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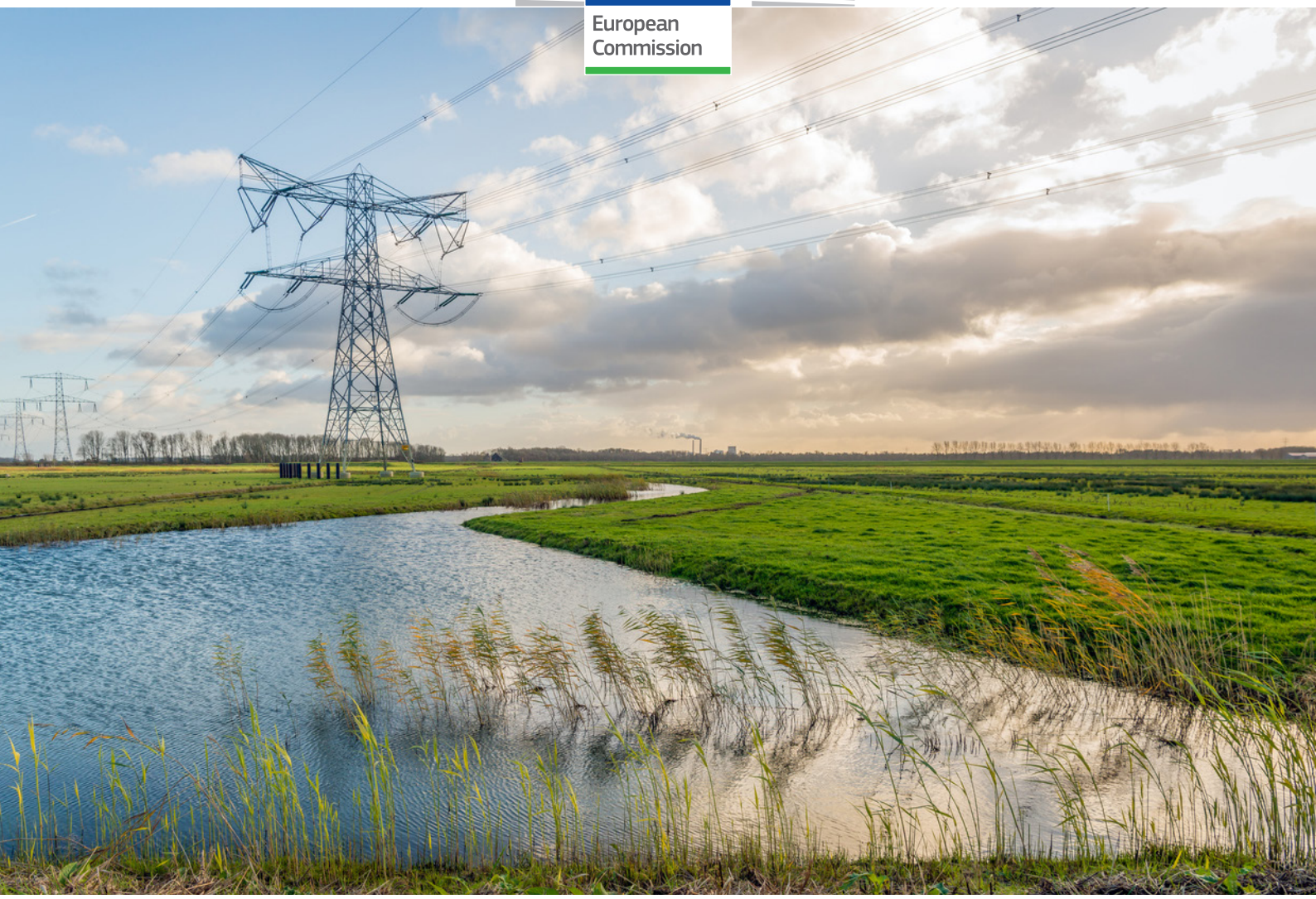

Guidance on Energy Transmission Infrastructure and EU nature legislation

Environment

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TABLE OF CONTENTS

ABOUT THIS DOCUMENT

Purpose

In November 2010, the European Commission published the communication *'Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network*'. It calls for a significant increase in energy transmission infrastructures in order to ensure a safe, sustainable and affordable energy supply across Europe, whilst, at the same time, reducing $C0_2$ emissions.

The new TEN-E Regulation (EU) No 347/2013 establishes an EU-wide framework for the planning and implementation of energy infrastructure in the EU. It establishes nine strategic infrastructure priority corridors in the domains of electricity, gas and oil, and three Union-wide priority thematic areas for electricity highways, smart grids and carbon dioxide transportation networks. It also introduces a transparent and inclusive process to identify and select concrete Projects of Common Interest (PCIs), which are needed to implement the priority corridors.

Like all development activities within the EU, energy transmission infrastructures must be fully compliant with the EU's environmental policy, including the Habitats and Birds Directives (the EU Nature directives). This document provides guidance on how best to achieve this in practice. It pays particular attention to the correct application of the permitting procedure under Article 6 of the Habitats Directive which requires that all plans and projects likely to have a significant negative effect on a Natura 2000 site undergo an appropriate assessment (AA) before authorisation. It also addresses the requirements for protection of species in the wider landscape.

Natura 2000 sites are not designed to be 'no go zones' and new developments are not excluded. Instead developments must be undertaken in a way that safeguards the rare and endangered species and habitat types for which the site has been designated. Often this can be achieved through careful planning, good and inclusive dialogue and, where appropriate, the use of suitable mitigation measures to remove or pre-empt any potential negative impacts of individual projects as well as cumulative impacts on the site's conservation objectives at the outset.

This document is designed principally for project developers, transmission system operators (TSOs) and authorities responsible for the permitting of energy transmission plans and projects, but it should also be of interest to impact assessment consultants, Natura 2000 site managers, NGOs and any other practitioners who are concerned by or involved in the planning, design, implementation or approval of energy infrastructure plans and projects. It is intended to give them an overview of the implications of energy infrastructure proposals on Natura 2000 and EU protected species and habitats and approaches to mitigating any negative effects.

This document might also be useful for assessment procedures carried out under the Environmental Impact Assessment Directive and Strategic Environmental Assessment Directive for energy transmission facilities plans and projects for which it is determined that Appropriate Assessment of their impact on Natura 2000 is not necessary.

Scope

The document provides guidance and best practices on the installation, operation and decommissioning of electricity, gas and oil transmission and distribution facilities in relation to Natura 2000 sites and species protected under the EU Habitats and Birds Directives in the wider landscape. It focuses on energy transmission infrastructures only and not on energy production facilities such as oil platforms, hydroelectric dams, wind turbines, power stations, etc.

The types of energy transmission infrastructures covered include gas and oil pipelines, as well as high and medium voltage electricity transmission cables and distribution facilities with the focus on the latter on land. A separate chapter is included regarding energy transmission infrastructure in the marine environment.

Structure and contents

The document contains eight chapters:

- *Chapters 1 and 2*: provide an overview of the EU policy context as regards energy infrastructure and the need for a modern, interconnected energy grid across Europe in line with the TEN-E Regulation. It highlights the legal provisions of the Birds and Habitats Directives that energy transmission developers, operators and authorities should be aware of including giving special attention to the permitting procedure under Article 6 for any plans or projects likely to have a significant effect on Natura 2000 sites as well as to the requirements on EU protected species across the wider landscape.

- *Chapter 3:* provides a general overview of the different types of potential impacts that energy transmission infrastructures might have on habitat types and species protected under the two EU nature Directives. Being aware of these potential impacts will not only ensure that the Appropriate Assessment under Article 6 of the Habitats Directive is carried out correctly but should also help to identify suitable mitigation measures that can be used to avoid or reduce any significant negative effects from arising in the first place.

- *Chapters 4 and 5:* focuses on the potential effects of electric grid infrastructures in particular and on identifying appropriate mitigation measures during different stages of the plan or project cycle. Detailed technical recommendations are given for remedial and mitigation measures wherever possible based on good practice experiences and latest research across Europe.

- *Chapter 6*: outlines the benefits of taking a more strategic and integrated approach to planning energy transmission infrastructures in a way that avoids or minimises the potential for conflicts with requirements of the EU nature legislation later on in the planning process when the options are much more limited. It also provides an overview of how the various impact assessments required under EU environmental laws, including under the Habitats Directives, can be effectively streamlined for PCIs, in particular in light of the shortened timelines for PCI permitting procedures under the TEN-E Regulation.

- *Chapter 7*: describes the permitting procedure under Article 6 of the Habitats Directive. It aims to provide practical advice on how to apply this permitting procedure in the context of energy transmission infrastructures in particular.

- *Chapter 8*: analyses the implications of energy transmission infrastructures on the marine environment. It first provides an overview of current energy infrastructure in EU marine

waters and predicted future developments. Then, it introduces the implications for marine Natura 2000 sites and protected species with reference to provisions in the Habitats Directive and Birds Directive, as well as relevant supporting measures and guidance from the EU and elsewhere. Thirdly, it reviews the potential impacts of transmission infrastructure (cables and pipelines) associated with oil, gas, wind, wave and tidal power, and Carbon Capture, transport and Storage (CCS) on marine species and habitats protected by the EU Habitats Directive and the EU Birds Directive. Examples of good practice are included as part of a discussion on ways to mitigate such effects. Fourthly, it examines the benefits of strategic planning for energy transmission infrastructure in the marine environment including the importance of setting this in the context of other EU legislation and policies such as the Marine Strategy Framework Directive and Marine Spatial Planning.

Throughout the document good practice examples are provided wherever possible to show how energy transmission facilities and EU nature legislation can be effectively reconciled in practice. They provide a useful source of ideas on the different types of techniques and approaches that can be used.

Nature of the document

This guidance document seeks to clarify the provisions of the Habitats and Birds Directives and place them in the context of energy transmission development and operation in particular. The document is not legislative in character but rather provides practical guidance and best practices on the application of existing rules. As such, it reflects only the views of the Commission services. It rests with the European Court of Justice to provide definitive interpretation of EU directives.

The document complements the Commission's existing general interpretative and methodological guidance documents on Article 6 of the Habitats Directive[1]. It is recommended that these guides be read in conjunction with the present document.

Finally, the document fully recognises that the two Nature Directives are enshrined in the principle of subsidiarity and it is for Member States to determine how best to implement the procedural requirements arising from them. The good practice procedures and proposed methodologies described in this document are therefore not prescriptive in their intent; rather they aim to offer useful advice, ideas and suggestions based on feedback and input from competent authorities, energy business representatives, NGOs and other experts and stakeholders.

The Commission would like to thank all those who participated in the preparation of this guidance document for their valuable contributions and discussions.

[1] All documents can be downloaded from: http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

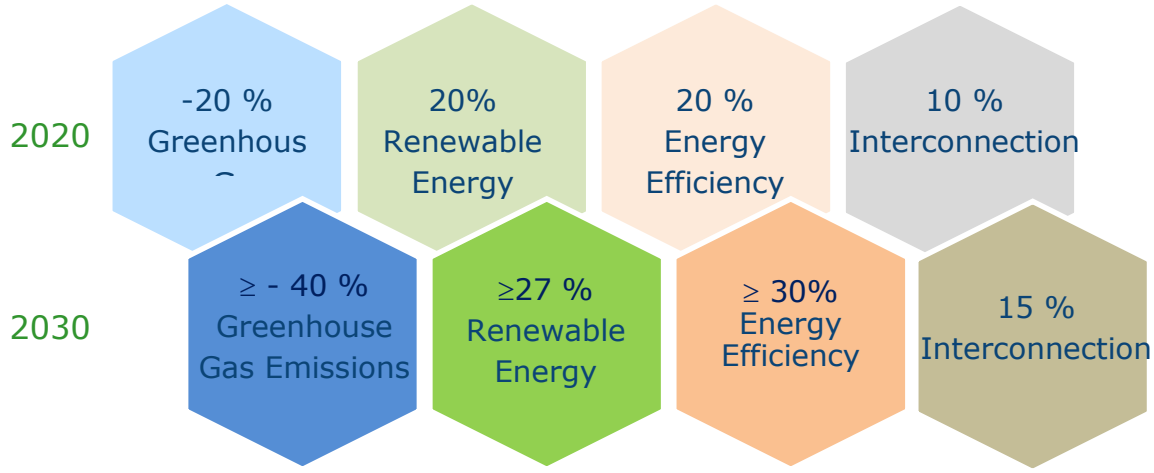
1. A RENEWED ENERGY INFRASTRUCTURE FOR EUROPE

1.1 The need for a renewed energy infrastructure in Europe

EU countries have agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives on greenhouse gas emissions, renewable energy, energy efficiency and electricity interconnections. These targets and policy objectives aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target.

Figure 1

2030 Framework for Energy and Climate – agreed headline targets



The Commission has presented, as one of its key priorities, a Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy[2]. Its goal is to help the EU deliver on its 2030 targets and objectives and give European consumers access to secure, sustainable, competitive and affordable energy and allow them to benefit from the ongoing fundamental transformation of Europe's energy system.

In order to meet the 2030 targets and objectives, it is essential that Europe's energy transmission and storage facilities are modernised[3]. Out-dated and poorly interconnected infrastructures are a major constraint on Europe's economy. The development of wind electricity generation in the North and Baltic Sea regions, for instance, is hampered by insufficient grid connections both off- and onshore. The risk and cost of disruptions and wastage is also expected to increase unless the EU invests in smart, effective and competitive energy networks, and exploits its potential for energy efficiency improvements.

[2] COM(2015) 80 final

[3] Energy infrastructure : priorities for 2020 and Beyond – a blueprint for an integrate European energy network http://ec.europa.eu/energy/publications/doc/2011_energy_infrastructure_en.pdf

The new EU energy infrastructure policy will help coordinate and optimise network development on a continental scale and so enable the EU to reap the full benefits of an integrated European grid, which goes well beyond the value of its single components.

A European strategy for fully integrated energy infrastructures based on smart and low-carbon technologies will not only reduce the costs of making the low-carbon shift through economies of scale for individual Member States. It will also improve security of supply and help stabilise consumer prices by ensuring that electricity and gas goes to where it is needed. European networks will also facilitate competition in the EU's single energy market, build up solidarity among Member States and ensure that European citizens and businesses have access to affordable energy sources.

In order to help implement this important step change in energy transmission, the EU adopted a new **TEN-E Regulation** (EU) No 347/2013[4] in 2013. This provides a comprehensive EU-wide framework for the planning and implementation of energy infrastructure.

It establishes nine strategic infrastructure priority corridors in the domains of electricity, gas and oil, and three Union-wide priority thematic areas for electricity highways, smart grids and carbon dioxide transportation networks to optimise network development at European level by 2020 and beyond.

[4] REGULATION (EU) No 347/2013 of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009 , OJ L 115 of 25.4.2013 p 39

Figure 2

Priority Corridors for Electricity gas and Oil

Map 1: Priority corridors for electricity, gas and oil

1.2. Infrastructure challenges

The challenge of interconnecting and adapting Europe's energy infrastructure to new needs concerns all sectors and all types of energy transmission facilities.

1.2.1. Electricity grids and storage

Electricity grids will need to be upgraded and modernised to meet increasing demand due to a major shift in the overall energy value chain and mix and also because of the multiplication of applications and technologies relying on electricity as an energy source. The grids must also be extended and upgraded to foster market integration and maintain the existing levels of system security, but especially to transport and balance electricity generated from renewable sources, which is expected to more than double in the period 2007-2020.

A significant share of generation capacities will be concentrated in locations further away from the major centres of consumption or storage. Significant shares will come from offshore installations, ground-mounted solar and wind farms in Southern Europe or biomass installations in Central and Eastern Europe. Decentralised generation is also expected to gain ground.

Beyond these short-term requirements, electricity grids need to evolve more fundamentally to enable the shift to a decarbonised electricity system in the 2050 horizon, supported by new high-voltage long distance and new electricity storage technologies which can accommodate ever-increasing shares of renewable energy, from the EU and beyond.

At the same time the grids also need to become smarter. Reaching the EU's 2020 energy efficiency and renewable targets will not be possible without more innovation and intelligence in the networks at both transmission and distribution level, in particular through information and communication technologies. These will be essential in the take-up of demand side management and other smart grid services.

1.2.2 Natural gas grids and storage

Natural gas is expected to continue to play a key role in the EU's energy mix in the coming decades and will gain importance as the back-up fuel for variable electricity generation. However, gas networks face additional flexibility requirements in the system, the need for bi-directional pipelines, enhanced storage capacities and flexible supply, including liquefied (LNG) and compressed natural gas (CNG).

1.2.3. Oil and olefin transport and refining infrastructure

If climate, transport and energy efficiency policies remain as they stand today, oil would be expected to still represent 30% of primary energy, and a significant part of transport fuels are likely to remain oil based in 2030. Security of supply depends on the integrity and flexibility of the entire supply chain, from the crude oil supplied to refineries to the final product distributed to consumers. At the same time, the future shape of crude oil and petroleum product transport infrastructure will also be determined by developments in the European refining sector, which is currently facing a number of challenges.

1.2.4. C02 capture, transport and storage (CCS)

CCS technologies can reduce CO2 emissions on a large scale but are still at an early stage of development. CCS commercial roll-out in electricity generation and industrial applications is expected to start after 2020. Due to the fact that potential CO2 storage sites are not evenly

distributed across Europe and that some Member States have only limited potential storage within their national boundaries, construction of European pipeline infrastructure spanning across State borders and in the maritime environment could become necessary.

1.3. Types of transmission and distribution facilities in use

The way in which different forms of energy are transported, distributed and stored varies of course in function of the type of energy in question and whether it is occurring on land or in the marine environment. For example, the transmission of electricity is generally realised by powerlines or cables, whilst the transmission of gas and oil is done by pipelines.

This document focuses in particular on the following facilities[5]:

- *Terrestrial gas and oil transmission facilities*: buried pipelines, above-ground pipelines including those crossing watercourses as well any associated components (initial injection stations, pump (oil) and compressor (gas) stations, partial delivery station, block valve stations, regulator stations and final delivery stations);
- *Terrestrial electricity transmission facilities:* buried/ underground powerlines, overhead powerlines, and associated components (towers, substations and converter stations).

1.3.1 Gas and oil transmission and distribution facilities

Pipelines are generally used to transport large quantities of crude oil, processed oil products or natural gas over land. Oil pipelines are made from steel or plastic tubes with an inner diameter typically from 100 to 1 200 mm. Most pipelines are buried at a depth of about 1 to 2 m. The oil is kept in motion by pump stations. Natural gas pipelines are constructed of carbon steel and vary from 51 to 1 500 mm in diameter. The gas is pressurised by compressor stations.

The pipeline is routed along what is known as a right-of-way (ROW). The steps for building a pipeline include the route selection that must then be surveyed to ensure any physical obstacles are anticipated, and cleared. Where needed, trenching is implemented, especially for main route and crossings. The pipe is later installed with its associated components (valves, intersections, etc.). Where relevant, the pipe and trench are then covered.

Photo left: Above ground pipeline, Guénange, Moselle, France © 2010 Benjamin Smith, Creative Commons. Photo right: Burying a pipeline along a ROW © 2007, Creative Commons

[5]Marine energy transmission infrastructures are covered in Section 8 of this document

1.3.2. Electricity transmission and distribution facilities

As electricity still cannot be stored in large quantities, it has to be generated in real-time. This means that its constant transport to users should be as effective as possible. In terrestrial environments, electricity transmission is the transfer of electricity from generating power plants to high-voltage electrical substations located near demand centres. Large amounts of electricity are transmitted at high voltages (110 - 750 kV in Europe, ENTSO, 2012) to reduce the energy lost in long-distance to a substation.

Transmission lines mostly use high-voltage three-phase alternating current (AC), that deliver large amounts of power over long distances (APLIC, 2006). High-voltage direct-current (HVDC) technology provides greater efficiency in very long distances (typically greater than 600 km). Electrical power may be transmitted through overhead lines or underground cables. In all cases, the voltages are high because, with present technologies, large amounts of power can only be transmitted efficiently with high voltages.

Electric power distribution carries electricity at a medium voltage from the transmission system to the final customers (often less than 33 kV). The distinction between high voltage power lines and medium voltage distribution lines is an important one from a nature conservation point of view as the risk of electrocution only exists for medium voltage distribution power lines whereas the risk of collision however exists for both transmission and distribution lines[6] (see chapter 4).

Electricity is usually transmitted through overhead power lines suspended by towers or utility poles, but buried/ underground power lines are also sometimes used, especially in urban areas or sensitive locations. Overhead power lines have specific impacts on biodiversity, health and the landscape, which are different from underground power lines. On the other hand the initial investment costs of underground cables can often be significantly higher than overhead powerlines.

Photo left: construction of overhead powerline on Hill of Aldie, UK © Anne Burgess, Creative Commons, Photo right: two-circuit, single-voltage power transmission line; "bundled" 4-ways© yummifruitbat, Creative Commons.

[6] In this guidance the term 'transmission' refers to the whole system, from transmission strictly speaking to distribution. If impacts differ between transmission, sub-transmission and distribution power lines, the specific term will be used.

1.4 Projects of Common Interest (PCIs)[7]

The existing TEN-E Regulation, which entered into force on 15 May 2013, sets out the legal and policy framework to optimise network development at European level by 2020 and beyond. It identifies 12 strategic priority corridors and thematic areas for energy infrastructure with a trans-European/cross-border dimension. The Regulation sets out a process to establish on a biennial basis Union-wide lists of **Projects of Common Interest** (so-called PCIs)8, which contribute to the development of energy infrastructure networks in each of the 12 priority corridors and thematic areas.

For a project to be included in the Union list, it has to have significant benefits for at least two Member States; contribute to market integration and further competition; enhance security of supply, and reduce CO2 emissions. The process of identification is based on regional cooperation, involving Member States and different stakeholders, who provide their knowledge and expertise with regard to the technical feasibility and market conditions, both from a national and a European perspective.

The third Union list of 173 energy infrastructure PCIs[9] was adopted in November 2017. The list covers 106 electricity projects, including electricity transmission lines and electricity storages, 4 smart grids projects and 53 gas projects. For the first time, the PCI list also includes 4 carbon-dioxide network projects. The list of PCIs is updated every two years to integrate newly needed projects and remove completed ones.

These PCIs may now be eligible for financial support under the Connecting Europe Facility (CEF). A budget of €5.35 billion has been earmarked for trans-European energy infrastructure under this new Facility for the 2014-2020 period. In 2016, under the second and third call for proposals a total of €707 million in grants was allocated to 27 PCIs. Of these grants, 11 were for projects in the electricity sector and 15 for projects in the gas sector; 1 was for a smart grid project. 8 grants were for construction works and 19 for studies. €800 million in CEF grants were set aside for PCIs in 2017.

Because of their strategic EU importance, **PCIs benefit from a streamlined planning and permit granting procedure**. This includes, for instance, the appointment of a single competent national authority to act as a 'one-stop-shop' for all permits and a binding three-and-a-half-years' time limit for project authorisation. The aim is to speed up procedures and ensure swift permitting and operation of projects which are considered necessary to bring about energy security and to help meet the EU's climate and energy targets, whilst at the same time ensuring that the highest standards imposed by Union environmental legislation are met, as well as to increase transparency and to improve public participation. This should, in turn, enhance the attractiveness of PCIs for investors thanks to an enhanced regulatory framework.

It should be noted however that the Union list contains PCIs in different stages of development. Some are still in the early phases of development, therefore studies are still needed to demonstrate that the project is feasible.

The inclusion of such projects in the Union list of PCIs is also without prejudice to the outcome of relevant environmental assessments and permitting procedures. If a project included in the Union list of PCIs turns out not to be in compliance with the EU acquis, it will be removed from the Union list.

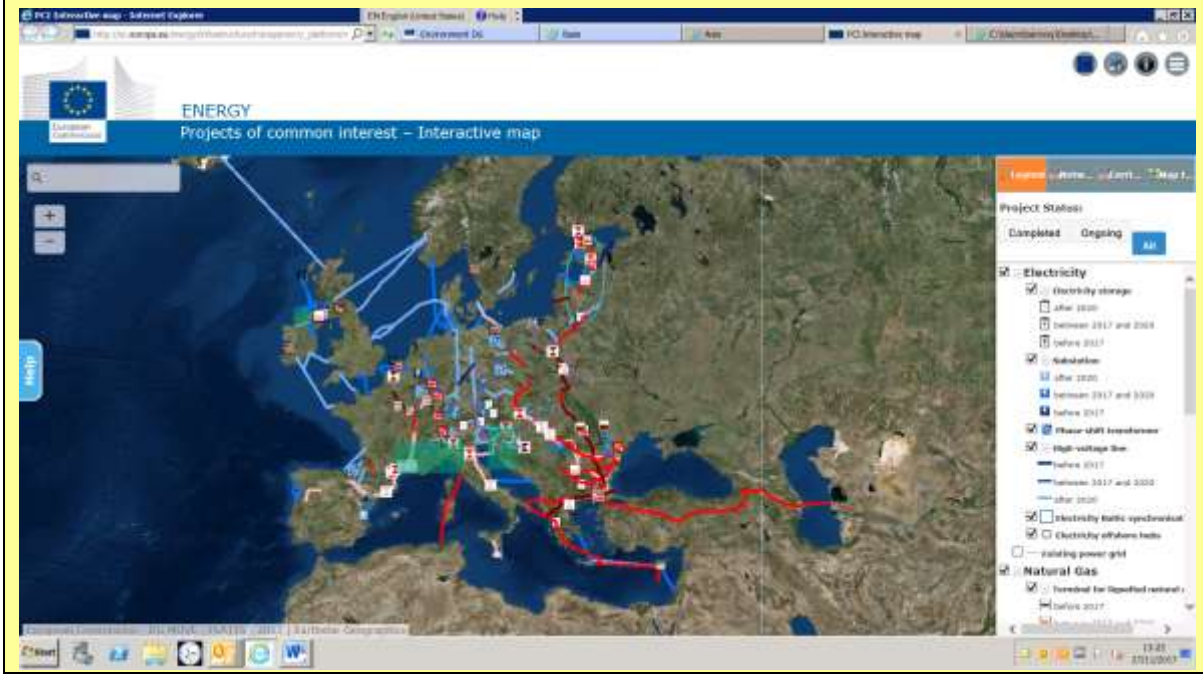
[7] https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest

[8] The types of energy infrastructure categories to be developed under the TEN-E Regulation are specified in Annex II of the Regulation

[9] https://ec.europa.eu/energy/sites/ener/files/publication/MJ3010705ENC.pdf

Energy Projects of Common interest: interactive map

The European Commission has developed A Transparency Platform[10] that enables the user to identify and explore each of the 173 PCIs adopted in 2017 through an on-line map viewer. Projects can be mapped according to type of energy (whether electricity, gas, oil or other), type of infrastructure, country and/or priority corridor. Technical summaries are also made available for each project shortly after adoption.



To support Member States in defining adequate legislative and non-legislative measures to streamline the various environmental assessment procedures, and to ensure a coherent application of those required under Union law for PCIs, the Commission issued a **Guidance document in July 2013**[11]**.**

What does "Streamlining" mean?

Streamlining means: improving and ***better co-ordinating*** *environmental assessment procedures, with a view to* ***reducing unnecessary administrative burden****, creating synergies and hence* ***shortening the time*** *needed to conclude the assessment process, whilst at the same time ensuring a* ***high level of environmental protection*** *through comprehensive environmental assessments in accordance with the EU environmental acquis.*

Source: Guidance Document "Streamlining environmental assessment procedures for energy infrastructure 'Projects of Common Interest' (PCIs)" July 2013

The Guidance document provides six main recommendations to streamline the procedures. These are based on, but also go beyond, the implementation experience and the good practices identified in the Member States so far (see chapter 4 for more details).

[10] http://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer

[11] Guidance Document "Streamlining environmental assessment procedures for energy infrastructure 'Projects of Common Interest' (PCIs)" July 2013. http://ec.europa.eu/energy/infrastructure/pci/doc/20130724_pci_guidance.pdf

The recommendations focus in particular on:

- Early planning, "roadmapping" and scoping of assessments
- Early and effective integration of environmental assessments and of other environmental requirements
- Procedural co-ordination and time limits
- Data collection, data sharing and quality control
- Cross-border co-operation, and
- Early and effective public participation.

Subsequent chapters in this guide focus in particular on the permitting procedure under the Habitats Directive in the context of energy transmission plans and projects. Other environmental permitting procedures are not covered in detail, but are mentioned when relevant.

The present document therefore complements the above-mentioned Streamlining Guide for PCIs but has a wider remit, covering all types of oil, gas and electricity transmission infrastructures, irrespective of whether they are PCIs or not.

2. EU NATURE LEGISLATION

2.1 Introduction

Some energy transmission infrastructure plans and projects may potentially affect one or more Natura 2000 sites included in the EU Natura 2000 network or may impact on certain rare and threatened species protected under EU legislation. The Habitats and Birds Directives lay down the provisions that need to be respected in such cases. An overview of these provisions is provided in this chapter. Subsequent chapters present specific elements of the permitting procedure under Article 6 of the Habitats Directive in particular as it relates to energy transmission plans or projects.

2.2 The Birds and Habitats Directives

Halting the loss of EU's biodiversity is recognised as an important element of the Europe 2020 Strategy, calling for a smart, inclusive and sustainable growth policy that takes account of the important socio-economic benefits that nature provides society.

In March 2010, the EU Heads of State and Government set themselves the ambitious target of halting, and reversing, the loss of biodiversity in Europe by 2020. In May 2011, the European Commission adopted a new EU Biodiversity Strategy 2020 (COM(2011) 244) [12] which sets out a policy framework for achieving this.

The Birds[13] and Habitats[14] Directives are the cornerstones of the EU's biodiversity policy. They enable all EU Member States to work together, within a common legislative framework, to conserve Europe's most endangered and valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

The two directives do not cover every species of plant and animal in Europe (i.e. not all of Europe's biodiversity). Instead, they focus on a sub-set of around 2000 species which are in need of protection to prevent their decline or degradation. These are often referred to as species of Community interest or EU protected species. Some 230 rare or endangered habitat types are also protected in their own right under the Habitats Directive.

The overall objective of the two directives is to ensure that the species and habitat types they protect are maintained and restored to a favourable conservation status[15] throughout their natural range within the EU. This target is defined in positive terms, oriented towards a favourable situation, which needs to be reached and maintained. It is therefore more than just avoiding deterioration.

[12] http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

[13] Directive 2009/147/EC Council (codified version of Council Directive 79/409/EEC on the conservation of wild birds, as amended) – see http://ec.europa.eu/environment/nature/legislation/index_en.htm

[14] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, consolidated version 01.01.2007 - http://ec.europa.eu/environment/nature/legislation/index_en.htm

[15] The concept of "favourable conservation status" is not mentioned in the Birds Directive but there are analogous requirements in Art 4.1 and 4.2 of the Birds directive for Special Protection Areas (SPA).

To achieve this objective, the EU Nature directives require Member States to:

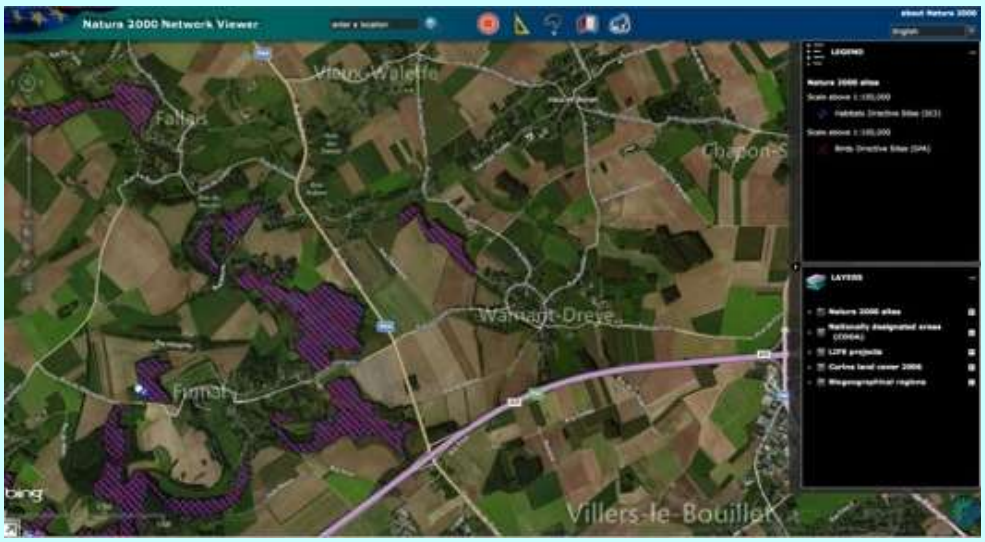
- **Designate and conserve core sites** for the protection of species and habitat types listed in Annex I and II of the Habitats Directive and Annex I of the Birds Directive, as well as for migratory birds. These sites form part of the EU-wide **Natura 2000 Network**;
- **Establish a species protection regime** for all wild European bird species and other endangered species listed in Annex IV and V of the Habitats Directive. This protection regime applies across the **species' entire natural range in the EU***,* that is across the broader landscape (ie both inside and outside Natura 2000 sites).

2.3 The management and protection of Natura 2000 sites

To date, over 27,000 sites have been designated as Natura 2000 sites. Together they cover around 18% of the European land area as well as significant marine areas. **The protection and conservation of Natura 2000 sites is governed by the provisions of Article 6 of the Habitats Directive**. It is divided into two types of measures – the first (governed by Article 6.1 and 6.2) [16] concerns the conservation management of all Natura 2000 sites at all times, whilst the second (governed by Article 6.3 and 6.4) lays down a permitting procedure for plans or projects likely to have a significant negative effect on a Natura 2000 site.

THE NATURA 2000 VIEWER: a useful tool for developers

The Natura 2000 viewer is an on-line Geographic Information System (GIS) mapping system that enables developers to locate and explore each Natura 2000 site in the EU Network. The sites can be examined at a very fine scale (1:500) which shows the boundaries of the site and its main landscape features at a very high resolution. For each site, a Standard Data Form (SDF) is available which lists the species and habitat types for which it was designated, as well as their estimated population size and conservation status on the site, and the importance of that site for the species or habitat types in question within the EU.



http://natura2000.eea.europa.eu/

[16] It should be clarified that Article 6(1) of the Habitats Directive does not apply to SPAs. However, analogous provisions apply to SPAs by virtue of Article 4(1) and (2) of Birds Directive laying down "special conservation measures" for the SPAs. However, pursuant to Article 7 of the Habitats directive the provisions of Article 6(2) -6(4) of the same directive, apply to both SCIs and already classified SPAs.

It is clear from this Article that Natura 2000 are not 'no-go zones' for development'. New plans and projects are entirely possible provided certain procedural and substantive safeguards are respected. The permitting procedure is in place to ensure that such plans and projects are implemented in a way that is compatible with the conservation objectives of the Natura 2000 site.

2.3.1 Taking positive conservation measures and ensuring non-deterioration

Article 6 of the Haitats Directive:
6.1. For special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites.

6.2 Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.

Articles 6.1 and 6.2 of the habiatts directive require Member States to:

- Take **positive conservation measures** that are necessary to maintain or restore habitat types and species for which the site has been designated (Article 6.1);
- Take measures to **avoid any deterioration** of habitat types or any significant disturbance of the species present (Article 6.2).

In respect of the former, Member States are required to set clear **conservation objectives for each Natura 2000 site** based on the conservation status and ecological requirements of the habitat types and species of EU interest present. At a minimum, the conservation objective should aim to maintain the conservation condition of species and habitats for which it was designated and not to allow this to deteriorate further.

However, as the overall objective of the Nature Directives is for the species and habitat types to reach a favourable conservation status across their natural range, more ambitious conservation objectives may be necessary to improve their conservation condition in individual sites. Being aware of the conservation objectives for a Natura 2000 site is particularly important for energy transmission developers, planners and authorities since the **potential negative effects of the plan or project will need to be assessed against these conservation objectives**[17].

Although not obligatory, the Habitats Directive encourages nature authorities to elaborate Natura 2000 management plans in close cooperation with local stakeholders[18]. These plans can be a very useful source of information as they usually provide detailed information on the species and habitat types for which the site has been designated, explain the site's conservation objectives and, where appropriate, the relationship with other land-uses in the area. They also outline the practical conservation measures that needed to achieve the site's conservation objectives.

17 http://ec.europa.eu/environment/nature/natura2000/management/docs/commission_note/commission_note2_EN.pdf

18 http://ec.europa.eu/environment/nature/natura2000/management/docs/commission_note/comNote%20conservation%20measures_EN.pdf

2.3.2 The permit procedure for plans and projects affecting Natura 2000 sites

Article 6 of the Habitats Directive:

6.3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appro- priate, after having obtained the opinion of the general public.

6.4. If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.

Articles 6.3 and 6.4 of the Habitats Directive lay down the permit procedure that must be followed when a plan and project is proposed that could affect one or more Natura 2000 site[19]. This permit procedure is applicable not just to plans or projects inside a Natura 2000 site but also those that are outside but could have a significant effect on the conservation of species and habitats within the site.

Article 6.3 of the Habitats Directive requires that any plan or project likely to have significant negative effect on a Natura 2000 site undergoes an **appropriate assessment** (AA) to study these effects in detail, in view of that particular site's conservation objectives. The competent authority can only agree to the plan or project if, based on the findings of the Appropriate Assessment, it has ascertained that it will not have an adverse affect the integrity of the site concerned. It is important to note that the onus is on demonstrating the absence (rather than the presence) of negative impacts.

Depending on the type and severity of the impacts identified, it may sometimes be possible to adjust the plan or project and/or introduce certain **mitigation measures** to avoid or pre-empt, remove or reduce them to a non-significant level so that the plan or project may be approved.

If this is not the case, then the plan or project must be rejected and alternative less damaging solutions explored instead. In exceptional circumstances, a derogation procedure under Article 6.4 may be invoked to approve a plan or project having an adverse effect on the integrity of one or more Natura 2000 sites, if it can be demonstrated that there is an absence of alternatives *and* the plan or project is considered to be necessary for **imperative reasons of overriding public interest.** In such cases, adequate compensation measures will need to be put in place to ensure that the overall coherence of the Natura 2000 network is protected.

Finally, it is important to note that the permit procedure under the Habitats Directive is not the same as that foreseen under the Environmental Impact Assesssment Directive (EIA) and Strategic Environmental Assessment Directive (SEA), even if they may be integrated (see chapter 7 for details).

[19] Pursuant to Article 7 of the Habitats directive the provisions of Article 6(3) and 6(4) of the same directive, apply to both SCIs and already classified SPAs.

Unlike the EIA/SEA assessments, the result of which needs to be taken into consideration when deciding to approve the plan or project, the **conclusions of the Appropriate Assessment are definitive and will determine whether the plan or project can be authorised.**

2.4 Species protection provisions

The second set of provisions of the two EU Nature Directives **concerns the protection of certain species across their entire range across the EU, i.e. both within and outside Natura 2000 site**s.

Some protected species are potentially vulnerable to certain types of energy infrastructure projects, such as overhead electricity cables. Therefore, these provisions also must be taken into account when considering such plans and projects in potentially sensitive areas outside Natura 2000 sites in the framework of the EIA/SEA procedures

The species protection provisions cover all naturally occurring wild bird species in the EU as well as other species listed in Annex IV and V of the Habitats Directive.

In essence they require Member States to prohibit:
- their deliberate disturbance during breeding, rearing, hibernation and migration;
- the deterioration or destruction of breeding sites or resting places;
- the deliberate destruction of nests or eggs, or the uprooting or destruction of protected plants.

The exact terms are laid down in Article 5 of the Birds Directive and Article 12 (for animals) and Article 13 (for plants) of the Habitats Directive[20].

Article 5 of the Birds Directive:

Without prejudice to Articles 7 and 9, Member States shall take the requisite measures to establish a general system of protection for all species of birds referred to in Article 1, prohibiting in particular:

(*a) deliberate killing or capture by any method;*

(b) deliberate destruction of, or damage to, their nests and eggs or removal of their nests;

(c) taking their eggs in the wild and keeping these eggs even if empty;

(d) deliberate disturbance of these birds particularly during the period of breeding and rearing, in so far as disturbance would be significant having regard to the objectives of this Directive;

(e) keeping birds of species the hunting and capture of which is prohibited;

***Article 12 of the Habitats Directive**:*

1. Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting:

(a) all forms of deliberate capture or killing of specimens of these species in the wild;

[20] See Guidance document on the strict protection of animal species of Community interest under the Habitats Directive http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

(b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;

(c) deliberate destruction or taking of eggs from the wild;

(d) deterioration or destruction of breeding sites or resting places.

2. For these species, Member States shall prohibit the keeping, transport and sale or exchange, and offering for sale or exchange, of specimens taken from the wild, except for those taken legally before this Directive is implemented

3. The prohibition referred to in paragraph 1 (a) and (b) and paragraph 2 shall apply to all stages of life of the animals to which this Article applies

Article 13 of the Habitats Directive

1. Member States shall take the requisite measures to establish a system of strict protection for the plant species listed in Annex IV (b), prohibiting:

(a) the deliberate picking, collecting, cutting, uprooting or destruction of such plants in their natural range in the wild;

(b) the keeping, transport and sale or exchange and offering for sale or exchange of specimens of such species taken in the wild, except for those taken legally before this Directive is implemented.

2. The prohibitions referred to in paragraph 1 (a) and (b) shall apply to all stages of the biological cycle of the plants to which this Article applies.

Derogations to these provisions are allowed in some circumstances (e.g. to prevent serious damage to crops, livestock, forests, fisheries and water) provided that there is no other satisfactory solution and the consequences of these derogations are not incompatible with the overall aims of the Directives.

The conditions for applying derogations are set out in Article 9 of the Birds Directive and Article 16 of the Habitats Directive. With reference to energy transmission infrastructures, it is primarily reasons related to ‘the interests of public health and public safety, or ‘other imperative reasons of public interest’ (ref. Article 16(1c)) that might apply.

3. POTENTIAL IMPACTS OF ENERGY TRANSMISSION FACILITIES ON NATURA 2000 AND EU PROTECTED SPECIES

3.1 Introduction

Energy infrastructure projects do not usually pose a major threat to biodiversity. There are many cases where well-designed and appropriately sited developments have no or only limited impacts. There are also examples of where projects have delivered net overall benefits for nature, especially in areas where the natural environment is already seriously impoverished. But this does not remove the obligation to examine, under the various legal environment assessment procedures in force such as EIA/SEAs and Appropriate Assessments (see chapter 7 for details), the potential effects that individual plans or projects can have on the natural environment.

This chapter reviews the type of possible impacts that energy infrastructures could have on the habitats and species protected under the Birds and Habitats Directives. It aim to provide developers, energy transmission operators and relevant authorities with an overview of the types of potential impacts to watch out for when preparing an energy transmission infrastructure plans or projects; and when carrying out an Appropriate Assessment under the permitting procedure foreseen in Article 6 of the Habitats Directive or assessment pursuant the EIA/SEA Directives.

3.2 The need for a case-by-case approach

It must be stressed that the potential effects are very much dependent on the design and location of the specific energy infrastructure in question and on the sensitivity of the EU protected habitats and species present. That is why it is **essential to examine each plan or project on a case-by-case basis**.

The design of each energy transmission facility project, including PCIs, will depend on a wide range of factors, including the type and volume of energy being transmitted, the receiving environment (e.g. whether on land or at sea), the distances required for transmission, and the capacity needed for reception or storage. Projects may concern not only the construction, but also for the renovation and/or decommissioning of any one or more of the facilities or infrastructures needed to transmit, receive or store energy on land.

When assessing the potential impacts on nature and wildlife it is important to consider not just the main infrastructure itself, but also all associated installations and facilities such as temporary access roads, contractors facilities and equipment storage, construction compounds, concrete foundations, temporary cabling, spoils and areas for soil surplus etc. The impacts may be temporary or permanent, on-site or off-site, cumulative and may come into play at different times during the project cycle (e.g. during construction, renovation, maintenance and/or decommissioning phases). All these factors must be taken into consideration.

The EU Nature Directives' species protection provisions must to be taken into account where there is a risk that the energy infrastructure plan or project may cause the death or injury, or deliberate disturbance during breeding, rearing, hibernation and migration, or the deterioration or destruction of breeding sites or resting places of species protected under the two Directives (e.g. such as eagles and marine mammals). This strict protection regime applies across the wider countryside, i.e. both inside and outside Natura 2000 sites.

Mitigation measures

The negative impacts mentioned in this chapter can sometimes be effectively mitigated against. Mitigation involves introducing measures into the plan or project to eliminate these potential negative effects or reduce them to a level where they are no longer significant. This means that they must be directly linked to the likely impacts and based on a sound understanding of the species/ habitats concerned. Mitigation measures can involve a change in location of the project, but they can also involve modifications to the size, design and configuration of various aspects of the energy infrastructure. Or they can take the form of temporal adjustments during the construction and operational phases. Further details, with examples of possible mitigation measures, are given in the next chapter.

3.3 An overview of potential impacts on EU protected species and habitats

The type and scale of impact is very much dependent on the EU protected species or habitat types present in the site, their ecology, distribution and state of conservation. Hence the need to examine each plan or project individually on a case by case basis. The following is an overview of the most frequent types of impacts that can occur:

3.3.1 Habitat loss, degradation or fragmentation

Energy transmission infrastructure projects may require the clearance of land and the removal of surface vegetation (often referred to as direct land-take). Through this process existing habitats may be altered, damaged, fragmented or destroyed. The scale of habitat loss and degradation depends on the size, location and design of the project and the sensitivity of the habitats affected.

It is important to note that, whilst the actual land take may seem limited, the indirect effects could be much more widespread, especially where developments interfere with hydrological regimes or geomorphological processes, and water or soil quality. Such indirect effects can cause severe habitat deterioration, fragmentation and loss, sometimes even at quite a distance from the actual project site.

The significance of loss also depends on the rarity and sensitivity of the habitats affected and/or of their importance as a feeding, breeding or hibernating place for species. Also, the potential role of some habitats as components of corridors or stepping stones important for dispersal and migration, as well as for more local movements between e.g. feeding and nesting sites, needs to be considered when assessing the significance of any habitat loss or degradation.

3.3.2. Disturbance and displacement:

Disturbance of species in their habitual breeding, feeding or resting sites, as well as along migration routes, can lead to displacement and exclusion, and hence loss of habitat use. The species may be displaced from areas within and around the project site due for instance to increased traffic, presence of people as well as noise, dust, pollution, artificial lighting or vibration caused during or after the construction works.

The scale and degree of disturbance, and the sensitivity of the species affected, determines the significance of the impact, as does the availability and quality of other suitable habitats nearby that can accommodate the displaced animals. In the case of rare and endangered species even small or temporary disturbances can have serious repercussions for their long term survival in the region.

3.3.3. Collision and electrocution risk:

Birds, and possibly bats, may collide with various parts of electricity overhead powerlines and other above-ground electrical facilities. The level of collision risk depends very much on site location and on the species present, as well as on weather and visibility factors and the specific design of the powerlines themselves (especially in the case of electrocution). Species that are long-lived, have low reproductive rates and/or that are rare or are already in a vulnerable conservation state (such as eagles, vultures and storks) may be particularly at risk.

The risk of collision and electrocution of birds is examined further in the chapters 4 and 5. As for bats, there is unfortunately a general lack of studies on the potential risks and impacts of collision with overhead power lines, due to the difficulties in monitoring the death of small animals along such long linear infrastructures.

3.3.4 Barrier effects

In the case of electricity, large transmission, receiving and storage infrastructures may force species to bypass the area altogether, both during migrations and, more locally, during regular foraging activities. Whether or not this is a problem depends on a range of factors such as the size of the sub-station, the spacing and routing of electricity cables, the extent of displacement of species and their ability to compensate for increased energy expenditure as well as the degree of disruption caused to linkages between feeding, roosting and breeding sites.

New emerging evidences that animals could be scared away from power cables because these give off UV flashes invisible to humans were reported by several scientific teams. A study[21] inspired by observations that reindeers avoid power lines running across the Arctic tundra was carried out by international team of researchers. Although the knowledge is still very limited in some particular cases this type of avoidance and fragmentation is relevant when establishing the significance of the impact.

3.4 Distinguishing between significant and insignificant effects

Identifying the species and habitats that are likely to be affected by an energy transmission infrastructure plan or project is the first step of any impact assessment, be it undertaken under Article 6 of the Habitats Directive, if the project affects a Natura 2000 site, or under the EIA or SEA Directive if it affects protected species outside the Natura 2000 network. After that, it is necessary to determine whether the impact is significant or not. The legal procedure for determining 'significance' for plans or projects specifically affecting Natura 2000 sites are described in chapter 7. Here, some of the general principles involved in determining the level of 'significance' in the case of wildlife (irrespective of whether it is in a Natura 2000 site or not) are briefly explained to help with the overall understanding of this concept.

[21] http://onlinelibrary.wiley.com/doi/10.1111/cobi.12262/full

The assessment of significance needs to be done on a case-by-case basis and in light of the species and habitats potentially affected. The loss of a few individuals may be insignificant for some species but may have serious consequences for others. Population size, distribution, range, reproductive strategy and life-span will all influence the significance of the effects. This is likely to vary from one site to another.

The interconnectivity of effects is also to be taken into account, for instance land take on its own may not be significant for a particular species, but when combined with major disturbance or displacement risks, it may reduce the fitness, and ultimately the survival rate, of that species to a significant level.

The assessment of significance needs also to be considered over an appropriate geographical scale. For migratory species that travel over long distances, the impact at a specific site may have consequences for the species over a much larger geographical area. Likewise, for resident species with large territories or changing habitat uses, it may still be necessary to consider potential impacts on a regional, rather than a local scale.

Finally, the considerations above should be based on the best available data. This may require dedicated field surveys or monitoring programmes some time in advance of the project.

3.5 Cumulative effects

Assessments of cumulative effects should also be taken into consideration when determining the impacts on Natura 2000 sites, as required by art 6.3 of the habitats directive. The cumulative effects of plans and projects can often be very important and need to be assessed carefully. They may arise when several energy infrastructures are present within an area or along a flyway corridor, or when an energy infrastructure project takes place in the same area as another type of plan or project (e.g. other industrial developments). The cumulative effect is the combined effect of all these activities taken together. It may be that one energy infrastructure project, on its own, will not have a significant effect, but if its effects are added to those of other plans or projects in the area their combined impacts could become significant.

For instance, an oil pipeline project that traverses part of a wetland may give rise to a small but acceptable level of temporary habitat degradation, which lies well within the capacity of that habitat to accommodate. But, if the wetland is also subjected to a land drainage scheme and/or a road construction project, the hydrological effects of all these projects, taken together, could lead to its permanent loss, fragmentation or desiccation. In this case, whereas the impact of the first and second projects, each on their own, is not discernible, the impact of both taken together could be significant. This influences the planning decision for both project proposals.

Cumulative impacts need to be taken into considerations also under the EIA/SEA procedures.

Because energy infrastructure developments are proceeding at a fast pace across the EU, it is therefore important that cumulative effects are assessed already in the early stages of an environmental assessment rather than merely as an ‘afterthought’ at the end of the process and thus delaying the decisions on the compatibility of the project proposals with the provisions of the EU legislation.

4. POTENTIAL IMPACTS OF ELECTRIC GRID INFRASTRUCTURES ON WILD BIRDS

4.1 Introduction

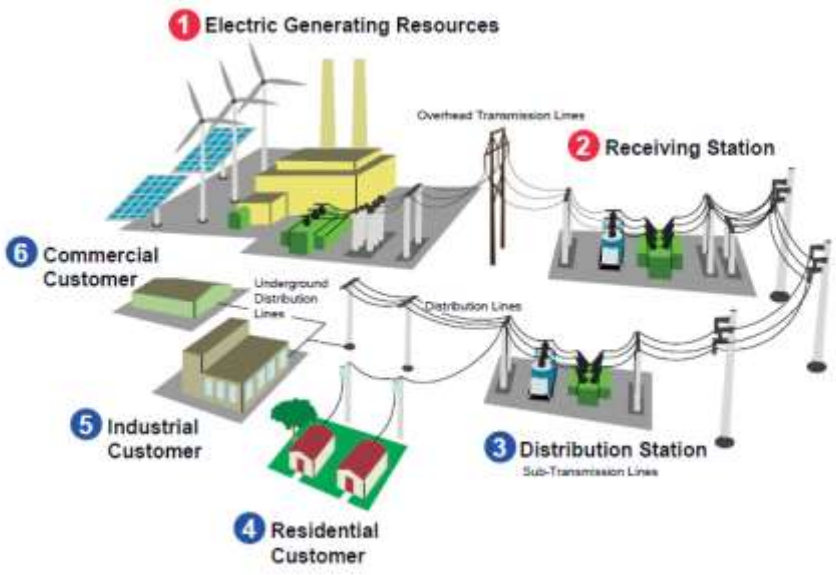
The previous chapter provided a general overview of the types of potential effects to look out for when developing energy infrastructure projects, particularly in and around Natura 2000 sites and in the vicinity of other sensitive areas used by species that are protected under the two EU nature Directives.

This chapter concentrates on analysing the potential effects of electricity infrastructure on wild European birds in particular. This is a subject that has received a lot of attention in recent years and one where the effects may be more frequent and more significant than for other types of terrestrial energy infrastructures.

4.2 Electric grid infrastructures

Unlike other commodities, electricity cannot be stored, so it needs to be produced and transported to the users in real-time. The electrical transmission system is consequently more complex and dynamic than other utility systems, such as water or natural gas. Once electricity has been generated at a power facility, high-voltage (110 - 750 kV in Europe, ENTSO, 2012) transmission lines carry large amounts of electricity across long distances to substations. From substations medium-voltage (1 – 60 kV) and low-voltage (1 kV >) distribution power lines carry electricity to residential and business consumers.

Figure 3 (USDA, 2009)



The electricity system is highly meshed. The transmission grid includes not only transmission lines that run from power plants to load centres, but also from transmission line to transmission line, providing a system that helps ensure the smooth flow of power. If a transmission line is taken out of service in one part of the power grid, the power is normally rerouted to other power lines so that it can continue to be delivered to the customer (PSCW, 2009).

Electrical power may be transmitted through overhead lines or underground cables, using alternating or direct current. In all cases, the voltages are high because they provide greater efficiency over long distances (typically greater than 600km). Overhead lines with alternating currents (AC lines) are the traditional way to transmit electrical energy (EASAC, 2009).

The advantages of overhead lines over underground cables are that, so far, the costs of building overhead lines have been significantly less than installing underground cables, and their capacity has been higher. The expected lifetime of overhead lines is high and can be up to 70 or 80 years. The main drawbacks of overhead lines are their use of land, their visual and different environmental impacts (EASAC, 2009)[22].

Transmission line structures support at least one three-phase circuit. They have three energized conductors (more if bundled), and may have one or two grounded conductors (usually referred to as static wires) installed above the phase conductors for lightning protection. Distribution line structures may support a variety of conductor configurations (APLIC, 2006).

Most AC commercial overhead power lines utilize some form of support structure from which insulators and electrical conductors are attached. Support structures may consist of wood poles, hollow or lattice steel structures, steel-reinforced concrete poles, or composite poles made from fiberglass or other materials. Insulators are made of porcelain or polymer materials that do not normally conduct electricity. Electrical conductors are usually manufactured from copper or aluminium (Bayle, 1999, Janss, 2000, APLIC, 2006).

Three-phase systems are used for both distribution and transmission lines. One of the primary benefits of three-phase systems is the ability to deliver large amounts of power over long distances (APLIC, 2006).

4.3 Potential negative impacts of electricity infrastructure on wild birds

The following provides an overview of the main types of impacts on wild bird species. Some protected European species are clearly more vulnerable to certain types of impacts – especially from electrocution and collision – due to their size, morphology, behaviour and distribution.

The table in Annex 2 presents a systematic prioritised list of impacts of bird populations/power line interactions (Birdlife, 2013). This table does not imply that these impacts will occur as described in all circumstances. Much will depend on the particular species and particular circumstances surrounding each individual case and on the availability of corrective measures for their mitigation.

[22] http://www.easac.eu/fileadmin/PDF_s/reports_statements/Transforming.pdf

Why are some bird species more vulnerable to power lines than others?

This is often due to the following physiological, behavioural and ecological features:

- Large body size;
- Poor frontal vision;
- Preference for nocturnal activity;
- "Poor fliers", less manoeuvrable birds (collision);
- Inexperienced flyers, young birds (electrocution and collision);
- Preference for elevated places for roosting, perching or nesting;
- Preference for treeless, open habitats (electrocution);
- Flocking and gregarious behaviour;
- Species susceptible to disturbance;
- Preference for low altitude habitats (i.e. in relation to higher density of electric grid);
- Rare and threatened species (coupling with low density, low-fecundity etc., see below);
- Low density species (with lower replacement potential);
- Species with low reproductive potential (through the increase in adult mortality it takes more time to recover from population losses);
- Species with low-fecundity, low mortality, long life expectancy (through decrease in recruitment potential during constant population loss)
- Long-distant intercontinental migrants (large spatial scale and very different level of mitigation of power line impacts).

4.3.1 Electrocution

Electrocution can have a major impact on several bird species, and causing the death of thousands of birds annually[23]. Electrocution may take place when a bird touches the two phase conductors or one conductor and an earthed device simultaneously, especially when the feathers are wet (Bevanger, 1998). Species that are particularly frequently affected by electrocution include Ciconiiformes; Falconiformes, Strigiformes and Passeriformes (Bevanger, 1998) – see table below.

There is a strong consensus that the risk posed to birds depends on the technical construction and detailed design of power facilities. In particular, electrocution risk is high with "badly engineered" medium voltage power poles ("killer poles") (BirdLife International, 2007).

Factors influencing the likelihood of bird electrocution include the following:

- *Bird morphology*: Large birds are more vulnerable because the likelihood of spanning electrical components with out - stretched wings or other body parts is higher than for small birds (Olendorff *et al.*, 1981; APLIC, 2006).
- *Bird behaviour:* Birds that use power poles to perch, roost and nest on are more vulnerable (Bevanger, 1998). Ground-nesting species (harriers and some owls) appear to infrequently get electrocuted because they typically hunt while in flight and perch on or near the ground (Benson, 1981).
- *Pole type and configuration*:
  - Most casualties occur at power poles of medium voltage distribution lines (1kV to 60 kV), which is due to the close spacing of the different parts (Haas & Nipkow, 2006).

[23] https://www.unenvironment.org/news-and-stories/story/planning-can-help-prevent-renewable-energy-surge-harming-wildlife

- Poles with a special function (strain poles, transposition poles, junction poles or transformer units) take much more victims than simple tangent structures (Demeter *et al.*, 2004).
- López-López and his colleagues (2011) demonstrated that bird casualties could have been dramatically reduced by retrofitting dangerous, poorly-designed poles.

- *Environmental factors*:
  - Prey abundance: the number of electrocuted raptors increases as the number of prey animals increases (Benson, 1981; Guil *et al.*, 2011).
  - Vegetation structure and coverage: vegetation structure may affect prey availability and the predator foraging performance (Guil *et al.*, 2011).
  - Habitat: birds more often use and get electrocuted on power poles in areas where places to perch are rare, e.g. grasslands, wetlands (Haas *et al.*, 2005; Lehman *et al.*, 2007).
  - Topography: In the case of electrocution, topography affects where birds will perch and roost, and vegetation height affects the availability of natural perches in the area. The mortality rates for eagles increased with slope, possibly due to the habit of hunting from perches. Studies have demonstrated that pylons located in dominant sites, surrounded by high slopes tend to produce higher electrocution rates. (Guil et al., 2011)

- *Sex:* Within the same species females bigger in size are more threatened by electrocution (Ferrer & Hiraldo, 1992).

- *Age:* Juvenile and immature birds are more prone to electrocution than adults. This is likely to be due to that lack of experience in landing and taking off (Benson, 1981; Harness, 1997; Bevanger, 1998; Harness & Wilson, 2001; Janss & Ferrer, 2001; González *et al.*, 2007).

- *Spatial:* In certain key areas for birds electrocution rate is higher than in low density areas (e.g. high density breding areas, dispersal zones, congregation sites, bottleneck areas) (González *et al.*, 2006; Cadahia *et al.*, 2010).

- *Seasonal:* Most casualties are reported from late summer, from the period of fledging or post-fledging. Large eagles are more threatened in autumn and winter maybe because of the feather wetting during inclement weather (rain, snow), which is extremely important to electrocution risk. (Benson, 1981; Bevanger, 1998; Lasch et al., 2010; Manville, 2005; Lehman et al., 2007)

- *Direction of the prevailing wind* relative to the crossarm also may contribute to raptor electrocutions. It is suspected that poles with crossarms perpendicular to the prevailing winds produced fewer eagle mortalities than those with crossarms diagonal or parallel to the wind, because of difficulties associated with crosswind take-offs and landings. (Nelson and Nelson (1976))

The following table provides an overview of European bird families that have been identified as vulnerable to electrocution and/ or collision (Birdlife, 2013).

Table 1. Severity of impacts on bird populations of mortality due to electrocution and collision with power lines for different bird families in Eurasia.

Bird families in Eurasia identified as vulnerable to electrocution and collision internationally	Casualties due to electrocution	Casualties due to collision
Loons (Gaviidae) and Grebes (Podicipedidae)	0	II
Shearwaters, Petrels (Procellariidae)	0	II
Boobies, Gannets (Sulidae)	0	I
Pelicans (Pelicanidae)	I	II-III
Cormorants (Phalacrocoracidae)	I	I
Herons, Bitterns (Ardeidae)	I	II
Storks (Ciconidae)	III	II
Ibisses (Threskiornithidae)	I	II
Flamingos (Phoenicopteridae)	0	II
Ducks, Geese, Swans, Mergansers (Anatidae)	0	II
Raptors (Accipitriformes and Falconiformes)	II-III	I-II
Partridges, Quails, Grouse (Galliformes)	0	II-III
Rails, Gallinules, Coots (Rallidae)	0	II
Cranes (Gruidae)	0	III
Bustards (Otidae)	0	III
Shorebirds/Waders (Charadriidae + Scolopacidae)	I	II-III
Skuas (Sterkorariidae) and Gulls (Laridae)	I	II
Terns (Sternidae)	0-I	I-II
Auks (Alcidae)	0	I
Sandgrouse (Pteroclididae)	0	II
Pigeons, Doves (Columbidae)	I-II	II
Cuckoos (Cuculidae)	0	I-II
Owls (Strigiformes)	II-III	II
Nightjars (Caprimulgidae) and Swifts (Apodidae)	0	I-II
Hoopoes (Upudidae) and Kingfishers (Alcedinidae)	I	I-II
Bee-eaters (Meropidae)	0-I	I-II
Rollers (Coraciidae)	I-II	I-II
Woodpeckers (Picidae)	I	I-II
Ravens, Crows, Jays (Corvidae)	II	I-II
Medium-sized and small songbirds (Passeriformes)	I	I-II

0 = no casualties reported or likely;
I = casualties reported, but no apparent threat to the bird population;
II = regionally or locally high casualties, but with no significant impact on the overall species population;
III = casualties are a major mortality factor, threatening a species with extinction, regionally or at a larger scale.

4.3.2 Collision

Collisions with power lines cause the death of millions of birds worldwide and can cause high mortality in some species of birds (Bevanger 1994, 1998; Janss 2000; APLIC, 2006; Drewitt & Langston, 2008; Jenkins *et al.*, 2010; Martin, 2011; Prinsen *et al.*, 2011). Empirical data and theoretical considerations indicate that **species with high wing loading and low aspect run a high risk of colliding with power lines**. These birds are characterised by rapid flight, and the combination of heavy body and small wings restricts swift reactions to unexpected obstacles (Bevanger, 1998). When the number of reported collision victims is considered relative to the abundance and population size of the species concerned, some Galliformes, Gruiformes, Pelecaniformes and Ciconiiformes species seem to be affected in disproportionately high numbers (Bevanger, 1998) - see *Table 1*.

Factors influencing collision include the following:

- *Bird morphology*: Birds with a high body mass and relatively short wings and tails, described as "poor fliers," are at greatest risk of collision (Bevanger, 1998; Janss, 2000).
- *Bird physiology*: Certain bird species are at least temporarily blind in the direction of travel (Martin, 2011).
- *Bird behaviour*:
  - Flocking behaviour, with species making daily flock movements across power lines to and from feeding, nesting, and roosting areas being particularly vulnerable (Janss, 2000).
  - Bird species that regularly fly low at night or in twilight are more susceptible to collision than species that mostly fly during the day.
- Other factors such as weather conditions, line configuration, routing of lines, habitat use, vegetation along lines, topography, disturbance, choice of migration routes and stopover sites should also be taken into considerations

Bird electrocution and collision cause economic losses

Bird-caused outages reduce power reliability and increase power delivery costs. Some outages may impact only a few customers temporarily, yet they can still affect a utility's service reliability and customer guarantees. Larger outages can have dramatic consequences and may cause significant economic loss at utility companies and at consumers (APLIC, 2006).

Costs associated with bird-related outages include those related to:

- Lost revenue,
- Power restoration,
- Equipment repair,
- Nest removal and other animal damage-control measures,
- Administrative and managerial time,
- Lost service to customers and negative public perception, and
- Reduced electrical system reliability (APLIC, 2006).

4.3.3 Habitat loss and fragmentation

The open rights-of-way corridors along power lines can fragment forests and other natural habitats. Power lines can also result in habitat loss through causing accidental forest fire (Rich *et al.*, 1994). Whilst the actual land take from electricity infrastructure may be relatively small, it can nevertheless be significant if that loss takes place in a core habitat for a

particular species, or if there are cumulative effects resulting for other projects in the same area and must therefore be examined on a case by case basis.

4.3.4 Disturbance/Displacement

During the construction phase and during the maintenance of power lines, some habitat destruction and alteration inevitably takes place (van Rooyen, 2004; McCann, 2005). Above-ground power lines can lead to the loss of useable feeding areas in breeding places as well as in staging and wintering habitats. For example recent studies showed that the presence of a power line influenced the flight direction of Great Bustards and restricted the use of suitable habitats (Raab *et al.*, 2010), and that transmission power lines are avoided by Little Bustards, being the most important factor determining breeding densities in sites with suitable habitat for the species (Silva, 2010; Silva *et al.*, 2010).

4.3.5 Electromagnetic fields

All electrical currents, including those running through power lines, generate electro-magnetic fields (EMFs). Therefore, many bird species, like humans, are exposed to EMFs throughout their lives (Fernie and Reynolds, 2005). A great deal of research and controversy exists as to whether or not exposure to EMFs affects the cellular, endocrine, immune, and reproductive systems of vertebrates. The research examining the effects of EMFs on birds indicate that EMF exposure of birds generally changes, but not always consistently, their behaviour, reproductive success, growth and development, physiology and endocrinology, and oxidative stress (Fernie, 2000; Fernie and Reynolds, 2005).

4.4 Potential positive effects of electricity infrastructure on wild birds

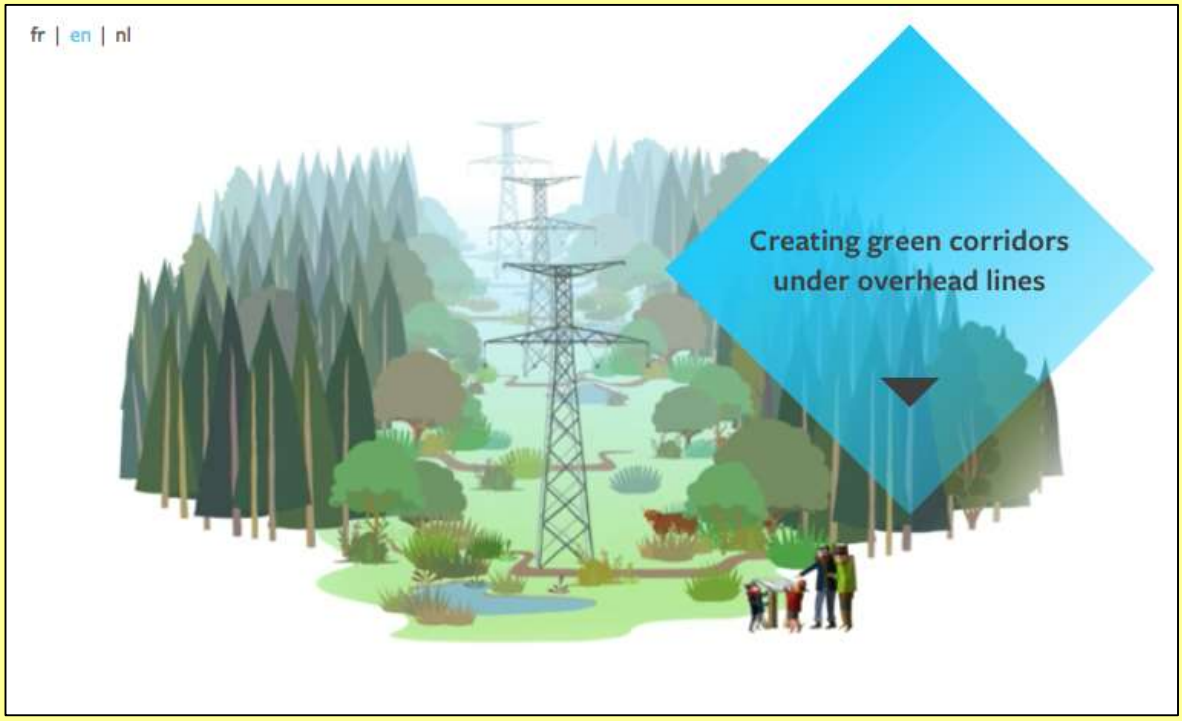
Electrical power lines, towers, and distribution poles can have a number of beneficial effects for wild bird species too. For instance they may offer:

- *Breeding substrate, nest site:* There are a variety of reasons why birds sometimes breed on electricity structures including: lack of alternative nesting sites such as trees and cliffs; electricity structures offer a mammalian-predator-safe and sturdy platform for birds to build their nests (van Rooyen, 2004; McCann, 2005). Utility structures can provide nesting substrates in habitats where natural elements are scarce, and offer some protection thereby facilitating the range expansion of some species or increasing the local density of some species, (APLIC, 2006).

- *Perching, roosting and hunting post:* Vultures and storks often seek power line structures for roosting since they are more protected from harsh weather and ground predators. The presence of electric poles in open-country habitats is beneficial to some raptors by providing perches with commanding views of hunting areas. Power line structures in relatively treeless areas have made millions of kilometres of suitable habitat available to perch-hunting raptors (Olendoff *et al.,* 1980).

- *Habitat management*: Power lines can also provide continuous habitat for species that require low vegetation. Research undertaken in the United States has shown that open rights-of-way along utility lines provide habitat for declining species of birds (Confer & Pascoe, 2003; Askins, 2012).

ELIA / RTE LIFE+ project: bringing benefits to nature[24]



ELIA (high-voltage electricity transmission system operator in Belgium), and RTE (electricity transmission system operator in France) led a 5-year project (2011-2017) to manage and restore over 300 hectares under medium and high-voltage overhead power lines in Wallonia and in France.

This project illustrates nature conservation measures, and how energy stakeholders may take infrastructure development as an opportunity to benefit biodiversity.

Ponds *(objective: 100 ponds on the 130 km project area)*

Wherever the soil is appropriate (presence of an impermeable layer: peat, white clay and gleyed clay soils) and primarily in the areas which offer good potential for certain rare species, ponds were dug or dams constructed on drainage channels to flood areas of at least 25 m² (minimum size to limit the silting process, i.e. natural filling of ponds by leaves). The network of intra-forest ponds will enable the colonisation of amphibians, dragonflies, damselflies, Dytiscidae and wetland birds and prevent populations from becoming isolated.

Orchards *(objective: 20 ha with 8 000 trees)*

A number of very rare and local species of fruit trees, mainly European Wild Pear (*Pyrus pyraster*), European wild apple (*Malus sylvestris*) and common medlar (*Mespilus germanica*), small-sized species, were planted under overhead power lines. Their presence brings diversity to the forest stands and also shelter and food to a whole range of local fauna (large animals, birds and insects).

Simple flower meadows *(objective: 20 ha)*

Simple flower meadows have been recreated on the access routes for the high-voltage power lines serving as refuge for rare flora, insects, birds and small mammals. Regular mowing and removal of the mowed vegetation will impoverish the soil and allow rare or lost plants to reappear. In extreme cases, flower meadows were recreated by sowing seeds from local plant varieties.

[24] http://www.life-elia.eu/en/

Peatlands and moors *(objective: restore or appropriately manage 20 additional hectares)*

The restoration of wetlands and moors under power lines is possible through removing the uppermost layer of soil, promoting the development of pioneer species from the underlying dormant seed bank. In some of the areas the water level was also locally restored by sealing drains, revitalising wet moorlands and peatlands. The objective is to maintain and improve exchanges of plants and animals between existing peatlands and moors, including those recently restored.

Pasturing *(objective: manage 20 ha through pasturing and 20 ha through mowing)*

Pasturing supported the restoration of damaged peatlands, moors, sparse meadows and valley bottoms, helping solving the problem of dominant species such as moor grass. In other cases (hay meadows, dry moors, sparse meadows), mowing (through contracts with local farmers), adapted in terms of periods and rhythm, helped maintaining the vegetation at the right level for a multitude of plant, insect and reptile species.

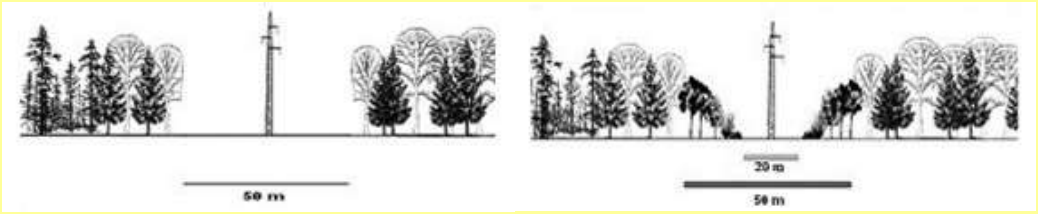
Invasive species *(objective: treat 20 to 30 ha)*

Under the project the growth of plant species on the Walloon list of invasive species was eradicated or brought under control, in particular, the black cherry (*Prunus serotina*), the summer lilac (*Buddleja davidii*), the giant hogweed (*Heracleum mantegazzianum*), the Himalayan balsam (*Impatiens glandulifera*), the Japanese knotweed (*Fallopia japonica*), the narrow-leaved ragwort (*Senecio inaequidens*) and, to a certain extent, the black locust (*Robinia pseudoacacia*) .

Fragmentation *(objective: create edges on 30 km (90 ha) and restore 40 km (120 ha))*

Currently, in the work areas of the project, the power line corridors created in forests are mainly U-shaped: at the centre is short grass, regularly cut, with an abrupt transition to the forest with tall trees on both sides. The project created V-shaped edge areas between the corridor and the forest.

These edges, with sizable trees from a variety of species, as ecotones, may provide food and shelter habitat for a whole range of insect, mammal and bird species which are absent in the corridors where the surrounding areas are "clean" and regularly maintained. The forest is enriched with secondary tree species that are often absent. These edges also reduce the damage that the wind can cause to the forest stand, creating a slope. These edges can also be very rich in deadwood, providing shelter for a huge number of insects and offering useful habitats for birds and bats. Once the density of these edges has increased, the growth of tall trees (birch, spruce, beech) that constitute a danger to the lines slows down.



Initial situation and situation after the project

5. POTENTIAL MITIGATION MEASURES FOR ELECTRIC GRID INFRASTRUCTURES AFFECTING WILD BIRDS

5.1 What are mitigation measures?

When the assessment of an energy infrastructure plan or project undertaken under Article 6 of the Habitats Directive identifies a number of negative effects on a Natura 2000 site, the plan or project is not automatically rejected. Depending on the severity of the potential impacts, it may be possible to introduce mitigation measures that will remove, pre-empt, or reduce to an insignificant level the potential negative impacts of a plan or project.

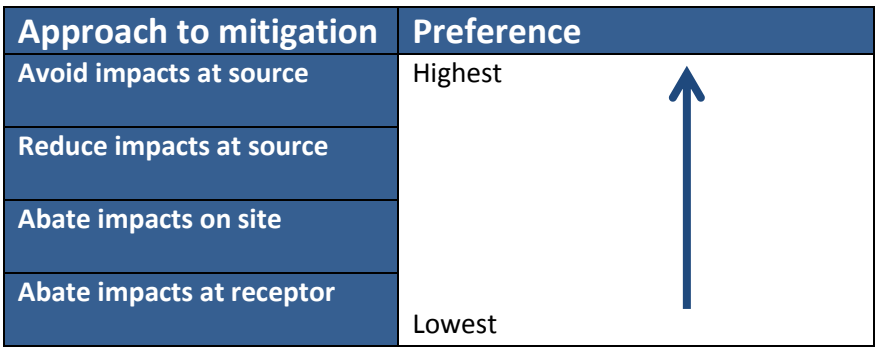
While this chapter is focusing on the Natura 2000 sites, measures that reduce the negative impacts should also be envisaged under EIA/SEA for plans and projects for which there is no need to undergo appropriate assessments but would have a negative impact on protected species.

In order to decide which mitigation measures are required, it is essential first to assess the effects of the plan or project on the EU protected species and habitat types present in the Natura 2000 site (alone or in combination with other projects or plans). This will identify the nature and extent of the negative effects and provide a baseline against which to determine the type of mitigation measures required.

In short, effective mitigation of adverse effects on Natura 2000 sites can only take place once the potential negative effects have been fully recognised, assessed and reported. The identification of mitigation measures, like the impact assessment itself, must be based on a sound understanding of the species/ habitats concerned.

Mitigation measures can involve modifications to the size, location, design and configuration of various aspects of the energy infrastructure plan or project (e.g. insulate the conductors to avoid electrocution). Or they can take the form of temporal adjustments during the construction and operational phases (e.g. avoiding construction works during the breeding season).

Figure 4: Hierarchical approach to adopting mitigation measures. Mitigation should always aspire to the top of the mitigation hierarchy (i.e. avoiding impacts at source)



Once suitable mitigation measures have been identified and worked out in detail, the plan or project can be approved under the Article 6 Habitats Directive procedure on condition that these mitigation measures are implemented in accordance with the instructions given by the competent authority.

If there is still a significant residual effect on the site, even after the introduction of mitigation measures, then alternative solutions will need to be examined instead (e.g. different location of the project, different scales or designs of development, or alternative processes). If these do not exist then the plan or project may still be approved, in exceptional cases, provided that the conditions of Article 6.4 are respected and suitable compensation measures are approved that will compensate for the remaining negative effects (see chapter 7 for details) so that the Natura 2000 network is not compromised.

For each mitigation measure proposed it is important to:

- explain how the measures will avoid or reduce to a non significant level the identified adverse impacts on the site;
- provide evidence of how they will be secured and implemented and by whom;
- provide evidence of the degree of confidence in their likely success;
- provide a timescale, relative to the project or plan, when they will be implemented;
- provide evidence of how the measures will be monitored and how additional measures will be introduced if the mitigation proves not to be sufficient.

EcoMOL project (Ecological Management of Overhead Lines)[25]

As part of the German project "Southwest Interconnecting Line / Thuringian Power Link", a study was undertaken (Erfurt University of Applied Sciences et al. 2010) which presents an interdisciplinary concept for the ecological management of overhead power line corridors (EcoMOL). This could be adapted and applied to various European regions.

The study recognises that operators have technical requirements, such as safety distances and construction work, in order to guarantee the transmission reliability for a high voltage overhead power line corridor. It gives methods to mitigate impacts such as habitat loss and degradation during construction and to implement compensation measures. It classifies biotope types of the corridor by growth height classes, derived from the natural growth characteristics of the species and possibly modified by management. Therefore, during line routing, the study distinguishes the corridor into areas not forested in the future, areas forested for the time being, and areas without felling requirements.

The combination of felling priority and current and potential growth height zones defines the range for possible creation or restoration measures. Detailed planning should be conducted separately for each of the three forest edge components (fringe, sheltering belt and low-density windbreak) differentiated by growth height

Figure 5: Ideally staggered composition of an outer forest edge along the OL corridor (FVA, 1996 modified) showing a schematic pilot

[25] Project summary available on:
http://www.50hertz.com/en/file/100304_EcoMOL_ShortReport_eng_final_med.pdf

5.2 Potential measures to mitigate negative effects of electricity plans or projects on wild bird species

The remainder of this chapter looks at the range of potential mitigation measures that can be used for electricity infrastructure plans and projects in relation to wild bird species in particular. Mitigation measures can be introduced at the level of a plan or at various stages in the project cycle.

5.2.1 Introducing proactive measures at the planning level

A range of measures can be introduced early on in the decision making process, especially at the initial planning stage to pre-empt, avoid or reduce the risk of potential impacts on Natura 2000 sites and on wild bird species. These may include the following:

Legislation

Create and endorse specific national legislative tools or amend existing ones in order to ensure that:

- Birds are protected from the negative effects of power lines (eg through the obligation to use underground cables in sensitive areas),
- New and fully reconstructed power lines are safe for birds by design and do not need further modification or retrofitting,
- Retrofitting of existing power lines and especially "killer" power poles is accomplished in a foreseeable time scale.

Planning

- Use the Appropriate Assessment/SEA of national power line infrastructure development plans to ensure that Natura 2000, and wild bird conservation considerations and priorities, are fully taken into account early on in the decision making process and,
- Wherever possible, adjust the plans to avoid sensitive Natura 2000 sites and other sites of importance for the bird species listed in chapter 4.
- Identify particularly sensitive bird species based on their vulnerability to power lines, conservation status, population size and distribution within the country
- Identify priority areas and sites based on the distribution, density and abundance of priority bird species and the existing and planned infrastructure and prepare a national sensitivity map to identify conflict hotspots and other priority (high-risk) sites for prevention and mitigation measures
- Prioritise powerlines for mitigation in function of bird mortality and distribution data.
- Avoid priority areas and sites (breeding and wintering areas, migration bottlenecks, breeding colonies, congregation sites, coast lines, wetlands) when possible during infrastructure planning/routing.
- Produce guidelines for technical solutions to mitigate bird strikes or electrocution hazard (for example Haas *et al.* 2005, Haas & Nikow, 2006, Prinsen et al., 2011).
- Conduct prior evaluation of the potential effectiveness of planned preventive and reactive strategies, to ensure management interventions are evidence-based.
- Set up an implementation plan for mitigation measures.
- Establish a national database and GIS for managing data of bird/power lines interactions and for adequate spatial planning including optimal routing of power lines based on ecological, technical and economic criteria.

Monitoring, research, evaluation and reporting progress of implementation

- Assess progress against objectives, milestones and timeframe of strategic plans.
- Evaluate lessons learnt to improve the future operation.
- Prepare implementation reports for key stakeholders.
- Support international exchange of experience.
- Collaborate in efforts to save threatened long-distance migratory birds from the negative effects of power lines.
- Initiate and support relevant research projects regarding prevention and mitigation measures and the development and production of bird-safety products.
- Develop a set of monitoring protocols standardised for different conditions.

A proposed general concept of area and site prioritisation

There are a number of steps that national authorities can follow to prioritise areas where electricity power line safety measures need be taken into account as priority. The general principle behind this approach is that areas holding or supporting the larger number of priority species as well as significant part of the populations of such species should be favoured for selection as national priorities for prevention and mitigation.

Both designated and non-designated areas and sites have to be prioritised according to their importance (temporal or permanent density & abundance) for priority species as High, Medium and Low priority areas.

Area's level of priority	Type of site
HIGH PRIORITY AREAS Importance: International (For example: - Special Protection Areas (SPAs which have a specific function to provide resting area for an internationally significant number of vulnerable species) - sites under IBA categories - Global: A1, A4i-iv; European: B1i-iv,B2 ; EU: C1, C2, C3, C4, C5, C6;)	Conflict hotspots for several priority species with the high species densities, such as - Key breeding areas for “source” populations of several priority species - Congregations, - Key stopover sites, - Key roosting areas, - Key wintering areas, - Bottleneck areas, - Key migration routes, - Key flyways between roost sites and foraging areas.
MEDIUM PRIORITY AREAS Importance: National	- Nationally important areas for one or few priority species. - Core breeding areas and source populations of several priority species, - The most important temporary settlement areas, - Nationally important congregation sites.
LOW PRIORITY AREAS Importance: Regional or Local	- Regionally or locally important areas for priority and for non-priority species.

Agreement on the Conservation of African-Eurasian Migratory Waterbirds AEWA guidelines on how to avoid or mitigate impacts of electricity grids

The 'Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region' adopted in 2012 by AEWA recommend seven essential steps (Prinsen et al. 2012):

Step 1: Develop and support strategic long term planning of nationwide electricity grid networks, including putting low to medium voltage power lines below ground. Apply appropriate SEA procedures for decisions on the need of power lines on a national scale and apply similar appropriate EIA procedures on the construction of a power line once it has been decided that such a power line is needed. Aspects of the risk for bird collision and electrocution have to be integrated into the EIA procedures.

Step 2: Develop and support collaboration between all stakeholders (utility companies, conservationists, governmental organisations) through support of Memoranda of Understanding on a volunteer basis, for example, or, if necessary, impose the cooperation of utility companies for strategic planning and mitigation of negative effects on birds through legislation.

Step 3: Develop scientifically based databases and spatial datasets on the presence of protected areas and other key bird areas and presence of susceptible bird species, including flight routes of these species between breeding, feeding and resting areas as well as important migration corridors. These datasets enhance strategic planning in steps 1 and 2 and define priorities in step 4. If no data are available, such as from regular national bird monitoring projects, then field data must be collected for a minimum of one year.

Step 4: Routing new above ground power lines away from key areas for birds, taking into account the presence of protected areas (with either a national or international status), abiotic factors that influence the bird/power line conflicts and the susceptibility of relevant bird species.

Step 5: Develop priority lists of key conservation areas and species in order to identify priorities for mitigating sections of new power lines and retrofitting existing power lines.

Step 6: Mitigate problematic sections of power lines, both existing and planned, to minimise the effects of electrocution and collisions on birds by using state-of-the-art techniques.

Step 7: Develop and support evaluation programs that use standardised protocols to monitor the effectiveness of mitigation measures as well as to improve mitigation techniques, including monitoring of incidents (electrocution and collision) and the presence and movements of birds in order to assess the (species-specific) scale of impact."

5.2.2 Investigating potential mitigation and preventive measures at the project-level

At the project level, it is recommended that the following aspects be taken into consideration during the Appropriate Assessment or when carrying out an impact assessment under EIA for projects that may affect protected species outside Natura 2000 (ref Article 5 of the Birds Directive and Article 12 of the Habitats Directive).

Phase I. Pre-construction

- Investigate different options of mitigation of bird/power line conflict in the EIA/AA of new power lines and of line reconstructions.
- Plan avian-safe solutions (underground cable, plastic-covered conductor "PAS cable") in transmission and distribution lines where technically and financially feasible, but especially in areas of high relevance to birds.
- Ensure that new overhead power lines are safe for birds by design.
- Cluster lines together.
- Site lines away from obvious flyways, roosting areas or other areas of concentration of birds if possible.
- Plan vegetation, topography, or man-made structures to shield lines.

- Plan Before-After Control-Impact (BACI) assessment and supporting monitoring.
- Replace reactive, per pole responses, where poles are retrofitted or overhead wires modified after bird death findings, by a structured, pro-active program to avoid most mortalities before they occur.

Phase II. Construction of new lines

- Ensure that fully reconstructed lines are safe for birds by design (e.g. underground cable, plastic-covered sheathed cable (PAS cable), pole heads safe by design).
- Avoid pole design with pin-insulators on new overhead lines.
- Use poles with suspended insulators.
- Avoid using neutral (ground) cable above conductor cables when possible.

Phase III. Operation - maintenance, modernisation, re-construction, retrofitting of existing lines

- Ensure that fully reconstructed lines are safe for birds by design (e.g. underground cable, plastic-covered PAS cable, pole heads safe by design).
- Ensure that priority power lines in term of bird conservation/distribution and the most dangerous pole types in all lines are retrofitted/changed to bird-friendly lines and pole types with state-of-the-art technical standards for bird safety.
- Conduct standardised monitoring of the impacts of power lines on birds and monitoring to evaluate the effectiveness of mitigation measures.
- Enhance habitats for mitigation of the impact of power lines on biodiversity.
- Create habitats on the same side of the power line to minimize crossings.
- Minimize human activities/disturbance near the line (educational process).
- Prepare report regularly on the results of monitoring and mitigation activities and share it with key stakeholders.

Phase IV. Decommissioning

- Ensure that no infrastructure is left along the path of power lines.
- Ensure habitat integrity along the path of former power lines.

5.3 Detailed technical recommendations for remedial and mitigation measures

To ensure avian safe electricity transmission and distribution facilities, the following mitigation measures and technical parameters are recommended:

5.3.1 Mitigation of electrocution

Principles of mitigation

1. Replace steel power poles with less hazardous concrete or wooden poles.
2. Because temporary insulation materials erode and retrofitted pylons may deteriorate to lethal structures over time, the use of safer pylon designs (for example with suspension insulators and with distances over the sufficient minimum safety spacing, see below) have to be given priority over temporary solutions.
3. Replace pin insulators with hanging insulators or retrofit pin insulators with the latest generation of insulating cover in the sufficient length.
4. Ensure that there is sufficient spacing between different conductors and between conductors and grounded wires or hardware.

5. Ensure that distances between conductors are not less than 1400 mm.
6. Ensure that distances between perch sites (cross-arm, pole top) and energised elements are not less than 600 mm.
7. Discourage birds from perching in unsafe locations.

Recommended mitigation methods:

Poles with pin insulators

- Insulate insulators and conductors with plastic insulating caps, 1400 mm in length.
- Apply cable tubing, 1400 mm in length.
- Insulate the centre conductor attached to a pin insulator on horizontal-configuration intermediate poles with no conducting cross-arm in order to achieve necessary clearance between outer conductors.

Poles with suspended insulators

- Use of pole types where the distance between the middle hanging insulator and the pole top is at least 1000 mm.
- In poles (triangle- or vault-shape type) with hanging insulators the insulation of the middle conductor over a total length of 2000 mm is recommended if there is a dangerous perching site below the middle insulator on the top of the pole.

Strain poles and junction poles

- Use insulator-chains which are at least 700 mm in length.
- Route at least two jumper wires below the cross-arm, and insulate the third jumper.
- Use insulated jumper wires.

Transformers, terminal structures

- Construct terminal structures with sufficient insulation on jumper wires and surge arresters.

Poles with switching devices

- Design switch poles so that perching by birds on switch gear is unlikely, and/or all dangerous components are insulated.
- Mount switches below the cross-arm, and jumper wires have to be insulated.
- Use bushing covers.
- Install insulated (not conductive) perches above the switch gear over the whole length or on the sides of the pole head satisfying minimum required distances for bird safety.
- Use effective perch deterrents in unsafe locations.

Re-construction of lines

- Replace overhead lines with underground lines when possible.
- Avoid pole design with pin-insulators on new overhead lines.
- Use poles with suspended insulators.

5.3.2 Mitigation of collision

- Decrease the number of collision planes (vertically separated number of conductors),
- Avoid to use neutral (ground) cable above conductor cables when possible,
- Install clearly visible large high contrast (i.e. black and white) markers and/or moving and reflecting bird flight diverters in energised conductors and ground wires.

6. THE IMPORTANCE OF ADOPTING A STRATEGIC APPROACH TO PLANNING

6.1 The benefits of integrated planning

An ineffective way of developing a plan or project, be it for energy transmission infrastructures or for any other development activities, is to first design the plan or project for its purpose and then, later on, to consider the wider environmental and other use implications. This means that potential conflicts are taken into consideration at a relatively late stage in the planning process, at a time when there are fewer options available.

When the design concept is already so far progressed, the environmental impact assessment necessarily becomes an exercise in damage limitation and, even though all the rules governing environmental impact assessments are followed thoroughly, there is no guarantee of success. This type of approach to project design and planning can also lead to long discussions with planning authorities, other interest groups and NGOs during the public consultation phase which can, in turn, cause significant delays to the planning process and incur additional costs.

Adopting an integrated and forward-thinking approach to energy transmission infrastructure planning that considers both the energy transmission needs and the ecological needs together at the outset and during the initial project or plan design has numerous important advantages:

- It promotes a more interactive and transparent planning process and encourages early and iterative dialogue, which can help to significantly reduce the overall time required for the permitting procedure.

- If done correctly, strategic (spatial) planning can help to avoid or reduce the number of potential site-specific conflicts at a later stage in the development process, when financial and legal resources have been committed and there is less room for manoeuvre.

- This can in turn also provide developers with a more transparent and stable regulatory environment and offer them greater certainty over the likely success of their permitting application because environmental concerns were taken into account already during the initial project concept.

- It can also be more cost effective in the long run. Were potential avoidance or mitigation measures factored in already at an early design or planning stage they are likely to be technically easier and cheaper to integrate;

- It can lead to the development of new, creative and innovative solutions and potential win-win situations which are unlikely to have been explored under the more classic sectoral approach to project planning.

- It can contribute to an improved public image of the project and the institutions responsible.

Whilst preparing and executing such an integrated planning process may require a more substantial initial investment there is strong evidence to show that this type of approach almost invariably delivers substantial benefits that far exceed the initial extra investment required.

A more integrated planning approach will also have a major influence on the Article 6.3 permitting process for Natura 2000 sites under the Habitats Directive. Whilst it may not guarantee the success of the project application it is likely to considerably facilitate the authorisation process.

Experience has shown that taking environmental considerations into account early on in the decision making process can lead to solutions being found when there is still a wide choice of options available.

If, on the other hand, this inter-sectoral dialogue is left to the last stages of the Article 6.3 permitting procedure the range of solutions becomes much narrower (and more expensive to implement) and there is a greater tendency for the discussion to become polarized and more confrontational.

This is especially the case if a sectoral policy or development strategy has been given the green light at a high governmental level, without considering other policy implications. Then when it comes to more detailed plans and projects, people have difficulty understanding why the Article 6.3 procedure may block something that has already been politically agreed at the highest levels (even without any spatial information).

However, there may still be occasions where a project might simply not be compatible with conservation objectives of the Natura 2000 sites, or be irredeemably damaging for certain wild bird species. Nevertheless, thanks to the integrated planning approach this conclusion would become evident very early on and steps can be taken to avoid such impacts where possible.

6.2. Determining suitable locations for energy transmission facilities

One of the most effective ways of avoiding potential conflicts with Natura 2000 sites and EU protected species is to consider the location of new energy transmission developments at a strategic planning level – for instance through a regional or national development plan – which allows for the sensitivities of Natura 2000 sites to be taken fully into account. This will help to identify the best sites for energy transmission whilst also wherever possible minimising the risk of potential conflicts with Natura 2000 sites at the individual project level.

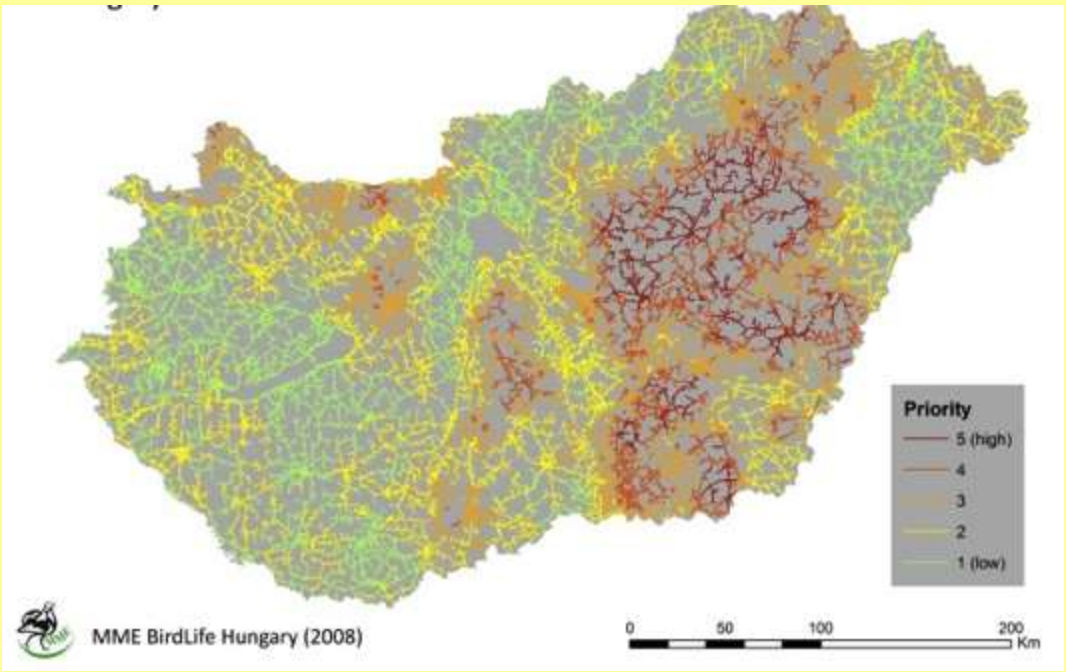
"Accessible skies" agreement in Hungary[26]

As a result of decade-long cooperation, the Hungarian Ornithological and Nature Conservation Society (MME / BirdLife Hungary) signed the "Accessible Sky" agreement with the Ministry of Environment and Water, and relevant electricity companies in Hungary on 26 February 2008. The objective of the agreement is to provide a long-term solution to the problem of bird electrocution.

Under this agreement, MME produced a map in 2008 showing key areas of conflict between power lines and bird populations in Hungary. Electric companies promised a "bird-friendly" transformation of all dangerous power lines in Hungary by 2020, and the use of "bird-friendly" management methods for newly constructed power lines.

[26] www.birdlife.org/datazone/sowb/casestudy/240

Bird conservation priorities along the medium voltage power line network in Hungary



The Coordinating Committee with representatives from each signatory guarantees a regular and structured cooperation. Electric companies and conservation experts cooperate to produce guidelines for the associated best available technology that are constantly updated and to field-test new solutions. The Amendment of the Act on nature conservation has further strengthened the cooperation.

The lessons learnt from the implementation of the agreement include that the co-ordination, progress monitoring and evaluation of the implementation of non-legally binding agreements need much capacity, preferably on the side of the lead nature conservation partner. Finding sufficient funding for priority actions remains a major challenge. Recent actions have been carried out thanks to the voluntary undertaking by the electricity utilities to provide 25% co-financing to EU LIFE Nature projects.

National planning in Slovenia

In Slovenia, the transmission system operator (Elektro-Slovenija, d.o.o.) and a nature conservation NGO (DOPPS – BirdLife Slovenija) collaborated on planning and installing bird-friendly transmission power lines.

The study reviews several topics closely related to bird conservation and transmission power lines: [1] the concept of threatened species and threatening factors to bird populations in Slovenia, [2] bird species in Slovenia and their conservation status, [3] legislation and legal practice relevant to power lines and bird conservation in Slovenia, [4] impacts of transmission power lines on birds, [5] possible measures to mitigate negative and enhance positive impacts of transmission power lines on birds, [6] assessment of effectiveness of possible mitigation measures.

Elektro-Slovenija, the transmission system operator in Slovenia, has recently funded an extensive review study about interactions between birds and transmission power lines in order to find ways to operate not only in favour of consumers of electricity but as well in favour of birds. The study was elaborated by the DOPPS – BirdLife Slovenija.

Nearly 242 km of existing transmission power lines cross Special Protection Areas (Natura 2000) in

Slovenia and additional 123 km of planned transmission power lines are overlapping these areas. Not every bird species in these areas is susceptible to interact with transmission power lines but most of the areas support important populations of birds which could be threatened by transmission power lines.

Therefore as an outcome of their cooperation, the following guidance for installation of bird-friendly transmission power lines are suggested:

- collaborate with bird (nature) conservation institutions from the beginning of the project
- plan the route of the transmission power lines with consideration to specific circumstances in the area, based on concrete all-year-round data on birds occurring in the area
- avoid installing transmission power lines in areas of high concentrations, regular flight routes and migration corridors of birds susceptible to collision
- use existing power line routes and merge the power lines with other existing linear infrastructure
- adjust configuration of conductors and earth wires
- equip the power lines with markers which increase visibility of conductors and especially earth wires
- if not possible to avoid highly vulnerable spots and if feasible, put cables underground
- put safe nesting platforms and nestboxes on power line towers to support certain nesting birds

German SEA on the ten-year electricity network development plan

The German Federal Network Agency (Bundesnetzagentur) has carried out a SEA on the German ten-year electricity network development plan. The following electricity transmission facilities had been taken into account: DC and AC high voltage terrestrial power lines (overhead and underground), submarine cables, hybrid networks, and associated components.

The goals of the SEA is to:

- Identify, describe and assess early the direct and indirect impacts of the development plan on the environment (notably animals, plants and biological diversity, and particularly Natura 2000 sites), as completely as possible
- Systematise and reinforce the integration of environmental issues in the decision-making process
- Improve the transparency of the weighting between notably economic, social and environmental issues in the decision-making process

The various environmental assessments on different individual projects that have been initiated and drafted by various institutions such as ministries, federal authorities, universities, consulting companies and network operators were collected and used for the purposes of the SEA. There was also public consultation to discuss the scope of analysis and the development of a joint methodology, aiming to avoid environmental assessments of individual network development projects to start from scratch.

As a result the scope was, however, appreciably wider and for the first time the Bundesnetzagentur examined the environmental impact not only of onshore projects but also of those in the territorial waters. In certain cases, the environmental effects of the projects using underground cables were also considered.

Furthermore, the analysis of alternative options in the environmental report becomes more extensive. Alternatives to individual projects were assessed as well as an alternative grid connection system in the territorial waters and different transmission technologies. In addition, the Bundesnetzagentur assessed the environmental impacts on different scenarios of development which helped them to make informed choices and select the least environmental damaged projects.

6.3 Looking for ways to streamline the permitting procedures for energy transmission facilities

Another benefit of adopting a more strategic approach to energy transmission planning is that it helps to organise the various permit procedures and environmental impact assessments in a more efficient way.

This streamlining process has been formalised in the case of PCIs under the TEN-E Regulation and specific Commission guidance has been produced on how to implement such streamlining mechanisms in practice whilst at the same time ensuring the maximum level of environmental protection in accordance with EU environmental law.

The guidance makes a series of recommendations which, although designed with PCIs in mind, are also very relevant for all other energy transmission infrastructure plans or projects. They are therefore summarised again here[27].

The recommendations focus in particular on:

- Early planning, "roadmapping" and scoping of assessments
- Early and effective integration of environmental assessments and of other environmental requirements
- Procedural co-ordination and time limits
- Data collection, data sharing and quality control
- Cross-border co-operation, and
- Early and effective public participation.

6.3.1 Early planning, "roadmapping" and scoping of assessments

As stated earlier in this chapter, an early planning and "**roadmapping**" of the different assessments and other environmental requirements to be met is vital for a successful streamlining of environmental assessment procedures. Ideally, this will happen at the very early concept stage of a plan or project (e.g. definition of connection points), and will lead to a concise assessment roadmap, indicating which type of assessment should take place at what point in the overall assessment / permit procedure. This roadmapping should be the main responsibility of the project promoter, in close co-operation with the co-ordinating authority.

In case of a staged assessment, the roadmap would also indicate which aspects could be assessed at what stage in the process to ensure complementarity and to avoid both non-consideration of certain elements and reduce the risk of repetitive assessments. The roadmap could also set out how and at what point in the process other environmental requirements should be met.

In order to adequately roadmap the different assessments required and other environmental requirements at stake, a **very early scoping of all potential environmental effects** of a project is recommended already at the conceptual stage. More detailed scoping could happen in line with the further development of the project, e.g. at the pre-application phase (as required under Article 10(4a) of the new TEN-E Regulation) or as part of the EIA/AA process.

[27] Guidance Document "Streamlining environmental assessment procedures for energy infrastructure 'Projects of Common Interest' (PCIs)" July 2013. http://ec.europa.eu/energy/infrastructure/pci/doc/20130724_pci_guidance.pdf

Scoping stimulates early dialogue, helps identify relevant legislation or necessary assessments and regulatory controls, or potential impacts that may be relevant to the project but not immediately perceived by the project promoter. It also helps to identify relevant data, possible alternatives, information gathering methods and their scope and level of detail, and issues of particular concern to affected stakeholders and the public. By agreeing the expectations of the assessment with the relevant authorities at the start, the project promoter can confidently and effectively plan the collection of environmental information well in advance.

6.3.2 Early and effective integration of environmental assessments and of other environmental requirements

It is highly advisable that environmental assessments are performed as early as possible, and to the level of detail possible and at an as early stage as possible in the overall process. **Effective tiering** (hierarchical linking**)** [28][29] should be applied to ensure that different assessments required under different pieces of EU legislation, or in different phases of the process, build on, and complement each other. Environmental requirements other than assessments (e.g. as regards the strict species protection regime under the two Nature Directives) could also be integrated as early as possible, in the overall process to identify and remedy problems at an early stage, and to avoid delays and public acceptance problems in the run-up to project permitting.

As for early integration of environmental assessments, **it is strongly recommended that SEAs and, where applicable, AAs, are made mandatory already at the planning stage for national energy programmes and plans** (e.g. network development plans submitted by TSOs and approved by the competent authorities, in accordance with Directive 2009/72/EC[30]). This allows the environmental suitability of different types of energy sources as well as different locations for energy projects to be assessed from the start.

It encourages a more integrated and efficient approach to territorial planning where environmental considerations are taken into account much earlier in the planning process and at a much more strategic level. It also ensures that the level of assessment always matches the level of planning/decision-making and avoids that *faits accomplis* are created by inclusion of projects in national energy plans, for which no relevant assessments have been carried out. This will lead to fewer conflicts at the individual project level, both in substance and in terms of public acceptance.

Integration of Appropriate Assessment at different levels of the planning and permitting process

The AA at the level of national energy or grid planning will focus on avoiding sensitive locations, i.e. locations where siting of the proposed energy infrastructure might jeopardise Natura 2000 site conservation objectives as well as EU protected species outside Natura 2000 sites. This does not mean that energy infrastructure cannot be built inside Natura 2000 areas, nor that energy infrastructure outside Natura 2000 sites will not harm Natura 2000 site conservation objectives. This has to be investigated case-by-case.

[28] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52009DC0469&from=en

[29] The concept of tiering can be defined as: distinguishing different levels of planning – policy, plans, programs – that are prepared consecutively and influence each other (EC 1999). Tiering is about how the different levels of planning relate to each other.

[30] Directive 2009/72/EC on common rules for the internal market in electricity

At the level of project-driven spatial planning, AA will focus in greater detail on the potential Natura 2000 impacts of the more narrowly defined location alternatives. These may be routing alternatives which differ by as little as a few kilometres or less. In some cases, the AA at this level will allow identification of the need for compensation measures and even the location of these measures.

Finally the AA in the framework of the permit granting process for a concrete project will focus on additional fine-tuning of the type and significance of impacts and any required mitigation measures. This fine-tuning might involve defining a more suitable location as well as the precise nature of measures to reduce the impact. In case of projects justified for Imperative Reasons of Overriding Public Interest (IROPI), if the need for re-routing or compensation only arises at the very last phase of the planning and permitting process, considerable time may be lost. Therefore, such issues need to be considered an early stage.

6.3.3 Procedural coordination and time limits

Under the new TEN-E Regulation, Member States are required to choose between an integrated, coordinated or collaborative permit scheme when implementing the so-called **"one-stop-shop" permit for PCIs**. Whilst the organisation of the overall permitting process is not directly related to the streamlining of relevant environmental assessment procedures, it is strongly recommended that Member States choose either the integrated or the co-ordinated approach to the permitting process, as both imply a level of overall co-ordination which is likely to maximise the streamlining effects also in the co-ordination of relevant environmental assessment procedures.

A further powerful tool to streamline environmental assessment procedures could be to **set time limits** for parts or all of the environmental assessment procedures. In view of the very specific scientific and technical surveys required for Appropriate Assessments under the Habitats Directive, time limits for such assessments need to be set on a case by case basis depending on the nature and duration of the field surveys required for the EU protected species and habitat types present.

It is also important to recall that time limits could only serve to reduce unnecessary delays in assessment procedures and encourage the creation of synergies between assessments where possible, but can in no way lower the quality of the environmental assessments performed. The revised EIA Directive 2014/52/EU has introduced specific obligations as regards the introduction of time-frames and of “one-stop shop” procedures.

6.3.4 Quality of the reports

The **use of suitably qualified external experts** and independent quality control can also ensure that assessment reports are robust and the data used are valid and relevant. This will help to avoid delays caused by an incomplete or poor quality assessment. In addition, according to the revised EIA Directive 2014/52/EU, MS have to ensure the completeness and quality of EIA reports. This issue is especially relevant in the case of the Article 6 permit procedure where the onus is on proving the *absence* of effects (rather than their presence) and where the findings of the AA are binding on the competent authority.

6.3.5 Cross-border co-operation

For cross-border projects Member States will have to co-operate and coordinate amongst themselves, especially regarding the definition of the scope and level of detail of the information to be submitted by the project promoter and the schedule for the permit granting procedure. This can be done by a joint procedure, particularly with regard to the assessment

of environmental impacts and the likelihood of their transboundary nature. Such procedures could be jointly organised by the competent authorities of the Member States concerned, or a third body (coordination body) could be set up specifically for cross-border co-ordination.

The EU is party to the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the Protocol on Strategic Environmental Assessment (SEA Protocol)[31]. In addition to the EIA and SEA Directives they provide that plans and projects which are likely to have significant effects on the environment of another Member State, or where a Member State likely to be significantly affected so requests, the Member State in whose territory the plan, programme or project is being prepared, or intended to be carried out, shall before its adoption, and as soon as possible inform the other Member State about it[32]. In 2013 the Commission produced a guidance on the application of the environmental impact assessment procedure for large-scale transboundary projects, aiming to facilitate the authorisation and efficient implementation of such projects in the future[33].

Under the new TEN-E Regulation, such cross-border cooperation is obligatory for transboundary PCIs (Article 8.3). Moreover, where a PCI encounters significant implementation difficulties, the Commission can, in agreement with the Member States concerned, designate a European coordinator to assist in and facilitate amongst others the public consultation and permitting process (Article 6). Such a co-ordinator could also be designated by Member States themselves at an earlier stage in the process and to avoid any implementation difficulties to arise at a later stage.

6.3.6 Early and effective public participation

The EU environmental assessment legislation (e.g. the EIA and SEA Directives) and other relevant EU and international instruments (Aarhus Convention) place public participation requirements on the process of approval for PCIs. In the case of the Habitats Directive, public consultation is not obligatory but it is strongly recommended, if appropriate.

It will be important for Member States to determine the ideal scope and timing of public involvement in the preparatory and permit granting processes. The early planning and roadmapping of environmental assessment procedures recommended above need to include also an **early planning and roadmapping of public participation**. Similarly, early scoping could not only look at potential environmental effects of a future project, but also at its specificities and potential problems with regard to public participation.

It is recommended that the public is already informed of and involved in the early scoping and roadmapping of the project at the conceptual stage. Public scoping events might be very helpful to inform and receive early feedback by the public.

[31] Council Decision of 27 June 1997 on the conclusion, on behalf of the Community, of the Convention on environmental impact assessment in a transboundary context (ESPOO Convention) (proposal OJ C 104, 24.4.1992, p. 5; decision not published) and Council Decision 2008/871/EC of 20 October 2008 on the approval, on behalf of the European Community, of the Protocol on Strategic Environmental Assessment to the 1991 UN/ECE Espoo Convention on Environmental Impact Assessment in a Transboundary Context (OJ L 308, 19.11.2008, p. 33).

[32] Article 7 of the SEA Directive and Article 7 of the EIA Directive

[33] http://ec.europa.eu/environment/eia/pdf/Transboundry%20EIA%20Guide.pdf

7. THE PERMITTING PROCEDURE UNDER ARTICLE 6 OF THE HABITATS DIRECTIVE

7.1 Introduction

As stated before, EU nature legislation does not exclude development activities in and around Natura 2000 sites. Instead, it requires that any plan or project that is likely to have a significant negative effect on one or more Natura 2000 sites undergoes an appropriate assessment (AA) in accordance with Article 6.3 of the Habitats Directive in order to assess the implications of that plan or project on the site(s).

This chapter explains how to carry out an appropriate assessment under Article 6, paying particular attention to energy transmission infrastructure plans and projects.

Because Natura 2000 concerns Europe's most valuable and endangered habitats and species, the procedures for approving developments that are likely to have a significant negative effect on these sites are sufficiently rigorous to avoid undermining the overall objectives of the Birds and Habitats Directives. Delays in the approval process are very often caused by poor quality assessments that do not allow the competent authorities to make a clear judgement on the impacts of the plan or project. Particular attention is therefore given to the need for decisions to be taken on the basis of sound scientific information and expertise.

It is also important to avoid confusion over the impact assessments carried out under the EIA and SEA Directives and the Appropriate Assessment carried out under Article 6.3 of the Habitats Directive. Whilst these assessments are very often carried out together, as part of an integrated procedure, each one has a different purpose and assesses impacts on different aspects of the environment. **An SEA or an EIA cannot therefore replace, or be a substitute for, an Appropriate Assessment.**

The outcome of each assessment procedure is also different. In the case of the EIA or SEA assessment, the authorities have to take the impacts into account. **For the AA**, however, **the outcome is legally binding** for the competent authority and conditions its final decision. Thus, if the AA cannot ascertain that there will be no adverse effect on the integrity of the Natura 2000 site, despite the introduction of mitigation measures, then the plan or project can only be approved if the conditions in the derogation procedure foreseen under Article 6.4 are met.

Annex 6 provides comparison between the impact assessments under the Habitats directive, EIA and SEA.

Article 6(3) of the Habitats Directive

Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

7.2. The scope of the Article 6 permitting procedure

The focus of the permit procedure and therefore of the Appropriate Assessment is on species and habitat types protected by the Birds and Habitats Directives, and in particular on those species and habitats for which the Natura 2000 site has been designated.

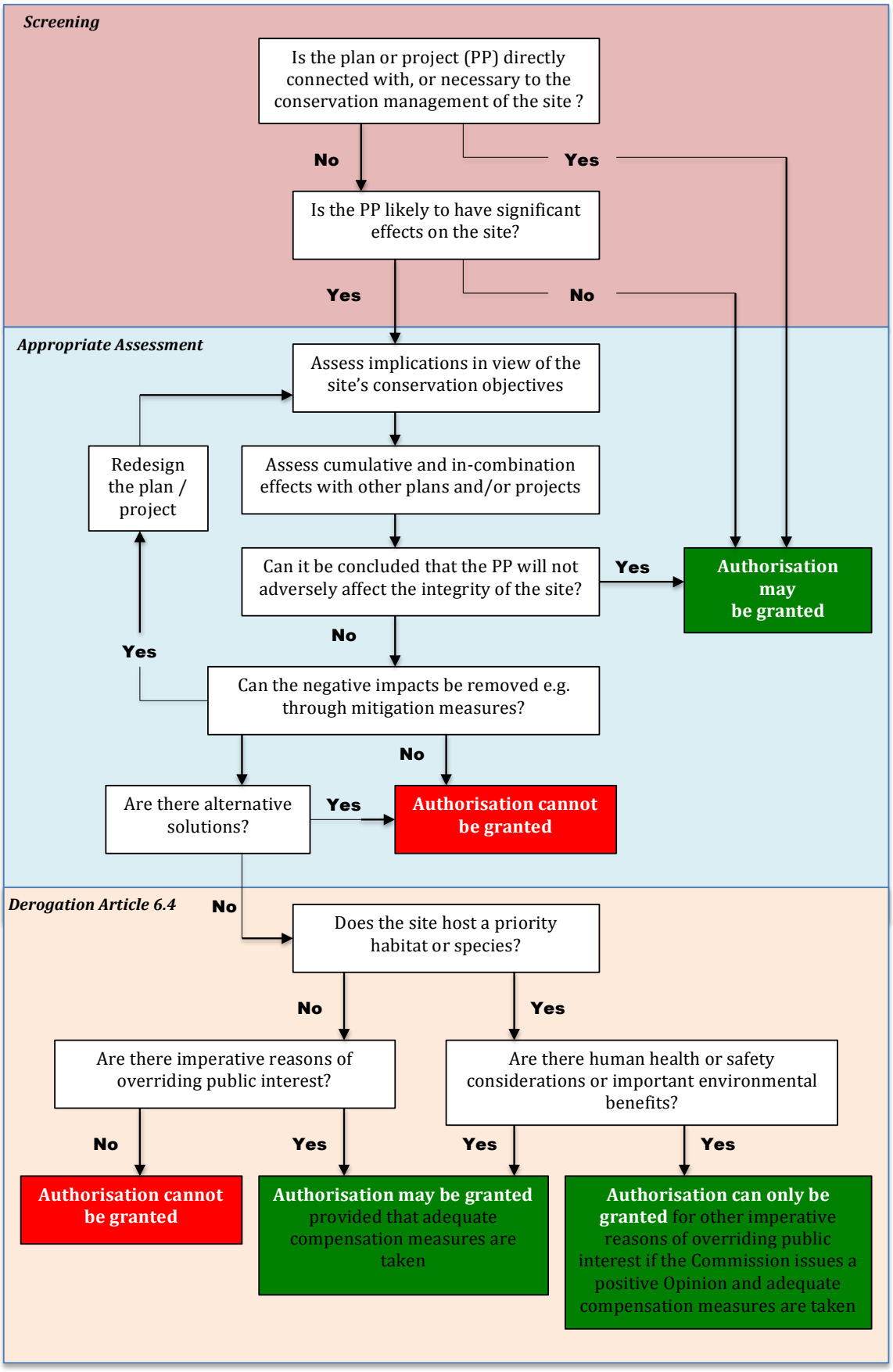
This means that the appropriate assessment does not have to assess the impact on other fauna and flora unless they are ecologically relevant for the EU protected species and habitats present on this site. An appropriate assessment under Article 6.3 is therefore narrower in scope than an assessment under EIA and SEA Directives, being confined to implications for Natura 2000 sites in view of their conservation objectives.

As regards its geographical scope, the provisions of Article 6.3 are not restricted to plans and projects carried out exclusively in a Natura 2000 site; they also target developments situated outside Natura 2000 sites but which are likely to have a significant effect thereon. The trigger for such an assessment is not based on whether the project is located inside the Natura 2000 or not but on whether it is likely to have a significant effect on a Natura 2000 site and its conservation objectives.

This includes the consideration of any likely transboundary effects. If a plan or project in one country is likely to have a significant effect on Natura 2000 site in a second country, either individually or in combination with other plans or projects, then the effects on the integrity of Natura 2000 sites in that second country will have be assessed as well. This is in line with the Espoo Convention and its SEA Protocol which are implemented within the EU through the EIA and SEA Directives (see point 6.3.5 of this guidance document)

The effects need to be determined in function of the species and habitat types for which a particular site has been designated. This will influence how far from the project area one should look for possible effects. For instance, a rare plant which is very localised and only occurs in specialised habitat conditions may only be affected by projects in the immediate vicinity compared to a migratory species which has wider habitat requirements and may therefore be affected by plans or projects further afield.

Figure 6: Flow chart of Art 6.3 and 6.4 procedure (Based on Commission Article 6 methodological guide)



7.3 A step-by-step procedure for carrying out appropriate assessments

The procedure laid out in Articles 6.3 must be carried out in sequential order. Every step determines whether a further step in the process is required. For instance if, after the screening, it is concluded that there will be no negative effects on the Natura 2000 site, then the plan or project can be approved without the need for further assessment.

The steps are as follows (see diagram):

- **Step one: screening** – this initial step is to determine whether a plan or project has to undergo an appropriate assessment or not. If it is likely to have a significant negative effect on a Natura 2000 site, then an appropriate assessment is required.

- **Step two: appropriate assessment** – once it has been decided that an AA is required, a detailed analysis must be undertaken of the potential impacts of the plan or project, alone or in combination with other plans or projects, on the integrity of Natura 2000 site(s) in view of its conservation objectives.

- **Step three**: **decision making** - If the appropriate assessment concludes that there is an adverse effect on integrity of the site and these cannot be mitigated against, then the competent authorities will need to refuse the plan or project.

Article 6.4 provides for certain derogations to this general rule. Thus, if it is concluded that the plan or project will have an adverse effect on a Natura 2000 site, it can still be approved under exceptional circumstances provided the conditions of Article 6.4 are met. It is clear from the above that this decision-making process is underpinned by the precautionary principle. The emphasis is on objectively demonstrating, with reliable supporting evidence, that there will be no adverse effects on the Natura 2000 site.

7.3.1 Step one: screening

The first step in the Article 6.3 procedure is to determine whether or not an AA is actually needed, i.e. if a plan or project is likely to have a significant effect on a Natura 2000 site. If it can be determined with sufficient certainty that the plan or project is **not** likely to have a significant effect, either individually or in combination with other plans or projects, then it can be approved without further assessment.

However, if there is any doubt, an appropriate assessment must be undertaken so that these effects can be studied in full. This was confirmed by the ECJ in the Waddensea ruling (C-127/02) in which the Court concluded that: " *the triggering of the environmental protection mechanism provided for in Article 6(3) of the Habitats Directive does not presume – as is, moreover, clear from the guidelines for interpreting that article drawn up by the Commission, entitled 'Managing Natura 2000 Sites: The provisions of Article 6 of the "Habitats" Directive (92/43/EEC)' – that the plan or project considered definitely has significant effects on the site concerned but follows from the mere probability that such an effect attaches to that plan or project.* In the same ruling the Court confirmed that in case of doubt as to the absence of significant effects such an assessment must be carried out, in order to be ensured effectively that plans or projects which adversely affect the integrity of the site concerned are not authorised.

The reasons for the final decision as to whether or not to carry out an appropriate assessment should be recorded and sufficient information should be given to justify the conclusion that has been reached.

7.3.2 Step two: the Appropriate Assessment

Once it has been decided that an appropriate assessment is required, such an assessment will need to be carried out before the competent authority makes its decision on whether or not to authorise the plan or project. As stated above the purpose of the appropriate assessment is to assess the implications of the plan or project on the site in view of its conservation objectives, either individually or in combination with other plans or projects.

The term "appropriate" essentially means that the assessment needs to be appropriate to its purpose under the Birds and Habitats Directives, i.e. that of safeguarding species and habitat types listed under the two directives. "Appropriate" also means that the assessment has to be a reasoned decision. If the report does not include a sufficiently detailed assessment of the effects on the Natura 2000 site or does not provide enough evidence to draw clear conclusions as to whether or not the site's integrity is adversely affected then the assessment does not fulfil its purpose and cannot be considered "appropriate".

Assessments that confine themselves to general descriptions and provide only a superficial review of existing data on nature within the area are not considered as "appropriate" for the purposes of Article 6.3. This has been confirmed by the European Court of Justice which has ruled that "*the appropriate assessment should contain complete, precise and definitive conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerne*d" (Commission/Italy, C-304/05).

The Court also emphasised the importance of using best scientific knowledge when carrying out the appropriate assessment in order to enable the competent authorities to conclude with a sufficient degree of certainty that there will be no adverse effects on the site's integrity. In this respect it considered that "*all the aspects of the plan or project which can, either individually or in combination with other plans or projects, affect those objectives must be identified in the light of the best scientific knowledge in the field*." (C-127/02, Para 54).

Because of the specialised nature of the appropriate assessment, it is strongly recommended that the assessment is based on analyses carried out by suitably qualified ecologists.

Finally, it should be noted that, whilst it may be the project proponent who undertakes or commissions the AA, it is the competent authorities' responsibility to ensure that the AA has been carried out correctly and is capable of objectively demonstrating, with supporting evidence, that there will not be any adverse effects on the integrity of the Natura 2000 site, in light of its conservation objectives.

- *Assessing effects in light of the site's conservation objectives*

As stated above, the assessment will assess the possible implications for the site of the plan or project *in view of the site's conservation objectives*. To understand what the conservation objectives are, it is necessary to look back at how Natura 2000 sites are selected. As explained earlier each site is included in the Natura 2000 network because it is of conservation value for one or more of the habitat types listed in Annex I or species listed in Annex II of the Habitats Directive, or species listed in Annex I of the Birds Directive as well as regularly occurring migratory bird species.

The conservation value of the site at the time of designation is recorded in a **Standard Data Form** (SDF). This provides the site's formal identification code, its name, location and size, and detailed map. It also records the ecological characteristics of the site which led to its designation as a Natura 2000 site and provides a broad assessment of the conservation condition of each species or habitat type on that site (scored A to D).

The SDF is therefore the reference base for setting conservation objectives for the site, in line with the overall objectives of the Habitats Directive (Article 6.1). At a minimum, the sites' conservation objective will be to maintain the species and habitats for which it was designated in the same condition (as recorded in the SDF). This means ensuring that they will not deteriorate below that level.

However, the overall objectives of the Habitats and Birds Directives go beyond simply preventing further deterioration. They aim to ensure that EU protected species and habitat types reach a favourable conservation state across their natural range in the EU. Thus more ambitious conservation objectives may be required to *restore and improve* the conservation condition of the EU protected species and habitat types present on that site (under Article 6.1).

If more ambitious conservation objectives have been set, then the impacts of the plan or project must be measured against these more ambitious objectives. For instance, if the objective is to restore the population of the Bearded vulture to a certain population level within 8 years, it has to be assessed if the plan or project will or will not prevent this conservation objective from being realised, and not merely whether the vulture population will remain stable.

It is recommended that the project proponent consults with the authorities responsible for Natura 2000 sites as early as possible to find out more about the site, its conservation objectives and the conservation condition of the habitat types and species for which it is designated. They will also be able to indicate if there are more detailed sources of information available on this – for instance a management plan adopted for the site or monitoring reports and studies about the conservation condition of the species and habitat types concerned within that region, or country

- *Collecting the necessary information for the AA*

Potential source of information for the Natura 2000 sites include:

- Natura 2000 Standard Data Forms;

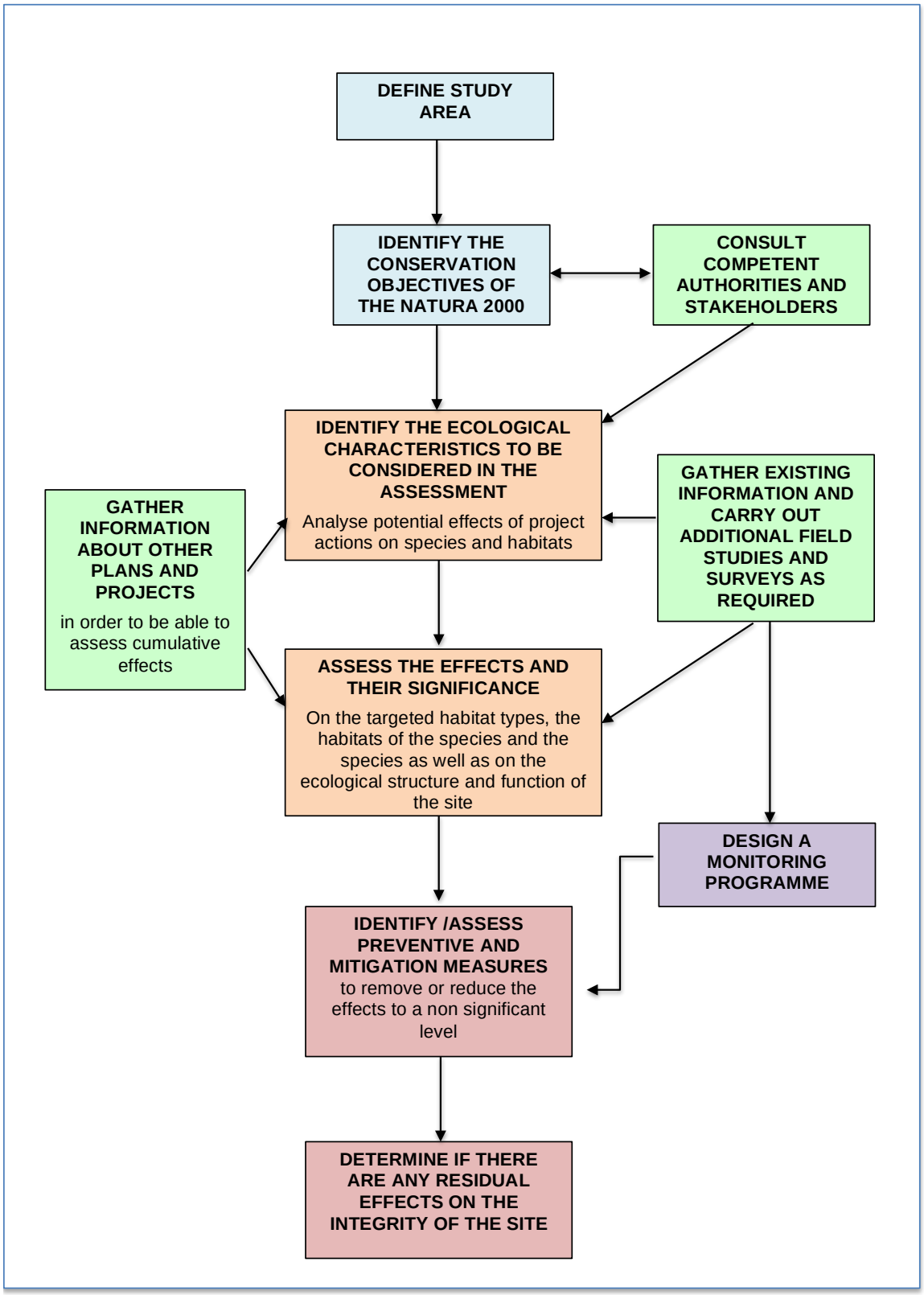
- Natura 2000 management plans;

-up-to-date data published in technical and scientific literature;

- nature conservation authorities, scientific experts and species or habitat specialist, conservation organisations, local experts;

-Article 12 of the Birds Directive and article 17 of the Habitats Directive reports on the conservation status of species and habitats

Figure 7: Steps to be undertaken as part of the appropriate assessment



Gathering all the necessary information on both the project and the Natura 2000 site is an important initial step of the appropriate assessment. This is usually an iterative process. If the first identification and analysis reveals that there are important gaps in knowledge, then further baseline ecological and survey field work may be necessary to supplement existing data.

As stated before, it is important that the **appropriate assessment is based on the best scientific knowledge in the field** and is capable of removing all reasonable scientific doubt as to the effects of the works proposed on the site concerned. This has been confirmed by several ECJ rulings. In the Waddensea case (C-127/02) the Court confirmed that "*the competent national authorities are to authorise (a plan or project) only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects*."

Detailed surveys and fieldwork have to focus on those habitats and species that are potentially sensitive to the project actions. Sensitivity needs to be analysed taking into account the possible interactions between the project activities (nature, extent, methods, etc.) and the habitats and species concerned (location, ecological requirements, vital areas, behaviour, etc.).

Any field studies must be sufficiently robust and long-lasting to take account of the fact that ecological conditions may vary significantly according to the seasons. For instance, undertaking a field survey on a species for a few days in winter will not capture their habitat usage during other more important periods of the year (e.g. during migration or breeding).

Consulting with nature authorities, other scientific experts and conservation organisations early on will help ensure that as complete a picture as possible is built up about the site, the species/habitats present and the type of effects to be analysed. They can also offer advice on the updated scientific information that is available on the site and its EU protected species and habitat types (including Natura 2000 management plans) and on what additional baseline studies and field surveys may be needed in order to assess the likely impacts of the project.

Other stakeholders such as conservation NGOs, research institutions or local organisations may also be able to provide further local knowledge and ecological information useful for the appropriate assessment.

- *Identifying negative impacts*

Once all the necessary baseline data has been gathered and checked for completeness, the assessment of the implications of the plan or project on the Natura 2000 site can begin. The description of potential negative impacts of energy transmission infrastructure plans and projects as described in chapters 3 and 4 should help to identify the type of effects to look out for.

This could concern in particular:
⇒ habitat loss, degradation or fragmentation
⇒ electrocution or collision
⇒ species disturbance and displacement
⇒ barrier effects

The effects of each project will be unique and must be evaluated on a case- by-case basis. This is in line with the Waddensea case: "*in assessing the potential effects of a plan or project, their significance must be established in the light, inter alia, of the characteristics and specific environmental conditions of the site concerned by that plan or project."*

The first step is to identify which EU protected habitats and species present within each site could be potentially affected and need to be subject to further assessment. This is important as every species and habitat type has its own ecological lifecycle and conservation requirements. The impacts on each will also vary from one site to another depending on their conservation state and the underlying ecological conditions of that particular site.

For each effect identified, the assessment will also look at the magnitude of the impact, type of impact, extent, duration, intensity and timing.

The AA also involves looking at all aspects of the plan or project that could have implications for the site. Each element of the plan or project needs to be examined in turn and the potential effects of that element should be considered first in relation to each of the species or habitat types for which the site has been designated. Thereafter, the effects of the different features will be looked at together, and in relation to one another, so that the interactions between them can be identified.

Whilst the focus should be on the species and habitats of EU interest that have justified the site designation, it should not be forgotten that these target features also interact closely with other species and habitats, as well as with the physical environment in complex ways. It is therefore important that all the elements considered essential for the structure, functioning, and dynamics of the ecosystem are examined as any alteration could also have a negative effect on the habitat types and species present.

Impacts have to be predicted as precisely as possible, and the basis of these predictions should be made clear and recorded in the AA (this means also including some explanation of the degree of certainty in the prediction of effects).

As with all impact assessments, the appropriate assessment should be undertaken within a structured framework to ensure that the predictions can be made as objectively as possible, using quantifiable criteria wherever possible. This will also greatly facilitate the task of designing mitigation measures that can help remove the predicted effects or reduce them to a non-significant level.

Predicting the likely impacts can be a complex task as one needs to have a solid understanding of ecological processes and conservation requirements of particular species or habitat types likely to be affected. It is therefore strongly recommended that the necessary expert advice and scientific support is secured when carrying out the appropriate assessment.

Commonly used methods for predicting impacts:

The AA should apply the best available techniques and methods to estimate the extent of the effects. Some of the techniques commonly used are listed in the following box.

- Direct measurements, for example of areas of habitat lost or affected, proportionate losses from species populations, habitats and communities.
- Flow charts, networks and systems diagrams to identify chains of impacts resulting from direct impacts; indirect impacts are termed secondary, tertiary, etc. impacts in line with how they are caused. Systems diagrams are more flexible than networks in illustrating interrelationships and process pathways.

- Quantitative predictive models to provide mathematically derived predictions based on data and assumptions about the force and direction of impacts. Models may extrapolate predictions that are consistent with past and present data (trend analysis, scenarios, analogies which transfer information from other relevant locations) and intuitive forecasting. Normative approaches to modelling work backwards from a desired outcome to assess whether the proposed project will achieve these aims.
- Population level studies are potentially beneficial for determining population level effects of impacts to bird or bat or marine mammal species, for instance.
- Geographical information systems (GIS) used to produce models of spatial relationships, such as constraint overlays, or to map sensitive areas and locations of habitat loss. GIS are a combination of computerised cartography, storing map data, and a database-management system storing attributes such as land use or slope. GIS enable the variables stored to be displayed, combined, and analysed speedily.
- Information from previous similar projects may be useful, especially if quantitative predictions were made and have been monitored in operation.
- Expert opinion and judgment derived from previous experience and consultations on similar inland waterway development projects.
- Description and correlation: physical factors (e.g. water regime, current, substrate) may be directly related to distribution and abundance of species. If future physical conditions can be predicted then it may be possible to predict future developments of habitats and populations or responses of species and habitats on this basis.
- Capacity analyses involve identifying the threshold of stress below which populations and ecosystem functions can be sustained. It involves the identification of potentially limiting factors, and mathematical equations are developed to describe the capacity of the resource or system in terms of the threshold imposed by each limiting factor.

Adapted from: "Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive"
http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

- *Assessing potential cumulative effects*

Cumulative effects must not be overlooked during the assessment; not only is this a legal requirement by art 6.3 of the Habitats directive but it can also have major implications for the plan or project, as well as other subsequent plans or projects which are put forward in the same area.

The energy infrastructure developments are proceeding at a fast pace across the EU, it is therefore important that cumulative effects are fully assessed in the early stages of the assessment and not treated merely as an 'afterthought' at the end.

Article 6.3 does not explicitly define which other plans and projects are within the scope of the combination provision but the underlying intention is to take account of cumulative impacts that may occur over time. In that context, one should consider plans or projects which are completed, approved but uncompleted, or actually proposed.

In considering a proposed plan or project, Member States do not create a presumption in favour of other similar, but as yet un-proposed, plans or projects in the future. On the contrary, if one or more projects have already been approved in an area, this may lower the ecological threshold as regards the significance of the impacts for future plans or projects in that area.

For instance, if electricity infrastructure projects within or around a series of Natura 2000 sites are submitted one after another, it could well be that the assessment of the first or second projects concludes that they will not adversely affect the Natura 2000, but then later projects may not be approved because their effects, when combined with those of the previous projects, becomes significant enough that the site's integrity will be adversely affected.

In this context, it is important that energy infrastructure projects are looked at strategically and in combination with each other over a larger geographical area, and not simply viewed as individual isolated projects.

- *Steps in Cumulative assessment*

Figure 8: Adapted from: "Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive" http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

Steps in the assessment	**Activity to be completed**
Identify all projects/plans which might act in combination	Identify all possible sources of effects from the project or plan under consideration, together with all other sources in the existing environment and any other effects likely to arise from other proposed projects or plans.
Impact identification	Identify the types of impacts (e.g. noise, water resource reduction, chemical emissions, etc.) that are likely to affect aspects of the structure and functions of the site vulnerable to change.
Define boundaries for assessment	Define boundaries for examination of cumulative effects: note these will be different for different types of impact (e.g. effects upon water resources, noise) and may include remote (off-site) locations.
Pathway identification	Identify potential cumulative pathways (e.g. via water, air, etc.; accumulation of effects in time or space). Examine site conditions to identify where vulnerable aspects of the structure and function of the site are at risk.
Prediction	Prediction of magnitude/extent of identified likely cumulative effects.
Assessment	Comment on whether or not the potential cumulative impacts are likely to be significant.

- *Determining the significance of the effects*

Once the effects have been identified, an appraisal needs to be made of their significance for the site and its target features. The following parameters can be considered when assessing significance:

⇒ Quantitative parameters: for instance, how much habitat is lost for that species or habitat type. For some the loss of even single units or small areas of occurrence within a given Natura 2000 site (e.g. for priority habitat types and species) will be taken as being a

significant impact. For others the significance threshold may be higher. Again it depends on the species and habitat types, their state of conservation in that site as well as their future prospects.

⇒ Qualitative parameters: the significance of the impacts should also take account of the quality of . the habitat type or species within that site, for instance it may be a site with an important occurrence of the species (e.g. a core area for the occurrence, larger areas of representative stands, etc.) or a site where the species is at the limit of its existing distribution range. The habitat or species may be in good conservation condition within the site or alternatively in a poor condition and in need of restoration.

⇒ Importance of the site from the point of view of the species biology e.g. site of reproduction (nesting places, spawning area, etc.); feeding habitat; sheltering possibilities; migration pathways.

⇒ Ecological functions necessary for maintenance or restoration of species and habitats present, and for overall site integrity.

Where there is doubt or differences over the degree of significance, it is best to find a broader agreement amongst relevant experts, e.g. regional and/or national specialists in the affected target feature so that a consensus can be built up over this.

- *Introducing mitigation measures to remove adverse effects*

Once the negative effects have been identified, it will be possible to consider whether mitigation measures can be introduced to remove, pre-empt or reduce these effects to a non-significant level (see chapter 5 for suggestions on different types of mitigation measures that could be used for energy infrastructure projects). When exploring suitable mitigation measures it is important to consider first those that can remove impacts at source and, only if these are not possible, should other mitigation measures be examined that can at least significantly reduce or abate the negative effects of the project.

Mitigation measures must be specifically designed to eliminate or reduce negative effects identified during the AA. They must not be confused with compensation measures which are intended to compensate for the damage caused. Compensation measures can only be considered if the plan or project has been accepted as being necessary for imperative reasons of overriding public interest and where no alternatives exist (under Article 6.4 – see below).

Proposed mitigation measures can contain:
- details of each of the measures proposed and an explanation of how it will eliminate or reduce the adverse impacts which have been identified;
- evidence of how they will be implemented and by whom;
- a timetable for implementation relative to the plan or project (some may need to be put in place before the development can proceed);
- details of how the measure will be monitored and how the results will be fed back into the day to day operation of the project (adaptive management – see below).

This will enable the competent authority to determine whether or not they are capable of removing the negative effects identified (and do not inadvertently cause other adverse effects on the species and habitat types in question). If the mitigation measures are deemed sufficient, they will become an integral part of the specification of the final plan or project or may be listed as a condition for the approval of the project.

- *Determining whether the site's integrity is affected*

Once the effects of the project have been predicted as accurately as possible, their level of significance assessed and all possible mitigation measures have been explored, the AA must reach a final conclusion as to whether they will adversely affect the integrity of the Natura 2000 site.

The term "integrity" clearly relates to **ecological integrity.** The "integrity of the site" can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is designated. A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required.

If a plan or project adversely affects the integrity of a site only in a visual sense or causes significant effects to habitat types or species other than those for which the site was designated as Natura 2000, this is not an adverse effect for purposes of Article 6.3. On the other hand, if one of the species or habitat types for which the site has been designated is significantly affected then the site integrity is necessarily also adversely affected.

The expression "integrity of the site" shows that the focus is on the specific site. Thus, an argumentation that damage to a site or part of it can be justified on the basis that the conservation status of the habitat types and species it hosts will anyway remain favourable within the European territory of the Member State cannot be accepted.

In practice the assessment of site integrity will focus in particular on identifying whether the project:
- causes changes to significant ecological functions necessary for the target features;
- significantly reduces the area of occurence of habitat types (even of those of lower quality) or viability of species populations in the given site which are target features;
- reduces the site diversity;
- leads to the site fragmentation;
- leads to a loss or reduction of the key site characteristics (e.g. tree cover, regular annual floodings) which the status of the target feature depends on;
- prevents meeting the site conservation objectives.

7.3.3 Step 3: approving or refusing the plan or project in light of the conclusions of the appropriate assessment

It lies with the competent national authorities, in the light of the conclusions of the AA, to approve the plan or project. This can be done only after having ascertained that it will not adversely affect the integrity of that site. If the conclusions are positive, in the sense that no reasonable scientific doubt remains as to the absence of effects on the site, the competent authorities can give their consent to the plan or project.

The onus is clearly on proving the absence of effects rather than their presence. This has been confirmed by several ECJ rulings. In the Waddensea case (C-127/02) the Court confirmed that "*a plan or project [...] may be granted authorisation only on the condition that the competent national authorities are convinced that it will not adversely affect the integrity of the site concerned. Where doubt remains as to the absence of adverse effects on the integrity of the site linked to the plan or project being considered, the competent authority will have to refuse authorization.*"

The appropriate assessment and its conclusions should be clearly recorded and the AA report should be sufficiently detailed and conclusive to demonstrate how the final decision was reached and on what scientific grounds the decision was made.

7.4 The derogation procedure under Article 6.4

Article 6(4)

If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.

Article 6.4 provides for exceptions to the general rule of Article 6.3. This is not an automatic process, it is up to the project or plan proponent to decide whether they wish to apply for a derogation. Article 6.4 lays down the conditions that need to be respected in such cases and the steps that need to be followed before a competent national authority can authorise a plan or project that has been assessed as adversely affecting the integrity of a site under Article 6.3.

Article 6.4 requires that the competent authorities ensure the following conditions are respected before a decision can be taken on whether or not to authorise a plan or project that may adversely affect a site:

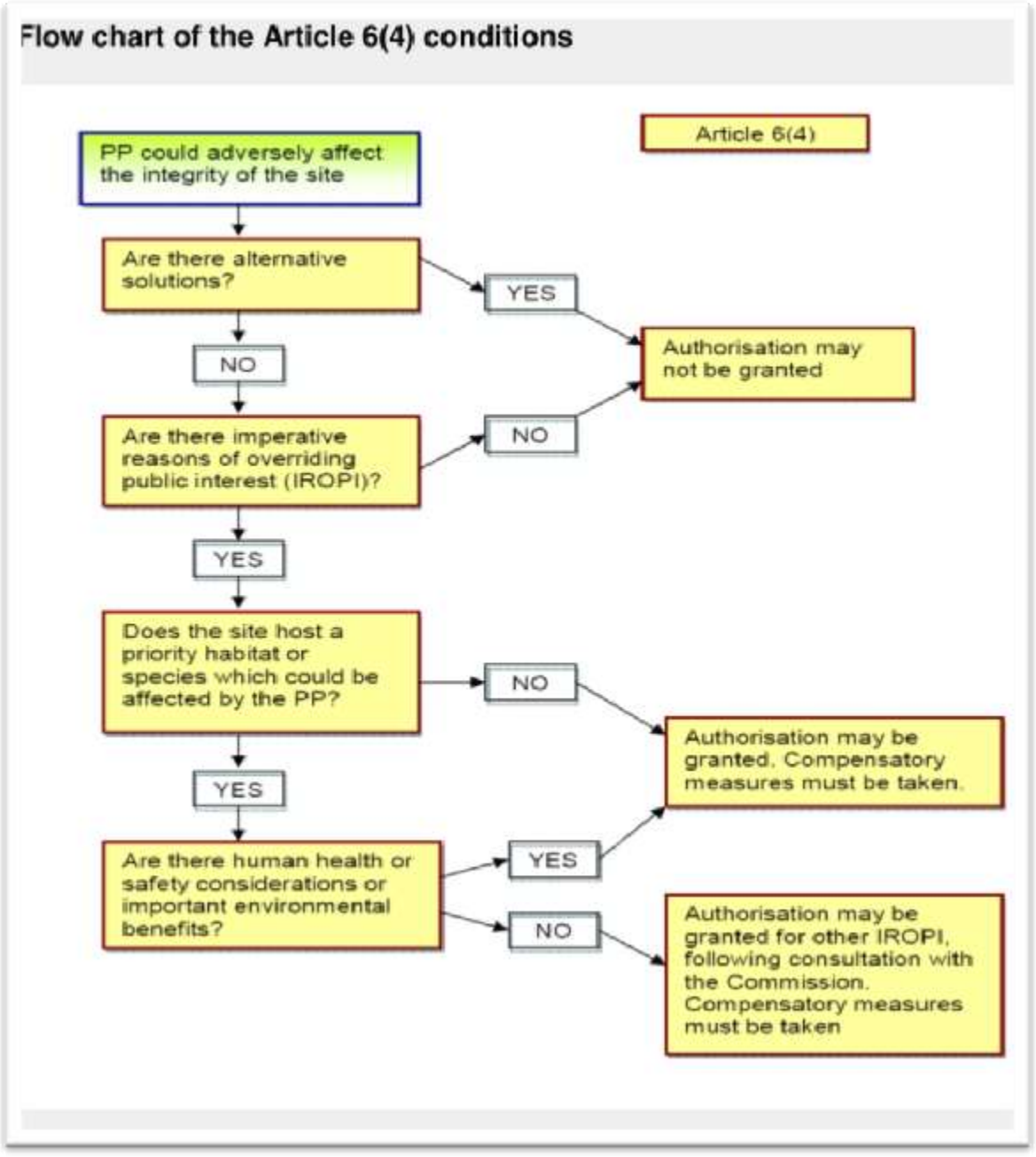
- The **alternative** put forward for approval is the least damaging for habitats, for species and for the integrity of a Natura 2000 site, and no other feasible alternative exists that would not affect the integrity of the site.

- There are **imperative reasons of overriding public interest** that justify the authorisation of the plan or project, including those of a social or economic nature.

- All **compensatory measures** required to ensure the protection of the overall coherence of the Natura 2000 network have been taken.

The order in which these conditions are examined is important as each step determines whether the next step is required. If, for instance, it is found that there is an alternative to the plan or project in question, then there is no point in examining whether the original plan or project is of overriding public interest or to develop suitable compensation measures since that plan or project could not, in any case, be authorised if a viable alternative exists.

Figure 9: Flowchart of Article 6.4 conditions



- *Demonstrating the absence of alternative solutions*

The search for alternatives can be quite broad and should be linked to the public interest objectives of the plan or project. It could involve alternative locations, different scales or designs of development, different methods of construction or alternative processes and approaches.

Although the requirement to search for alternatives falls within the scope of Article 6.4, in practice it is useful for the planner to consider all possible alternatives as early as possible when initially planning their development project. If an appropriate alternative is found at this

stage which is not likely to have a significant effect on a Natura 2000 site, then it can be approved immediately and an appropriate assessment will not be required.

However, in the case where the project has gone through an AA which has concluded that there will be an adverse effect on the integrity of the site, it is then for the competent authority to determine whether alternative solutions exist. All feasible alternatives, in particular, their relative performance with regard to the conservation objectives of the Natura 2000 site and the site's integrity should be analysed.

The alternative solutions chosen will also have to be subject to a new appropriate assessment if it is likely to have a significant effect on the same or another Natura 2000 site. Usually, if the alternative is similar to the original proposal, the new assessment may be able to draw a lot of the information needed from the first appropriate assessment.

- *Imperative reasons of overriding public interest (IROPI)*

In the absence of alternative solutions, or in the presence of solutions having even more negative effects on the conservation objectives or integrity of the site concerned, the competent authorities must examine whether there are imperative reasons of overriding public interest which justify the authorisation of the plan or project in spite of the fact that it may adversely affect the integrity of a Natura 2000 site.

The concept of "imperative reason of overriding public interest" is not defined in the directive. However it is clear from the wording that, for a plan or project to be authorised in the context of Article 6.4, it must meet all three of the following conditions:

- there must be **imperative** reasons for undertaking the plan or project – imperative in this sense clearly means that the project is essential for society, rather than merely desirable or useful;
- the plan or project must be of **overriding interest** – in other words it must be demonstrated that implementing the plan or project is even more important than fulfilling the objectives of the Birds and Habitats Directives. It is clear that not every kind of public interest of a social or economic nature is sufficient, in particular when seen against the particular weight of the interests protected by the directive. It is also reasonable to assume that the public interest can only be overriding if it is a long-term interest; short term economic interests or other interests which would only yield short-term benefits would not be sufficient to outweigh the long-term conservation interests protected by the directive.
- be of **public interest** - it is clear from the wording that only public interests, can be balanced against the conservation aims of the directive. Thus, projects developed by private bodies can only be considered where such public interests are served and demonstrated.

Article 6.4 second subparagraph mentions human health, public safety and beneficial consequences of primary importance for the environment as examples of such imperative reasons of overriding public interests. It also refers to "other imperative reasons of overriding public interest" of social or economic nature.

In the case of PCIs under the TEN-E Regulation, they shall be considered as being of public interest from an energy policy perspective, and may be considered as being of overriding public interest, provided that all the conditions set out in Article 6.4 are met.

It should be noted that the conditions of overriding public interest are even stricter when it comes to the realisation of a plan or project likely to adversely affect the integrity of a Natura 2000 site that hosts priority habitat types and/or species, where those habitat types and/or species are affected.

These can only be justified if the imperative reasons of overriding public interest concern:

- human health and public safety or;
- overriding beneficial consequences for the environment, or;
- for other imperative reasons if, before granting approval to the plan or project, the opinion of the Commission has been given.

- *Compensatory measures*

If the above conditions are met then the authorities must also ensure that compensatory measures are adopted and put in place before the project can begin. Compensatory measures therefore constitute the "last resort" and are used only when the decision has been taken to proceed with a plan or project because it has been demonstrated that there are no alternative solutions and that the project is necessary for imperative reasons of overriding public interest under the conditions described above.

Compensatory measures under Article 6.4 are clearly distinct from the mitigation measures introduced through Article 6.3. Mitigation measures are those measures which aim to minimise, or even cancel, the negative impacts on a site that are likely to arise as a result of the implementation of a plan or project.

Compensatory measures on the other hand are *sensu stricto* independent of the project. They are intended to compensate for the negative effects of the plan or project (after all possible mitigation measures have been introduced to the plan or project) so that the overall ecological coherence of the Natura 2000 network is maintained. The compensatory measures must be able to compensate fully for the damage caused to the site and to the EU protected habitats and species present and must be sufficient to ensure that the overall coherence of Natura 2000 is protected.

To ensure that the overall coherence of Natura 2000 is protected, the compensatory measures proposed for a plan or project will in particular:

- contribute to the conservation of affected habitat types and species within the biogeographical region concerned or within the same range, migration route or wintering area for species in the Member State concerned;
- provide functions comparable to those which had justified the selection of the original site, particularly regarding the adequate geographical distribution;
- have to be additional to the normal duties under the directive, i.e. they cannot substitute existing commitments, such as the implementation of Natura 2000 management plans.

According to existing Commission guidance[34], compensatory measures under Article 6.4 can consist of one or more of the following:

- the recreation of a comparable habitat or the biological improvement of a substandard habitat within an existing designated site provided this goes beyond the site's conservation objectives;
- the addition to the Natura 2000 network of a new site of comparable or better quality and condition to the original site;

34 http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/new_guidance_art6_4_en.pdf

- the recreation of a comparable habitat or the biological improvement of a substandard habitat outside a designated site which is then included in the Natura 2000 network.

The habitat types and species negatively affected must as a minimum be compensated for in comparable proportions, but, considering the high risks and scientific uncertainty involved in attempting to recreate or restore substandard habitats, it is strongly recommended that ratios well above 1:1 or more are applied to be sure that the measures really do deliver the necessary compensation.

It is considered good practice to adopt compensatory measures as close as possible to the affected area in order to maximise chances of protecting the overall coherence of the Natura 2000 network. Therefore, locating compensation within or nearby the Natura 2000 site concerned in a location showing suitable conditions for the measures to be successful is the most preferred option. However, this is not always possible and it is necessary to set a range of priorities to be applied when searching locations that meet the requirements of the Habitats Directive. Under these circumstances, the likelihood of long-term success is best evaluated by peer-reviewed scientific studies of trends.

Member States have to pay particular attention when the negative effects of a plan or project are produced in rare natural habitats or in natural habitats that need a long period of time to provide the same ecological functionality. For some habitats and species it may simply not be possible to compensate for any loss within a reasonable time frame as their development may take decades or simply be technically impossible.

Finally, the compensatory measures need to be in place and fully functional before the work on the plan or project has begun. This is to help buffer the damaging effects of the project on the species and habitats by offering them suitable alternative locations in the compensation area. If this is not fully achievable, the competent authorities should require extra compensation for the interim losses that would occur in the meantime.

The information on the compensatory measures should be submitted to the Commission before they are implemented and before the realisation of the plan or project concerned. It is therefore advised that information on compensatory measures be submitted to the Commission as soon as they have been adopted in the planning process in order to allow the Commission to assess whether the provisions of the directive are being correctly applied.

8. ENERGY TRANSMISSION INFRASTRUCTURE IN THE MARINE ENVIRONMENT

This section of the document is concerned with impacts relating to the installation, operation, and decommissioning of energy transmission infrastructure in the marine environment, and its connection to the onshore grid across intertidal areas. The principle components of this infrastructure are subsea cables and pipelines. Impacts from offshore electricity substations and LNG terminals as well as the transport of oil and gas by shipping, and associated infrastructure such as port facilities, as well as offshore production platforms are not covered in this document. Information is available on the potential environmental effects associated with these activities and infrastructure, and it should be noted that these can be significant e.g. major oil spills and impact on marine Natura 2000 habitats and species. There is also relevant guidance available from a number of sources including the European Commission, Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), Convention on the protection of the marine environment of the Baltic Sea Area (HELCOM) and the International Maritime Organisation(IMO, on potential mitigation measures [35].

The environmental impact of marine energy transmission in Europe associated with the offshore oil and gas industry has been the subject of extensive study for more than 50 years. Over that period lessons learnt, new technologies, and improved understanding of impacts have resulted in a significant body of information on how to avoid and/or mitigate potential impacts. This information is not only relevant to the oil and gas industry but also to the newer marine energy technologies such as offshore wind, marine current turbines and potential future infrastructure associated with Carbon Capture and Storage (CCS). Opportunities and approaches to mitigating effects, based on good practice experiences from across the EU and beyond are introduced in this section and the reader is also directed to other sources of information on this subject.

8.1. An overview of current energy infrastructure in EU marine waters

The unequal global distribution of energy sources such as oil, gas, coal and even some renewables, compared to locations where energy demand is greatest means that there is considerable transport of energy, in all its forms, around the world. A significant amount of the infrastructure which has been built to transmit the necessary materials is in the marine environment. In Europe this is not only located in the relatively shallow waters of the Continental Shelf, the Baltic, the Irish Sea and the North Sea but also in the deeper waters of the Mediterranean, the Norwegian Trench and the Atlantic to the north and west of the British Isles.

Cables and pipelines provide the main infrastructure, and there are also potential new uses for existing pipelines such as deployment as part of CCS operations.

8.1.1. Oil and gas

[35] http://ec.europa.eu/environment/nature/natura2000/management/docs/Wind_farms.pdf; http://ec.europa.eu/news/energy/101013_en.htm ; http://qsr2010.ospar.org/en/ch07_01.html http://www.ospar.org/content/content.asp?menu=00210305000000_000000_000000

Oil and gas has been the mainstay of the offshore energy industry in European waters for nearly 50 years starting with the discovery of the Brent and Forties field in the North Sea in the 1960s. Pipelines of different sizes and construction materials provide the essential infrastructure to transport fluids involved in oil and gas production (Table 2). Ancillary equipment which forms part of the infrastructure includes concrete mattresses which secure flow lines to the seabed, and crossings which may be constructed using mattresses, grout filled bags and cast concrete structures with protective rock dumps. An estimated 35,000-45,000 concrete mattresses have been deployed on and around oil and gas subsea infrastructure in the UK sector of the North Sea for example, and more than 45,000km of pipeline and cabling (Oil & Gas UK, 2013).

Table 2. High level categorisation of pipelines in operation in the North Sea (Figure 1 from Oil & Gas UK, 2013)

Pipeline Description	Typical Dimensions	Applications	Primary Materials of Construction	Additional Coatings
Trunklines	Up to 44 inches diameter, up to 840 kilometres long	Major export infrastructure for oil and gas	Carbon steel	Anti-corrosion coating plus concrete weight coating
Rigid flowlines	Up to 16 inches diameter, less than 50 kilometres long	Infield flowlines and tie-in spools	Carbon steel or high specification alloy	Polymer anti-corrosion coating
Flexible flowline	Up to 16 inches diameter, up to 10 kilometres long	Infield flowlines and tie-in-spools	Carcass of high specification alloys and polymer layers; alloy-end-fittings	Polymer external coatings
Umbilical	Between 2 and 8 inches diameter, up to 50 kilometres long	Chemical, hydraulic and communication distribution	Thermoplastic polymer or high alloy steel tubes; wire armoured protection	Polymer external coatings
Power Cables	Between 2 and 4-inches diameter; up to 300km. long	Power distribution between and within fields	Copper cores with wire armoured protection	Polymer external coatings

Oil and gas pipelines are present in all the regional seas of Europe. In the Mediterranean three pipelines transport gas directly from North Africa to Spain and Italy. Pipelines and cables associated with major oil and gas developments in the northern North Sea, gas developments in the southern North Sea as well as production wells in the Irish Sea, Celtic Sea, Bay of Biscay and Gulf of Cadiz also form part of the transmission infrastructure (OSPAR, 2010).

Undersea cables associated with offshore oil and gas are another component. Four different types are used for Alternating Current transmission; single or three conductor oil-insulated cables and single or three-conductor PolyEthylene (PEX) insulated cables. These have not only increased in number as the sector has developed over the last 50 years but also in their technical complexity to the point where some offshore installations, such as Floating

Production Storage and Offloading facilities (FPSOs) can be powered from shore based facilities via submarine cables.

8.1.2. Offshore wind, wave and tidal current power

In the last two decades, the growth of the renewable energy industry in Europe has included an expansion into the marine environment. Initially small numbers of wind turbines were built close to the shore in the North Sea and Baltic Sea with generation capacities of less than 1MW. Turbine size and the scale of projects have increased and changes in the technology and economics of offshore wind has enabled construction to take place in deeper waters, sometimes more than 20km from the shore. Most of the current offshore wind farm capacity in Europe is in the North Sea (Figures 10, Table 3)[36] . The largest of these, the London Array in the outer Thames estuary (175 turbines with a combined capacity of 630MW), is currently the largest offshore wind farm in the world.

Figure 10:

Installed capacity - Cumulative share by country (MW)

The UK has the largest amount of installed offshore wind capacity in Europe representing 40.8% of all installations. Germany follows with 32.5%. Despite no additional capacity in 2016, Denmark remains the third largest market with 10.1% and the Netherlands (8.8%) displaces Belgium (5.6%) to have the fourth largest share in Europe

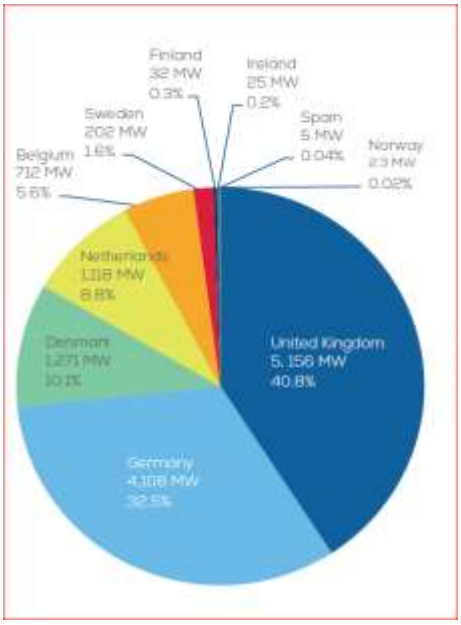


Table 3. Installed Offshore wind capacity in Europe in by the end of 2016 (Wind Europe, 2016)

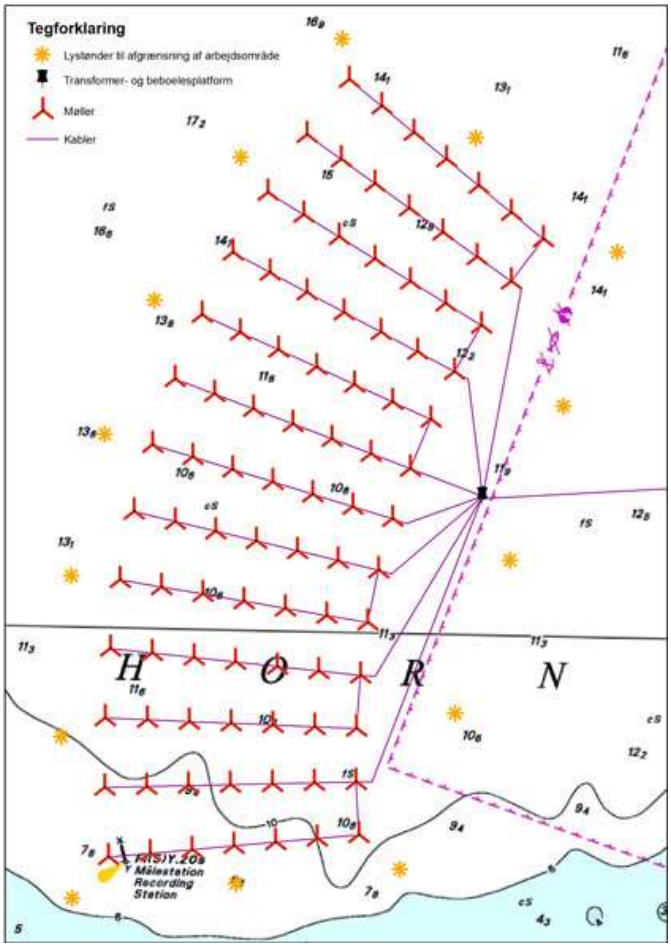
COUNTRY	BE	DE	DK	ES	FI	IE	NL	NO	SE	UK	TOTAL
No. of Farms	6	18	13	1	2	1	6	1	5	28	81
No. of turbines connected	182	947	517	1	11	7	365	1	86	1,472	3,589
Capacity Installed	712 MW	4,108 MW	1,271 MW	5 MW	32 MW	25 MW	1,118 MW	2 MW	202 MW	5,156 MW	12,631 MW

The infrastructure associated with energy transmission from offshore wind farms includes subsea transmission cables with landfall and transition pits. As the number and size of these facilities has grown there has been a corresponding increase in the density of cable networks close to the shore as well as in the export and inter-array/in-field cabling. The Horns Rev 2 offshore windfarm has 70km of inter-array cabling for example[37] (Figure 3) and more than 200km of inter-array cabling has been laid for the London Array offshore windfarm. Both

[36] https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Offshore-Statistics-2016.pdf
[37] http://www.4coffshore.com/windfarms/horns-rev-2-denmark-dk10.html

Alternating Current (AC) and High-voltage Direct Current (HVDC) cables are used depending on transmission requirements and cost considerations.

Figure 11. Inter array cabling at the Horns Rev 2 offshore windfarm



Compared to offshore wind, the technology to convert energy from waves and tidal streams is at a relatively early stage of commercial development. Nevertheless it has reached the point where large-scale prototype devices are being deployed and in some cases, these are feeding energy into the grid. They include devices which are buoyant, semi-submerged, and fixed to the seabed by anchoring, monopoles and gravity base foundations.[38] Specific development zones in EU Member States, including testing facilities, grid infrastructure and licensing rounds are available to developers in Ireland, Denmark, the UK, Portugal, Finland, Spain, France and Italy. Within Europe there was over 14 MW of installed capacity as of end 2016[39] most of which was in UK waters. The European Marine Energy Centre (EMEC) in Orkney provides the first full scale grid connected testing and accreditation facility in real sea conditions and 'Wave Hub' off the North Cornish coast provides shared offshore infrastructure for the demonstration and testing of arrays of wave energy devices.

The transmission infrastructure needed from wave and current devices is likely to be similar to the AC transmission infrastructure for offshore wind, although HVDC cables may also be considered in the future. Given the more energetic environments in which they need to be deployed, including current scoured rocky seabed, there may however be a need for more

[38] http://si-ocean.eu/en/upload/docs/WP3/Technology%20Status%20Report_FV.pdf
[39] https://ec.europa.eu/jrc/en/news/jrc-ocean-energy-status-report-2016-edition

sophisticated mooring arrangements. At this stage of development the generation facilities are close to shore, with fewer cable and substation infrastructure requirements, compared to the more mature offshore wind sector.

8.1.3. Carbon Capture and Storage (CCS)

The capture of CO_2 from burning fossil fuels, and its transport and storage to geological formations under the seabed, is a relatively recent development in the energy sector. The process may involve transporting CO_2 in pipelines from land based plants to offshore storage reservoirs as well as from offshore production facilities to land for treatment and then offshore again for storage. Relevant experience to date in the marine environment includes Enhanced Oil Recovery (EOR) (at the Norwegian Sleipner West gas field in the Northern North Sea) and the capture and storage of CO_2 from the Sohvit gas field which has been piped 152km back to the field for injection into an offshore deep saline formation.[40] CO_2 is compressed into its dense phase (i.e. liquid or supercritical phase) to allow for efficient flow.

8.1.4. Transmission grids

Several medium and large HVDC interconnections cross the Baltic. They include links between Finland and Sweden, Sweden and Poland, Denmark and Germany, and Sweden and Germany. The 580km long NorNed link in the North Sea, which connects the power grids of Norway and the Netherlands, is the longest submarine high-voltage cable in the world. At the present time there is only one power transmission route between southern and eastern Mediterranean countries and EU Member States, between Morocco and Spain, but there are plans for other schemes such as between Tunisia and Italy (operational by 2017). Other examples are the subsea connections between Italy and Greece, Corsica and Italy, and from Sardinia to the Italian mainland.

8.1.5. Projections for the future

Future energy transmission infrastructure in the seas around Europe will involve maintenance, upgrading to expansion, as well as some decommissioning. This will be needed to make best use of existing resources to accommodate more capacity (for offshore renewables generation) and take advantage of newer marine generation technologies. Changes are also being driven by strategic issues such as the need for better energy security, system optimisation and the cost of transmission.

The North Sea offers a unique opportunity to supply a substantial amount of low carbon, indigenous energy, produced close to the part of Europe where a large part of its GDP is generated. Until 2030, the expectation is that this new generation will mainly come from offshore wind generation. There is also a significant potential for electricity trade and market integration, which would address the structural electricity (wholesale) price differences between markets in the region (UK prices being significantly higher than those on the continent). The North Sea also allows for the demonstration and large scale deployment of new low carbon technologies, such as CCS, wave and tidal energy and offshore energy storage.

Improved interconnectivity and the coordinated development of an offshore grid will be key to capturing this potential. An integrated energy resource system in the Northern Seas will boost economic growth and the creation of highly-skilled jobs in the region. The development of such a system would benefit all countries, given the many complementarities in the energy profiles of the countries.

[40] http://sequestration.mit.edu/tools/projects/index.html

Existing marine infrastructure transports large volumes of oil and gas across Europe and beyond. This is not only set to continue but is likely to be supplemented as production becomes viable further offshore and new discoveries are made such as in the hydrocarbon fields in the Levant basin in the Eastern Mediterranean. There are infrastructure proposals aiming at transporting gas from Russia, the Caspian Region, the Middle East, the East Mediterranean and North Africa to the European Union Several of these proposals would include sections of subsea pipelines in the Black Sea, the Mediterranean Sea and the Adriatic Sea.

The infrastructure needs for CCS in Europe are unclear with future associated pipeline requirements difficult to predict although some proposals have reached a public consultation stage.

Infrastructure to integrate an increasing amount of offshore generation from renewable sources is another predicted requirement. Any growth of this sector will require an associated increase in cabling to transmit electricity between the generation sites and onshore grids as well as reinforcement of the onshore grid. The European Wind Energy Association (now Wind Europe) estimates that by 2020 there will be 24.6 GW installed capacity, By 2030 offshore wind capacity could reach 150 GW which would meet around 14% of the predicted EU electricity demand[41]. In the medium term the industry predicts that the North Sea will continue to be the main region for offshore deployment although the Atlantic and Baltic will contribute to attract important developments.

Commercial scale generation of electricity from wave and tidal current energy is less well advanced than offshore wind. This sector is estimated to deliver 120MW by 2020 in the UK[42] while the Spanish Government's Renewable Energy Plan includes a target for an annual installation rate for marine energy of 20-25 MW between 2016 and 2020. An estimated 2GW of projects are being considered by Europe's largest utilities.

A meshed offshore grid, linking clusters of offshore wind farms to hubs, and linking these hubs to interconnections, would bring significant welfare benefits compared to the traditional practice of linking each windfarm radialy to the shore. These benefits would also include a significant reduction in total subsea cabling length, and by bundling the cables to shore the fragile and valuable coastal zone would have to be traversed less often. The North Seas Countries Offshore Grid Initiative (NSCOGI), set up in 2009 and involving nine EU Member States and Norway and also the Commission has been researching potential grid designs for the evolution of an offshore grid, including through the NorthSeaGrid project[43] and a study on the benefits of a meshed offshore grid[44]. In the Mediterranean, MEDRING is promoting interconnections between the Mediterranean Basin's power systems. This includes plans for several interconnectors to supply the north with power from significant renewable wind and solar potential in the southern Mediterranean.[45]

Given the identified need for an increase in grid capacity, various infrastructure projects are being suggested. These include submarine power cable links to improve the connections between the littoral states. Norway and the UK are planning a 700km interconnector by 2020, and an interconnector between Germany and Norway is due to come on line in 2018. A number of projects are also foreseen to improve the interconnection level between the UK and Ireland and the continent. Various options for offshore grid designs to incorporate electricity from offshore wind farms are also being discussed. The North Sea Grid project has

[41] https://windeurope.org/about-wind/reports/wind-energy-in-europe-scenarios-for-2030/
[42] http://www.renewableuk.com/en/renewable-energy/wave-and-tidal/
[43] http://northseagrid.info/project-description
[44] http://ec.europa.eu/energy/infrastructure/studies/doc/2014_nsog_report.pdf
[45] http://www.europarl.europa.eu/meetdocs/2009_2014/documents/itre/dv/160/160620/16062011_study_pe457373_en.pdf

identified 16 interconnection projects in the pipeline, some of which have the potential to evolve towards a North Sea Grid[46].

Energy infrastructure priority corridors and areas identified in Annex I of the TEN-E Regulation[47] include the Northern Seas Offshore Grid (NSOG) as a priority electricity corridor, and the Baltic Energy Market Interconnection Plan as a priority gas corridor. The priority thematic areas in TEN-E which are most relevant to marine energy infrastructure are accommodating wind surplus generation in and around the Northern and Baltic Seas, and infrastructure for a cross-border carbon dioxide network.

Finally, it should be noted that decommissioning of energy infrastructure is also becoming relevant. In the North Sea this has been ongoing since the 1990s as systems reach the end of their economic life.

8.2. NATURA 2000 in the marine environment

By December 2014, more than 3000 marine Natura 2000 sites had been established covering about more than 300 000 km^2. This corresponds to just over 5% of European Seas. The extent of coverage varies depending on distance from the shore with the majority close to the coast. For example marine Natura 2000 sites cover 33% of European Seas within 0-1nm of coastlines but only 2% between 12nm and the exclusive economic zone (EEZ) boundaries. There has been significant progress in establishment of sites in the last few years and Member State efforts are still ongoing. However the assessment for the period 2007-2012 undr Article 17 of the Habitats directive indicated that only 9% of marine habitats and 7% of marine species are in favourable status while 64% of the marine species assessments and about 25% of the marine habitat assessments were classed as unknown.[48]

The general requirements of the Habitats and Birds Directive, including the establishment and management of the Natura 2000 network, are described in Section 2 of this document. This section highlights and elaborates on aspects that are especially relevant to planning or implementing new energy infrastructure plans and projects in the marine environment, including links with the Marine Strategy Framework Directive (MSFD).

8.2.1. The protection of marine environment, habitats and species

The Habitats Directive lists around 230 habitats in Annex I for which the designation of protected sites as well as other measures are required to achieve their favourable conservation status (FCS). Ten of these habitats are treated as 'marine' for reporting purposes;

- 1110 Sandbanks which are slightly covered by sea water all the time
- 1120 *Posidonia* beds
- 1130 Estuaries
- 1140 Mudflats and sandflats uncovered at low tide
- 1150 Coastal lagoons
- 1160 Large shallow inlets and bays
- 1170 Reefs
- 1180 Submarine structures made by leaking gas
- 1650 Boreal Baltic narrow inlets
- 8330 Submerged or partly submerged caves.

[46] http://e3g.org/showcase/North-Seas-Grid
[47] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:115:0039:0075:EN:PDF
[48] http://ec.europa.eu/environment/nature/knowledge/rep_habitats/index_en.htm

Some of these habitats are coastal whilst others occur in both shallow seas and deeper offshore waters[49] Submerged or partly submerged caves are probably the least likely habitat type to coincide with marine energy infrastructure but all of the remainder could potentially overlap and may be sensitive to activities associated with the construction, maintenance and decommissioning of marine energy infrastructure.

The Habitats Directive and Birds Directive also require protective measures to be introduced for certain marine species, most of which are highly mobile. In the case of the Habitats Directive these are the cetaceans, seals, reptiles, fish, invertebrates and plants listed in Annex II or IV. The Birds Directive establishes a general system of protection for all naturally occurring wild bird species in the EU, including seabirds.

Developers and planners need to assess the vulnerability and potential impacts of marine energy infrastructure on these marine habitats and species both within and outside the boundaries of Natura 2000 sites.

Where it is considered that the activity is not a plan or project in the sense of Article 6.3, Member States must nevertheless ensure the species and habitats for which a site has been designated do not deteriorate in accordance with Article 6.2. If the activities are directly connected with or necessary to the management of the site (in line with Art 6.3), then an Appropriate Assessment may not be necessary either.

Article 12 of the Habitats Directive and Article 5 of the Birds Directive require Member States to protect respectively Annex IV species of Community interest and all wild birds throughout their natural range within the EU.

The **EU Marine Strategy Framework Directive** (MSFD) was adopted in June 2008. The Directive establishes a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status (GES) of the EU's marine waters by 2020 (Art.1.1). The main purpose is to protect, preserve, prevent deterioration or, where practical, restore Europe's oceans and seas where they have been adversely affected and to prevent and reduce impacts to the marine environment (Art 1.2(a) & (b)). Eleven qualitative descriptors for determining GES are listed in Annex I, several of which may be affected by the installation, maintenance and decommissioning of marine energy infrastructure. They include Descriptor 1 (Biological Diversity), Descriptor 6 (Sea Floor Integrity), Descriptor 11 (Introduction of energy including underwater noise), Descriptor 7 (hydrographical conditions), Descriptor 8 (pollution from contaminants) and Descriptor 10 (marine litter).

Two broad categories of habitats are considered in assessments, determination, and monitoring of GES: predominant habitats and special habitats. The latter refers especially to those recognised or identified under Community legislation (e.g. Habitats and Birds Directives) or International Conventions, as being of special scientific or biodiversity interest. The overlap with marine habitats listed under the Habitats Directive is shown in Table 3. MSFD does not focus on particular species but rather addresses all elements of marine biodiversity. All species covered by the Birds and Habitats Directive will therefore also fall under the remit of MSFD as part of an assessment of GES.

[49] European Commission (2013) Interpretation Manual of European Union Habitats. EUR 28 April 2013. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

Table 4 Potential overlap between MSFD and Habitats Directive marine habitat types[50]

Predominant seabed habitat types for MSFD	HABITAT TYPES LISTED IN ANNEX 1 OF THE HABITATS DIRECTIVE AND CONSIDERED 'MARINE' FOR ARTICLE 17 REPORTING									
	1110 Sandbanks slightly covered all the time	1120 *Posidonia* beds	1130 Estuaries	1140 Mudflats & sandflats not covered at low tide	1150 Coastal lagoons	1160 Large shallow inlets and bays	1170 Reefs	1180 Submarine structures made by leaking gas	1650 Boreal Baltic narrow inlets	8330 Submerged or partially submerged sea caves
Littoral rock & biogenic reef			■		■	■	■	These structures may occur in a range of predominant habitat types		■
Littoral sediment			■	■	■	■				
Shallow sublittoral rock & biogenic reef			■		■	■			■	■
Shallow sublittoral coarse sediment	■	■	■		■	■			■	
Shallow sublittoral sand	■	■	■		■	■			■	
Shallow sublittoral mud		■	■		■	■			■	
Shallow sublittoral mixed sediment	■	■	■		■	■			■	
Shelf sublittoral rock & biogenic reef							■			■
Shelf sublittoral coarse sediment										
Shelf sublittoral sand										
Shelf sublittoral mud										
Shelf sublittoral mixed sediment										
Upper bathyal rock & biogenic reef							■			
Upper bathyal sediment										
Lower bathyal rock & biogenic reef							■			
Lower bathyal sediment										
Abyssal rock & biogenic reef							■			
Abyssal sediment										

From Commission Staff Working Paper (October 2011)

Estuaries (1130) typically fall within transitional waters of WFD and therefore may mostly fall outside the scope of MSFD. Coastal lagoons (1150) are considered under marine reporting if there is a permanent connection with the sea. Coastal habitats (e.g. Atlantic salt meadows

[50] http://ec.europa.eu/environment/nature/natura2000/marine/docs/FAQ%20final%202012-07-27.pdf

(1330), *Spartina* swards (1320)) are covered under terrestrial reporting of HD but may occur within 'coastal waters' of WFD and hence fall within scope of MSFD

8.2.2. Supporting measures and useful sources of information

The European Union and its Member States, as well as other European countries are Contracting Parties to various relevant international environmental Conventions and Agreements. These have helped to shape the legal framework for biodiversity policy and legislation within the EU and also helped define the relationship between the EU and other countries. European and national legal frameworks on nature and biodiversity conservation must take full account of the commitments entered into under these Conventions and Agreements. The most relevant to biodiversity conservation in Europe in the context of marine energy infrastructure are described below.

The **Convention for the Protection of the Marine Environment of the North-East Atlantic** (OSPAR) provides a mechanism for fifteen Governments of the western coasts and catchments of Europe, together with the European Union to cooperate to protect the marine environment of the North East Atlantic. The OSPAR Biological Diversity and Ecosystem Strategy identifies the laying, maintenance and decommissioning of cables and pipelines as one of the human activities that can adversely affect the marine environment. The potential impact of pipelines has been assessed by the OSPAR Joint Assessment and Monitoring Programme (JAMP) as part of an evaluation of the extent, input and impact of offshore oil and gas industry (OSPAR, 2009a), whilst the OSPAR Biodiversity Committee have assessed the environmental impacts of sub-sea cables (OSPAR, 2009). OSPAR has also produced Guidelines on Best Environmental Practice in Cable Laying and Operation, including the scope for potential mitigation measures (OSPAR, 2012). OSPAR's sister organisation, the BONN Agreement[51] is also working on an integrated approach to managing the impact of accidental spills of oil and other hazardous substances in the marine environment.

The **Convention on the Protection of the Marine Environment of the Baltic Sea Area** (HELCOM, 'Helsinki Convention') covers the Baltic Sea basin plus all inland waters in its catchment areas. All countries bordering the Baltic Sea plus the EU are Contracting Parties. The Baltic Sea Action Plan (2007) developed under the auspices of HELCOM and adopted by all the coastal states and the EU includes agreement that Contracting Parties will follow relevant processes to prevent, reduce or offset as fully as possible the environmentally significant adverse impacts caused by any offshore installation, including subsea cables and pipelines.

The Contracting Parties of the **Convention for the Protection of the Marine Environment and Coastal Region of the Mediterranean** ('Barcelona Convention') undertake "to prevent, abate and combat pollution of the Mediterranean Sea and to protect and enhance the marine environment in that area" (Art 4(1)). The obligations which are particularly relevant to marine energy infrastructure are those concerned with pollution resulting from exploration and exploitation of the continental shelf and the seabed and its subsoil (the 'Offshore Protocol'), dealing with pollution emergencies, and monitoring, which has been ratified by the EU.

The **Convention on Environmental Impact Assessments in a Transboundary Context** (ESPOO Convention) promotes international cooperation and participation of the public when the environmental impact of a planned activity is expected to cross a border. Large diameter oil and gas pipelines are on the list of activities that are likely to cause significant adverse transboundary impact and which should be subject to the EIA procedure set out in the Convention.

[51] https://www.bonnagreement.org

The **Convention on the Conservation of Migratory Species of Wild Animals** ('Bonn Convention') aims to preserve migratory species throughout their natural range. Several agreements signed under this Convention are relevant to the management of conflicts between migrating animals and marine energy infrastructure

- **Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas** (ASCOBANS): this aims to co-ordinate measures to reduce negative impact of by-catches, habitat loss, marine pollution and acoustic disturbances among the ten parties. A resolution on adverse effects of underwater noise on marine mammals during offshore construction activities for renewable energy production was adopted in 2009 and a resolution on the adverse effects on sound, vessels and other forms of disturbance on small cetaceans was adopted in 2006. Both are relevant to considering the potential impact associated with marine energy infrastructure

- The **Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area** (ACCOBAMS) is a cooperative framework for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its main purpose is to reduce the threat to and improve knowledge about cetaceans in these seas. The agreement includes resolutions on the assessment and impact assessment of man-made noise which is relevant to managing the conflicts between cetaceans, which are protected by the Habitats Directive, and marine energy infrastructure. Guidance on underwater noise mitigation measures have also been published (ACCOBAMS-MOP5, 2013).

8.3. Potential impacts and approaches to mitigation

Environmental impacts of energy infrastructure on marine biodiversity can arise from biological, physical and chemical pressures, with precise effects depending on a range of factors. These include whether the infrastructure is at an installation, operational or decommissioning phase; the timing and frequency of works; the scale of the infrastructure; and where it is located. Pressures on protected habitats and species can be indirect as well as direct, and impacts may be acute or chronic. The potential impacts on Natura 2000 habitats and species are summarised in Table 5. The effects and potential mitigation measures are described below. Projects will need to be assessed on a case by case basis to determine whether such measures are sufficient to safeguard the Natura 2000 interest.

However, for marine energy infrastructure plans and projects limitations which may affect the adequacy of AAs include:

- Data availability, accessibility and ability to gather relevant data
- Scientific understanding – of ecological processes, sensitivity of marine Natura 2000 habitats and species to particular pressures, and of potential cumulative effects
- Mitigation strategies – short timescale over which to determine effectiveness, experimental or poorly developed as yet
- Development type – novel, still under development, and complex in that they may have both terrestrial and marine components

It is also the case that for marine renewables [wave and tidal power], much of the impact assessment work to date has been concerned with the generation devices. These have still to be operationalised at scales where they might become commercially viable operations. The potential environmental impacts of arrays and their required transmission infrastructure has therefore still to be tested. There is also uncertainty in our understanding of the scale and complexity of the combined and cumulative effects of the marine energy infrastructure in

association with other maritime activities, hence the need for strategic planning as suggested in Section 4. A case by case assessment will typically be required in order to identify the type and severity of likely impacts with reference to the site specific circumstances and available data.

Table 5. The potential sensitivity of habitats and species protected under Natura 2000 to pressures associated with the construction, maintenance and decommission of marine energy infrastructure.

	PHYSICAL LOSS/ DAMAGE	BIOLOGICAL DISTURBANCE/ DAMAGE/LOSS	HYDRO-LOGICAL CHANGE	HAZARDOUS SUBSTANCES	ELECTRO-MAGNETIC FIELDS+
Sandbanks	V	V	V	V	
Posidonia beds	V	V	V	V	
Estuaries	V	V	V	V	
Mudflats & sandflats	V	V	V	V	
Coastal lagoons	V	V	V	V	
Inlets & bays	V	V	V	V	
Reefs	V	V	V	V	
Structures made by leaking gas	V	V	V	V	
Boreal Baltic narrow inlets	V	V	V	V	
Caves*	?	?	?	V	
Cetaceans	?	V	?	V	
seals	?	V	?	V	
reptiles	?	V	?	V	
fish	?	V	V	V	V
invertebrates	V	V	?	V	
plants	V	V	V	V	
seabirds		V		V	

* as unlikely routeing location + mechanisms and impacts still poorly understood
? unknown/poorly understood

- **Summary of potential impacts**

There is a significant body of information on the potential impacts of subsea pipelines because of their extensive and longstanding use to transport oil and gas in the marine environment. Cable laying is also a widely used technology although most information on potential environmental impacts come from the telecommunications sector. Cables used for energy transfer are generally heavier, stiffer and have a larger diameter. Ways in which to avoid or mitigate environmental impacts of both cables and pipelines have also been subject to investigation and include avoidance and mitigation strategies relevant to Natura 2000 habitats and species.

The most obvious direct effects are damage, disturbance or loss of benthic habitats during cable and pipeline laying operations. This is because routeing is mostly across areas of soft sediment involving trenching or burial operations. The affected space is strongly dependent on the techniques and machinery used as well as the type of sediment and may cover a zone within 10-20m of the line. The benthos in this disturbed zone can recover although not necessarily to the same suite of species and the rate of recovery will be influenced by the sediment type and local conditions. Impacts will depend on the scale and longevity of any changes as well as site specific characteristics. Different sediment types may also be introduced into the site, potentially changing its character. Subtidal sandbanks, the soft

sediment habitats of inlets and bays, intertidal mudflats and sandflats, seagrass beds, *Posidonia* beds and reefs are some of the Natura 2000 habitats which are vulnerable to direct habitat damage or change associated with routeing cables and pipelines. In some cases cables may need to cross areas of rocky seabed. Habitat damage, for example to reef environments, may occur if trenches need to be cut into the rock.

The introduction of the artificial hard surfaces of the cables and pipelines as well as rock armour and concrete mattresses to protect operational infrastructure or decommissioned pipelines can have a localised effect by enabling colonisation by species untypical of soft sediment habitats. There is also the potential for invasive alien species to colonise and disperse from such structures. Changes in turbidity, seabed currents and topography are another potential pressure on benthic communities in the vicinity of cables and pipelines, whilst changes in feeding behaviour, disturbance, and displacement during installation works may have an impact on marine mammals and seabirds protected under the Habitats and Birds Directives. Less is known about the effects of the electromagnetic fields (EMF) around cables but this could be an issue for fish like the sturgeon, a protected species under the Habitats Directive, which are known to be able to detect these types of fields. Heat emissions may also impact some species which are sensitive to even minor increases in the ambient temperature but the type and significance of any effects on benthic communities such as those associated with sandbank habitats are not known. Reduction and avoidance of such emissions by cable design is discussed in the section on mitigation measures.

The risks and potential impacts of chemical contamination on Natura 2000 habitats and species are other aspects which need to be considered. These could arise from damaged pipelines, disturbance of contaminated sediments or hazardous substances, or from the breakdown of cables. Emissions from vessels involved in construction and maintenance of infrastructure may have water quality implications although it is difficult to separate these out from emissions associated more generally with offshore construction and maintenance works.

- **Summary of potential mitigation measures**

The OSPAR Commission has provided a useful summary of the potential mitigation measures to minimise or avoid environmental impacts associated with sub-sea cables (Table 6)[52]. Foremost amongst these are careful routeing and scheduling of installation activities, suitable choice of cable types, appropriate burial of the cable, and use of inert materials if protective covering is necessary. Disturbance of the seabed, noise, contamination, smothering, habitat loss, corridors for dispersal for alien species and cumulative effects are also relevant to the construction and maintenance of sub-sea pipelines.

Table 6. Possible mitigation measures to avoid or minimise environmental impacts of various anthropogenic pressures due to cable laying and operation (from OSPAR, 2009).

	Mitigation measures					
Environmental impacts	Route selection	Construction times	Burial technique	Burial depth	Cable type	Removal
Disturbance	x	x	x	(x)	(x)	See text
Noise	(x)	(x)	(x)			
Heat emission	(x)			x	x	
Electromagnetic				x	x	
Contamination	x		(x)	(x)	x	x
Cumulative	x	x	x	x	x	

[52] http://qsr2010.ospar.org/media/assessments/p00437_Cables.pdf;

effects*						
x: Important measure; (x) less important measure; * Knowledge insufficient						

The following sections provide more detail on the potential impacts and mitigation measures concerned with the installation, operation and decommissioning of cables and pipelines.

8.3.1. Installation

A variety of methods are used to deploy sub-sea cables and pipelines. In areas of soft sediment, ploughs and water jetting equipment individually and in combination can be used to create trenches, typically 1-3m deep, and simultaneously bury cables and pipelines within them. Alternatively, spoil from the trench is temporarily removed from the site or deposited alongside the works with cable or pipeline placement and infilling of the pre-cut trenches taking place sometime later. Invertebrate mortality along the proposed cable route is likely to be higher when jetting is used (liquefying the sediment below the cable to let it sink to a specified depth) as there is more disturbance to the sediment and the likely exposure of many of the animals to predation. When ploughs are used the skids that support the plough can leave a surface footprint, particularly in zones of soft sediment. Potential impacts under these circumstances are increased sediment compaction and disruption of marine fauna. The zone of disturbance will depend on the characteristics of the environment and installation method.[53]

Whilst some mobile species can avoid the disturbed areas, most sessile species cannot and certain biogenic reef habitats such as horse mussel beds and maerl beds, two sub-habitat types of subtidal sand banks, as well as seagrass beds can be particularly vulnerable to direct loss or smothering by suspended sediments (e.g. OSPAR 2010). Localised damage of benthic communities of reef habitats may also result when cabling crosses areas of rocky seabed either through abrasion or the excavation of trenches through soft and hard rock.

The re-suspension and remobilisation of nutrients and hazardous substances during trenching operations poses risks in areas of contaminated sediment while changes in seabed profile may lead to changes to the hydrodynamic regime. This can affect the stability of subtidal habitats, such as sand banks, as well as potentially altering the associated marine communities. A final consideration is the potential impact of commissioning activities. In the case of pipelines this involves pumping through test water containing biocides and corrosion inhibitors. The composition and dispersion of test waters needs to be determined, although increased concentrations at the discharge points are generally considered to be short-term. There is insufficient information to gauge the potential effects on the marine communities associated with Natura 2000 habitats and on protected species.

→ CHANGES TO BENTHIC HABITATS, COMMUNITIES AND SPECIES

The immediate impacts of laying cables and pipelines are localised damage, abrasion, displacement and the disturbance of seabed habitats and species in a swathe around the construction works (Söker *et al*. 2000). Benthic communities within and close to trenches can be affected by sediment spill, burial, stirring, settling of fine sediment, and changes in chemical properties through the resuspension of contaminants or disturbance of anoxic layers but these effects may only be short-term or result in subtle longer term changes whose significance is difficult to evaluate.

A study of impacts and recovery associated with a cable trench in the Lagoon of Rødsand, a Natura 2000 site in Denmark, for the Nysted offshore wind farm showed significant differences in the shallow water *Macoma* community, immediately following the works. The

[53] A zone between 2-8m wide, depending on plough size is quoted by (Carter *et al.,* 2009).

shoot density and biomass of eelgrass rhizomes was also reduced close to the trench (attributed to the combined effect of shading and burial), but recovered within two years to pre-construction values (Birklund, 2003). The benthic macrofauna along a submarine cable in the Baltic between Sweden and Poland also showed recovery with no significant changes in the composition, abundance or biomass that could be clearly related to cable installation after one year (Andrulewicz *et al.,* 2003).

These studies suggest that although impacts on subtidal soft sediment communities such as those found on shallow sandbanks can be significant, they may be relatively short-lived and limited to a cable corridor of perhaps 10m wide (OSPAR, 2009). Longer term effects may be seen on biogenic reefs comprised of species sensitive to smothering such as maerl beds, on submarine structures made by leaking gas or on species which are particularly long lived and slow to re-establish, such as horse mussel reefs. The precise effects will depend on the habitats present and the characteristics of the site.

Apart from direct damage other potential pressures from construction works on benthic habitats and species are increases in turbidity, contaminate release and changes in sediment composition. Impacts will depend on the scale and longevity of any changes as well as site specific characteristics. Soft sediment being redistributed onto rocky reef habitats, or habitats sensitive to smothering such as *Posidonia* beds and maerl beds, will be more of an issue than resettlement in areas with similar sediment characteristics (Zucco *et al.,* 2006; Hall-Spencer & Moore, 2000). Different sediment types may also be introduced into the site, potentially changing its character. At the Nysted offshore windfarm in Denmark, for example, the need to cover exposed cables sometime after the initial laying operation meant that shingle had to be imported to fill the trench in an area dominated by soft sediments (Andrulewicz *et al.,* 2003).

In areas of rock, highly mobile sand, or deep waters, where the seabed is unsuitable for the burial of cables and pipelines, infrastructure may be protected or stabilised by rock amour and concrete mattresses. A temporary increase in turbidity in the vicinity of operations is likely even when no trenching takes place. Rock dumping can involve the placement of 1 tonne of rock per square meter, 5m either side of the pipeline, and therefore could introduce a significant amount of material of a different character to existing sediments in the area prior to installation.

Examples of mitigation measures applied to subtidal habitats in the Natura 2000 network

The route of the SwePol transmission line between Sweden and Poland to parts of the Slupsk Bank Natura 2000 site was partially rerouted as a mitigation measure. Whilst most of the cable route passes through endangered habitats, the stone and boulder areas of the Slupsk Bank which support declining red algae species was avoided. The same project eliminated potential chemical contamination from Chlorine by changing the proposal from a monopolar design which would require sacrificial anodes to a bipolar system (Andrulewicz *et al.,* 2003).

→ DAMAGE TO INTERTIDAL HABITATS AND SPECIES

Intertidal habitats and species protected by the Habitats and Birds Directives may be subject to disturbance, damage and loss from cables and pipelines laying operations. The Natura 2000 habitat types most likely to be affected are marine inlets and bays, Boreal Baltic narrow

inlets, estuaries, intertidal mudflat and sandflats, and *Posidonia* beds. The most vulnerable protected species include waders and wildfowl.

The effects on infauna are often dramatic but may be short-term. A study of the effects of trenching for pipeline installation across an area of intertidal mud and sandflats in Ireland, for example, showed a total loss of benthic invertebrates and a change in sediment structure immediately after the works were completed. The affected area was subsequently recolonized to the point where there was no discernible difference in the number of individuals of all species collected in sediment cores six months later, although the taxa represented were different (Lewis *et al.,* 2002). Other studies have reported similar effects and although species richness may be restored, total biomass may take several years to reach similar levels to that of the surrounding undisturbed area. Recovery will depend on the species present in the surrounding areas, their lifecycle and mobility, and the timing of any construction works.

Examples of mitigation measures applied to protect intertidal habitats

Mitigation measures relating to cable landfall and the transition pit across intertidal habitats such as those in estuaries, range from rerouting to avoid sensitive areas, minimising the affected area, careful timing of construction works to avoid disturbance and using less damaging excavation techniques. These are some of the mitigation measures that were agreed when laying export cables across an intertidal area of the Swale Estuary to connect the London Array offshore windfarm to the transmission grid (London Array/National Grid 2007).

- No works to be undertaken within the Swale SPA and Ramsar site, or within 500m of their seaward boundary, during the period 1 Oct – 31 March
- No works at any time within areas supporting eelgrass beds or within the main mussel beds. This encompasses all works associated with cable laying, including the position of the anchor points for barges (if needed).
- Cables installed across the intertidal area should be buried to a depth of not less than 1m, and normally installed by means of ploughing or and trenching. If trenching is used within the intertidal area, excavation and subsequent backfilling of the cable trench should be carried out in such a way as to maintain the sediment profile. Jetting should only be considered as an exceptional technique, subject to prior approval and monitoring
- Ornithological surveys of the foreshore, intertidal and onshore areas should be carried out between October and March in each year of construction and for at least one year
- No works to be carried out until measures regard handling and storage of potentially hazardous substances, response to spillages and provision for surface water drainage have been approved by the appropriate regulatory bodies
- Staff/contractors to be briefed on the locations of environmentally sensitive features and on the working practise required to safeguard these features
- Intertidal cable laying methods should be selected that reduce the liberation of suspended sediment to a minimum
- Construction activities should be undertaken in a way that minimises disturbance to birds e.g. directional lighting techniques.

→ DISTURBANCE AND DISPLACEMENT OF HIGHLY MOBILE SPECIES

Noise and the presence of people, machinery and activities associated with construction works in both intertidal and offshore locations are known to affect the behaviour of highly mobile species including seabirds, waders and wildfowl, cetaceans, seals, turtles and fish protected under the Habitats and Birds Directives. The main effects are disturbance and displacement. The potential impacts, which are species specific, include loss of feeding opportunities, collision risk, and barriers to movement, both of which could have energetic costs. Diving birds are known to be very sensitive to visual disturbance and are displaced by ship traffic (Mendel *et al*., 2008). Longer term impacts may occur such as auditory damage to marine mammals that are exposed to high levels of sound for long periods. A critical issue is the level of background noise relative to construction noise since this influences the ability of animals to detect and respond to the pressure (Robinson & Lepper, 2013).

Noise from pipeline and cable laying is typically associated with trenching, pipe laying, and rock placement. In the case of the proposed 65km export cable from the Beatrice Offshore Wind Farm in the Moray Firth installation noise was distinguished by modelling which identified the potential disturbance zone for different species (see box below). The OSPAR assessment is that there are no clear indications that underwater noise caused by the installation of sub-sea cables poses a high risk to marine fauna (OSPAR, 2009).

Scoping to assess risks to mobile marine species

Assessment of the likely impact of noise associated with the installation of 65km of export power cables at the Beatrice Offshore Windfarm to landfall in Moray Firth, North –East coast of Scotland, was undertaken by modelling the potential behavioural impact on a number of species (Nedwell *et al.,* 2012). The results suggest that trenching was likely to have the greatest impact on the various marine species and that the greatest likely impact was on harbour porpoise.

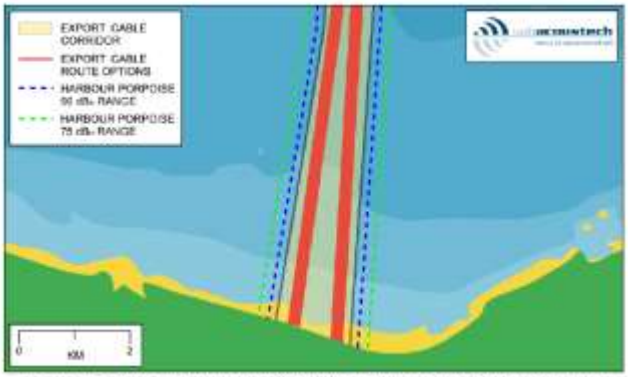


Figure 5-1 Contour plot showing the 90 and 75 dB_{ht} impact ranges for harbour porpoise during trenching operations

The dBht (Species) metric has been developed as a means for quantifying the potential for a behavioural impact on a species in the underwater environment (Nedwell et al., 2007). The sound will be perceived differently by different species. Levels above 90dBht were considered to elicit a strong avoidance reaction by virtually all individuals.

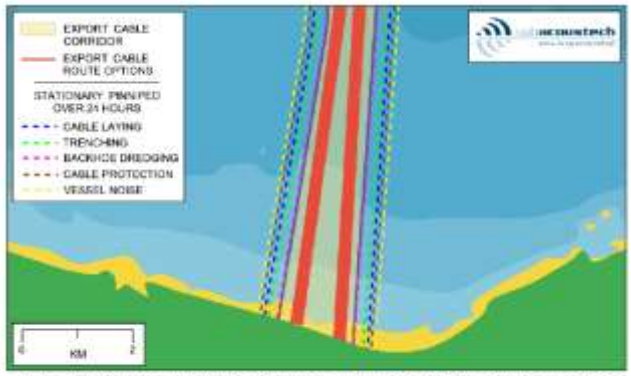


Figure 5-2 Contour plot showing the ranges out to which auditory injury is expected for the pinnipeds hearing group using the 186 dB re.1µPa/s^2(M_{pw}) criteria for a stationary animal model for the five activities

In this case there was predicted to be a short-term localised noise disturbance during cable laying operations which could lead to temporary displacement of marine mammals from a very small proportion of their suitable habitat (Arcus, 2012). Other aspects of the construction works were considered to be significant for bottlenose dolphin and harbour seal and consequently subject to mitigation measures e.g. 'soft starts' for pile driving operations, and the use of marine mammal observers.

8.3.2. Operation

The negative impacts associated with operational cables and pipelines are most likely to arise from pollution. This could be from acute incidents such as accidental discharges from operational support vessels or from the rupture of pipelines. Chronic effects resulting from the breakdown of cables and pipelines and the leaching of chemicals may occur. The likely effects of electromagnetic fields (EMF) and increases in temperature around cables are less well studied. Maintenance and repair works which result in re-suspension of sediments and hazardous substances would result in similar effects to those described during the installation work.

→ **POLLUTION**

Pipeline damage may result from corrosion, seabed movements, and contact with anchors and bottom fishing gear. The consequences can be small short-term or long-term leakages or more catastrophic blow outs resulting in major pollution incidents. The European Gas pipeline incident database identifies external interference as the most common cause of incidents (48.4%) followed by construction defect/material failure and corrosion but do not distinguish between subsea and other gas pipelines (EGIG, 2011). Hydrocarbons, and gases such as carbon dioxide, methane, and hydrogen sulphide are some of the contaminants that may be introduced to the water column.

A further source of contaminants are sacrificial anodes used to slow the corrosion of pipelines in seawater. Components of these anodes (mercury, copper, cadmium and lead) can migrate through sediment and accumulate in some marine species. The rate of corrosion of these anodes will depend on the site characteristics such as water depth, temperature, and salinity. The likelihood of effects on Natura 2000 habitats and species is unclear.

In the case of CCS operations, temperature and pressure will determine whether the CO_2 is transported through pipelines as a liquid or as a gas. This needs to be carefully controlled as

hydrate formation in the pipeline increases internal corrosion and could cause blockages, increasing the risk of pipeline failure. The principal effect of pipeline damage or failure would be acidification of surrounding water.

The acute and chronic effects of oil pollution on marine species and habitats listed in the Habitats and Birds Directive such as marine mammals, seabirds, seagrass beds and mudflats and sandflats are extensively studied and well documented[54]. So is the need for monitoring and contingency planning to avoid escalation of incidents and reduce the impact. There is also information on the effects of other pollutants such as heavy metals in marine mammals, and the potential effects of ocean acidification, but not specifically in relation to marine energy infrastructure.

The main approach to mitigating pollution from cables and pipelines is to minimise the risk of discharges, by design and regular inspection. Regular monitoring acts as an early warning system, and contingency planning sets out measures to reduce any impacts on marine habitats and species should incidents occur.

→ ELECTROMAGNETIC FIELDS AND EFFECTS ON FISH

Low-frequency electromagnetic fields (EMF) are emitted during the transmission of electricity, including along subsea cables. Electrical fields can also be induced in the surrounding environment by the movement of water and organisms through the magnetic field. Marine organisms that use EMFs for spatial location, large scale movement, small-scale orientation, feeding or finding mates could therefore show some effects if the EMF is large enough and/or discernible from background levels. The likelihood and significance of any impacts are not well understood (Boehlert & Gill, 2010). Simulation of magnetic fields around the bipolar transmission line between Sweden and Poland suggested that any changes of inclination would not exceed natural changes in the terrestrial field at a distance exceeding 20m from the cables. *In-situ* measurements of the underwater magnetic field once the cabling was in place showed that they did not exceed those predicted by the simulations (Andrulewicz *et al.,* 2003).

Fish species known to detect electric fields include Elasmobranchs and sturgeons and some of these show behavioural changes within the range of EMF which may be emitted around cables. In the case of magnetic fields, monitoring of migrating European eel (*A.anguilla*) in the Baltic Sea reported temporary responses with the eels diverting from cables in their path during migration but there was no evidence that this was a permanent obstacle. In the case of electrical fields, changes in behaviour of Lesser Spotted Dogfish (*S.canicula*), Thornback Ray (*R.clavata*) and Spurdog (*S.acanthias*), which may be associated with sandbank habitats, have been reported although the effects differed between individuals[55].

Some mitigation is already incorporated through industry standard shielding which restricts the directly emitted electric fields but not the magnetic component. Other possibilities are modifications in cable design, reductions in current flow, and deeper burial.

The mechanisms and impacts of EMF on marine organisms are not fully understood nor is the significance of the levels emitted compared to those of the Earth's geomagnetic field. Current practice in Europe involves consideration of EMF in EIA and consent processes but with different levels of obligation regarding the monitoring and investigation of any potential effects in different Member States.

[54] E.g. Camphuysen *et al.,* (2009);Jenssen (1996); de la Huz *et a*l., (2005)
[55] Summarised in AMETS Foreshore Lease Application EIS, Appendix 4 (2010)

→ CHANGES TO BENTHOS

In the longer term, for surface laid cables and pipelines, the introduction of hard substrates can have a 'reef effect' as they are colonised by a variety of species[56]. By way of example, species predicted to colonise rock dumps and concrete mattresses around pipelines in the northern North Sea Mariner Area Development include hydroids, soft corals, anemones, tubeworms, barnacles, tunicates and mobile organisms like crustaceans, polychaetes and echinoderms (Statoil, 2012). At the Nysted and Horns Rev offshore windfarms colonisation around the base of the turbines has increased biomass and habitat heterogeneity. The introduction of hard surfaces in an area dominated by sandy sediments has resulted in a significant change in the benthos. There is also the potential for invasive alien species to disperse through colonisation of these structures especially if there are associated changes in temperature. Small rises in temperature can occur within a few centimetres of power transmission cables depending on burial depth, type of cable and characteristics of the surrounding sediment. These increases are likely to be more significant for AC cables than HVDC cables at equal transmission rates. Heat emission may alter the physico-chemical conditions in the sediment and increase bacterial activity which could have secondary impacts on benthic fauna and flora (Meissner & Sordyl, 2006).There is evidence that some species are sensitive to even minor increases in the ambient temperature but the type and significance of any effects on benthic communities such as those associated with sandbank habitats are not known.

8.3.3. Decommissioning

There are various international obligations on the decommissioning of offshore installations, such as those agreed by OSPAR (Decision 98/3) but these do not cover cables and pipelines. The potential impacts of decommissioning cables and pipelines on marine habitats and species are similar to those described for installation and can be supported by similar mitigation measures. In the case of pipelines the starting point is purging and cleaning pipelines. This is followed by removal from the seabed or cutting and abandonment *in-situ* with appropriate protection and subsequent monitoring. Buried cables may need to be exposed by ploughing or water jetting prior to removal disturbing the sediment and associated benthic communities. Other associated infrastructure such as mattresses may need to be removed by grabs, depending on their condition.

Techniques used for pipeline removal such as reverse reeling, cutting and lifting, and towing at the surface or a controlled depth may directly damage seabed habitats, disturb or displace mobile species and reduce water quality if there are discharges to sea from vessel traffic and operations. The physical disturbance to the seabed, increases in turbidity, potential smothering of benthos and recovery rates are likely to be similar to those described for installation, impacting the same habitats and species in a zone either side of the pipeline. Older mattresses or those which have broken up may need to be removed by conventional grabs. Where rock dumps need to be placed on the seabed to protect sections of decommissioned pipelines these will provide a hard surface for attachment in what are predominantly soft sediment areas, changing the marine communities in these areas.

Decommissioning plans are usually required at the outset of a project, with a case by case assessment as they will vary depending on pipeline type, diameter, length, integrity and condition. Options include leaving *in situ*, reuse *in situ*, reuse in other locations, or removal and disposal onshore. In the Danish Field to the west of Jutland, for example, an

[56] E.g. Meissner & Sordyl, 2006 http://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Forschungsberichte/Ecological_Research_Offshore-Wind_Part_B_Skripten_186.pdf

investigation into decommissioning options identifies the first and last of these as meriting further consideration. Where pipelines are left on the seabed long-term monitoring is likely to be needed to ensure stability and safety for other sea users as they may take decades to deteriorate (HSE, 1997).

8.3.4. Cumulative effects

Marine energy infrastructure projects do not take place in isolation. They are part of oil and gas, CCS, offshore wind and marine renewable schemes and may also be located near other plans and projects. The combined effect of these activities, whether past, present or planned for the future, can result in cumulative environmental effects on Natura 2000 habitats and species. Highly mobile species such as marine mammals, fish and seabirds may be particularly vulnerable as they could be affected by activities in a variety of locations, including some which are widely separated.

Cumulative effects may arise within an individual project, for example, because of the density of infrastructure and activities in one place (cables, pipelines, platforms, maintenance vessel traffic). The potential for cumulative effects also arises when there are other schemes in the vicinity. In the case of the Beatrice field offshore wind farm in the northern North Sea the predicted noise from cable laying and an increase in suspended solids in the vicinity of the transmission works were not considered to be significant. However when considered together with other activities on site and another nearby offshore renewables scheme, simultaneous construction noise was assessed as potentially having a cumulative effect on herring, European eel, salmon and sea trout. On the other hand when the two developments were considered together, no additional effects on sediment transport were considered to be likely (Arcus, 2012).

Cumulative impact assessment needs to be undertaken as part of EIAs, SEAs and is a legal requirement for the Appropriate Assessment of plans and projects under the Habitats Directive. Scoping potential impacts, suggesting mitigation and monitoring measures as well as reporting on areas of uncertainty are key elements. There is both generic and sector specific guidance on assessing cumulative effects (e.g. RenewableUK, 2013) with further detail provided in Section 7.3 of this document.

8.3.5. Potential mitigation measures

Guidance on the approach to mitigation is set out in Section 5 of this document. Key opportunities for mitigating the potential impacts of marine energy infrastructure projects on Natura 2000 habitats and species are listed below.

Possible options for mitigation measures at different stages of energy infrastructure projects

Assessment

- Scoping, screening and initial appraisal of installation, operation and decommission stages to identify potential pressures, effects and impacts on Natura 2000 habitats and species. Mitigation measures to be proposed as part of this process.

Routeing/Placement

- Route cable and pipeline corridors to avoid Natura 2000 habitats and impacts on EU protected species e.g. avoiding *Posidonia* beds, seal haul out sites, intertidal feeding areas for waders and wildfowl.
- Avoid construction of substations/converter stations in Natura 2000 sites

- Avoid routeing through areas where there is a risk of disturbing hazardous substances or contaminated sediments

Footprint
- Reduce zone of disturbance by minimising trench corridors for example by considering infrastructure type, size, spacing between trenches, bundling cables, and parallel routeing
- Minimise cable runs connections between generation devices (inter-array), converter stations and substations and grid entry points on land.
- Deploy installation methods (e.g. ploughing, jetting, horizontal directional drilling, coffer dams) which minimise disturbance to seabed and intertidal habitats.
- Consider opportunities to co-ordinate installation work in trenches and to install spare capacity in anticipation of future development
- Minimise the amount of material to be dumped on the seabed

Time frame
- Minimise installation and decommissioning times to reduce period of disturbance.

Scheduling
- Minimise time between trenching and burial of cables and pipelines
- Schedule installation and decommissioning operations to avoid periods when disturbance of protected species is likely to have significant effects such as breeding and migration seasons.

Design
- Assess size and type of infrastructure required with reference to likely environmental impacts e.g. cable types to reduce magnitude and extent of EMFs.

Operational issues
- Avoid installation and decommissioning methods that are likely to result in noise and visual disturbance e.g. underwater explosives
- Use mitigation measures to reduce risk of pollution incidents and have contingency measures to deal with incidents should they occur
- Use mitigation measures to reduce risk of impact where noise is likely to be an issue e.g. active sound mitigation measures (bubble curtains, isolation of piles, coffer dams), soft start and marine mammal observers when pile driving.
- Reduce the magnitude and extent of the EMF by reviewing cable type and burial depths
- Consistent with legal obligations, select decommissioning options which minimise potential environmental impact.

Monitoring
- Enabling rapid response/ intervention if thresholds likely to be breached e.g. in relation to pipeline integrity, coverage of cables, noise, EMFs

Framework
- Work within existing international, European and national legislation with reference to relevant guidance e.g. MARPOL, OSPAR, SEA/AA

8.4. THE IMPORTANCE OF STRATEGIC PLANNING

Marine energy infrastructure is one of many uses competing for space in European seas. In many parts of the world the potential conflicts which arise are being identified through a process of Maritime Spatial Planning (MSP). MSP is also being used to take a more integrated and strategic approach to planning the use of our seas across different sectors, including environmental protection and nature conservation.

Potential Benefits of Marine Spatial Planning (on the basis of UNESCO/IOC[57])

Economic Benefits:

• Creation of greater certainty to the private sector when it plans new investments, often with a 30-year lifetime;
• Identification of compatible uses within the same area for development;
• Reduction of conflicts among incompatible uses and between uses and nature;
• Streamlined permitting process; and
• Promotion of the efficient use of resources and space.

Environmental Benefits

• Identification of areas of biological or ecological importance;
• Incorporation of biodiversity and ecosystem objectives at the heart of marine spatial planning and management, applying the ecosystem approach
• Allocation of space for biodiversity and nature conservation; also of space for renewable energies for climate reasons
• Provision of a planning context for a network of marine protected areas; and
• Reduction of negative impacts of human uses on marine ecosystems based on an Strategic Environmental Assessment (SEA) taking cumulative impacts into account
• Preserving the typical vast open space of the sea by keeping large areas free from concrete uses

Social Benefits

• Improved opportunities for public and administrative participation, for transboundary consultation and cooperation;
• Identification of impacts of decisions on the allocation of ocean space for certain use (or non-use) for onshore communities and economies;
• Identification and improved protection of cultural heritage; and
• Identification and preservation of social and spiritual values related to ocean use.

Within the EU, the MSFD requires Member States to develop marine strategies for their own waters, and coordinated strategies with other Member States for the Baltic Sea, North-East Atlantic Ocean, Mediterranean Sea and Black Sea. This is the environmental pillar of the EU Integrated Maritime Policy, promoting an ecosystem approach to management and the integration of environmental concerns into different policies. Maritime Spatial Planning (MSP) has been identified as a cross-sectoral tool supporting these objectives. The EU Directive 2014/89/EU establishing the framework for maritime spatial planning (MSP Directive)[58] calls on the Member States to establish and implement maritime spatial planning with the aim to support sustainable development of marine areas, applying an ecosystem approach and promoting the co-existence of relevant activities and uses. Its recital 23 acknowledges that where maritime spatial plans are likely to have significant effect on the environment they are

[57] http://www.unesco-ioc-marinesp.be/msp_faq

[58] http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0089&from=EN

subject to the SEA Directive, as well as where maritime spatial plans include Natura 2000 sites, such an environmetnal assessment can be combined with the requirements of Article 6 of the Habitats Directive, to avoid duplication.

The strategic planning for marine areas includes;

- Development of sustainable maritime activities and the protection of the marine environment based on a common framework and similar legislative implications
- Reducing the risk of spatial conflicts between expanding maritime uses, including the protection of the marine environment, in such a way that the social and economic demands on marine areas are compatible with safeguarding the marine environment and its ecological functions.
- Supporting the implementation of existing EU legislation
- A common approach providing Member States who apply MSP with an opportunity to share their expertise with others.

Experience has shown time and again that taking environmental considerations into account early on in the decision making process can lead to solutions being found when there is still a wide choice of options available. It also fosters a more open and imaginative decision making process where co-benefits and win-win solutions may be easier to identify and are less costly or onerous to implement. This also may include informal strategies and processes in advance or in parallel to formal planning procedures, such as the Integrated Coastal Management (ICM), especially in order to take into account land-sea-interactions or the use of matrices to analyse the significance of an impact.

If, on the other hand, this inter-sectoral dialogue is left to the last stages of the Article 6.3 permitting procedure the range of solutions becomes much narrower and less effective as in a spatial and sectoral overall context (and more expensive to implement) and there is a greater tendency for the discussion to become polarised and more confrontational.

The increasingly transboundary nature of many marine energy infrastructure projects is another reason why strategic planning is beneficial, ensuring a consistent approach to project level where many parties and legal frameworks are involved.

Transboundary planning is also being undertaken within the marine energy sector (e.g. North Seas Countries Offshore Grid Initiative) as well as for all sea uses (e.g. BaltSeaPlan and the TPEA project (Transboundary Planning in the European Atlantic) involving Spain Portugal, Ireland and the UK). Grid planning for offshore windfarms in the German EEZ is an example of applying a sector specific approach, incorporating environmental safeguards as key principles, and integrating this into a multi-sectoral spatial plan. A similar approach but cross-border and during the planning of options for transmission and generation would also enable cumulative impacts at a large scale to be identified and addressed before consenting.

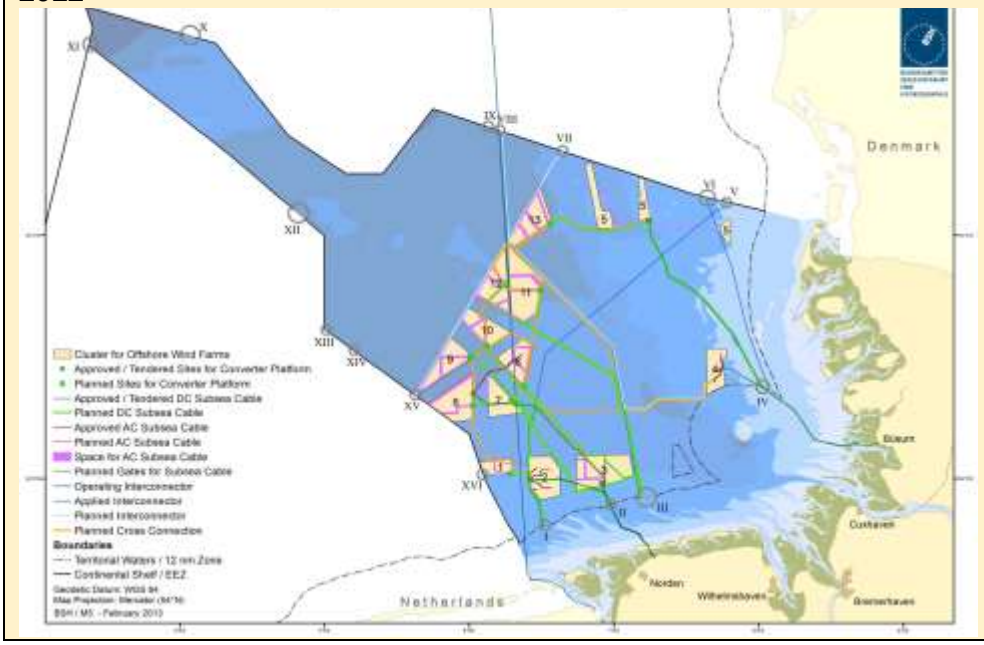
Spatial planning including designations of pipelines and cables in the German EEZ and Offshore grid planning in the German North Sea EEZ

The German Spatial Plan sets out guidelines for spatial development, alongside targets and principles for functions and uses of the German EEZ according to the German Spatial Planning Act. It includes provisions for co-ordinating the laying of pipelines and submarine cables with other activities such as shipping, fisheries, and nature conservation. Priority areas have been designated for shipping, pipelines, and offshore wind energy production and, where consistent with international law; other uses are prohibited in these areas unless they are compatible. In NATURA 2000 areas, however, wind turbines are not allowed. At the transition to the territorial sea and to the crossing of the traffic separation schemes submarine cables for the transport of power generated in the EEZ shall be routed along designated cable corridors. With the establishment of the plan a SEA has been carried out.

To minimise possible negative impacts on the marine environment when laying pipelines and cables, the plan states that sensitive habitats should not be crossed during periods of high vulnerability of particular species. Damage to or destruction of sandbanks, reefs and areas of benthic communities of conservation concern, which constitute particularly sensitive habitat are to be avoided during the laying and operation of pipelines and cables and best environmental practices according to the OSPAR Convention are to be followed. The plan has also sought to overlap designation for pipeline and windfarm priority areas.

Offshore grid connections for the windfarms are planned by the Federal Maritime and Hydrographic Agency (BSH) according to the German Energy Act. An Offshore Grid Plan as a sectoral spatial approach has been in force for the North Sea since March 2013 and is under development for the Baltic Sea. This identifies offshore wind farms suitable for bundled grid connections, sites for converter stations, routes for grid connections, cross border cables (interconnectors) and routes for possible cross connections between grid infrastructures. Planning principles in the document such as maximum bundling of cables and avoiding routes through Natura 2000 sites are aimed at reducing the area needed for grid infrastructure and lowering potential impacts on the marine environment. The plan, which was subject to a SEA set out the capacity and expected timing of offshore grid connections to be built over the next 10 years. The spatial regulations from these plans will be integrated into updated MSPs for the German EEZs of the North Sea and Baltic Sea (BSH, 2012).

Spatial Offshore Grid Plan for the German Executive Economic Zone of the North Sea 2012



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Annex 1: National and international initiatives

Examples of national legislation

This section describes examples among others of national legislation on biodiversity impacts of energy transmission facilities.

Germany
Article 41 of the German Law on Nature Protection and Landscape Conservation (Gesetz über Naturschutz und Landschaftspflege), indicates that the poles and technical components of the medium voltage cables to be constructed must be designed to protect birds from electrocution. For existing medium voltage cables with a high risk to birds, the necessary measures must be taken up to 31 December 2012 to protect birds from electrocution.

Slovakia
Under Slovakian law, article §4 of the Act No 543/2002 Coll. on Nature and Landscape Protection states (as amended): ”everyone who constructs or carries out scheduled reconstruction of overhead electricity lines is obliged to use technical solutions that prevent killing birds” and “if killing birds on electricity lines or telecommunication facilities is verifiable, the nature protection body may rule that an administrator of electricity lines or telecommunication facilities has to adopt measures to prevent killing birds”. The district or regional environmental offices give their opinion for each territorial decision or building permit (including those on electricity infrastructure). In 2007, a guidance was prepared to eliminate mortality of birds on electricity infrastructure. It contains the summary of legal tools, the description of appropriate technical solutions, both for mountainous and plain sites, and suggestions for further solutions (such as not legally binding meetings with the energy companies before the decision is made).

Spain
In Spain, regional and national laws were approved with regard to avian electrocution: decree 178/2006 (October 10th)[59] establishing rules for the protection of birds from high-tension power lines in the Junta de Andalucía, and Royal Decree 1432/2008 (August 29th)[60], establishing technical measures for high-tension power lines in order to protect birds. This national decree prevents companies from putting up dangerous power lines in sensitive areas for birds (including SPAs). This decree settles some binding technical prescriptions for the electricity pylon design, anti-collision measures, schedule of works, etc.

Implementation of international conventions
Several MS are also implementing recommendation n°110 of the Bern Convention by adopting in national legislation the technical standards for safety of power lines, planning and anti-collision measures.

Voluntary agreements and tools

[59] DECRETO 178/2006, de 10 de octubre, por el que se establecen normas de protección de la avifauna para las instalaciones eléctricas de alta tensión

[60] REAL DECRETO 1432/2008, de 29 de agosto, por el que se establecen medidas para la protección de la avifauna contra la colisión y la electrocución en líneas eléctricas de alta tensión

This section describes examples among others of voluntary agreements relative to biodiversity impacts of energy transmission facilities.

European Grid Declaration on Electricity Network Development and Nature Conservation in Europe[61]

Several European NGOs, TSOs and supporters have signed this declaration on 10 November 2011. Its main objective is to provide an agreed framework of principles guiding the stakeholders in their efforts to minimise negative impacts on the natural environment (biodiversity and ecosystems) that can arise in developing electricity transmission facilities (both above and below ground lines). The declaration includes overarching principles, principles for strategic planning (including alignment on the need for consideration of environmental concerns at the earliest stages (principle 4.1.1), the use of spatial mapping tools (4.1.4), etc.), and principles for project planning and reducing impacts of existing power lines.

The Renewables Grid Initiative[62]

This is a collaboration of NGOs and TSOs from across Europe. We promote transparent, environmentally sensitive grid development to enable the further steady growth of renewable energy and the energy transition. RGI members originate from a variety of European countries, consisting of TSOs from Belgium (Elia), France (RTE), Germany (50Hertz and TenneT), Italy (Terna), the Netherlands (TenneT), Spain (Red Eléctrica), Switzerland (Swissgrid) and Norway (Statnett), Spain (REE); and NGOs such as WWF International, BirdLife Europe, Fundación Renovables, Germanwatch, Legambiente, the Royal Society for the Protection of Birds (RSPB), Climate Action Network (CAN) Europe and Natuur&Milieu. RGI was launched in July 2009.

Accessible sky agreement[63]

On 26 February 2008, the Hungarian Ornithological and Nature Conservation Society (MME / BirdLife Hungary) signed this agreement with the Ministry of Environment and Water, and relevant electric companies in Hungary, to provide a long-term solution for the problem of bird electrocution. Under this agreement, MME produced a map in 2008 with priority areas of conflict between power lines and bird populations in Hungary. Electric companies promised a “bird-friendly” transformation of all dangerous power lines in Hungary by 2020, and the use of “bird-friendly” management methods for newly constructed power lines. In cooperation between electric companies and conservation experts, guidelines for the associated best available technology are constantly updated and new solutions are field-tested.

Budapest Declaration on bird protection and power lines[64]

This declaration has been adopted by the recent conference "Power lines and bird mortality in Europe" (Budapest, 13 April 2011). This conference was co-organised by MME/BirdLife Hungary, the Ministry of Rural Development of Hungary and BirdLife Europe. It was attended by stakeholders of European and Central Asian countries, the European Commission, UNEP-AEWA, energy and utility companies, experts, businesses and NGOs. The declaration called on all interested parties to jointly undertake a programme of follow up actions leading to effective minimisation of the power line induced bird mortality across the European continent and beyond.

Slovakian technical norm

[61] For further details, please see: renewables-grid.eu/documents/eu-grid-declaration.html
[62] For further details, please see: http://renewables-grid.eu/news.html
[63] For further details, please see:www.birdlife.org/news/news/2008/03/Hungary_powerlines.html
[64] For further details, please see: www.mme.hu/component/content/article/20-termeszetvedelemfajvedelem/1387-budapest-conference-13-04-2011.html

In 2009, the Eastern Slovakia Electricity Company issued an internal technical norm called: "Construction and amendment of aerial 22kV power lines with respect to bird protection."

The Energy & Biodiversity initiative[65]

As leading energy companies came to recognize the value of integrating biodiversity conservation into upstream oil and gas development, several of them joined with leading conservation organizations to develop and promote biodiversity conservation practices for meeting this goal. Their partnership, the Energy and Biodiversity Initiative (EBI), which began in 2001 and ceased in 2007 produced practical guidelines, tools and models to improve the environmental performance of energy operations, minimize harm to biodiversity, and maximize opportunities for conservation wherever oil and gas resources are developed.

The LIFE+ programme[66]

Life+ is the EU's financial instrument supporting environmental and nature conservation projects. Several LIFE+ projects targeted electric infrastructures impacts on birds, and in many plans protecting birds, provisions about electricity lines are included. The table below presents a non-exhaustive overview of these projects from the year 2000.

LIFE+ projects linked to electricity infrastructures and birds

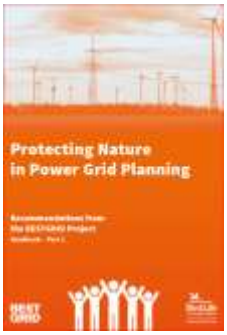
Reference	Title	MS
LIFE04 NAT/ES /000034[67]	**ZEPA eléct. Aragón - Adaptation of the electric power lines in the SPA of Aragón** The project's overall aim was to implement a strategy, devised by the government of Aragón, for the adaptation of the overhead electric power line network to the conservation needs of 16 SPAs in the region.	ES
LIFE06 NAT/E /000214[68]	**Tendidos Electricos Murcia - Correction of Dangerous Overhead Cables in Special Protection Areas for Birds in the Region of Murcia** The project implements the strategy devised by the Regional Government of Murcia for the correction of the overhead cables to the conservation needs of 5 SPAs of the Natura 2000 regional network.	ES
LIFE10 NAT/BE /000709[69]	**ELIA - Development of the beddings of the electricity transportation network as means of enhancing biodiversity** The aim of the ELIA Biodiversity project is to develop innovative techniques for the creation and maintenance of corridors under overhead lines, allowing the maximisation of their potential benefits for biodiversity.	BE

[65] For further details, please see: www.theebi.org/abouttheebi.html
[66] For further details, please see: ec.europa.eu/environment/life/
[67] Project information: ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s_ref=LIFE04%20NAT/ES/000034&area=1&yr=2004&n_proj_id=2628&cfid=5499&cftoken=4d0dc811a13b045f-7045FECB-C948-3D16-E530CBE465C8D200&mode=print&menu=false
[68] Project information: ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s_ref=LIFE06%20NAT/E/000214&area=1&yr=2006&n_proj_id=3158&cfid=5078&cftoken=60a9b7217d1cb752-60A07C25-BB06-B077-2930A6DC7B2ADB22&mode=print&menu=false
[69] Project website: www.life-elia.eu/

LIFE05 ENV/NL /00003670	**EFET - Demonstration of a new environmentally friendly high voltage overhead line** The project's aim was to demonstrate a new combination of high-voltage line and pylon that emits much lower magnetic field strengths, thereby reducing negative impacts on health and the environment	NL
LIFE00 NAT/IT /007142[71]	**Po ENEL - Po ENEL - Improvement of the habitats through restoration and/or transformation of electrical plants existing and under construction in the Po Delta Park** The main aim of this LIFE Nature project was to reduce and eliminate the risk of bird collision and electrocution in 20 areas identified as risky, involving a total of approximately 91 km of electric power lines.	IT
Other LIFE projects focus on the conservation of specific bird species and therefore include measures related to the impacts of power lines on birds, for example *Aquila heliaca* in the Carpathian basin (LIFE02 NAT/H/008627 and LIFE03 NAT/SK/000098), OTISHU on the conservation of *Otis tarda* in Hungary (LIFE04 NAT/HU/000109), ZEPA La Serena on the management of the PSA-SCI 'La Serena y Sierras periféricas (LIFE00 NAT/E/007348), Grosstrappe - Cross-border Protection of the Great Bustard in Austria (LIFE05 NAT/A/000077 and LIFE09 NAT/AT/000225), Ochrona bociana białego - Protection of the white stork population in the OSO Natura 2000 Ostoja Warmińska (LIFE09 NAT/PL/000253), etc.		

BESTGRID project[72]

Launched in April 2013, BESTGRID is made up of four pilot projects located in Belgium, Germany and the UK. During the project nine partners - TSOs, European NGOs and a research institute worked together to improve local and public acceptance for grid development processes. Objectives of the project were to enhance transparency and public participation, to speed up permitting procedures by proactively addressing or even surpassing environmental protection standards, and to encourage the implementation of constructive public engagement in permitting procedures for European energy infrastructure "projects of common interest." In the framework of the project a handbook on Protecting Nature in Power Grid Planning has been developed[73]



The European Business and Biodiversity Campaign[74]

The European Business and Biodiversity Campaign was initiated by a consortium of European NGOs and companies lead and coordinated by the Global Nature Fund in order to strengthen private sector commitment for biodiversity and ecosystem services. The campaign is supported by the European Union LIFE+ Programme. Business and Biodiversity initiatives are being developed in many parts of the world and initiated by different actors, be they non-business organisations or from businesses and business associations themselves.

The Portuguese Business and Biodiversity Initiative[75]

The Portuguese Business and Biodiversity Initiative seeks to promote, through voluntary agreements of long duration, a common ground for collaboration between these two distinct systems: business and biodiversity, which promotes the introduction of biodiversity strategies and policies of companies. Notably, guides on biodiversity impacts of energy transmission facilities have been developed among the Portuguese authority (ICNB, Institute for Nature Conservation and Biodiversity) and the Portuguese TSO and DSO.

[70] Project information: ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2863
[71] Project website: www.parcodeltapo.it/er/info/progetti.life/enel-parco/index.html
[72] http://www.bestgrid.eu/
[73] http://www.bestgrid.eu/uploads/media/D7.2_Guidelines_Protecting_Nature.pdf
[74] For further details, please see: www.business-biodiversity.eu/
[75] For further details, please see: www.business-biodiversity.eu/default.asp?Menue=132&News=70

Actions in the context of the State Nature Conservancy of the Slovak Republic[76]
The State Nature Conservancy of the Slovak Republic (expert body of the ministry of the environment) cooperates with three main electricity distribution companies (operating in east, central and west Slovakia). This cooperation, supported by the ornithological NGOs, has been strengthened by several LIFE projects. It varies from the written agreement to the strategy to eliminate threats of the 22 kV electricity power lines on birds. Setting annual plans, step-by-step identification of "priority" sections, cooperation in methodology - promoting and testing mitigation measures are some of results of long-term cooperation that was strengthened via several LIFE projects.

Relevant international nature and biodiversity Conventions and Agreements

The European Union and its Member States, as well as most other European countries are contracting parties to various relevant international environmental Conventions and Agreements. Thus, European and national legal frameworks on nature and biodiversity conservation must take full account of the commitments entered into under these Conventions and Agreements as well.

These Conventions and Agreements have helped to shape the legal framework for biodiversity policy and legislation within the EU and also helped define the relationship between the EU and other countries. The following outlines the most relevant in the context of energy infrastructures and nature conservation in Europe. Several have also adopted specific recommendations and resolutions on energy infrastructures and wildlife, notably on overhead power lines[77].

Convention on Biological Diversity[78]
The CBD is a global treaty, adopted in Rio de Janeiro in June 1992. It widened the scope of biodiversity conservation from species and habitats to the sustainable use of biological resources to the benefit for mankind. To date, 193 countries are parties to the convention.

Convention on the Conservation of European Wildlife and Natural Habitats[79]
The 'Bern Convention' came into force in 1982. It has played a significant role in strengthening the work on biodiversity conservation in Europe. It has been ratified by 45 Member States of the Council of Europe, by the European Union and by four countries in Africa. An important objective of the convention is the creation of the **Emerald Network**[80] of Areas of Special Conservation Interest (ASCIs). This operates alongside the EU Natura 2000 Network. The Bern Convention Standing Committee adopted in 2004 a recommendation (n° 110) on minimising adverse effects of above-ground electricity transmission facilities (power lines) on birds[81]. In 2011, the Standing Committee requested from the Parties to the Convention to report on a bi-annual basis the progress in implementation of recommendation n° 110.

Convention on the Conservation of Migratory Species of Wild Animals[82]

[76] For further details, please see: www.sopsr.sk/web

[77] As of 2nd July 2012.

[78] www.cbd.int

[79] www.coe.int/t/dg4/cultureheritage/nature/bern/default_en.asp

[80] www.coe.int/t/dg4/cultureheritage/nature/EcoNetworks/Default_en.asp

[81] https://wcd.coe.int/wcd/ViewDoc.jsp?Ref=Rec(2004)110&Language=lanEnglish&Ver=original&Site=DG4-Nature&BackColorInternet=DBDCF2&BackColorIntranet=FDC864&BackColorLogged=FDC864

[82] www.cms.int

The CMS, or 'Bonn Convention', aims to preserve migratory species throughout their natural range. It entered into force in 1983 and has now been signed by 116 parties. Several resolutions, recommendations and agreements signed under this Convention are relevant to the management of conflicts between migrating animals and energy infrastructures, in particular overhead power lines:

Resolution 7.4[83] of the Convention on Migratory Species (CMS) on the electrocution of migratory birds calls on all Parties and non-Parties to curb the electrocution risk by taking appropriate measures in planning and constructing lines.

Catalogue of measures contained in document UNEP/CMS/Inf.7.21.

Action Plan of the Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MoU)[84] considers power lines as principle threats to birds and formulates a Priority Action to reduce their effect. The plan aims at 'b. Promoting, as far as possible, high environmental standards, including through Environmental Impact Assessments, in the planning and construction of structures to minimise their impact on species, particularly by collision and electrocution, and seeking to minimise the impact of existing structures where it becomes evident that they constitute a negative impact for the species concerned;'
The Action Plan proposes the following four Activities regarding power lines and raptors:

- 1.4 Review relevant legislation and take steps where possible to make sure that it requires all new power lines to be designed to avoid bird of prey electrocution.
- 2.3 Conduct risk analysis at important sites (including those listed in Table 3 of the Raptors MoU) to identify and address actual or potential causes of significant incidental mortality from human causes (including fire, laying poisons, pesticide use, power lines, wind turbines).
- 3.2 Where feasible, take necessary actions to ensure that existing power lines that pose the greatest risk to birds of prey are modified to avoid bird of prey electrocution.
- 5.5 Monitor power line and wind farm impacts on birds of prey, including through analysis of existing data such as ringing data.

Agreement on the Conservation of African-Eurasian Migratory Waterbirds[85] (AEWA) calls for coordinated action throughout the migration routes or flyways. It came into force in 1999. The agreement covers 119 countries and 235 species of waterbirds. The European Community ratified AEWA in 2005.

Illustration: Guidance from UNEP/AEWA[86]

The German energy company, RWE Rhein-Ruhr Netzservice GmbH (RWE RR NSG) and the UNEP/AEWA Secretariat signed a partnership agreement at the 37th Meeting of the CMS Standing Committee (Bonn, 23-24 November 2010). As part of this agreement, RWE RR NSG provided funding for the preparation of an independent review on the conflict between migratory birds and electricity power grids in the African-Eurasian region (Prinsen *et al.* 2011) and the development of guidelines for mitigating and avoiding such a conflict (Prinsen *et al.*, 2012).

[83] E.g. available from www.cms.int/bodies/ScC/12th_scientific_council/pdf/English/Inf08_Resolutions_and_Recommendations_E.pdf

[84] www.cms.int/species/raptors/index.htm

[85] www.unep- aewa.org

[86] Both documents are available respectively from www.cms.int/bodies/COP/cop10/docs_and_inf_docs/inf_38_electrocution_review.pdf and www.unep-aewa.org/meetings/en/stc_meetings/stc7docs/pdf/stc7_20_electrocution_guidelines.pdf

At the end of 2010, the UNEP/AEWA Secretariat, also on behalf of the Convention on Migratory Species (CMS) and the CMS MoU on Birds of Prey, commissioned the preparation of the review and the guidelines to an international consortium of expert organisations. These guidelines offer various technical and legislative approaches for avoiding or mitigating the impact of electrocution and collision of migratory birds across the African-Eurasian region as well as suggestions for assessing and monitoring the effectiveness of mitigation and preventive measures.
Following formal consultations, the 5th Meeting of the Parties adopted these guidelines as Conservation Guidelines in the sense of Article IV of the Agreement (draft Resolution AEWA/MOP5 DR10 Revision and Adoption of Conservation Guidelines). The European Union is a Party to the Agreement as well as most MS. The Guidelines assist the Parties in the implementation of their obligations under the Agreement.

Agreement on the Conservation of Populations of European Bats[87] (EUROBATS) concerns the protection of all 45 species of bats found in Europe. It entered into force in 1994. Currently 32 countries have signed up. Implementation of common conservation strategies and international experience-sharing are its main activities.

Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea[88] (ASCOBANS) aims to co-ordinate measures to reduce negative impact of by-catches, habitat loss, marine pollution and acoustic disturbances among the ten parties. It was launched in 1991. A resolution on adverse effects of sound on small cetaceans, and with relevance for potential impact from energy infrastructures, was adopted in 2006.

Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area[89] (ACCOBAMS) is a cooperative framework for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its main purpose is to reduce the threat to and improve knowledge about cetaceans in these seas. The agreement came into force in 2001.

Convention of Wetlands of International Importance[90]
The 'Ramsar Convention' is an intergovernmental treaty providing a framework for national action and international cooperation for the conservation and wise use of wetlands. It was adopted in 1971 and amended in 1982 and 1987. There are to date 160 parties and so far 2006 sites worldwide have been added to the 'Ramsar' list of wetlands of international importance. The Convention does not foresee ratification by supra-national bodies such as the European Union but all Member States of the EU are contracting parties.

Convention for the Protection of the Marine Environment of the North-East Atlantic[91]
OSPAR guides international cooperation on a range of issues including the conservation of marine biodiversity and ecosystems, the impact of eutrophication and hazardous substances, and monitoring and assessment. It was launched in 1992, following of the merger of the previous Oslo and Paris Conventions (from 1972 and 1974). Several studies of potential impact of energy infrastructure on the marine environment have been initiated under the auspices of this Convention.

[87] www.eurobats.org
[88] www.ascobans.org
[89] www.accobams.org
[90] www.rasmsar.org
[91] www.ospar.org

Convention on the protection of the marine environment of the Baltic Sea Area[92]
HELCOM, or the 'Helsinki Convention', covers the Baltic Sea basin plus all inland waters in its catchment area. It was adopted in 1980 and revised in 1992. All countries around the Baltic Sea plus the EU are contracting parties.

Convention for Protection against Pollution in the Mediterranean Sea[93]
The 'Barcelona Convention' aims primarily to regulate and reduce the negative impact of all kinds of pollutants in the Mediterranean basin. It was set up in 1976 and last amended in 1995. Most countries bordering the sea have signed up to it.

North Seas Countries' Offshore Grid Initiative
The North Seas Countries' Offshore Grid Initiative is an agreement between North Seas countries on developing offshore grids, notably with the objective "to facilitate a strategic, coordinated and cost-effective development of offshore and onshore grids".

[92] www.helcom.fi
[93] www.unep.ch/regionalseas/regions/med/t_barcel.htm

Annex 2 Systematic prioritised list of impacts of bird/power line interactions (Birdlife, 2013)

Type of the Impact	Status of the Impact[1]	Severity / Significance[2]	Reversibility[3]	Scale of the Impact[4]	Cumulative Impact[5]
Negative – Ecological & Physiological					
Mortality	Direct	High	Partly reversible	Multi-national	**High**
Electrocution	Proven	High	Partly reversible	Multi-national	**High**
Collision	Potential	Moderate	Partly reversible	Regional	**High**
Habitat loss and fragmentation	Potential	Moderate	Partly reversible	Regional	**Medium**
Disturbance/ Displacement	Potential	Moderate	Partly reversible	Local	**Medium**
Electromagnetic field	Potential	Unknown	Unknown	Multi-national	**Unknown**
Negative – Economic					
Loss of income at electric utilities					
Lost revenue	Proven	High	Partly reversible	Multi-national	High
Power restoration	Proven	High	Completely reversible	Multi-national	High
Equipment repair	Proven	High	Completely reversible	Multi-national	High
Nest removal and other animal damage-control measures	Proven	Moderate	Completely reversible	Multi-national	Medium
Administrative and managerial time	Proven	High	Partly reversible	Multi-national	High
Lost service to customers and negative public perception	Proven	High	Partly reversible	Multi-national	High
Reduced electrical system reliability	Proven	High	Partly reversible	Multi-national	High
Loss of income at land-users	Proven	High	Partly reversible	Multi-national	High
Hunting & game management	Proven	High	Partly reversible	National	High
Agricultural land-use, irrigation	Proven	Low	Irreversible	National	Low
Forestry	Proven	Moderate	Irreversible	National	Moderate
Positive –Ecological					
Breeding substrate, nest site	Proven, direct	High	-	Multi-national	-
Perching, roosting and hunting post	Proven, direct	High	-	Multi-national	-
Habitat creation, management	Proven, direct	Moderate	-	National	-

(Based on McCann, 2005; APLIC, 2006 and van Rooyen, 2012 and supplemented with information from this review)

1. Status of the impact: Potential – Proven

Direct impact: Impacts on the environment, which is a direct result of power lines. For example: mortality of birds through electrocution on or collision with power lines.
Indirect impact: Impact on the environment, which is not a direct result of power lines, often produced away from or as a result of a complex pathway. Sometimes referred to as second or third level impact, or secondary impact. For example: a development changes the water table and thus affects a nearby wetland causing an impact on the ecology of that wetland.

2. Severity/significance of the impact: Low – Moderate – High

3. Reversibility

Irreversible: The impact is irreversible and no mitigation measures exist.
Barely reversible: The impact is unlikely to be reversed even with intense mitigation measures.
Partly reversible: The impact is partly reversible but more intense mitigation measures are required.
Completely reversible: The impact is reversible with implementation of minor mitigation measures.

4. Scale of the impact: Site - Local - Regional - National - Multi-national

5. Cumulative impact: Negligible - Low - Medium - High

Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the effect of power lines. For example: Several developments with insignificant impacts individually but which together have a cumulative effect, e.g. development of a power line section may have an insignificant impact on habitat use of birds, but when considered with several nearby power line sections there could be a significant cumulative impact on local ecology and landscape as power lines can form an effective line barrier between birds and their preferred habitats.
(Based on Walker and Johnston, 1999 and van Rooyen, 2012)

Annex 3 Summary of evidence on the population-level impact of power lines on globally threatened (IUCN, 2012) bird species

Species	Main impact	Location	Study period	Casualties	Conclusions	Key papers
Dalmatian Pelican *Pelecanus crispus*	Additional mortality due to collision.	Porto-Lago, Greece (Wintering ground)	1985-1987	28 killed individuals (69% 1st-year, 31% immature)	Combined with the effects of illegal shooting an estimated 1.3-3.5% decrease in breeding pairs in Greece and Bulgaria in a 3-year period.	Crivelli, 1988
Lesser White-fronted Goose *Anser erythropus*	Additional mortality due to collision.	-	-	-	May increase mortality. A potential factor, but importance unknown. Has to be taken into account in EIAs.	AEWA, 2008
Red-brested Goose *Branta ruficollis*	Additional mortality due to collision.	-	-	-	There are no quantitative data or predictive models to estimate the impact of collision mortality on Red-breasted Goose populations. A potential threat, but importance unknown.	BSPB, 2010
Egyptian Vulture *Neophron percnopterus*	Additional mortality due to electrocution.	Port Sudan, Sudan	1982, 1983, 2005, 2010	48+2+5+17 killed individuals	All birds were found under the same 31-km segment of power line. 0,055dead bird per pylon. The magnitude of the mortality is fully consistent with observed population declines in potential source populations in Israel, Syria, Turkey and Jordan, and highlights that electrocution-caused mortality may potentially have population-level effects over a broad geographic scale.	Angelov *et al.*, 2012 Nikolaus, 1984, Nikolaus, 2006
Greater Spotted Eagle *Aquila clanga*	Additional mortality due to electrocution.	Russia, Kazakhstan	1990 - 2010	6 individuals (in a 2082 km survey)	A potential factor, but significance is presumably low.	Karyakin, 2012
Eastern Imperial Eagle *Aquila heliaca*	Additional mortality due to electrocution.	Hungary	2001-2009	20 out of 90 individuals	22.22% electrocution rate of total mortality. In spite of the almost 20-year effort for bird-friendly modification of electric pylons in Hungary, electrocution is still among the most important mortality factors of several raptor species, including the Imperial Eagle.	Horváth *et al.*, 2011

Eastern Imperial Eagle *Aquila heliaca*	Additional mortality due to electrocution.	Bulgaria	2010-2011	5 out of 15 individuals	Satellite tracking showed 33% electrocution rate of total mortality.	BSPB, 2011
Spanish Imperial Eagle *Aquila adalberti*	Additional mortality due to electrocution.	Doñana, Andalusia, Spain	1974-2009	63 electrocuted individuals	39.87% electrocution rate of total mortality. Shift in the main causes of mortality between the two periods, before and after the approval of mandatory regulation against bird electrocution in the Andalucía region. After mitigation there has been a strong decrease in electrocution in both Doñana (-96.90%) and Andalucía (-61.95%).	López-López, 2011
Spanish Imperial Eagle *Aquila adalberti*	Additional mortality due to electrocution.	Doñana NP, Andalusia, Spain	1957-1989	6 adult 33 immature individuals	Responsible for 46.1% of adult mortality and 39,8% of immature mortality.	Ferrer, 2001
Spanish Imperial Eagle *Aquila adalberti*	Additional mortality due to electrocution and collision.	Spain	1989-2004	115 + 6 individuals	Electrocution caused 47.7% of the total mortality cases (probably overestimations), collision caused 2.48%. Subadults were electrocuted more frequently than expected and 1-2 cy birds were electrocuted more frequently than 3-4 cy birds. Electrocution occurred most often in autumn and winter and on temporary settlement areas.	González *et al.*, 2007
Saker Falcon *Falco cherrug*	Additional mortality due to electrocution.	Hungary, Slovakia, Austria, Ukraine, Romania	2007-2010	5 out 71 satellite tagged Sakers	7.0% proved mortality (n=71). Only proven cases have been considered for the calculation so the real numbers are certainly higher.	Prommer, Saker LIFE, 2011
Houbara Bustard *Chlamydotis undulata*	Additional mortality due to collision.	Fuerteventura, Lanzarote, Canary Islands, Spain	2008		An estimated 25.5% of the total population of the Houbara Bustard was killed in a year.	Garcia-del-Rey and Rodriguez-Lorenzo, 2011
Great Bustard *Otis tarda*	Additional mortality due to collision.	south-west Spain	1991-1993	16 individuals	4+8+4 km line sections were studied	Janss, 2000

Annex 4 Examples of impacts of power lines on meta-populations of species listed in Annex I of Birds Directive

Species	Main impact	Location	Study period	Casualties	Conclusions	Key papers
White Stork *Ciconia ciconia*	Additional mortality due to electrocution and collision.	Germany	-	In 226 cases out of 1185 ring recoveries	The cause of recoveries was 'overhead wires'.	Riegel & Winkel, 1971
White Stork *Ciconia ciconia*	Additional mortality due to electrocution and collision.	Switzerland	1984-1999	195 out of 416 dead recoveries. Sample size: 2912 ringed individuals.	Power line mortality is important for White Storks, with about one in four juveniles and one in 17 adults dying each year because of power line collision and electrocution.	Schaub & Pradel, 2004
White Stork *Ciconia ciconia*	Additional mortality due to electrocution and collision.	Central Spain	1999-2000	51 individuals were found electrocuted and 101 individuals died by collision	Ca. 1% of present storks died during post-breeding migration, while 5-7% population did during winter.	Garrido & Fernández-Cruz, 2003
Bonelli's Eagle *Aquila fasciata*	Additional mortality due to collision.	Catalonia, Spain	1990-1997	2 out of 12 breeding individuals	Collision itself accounts for 17% of the annual mortality which is a serious problem on the population level. Annual adult mortality rate must not exceed 2-6% for the population to remain at equilibrium.	Manosa & Real, 2001
Bonelli's Eagle *Aquila fasciata*	Additional mortality due to electrocution.	Catalonia, Spain	1990-1997	6 out 12 breeding individuals	Electrocution itself accounts for 50% of the annual mortality which is a serious problem on the population level. Annual adult mortality rate must not exceed 2-6% for the population to remain at equilibrium .	Manosa & Real, 2001
Eurasian Eagle Owl *Bubo bubo*	Additional mortality due to electrocution.	Switzerland	-	-	Electrocution and collision accounted for more than 50% of all the unnatural causes. The population was at a critical level. It would have depended on immigration from nearby populations after mitigating the sources of all unnatural causes of death.	Schaub, 2010
Eurasian Eagle Owl *Bubo bubo*	Additional mortality due to electrocution.	Italy	-	-	High electrocution-related territory abandonment resulting in a steeply declining, low-density population.	Sergio, 2004
Little Bustard *Tetrax tetrax*	Additional mortality due to collision.	Portugal	-	-	1.5% of the Portugese population dies by collision with overhead wires. High risk of potential avoidance of areas with transmission power lines (affecting reproductive success through limiting the size and density of leks).	Silva, 2010

Annex 5 Proposed list of priority species for prevention and mitigation of power line impact within the EU

Common name	Scientific name	Global IUCN Red List Category	Birds Directive	Casualties due to electrocution[94]	Casualties due to collision [95]	European Conservation Status[96]	Spatial scale by migration patterns (Birdlife International, 2004)
Egyptian Vulture	*Neophron percnopterus*	EN	I	III	II	Unfavourable	Long-distance intercontinental migrant
Red-brested Goose*	*Branta ruficollis*	EN	I	I	II	Unfavourable	Full migrant within Europe
Imperial Eagle	*Aquila heliaca*	VU	I	III	II	Unfavourable	Partial migrant within Europe
Spanish Imperial Eagle	*Aquila adalberti*	VU	I	III	II	Unfavourable	Resident
Saker Falcon	*Falco cherrug*	VU	I	II-III	II	Unfavourable	Partial migrant within Europe
Greater Spotted Eagle	*Aquila clanga*	VU	I	II	II	Unfavourable	Short-distance intercontinental migrant
Dalmatian Pelican	*Pelecanus crispus*	VU	I	I	II-III	Unfavourable	Partial migrant within Europe
Lesser White-fronted Goose*	*Anser erythropus*	VU	I	I	II	Unfavourable	Full migrant within Europe
Red-footed Falcon	*Falco vespertinus*	NT	I	II-III	II	Unfavourable	Long-distance intercontinental migrant
Red Kite	*Milvus milvus*	NT	I	III	II	Unfavourable	Partial migrant within Europe
Great Bustard	*Otis tarda*	VU	I	0	III	Unfavourable	Partial migrant within Europe
Cinereous Vulture	*Aegypius monachus*	NT	I	III	II	Unfavourable	Resident
Black Stork	*Ciconia nigra*		I	III	III	Unfavourable	Long-distance intercontinental migrant
White Stork	*Ciconia ciconia*		I	III	III	Unfavourable	Long-distance intercontinental migrant
Houbara Bustard*	*Chlamydotis undulata*	VU		0	III	Unfavourable	Resident
European Roller	*Coracias garrulus*	NT	I	I-II	I-II	Unfavourable	Long-distance intercontinental migrant
Booted Eagle	*Aquila pennata*		I	III	II	Unfavourable	Long-distance intercontinental migrant
Lesser Kestrel	*Falco naumanni*		I	II-III	II	Unfavourable	Long-distance intercontinental migrant

[94] AEWA-CMS, 2011a
[95] AEWA-CMS, 2011a
[96] Birdlife International, 2004

Common name	Scientific name	Global IUCN Red List Category	Birds Directive	Casualties due to electrocution[94]	Casualties due to collision [95]	European Conservation Status[96]	Spatial scale by migration patterns (Birdlife International, 2004)
White-tailed Eagle	*Haliaeetus albicilla*		I	III	II	Unfavourable	Partial migrant within Europe
Northern Harrier	*Circus cyaneus*		I	III	II	Unfavourable	Partial migrant within Europe
Golden Eagle	*Aquila chrysaetos*		I	III	II	Unfavourable	Partial migrant within Europe
Little Bustard*	*Tetrax tetrax*	NT	I	0	III	Unfavourable	Partial migrant within Europe
Eurasian Curlew	*Numenius arquata*	NT		I	II-III	Unfavourable	Short-distance intercontinental migrant
Black-tailed Godwit	*Limosa limosa*	NT		I	II-III	Unfavourable	Short-distance intercontinental migrant
Black-winged Kite*	*Elanus caeruleus*		I	III	II	Unfavourable	Resident
Lammergeier	*Gypaetus barbatus*		I	III	II	Unfavourable	Resident
Bonelli's Eagle	*Aquila fasciata*		I	III	II	Unfavourable	Resident
Purple Heron	*Ardea purpurea*		I	II	II	Unfavourable	Long-distance intercontinental migrant
European Honey-buzzard*	*Pernis apivorus*		I	III	II	Favourable	Long-distance intercontinental migrant
Black Kite	*Milvus migrans*		I	III	II	Favourable	Long-distance intercontinental migrant
Short-toed Snake-eagle	*Circaetus gallicus*		I	III	II	Favourable	Long-distance intercontinental migrant
Montagu's Harrier	*Circus pygargus*		I	III	II	Favourable	Long-distance intercontinental migrant
Osprey	*Pandion haliaetus*		I	III	II	Favourable	Long-distance intercontinental migrant
Merlin	*Falco columbarius*		I	II-III	II	Unfavourable	Partial migrant within Europe
Gyrfalcon	*Falco rusticolus*		I	II-III	II	Unfavourable	Partial migrant within Europe
Eurasian Spoonbill	*Platalea leucorodia*		I	II	II	Unfavourable	Short-distance intercontinental migrant
Common Crane	*Grus grus*		I	I	III	Unfavourable	Short-distance intercontinental migrant
Lanner Falcon	*Falco biarmicus*		I	II-III	II	Unfavourable	Resident
Ruff	*Philomachus pugnax*		I	I	II-III	Unfavourable	Long-distance intercontinental migrant
Eurasian Griffon	*Gyps fulvus*		I	III	II	Favourable	Partial migrant within Europe
Western Marsh-harrier	*Circus aeruginosus*		I	III	II	Favourable	Partial migrant within Europe
Northern Goshawk	*Accipiter gentilis*		I	III	II	Favourable	Partial migrant within Europe

Common name	Scientific name	Global IUCN Red List Category	Birds Directive	Casualties due to electrocution[94]	Casualties due to collision [95]	European Conservation Status[96]	Spatial scale by migration patterns (Birdlife International, 2004)
	arrigonii						
Eurasian Sparrowhawk	*Accipiter nisus granti*		I	III	II	Favourable	Partial migrant within Europe
Long-legged Buzzard	*Buteo rufinus*		I	III	II	Favourable	Partial migrant within Europe
Great White Pelican	*Pelecanus onocrotalus*		I	I	II-III	Unfavourable	Short-distance intercontinental migrant
Rock Ptarmigan*	*Lagopus mutus*		I	I	III	Unfavourable	Resident
Eurasian Golden-plover	*Pluvialis apricaria*		I	I	II-III	Unfavourable	Full migrant within Europe
Steppe Eagle	*Aquila nipalensis*			III	II	-	Long-distance intercontinental migrant
Common Kestrel	*Falco tinnunculus*			II-III	II	Unfavourable	Partial migrant within Europe
Peregrine Falcon	*Falco peregrinus*		I	II-III	II	Favourable	Partial migrant within Europe
Eurasian Eagle-owl*	*Bubo bubo*		I	II-III	II	Favourable	Resident
Ural Owl	*Strix uralensis*		I	II-III	II	Favourable	Resident
Tundra Swan	*Cygnus columbianus*		I	I	II	Unfavourable	Full migrant within Europe
Black Tern	*Chlidonias niger*		I	I	I-II	Unfavourable	Long-distance intercontinental migrant
European Turtle-dove	*Streptopelia turtur*			I-II	II	Unfavourable	Long-distance intercontinental migrant
Eurasian Hobby	*Falso subbuteo*			II-III	II	Favourable	Long-distance intercontinental migrant
Whimbrel	*Numenius phaeopus*			I	II-III	Unfavourable	Long-distance intercontinental migrant
Common Buzzard	*Buteo buteo*			III	II	Favourable	Partial migrant within Europe
Greater Flamingo	*Phoenicopterus roseus*		I	0	III	Unfavourable	Partial migrant within Europe
Corncrake	*Crex crex*		I	0	II	Unfavourable	Long-distance intercontinental migrant
Garganey	*Anas querquedula*			I	II	Unfavourable	Long-distance intercontinental migrant
Long-eared Owl	*Asio otus*			II-III	II	Favourable	Partial migrant within Europe
Northern Lapwing	*Vanellus vanellus*			I	II-III	Unfavourable	Partial migrant within Europe
Common Snipe	*Gallinago gallinago*			I	II-III	Unfavourable	Partial migrant within Europe
Common Redshank	*Tringa totanus*			I	II-III	Unfavourable	Partial migrant within Europe
Brent Goose	*Branta bernicla*			I	II	Unfavourable	Full migrant within Europe

Common name	Scientific name	Global IUCN Red List Category	Birds Directive	Casualties due to electrocution[94]	Casualties due to collision [95]	European Conservation Status[96]	Spatial scale by migration patterns (Birdlife International, 2004)
Whooper Swan	*Cygnus cygnus*		I	I	II	Favourable	Full migrant within Europe
Greater White-fronted Goose	*Anser albifrons flavirostris*		I	I	II	Favourable	Full migrant within Europe
Barnacle Goose	*Branta leucopsis*		I	I	II	Favourable	Full migrant within Europe
Common Tern	*Sterna hirundo*		I	I	I-II	Favourable	Long-distance intercontinental migrant
Common Quail	*Coturnix coturnix*			I	II-III	Favourable	Long-distance intercontinental migrant
Northern Shoveler	*Anas clypeata*			I	II	Unfavourable	Partial migrant within Europe
Cattle Egret	*Bubulcus ibis*			II	II	Favourable	Partial migrant within Europe
Grey Heron	*Ardea cinerea*			II	II	Favourable	Partial migrant within Europe
Grey Phalarope	*Phalaropus fulicarius*			I	II-III	Not assessed*	Short-distance intercontinental migrant
Eurasian Woodcock	*Scolopax rusticola*			0	II-III	Unfavourable	Partial migrant within Europe
Eurasian Oystercatcher	*Haematopus ostralegus*			I	II-III	Favourable	Partial migrant within Europe
Bean Goose	*Anser fabilis*			I	II	Favourable	Full migrant within Europe
Pink-footed Goose	*Anser brachyrynchus*			I	II	Favourable	Full migrant within Europe
Great Cormorant	*Phalacrocorax carbo*			I	II	Favourable	Partial migrant within Europe
Mute Swan	*Cygnus olor*			I	II	Favourable	Partial migrant within Europe
Greylag Goose	*Anser anser*			I	II	Favourable	Partial migrant within Europe
Eurasian Wigeon	*Anas penelope*			I	II	Favourable	Partial migrant within Europe
Mallard	*Anas platyrhynchos*			I	II	Favourable	Partial migrant within Europe
Great Black-backed Gull	*Larus marinus*			I	II	Favourable	Partial migrant within Europe
Herring Gull	*Larus argentatus*			I	II	Favourable	Partial migrant within Europe
Common Black-headed Gull	*Larus ridibundus*			I	II	Favourable	Partial migrant within Europe
Water Rail	*Rallus aquaticus*			0	II	Favourable	Partial migrant within Europe
Common Moorhen	*Gallinula chloropus*			0	II	Favourable	Partial migrant within Europe
Common Coot	*Fulica atra*			0	II	Favourable	Partial migrant within Europe

* species not listed in Prinsen et al., (2011a)
IUCN = Global Red List categories (IUCN, 2012)

EN = Endangered
VUL = Vulnerable
NT = Near threatened
Severity of impacts on bird populations (Haas et al., 2003; Prinsen et al., 2011):
0 = no causalities reported or likely
I = casualties reported, but no apparent threat to the bird population
II = regionally or locally high casualties, but with no significant impact on the overall species population
III = casualties are a major mortality factor; threatening a species with extinction, regionally or at a larger scale

Annex 6 Comparison of procedures under Appropriate Assessment (AA), EIA and SEA

	AA	EIA	SEA
Which types of developments are targeted?	Any **plan** or **project** which - either individually or in combination with other plans/projects - is likely to have an adverse effect on a Natura 2000 site (excluding plans or projects directly connected to the conservation management of the site).	All **projects** listed in Annex I. For projects listed in Annex II the need for an EIA shall be determined on a case by case basis or through thresholds or criteria set by Member States (taking into account criteria in Annex III).	Any **plans** and **programmes** or amendments thereof which are (a) prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to EIA Directive, or (b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC.
What impacts need to be assessed relevant to nature?	The assessment should be made in view of the **site's conservation objectives** (which relate to the species/ habitat types for which the site was designated). The impacts should be assessed to determine whether or not they will adversely affect the integrity of the site concerned.	Direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative significant effects on, amongst others, fauna and flora.	Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors.
Who is responsible for the Assessment?	It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other	The developer supplies the necessary information to be taken into consideration by the competent authority issuing the development consent	The competent planning authority

	sources as appropriate.		
Are the public/ other authorities consulted?	Not obligatory but encouraged ("if appropriate").	Compulsory – consultation to be done before adoption of the development proposal. Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project are given an opportunity to express their opinion on the request for development consent. The same principles apply for consulting the public. In case of likely significant effects on the environment in another Member State, the relevant authorities and the public of the latter have to be consulted.	Compulsory – consultation to be done before adoption of the plan or programme. The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or programme or its submission to the legislative procedure. Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned. In case of likely significant effects on the environment in another Member State, the relevant authorities and the public of the latter have to be consulted.
How binding are the outcomes of the Assessment?	**Binding**. The competent authorities can agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site.	The results of consultations and the information gathered as part of the EIA ***shall be duly taken into account*** in the development consent procedure.	The environmental report, as well as the opinions expressed ***shall be taken into account*** during the preparation of the plan or programme and before its adoption or submission to the legislative procedure.

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