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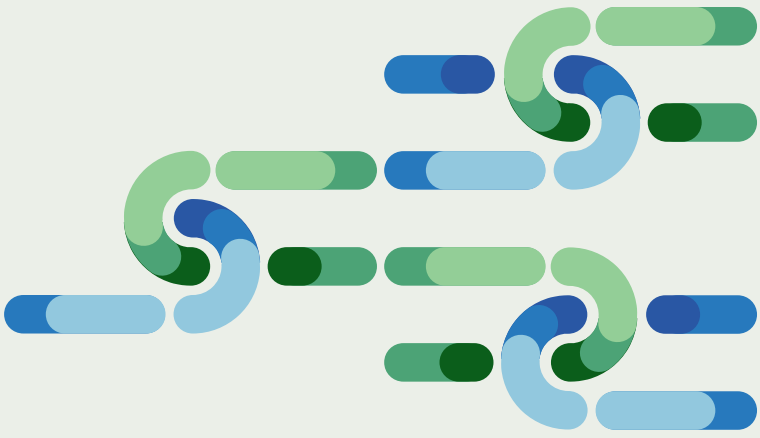
PlanToConnect

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

Planungsregion 17: “Oberland”

Mapping report outlining GBI network elements and areas of land use conflicts for renewable energy production and other major developments that may threaten GBI connectivity function



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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

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EXECUTIVE SUMMARY

This report explores the effects main threats have on Green Infrastructure networks within the pilot area in the planning region of “Oberland”. Hereby the focus lays on the effects that especially renewable energy infrastructures have regarding green infrastructures. But additionally, our report underlines the effects other major issues on infrastructure are present and of high importance. These include areas of high risk for flood retention and agricultural uses.

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.

As part of the PlanToConnect project, the University of Wuerzburg is conducting a case study on the integrated planning of a GBI (Green and Blue Infrastructure) connectivity network in the pilot area “Planungsregion 17: ‘Oberland’”, in the administrative perimeter of the government of Upper Bavaria. The design of a GBI network for connectivity in the pilot region has been developed and described in the report D2.3.1. Priority areas for conservation and restoration were identified there in regards to their specific ecosystem services. These thematic areas form the basis for integrating ecological connectivity into planning instruments. Ecological connectivity in the pilot region Oberland is not considered in the sense of an uninterrupted corridor with directly adjacent habitats, but rather as a wide ecological network featuring structural diversity by protecting and restoring landscape functionality and ecosystem services for ecological connectiviy (see report D2.3.1).

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

- to assess the impact by agriculture and environmental risks (flooding) on ecological connectivity
- potential of implementation of exclusion areas of renewable energy infrastructures through regional planning with a focus on photovolatik-infrastructures that may threaten 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.

The focus of this report lays mostly on renewable energies in the form of solar energy installationsbut also covers multiple land-use aspects that are of relevance in the pilot area. 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 focusses on renewable energies and excludes urban/industrial development and infrastructures. While agricultural land use per se also affects ecological connectivity (see report D1.2.1), but spatial planning and its instruments

[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).

virtually have no mandate or steering influence, those areas are of strategic importance for highlighting exclusion or strategic areas of interest for specific uses.

Structure of the report

Chapter 2 shortly describes the pilot region.

Chapter 3 deals with the methodological approach and relevant datasets present within the region used in the pilot region.

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

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

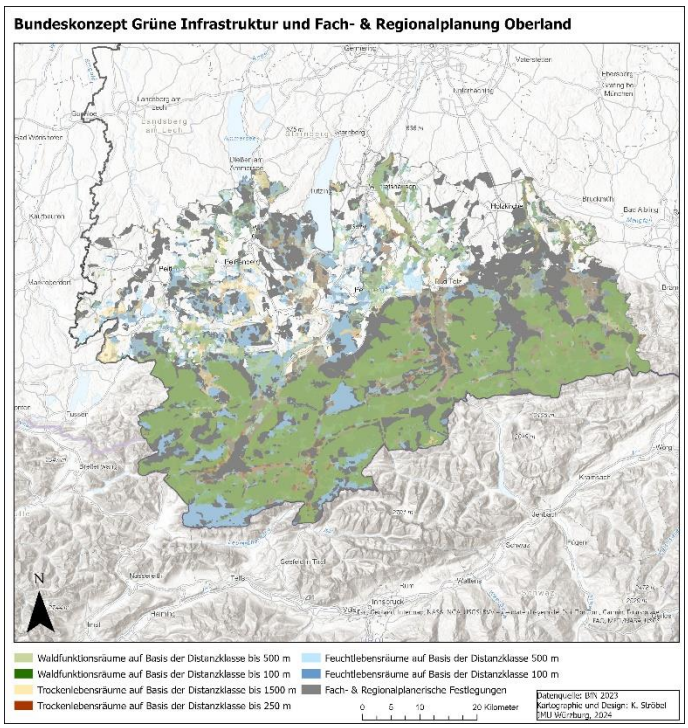
Chapter 6 describes the possible mitigation and compensation measures in the context of spatial planning for the existing and planned infrastructures in the pilot region.

2 Pilot region Oberland

Please describe your pilot region very briefly using text and pictures from D 2.3.1. One map of the pilot region is sufficient as an overview.

The planning area No. 17: “Oberland” is a structural and strategic planning area in the south of Upper Bavaria that is of high interest for the specific analysis due to the topographic potentials but also limitations. Being in the south of Bavaria in the Bavarian part of the European Alps while being close to the agglomeration of Munich, it has high economic and settlement interests that oppose being multiple pressures on the existing land.

The pilot region is structured by a strong relief in the south with well settled valley bottoms as well as soft and highly settled distributed settlement areas in the northern part.



Picture 1: Overview – pilot region Oberland

3 Methodological steps

3.1 Description of the approach/ working steps

Working Step	Description
1 **General threats of infrastructures and land uses posed to GBI ecological networks**	The first step is to identify which infrastructures or land uses generally have a negative impact on connectivity. The results of report D1.3.1 can be used for this purpose. Additional information was collected within the frame of one stakeholder workshop and one expert interview.
2 **Definition of relevant planning instruments and existing data**	The second step is to identify which areas or planned infrastructures in the pilot region are spatially relevant. For this purpose existing data was compiled and an analysis was carried out of planning instruments that deal with these land-uses and infrastructures that were identified in Step 1. A focus was established on specific planning instruments
3 **Existing pressures and expected major threats in the pilot region**	In a third step, all spatially relevant existing infrastructures in the pilot region are compiled on the basis of • references to existing relevant infrastructure and projects by the Regional Connectivity Working Group • interviews with planning experts from the regional level) to identify major developments that are of concern for the overall connectivity network • information conducted within stakeholder interviews
4 **Compilation of general criteria for unsuitable locations**	General criteria for unsuitable locations can be found in report D1.3.1., a collection of strategies for planning unsuitable locations was carried out within one stakeholder expert interview
5 **Development of planning approaches for major land use threats**	Strategic planning was developed and analysed through stakeholder involvement for how spatial planning at the regional level can deal with the major land use threats that exist within the pilot area.

Working Step	Description
6 **Mapping the land use conflicts for renewable energy production**	With regard to ecological connectivity a map of the exclusion zones for each relevant type of infrastructure (hydropower, wind power, solar power) is generated (using simple overlay functions and proximity tools). Including data for agricultural value and of relevance for further land use conflicts. Additionally, ecosystem services were included as well. Biomass, high voltage transmission lines, roads, railways and urban/industrial development are not being considered in this report.
7 **Mitigation or compensation measures**	Mitigation potential is only briefly discussed as we are not analysing the local level that is presented with another depth of how to deal with land use conflicts and major threats to GBI. We highlight specifically the regional planning level and identify potentials through existing planning structures.

3.2 Data used

The Table 1 shows the data that were used and were available for analysing the pilot region.

Table 1: Overview of regional data used

Data	Source	Description
Nature conservation area („*Naturschutzgebiet – NSG*“; 2023)	LfU (Bayerisches Landesamt für Umwelt - Bavarian State Office for the Environment)	Core areas of nature conservation for the special protection of nature and landscape
Landscape protection area („*Landschaftsschutzgebiet – LSG*“; 2023)	LfU	Areas which protect the ecosystem and its functionality, the diversity and beauty of the landscape and its recreational value.
FFH – Fauna Flora Habitat (2016) / N2K areas	LfU	Areas of protected animal and plant species and habitats as well as the biodiversity in an EU-wide NATURA 2000 network of protected areas
Nature park („Naturpark“)	LfU	Protected areas that include the Nature Conservation area

Data	Source	Description
Drinking water protection areas	LfU	Protected areas for drinking water sources
Priority areas for flooding areas	LfU & Reg. v. Obb	Priority areas relevant within the regional plans for retention areas in relation to flooding
Priority areas for water supply	LfU & Reg. v. Obb	Priority areas relevant within the regional plans for retention areas in relation to flooding
Alpenplan Zone A, B and C	Reg. v. Obb. And own calculations (C. Meyer)	Mapping of
ATKIS Basis-DLM	LfU	Land use data
Energy data of Regional planning association for photovoltaic installations	RPV 2024	Planned and existing Photovoltaic installation within the pilot area
Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m and moist soil conditions	ifuplan (D2.3.1)	objective of the habitat network on the pilot region is a semi-open connectivity corridor with a focus on moors and wetlands

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!

Sector	Type of infrastructure/ Land use	Comments on Connectivity
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)
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).

Germany defines project types for which an EIA or a preliminary assessment must be carried out in Annex 1 to the EIA Act (UVPG). We have decided to define all projects as spatially

relevant for which an EIA or a preliminary environmental impact assessment is mandatory. The derivation of these threshold values can be found in the Annex 1.

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 Any river canalisation and stream correction work
Windpower (windmills)	Wind farm with 3 wind turbines with a total height of more than 50 metres each
Solar power (ground mounted photovoltaic systems)	ground mounted photovoltaic system with a size of at least 2 hectares
Biomass (biogas plant)	Biogas plant with more than 1.2 million standard cubic metres of raw gas per year
High voltage transmission line	transmission line with a voltage of 110 kV or more
Roads/ highways	four-lane or multi-lane federal road with continuous length of 5 km or more
Railways	railway track associated operating facilities with more than 2000 m²

It is important to note that Table 2 and Table 3 refer to the general threats and are not specifically adapted to the pilot region. This step follows in the next section of this report.

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 “Oberland”

Type of infrastructure/ Land use	**Existing (pressures)**	**expected (threats)**	**Description**
Hydropower - Hydroelectric reservoir (dam)	-	-	No existing or planned major dam
Hydropower - Run-off-River power plant	Obernach:	-	No planned major river power plant

Type of infrastructure/ Land use	Existing (pressures)	expected (threats)	Description
	12,8 MW Walchenseekraftwerk : 124 MW		
Windpower - windmills	Schongau-Peiting	Priority areas existing and in planning	Site-search for windpower in Energie-Atlas Bayern
Solar Power - Photovoltaics: Ground-mounted solar panels	Ground-mounted solar panels along the roads	Planned ground-mounted solar panels (agriculturally used areas); Various small-scale areas	…interesting planning basis is the agricultural value of the ground for PV (c.f. Energie-Atlas Bayern)
Bioenergy - Biomass	Various plans exist, but no strong stressor for connectivity		No existing or planned major Biogas plant. Existing plans alongside settlement areas that are excluded from pilot area sites for analysis.
Transmission of electricity - High voltage transmission line	TenneT TSO, Transmission LVN “Spannfeld” & “Umspannwerk“, BAG Hochspannungsnetz		Transmission lines are within valley bottom of study area.
Roads/ Highways	A95		4-lane roadways are existing throughout the whole corridor in north-south direction to Garmisch-Partenkirchen-Munich No further major roads or highways are planned
Railway			No extension known.
Urban/ industrial development			No major development plans known but constant pressures from agglomeration Munich into the pilot area does exist.

5 Choice of Locations for major developments / renewable energy facilities

This chapter should include the following information:

- *Compilation of **general criteria for unsuitable locations** (see D1.3.1): What are the general criteria for unsuitable locations for the project types considered?*
- *Compilation of specific criteria for unsuitable locations in the pilot region (Exclusion zones): **What are the exclusion zones for the analysed project types and what distances** (buffers) must be kept?*
- *Cartographic illustration of the exclusion zones for each considered Infrastructure/Land use*

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
Hydropower	• protected areas (e.g. Natura 2000 areas, nature reserves, …) • natural or semi-natural rivers
Windpower	• protected areas (e.g. Natura 2000 areas, nature 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	• protected areas (e.g. Nature 2000 areas, nature 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

	Unsuitable locations
Biomass (bioenergy plant)	• protected areas (e.g. Nature 2000 areas, nature reserves, core areas of biosphere reserves, water protection areas) • areas of high nature conservation value
High voltage transmission line	• 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	• 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	• 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	• 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 should 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. Nature 2000 areas, nature 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 existing photovoltaic installations within our area of analysis.

There are different buffers for different infrastructures in each country. With regard to the existing standards for our pilot region we have adopted the relevant exclusion zones from the Oberland regional plan. Other regions use different distances.

The second approach is based on the existing data of infrastructure projects directly published by the regional planning association.

The following table lists the unsuitable areas that occur in the pilot region with the proposed buffers. The proposed buffers are based on an evaluation of buffers from various sources and on our expert opinion - if no values could be found.

Our focus primarily lays on Solar power as the other threats are not of main concern within our pilot region. This was clarified within several stakeholder meetings. Nevertheless, we included wind power in the next table, even though this is already in planning within the planning region and is governed by higher levels of planning with a positive planning approach (“searching area”).

Hydropower, Biomass and high voltage transmission lines were not included into our analysis due to the level of pressure our pilot region puts on solar power mainly.

Table 6: Compilation of unsuitable locations (in the open space and excluding settlement areas) and their corresponding buffers in the pilot region Oberland

	Relevant dimension	Unsuitable location	Buffer (m)	Reference
Windpower	1 wind turbine with a total height of 266,5 m	EU-FFH areas, nature protection areas, Nature "Denkmal", Biotopes, areas with high perceived scenic quality, Landscape protection area („*Landschaftsschutzgebie*t – LSG"), …	Not defined	Regional planning association as of 03.12.2024
		EU-SPA areas	80 m	Regional planning association as of 03.12.2024
		Risk for collision with bats	300 m	Regional planning association as of 03.12.2024
		Settlement areas	800 – 80 m	Regional planning association as of 03.12.2024
		Topographic limitations (slope: > 30 % and wind < 4,7 m/s)	-	Regional planning association as of 03.12.2024
		Road and railway linear infrastructures	195 – 115 m	Regional planning association as of 03.12.2024
Solar power	Power plants	Natural yield capacity of agricultural soils	Not defined and no precise demarcation (exclusion of high value areas (but still possible for Agri-PV))	Energy Atlas Bayern
		Flooding areas and wetland	Not defined	Energy Atlas Bayern
		Roads and parking areas	Not defined	Energy Atlas Bayern

	Relevant dimension	Unsuitable location	Buffer (m)	Reference
		Protected areas (National parks, monuments, Conservation areas, Biosphere Reserves, Biotopes, N2K-areas, AlpenPlan Zone C, priority areas of other uses (flooding areas, agriculture, excluding Agri-PV), water protection sites and natural water bodies, water sites, retention areas, …	Exclusion site	Energy Atlas Bayern
		Landscape protection areas, ground monument, compensation areas	Under discussion and possible for construction after discussion	Energy Atlas Bayern

5.3 Mapping the land use conflicts for renewable energy production

The following figures show the planning zones wind and solar power installation from a regional planning perspective.

5.3.1 Windpower (positive planning) in the whole planning region

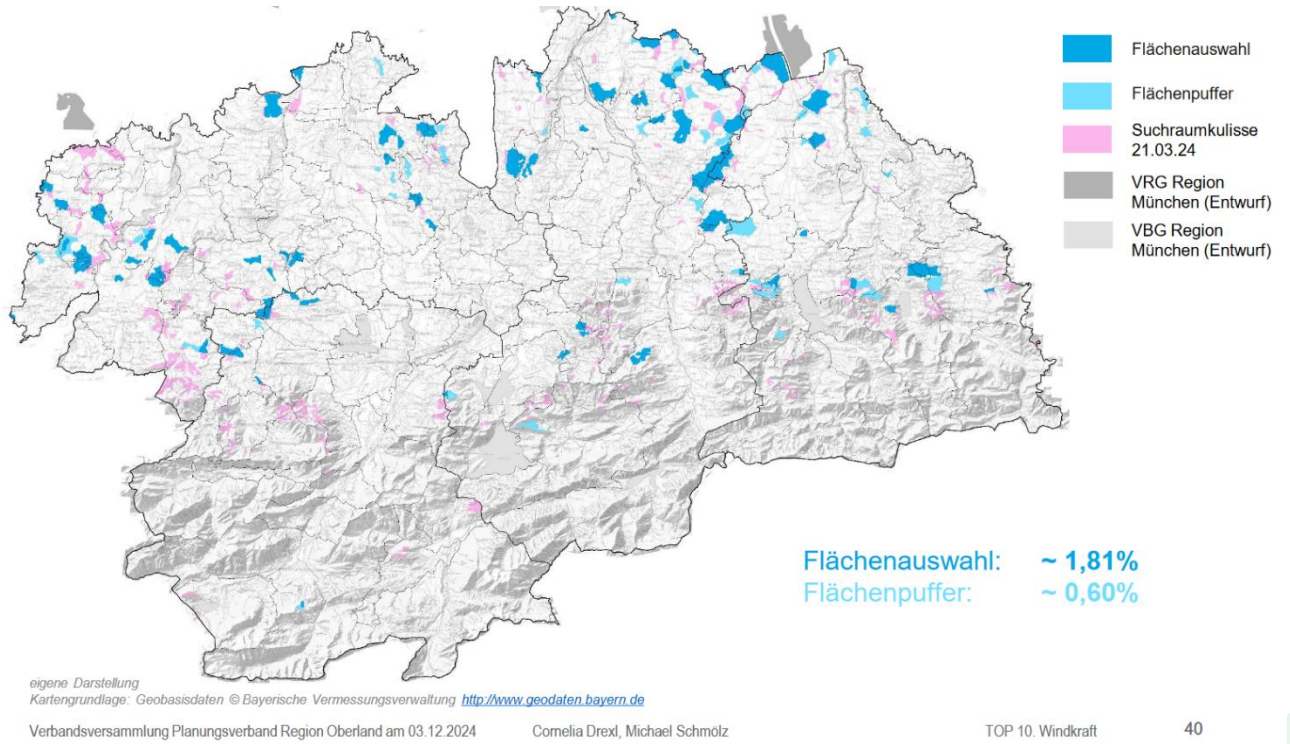


Figure 1: Areas for Wind power installation potential

Source: Regional planning association (Drexl/Schmölz, as of 03.12.2024)

5.3.2 Solar power

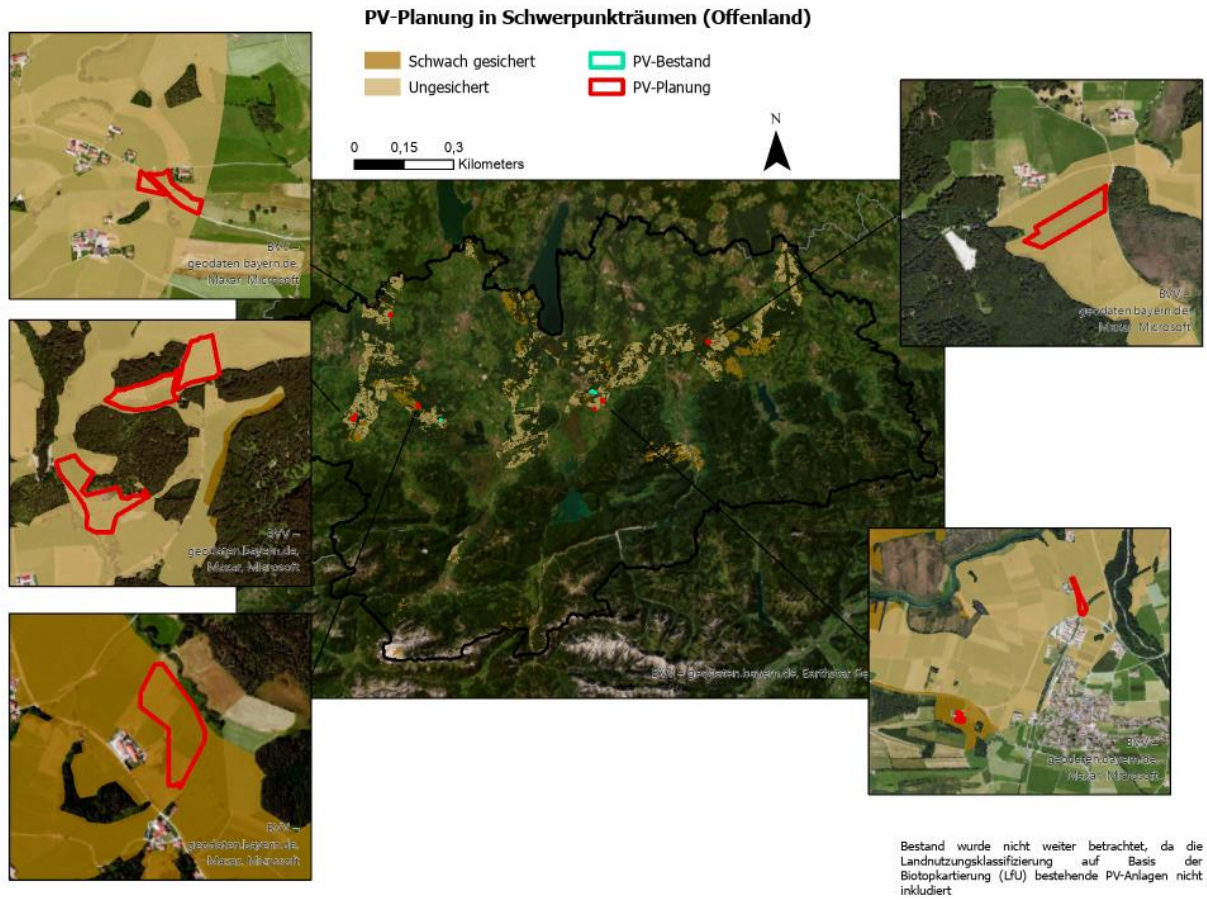


Figure 2: planning areas within analysis study areas in planning region.

It is evident that the impact presented by planned installations is not high. The effort lays therefore in the creation of criteria for exclusion.

Therefore, we highlighted the following areas according to exclusion criteria. These areas should not be considered for solar power installation.

Note: All protected areas and instrumentally strongly protected areas (also see D2.3.1) are already excluded from the zoning as these are already defined as exclusion zones.

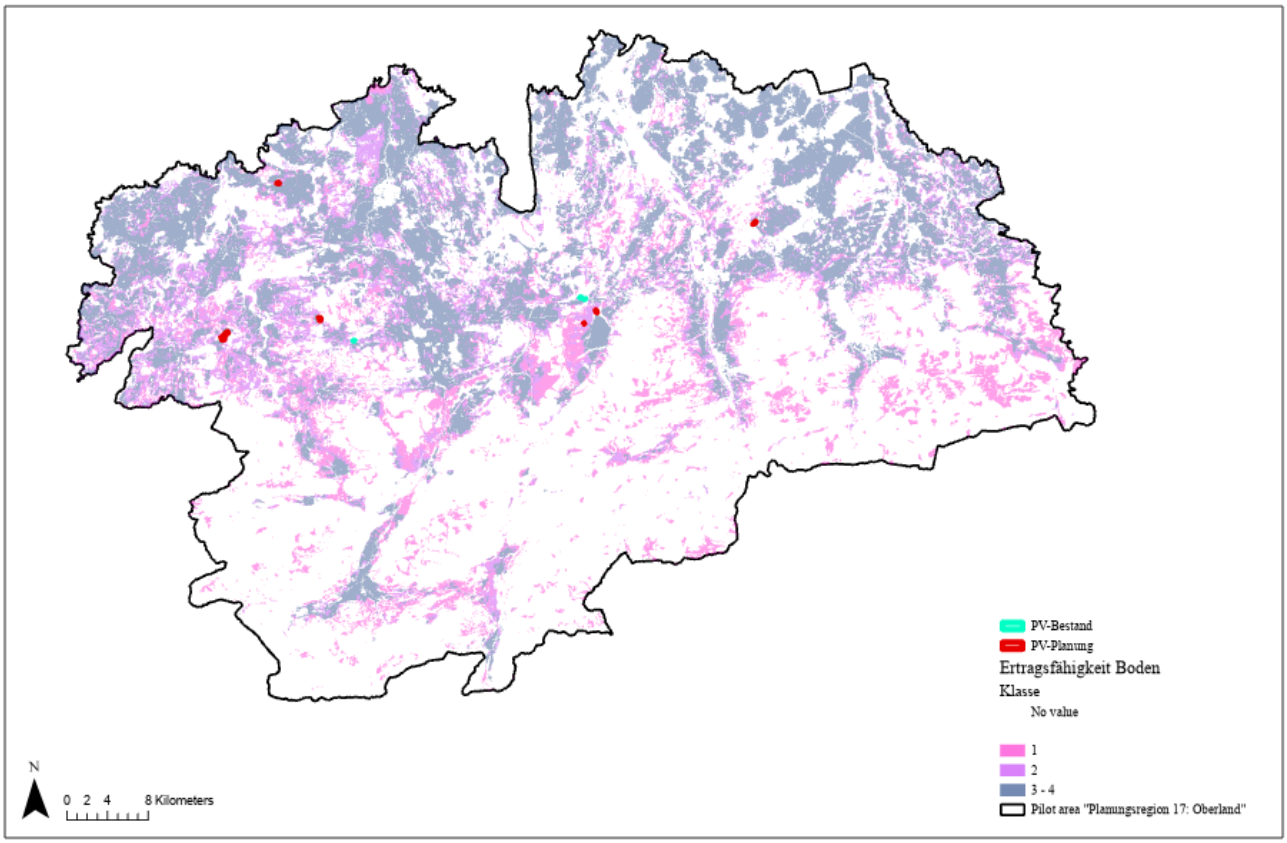


Figure 3: Soil value for agriculture and existing and planned photovoltaik installations

Source: own map, LfU Bayern 2024, Regionaler Planungsverband Oberland 2024.

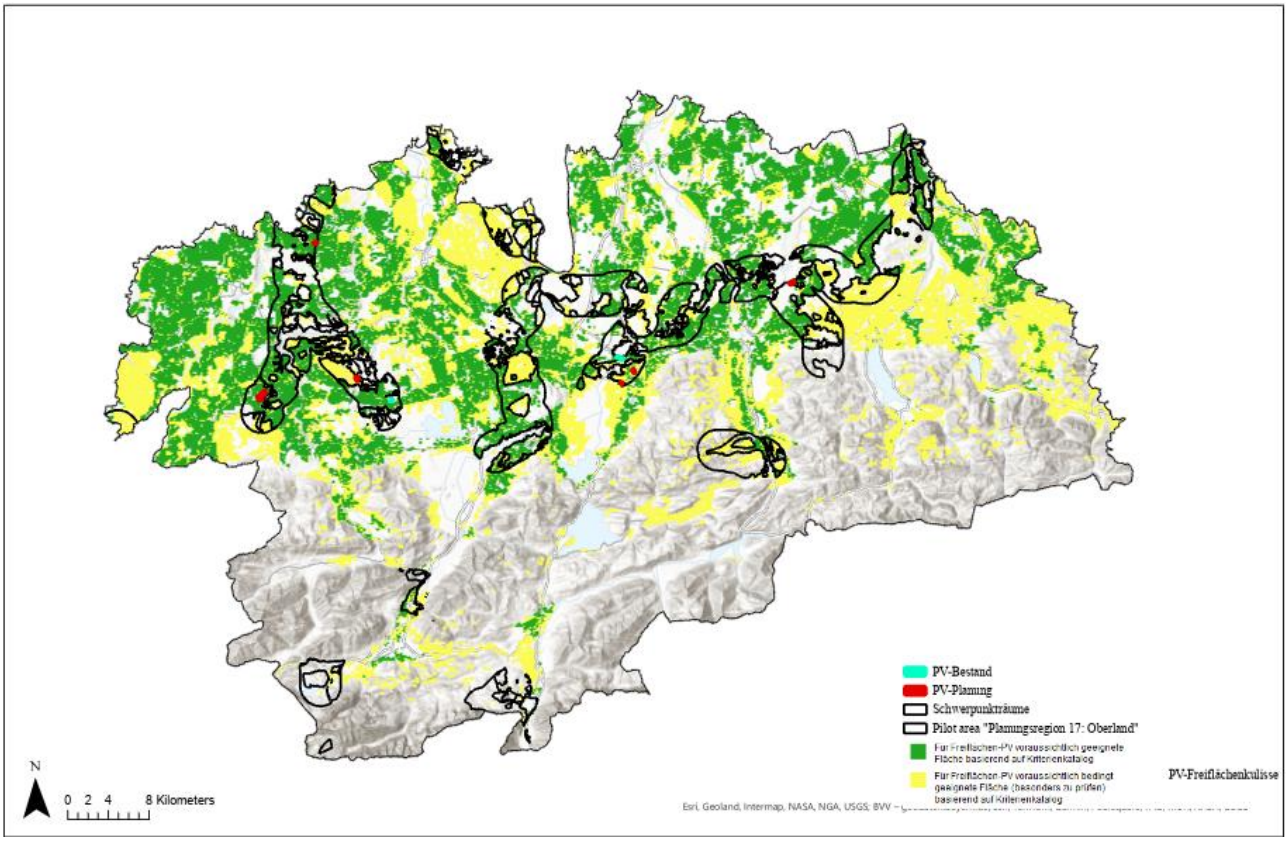


Figure 4: Suitable locations for photovoltaic and planned photovoltaik installations within our analysed priority areas.

Source: own map, Energie Atlas Bayern 2025, Regionaler Planungsverband Oberland 2024.

Excluded should be the areas of high value for agriculture as well as the well suitable areas already highlighted. Additionally, respective single-case areas should also overlay flood mapping and ecological corridors as well as land use types (see Report D2.3.1).

6 Possible mitigation and compensation measures

The following table focuses on solar energy only.

A list of all possible mitigation and compensation measures can be found in the Annex 2. The following table lists possible mitigation and compensation measures for the RE infrastructures in the pilot region Oberland. They are based on the corresponding chapters of the report D1.3.1.

Table 7: Mitigation / compensation measures for existing and planned RE in the pilot region “Oberland”

	Project	**Mitigation / Compensation**
Solar power	No threatening project known. But strategically the regional plan was offered additional instruments on the last expansion of the Bavarian LEP 2023 to protect areas from open space photovoltaic installations (e.g. priority areas for agriculture, priority areas for flooding).	One pilar of this strategy is to highlight high value agricultural land as priority areas for agriculture to avoid open space photovoltaic on high valuable areas for food production. A second pilar is the expansion of retention areas and wetland areas as those functions would be limited if photovoltaic areas would be created. The only multifunctionally realistic use of space for “Agri-PV” is on less valuable agricultural land or on land that is simultaneously planned for animal use and also enables crossing of species.

7 Conclusions

This report highlighted the threats posed by renewable energy on ecological connectivity within the pilot region. The focus was put on solar power in our analysis from a strategic planning perspective as the other forms of RE (water plants, biomass, etc.) do not pose a significant threat within our pilot region.

It is evident when viewing the pilot region from the regional perspective, that photovoltaic and RE installations in general need a single-case evaluation and a creation of a clearly delimited area. Herefore additional use of data is highly required to create a thorough image about the region. Local data and site visits are the best way to achieve a realistic data availability. In the preparatory phase and to create “searching areas” or “avoidance areas” regional data is fully sufficient.

To analyse exclusion areas for photovoltaic areas, it is evident that agricultural areas are a first land use type that is affected by installations, mostly due to accessibility. To avoid a loss of highly valuable agricultural land that is needed for food production, high value agricultural land should be in a first step excluded from any photovoltaic installation plans. The regional planning instrument of priority areas for agriculture (“VRG/VBG für die Landwirtschaft”) offers the best possible solution for these areas to preserve the valuable agricultural landscape.

Additional functions of open spaces such as their function to serve as flood and retention areas creates a second pillar to highlight these areas as priority areas e.g. flooding (“VRG/VBG für den Hochwasserschutz”).

Wind power is already positively planned by the regional planning authorities, therefore our report only stated the fact and collected the buffer information.

A next step in our analysis requires adapting our findings to specific instruments the planning governance provides.

8 Glossary

…	…
Bioenergy plants	….
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)
Fragmentation	…..
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)
Hydropower (dams, weirs, run-off-river power plant)	power derived from the energy of falling water or fast running water to generate electricity 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).
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	Definition by the European Environment Agency 2020 (State of nature in the EU - Results from reporting under the nature directives 2013-2018): *"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."*
Solar PV panel	an arrangement of PV materials that absorbs and converts sunlight into electricity
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

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ANNEXES

Annex 1 Identification of projects thresholds for spatial planning

	Relevance for Environmental Impact Assessment (EIA)	Relevance for spatial planning
Hydropower	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). For Germany, the following projects are subject to an EIA: • 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)	Any construction and operation of a hydropower plant Any river canalisation and stream correction work
Windpower (windmills)	In the EU's Environmental Impact Assessment Directive windpower is not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA). For Germany, the following projects are subject to an EIA: Construction and operation of a wind farm with turbines with a total height of more than 50 metres each with • 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)	Wind farm with 3 wind turbines with a total height of more than 50 metres each

	Relevance for Environmental Impact Assessment (EIA)	Relevance for spatial planning
Solar power (ground mounted photovoltaic systems)	In the EU's Environmental Impact Assessment Directive solar power is not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA). 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: • 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)	In the EU's Environmental Impact Assessment Directive bioenergy plants are not mentioned as a subject to an obligatory Environmental Impact Assessment (EIA). For Germany, the following projects (only for biogas) are subject to an EIA. Production of biogas with a production capacity of • 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 thenn1.2 million standard cubic metres of raw gas per year
High voltage transmission line	In the EU's Environmental Impact Assessment Directive transmission lines are not mentioned as a subject of an obligatory Environmental Impact Assessment (EIA). For Germany, the following projects are subject to an EIA. Construction and operation of a high-voltage overhead line with • 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
Rods/ highways	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). For Germany, the following projects are subject to an EIA: • 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	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
	For Germany, the following projects are subject to an EIA:
	• 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
	  • 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 m²

Annex 2 Mitigation /compensation (see D1.3.1)

	Mitigation / Compensation
Hydropower	• 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: ➢ 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	• 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	• 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 ➢ 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)	• -

	Mitigation / Compensation
High voltage transmission line	• 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	• 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	• 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
Urban /industrial development	• 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

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

D.2.4.2 Mapping report outlining GBI network elements and areas of land use conflicts for renewable energy production and other major developments that may threaten GBI connectivity function

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