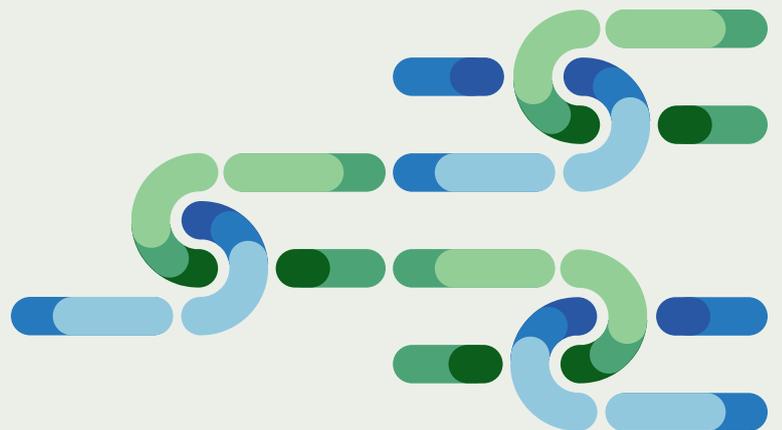


GBI-network: Land use conflicts for Renewable Energy production and other threats

South of Lake Annecy

Reference in AF: D2.4.1

Héloïse VENAUT, Asters CEN74
Jules GRILLOT, Asters CEN74



GBI-network Land use conflicts

Mapping report outlining GBI network elements and areas of land use conflicts for renewable energy production and other major developments.

Activity 2.4 Case Studies 3rd step: Identify unsuitable locations/mitigation measures for impact assessment of renewable energy systems and other major developments that may threaten GBI connectivity function.

Héloïse VENAUT, Asters CEN74
Jules GRILLOT, Asters CEN74

Annecy, April 2025

Reference in AF: D2.4.1

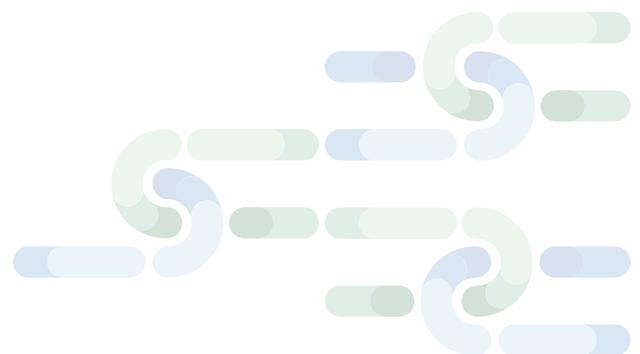


Table of Contents

EXECUTIVE SUMMARY	4
REPORT	5
1 Introduction.....	6
2 Pilot region in the south of Lake Annecy	8
3 Methodological steps.....	12
3.1 Description of the approach/ working steps	12
3.2 Data used	13
4 Major pressures and threats to ecological connectivity	15
4.1 General threats to GBI ecological networks posed by infrastructure and land uses 15	
4.2 Definition of relevant infrastructures	17
4.3 Existing pressures and expected major threats in the pilot region	18
5 Choice of locations for major developments / renewable energy facilities	20
5.1 General criteria for unsuitable locations	20
5.2 Development of specific criteria for unsuitable locations in the pilot region (exclusion zones) 21	
5.3 Mapping the land use conflicts for renewable energy production.....	25
5.3.1 <i>River power plants</i>	25
5.3.2 <i>Wind power</i>	27
5.3.3 <i>Solar power</i>	28
5.3.4 <i>High voltage transmission line</i>	30
5.3.5 <i>Bioenergy plant</i>	31
5.3.6 <i>Roads/ Highways and Railways</i>	32
5.3.7 <i>Urban /industrial development</i>	33
5.3.8 <i>ZAER</i>	34
5.3.9 <i>Potential location sites</i>	35
6 Possible mitigation and compensation measures	36
7 Conclusions.....	37
8 GLOSSARY.....	38
9 References	40

ANNEXES 41

List of Tables

Table 1: Overview of local or regional data used 13
 Table 2: Infrastructures and land uses with their impact on connectivity 15
 Table 3: Identification of projects thresholds for spatial planning 17
 Table 4: Overview – Existing pressures and expected major threats in the pilot region of the South of Lake Annecy 18
 Table 4: General criteria for unsuitable sites (D1.3.1) 20
 Table 6: Compilation of unsuitable locations and their corresponding buffers in the pilot site in the South of Lake Annecy 22

List of Annexes

Annex 1 Identification of projects thresholds for spatial planning 41
 Annex 2 Mitigation /compensation (see D1.3.1) 44



EXECUTIVE SUMMARY

This report explores the land-use conflicts arising from renewable energy facilities and other infrastructural developments that may threaten the GBI network for connectivity in the pilot region. It covers all spatially relevant infrastructures that already had a negative impact on connectivity (pressures) as well as those that pose a threat to connectivity in the future (threats).



REPORT



1 Introduction

The aim of the PlanToConnect project is to develop and test an Alpine spatial planning strategy for ecological connectivity in cooperation with stakeholders in pilot areas. Proposals for the adaption of spatial planning systems and territorial policies will be developed.

Asters CEN74 is conducting a case study on the South of Lake Annecy. Main issues in the pilot site is the presence of major natural areas with rich biodiversity surrounded by urban areas and an anthropic great lake that can create barriers and even insulating effect on some sites. Poor connectivity of corridors can be caused by urban sprawling, downgrading of agricultural and natural lands into urban one in local urban planning and an increase of road users.

This report (D2.4.1) focuses on the land-use conflicts arising from renewable energy facilities and other infrastructural developments that may threaten the GBI network for connectivity in the pilot region. The objectives are:

- to assess potential impacts of renewable energy infrastructures or other infrastructures that may threaten the GBI network for connectivity,
- to assess evaluation criteria for unsuitable locations for the various types of infrastructures with a focus on renewable energy,
- to map the land use conflicts for renewable energy production
- to suggest possible mitigation measures.

This report covers all spatially relevant infrastructures that have already had a negative impact on connectivity (pressures) as well as those that pose a threat to connectivity in the future (threats)¹.

As a thematic delimitation, this report focuses on renewable energies and includes urban/industrial development and infrastructures. While agricultural land use also affects ecological connectivity (see report [D1.2.1](#)), it is not addressed in the scope of this report as it is mostly driven by market conditions and agricultural practices. Spatial planning and its instruments virtually have no mandate or steering influence.

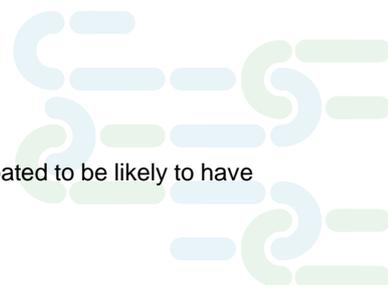
Structure of the report

Chapter 2 shortly describes the pilot region.

Chapter 3 deals with the methodological approach used in the pilot region.

Chapter 4 shows the major pressures and threats to ecological connectivity in the pilot region (findings).

¹ Pressures are factors that have affected habitats and species, threats are factors that are anticipated to be likely to have an impact in future (European Environment Agency, 2020).



Chapter 5 discusses opposing factors for major developments / renewable energy facilities (exclusion zones) in the pilot region.

Chapter 6 describes the possible mitigation and compensation measures for the existing and planned infrastructures in the pilot region.



The territory is composed of 41% of natural areas and 20% of the territory is identified by the regional plan as a biodiversity reservoir (SRADDET, 2020). At a regional scale, Annecy's basin plays an important role to link alpine habitats and the habitats of Rhone's valley.

At a smaller scale, differences of landscape are also visible throughout differences of land use. In the valley, the land use is mostly characterised by villages, urbanised areas and agricultural lands (Naturalia, 2023).

On first slopes, the landscape is more diverse with smaller fields, hedgerows and forests.

At mid-mountain level, the forest is highly represented on the slopes, whose growth were favoured by its low accessibility and an abandonment of these areas for human activities.

Most of the urban sprawl is located next to Lake Annecy. Urban areas are constrained by mountainous areas and the lake, gathering all the urbanisation in valleys where some important places for ecological connectivity are located. Urban landscape is described in the regional planning document as an exploded view and dissolute urbanisation around historical villages (Naturalia, 2023).



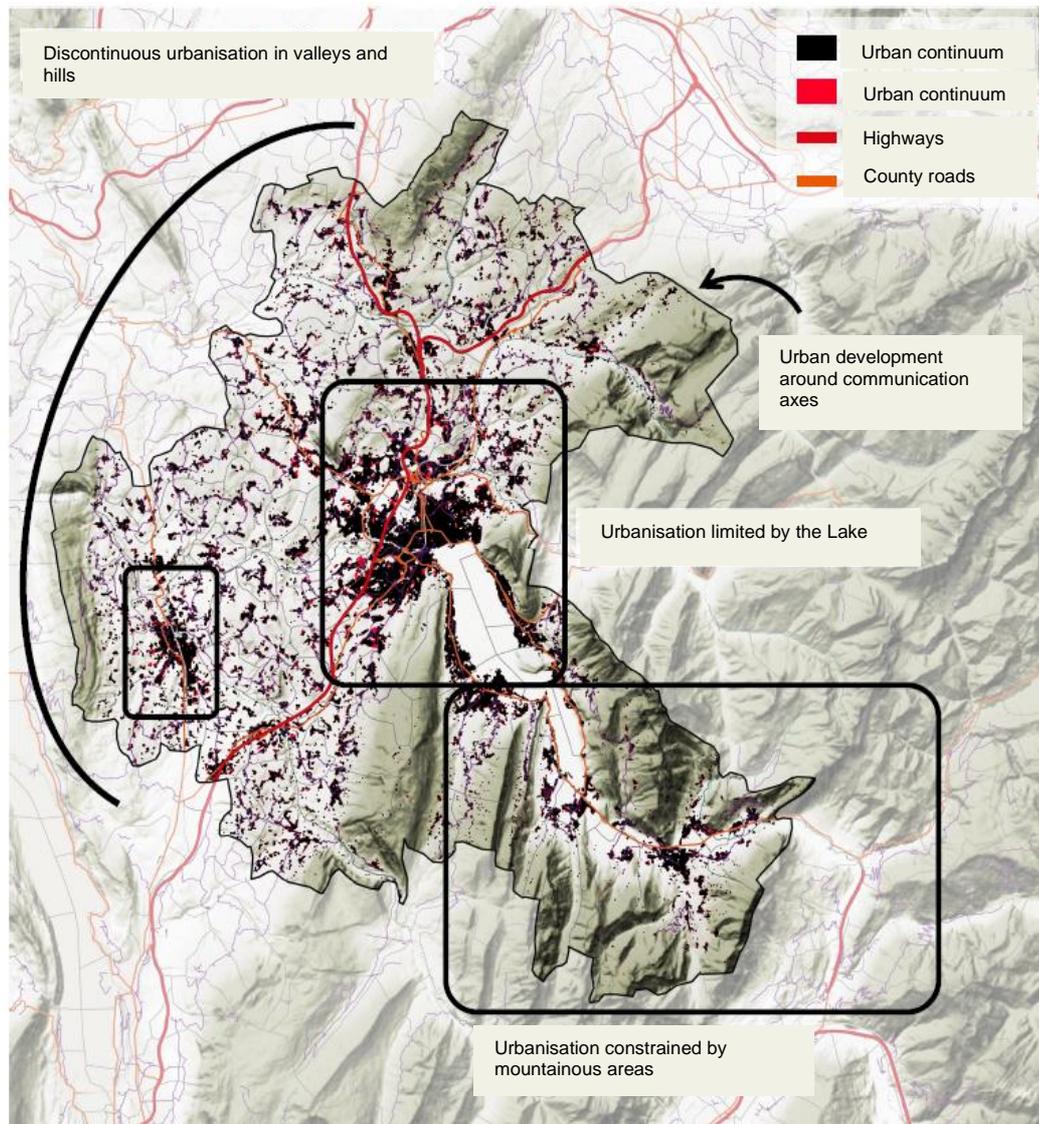


Figure 2: Urban areas in the SCOT of Annecy's basin

Several protected areas and natural valuable areas are identified in Annecy's basin with different levels of protection:

- Natural reserves have one of the highest level of protection in France, characterised by their own local regulation and dedicated guards to assure law enforcement,
- Several Sensitive Natural Areas, Prefectoral Order of Biotope Protection with a medium level of protection through land ownership and law enforcement,
- Several Natura 2000 sites and a Regional Natural Park with low protection characterised by managed areas where biodiversity is taken into consideration in local planning.

Protected areas and natural valuable areas represent biodiversity reserves in the regional plan (SRADDET) and contribute to maintain valuable core areas of biodiversity.

Two National Action Plans are located in the pilot site. One in the South of lake Annecy indicates that lynx (*Lynx lynx*) are roaming within the area, the other concerns the middle part of the lake and its surroundings where Yellow-bellied toad (*Bombina variegata*) is located.



3 Methodological steps

3.1 Description of the approach/ working steps

Working Step	Description
1 Bibliography	France already made a platform concerning renewable energy, it allows land planners to analyze productivity potential and different legislation concerning each energy source.
2 List all reglementation for every renewable energy	Next step is to identify global reglementation like managed natural areas, littoral law or mountain law but also specific reglementation for every energy resource.
3 Collect data to create multi-criteria analysis	In a third step, dataset of infrastructures, energy resources, environmental areas are compiled.
4 Compilation of general criteria for unsuitable locations	A layer is created with every general criteria such as laws and protected areas. These criteria are the same for every energy source. This layer will be used for every analyse.
5 Development of specific criteria for unsuitable locations in the pilot region (exclusion zones)	Every renewable energy is then analysed to add specific criteria, sometimes only the distance is changed (distance to residential areas may change), some other times a specific dataset is used (distance to lake for windpower). Every distance is based on a text of law.
6 Mapping the land use conflicts for renewable energy production	<p>A map for every renewable energy is made with all the criteria. On each map we can see:</p> <ul style="list-style-type: none"> • the suitable locations for the specific development infrastructure • every specific criteria <p>Most of the time general criteria are not shown in the map specifically to a development infrastructure. A unique map will be made containing all general criteria.</p>



3.2 Data used

The following table shows the data that were used and were available for analysing the pilot region.

Table 1: Overview of local or regional data used

Data	Source	Description
General informations		
RNP, Regional Natural Park	INPN	Perimeter of the Bauges' RNP
National Natural Reserve	Asters CEN74	Perimeter of the NNR
Wetlands	Asters CEN74	Perimeter of the wetlands
River	Sandre, BD Topage	Delimitation of the rivers
Protected Areas (N2000, POBP, SNA)	INPN	Perimeter of the protected areas
Municipalities subject to the mountain law	Ministère de la transition écologique de la biodiversité, de la forêt, de la mer et de la pêche	List of municipalities subject to a specific law. In our case, it mostly concerns the rivers.
Natural risk protection plan	BRGM and Ministère de la transition écologique de la biodiversité, de la forêt, de la mer et de la pêche, Géorisques	No risk where found in the study area.
Lake Annecy	IGN, BD TOPO	Perimeter of Lake Annecy
Géosites	INPN	Perimeter of Géosites, a place where you can observe geological features and phenomena of interest for understanding geology
River power plants		
Flow obstacles (ROE : référentiel national des obstacles à l'écoulement ; site EauFrance)	Sandre, ROE	Inventory of the flow obstacles in France

Data	Source	Description
Solarpower plants		
Potentiel solaire/cadastre solaire	Cerema	Solar potential
Residential area	IGN, BD TOPO	
Biomass plants		
Industrial area	IGN, BD TOPO	
Residential area	IGN, BD TOPO	
Public buildings	IGN, BD TOPO	
Public roads	IGN, BD TOPO	
High voltage transmission line		
Transmission line	IGN, BD TOPO	
Residential area	IGN, BD TOPO	
Roads, highways and railways		
Express roads	IGN, BD TOPO	Departemental roads
High traffic roads	IGN, BD TOPO	Mostly roads in urban areas
Railways	IGN, BD TOPO	No data in the study area
Urban and industrial development		
Urban area	IGN, BD TOPO	
Bottlenecks	Asters CEN74	



4 Major pressures and threats to ecological connectivity

4.1 General threats to GBI ecological networks posed by infrastructure and land uses

The table below lists infrastructures and land uses analysed in [report D1.3.1](#) and assesses their impact on connectivity across the landscape. A distinction is made between structural and functional connectivity (see [report D1.3.1](#)).

Table 2: Infrastructures and land uses with their impact on connectivity

Sector	Type of infrastructure/ Land use	Comments on Connectivity
Renewable energy	Hydropower - Hydroelectric reservoir (dam)	High impact on structural and functional connectivity because of usually large land take and barrier/ fragmentation effects.
	Hydropower - Run-off-river power plants	Low impact on structural connectivity because of minimal land take high impact on functional connectivity because of barrier/fragmentation effects in the water body.
	Windpower - Windmills	Low impact on structural connectivity because of minimal land take partly high impact on functional connectivity because of collisions (birds, bats).
	Solar Power - Photovoltaics: Ground-mounted solar panels	Mostly low impact on structural and functional connectivity because of usually low soil sealing and marginal barrier effects. Effects depend on the area size and design. Large area photovoltaics: high impact due to extensive habitat changes (structural connectivity) and to fragmenting effects if fenced (functional connectivity). Above a length of 500 metres, fragmenting effects on large mammals are to be expected.
	Bioenergy - Biomass	Bioenergy plants: Mostly low impact on structural and functional connectivity because of usually low land take and marginal barrier effects. Effects depend on the area size of the facility! Change of land management and land use: no general statements possible because effects depend on the area size, the location and intensity of the biomass production.
Energy sector as a whole	Transmission of electricity - High voltage transmission line	Low impact on structural connectivity because of minimal land take outside of forests ; partly high impact on functional connectivity because of collisions (birds)

Sector	Type of infrastructure/ Land use	Comments on Connectivity
Transport	Roads/ highways	High impact on structural and functional connectivity because of usually large land take, barrier effects, wildlife mortality due to traffic and impacts due to noise, dust and pollutants
Transport	Railway	High impact on structural and functional connectivity because of land take (habitat loss), barrier effects, wildlife mortality due to traffic and impacts due to noise, dust, pollutants and vibrations
Urban /industrial development	Urban/ industrial development	High impact on structural and functional connectivity because of land take (habitat loss), barrier effects and impacts due to noise and other pollutants



4.2 Definition of relevant infrastructures

As already described in report [D1.3.1](#) and in Table 2 it depends on the size and design of a certain infrastructure whether negative impacts on the environment are to be expected. For example, it makes a big difference whether the size of a PV system is one hectare or 20 hectares.

Therefore, it must first be analysed which infrastructures generally pose a pressure or a threat to connectivity and are relevant for spatial planning. The question is: Are there threshold values for projects above which significant negative effects on the environment can be assumed? Or to put it another way: Are there any small-scale infrastructure projects that are not relevant to spatial planning and therefore do not need to be considered in the context of this report?

The EU's Environmental Impact Assessment Directive provides specifications for which projects an Environmental Impact Assessment (EIA) are obligatory. These specifications can be interpreted as an orientation for the spatial planning significance of different infrastructures. In the EU's Environmental Impact Assessment Directive relevance thresholds are not specified for all project types. EU Member States can provide further details with regard to the necessity of an environmental impact assessment or a preliminary environmental impact assessment (on a case-by-case basis or by setting specific criteria such as the location, size or type of project).

In France, the article R.122-2 and L122-1 from the Environmental Code are framing the application of the French law to infrastructures that requires mandatory EIA. The following table shows the project types that are considered to be spatially relevant and thus may have negative impacts on the environment and connectivity.

Table 3: Identification of projects thresholds for spatial planning

	Relevance for spatial planning
Hydropower	Any construction and operation of a hydropower plant superior to 4,5MW Any river canalisation and stream correction work of more than 100m length Any riverbed protection of more than 200m length Any work that can impact more the 200m ² of fish/shellfish/amphibians spawning ground surrounding or within the riverbed
Windpower (windmills)	Wind farm with 1 wind turbines with a total height of more than 50 metres each
Solar power (ground mounted photovoltaic systems)	Any solar power plant that produce 300kWc or more
High voltage transmission line	Any transmission line of 15km length or more Substation with a voltage of 63 kV or more
Roads/ highways	Four-lane or multi-lane road with continuous length of 10 km or more

	Relevance for spatial planning
Railways	Railway track of more than 500m associated with operating facilities of more than 1000 m Infrastructures related: train station, platform, etc...
Urban/ industrial development	Any building coverage ratio superior or equal to 40 000m ² (and a case by case analysis for 10 000m ² building coverage ratio's projects)
Camping	Welcoming capacities from 7 to 200 tents or caravans
Sport building	Any running trail, amusement parks Golf course higher or equal to 4 hectares Any sport building with a welcome capacity of a 1000 people

4.3 Existing pressures and expected major threats in the pilot region

The following table lists all projects with spatial relevance in the pilot region (based on the definition of spatially relevant project types, see Table 3. A distinction is made between existing infrastructure (pressures) and planned projects (threats).

Table 4: Overview – Existing pressures and expected major threats in the pilot region of the South of Lake Annecy

Type of infrastructure/ Land use	Existing (pressures)	Expected (threats)	Description
Hydropower - Hydroelectric reservoir (dam)	-	-	No existing or planned major Hydroelectric reservoir
Hydropower - Run-off-River power plant	Several river power plants and weirs	Possible construction of new weirs	Most of rivers have at least some weir on their path that disturb the river connectivity, mostly for some local fish such as the brown trout (<i>Salmo trutta</i>)
Windpower - windmills	-	Possible construction of winpower	Possible construction of winpower
Solar Power - Photovoltaics: Ground-mounted solar panels	-	Possible construction of solar power plant	Possible construction of solar power plants
Bioenergy - Biomass	-	Possible construction of biomass	Possible construction of biomass plants

Type of infrastructure/ Land use	Existing (pressures)	Expected (threats)	Description
Transmission of electricity - High voltage transmission line	2 major high voltage transmission lines are crossing the pilot site	Possible construction of electric lines	The 2 major high voltage transmission lines have 225kv and 400kv
Roads/ Highways	The raise of the use of existing roads surrounding the Lake Annecy (D1508, D909A, D912, D41, etc...)	Possible construction of new roads Project of road extension, enlargement to higher car capacity	The use of roads increases the barrier effect of these infrastructures that became impermeable for the terrestrial fauna
Railway	-	Potential project of common transport (tramway) on the side of D1508	Potential future project of common transport
Urban/ industrial development	Urban expansion	Urban expansion for housing, new industries, sport fields	Growth of the cities of Annecy and Geneva that brings new inhabitants, companies and leisure projects in the Lake Annecy's basin



5 Choice of locations for major developments / renewable energy facilities

5.1 General criteria for unsuitable locations

The general criteria for unsuitable sites are compiled in the following table. They are based on the corresponding chapters of the [report D1.3.1](#).

Table 5: General criteria for unsuitable sites (D1.3.1)

	Unsuitable locations
General rules	<ul style="list-style-type: none"> • Natural reserves, National parks and related environmental protections • Drinkable water capture area • Wetlands • Natural risk areas
Hydropower	<ul style="list-style-type: none"> • protected areas (e.g. natural reserves, APPB, etc...) • natural or semi-natural rivers
Windpower	<ul style="list-style-type: none"> • protected areas (e.g. natural reserves, core areas of national parks and biosphere reserves) • European bird protection areas with occurrences of wind energy-sensitive bird species • designated bird migration routes • density centers of collision-sensitive bird species • old natural or semi-natural forests • forested ridgelines because of high collision rates of birds and bats • areas with high perceived scenic quality (landscape quality)
Solar power	<ul style="list-style-type: none"> • protected areas (e.g. Natural reserves, water protection areas) • areas of high nature conservation value • riparian buffer zones, floodplains • natural watercourses and lakes • soil with very high significance for natural soil functions • agricultural soil with high degree of productivity
Biomass (bioenergy plant)	<ul style="list-style-type: none"> • protected areas (e.g. Nature 2000 areas, nature reserves, core areas of biosphere reserves, water protection areas) • areas of high nature conservation value



	Unsuitable locations
High voltage transmission line	<ul style="list-style-type: none"> • European bird protection areas (Important Bird Areas (IBAs) or Special Protection Areas (SPAs)) • wetlands of international importance according to the Ramsar Convention • designated bird migration routes • near large bodies of water and reservoirs • protected areas specifically for landscape (UNESCO World Heritage Sites, Landscape conservation areas, priority areas for tourism) • other protected areas (e.g. Natura 2000 areas, nature reserves, core areas of national parks and biosphere reserves) • old natural or semi-natural forests • water protection areas of zones I and II (no construction of transmission poles in waterways or banks of waterways)
Roads/ highways	<ul style="list-style-type: none"> • protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland • soil with very high significance for natural soil functions
Railways	<ul style="list-style-type: none"> • protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland
Urban /industrial development	<ul style="list-style-type: none"> • protected areas (e.g. Nature 2000 areas, nature reserves, core zones of national parks and biosphere reserves, water protection areas) • areas of high nature conservation value like old-growth forests or wet- and peatland • existing ecological corridors, especially in bottleneck areas

5.2 Development of specific criteria for unsuitable locations in the pilot region (exclusion zones)

Exclusion zones in this context are areas where certain infrastructures are not allowed to be built or operated. Exclusion zones are the most common planning instrument to mitigate environmental impacts of human land-use, including the deployment of RE.

As can be seen from the table above, the unsuitable locations are often identical. They include mainly protected areas of various types: e.g. natural reserves, core zones of national parks and biosphere reserves, water protection areas or the developed GBI network for connectivity (including priority areas for conservation and restoration).

For the definition of exclusion zones, however, it is not sufficient to use only the boundaries of ecologically valuable areas. Many infrastructure projects have far-reaching effects (for example wind turbines or roads), so that positioning them directly next to an ecologically valuable area can affect the area in a negative way. As described in report D1.3.1 edge effects and barrier or fragmentation effects influence not only the habitats adjacent to an infrastructure, but also the ecosystems and living conditions of wildlife in wider areas (see [report D1.3.1](#)).

The question is: What distances must be kept to ensure that an ecologically valuable area is not adversely affected by a certain infrastructure. This distance depends on the type of area and species occurring in the area as well as the type of infrastructure. Two approaches were taken to answer this question:

- compilation of existing standards or guidelines for determining unsuitable areas for a certain type of infrastructure, and
- compilation of the maximum impact ranges of infrastructure projects used as a buffer around ecologically valuable areas.

The following table lists the unsuitable areas that occur in the pilot region with the proposed buffers. The proposed buffers are based on the French law frames restrictions and limits from these infrastructures.

Table 6: Compilation of unsuitable locations and their corresponding buffers in the pilot site in the South of Lake Annecy

Infrastructure	Distance to...	Buffer (minimum distance)	Law	Citation
Hydropower plants				
Fishing activities (forbidden)	Hydropower plants	50 m downstream	Article R. 436-71 du Code de l'Environnement	https://aida.ineris.fr/reglementation/livre-iv-patrimoine-naturel-partie-reglementaire#Article_R_414_29
Fishing activities with nest and machines (forbidden)	Hydropower plants	200 m downstream	Article R. 436-71 du Code de l'Environnement	https://aida.ineris.fr/reglementation/livre-iv-patrimoine-naturel-partie-reglementaire#Article_R_414_29
Windpower set up (from mast based) ; >12m			Art. 98 de la loi no 2003-590 du 2 juillet 2003 et art. R. 421-1 du Code de l'Urbanisme	https://www.legifrance.gouv.fr/loda/id/JORFTEXT00000603905/
	Residential areas, Accommodations or areas dedicated for housing	500 m	Article L.515-44 du Code de l'Environnement	https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000033933299

	Shore of seas, ocean or lakes bigger than 1 000 hectares	1 km	Article L121-12 du Code de l'Urbanisme (Article L321-2 du CE)	https://www.legifrance.gouv.fr/codes/id/LEGISCTA000031212412
	Wind power set up (from mast based)	1500 m	Décret no 2003-282 du 27 mars 2003	https://www.bulletin-officiel.developpement-durable.gouv.fr/documents/Bulletin-officiel-0002441/A0220016.pdf
Solar power				
			LOI n° 2023-175 du 10 mars 2023 relative à l'accélération de la production d'énergies renouvelables (1) - Article 54	https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000047294244
Bioenergy plant				
	Residential areas	100 meters	Annexe1 - Arrêté du 03/08/18	https://aida.ineris.fr/reglementation/arrete-030818-relatif-prescriptions-generales-applicables-installations-relevant
	Public buildings and public roads	20 meters	Article 5 de l'arrêté du 3 août 2018 du Code de l'Environnement	
	Industrial buildings	10 meters	Article 5 de l'arrêté du 3 août 2018 du Code de l'Environnement	
High voltage transmission line				
		U = tension in kilovolts Neighbourhood low : 0,0025*U meter Neighbourhood medium : 0,005*U meter Neighbourhood	Article 12 - Arrêté du 17 mai 2001 du Code de l'Environnement	https://www.legifrance.gouv.fr/loda/id/LEGITEXT000005631045/2020-12-03/

		high : 0,0075*U meter		
Roads/ highways				
	Outside urban areas : for accomodations and buildings	100m from the side of a highway, diversion, express roads 75m from road classified with high traffic	Article L111-6 du Code de l'Urbanisme	https://www.legifrance.gouv.fr/codes/id/LEGIARTI000031210191/2016-01-01/#LEGIARTI000031210191
Railways				
Low circulation or lines with a speed <= 160km/h	Any kind of infrastructure	2,2 meters from the side of the rail	Article 1 - Décret n° 2021-1772 du 22 décembre 2021 relatif à la protection du domaine public ferroviaire	https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044554622
Lines with a speed over 160km/h	Any kind of infrastructure	3 meters	Article 1 - Décret n° 2021-1772 du 22 décembre 2021 relatif à la protection du domaine public ferroviaire	https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044554622
Urban /industrial development				
			Décret n° 2015-1676 du 15 décembre 2015 relatif aux schémas régionaux et départementaux des carrières ainsi qu'à l'application du code de l'environnement outre-mer	https://www.legifrance.gouv.fr/codes/id/LEGIARTI000031637517/2015-12-18

For all type of infrastructures				
	Core center of National Parks, National and Regional Natural Reserve, sites classés (loi 1930)	Forbidden to build within the perimeter	- Article L331-4 du Code de l'Environnement (National Parks) - Art. L. 332-1 et suivants et L. 411-2 du Code de l'Environnement (Natural Reserve) - Article L.341-10 du Code de l'Environnement (sites classés)	https://www.bulletin-officiel.developpement-durable.gouv.fr/documents/Bulletin-officiel-0002441/A0220016.pdf
	In mountains : Natural or artificial lakes, rivers or water infrastructure < 1000 hectares	300 m	Article L145 de la Loi n°85-30 du 9 janvier 1985 du Code de l'Urbanisme	https://www.legifrance.gouv.fr/codes/id/LEGIARTI000006814877/1985-01-10
	Shore of seas, ocean or lakes bigger than 1 000 hectares	<100 m : Forbidden to build within the perimeter	Article L. 121-16 à L. 121-19 du Code de l'Urbanisme	https://www.ecologie.gouv.fr/sites/default/files/documents/La%20bande%20littorale%20de%20100%20m%20%C3%A8tres_0.pdf

5.3 Mapping the land use conflicts for renewable energy production

The following figures show the suitable sites and exclusion zones for each infrastructure analysed.

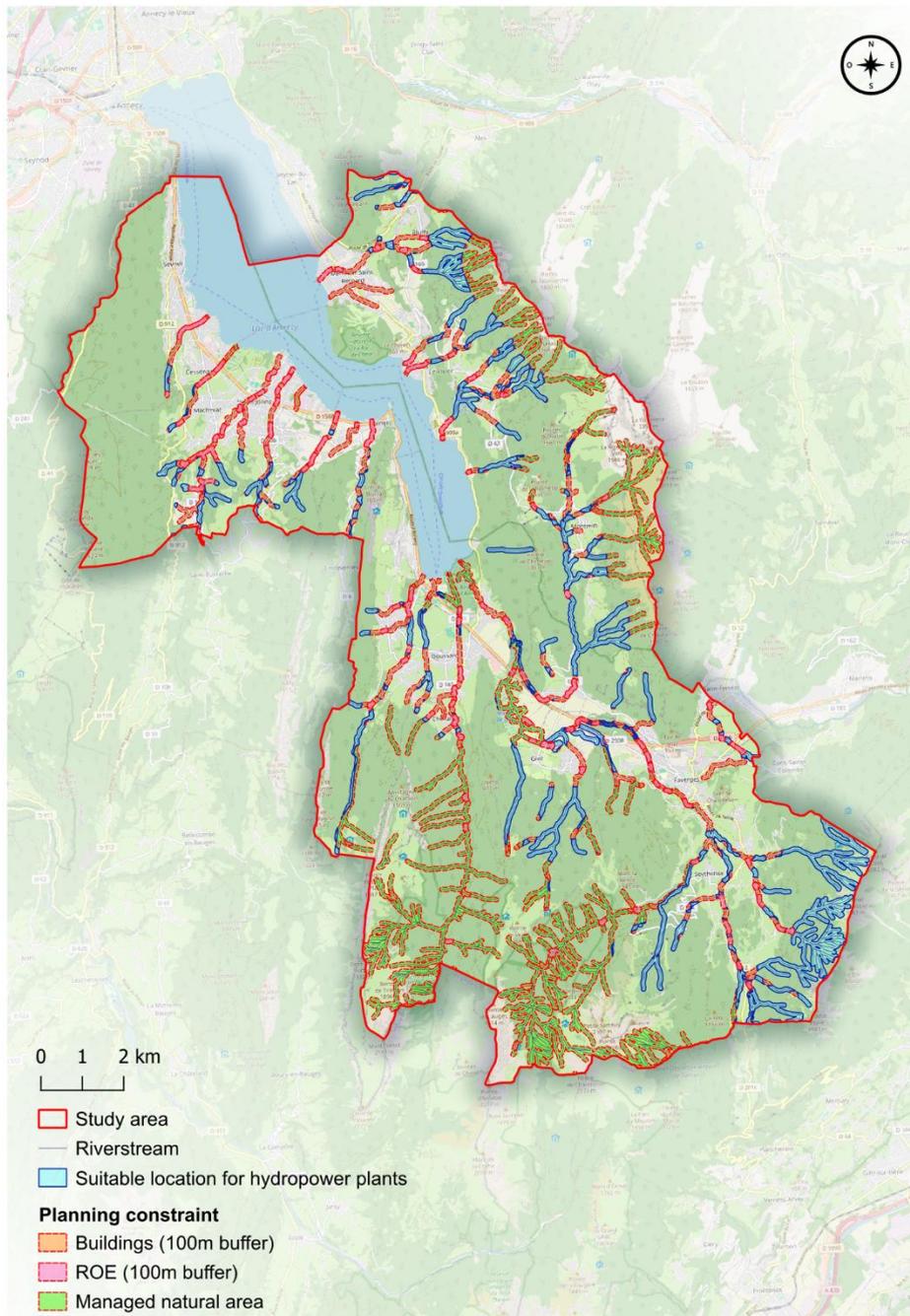
5.3.1 River power plants

The valley and rivers in the South of lake Annecy are not suitable for hydroelectric reservoirs but a certain number of smaller hydraulic infrastructures such as weirs are already settled in the area and can increase in number in the future. There are called under the common name of ROE (référentiel national des obstacles à l'écoulement) and gathers all types of river obstacles.

These run-off river power plants can disturb river connectivity, mostly for some local fish such as the brown trout (*Salmo trutta*). As shown in the map below a lot of these infrastructures are already settled in the bottom parts of rivers, which can cause river

fragmentation for migratory fishes. The only bottom rivers next to the lake not set up are located in the Natural Reserve of the Tip of the Lake.

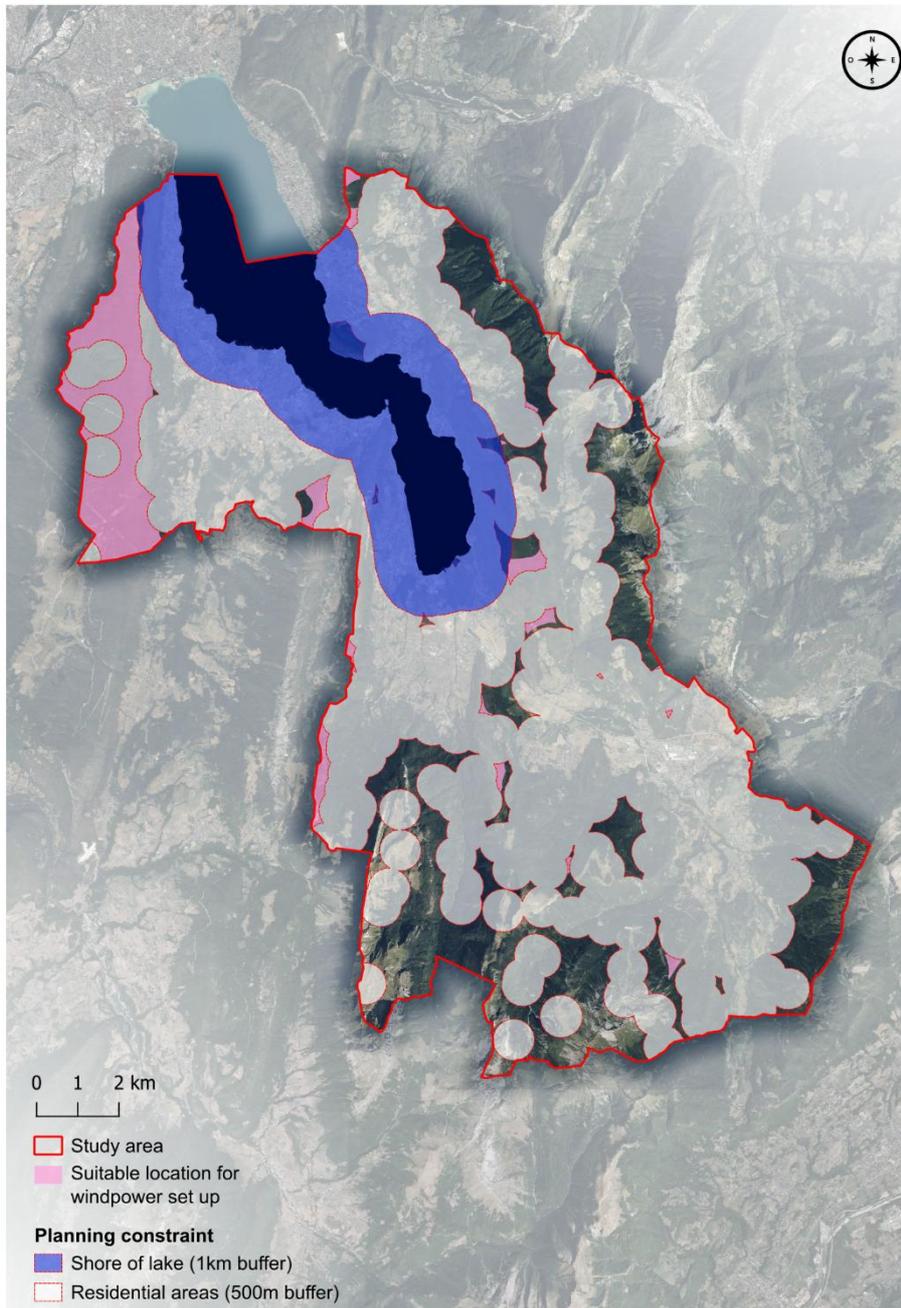
Upstream, rivers are less converted and could be potential places of new weir's installation in several rivers around the basin of lake Annecy with few restrictions. There is some exception in the South-West with managed natural areas where the Regional park sets limits on build ups and in the East where Sensitive Natural Area can be also a restriction for build ups.



5.3.2 Wind power

The pilot site is in its overall not a suitable place for wind power infrastructures due to a high density of housing and urban areas. Lake Annecy also represent an exclusion zone, leaving few places available to install wind power infrastructures.

However, the forest of the Semnoz could represent a potential site for wind power infrastructures and should be monitored carefully to avoid a build-up in this key biodiversity reservoir.



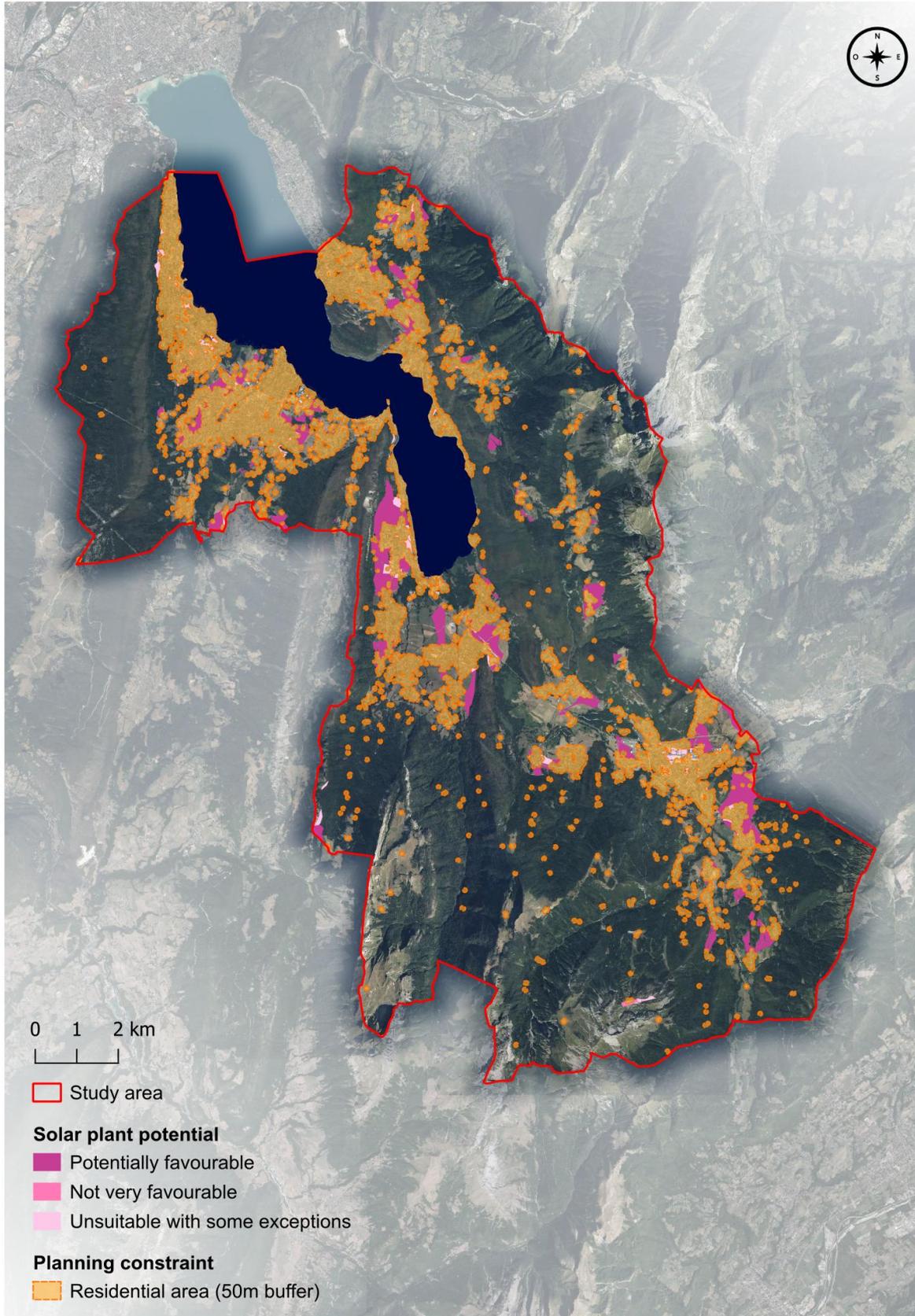
5.3.3 Solar power

The South of lake Annecy could be threatened by the establishment of solar panel fields. Most of exclusion zones are composed of forest or mountainous areas. Even if no law exists, there are recommendations to settle solar panel field at a minimum distance of 50m from any urban settlements or housing, which are buffers represented on these maps. Buildings, parking lots and infrastructures in general were not analysed in this case study, that could nonetheless represent highly suitable places for solar installation.

Suitable places are mostly represented in this map as agricultural fields and uncultivated areas of more than a hectare. Most of them are essential places to allow a good functionality of corridors. Solar power infrastructures could therefore represent a serious threat to the local connectivity.

For example, there is an area near the road D1508 which is a key element for the connectivity of the area, located in an urban bottleneck. It is part of the stepping stone path from the Natural Reserve of the Tip of Lake Annecy to the Prefectoral Order of Biotope Protection. If this key place would be build-up, it would close a whole corridor connection. Solar power is therefore representing in this area a major threat for local connectivity.



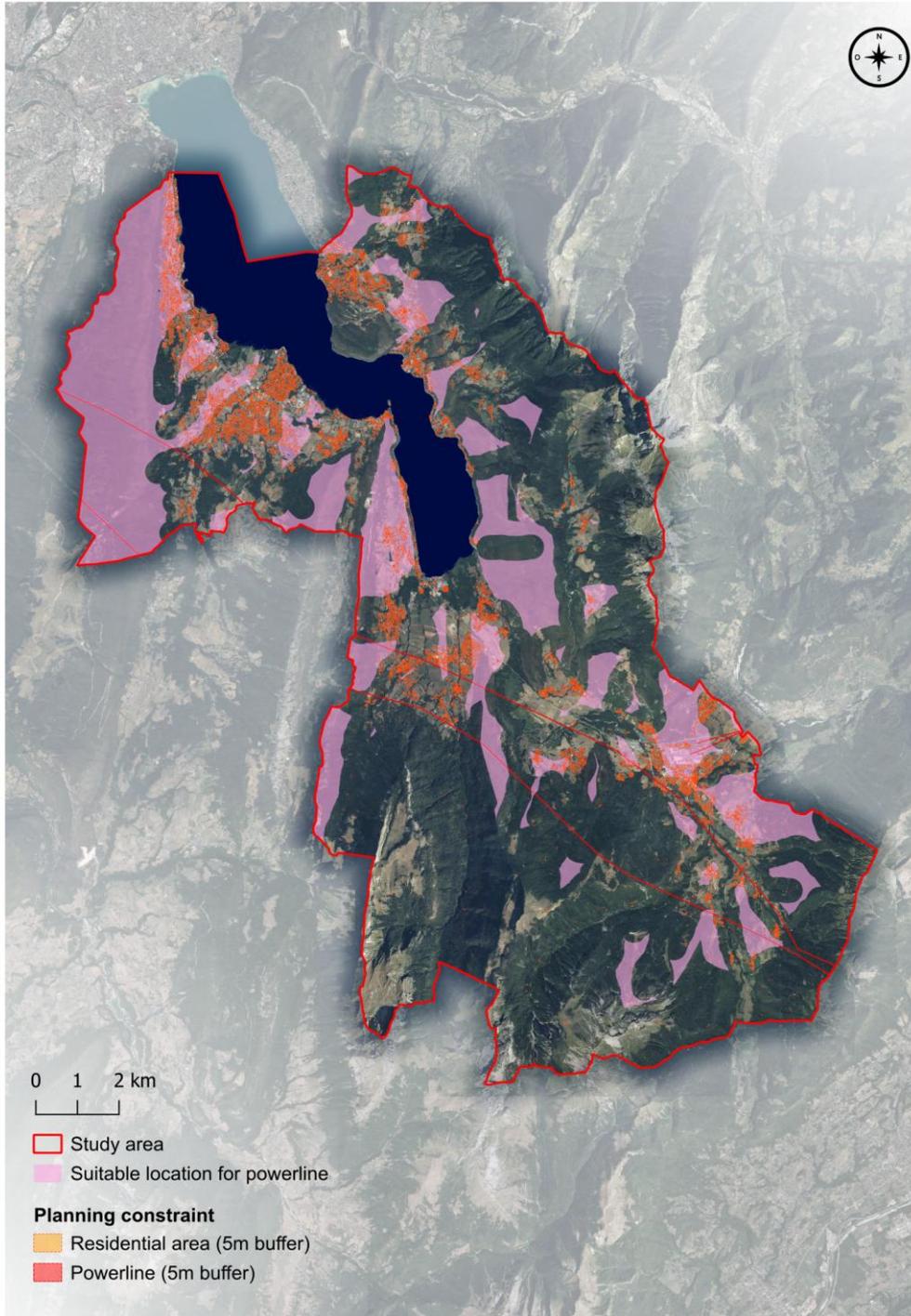


Credits : BD ORTHO® (IGN), Potentiel solaire au sol (DGEC / Cerema); Realisation : Asters - CEN74 le 16/06/2025



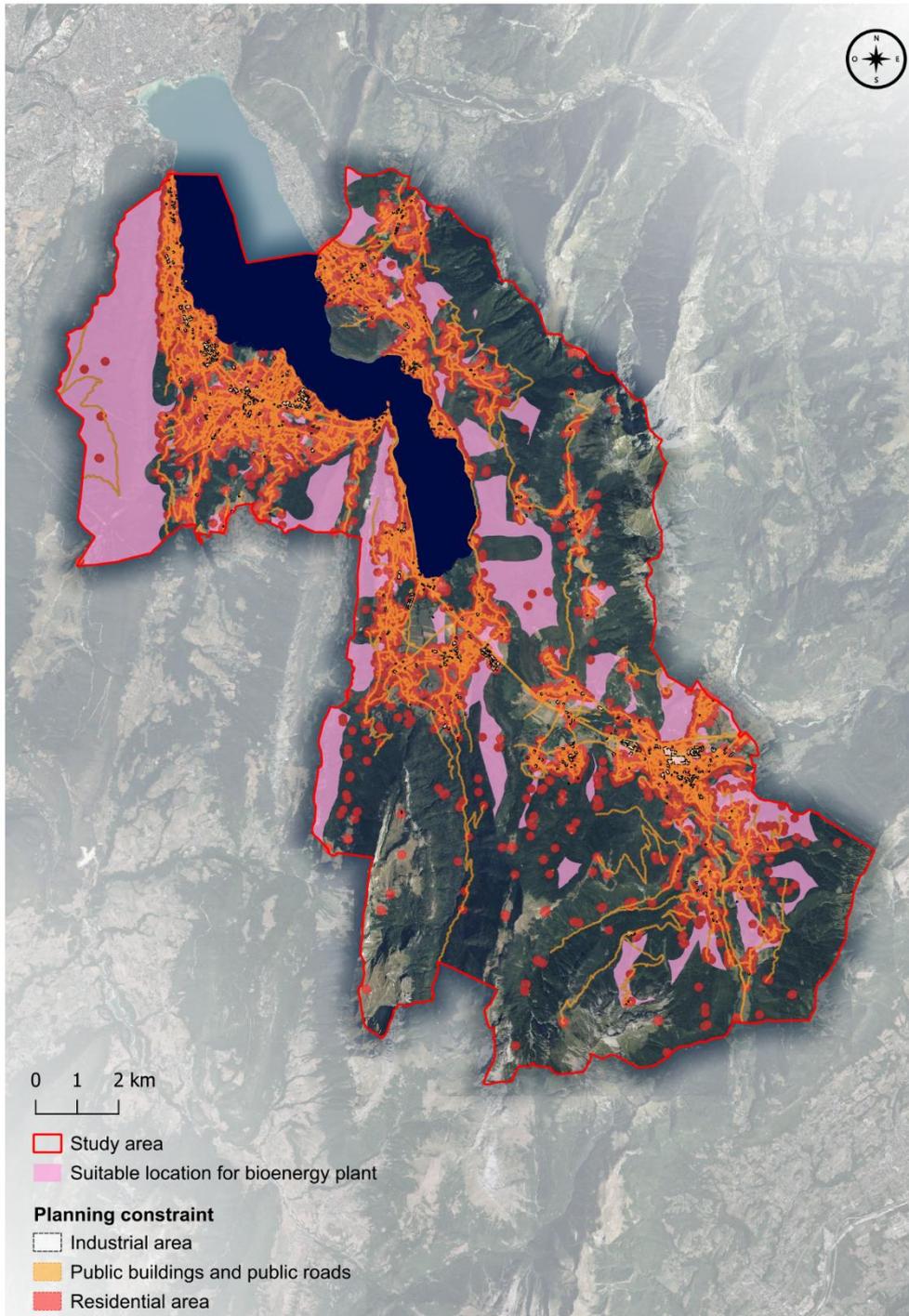
5.3.4 High voltage transmission line

High, as well as low, voltage transmission lines could be settled in a high range of places around the pilot site and impact aerial corridors in most places around lake Annecy. There is less planning constraints for these types of infrastructures than for other types.



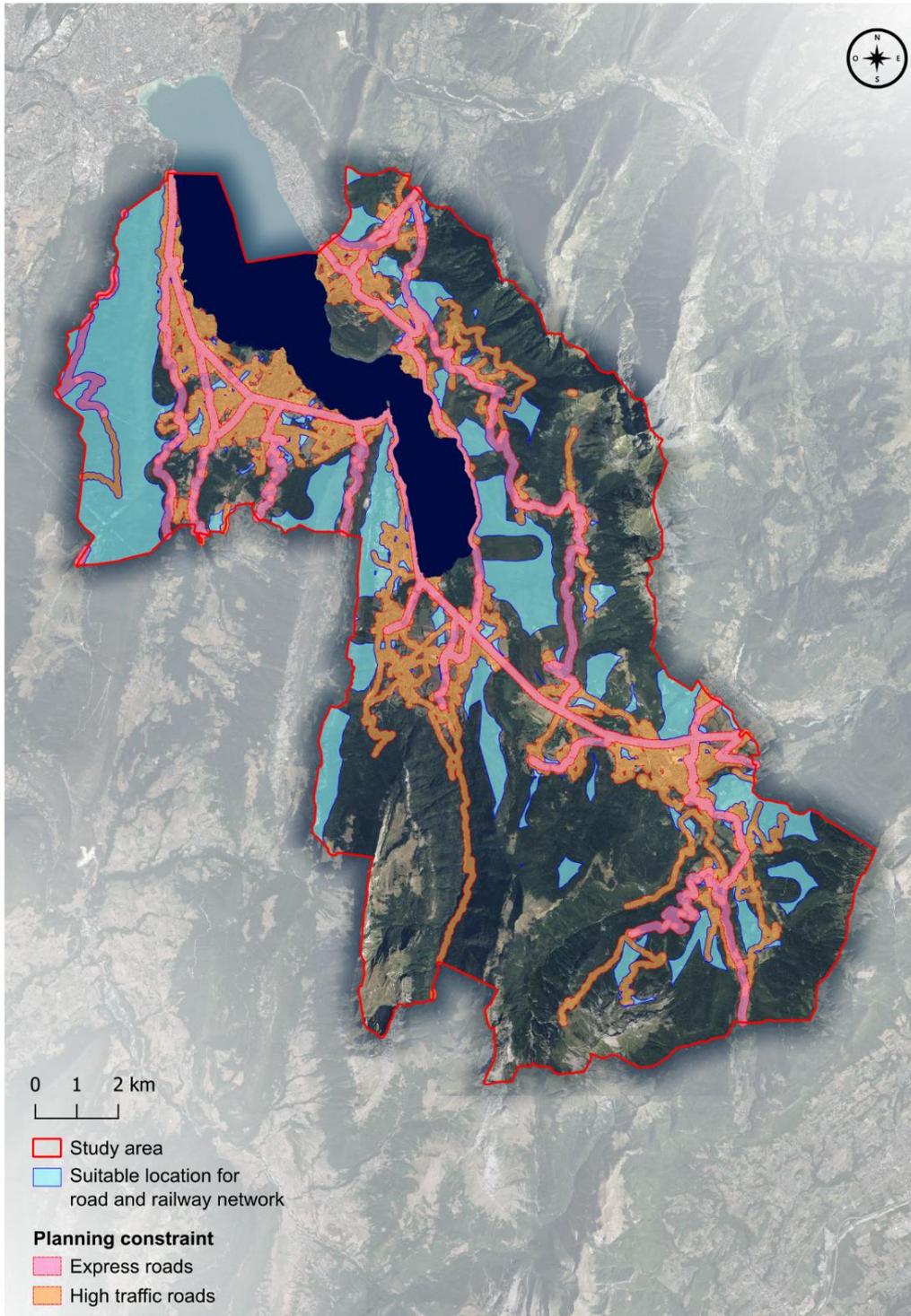
5.3.5 Bioenergy plant

These infrastructures do not have a lot of planning constraints besides to be built at a certain distance from other buildings. It can therefore be constructed in several places within the pilot site.



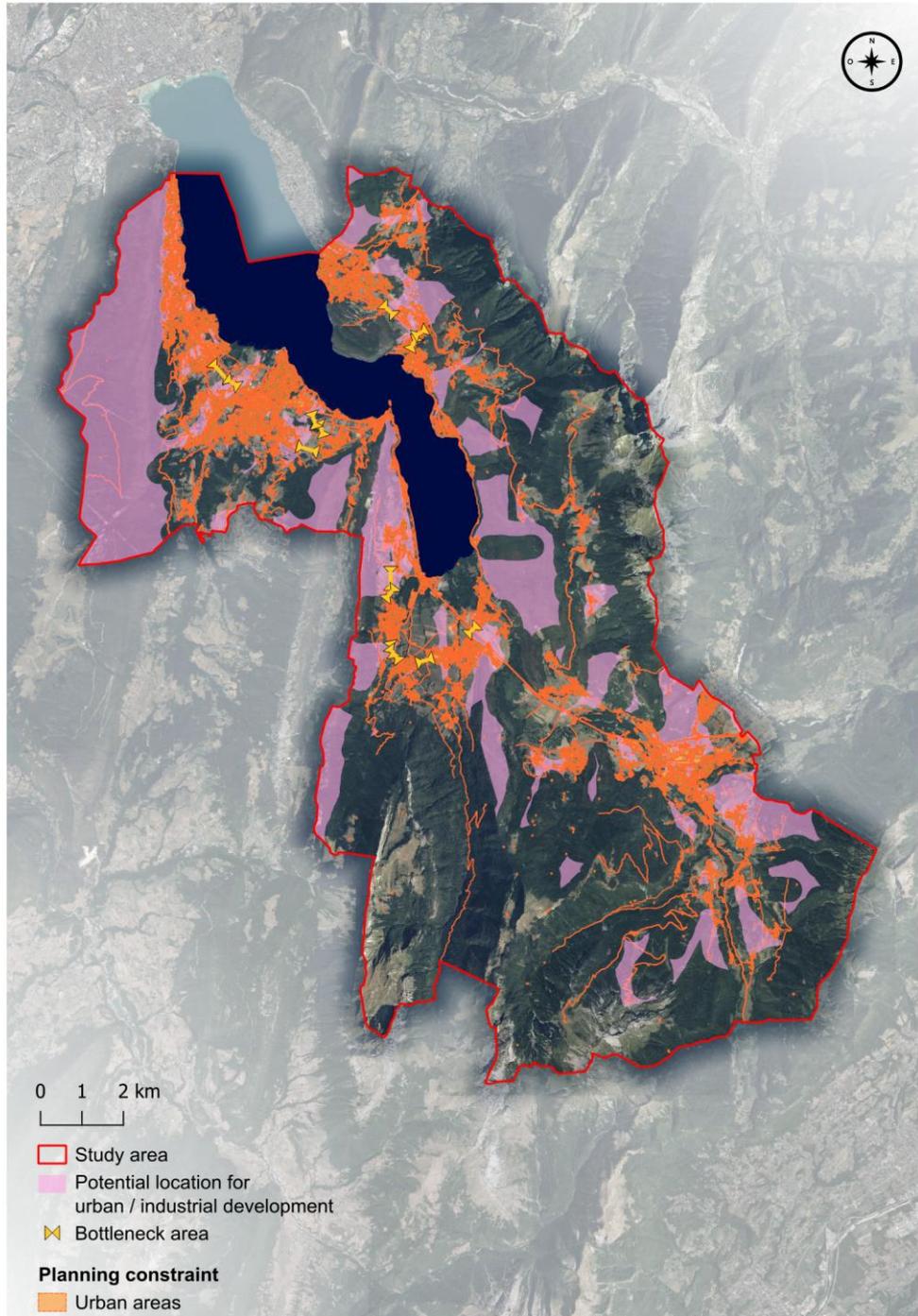
5.3.6 Roads/ Highways and Railways

In a similar way as the suitable places for bioenergy plants, roads and railways could be built in several places around lake Annecy.



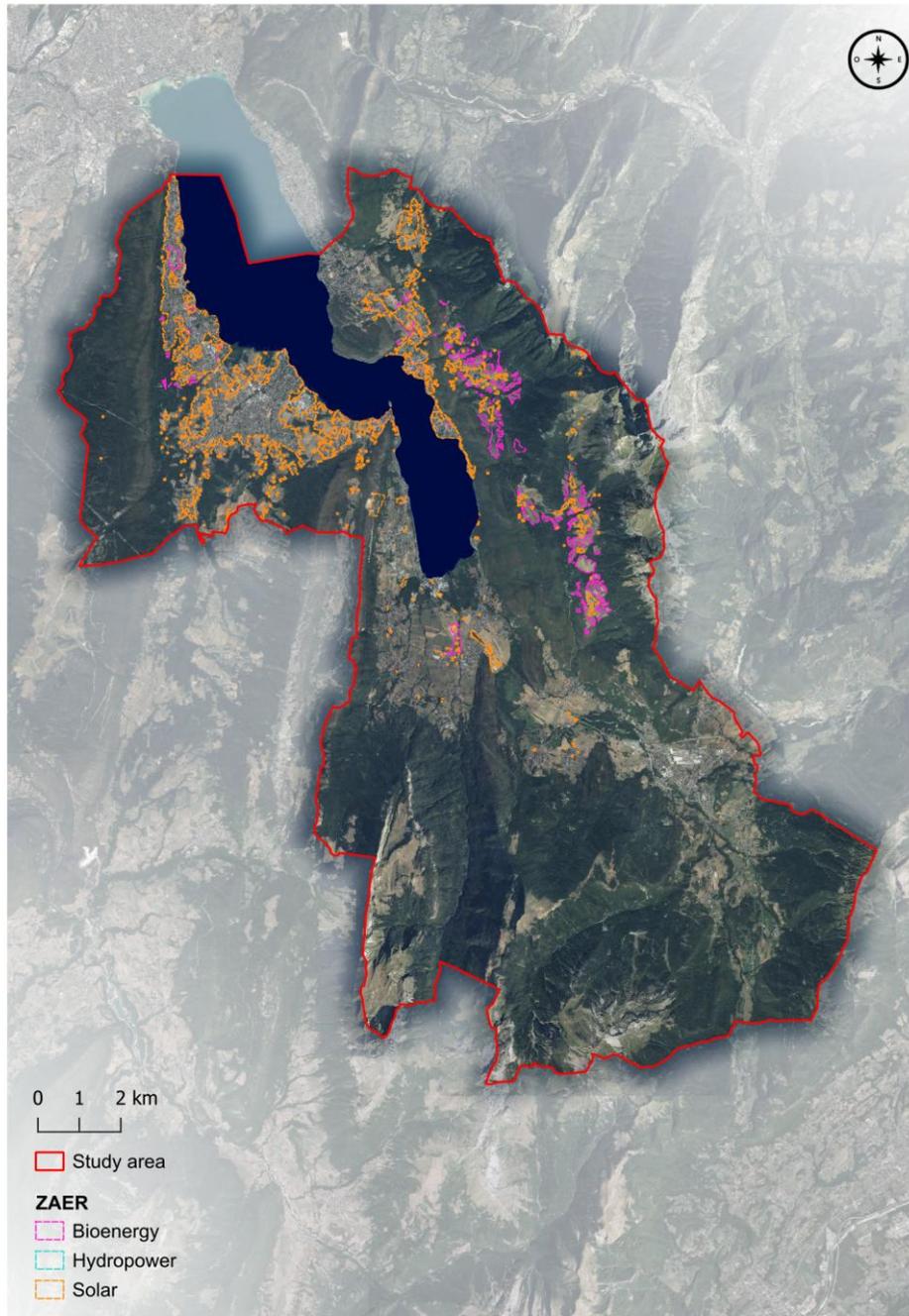
5.3.7 Urban /industrial development

Urban expansion could be located in several suitable areas and bottlenecks should be most monitored places to protect for the local connectivity.



5.3.8 ZAER

In France, the ZAER, acceleration zones for renewable energies, were defined and mapped on the territory. These places are taking into account some planning constraints we represented in the map before, but it adds information of energy availability. If compared with maps we created, similar places are represented as suitable for renewable energies in the bottom valleys and the forest of the Semnoz is not a suitable anymore.

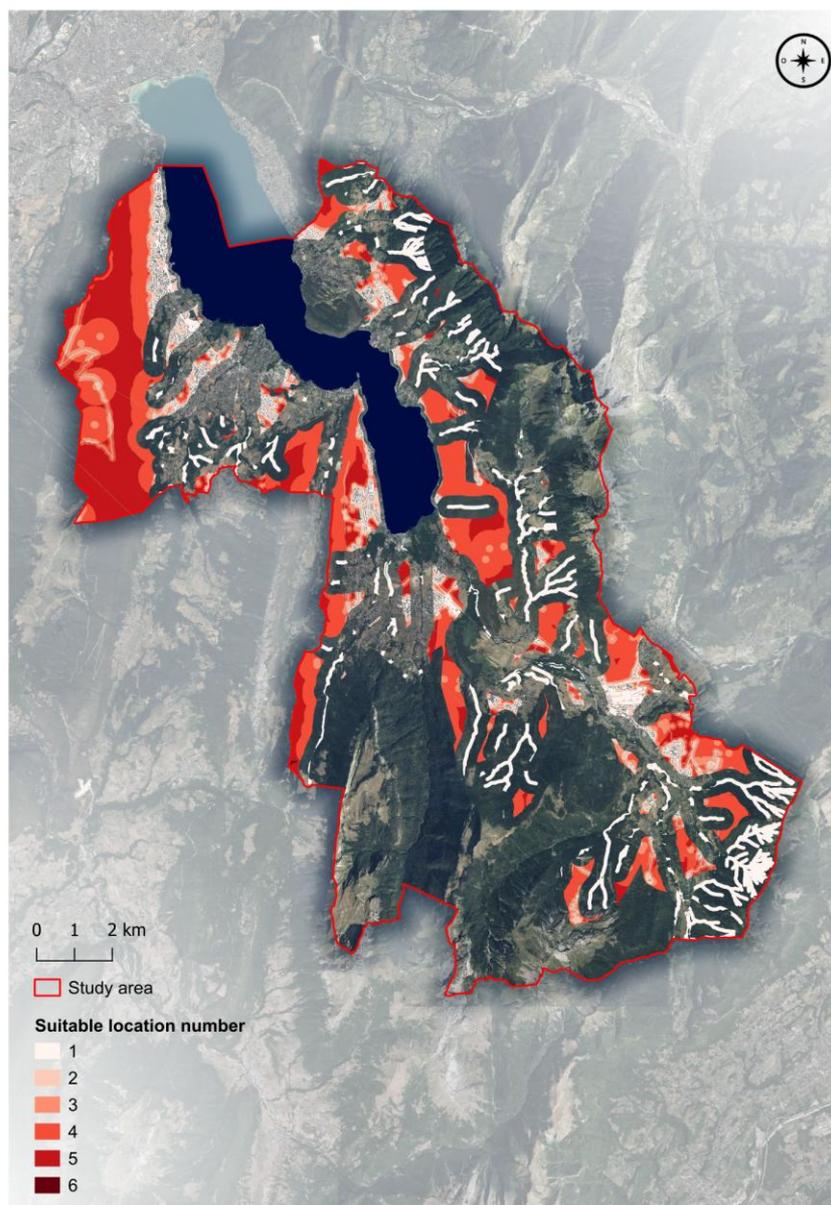


5.3.9 Potential location sites

The map below summarizes potential sites for renewable energy settlement, the highest the number (6) the more different type of energy firms could be built in this area.

Most potential settlement places are located in agricultural fields that surrounds the urban areas of the valley bottoms. These places are also representing key chains of the local corridors and could be a threat if renewable energy settled on these areas.

The mountainous forest of the Semnoz is also a place suitable for several settlement of renewable energies and the limits of the regional park does not cover this part entirely, limiting its capacities to intervene into planning projects.



6 Possible mitigation and compensation measures

A list of all possible mitigation and compensation measures can be found in the Annex 2. They are based on the corresponding chapters of the report [D1.3.1](#).



7 Conclusions

The South of lake Annecy already faces strong pressures on valley bottoms due to urban expansion and road infrastructures, enhanced by the scarcity of space with constraining natural frames such as the lake, steep mountainous areas and some protected natural areas.

These bottom valleys areas could be even more threatened by the implantation of renewable energies. Maps created in this report show that most suitable areas are already under pressure and represent at the same time important places for the regional and local connectivity. There are mostly composed of agricultural field, urban gaps and bottlenecks which are essential part of the local ecological network. Any RE installation would therefore have a high impact on the local connectivity of the pilot site.



8 GLOSSARY

Bioenergy plants	Bioenergy is a source of energy from the organic material that makes up plants, known as biomass (IEA, 2025).
Connectivity (structural and functional)	<p>“Connectivity comprises two components, structural and functional connectivity. It expresses how landscapes are configured, 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)</p> <p>(Definition of connectivity see also Deliverable 1.1.1, chapter 8)</p>
GBI – Green and blue infrastructure	<p>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)</p> <p>(Definition of connectivity see also Deliverable 1.1.1, chapter 6)</p>
Hydropower (dams, weirs, run-off-river power plant)	<p>Power derived from the energy of falling water or fast running water to generate electricity</p> <p>Hydropower generation including development and use of associated infrastructure (e.g. building dams or weirs, changes of hydrological functioning rivers or chemical and thermal properties of water due to operation of dams and weirs).</p>
Hydroelectric dam	A barrier that stops or restricts the flow of water; used to create energy in the water flow that can be captured by a turbine to generate electricity
Pressures and Threats	<p>Definition by the European Environment Agency 2020 (State of nature in the EU - Results from reporting under the nature directives 2013-2018):</p> <p><i>“Pressures are considered to be factors that have affected habitats and species within the current reporting period, while threats are factors that are anticipated to be likely to have an impact during the subsequent two reporting periods.”</i></p>
SCOT	Direct translation of the French designation “Schéma de Cohérence Territoriale”. It is an urban planning gathering several municipalities.
Solar PV panel	An arrangement of PV materials that absorbs and converts sunlight into electricity
SRADDET	Direct translation of the French designation “Schéma régional d'aménagement, de développement durable et d'égalité des territoires”. Management plan at a regional scale aiming for a global consistency of territories. Local plans must be aligned to the SRADDET's purposes. Within the SRADDET, Green and Blue infrastructures are identified and are compulsory to take them into account in local planning.

Transmission lines	Power lines used to move electricity from a generating site (e.g., a power plant) to an electrical substation, which often transforms the voltage from high to low before reaching consumers
Wind farm	A group of wind turbines used to produce electricity



9 References

- European Environment Agency (2020) State of nature in the EU - Results from reporting under the nature directives 2013-2018, Doi : https://www.researchgate.net/publication/344930566_State_of_nature_in_the_EU_Results_from_reporting_under_the_nature_directives_2013-2018, Accessed 24/06/25
- IEA, International Energy Agency (2025) Bioenergy, Doi : <https://www.iea.org/energy-system/renewables/bioenergy>, Accessed 24/06/25
- Legifrance (2025) Code de l'urbanisme, Doi : <https://www.legifrance.gouv.fr/codes/id/LEGIARTI000006814877/1985-01-10>, Accessed 24/06/25
- Naturalia Environnement (2023) SCOT du bassin annécien, Diagnostic
- SRADDET, 2020



ANNEXES

Annex 1 Identification of projects thresholds for spatial planning

	Relevance for Environmental Impact Assessment (EIA)	Relevance for spatial planning
Hydropower	<p>According to the EU's Environmental Impact Assessment Directive dams of a certain capacity must be assessed for their impact on the environment (Environmental Impact Assessment - EIA).</p> <p>For Germany, the following projects are subject to an EIA:</p> <ul style="list-style-type: none"> • Construction of a dam or other facility for the retention or permanent storage of water where 10 million m³ or more of water is retained or stored (No. 13.6.1 Annex 1 UVPG) → project is subject to an EIA • Construction of a dam or other facility for the retention or permanent storage of water, where less than 10 million m³ of water is retained or stored (No. 13.6.2 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG,) • Construction and operation of a hydropower plant (No. 13.14 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • River canalisation and stream correction work (No. 13.8 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) 	<p>Any construction and operation of a hydropower plant</p> <p>Any river canalisation and stream correction work</p>
Windpower (windmills)	<p>In the EU's Environmental Impact Assessment Directive windpower is not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA).</p> <p>For Germany, the following projects are subject to an EIA:</p> <p>Construction and operation of a wind farm with turbines with a total height of more than 50 metres each with</p> <ul style="list-style-type: none"> • 20 or more wind turbines (No. 1.6.1 Annex 1 UVPG) → project is subject to an EIA • 6 to 20 wind turbines (No. 1.6.2 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • 3 to 6 wind turbines (No. 1.6.3 Annex 1 UVPG) → site-specific preliminary assessment of the individual case (Section 7 (2) UVPG) 	<p>Wind farm with 3 wind turbines with a total height of more than 50 metres each</p>



	Relevance for Environmental Impact Assessment (EIA)	Relevance for spatial planning
Solar power (ground mounted photovoltaic systems)	<p>In the EU's Environmental Impact Assessment Directive solar power is not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA).</p> <p>In Germany, solar systems are not explicitly listed in the UVPG. The following projects can be regarded as comparable projects: Construction of a leisure park (No. 18.3 Annex 1 UVPG), construction of an industrial zone (No. 18.5 Annex 1 UVPG) and construction of an urban development project (No. 18.7 Annex 1 UVPG). The following sizes of the planning area apply to these projects:</p> <ul style="list-style-type: none"> • 10 ha or more (No. 18.3.1 Annex 1 UVPG, No. 18.5.1 Annex 1 UVPG, No. 18.7.1 Annex 1 UVPG) → project is subject to an EIA • 4 ha to less than 10 ha (No. 18.3.2 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • 2 ha to less than 10 ha (No. 18.5.2 Annex 1 UVPG, No. 18.7.2 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) 	ground mounted photovoltaic system with a size of at least 2 hectares
Biomass (biogas plant)	<p>In the EU's Environmental Impact Assessment Directive bioenergy plants are not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA).</p> <p>For Germany, the following projects (only for biogas) are subject to an EIA.</p> <p>Production of biogas with a production capacity of</p> <ul style="list-style-type: none"> • 2 million standard cubic metres or more of raw gas per year (No. 1.11.1.1 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • 1.2 million to less than 2 million standard cubic metres of raw gas per year (No. 1.11.1.2 Annex 1 UVPG) → site-specific preliminary assessment of the individual case (Section 7 (2) UVPG) 	Biogas plant with more than 1.2 million standard cubic metres of raw gas per year
High voltage transmission line	<p>In the EU's Environmental Impact Assessment Directive transmission lines are not mentioned as a subject of an obligatory Environmental Impact Assessment (EIA).</p> <p>For Germany, the following projects are subject to an EIA.</p> <p>Construction and operation of a high-voltage overhead line with</p> <ul style="list-style-type: none"> • a length of more than 15 km and with a rated voltage of 220 kV or more (No. 19.1.1 Annex 1 UVPG) → project is subject to an EIA • a length of more than 15 km and with a rated voltage of 110 kV up to 220 kV (No. 19.1.2 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • a length of 5 km to 15 km and with a nominal voltage of 110 kV or more (No. 19.1.3 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • a length of more than 200 m and less than 5 km and a rated voltage of 110 kV or more (No. 19.1.4 Annex 1 UVPG) → site-specific preliminary assessment of the individual case (Section 7 (2) UVPG) 	transmission line with a voltage of 110 kV or more

	Relevance for Environmental Impact Assessment (EIA)	Relevance for spatial planning
Roads/ highways	<p>According to the EU's Environmental Impact Assessment (EIA) Directive motorways and express roads must be assessed for their impact on the environment (Environmental Impact Assessment - EIA).</p> <p>For Germany, the following projects are subject to an EIA:</p> <ul style="list-style-type: none"> • Construction of a federal motorway or other federal road (No. 14.3 Annex 1 UVPG) → project is subject to an EIA • Construction of a new four-lane or multi-lane federal road if this new road has a continuous length of 5 km or more (No. 14.4 Annex 1 UVPG) → project is subject to an EIA • Construction of a four-lane or multi-lane federal road by relocating and/or upgrading an existing federal road if this modified section of federal road has a continuous length of 10 km or more (No. 14.5 Annex 1 UVPG) → project is subject to an EIA 	four-lane or multi-lane federal road with continuous length of 5 km or more
Railways	<p>According to the EU's Environmental Impact Assessment (EIA) Directive long-distance railways must be assessed for their impact on the environment (Environmental Impact Assessment - EIA)</p> <p>For Germany, the following projects are subject to an EIA:</p> <ul style="list-style-type: none"> • Construction of a railway track with the associated operating facilities and traction power lines on the site of the operating facility or along the railway track (No. 14.7 Annex 1 UVPG) → project is subject to an EIA • Construction of other railway operating facilities if they cover an area <ul style="list-style-type: none"> • of 5000 m² or more (No. 14.8.3.1 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) • from 2000 m² to less than 5000 m² (No. 14.8.3.2 Annex 1 UVPG) → site-specific preliminary assessment of the individual case (Section 7 (2) UVPG) • Construction of another railway line for public track-guided traffic with the associated operating facilities (No. 14.10 Annex 1 UVPG) → general preliminary assessment of the individual case (Section 7 (1) sentence 1 UVPG) 	railway track associated operating facilities with more than 2000 m ²



Annex 2 Mitigation /compensation (see [D1.3.1](#))

	Mitigation / Compensation
Hydropower	<ul style="list-style-type: none"> • Upstream and downstream fish passage facilities (fish ladders, bypasses) to allow migration • intelligent turbine design or turbine shutdown on a fixed schedule decreasing turbine related mortality • ecologically effective minimum flow of water • bed-load management • morphological enhancement measures: <ul style="list-style-type: none"> ➢ improvement of the riverbank structure (unsealing the riverbank) ➢ introduction of gravel banks ➢ introduction of disturbance elements (stones, deadwood) • New hydropower technologies with less environmental impacts
Windpower	<ul style="list-style-type: none"> • turbine design optimization • switch off systems at times of increased bird/bat activity to prevent/avoid collisions (Automatic anti-collision systems) • unattractive design of the environment at the base of the mast and in surrounding fields for wind energy-sensitive birds (red kites)
Solar power	<ul style="list-style-type: none"> • landscape-oriented design of the facility, visual integration into the environment: suitable arrangement of the solar panels (e.g. "Solar biotope network") • sufficiently large (wide) open spaces between the rows of solar panels (sunlit strips at least 3 m wide between the rows) • elevation of the solar panels (panel distance to the ground at least 0.8 m) • no fencing or at least permeable for small and medium-sized mammals (15 cm distance between the fence and the ground), migration corridors as crossing aids for large-scale facilities • development and maintenance of extensively used, species- and flower-rich grassland in the solar park <ul style="list-style-type: none"> ➢ using seeds from local species or locally obtained mown material ➢ no fertilization, no use of pesticides ➢ up to 2 mowing intervals (use of insect-friendly mower, cutting height 10 cm) with removal of mowed material or/and site-adapted grazing • no mulching
Biomass (bioenergy plant)	<ul style="list-style-type: none"> • -



	Mitigation / Compensation
High voltage transmission line	<ul style="list-style-type: none"> • bundling of linear infrastructure, appropriate route alignment • appropriate design of the pylons to reduce fragmentation including spanning above the forest canopy • marking transmission lines to reduce bird collision risk • ecological rights-of-way vegetation management creating and connecting new habitats
Roads/ highways	<ul style="list-style-type: none"> • appropriate route alignment • traffic management measures: reducing traffic volume or speed • fencing combined with wildlife passages • wildlife passages as overpasses (e.g. green bridge, fauna overpass, multiuse overpass) or as underpasses (e.g. viaduct, fauna underpass, multiuse underpass, small fauna underpass, adapted culverts, fish passage, amphibian passage) reducing the barrier effect and providing a safe crossing • embankments to mitigate noise and provide new habitats for endangered flora species • adapting infrastructure verges • mechanical methods for vegetation control or grazing as alternative methods to the use of chemical substances in the management of green areas • adapting road lighting for mitigating light pollution • noise screens, placing the road between cuttings or earthen mounds, silent pavements for mitigating noise • runoff water management: Retention ponds
Railways	<ul style="list-style-type: none"> • appropriate route alignment • fencing combined with wildlife passages • wildlife passages as overpasses (e.g. green bridge, fauna overpass, multiuse overpass) or as underpasses (e.g. viaduct, fauna underpass, multiuse underpass, small fauna underpass, adapted culverts, fish passage, amphibian passage) reducing the barrier effect and providing a safe crossing • embankments/ earthworks to mitigate noise and provide new habitats for endangered species • adapting infrastructure verges • mechanical methods for vegetation control or grazing as alternative methods to the use of chemical substances in the management of green areas • noise screens, placing the road between cuttings or earthen mounds, rail noise absorbers for mitigating noise • runoff water management: Retention ponds



	Mitigation / Compensation
<p>Urban /industrial development</p>	<ul style="list-style-type: none"> • appropriate location of new urban/industrial development (avoid areas of high nature conservation value including ecological corridors) • preservation of large, undissected open spaces, safeguarding inner-urban trees (particularly large/mature trees) • minimizing the road infrastructure associated with urban/industrial development, keeping vehicle speeds low • reducing use of fertilizers and pesticides in maintenance of public and private green • minimizing artificial lighting • good pet ownership to reduce domestic animal damages to wildlife • runoff water management: minimize water runoff into streams • Integration of connectivity elements in zoning plans / optimising connectivity planning and interfaces between regional concepts and municipal planning



PlanToConnect

GBI-network: Land use conflicts for Renewable Energy production and other threats
South of Lake Annecy

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)
Salzburg Institute for Regional Planning and Housing (AT)
E.C.O. Institute of Ecology Ltd. (AT)
Fondazione Politecnico di Milano (IT)

GBI-network: Land use conflicts for Renewable Energy production and other threats South of Lake Annecy

Author(s)

Héloïse VENAUT, Asters CEN74, ASTERS Conservatoire d'Espaces Naturels de Haute-Savoie heloise.venaut@cen-haute-savoie.org

Jules GRILLOT, Asters CEN74, ASTERS Conservatoire d'Espaces Naturels de Haute-Savoie
jules.grillot@cen-haute-savoie.org

Layout

Héloïse VENAUT, Asters CEN74, ASTERS Conservatoire d'Espaces Naturels de Haute-Savoie

April, 2025

