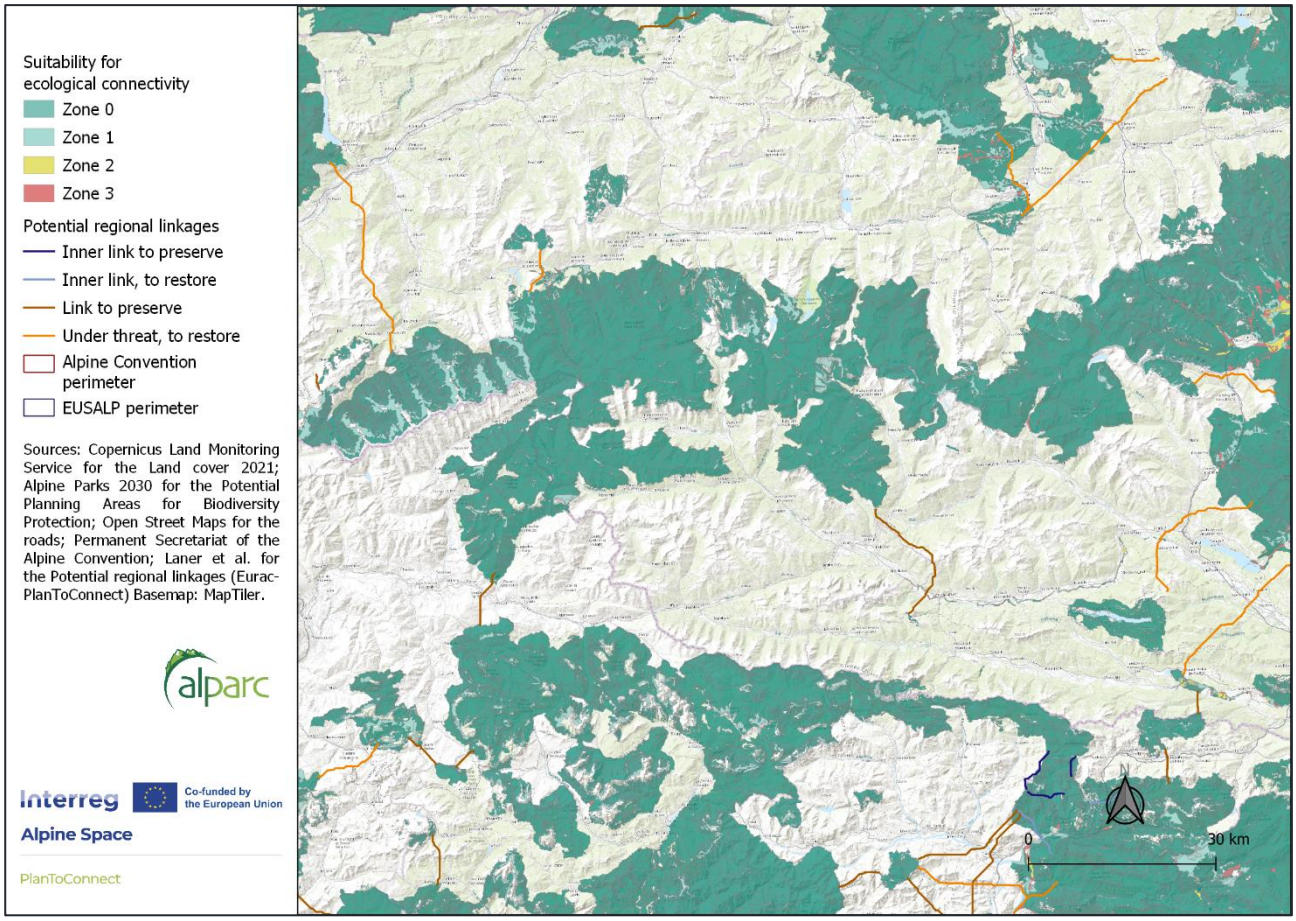
Map 18 Implementation - Northern Limestone Alps



5. Central Alpine space

The region plays a key role into intra Alpine ecological connectivity serving as an intersection point between the Northern Alps and the foothills of Slovenia, The Hohe Tauern national park is in close cooperation with Rieserferner-Ahrn Nature park, helping to protect this transit area for wildlife. Unlike other regions, the presence of large settlements is less widespread here. However, ecological connectivity still faces potential threats from expanding land uses, particularly tourism-related activities, that could alter the landscape and fragment habitats.

Map 19 Implementation - Central Alpine space



4.2 Key spatial planning instruments

Ecological connectivity and GBI implementation are highlighted as key element for ensuring biodiversity protection in different legal and strategic frameworks. These dispositions are translated into national strategies and legal documents, which are then implemented at the local scale.

These frameworks emphasize the importance of developing a coherent ecological network, taking into account that there are multiple territorial levels with heterogeneous competences and responsibilities and also of different sectors of activity relevant for the Alpine space. The table summarizes some of the main documents guiding the orientation of the policy for the Alps.

Table 3 Overview of European and Alpine Space framework with relevance for ecological connectivity

Territorial level	Main provisions - ecological connectivity	Framework
EU	The Global Biodiversity Framework (CoP-15) adopted in December 2022 includes ecological connectivity as one of the main elements to preserve biodiversity • Ecosystems are safeguarded by maintaining, enhancing or restoring its integrity, connectivity and resilience. (Goal 1) • Effective restoration, enhancing among others, connectivity (Target 2) • Effective conservation and management of areas of particular importance for biodiversity - well-connected systems of protected areas (Target 3) • Green and blue spaces - improvements on surface, quality and connectivity. (Target 12)	Convention on Biological Biodiversity (CBD)[6][7]
EU	• Enlargement of the existing Natura 2000 areas, with the identification of non-protected areas with a *"very high biodiversity and climate value"* • Elaboration of concrete commitments integrated into the EU nature restoration plan.	European Commission Biodiversity strategy for 2030[8]
EU	The Nature Restoration Law of the European Union (EU) aims to address the ongoing degradation of ecosystems and biodiversity loss and to achieve the objectives regarding climate change adaptation among other measures to meet other UE international commitments. The law sets out a series of restoration targets to fulfil on the 2030, 2040 and 2050 horizon, these measures apply to habitats where improvements need to be done, the measures apply to different landscapes:	European Commission EU Nature restoration law[9]

[6] Convention on Biological Biodiversity (CBD) 2022; Global goals for 2050; https://www.cbd.int/gbf/goals

[7] Convention on Biological Biodiversity (CBD) 2022; Global targets for 2030; https://www.cbd.int/gbf/targets

[8]European Commission; 2020; Biodiversity strategy for 2030; https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en#:~:text=Media-,Objectives,people%2C%20climate%20and%20the%20planet

[9] European Commission; 2024; Nature Restauration Law; https://data.consilium.europa.eu/doc/document/PE-74-2023-INIT/en/pdf

Territorial level	Main provisions - ecological connectivity	Framework
	- Terrestrial, coastal and freshwater ecosystems: Restoration measures implemented on at least 30% of the surface of the identified habitats by 2030, at least 60% by 2040 and at least 90% by 2050. - Marine ecosystems: Restoration measures implemented on at least 30% of the surface of a selection of marine habitats by 2030, at least 60% by 2040 and at least 90% by 2050. - Urban ecosystems: Increase of urban green space. - Agricultural ecosystems: Includes measures for enhancing biodiversity, restoration of organic soils and high-diversity landscape features. - Forest ecosystems: Addresses restoration measures and establishes a set of indicators to evaluate the enhancement of biodiversity on forest ecosystems. Ecological connectivity is a crucial aspect enunciated in the Nature Restoration Law, the efforts in nature restoration enhances ecological connectivity, the framework promotes the establishment and maintenance of ecological corridors to facilitate the movement of wildlife and creates dedicated measures to monitor, evaluate and improve the ecological integrity and connectivity of ecosystems.	
Alps	The contracting parties make the commitment to adopt measures to ensure to create a network of protected areas and other landscapes, connectivity between natural elements - network of biotopes is mentioned among these measures.	Protocol on the implementation of the Alpine Convention related to nature protection and landscape conservation[10]
Alps	The Alpine Green Infrastructure Network aims to secure the provision of services and functions from nature including urban and rural areas by enhancing and enhancing links between protected and non-protected areas to ensure *"structural and functional landscape connectivity"*	EUSALP - Action Group 7 Political declaration[11]

[10] Alpine Convention; 1994; Protocol on the implementation of the Alpine Convention relating to nature protection and landscape conservation; https://www.alpconv.org/fileadmin/user_upload/Convention/EN/Protocol_Conservation_of_Nature_EN.pdf

[11] EU strategy for the Alpine space. EUSALP; 2017; "Alpine Green Infrastructure – Joining forces for nature, people and the economy, Joint declaration of Alpine States and Regions 2017"

Further legal framework is mentioned in the report *"Planning instruments and processes for GBI network planning and implementation in the Alps"*

4.2.1 Technical proposal

The implementation of protection and restauration measures of the large continuities among with the last linkages that allow to connect them, is essential to achieve an effective nature conservation. This proposal includes the identification of priority areas where spatial planning can help to preserve functional connectivity among these landscapes.

The table below summarizes other complementary implementation measures that support the application of the actions described in the previous chapters.

Table 4 Implementation measures to accelerate GBI integration into spatial planning

Measure	Main challenges	Tool / Implementation
Strengthen multilevel governance	Lack of coordination and conceptual divergences among the already existing frameworks creates obstacles for the development and implementation of a shared concept of ecological connectivity.	Alpswide methodological and conceptual approach serving as a basis for national framework formulations.
Strengthen transectoral cooperation	Challenges in sectoral cooperation directly impact the feasibility of implementing ecological connectivity measures and can negatively affect the current state of biodiversity. Biodiversity often coexists with, and at times conflicts with, other land-use activities, making coordinated approaches essential.	Effective implementation of actions towards biodiversity protection implies the engaging in discussion with multiple stakeholders including other sectors of activity. Communication tools play a key role in translating the conceptual framework into local contexts and guiding spatial planning to help balance diverse interests within this multi-stakeholder setting.
Increase stakeholder engagement through participatory planning processes	GBI and ecological connectivity are not as widespread as other biodiversity protection approaches, which makes it challenging to engage stakeholders in the development and implementation of measures aimed at enhancing ecological connectivity at the territorial level.	Elaboration of different communication tools oriented towards different types of stakeholders is essential to help position the topic of ecological connectivity within their specific activities and territorial contexts.

Measure	Main challenges	Tool / Implementation
Promote data sharing	There is an important amount knowledge, obtained from initiatives and projects focused on the implementation of ecological connectivity and GBI within the Alps. This knowledge is not always exploited in the elaboration of planning instruments and policy frameworks.	Involving spatial planners in methodological discussions and sharing results that support conceptual coherence in decision making on the local level is essential. Actively engaging them in dialogue helps ensure that ecological connectivity and GBI considerations are effectively integrated into spatial planning processes. The WebGIS Jecami is a concrete example of a tool that allows to engage the discussion.

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PlanToConnect
Mainstreaming ecological connectivity in spatial planning systems of the Alpine Space

Project partners:

Urban Planning Institute of the Republic of Slovenia (SI)
Veneto Region (IT)
ALPARC – the Network of Alpine Protected Areas (FR)
Asters, organisation for the conservation of natural areas in Upper Savoy (FR)
Eurac Research (IT)
ifuplan - Institute for Environmental Planning and Spatial Development (DE)
University of Würzburg (DE)
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D.2.5.1 - Technical proposal for implementing GBI connectivity networks in spatial plans of pilot sites – Alpine space

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