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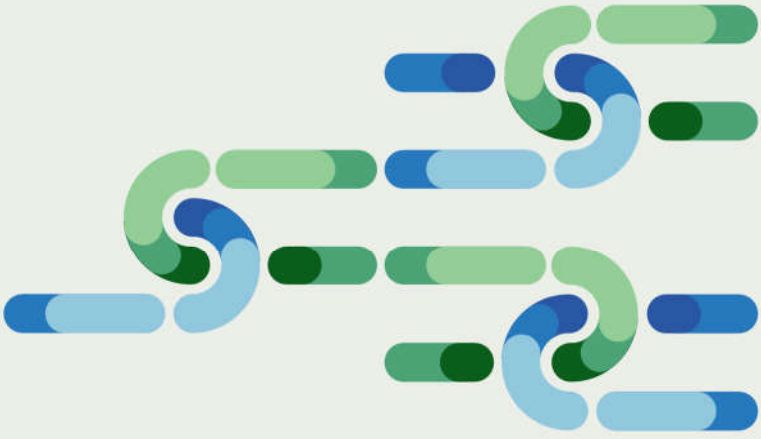
PlanToConnect

D.2.4.1 GBI-network: Land use conflicts for RE production and other threats

Pilot Region: Illertal

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

The PlanToConnect project aims to develop an Alpine spatial planning strategy for ecological connectivity in cooperation with stakeholders. This report focuses on the Illertal pilot region in Germany, where ifuplan is conducting a case study on integrated planning of a Green and Blue Infrastructure (GBI) connectivity network. The report specifically addresses land-use conflicts arising from renewable energy facilities and other infrastructural developments that may threaten the GBI network. The objectives include

- assessing potential impacts of infrastructures on ecological connectivity,
- evaluating criteria for unsuitable locations,
- mapping land use conflicts and
- suggesting mitigation measures.

The report primarily focuses on renewable energies while excluding urban/industrial development and agricultural land use.

Existing pressures and expected threats in the pilot region are identified, focusing particularly on renewable energy development. While there are no large wind farms in the pilot region yet, there are existing ground-mounted solar installations, including the "*Solarpark Schlechtenberg*" (12.5 ha) and the relatively small "*Photovoltaik-Anlage Herzmanns*" (1.4 ha). Planned developments include the expansion of "*Solarpark Schlechtenberg*" (6 ha) and the new "*Solarpark Nägelried*" (5.5 ha).

General criteria for unsuitable locations based on ecological value and protected status are established. For the pilot region, specific exclusion zones with corresponding buffers were defined for both wind power and solar power installations. These exclusion zones are based on existing standards from regional plans and the Bavarian Energy Atlas, as well as maximum impact ranges of infrastructure projects. The report includes detailed maps showing individual and aggregated exclusion zones with corresponding buffers for both wind and solar power. These maps visualize areas where renewable energy development would conflict with ecological connectivity.

Mitigation and compensation measures for renewable energy facilities, particularly for wind and solar power, are outlined. For solar installations, these include permeable fencing for wildlife movement, wildlife escape openings, the development and maintenance of extensively used, species- and flower-rich grassland. The landscape conservation plan for the planned *"Solarpark Nägelried"* already incorporates such important mitigation measures. For windpower installations important mitigation measures include the appropriate location of wind turbines, turbine design optimization or the unattractive design of the environment in surrounding fields for wind energy-sensitive birds.

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, ifuplan is conducting a case study on the integrated planning of a GBI (Green and Blue Infrastructure) connectivity network in the pilot area "Illertal", south of Kempten in Germany. The design of a GBI network for connectivity in the pilot region has been developed and described in the report D.2.3.1. Priority areas for conservation and restoration were identified there. These areas form the basis for integrating ecological connectivity into planning instruments. Ecological connectivity in the pilot region Illertal 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 both smaller and larger patches (see report D.2.3.1).

This report (D.2.4.1) 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 and
- 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 focusses on renewable energies and excludes urban/industrial development. While agricultural land use also affects ecological connectivity (see report D.1.2.1), 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.

[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).

Structure of the report:

Chapter 2 shortly describes the pilot region.

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

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

Chapter 5 discusses opposing factors for renewable energy facilities (exclusion zones) in the pilot region “Illertal”.

Chapter 6 describes the possible mitigation and compensation measures for the planned renewable energy infrastructures in the pilot region “Illertal”.

2 Pilot region Illertal

The pilot region is located in the northern part of the district “Oberallgäu”. The size of the pilot area is about 16,000 ha. The area is characterized by a strongly moving and irregular relief. Also typical are the wetland areas as landscape elements (for further description see D.2.3.1)

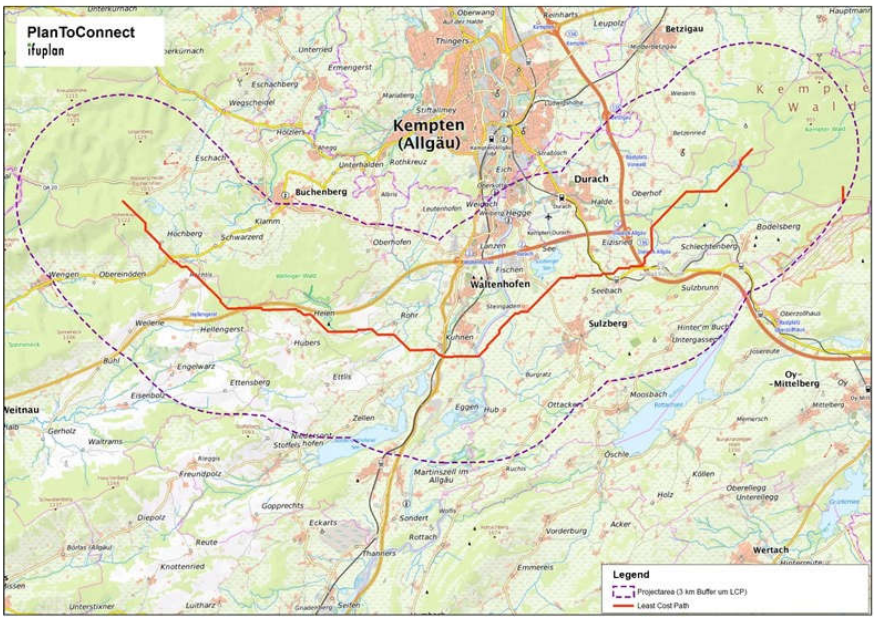

Figure 1: Overview – pilot region Illertal

Figure 2: Pilot region Illertal

3 Methodological steps

3.1 Description of the approach/ working steps

To assess the potential impacts of renewable energies (RE) or other major developments that may threaten ecological connectivity the following questions should be answered for the pilot region:

- What types of projects or plans are being considered in the pilot region (RE, other infrastructures)?
- What types of projects generally pose a pressure or a threat to ecological connectivity? Are there thresholds?
- What are the existing pressures and future threats in the pilot region?
- What are the general criteria for unsuitable locations for the project types considered?
- What are the exclusion zones for the analysed project types and what distances (buffers) must be kept?
- How are land use conflicts for renewable energies in the pilot region visualised cartographically (mapping)?
- What kind of mitigation or compensation measures for renewable energy facilities in the pilot region can be proposed?

The individual working steps are briefly described below.

Table 1: Description of the working steps for the pilot region “Ilertal”

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 ecological connectivity. The results of report D.1.3.1 will be used for this purpose.
2 Definition of relevant infrastructures	The second step is to identify which existing or planned infrastructures in the pilot region “Illertal” are spatially relevant. For this purpose threshold values from EU’s Environmental Impact Assessment Directive and the German Environmental Impact Assessment Act are compiled and analysed.

Working Step	Description
3 **Existing pressures and expected major threats in the pilot region**	In a third step, all spatially relevant existing and planned infrastructures in the pilot region "Illertal" are compiled on the basis of • References to existing relevant infrastructure by the Regional Connectivity Working Group • Interviews with planning experts from the pilot region (or at regional level) to identify major infrastructural developments being planned for the coming years • Search for official, publicly available lists of planned projects required to conduct an EIA.
4 **Compilation of general criteria for unsuitable locations**	General criteria for unsuitable locations can be found in report D.1.3.1.
5 **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 be allowed to be built or operated (unsuitable areas). For the definition of exclusion zones, it is not sufficient to use only the boundaries of the developed GBI network for connectivity (including priority areas for conservation and restoration). Many infrastructure projects have far-reaching effects. The question is: What distances must be kept to ensure that an ecologically valuable area is not adversely affected by a certain infrastructure project. Two aspects are important to consider when answering 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. This is followed by an evaluation of existing standards/ guidelines to check whether they provide effective criteria to protect areas with particular ecological connectivity function.
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 (wind power, solar power) is generated (using simple overlay functions and proximity tools). Hydropower, biomass, high voltage transmission lines, are not being considered in this report, as no relevant projects are planned in these sectors. Railway and particularly road infrastructure have been significantly expanded in the past, so no significant additional projects are currently planned. The aspect of urban/industrial development has been excluded, as these developments are taking place incrementally below a threshold of individual spatial relevance.

Working Step	Description
7 Possible mitigation and compensation measures	Possible mitigation or compensation measures for renewable energy facilities (existing and planned) in the pilot region "Illertal" are proposed referring to the threats report (D.1.3.1) and the report on conflicting land uses (D.1.2.1).

3.2 Data used

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

Table 2: Overview of local or regional data used

Data	Source	Description
Nature conservation area („*Naturschutzgebiet – NSG*"; 2023)	Bavarian State Office for the Environment ("LfU -Bayerisches Landesamt für Umwelt")	Core areas of nature conservation for the special protection of nature and landscape protected under the German Federal Nature Conservation Act
Landscape protection area („*Landschaftsschutzgebiet – LSG*"; 2023)	LfU	Areas protecting the ecosystem and its functionality, the diversity and beauty of the landscape and its recreational value under the German Federal Nature Conservation Act.
FFH – Fauna Flora Habitat (2016)	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
Natural Monument („*Naturdenkmal – NDK*"; 2023)	LfU	Landscape element < 5 ha protected under the German Federal Nature Conservation Act
Protected Landscape Features („*geschützte Landschaftsbestandteile-LB*"; 2023)	LfU	Landscape features protected under the German Federal Nature Conservation Act
Species conservation mapping Bavaria ("*Artenschutzkartierung – ASK*")	LfU	A state-wide database providing important information on the plant, fungi and animal species in Bavaria

Data	Source	Description
Bavarian biotope mapping ("*Bayerische Biotopkartierung*")	LfU	Shows areas that contain valuable biotopes within the open land throughout Bavaria. Biotope mapping has only been carried out in open land including groves, shrubs, hedges, trees (up to a size of about 0,5 hectare). This means that forests are not included.
Soil overview map („*Übersichtsbodenkarte*", M 1:25.000) (2023)	LfU	Overview of the condition of the soil
Peatland map ("*Übersichtsmoorbodenkarte*", M 1:25.000) (2023)	LfU	Areas that constitute a moorland area
Land cover Dataset 5x5 m (2023)	EURAC	Raster Dataset published by the Institute for Alpine Environment of Eurac Research. The landcover data categories provide an overview of the landcover but are too unspecific for detailed planning
Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m and moist soil conditions	ifuplan (D.2.3.1)	Objective of the habitat network on the pilot region is a semi-open connectivity corridor with a focus on moors and wetlands
Core areas of dry habitats buffered and dissolved with a distance of with 250 m and dry soil conditions	ifuplan (D.2.3.1)	
Donau-Iller regional plan for wind energy („*Regionalplan Donau-Iller, Teilfortschreibung Windenergie, Stand: 02.07.2024"*)	Regional Planning Association Donau-Iller (*Regionaler Planungsverband Donau Iller)*	Among other things, the regional planning communities draw up regional plans as part of state planning and thus define the principles and objectives of spatial development in the regions.The reference was used for determining buffer distances applied to the case study area.
Donau-Iller regional plan for Photovoltaic („*Regionalplan Donau-Iller: Erläuterungen zu erweiterten Planungshinweiskarten für Freiflächen-PV-Anlagen in der Region Donau-Iller, Stand: 25.10.2022*")		

Data	Source	Description
Allgäu regional plan for wind energy („*Regionalplan Allgäu: Fortschreibung des Teilfachkapitels B IV 3.2 – Nutzung der Windenergie, Stand: 27.11.2024*)	Regional Planning Association Allgäu *(„Regionaler Planungsverband Allgäu“)*	Among other things, the regional planning communities draw up regional plans as part of state planning and thus define the principles and objectives of spatial development in the regions.
Energy Atlas Bavaria („*Energie-Atlas Bayern*“)	Bavarian State Ministry of Economic Affairs, Regional Development and Energy (*StMWI*)	The Bavarian Energy Atlas is the Bavarian state government's internet portal for the energy transition and for energy saving, energy efficiency and renewable energies.
Urban land-use plans of the municipalities (“*Bebauungspläne der Gemeinden*”)	Durach, Sulzberg, Waltenhofen Buchenberg Weitnau	The development plan shows existing or expected plans within the municipal area
District of Oberallgäu - Environment and nature - Allgäu- Climate protection („*Landkreis Oberallgäu - Umwelt und Natur - Allgäu- Klimaschutz*“)	District of Oberallgäu („*Landkreis von Oberallgäu*“)	Information on the objectives of climate protection in the district of Oberallgäu

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 D.1.3.1 and assesses their impact on ecological connectivity across the landscape. A distinction is made between structural and functional connectivity (see report D.1.3.1).

Table 3: Infrastructures and land uses with their impact on ecological 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 – wind turbines	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.

Sector	Type of infrastructure/ Land use	Comments on Connectivity
	Bioenergy - Biomass	Bioenergy plants: Mostly low impact on structural and functional connectivity because of usually low soil sealing 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 area size, 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)
Transport	Roads/ highways	High impact on structural and functional connectivity because of usually large land take (habitat loss), 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 D.1.3.1 and in Table 3 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 for ecological connectivy whether the size of a photovoltaic 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 thus 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 Annex 1, the German Environmental Impact Assessment Act (UVPG) defines project types for which an EIA or a preliminary assessment must be carried out . 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 of this report.

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 4: 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 (wind turbines)	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 length of at least 200 m and 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

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 4). A distinction is made between existing infrastructure (pressures) and planned projects (threats).

Table 5: Overview – Existing pressures and expected major threats in the pilot region Illertal

Type of infrastructure/ Land use	Existing (= pressures)	Expected (= threats)	Description
Hydropower - Hydroelectric reservoir (dam)	-	-	No existing or planned dam
Hydropower - Run-off-River power plant	Waltenhofen: Running power plant (Laufkraftwerk): 1.000 bis 4.999 kW (Graben/Hegge); 500 - 999 kW (Au)		No planned major river power plant
Windpower – wind turbines			Site-search for windpower project in Buchenberg. General looking for areas for windpower with at least a size of 8 ha in the district "*Oberallgäu*"
Solar Power - Photovoltaics: Ground-mounted solar panels	"*Solarpark Schlechtenberg*" (12,5 ha), along the railway Schlechtenberg-Bodelsberg "*Photovoltaik-Anlage Herzmanns*" (1,4 ha), between Herzmanns and Greith east of the Federal road B19	Expansion of "*Solarpark Schlechtenberg*" (approx. 6 ha) „*Solarpark Nägeleried*" (5.5 ha), between Nägelried and Schlechtenberg	Location of the solar installation see Figure 7
Bioenergy - Biomass			No existing or planned major Biogas plant

Type of infrastructure/ Land use	Existing (= pressures)	Expected (= threats)	Description
Transmission of electricity - High voltage transmission line			No major transmissions lines are existing or planned
Roads/ Highways	Motorway A7 and A970, Federal roads B12 and B19		4-lane roadways are existing throughout the whole corridor No further major roads or highways are planned
Railway		Presumably at some point “Illertalbahn” Expansion/ Electrification	Possible expansion and rail electrification of the Illertalbahn. No detailed plan existing yet
Urban/ industrial development		Commercial area Herzmanns Süd, south of the ground-mounted solar field Herzmanns (Waltenhofen)	Mostly expansions of settlements that do not pose a threat One big commercial development of the company “Herzmanns Süd” expected

General Information about RE in the pilot region

Electricity production from renewable energies in the district of Oberallgäu has been very dynamic since 2006, particularly in the area of photovoltaics. With a 23% share of total electricity consumption in the district, this has now become the most important source of energy. Hydropower accounts for 18% of electricity consumption. Wind power and biogas are all between 5 and 7%. Overall, the share of renewable energies in the district of Oberallgäu was 50.2% in the electricity sector in 2020. At national level, this share was 45.4% (2020).[2] The current focus in the region is on the expansion of solar energy. Wind power is also becoming an emerging topic in the region. Therefore, the following remarks focus on wind and solar energy.

[2] https://www.allgaeu-klimaschutz.de/energiedaten-landkreis-oberallgaeu.html

Wind Power

So far, there are no large wind farms in the pilot region (according to the projects thresholds: Wind farm with 3 wind turbines with a total height of more than 50 metres each, see Table 4).

Solar Power

Existing ground-mounted solar panels include:

- "*Solarpark Schlechtenberg*" (size: 12,5 ha, Energy capacity: 8,2 MW) along the railway Schlechtenberg-Bodelsberg: Start of operation: 2013 (see Figure 3)
- "*Photovoltaik-Anlage Herzmanns*" (size: 1,4 ha, Energy capacity: 0,7 MW) between Herzmanns and Greith east of the Federal road B19

Figure 3: „*Solarpark Schlechtenberg*", existing solar panels along the railway Schlechtenberg-Bodelsberg

Planned expansion of "Solarpark Schlechtenberg" (size: approx. 6 ha)

Expansion of the existing solar park east of the railway line Schlechtenberg-Bodelsberg.[3]

Planned "*Solarpark Nägelried*" (size: 5.5 ha)

On areas of agricultural grassland east of the motorway A7 Kempten-Füssen, ground-mounted solar installations shall be erected. The aim is to develop and maintain species- and flower-rich grassland on the area of the solar installation. The landscape conservation plan for the planned solar plant includes the following measures[4]:

- Sunlit strips at least 3 m wide between the rows of modules
- Module distance from the ground of at least 0.8 m
- Greening of the plant area using seeds from local species or locally harvested mown material, no fertilisation, no use of pesticides
- Maintanance by mowing twice a year (use of insect-friendly mower, cutting height 10 cm) with removal of the cuttings or by site-adapted grazing as soon as the development goal has been achieved
- fence distance of around 15 cm from the ground to allow small animals to wander in and through the module area,
- Installation of a wildlife opening to allow a deer that has accidentally entered the system to escape

[3] Project-related land-use plan („Vorhabenbezogener Bebauungsplan - Freiflächenphotovoltaikanlage bei Schlechtenberg"): https://wms1.riwagis.de/oberallgaeu_lk_bp/bp-dateien/sulzberg/sulzberg_pv_schlechtenberg_begruendung.pdf

[4] Environmental Report/ Accompanying landscape management plan („*Landschaftspflegerische Begelitplanung Solarpark Nägeleried - Freiflächen-PV-Anlage an der A7 in Sulzberg*"): https://sulzberg.de/fileadmin/user_upload/Dateien/2.3.2_Bauleitplanung/Bebauungsplans__Solarpark_Naegeleried___vorhabenbezogener_Bebauungsplan_/foermliche_Beteiligung/Umweltbericht_mit_Anlagen_2024-08-14.pdf

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 D.1.3.1.

Table 6: General criteria for unsuitable sites (D.1.3.1)

	Unsuitable locations
Hydropower	• Protected areas (e.g. Natura 2000 areas, nature reserves, …) • Natural or semi-natural rivers including riparian zones, areas designated as ecological corridors
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, areas designated as ecological corridors • Riparian buffer zones, floodplains • Natural watercourses and lakes • Soil with very high significance for natural soil functions
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, areas designated as ecological corridors

	Unsuitable locations
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, areas designated as ecological corridors • 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, areas designated as ecological corridors
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)

In the Illertal pilot region, the expansion of renewable energies focusses on wind and solar power. The following description is therefore limited to wind turbines and ground-mounted solar panels.

Exclusion zones ("*Ausschlussflächen*") 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 (Lehmann & Tafarte 2024). Annex 3 contains a list of exclusion areas with their corresponding buffers for all infrastructures analysed in different countries (including ecologically valuable areas as well as settlements, roads, etc.).

In this report the exclusion zones only refer to areas that are important for ecological connectivity, i.e. mainly areas that are important for nature conservation. Exclusion zones relating to settlements, roads, etc. are not considered.

As can be seen from Table 6, the unsuitable locations are often identical. They include mainly protected areas of various types: e.g. Nature 2000 areas, nature reserves or water protection areas. 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), so that positioning them directly next to an ecologically valuable area can affect the area in a negative way. As described in report D.1.3.1 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 D.1.3.1).

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 on 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.

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 Allgäu regional plan ("*Regionalplan Allgäu*") and the Danube-Iller regional plan ("*Regionalplan Donau-Iller*"), a neighboring region to the pilot region. Other regions use different distances. The specifications from the Bavarian Energy Atlas ("*Energie-Atlas Bayern*") were also used.

The second approach is based on the maximum impact ranges of infrastructure projects. These impact ranges can then be used as a buffer around the ecologically valuable areas.

The following tables list 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.

For the territorial scope for wind power installations ("*Gebietskulisse Windkraft*"), the Bavarian Energy Atlas ("*Energie Atlas Bayern*") distinguishes between the following categories:

- Exclusion ("*Ausschluss*"),
- Regular exclusion ("*regelmäßiger Ausschluss*"): As a general rule, energy use is not suitable here, but exceptions are possible.
- Limited suitability ("*bedingt geeignet*"): Areas of limited suitability for energy use, examination in more detail is required.

Table 7: Compilation of unsuitable locations (Exclusion zones) and their corresponding buffers in the pilot region Illertal for windpower

Windpower: Exclusion zones ("Ausschlussflächen") unsuitable areas	**Data**	**Buffer**	**Reference**
Natura 2000 areas, FFH areas	Data available	1000 m	§ 26 (3) BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Natura 2000 areas, FFH areas	Data available	100 m	Regionalplan Allgäu (Nutzung der Windenergie)
Natura 2000 areas, FFH areas: regular exclusion (exception possible)	Data available	-	Energieatlas Bayern (Windkraft)
Density centers of collision-sensitive bird species - 25% of known breeding territories of species at risk of collision *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 1 - 25% der bekannten Brutreviere kollisionsgefährdeter Arten"*	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Density centers of collision-sensitive bird species - 25% of known breeding territories of species at risk of collision: regular exclusion (exception possible) *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 1 (25% der bekannten Brutreviere kollisionsgefährdeter Arten: regelmäßiger Ausschluss"*	Data available	-	Energieatlas Bayern (Windkraft)
Density centers of collision-sensitive bird species - 50 % of the known breeding territories of species at risk of collision, provided that at least 2 species are affected for which no effective switch-off device exists *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 2 - 50 % der bekannten Brutreviere kollisionsgefährdeter Arten, sofern mindestens 2 Arten betroffen sind, für die keine wirksamen Abschaltvorrichtung existiert"*	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Density centers of collision-sensitive bird species - 50 % of known breeding territories of species at risk of collision: limited suitability (examination required) *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 2 - 50 % der bekannten Brutreviere kollisionsgefährdeter Arten: bedingt geeignet (Einzelfallprüfung)"*	Data available	-	Energieatlas Bayern (Windkraft)
Areas of particular importance for bird conservation (main bird migration routes) only insofar as they are not located within 300 metres in both directions from the highest point of a ridge' *„Gebiete mit besonderer Bedeutung für den Vogelschutz (Hauptvogelzugrouten) nur insoweit sie nicht in einem Bereich von 300 Metern in beiden Richtungen von der höchsten Stelle eines Höhenrückens liegen"*	No data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Breeding sites of collision-sensitive bats plus safety distance of 300 m: limited suitability (examination required)	Data available	300 m	Energieatlas Bayern (Windkraft)

Windpower: Exclusion zones ("Ausschlussflächen") unsuitable areas	**Data**	**Buffer**	**Reference**
Core areas Mooralliance, fens, raised bogs („*Kerngebiete Mooralliance, Niedermoore, Hochmoore - Moore im Wirlinger Wald, Moore westlich Buchenberg*")	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Species and habitats protection maps category 4 and 5 ("*Schutzgutkarte Arten- und Lebensräume, Stufe 4 und 5*"): limited suitability (examination required)	Data available	-	Energieatlas Bayern (Windkraft)
Nature conservation area („*Naturschutzgebiet*")	Data available	200 m (Precautionary distance)	§ 23 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Nature conservation area („*Naturschutzgebiet*")	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Natural Monuments ("*Flächenhafte Naturdenkmäler*")	Data available	-	§ 28 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie) Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Protected Landscape Features ("*Geschützte Landschaftsbestandteile*")	Data available	-	§ 29 BNatSchG Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Water protection area („*Wasserschutzzone I, II*")	Data available	-	Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Water protection area („*Wasserschutzzone I, II, III*")	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Aboveground watercourses and lakes of the first order ("*Oberirdische Gewässer 1. Ordnung*")	Data available	50 m	§ 61 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Aboveground watercourses and lakes ("*Oberirdische Gewässer*")	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)

Windpower: Exclusion zones ("Ausschlussflächen") unsuitable areas	Data	Buffer	Reference
Legally protected biotopes („*gesetzlich geschützte Biotope nach §30 BNatSchG/Art. 23 BayNatSchG"*)	Data available	-	Energieatlas Bayern (Windkraft)
Biotopes (Bavarian biotope mapping)	Data available	-	Regionalplan Allgäu (Nutzung der Windenergie)
Compensation areas *("Ökokontoflächen")* registered in the *"Ökoflächenkataster"*: regular exclusion (exception possible)	Data available	-	Energieatlas Bayern (Windkraft)
Old, natural or semi-natural forests, forested ridgelines	No data available	1000 m	Our own estimation

Regionalplan Donau-Iller: Teilfortschreibung Windenergie, Stand: 02.07.2024
Regionalplan Allgäu: Fortschreibung des Teilfachkapitels B IV 3.2 – Nutzung der Windenergie, Stand: 27.11.2024
Energieatlas Bayern: Gebietskulisse Windkraft Bayern, Stand: 09.07.2024

For the territorial scope for photovoltaic installations ("*Gebietskulisse Freiflächenphotovoltaik*"), the Bavarian Energy Atlas ("*Energie Atlas Bayern*") distinguishes between the following categories:

- Exclusion ("*Ausschluss*"),
- Limited suitability ("*bedingt geeignet*"): Areas of limited suitability for energy use, examination in more detail is required.

Table 8: Compilation of unsuitable locations (Exclusion zones) and their corresponding buffers in the pilot region Illertal for solar power

Solar power: Exclusion zones ("Ausschlussflächen") unsuitable areas	Data	Buffer	Reference
Natura 2000- areas (FFH + SPA)	Data available	-	Regionalplan Donau-Iller (Freiflächen-PV)
Natura 2000 areas (FFH + SPA): limited suitability (examination required)	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Nature conservation area („*Naturschutzgebiet*")	Data available	-	§ 23 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Protected Landscape Features ("*Geschützte Landschaftsbestandteile*")	Data available	-	§ 29 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)

Solar power: Exclusion zones ("Ausschlussflächen") unsuitable areas	**Data**	**Buffer**	**Reference**
Natural Monuments ("*Flächenhafte Naturdenkmäler*")	Data available	-	§ 28 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Forest („*Wald*")	Data available	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Woodland, bog, swamp ("*Gehölz, Moor, Sumpf*"): limited suitability (examination required)	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Legally protected biotopes („*gesetzlich geschützte Biotope nach §30 BNatSchG/Art. 23 BayNatSchG")*	Data available	-	Regionalplan Donau-Iller (Freiflächen-PV)
Biotopes according to the Bavarian Biotope Mapping ("*Bayerische Biotopkartierung*")	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Compensation areas *("Ökokontoflächen")* registered in the *"Ökoflächenkataster"*	Data available	-	Regionalplan Donau-Iller (Freiflächen-PV)
Compensation areas *("Ökokontoflächen")* registered in the *"Ökoflächenkataster"*: limited suitability (examination required)	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Priority areas of the Species and Biotope Protection Programme Bavaria (ABSP) ("*ABSP-Schwerpunkträume Bayern*"): generally unsuitable, exceptions possible	Data available	-	Regionalplan Donau-Iller (Freiflächen-PV)
Baden-Württemberg biotope network - core areas wet, medium, dry, water bodies („*Biotopverbund Baden-Württemberg - Kernräume feucht, mittel, trocken, Gewässer")*: generally unsuitable, exceptions possible	No data available	-	Regionalplan Donau-Iller (Freiflächen-PV)
Biotope network - General wildlife route plan ("*Biotopverbund – Generalwildwegeplan*"): generally unsuitable, exceptions possible	No data available	500 m	Regionalplan Donau-Iller (Freiflächen-PV)
Water protection areas ("*Trinkwasserschutzgebiete, Zone I und II*")	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse) Regionalplan Donau-Iller (Freiflächen-PV)
Water protection areas ("*Trinkwasserschutzgebiete, Zone III*"): limited suitability (examination required)	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Floodplains for 100-year flood events („*Überschwemmungsgebiete, HQ100*")	Data available	-	Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Aboveground watercourses and lakes of the first and second order ("*Oberirdische Gewässer 1. und 2. Ordnung"*)	Data available	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Edge strip of aboveground watercourses and lakes of the first and second order ("*Randstreifen von oberirdischen Gewässern 1. und 2. Ordnung*"): limited suitability (examination required)	Data available	60 m	Energieatlas Bayern (PV-Freiflächenkulisse)

Solar power: Exclusion zones ("Ausschlussflächen") unsuitable areas	Data	Buffer	Reference
Aboveground watercourses and lakes of the third order ("*Oberirdische Gewässer 3. Ordnung*"): limited suitability (examination required)	Data available	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Edge strip of aboveground watercourses and lakes of the third order ("*Oberirdische Gewässer 3. Ordnung*"): limited suitability (examination required)	Data available	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Watercourses (width ≥ 3 m) and lakes	Data available	10 m	Regionalplan Donau-Iller (Freiflächen-PV)

Regionalplan Donau-Iller: Erläuterungen zu erweiterten Planungshinweiskarten für Freiflächen-PV-Anlagen in der Region Donau-Iller, Stand: 25.10.2022
Energieatlas Bayern: PV-Freiflächenkulisse, Stand: 30.04.2024

The existing guidelines of the regional plans and the Bavarian Energy Atlas on the subject of exclusion areas represent good criteria for protecting biodiversity in general. However, they do not consider ecological connectivity in the landscape adequately. In Report D.2.3.1, we have defined core areas (areas of high nature conservation value) in the pilot region (see Annex 4, Figure 10) and developed a GBI network for connectivity including priority areas for conservation and restoration:

- Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m (see Annex 4, Figure 11) and
- Core areas of dry habitats buffered and dissolved with a distance of with 250 m(see Annex 4, Figure 12).

The objective was to create a wide ecological network featuring structural diversity rather than an uninterrupted corridor with directly adjacent habitats. In order to ensure the conservation and restoration of the areas of high nature conservation value, the proposed priority areas should be kept free of wind or solar energy installations.

5.3 Mapping the land use conflicts for renewable energy production

GIS (Geographic Information Systems) analysis plays a crucial role in the siting of renewable energy facilities by providing a comprehensive, data-driven approach to identifying optimal or unsuitable locations. This technology enables to integrate and analyze multiple layers of spatial information simultaneously.

With regard to ecological connectivity maps of the exclusion zones for wind power and solar power are generated (using simple overlay functions and proximity tools). Hydropower, biomass, high voltage transmission lines, are not being considered in this report, as no relevant projects are planned in these sectors. Railway and particularly road infrastructure have been significantly expanded in the past, so no significant additional projects are currently planned. The aspect of urban/industrial development has been excluded, as these

developments are taking place incrementally below a threshold of individual spatial relevance.

5.3.1 Windpower

As can be seen from Table 7, there are some similarities but also differences in the individual categories and buffers. There are also categories for which no matching data could be found. In order to map exclusion zones with their corresponding buffers for planning purposes, the categories must be clearly defined. In the following table, the exclusion zones with their corresponding buffers are summarized following the precautionary principle. The core areas we have developed (see D.2.3.1) already contain some data such as biotopes.

Table 9: Relevant Exclusion zones and buffers for windpower in the pilot region Illertal

Windpower: Exclusion zones ("Ausschlussflächen") unsuitable areas	**Buffer**
Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m (see D.2.3.1 and see Annex 4, Figure 11) including • Core areas Moorallianz („*Kerngebiete Moorallianz, Niedermoore, Hochmoore - Moore im Wirlinger Wald, Moore westlich Buchenberg*") • Species and habitats protection maps ("*Schutzgutkarte Arten- und Lebensräume, Stufe 4 und 5*") • Natural Monuments ("*Flächenhafte Naturdenkmäler*") • Protected Landscape Features ("*Geschützte Landschaftsbestandteile*")	-
Core areas of dry habitats buffered and dissolved with a distance of with 250 m (see D.2.3.1 and see Annex 4, Figure 12)	-
Natura 2000 areas, FFH areas	100 m
Density centers of collision-sensitive bird species - 50 % of the known breeding territories of species at risk of collision, provided that at least 2 species are affected for which no effective switch-off device exists *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 2 - 50 % der bekannten Brutreviere kollisionsgefährdeter Arten, sofern mindestens 2 Arten betroffen sind, für die keine wirksamen Abschaltvorrichtung existiert"*	-
Breeding sites of collision-sensitive bats plus safety distance of 300 m	300 m
Nature conservation area („*Naturschutzgebiet*")	200 m
Water protection area („*Wasserschutzzone I, II, III*")	-
Watercourses and lakes ("*Oberirdische Gewässer 1. Ordnung*")	50 m
Compensation areas *("Ökokontoflächen")* registered in the *"Ökoflächenkataster"*	-

The following two figures show the exclusion zones (individual and aggregated) and their corresponding buffers for wind power in the pilot region "Illertal". These maps visualize areas where windpower would conflict with ecological connectivity.

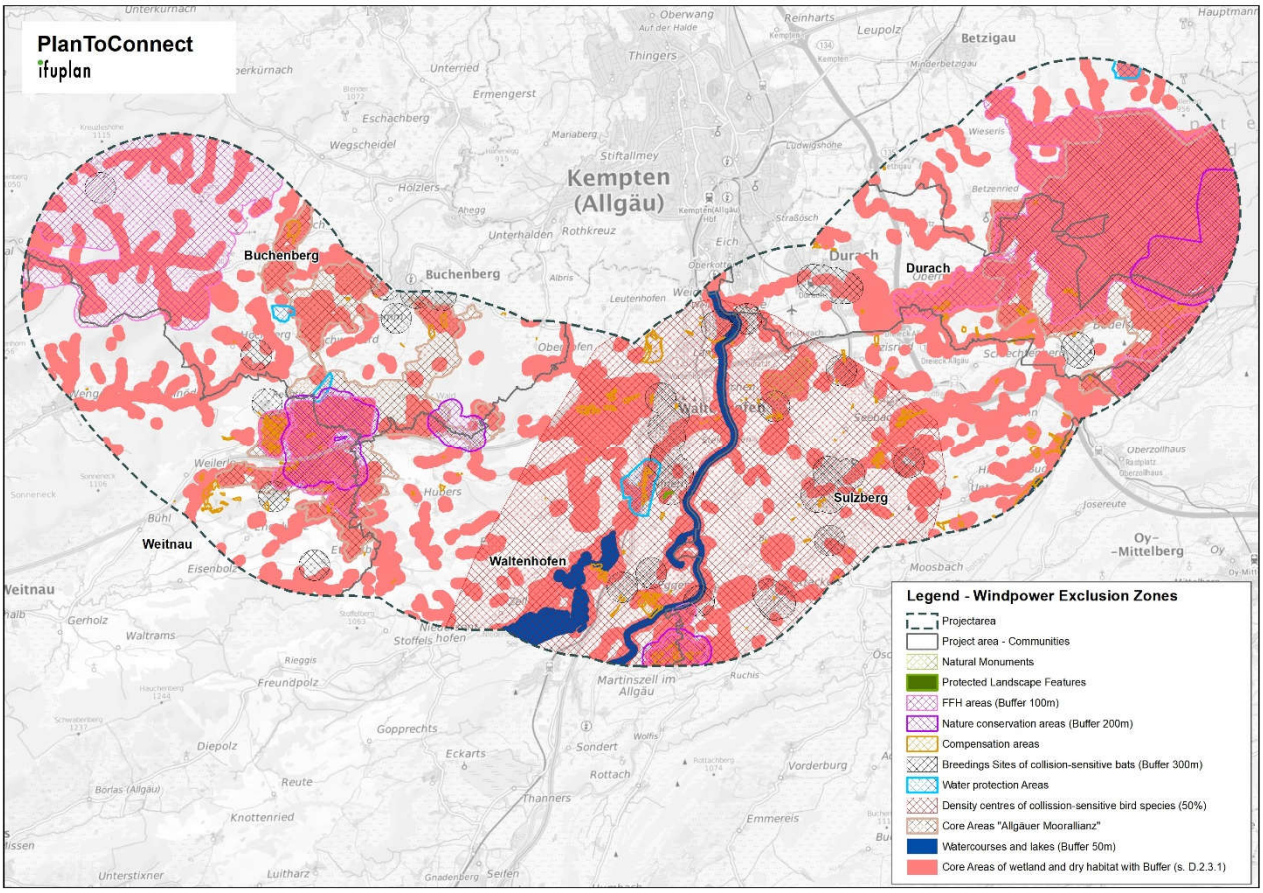

Figure 4: Individual exclusion zones with corresponding buffers for wind power

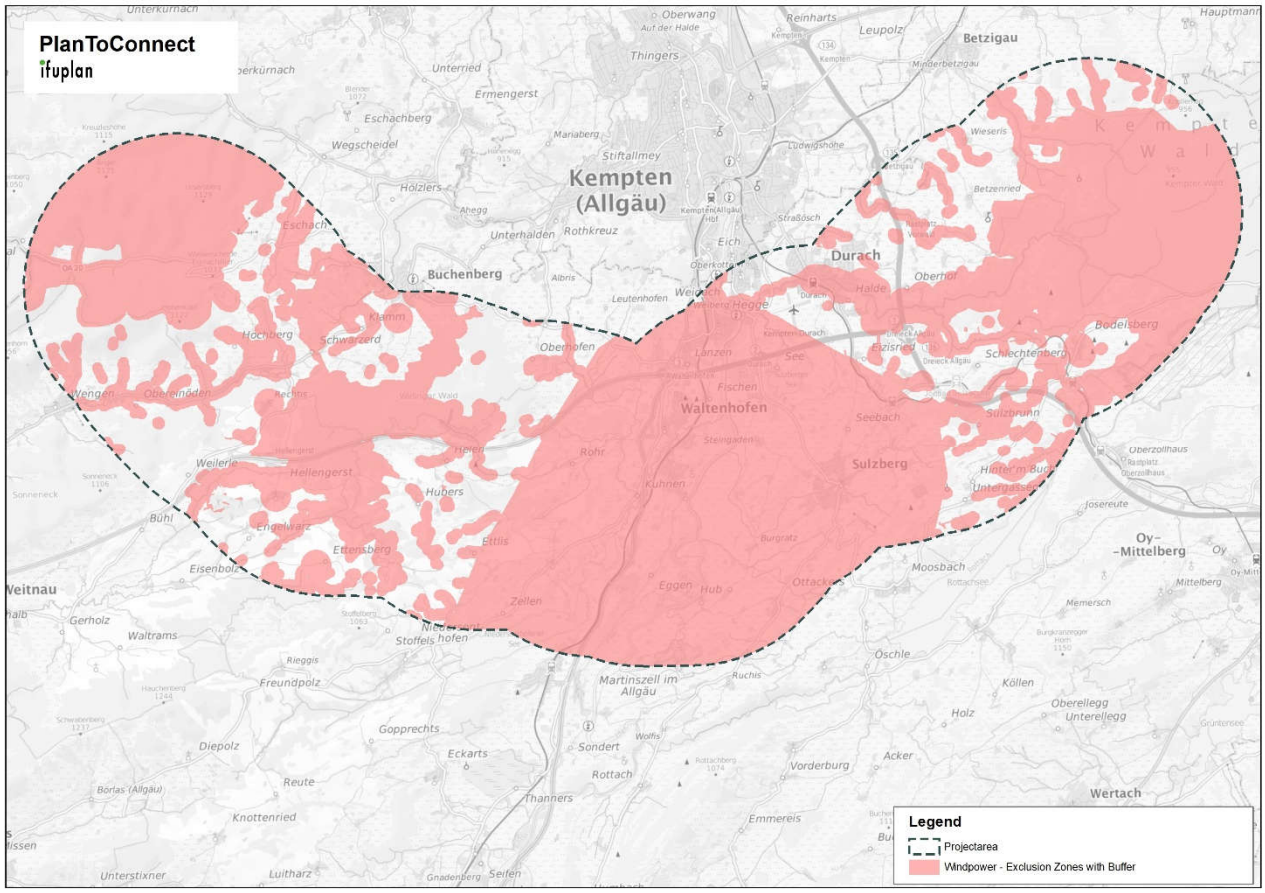

Figure 5: Aggregated exclusion zones with corresponding buffers for wind power

About 73 % (11718 ha) of the whole pilot region is not suitable for windpower installations (see Figure 5).

5.3.2 Solar power

As can be seen from Table 8, there are some similarities but also differences in the individual categories and buffers. There are also categories for which no matching data could be found. In order to map exclusion zones with their corresponding buffers for planning purposes, the categories must be clearly defined. In the following table, the exclusion zones with their corresponding buffers are summarized following the precautionary principle. The core areas we have developed (see D.2.3.1) already contain some data such as biotopes.

Table 10: Relevant Exclusion zones and buffers for solar power in the pilot region Illertal

Solar power: Exclusion zones ("Ausschlussflächen") unsuitable areas	**Buffer**
Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m (see D.2.3.1 and see Annex 4, Figure 11) including • Nature conservation area („*Naturschutzgebiet*") • Protected Landscape Features ("*Geschützte Landschaftsbestandteile*") • Natural Monuments ("*Flächenhafte Naturdenkmäler*")	
Core areas of dry habitats buffered and dissolved with a distance of with 250 m (see D.2.3.1 and see Annex 4, Figure 12)	
Natura 2000- areas (FFH)	-
Forest („*Wald*")	10 m
Woodland, bog, swamp ("*Gehölz, Moor, Sumpf*")	-
Compensation areas *("Ökokontoflächen")* registered in the *"Ökoflächenkataster"*	-
Priority areas of the Species and Biotope Protection Programme Bavaria (ABSP) ("*ABSP-Schwerpunkträume Bayern*"):	-
Wildlife habitats, wildlife corridors and crossing options for large mammal species on federal roads in Bavaria ("*Wildtierlebensräume, Wildtierkorridore und Querungsmöglichkeiten für große Säugetierarten an Bundesfernstraßen in Bayern*")[5]	250 m Our own estimation
Water protection area („*Wasserschutzzone I, II, III*")	-
Riparian buffer zones, floodplains („*Festgesetzte Überschwemmungsgebiete, HQ100*")	-
Watercourses and lakes ("*Oberirdische Gewässer 1. Ordnung*")	10 m

The following two figures show the exclusion zones (individual and aggregated) and their corresponding buffers for ground-mounted solar panels in the pilot region "Illertal". These maps visualize areas where solar power would create conflicts with ecological connectivity.

[5] https://www.lfu.bayern.de/natur/wildtierkorridore/doc/karte_wildtierkorridore.pdf

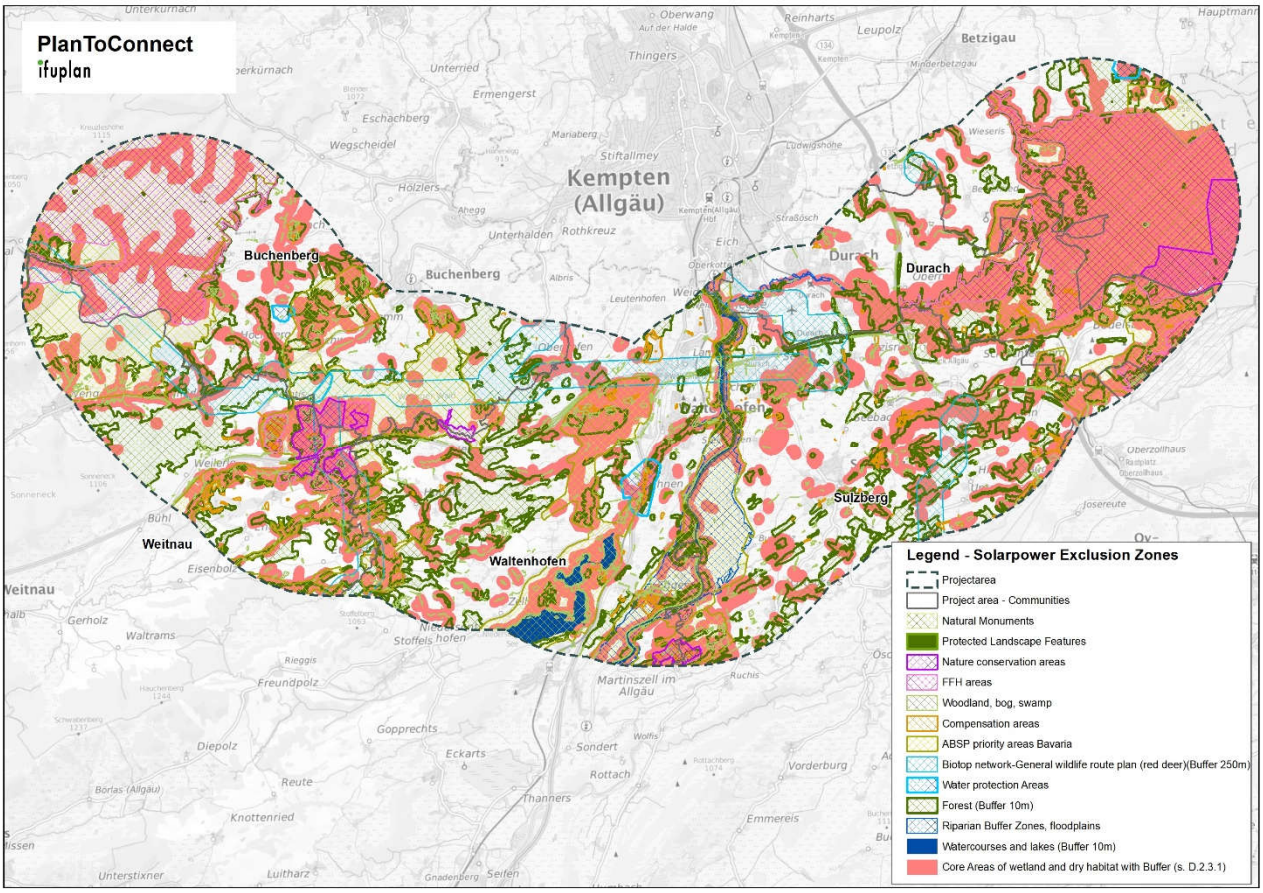

Figure 6: Individual exclusion zones with corresponding buffers for solar power

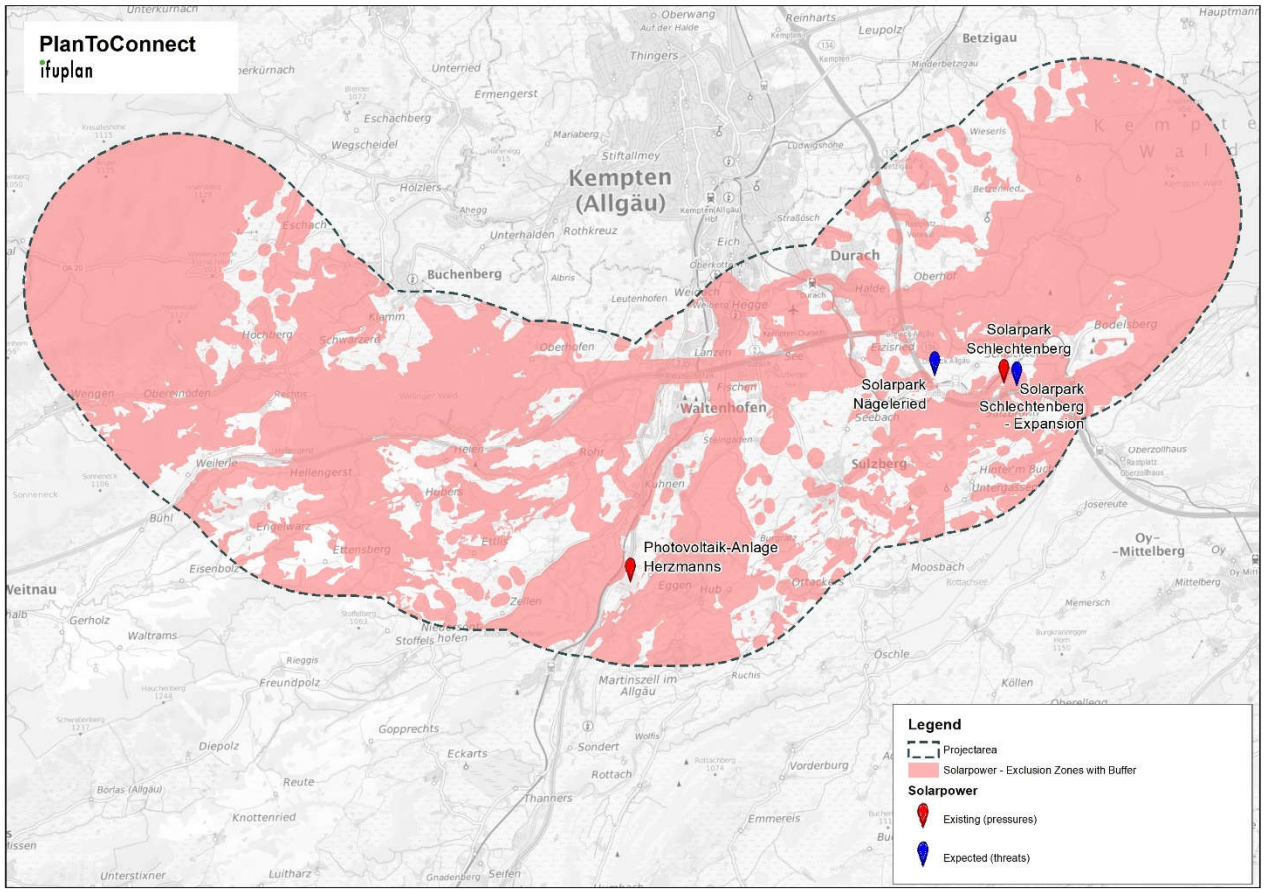

Figure 7: Aggregated exclusion zones with corresponding buffers for solar power

About 72 % (11624 ha) of the whole pilot region is not suitable for ground-mounted solar panels (see Figure 7).

The map (Figure 7) also shows that the existing "*Photovoltaik-Anlage Herzmanns*" and the planned „*Solarpark Nägeleried*" are located outside the proposed exclusion zones.

The existing "*Solarpark Schlechtenberg*" and its planned extension are located within an identified exclusion zone, indicating a current land use conflict with ecological connectivity priorities. The exclusion zone in the area of the existing and planned solar park is a core area of wetland habitats. It contains a river ("*Sulzberger Ach*"), an undisturbed watercourse with riparian woodland as well as wet meadows and swamps.

The "*Solarpark Schlechtenberg*" (12,5 ha) is a relatively large area with ground-mounted solar panels along the railway Schlechtenberg-Bodelsberg (see Figure 3). The planned expansion is located south of the railway line and will cause the loss of groves and wet meadows. This will negatively affect the core area of wetland habitats.

6 Possible mitigation and compensation measures

Several measures can be proposed to increase ecological connectivity across landscapes, addressing the challenges of habitat fragmentation and supporting biodiversity conservation. 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 wind power and solar power in the pilot region Illertal. They are based on the corresponding chapters of the report D.1.3.1. Other infrastructures are not being considered, as no relevant projects are planned in these sectors.

Table 11: Mitigation / compensation measures for existing and planned RE in the pilot region "Illertal"

RE	Existing and planned projects	Mitigation / Compensation
Windpower	Site-search for windpower project in Buchenberg and "Oberallgäu"	• Appropriate location of wind turbines (avoid exclusion zones and buffers for windpower, see Table 9 and Figure 5) • Turbine design optimization • Switch off systems at times of increased bird/bat activity to prevent/avoid collisions • Unattractive design of the environment at the base of the mast and in surrounding fields for wind energy-sensitive birds (red kites)
Solar power	Existing "S*olarpark Schlechtenberg*" (12,5 ha), along the railway Schlechtenberg-Bodelsberg Existing "*Photovoltaik-Anlage Herzmanns*" (1,4 ha), between Herzmanns and Greith east of the Federal road B19	The following improvements can be implemented in the existing solar parks: • fencing should be permeable for small and medium-sized mammals (15 cm distance between the fence and the ground), see Figure 8 • 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 (see Figure 9) ➢ No mulching

RE	Existing and planned projects	Mitigation / Compensation
Solar power	Expansion of "*Solarpark Schlechtenberg*" (approx. 6 ha)	Due to its location within a core area of wetland habitats the planned expansion is unsuitable. Approval should only be possible with the following strict restrictions: • Landscape-oriented design of the facility with suitable arrangement of the solar panels with preservation of the existing biotope areas • 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 wet grassland (wetland habitats) 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
Solar power	Planned „*Solarpark Nägeleried*" (5.5 ha) between Nägelried and Schlechtenberg	The landscape conservation plan for the planned „*Solarpark Nägeleried*" already identifies important mitigation measures (see Chapter 4.3).

Figure 8: "*Solar Park Schlechtenberg*" with fence, not permeable for small and medium-sized mammals

Figure 9: "*Solar Park Schlechtenberg*", example for grazing

7 Conclusions

For the pilot region, specific exclusion zones with corresponding buffers were defined for both wind power and solar power installations. The purpose is to preserve ecologically valuable areas as well as to protect connectivity in the Illertal region.

For wind power, the exclusion zones cover large, continuous areas particularly in the eastern, western and the central part of the pilot region (due to the density centers of collision-sensitive bird species). For solar power, the exclusion zones are distributed in a more fragmented way across the pilot region with obviously larger areas on forested areas.

While regional plans and the Bavarian Energy Atlas provide good criteria for protecting biodiversity in general, they do not adequately consider ecological connectivity in the landscape. Additionally, ecological provisions in regional plans such as buffer distances should be harmonised between planning regions for interterritorial consistency and acceptance among decision makers. Therefore, connectivity should be incorporated as a fundamental criterion not only with regard to the design of area-based conservation measures but also with regard to the installation of renewable energies. Connectivity considerations should be integrated into existing planning instruments.

In regard to mitigation measures, the renewable energy installations in the pilot region illustrate a huge potential for improved mitigation measures in existing installations, e.g. in regard to permeability of ground-mounted photovoltaic systems. For future renewable energy installations the mitigation and compensation measures outlined in this report should be integrated in project authorisation.

Transport and settlement infrastructure development of the past is already posing a significant barrier to ecological connectivity in the pilot area. In these cases, conventional spatial planning approaches that focus on weighing and allocating land use categories on open spaces are not sufficient. Spatial and urban planning instruments therefore need to be realigned to also contribute to improving connectivity within the existing grey infrastructure.

8 Glossary

Connectivity (structural and functional)	"Connectivity comprises two components, structural and functional connectivity. It expresses how landscapes are configurated, allowing species to move. Structural connectivity, equal to habitat continuity, is measured by analysing landscape structure, independent of any attributes of organisms. […]. Functional connectivity is the response of the organism to the landscape elements other than its habitats (i.e. the non-habitat matrix). This definition is often used in the context of landscape ecology. A high degree of connectivity is generally linked to low fragmentation." (EUROPEAN COMMISSION - Technical information on Green Infrastructure (GI), 6.5.2013, Glossary) (Definition of connectivity see also Deliverable 1.1.1, chapter 8)
GBI – Green and blue infrastructure	Green infrastructure (GI) is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings." (EUROPEAN COMMISSION - Green Infrastructure (GI) — Enhancing Europe's Natural Capital, 6.5.2013) (Definition of connectivity see also Deliverable 1.1.1, chapter 6)
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

internet links as footnote in the text

egrid (2021): Energienutzungsplan zur GIS-basierten Analyse des Freiflächen-PVPotentials im Landkreis Oberallgäu, Abschlussbericht, gefördert durch das Bayerische Staatsministerium für Wirtschaft, Landesentwicklung und Energie

Lehmann, P., Tafarte P. (2024): Exclusion zones for renewable energy deployment: One man's blessing, another man's curse, Resource and Energy Economics Volume 76, February 2024, 101419, https://doi.org/10.1016/j.reseneeco.2023.101419

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 (wind turbines)	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 than1.2 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 length of at least 200 m and 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)	railway track associated operating facilities with more than 2000 m²

Annex 2: Mitigation /compensation (see D.1.3.1)

	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)	• -
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

	Mitigation / Compensation
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
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

Annex 3: Collection of buffers in various countries

Table 1: Buffers related to windpower plants

Distance to…	Country	Buffer	Reference
Natura 2000 areas, FFH areas	Germany	1000 m	§ 26 (3) BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Natura 2000 areas, FFH areas	Germany	100 m	Regionalplan Allgäu (Nutzung der Windenergie)
Natura 2000 areas, FFH areas: regular exclusion (exception possible)	Germany	-	Energieatlas Bayern (Windkraft)
European bird protection areas (SPA areas) (*„Vogelschutzgebiete der EU*“)	Germany	1000 m	EU-Vogelschutzrichtlinie i.V. m. § 7 BNatSchG Regionalplan Allgäu (Nutzung der Windenergie) Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
European bird protection areas (SPA areas) (*„Vogelschutzgebiete der EU*“): regular exclusion (exception possible)	Germany	1000 m	Energieatlas Bayern (Windkraft)
Breeding sites of highly collision-sensitive bird species (Aquila chrysaetos, Clanga pomarina)	Germany	1000 - 1500 m (minimum)	Anlage 1 zu § 45b BNatSchG (Betrieb von Windenergieanlagen an Land)
Breeding sites of collision-sensitive bird species (Haliaeetus albicilla, Pandion haliaetus, Milvus milvus, Milvus migrans, Falco peregrinus, Pernis apivorus, Ciconia ciconia, Asio flammeus)	Germany	500m (minimum)	Anlage 1 zu § 45b BNatSchG (Betrieb von Windenergieanlagen an Land)
Density centers of collision-sensitive bird species - 25% of known breeding territories of species at risk of collision *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 1 - 25% der bekannten Brutreviere kollisionsgefährdeter Arten“*	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)

Distance to…	Country	Buffer	Reference
Density centers of collision-sensitive bird species - 25% of known breeding territories of species at risk of collision: regular exclusion (exception possible) *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 1 (25% der bekannten Brutreviere kollisionsgefährdeter Arten: regelmäßiger Ausschluss“*	Germany	-	Energieatlas Bayern (Windkraft)
Density centers of collision-sensitive bird species - 50 % of the known breeding territories of species at risk of collision, provided that at least 2 species are affected for which no effective switch-off device exists *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 2 - 50 % der bekannten Brutreviere kollisionsgefährdeter Arten, sofern mindestens 2 Arten betroffen sind, für die keine wirksamen Abschaltvorrichtung existiert“*	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Density centers of collision-sensitive bird species - 50 % of known breeding territories of species at risk of collision: limited suitability (examination required) *„Dichtezentren kollisionsgefährdeter Arten der Kategorie 2 - 50 % der bekannten Brutreviere kollisionsgefährdeter Arten: bedingt geeignet (Einzelfallprüfung)“*	Germany	-	Energieatlas Bayern (Windkraft)
Areas of particular importance for bird conservation (main bird migration routes) only insofar as they are not located within 300 metres in both directions from the highest point of a ridge’ *„Gebiete mit besonderer Bedeutung für den Vogelschutz (Hauptvogelzugrouten) nur insoweit sie nicht in einem Bereich von 300 Metern in beiden Richtungen von der höchsten Stelle eines Höhenrückens liegen“*	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Designated bird migration routes	Germany	-	
Breeding sites of collision-sensitive bats plus safety distance of 300 m: limited suitability (examination required)	Germany	300 m	Energieatlas Bayern (Windkraft)

Distance to…	Country	Buffer	Reference
Core areas Moorallianz, fens, raised bogs („*Kerngebiete Moorallianz, Niedermoore, Hochmoore - Moore im Wirlinger Wald, Moore westlich Buchenberg*“)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Species and habitats protection maps category 4 and 5 (“*Schutzgutkarte Arten- und Lebensräume, Stufe 4 und 5*”): limited suitability (examination required)	Germany	-	Energieatlas Bayern (Windkraft)
Nature conservation area („*Naturschutzgebiet*“)	Germany	200 m (Precautionary distance)	§ 23 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Nature conservation area („*Naturschutzgebiet*“)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Natural Monuments (“*Flächenhafte Naturdenkmäler*”)	Germany	-	§ 28 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie) Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Protected Landscape Features (“*Geschützte Landschaftsbestandteile*“)	Germany	-	§ 29 BNatSchG Regionalplan Allgäu (Nutzung der Windenergie) Energieatlas Bayern (Windkraft)
Water protection area („*Wasserschutzzone I, II*“)	Germany	-	Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
Water protection area („*Wasserschutzzone I, II, III*“)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Aboveground watercourses and lakes of the first order (“*Oberirdische Gewässer 1. Ordnung*”)	Germany	50 m	§ 61 BNatSchG Regionalplan Donau-Iller (Teilfortschreibung Windenergie)

Distance to…	Country	Buffer	Reference
Aboveground watercourses and lakes (“*Oberirdische Gewässer*”)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Protected forests, natural forest reserves (“*Bannwälder, Naturwaldreservate*”)	Germany	200 m (Precautionary distance)	Regionalplan Donau-Iller (Teilfortschreibung Windenergie)
natural forest reserves (“*Naturwaldreservate*”)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Legally protected biotopes (*„gesetzlich geschützte Biotope nach §30 BNatSchG/Art. 23 BayNatSchG“)*	Germany	-	Energieatlas Bayern (Windkraft)
Biotopes (Bavarian biotope mapping)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie)
Compensation areas *(“Ökokontoflächen”)* registered in the *“Ökoflächenkataster”*: regular exclusion (exception possible)	Germany	-	Energieatlas Bayern (Windkraft)
Old, natural or semi-natural forests, forested ridgelines	Germany	1000 m	Our own estimation
areas with high perceived scenic quality, Landscape protection area	Germany	1000 m	Our own estimation
Landscape protection areas (*„Landschaftsschutzgebiete – LSG*“)	Germany	-	Regionalplan Allgäu (Nutzung der Windenergie
Landscape Protected areas, important bird areas	Styria, Austria	No windcraft accepted	
Residential areas	Austria	+/- 1,000 m, depending on federal state	https://www.igwindkraft.at/fakten/?mdoc_id=1030050; https://windfakten.at/?mdoc_id=1030050
Residential areas	Germany	400 – 1,500 m	Individual legal issues regarding the minimum distance between wind turbines and residential areas: https://www.bundestag.de/resource/blob/823414/f14766442bc688032709eb942adf8a65/WD-7-140-20-pdf-data.pdf

Distance to…	Country	Buffer	Reference
Residential areas	France	500 m	Article L.515-44 du Code de l'Environnement, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000033933299
Residential areas	Italy	variable	https://www.bosettiegatti.eu/info/norme/statali/1995_0447.htm
Residential areas	Slovenia	No minimum distance defined by regulations or act; but typically the distance is between 300 and 500 m	Available at: https://www.zurnal24.si/trajnostno/procesi-so-zdaj-prezapleteni-424904, https://dokumenti-pis.mop.gov.si/javno/veljavni/02_rep_priprava/992/0b/VE_Ojstrica_Analiza_smernic_sept2017.pdf
Shore	France	1,000m	Article L121-12 du Code de l'Urbanisme (Article L321-2 du CE) https://www.legifrance.gouv.fr/codes/id/LEGISCTA000031212412
Airport	Italy	variable	Risk plans ex L. 165/2004 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2004-11-09;265
Traffic routes	Germany	100-200m	Regionaler Planungsverband Allgäu, Fortschreibung des Teilfachkapitels B IV 3.2 – Nutzung der Windenergie: https://www.region.allgaeu.org/regionalplan/windenergie-fortschreibung-2/ Teilfortschreibung Windenergie des Regionalplans Donau-Iller Informelle Anhörung 15.05.2023 bis 14.07.2024

The Bavarian Energy Atlas ("Energie Atlas Bayern") distinguishes between the following categories:

- Exclusion ("*Ausschluss*"),
- Regular exclusion ("*regelmäßiger Ausschluss*"): As a general rule, energy use is not suitable here, but exceptions are possible.
- Limited suitability ("*bedingt geeignet*"): Areas of limited suitability for energy use, examination in more detail is required.

Table 2: Buffers related to ground-mounted solar power

Distance to…	Country	Buffer	Reference
Protected areas	Italy	500 m	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
Natura 2000- areas (FFH + SPA)	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)
Natura 2000 areas (FFH + SPA): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Nature conservation area („*Naturschutzgebiet*“)	Germany	-	§ 23 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Protected Landscape Features (“*Geschützte Landschaftsbestandteile*“)	Germany	-	§ 29 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Natural Monuments (“*Flächenhafte Naturdenkmäler*”)	Germany	-	§ 28 BNatSchG Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Protected forests, natural forest reserves (“*Bannwälder, Naturwaldreservate*”)	Germany	-	Art. 12a BayWaldG Regionalplan Donau-Iller (Freiflächen-PV)
Protected forests, natural forest reserves (“*Bannwälder, Naturwaldreservate*”)	Germany	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)

Distance to…	Country	Buffer	Reference
Forest („*Wald*“)	Germany	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Woodland, bog, swamp (“*Gehölz, Moor, Sumpf*”): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Legally protected biotopes („*gesetzlich geschützte Biotope nach §30 BNatSchG/Art. 23 BayNatSchG*“)	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)
Biotops according tot he Bavarian biotope mapping (“*Bayerische Biotopkartierung*”)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Compensation areas *(“Ökokontoflächen”)* registered in the *“Ökoflächenkataster”*	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)
Compensation areas *(“Ökokontoflächen”)* registered in the *“Ökoflächenkataster”*: limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Landscape protection areas („*Landschaftsschutzgebiete – LSG*“)	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)
Landscape protection areas („*Landschaftsschutzgebiete – LSG*“): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Priority areas of the Species and Biotope Protection Programme Bavaria (ABSP) (“*ABSP-Schwerpunkträume Bayern*”): generally unsuitable, exceptions possible	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)
Baden-Württemberg biotope network - core areas wet, medium, dry, water bodies („*Biotopverbund Baden-Württemberg - Kernräume feucht, mittel, trocken, Gewässer“)*: generally unsuitable, exceptions possible	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV)

Distance to…	Country	Buffer	Reference
Biotope network - General wildlife route plan ("*Biotopverbund – Generalwildwegeplan*"): generally unsuitable, exceptions possible	Germany	500 m	Regionalplan Donau-Iller (Freiflächen-PV)
Field bird scenery lapwing ("*Feldvogelkulisse Kiebitz*"): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Water protection areas ("*Trinkwasserschutzgebiete, Zone I und II*")	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse) Regionalplan Donau-Iller (Freiflächen-PV)
Water protection areas ("*Trinkwasserschutzgebiete, Zone III*"): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Floodplains for 100-year flood events („*Überschwemmungsgebiete, HQ100*")	Germany	-	Regionalplan Donau-Iller (Freiflächen-PV) Energieatlas Bayern (PV-Freiflächenkulisse)
Aboveground watercourses and lakes of the first and second order ("*Oberirdische Gewässer 1. und 2. Ordnung"*)	Germany	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Edge strip of aboveground watercourses and lakes of the first and second order ("*Randstreifen von oberirdischen Gewässern 1. und 2. Ordnung*"): limited suitability (examination required)	Germany	60 m	Energieatlas Bayern (PV-Freiflächenkulisse)
Aboveground watercourses and lakes of the third order ("*Oberirdische Gewässer 3. Ordnung"*): limited suitability (examination required)	Germany	-	Energieatlas Bayern (PV-Freiflächenkulisse)
Edge strip of aboveground watercourses and lakes of the third order ("*Oberirdische Gewässer 3. Ordnung"*): limited suitability (examination required)	Germany	10 m	Energieatlas Bayern (PV-Freiflächenkulisse)

Distance to…	Country	Buffer	Reference
Watercourses (width ≥ 3 m) and lakes	Germany	10 m	Regionalplan Donau-Iller (Freiflächen-PV)
Soil with very high significance for natural soil functions	Germany		
Settlements	Italy	500 m (protected areas managing authorities can exclude specific areas from installation or settle specific distances from the most sensitive areas)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
Traffic routes	Germany	200 m (within this distance to the infrastructure, ground-mounted photovoltaics are considered priviledged according to § 35 1 8b of the Federal Building Code BauGB)	Gesetz zur sofortigen Verbesserung der Rahmenbedingungen für die erneuerbaren Energien im Städtebaurecht vom 04.01.2023, https://www.recht.bund.de/bgbl/1/2023/6/VO.html
Traffic routes	Italy	300 m (maximum)	https://www.studiolegalesantiapichi.it/le-cd-aree-idonee-agli-impianti-fer-passaggio-alla-direttiva-red-iii-legislazione-italiana-a-confronto-con-la-disciplina-ue/
Airports	Italy	variable	Risk plans ex L. 165/2004 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:legge:2004-11-09;265

The Bavarian Energy Atlas ("*Energie Atlas Bayern*") distinguishes between the following categories:

- Exclusion ("Ausschluss"),
- Limited suitability ("bedingt geeignet"): Areas of limited suitability for energy use, examination in more detail is required.

Table 3: Buffers related to Hydropower plants

Distance to…	Country	Buffer	Reference
Fishing activities	France	50-200m 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
Settlements, artifacts, any activity inside rivers, protected areas, specific parts of dams/water channels	Italy	variable	https://documenti.camera.it/leg19/dossier/pdf/AP0055.pdf hydrogeologic plans ex L. 183/1989 https://www.gazzettaufficiale.it/eli/id/1989/05/25/089G0240/sg

Table 4: Buffers related to Bioenergy plant

Distance to…	Country	Buffer	Reference
Settlements	Germany	100-300 m	Applicable to plants requiring permits under the immission protection law BImSchG; TA Luft 2021 Nr. 5.4.1.15; https://www.lfu.bayern.de/energie/biogashandbuch/doc/kap222.pdf
Settlements	France	100 m	Annexe1 - Arrêté du 03/08/18 https://aida.ineris.fr/reglementation/arrete-030818-relatif-prescriptions-generales-applicables-installations-relevant
Settlements	Slovenia	Closed: 300m; Open: 500m; Biogas: 300-500m	Uredba o predelavi biološko razgradljivih odpadkov in uporabi komposta ali digestata (2013) Ur. list RS št. 99.
Settlements	Italy	variable	D.M. 03/02/2016 + D. Min. Svil. Econ 17/04/2008

Table 5: Buffers related to High-voltage transmission lines

Distance to…	Country	Buffer	Reference
Settlements/ buildings	France	0.0025-0.0075*U meters (U = tension in kilovolts)	Article 12 - Arrêté du 17 mai 2001 du Code de l'Environnement https://www.legifrance.gouv.-fr/loda/id/LEGITEXT000005631045/2020-12-03/
Settlements/ buildings	Slovenia	1-40m	Energetski zakon EZ-1, 2019 Available at: https://pisrs.si/pregled-Predpisa?id=ZAKO6665
Settlements/ buildings	Italy	variable	https://documenti.camera.it/-leg19/dossier/pdf/AP0055.pdf D.lgs. 105/15 + Lettera Circolare Min. Int. VV.F. n.3300 del 06/03/2019
Airports	Italy	variable	Risk plans ex L. 165/2004; https://www.normattiva.it/urires/N2Ls?urn:nir:stato:legge:2004-11-09;265
Protected areas	Italy	variable	

Table 6: Buffers related to Roads/Highways

Distance to…	Country	Buffer	Reference
Settlements	Italy	10-60m	https://www.bosettiegatti.eu/info/norme/statali/1992_0495.htm
Settlements	Slovenia	1-40m	Zakon o cestah, ZCes-2, 2022 Available at: https://pisrs.si/pregledPredpisa?id=ZAKO8298
Settlements	France	75-100m	Article L111-6 du Code de l'Urbanisme https://www.legifrance.gouv.fr/codes/id/LEGIARTI000031210191/2016-01-01/#LEGIARTI000031210191

Table 7: Buffers related to Railways

Distance to…	Country	Buffer	Reference
Settlements	Italy	30m	https://www.bosettiegatti.eu/info/norme/statali/1980_0753.pdf
Settlements	Slovenia	50-100m	Zakon o železniškem prometu ZZEIP, 1999. Available at: https://pisrs.si/pregledPredpisa?id=ZAKO1614
Settlements	France	2,2-3m	Article 1 - Décret n° 2021-1772 du 22 décembre 2021 relatif à la protectiondu domaine public ferroviaire https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044554622

Table 8: Buffers related to urban/ industrial developement

Distance to…	Country	Buffer	Reference
River banks	Italy	Buildings: 4-10 m Plantations: 1-10m	R.D. 8 maggio 1904, n. 368, https://www.bonificaferrara.it/images/Allegati/Amministrazione_trasparente/Disposizioni_generali/Atti_generali/R.D.%2008-05-1904,%20%20n.%20368.pdf R.D. n. 523/1904 D.lgs. n. 152/2006
Shore of the sea and lakes	Italy	300m	Legge 8 agosto 1985, n. 431 (legge Galasso) + D.lgs. 42/2004
Plot boundary	Slovenia	4m	Diverse municipal spatial plans
Settlements	Italy	variable	D.lgs. 105/15 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2015;105~art27
Forests	Italy	variable	D.lgs. 105/15 https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2015;105~art27

Annex 4: Core areas in the pilot region (see D.2.3.1)

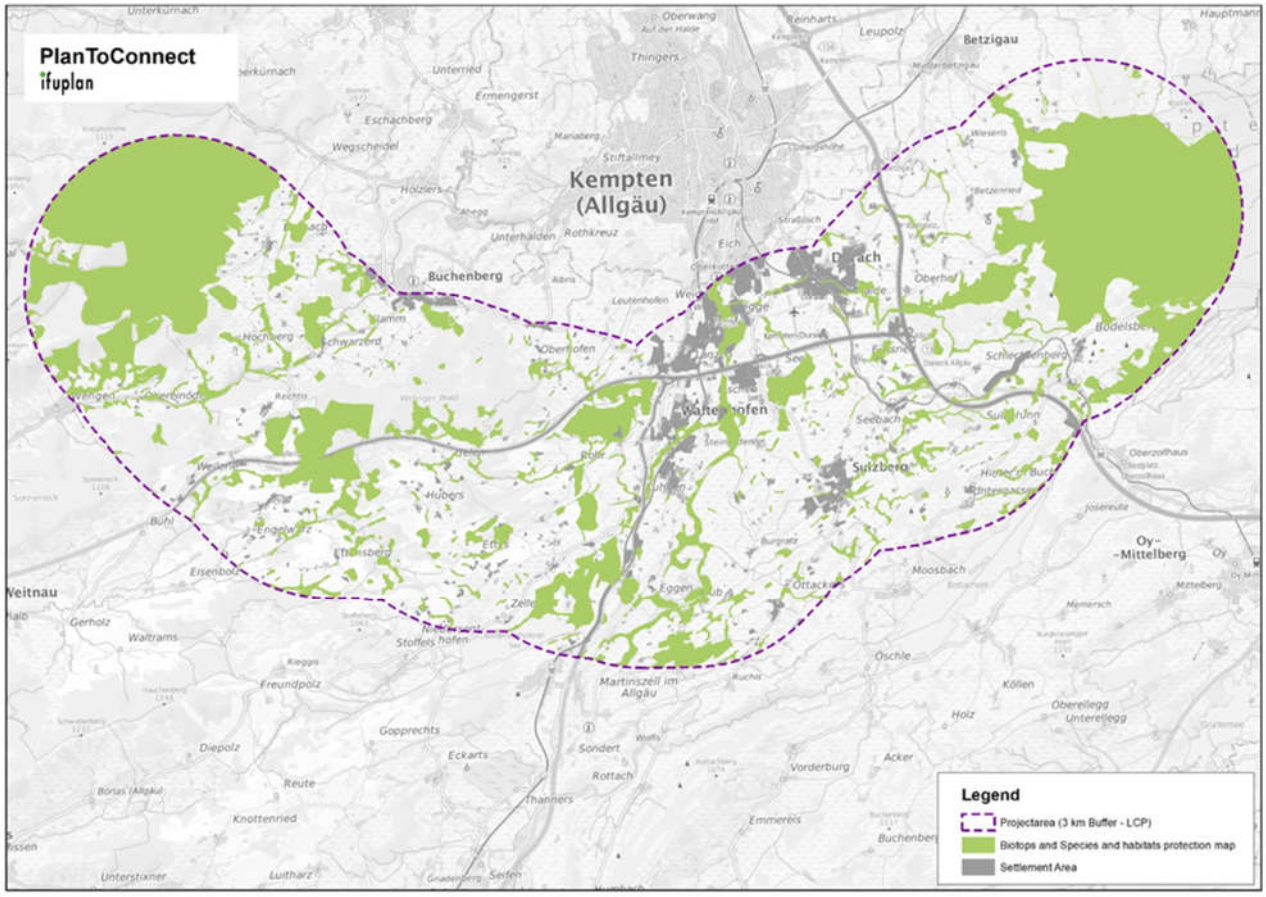

Figure 10: Defined core areas (areas of high nature conservation value) in the pilot region

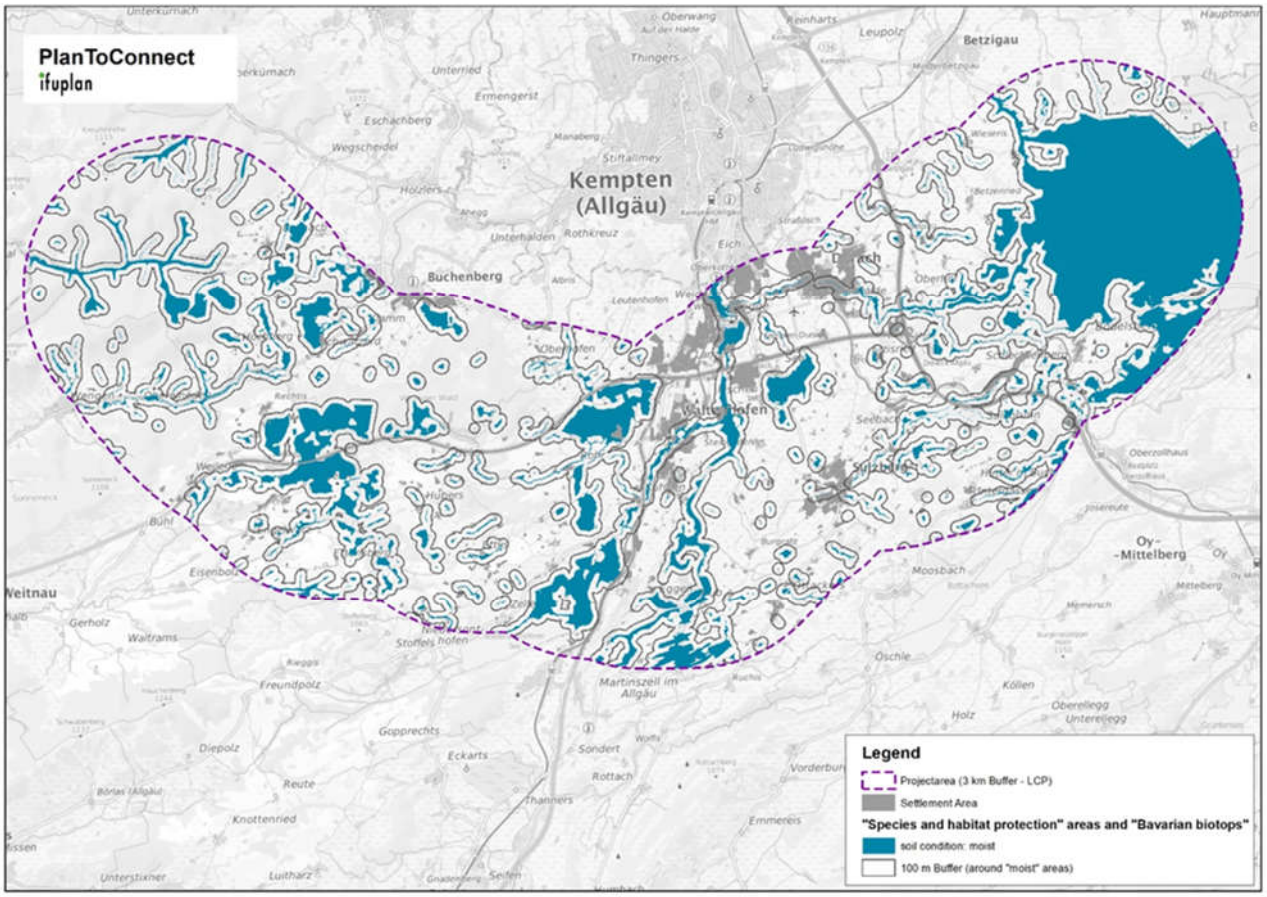

Figure 11: Core areas of wetland habitats (moist) buffered and dissolved with a distance of 100 m

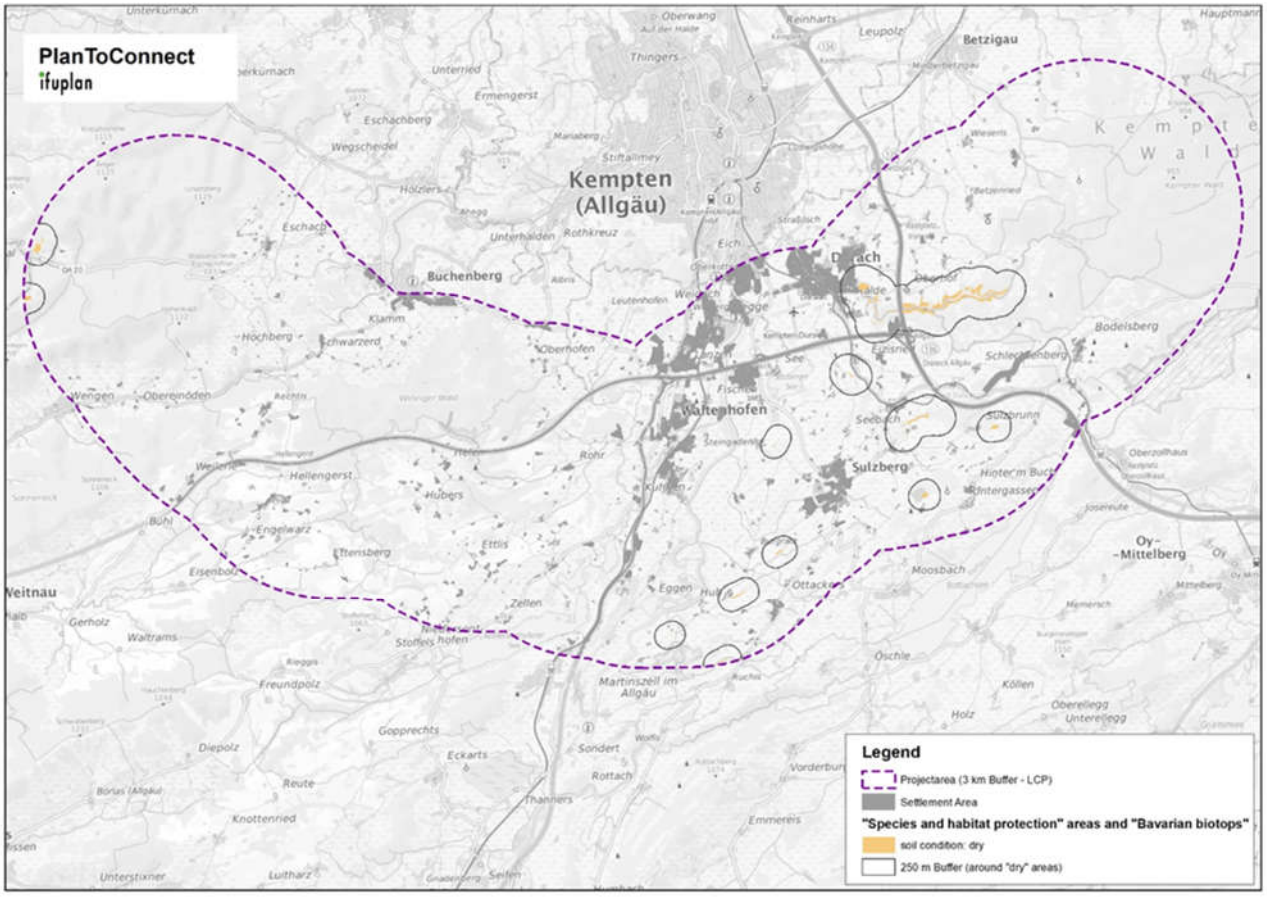

Figure 12: Core areas of dry habitats buffered and dissolved with a distance of 250 m

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