Mainstreaming energy and climate policies into nature conservation

THE ROLE OF WIND ENERGY IN WILDLIFE CONSERVATION

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EXECUTIVE SUMMARY

Wind energy is one of the most efficient solutions to reduce emissions in the power sector. But in spite of its crucial contribution to avoid climate change, there may be conflicts arising between its deployment and nature conservation at a local level.

This paper provides practical information on the mitigation measures to reduce wind turbine impact on wildlife. It references these measures with real examples included in the annex of this paper. It also outlines industry recommendations on the development of wind energy in Natura2000 areas, technology innovation and how to address knowledge gaps in environmental impacts from wind energy projects.

Key messages:

- **Climate change is one of the most significant threats to biodiversity**. Rising global temperatures triggers more extreme weather. This degrades ecosystems on land and in the sea, with the consequent loss of biodiversity.

- **Wind energy and other renewables contribute to the conservation of biodiversity** by saving CO2 emissions, returning significantly more energy back to the society than it consumes over its lifecycle, consuming no water for power generation and avoiding air, soil and water pollution during operation.

- **There is a clear hierarchy of measures to follow in order to avoid or minimise impacts of wind turbines to wildlife.** These are the so-called "mitigation hierarchy**": Avoid – Reduce – Compensate - Offset.**

- **There is not a "one size fits all" mitigation option available**. The mitigation hierarchy needs to be tailored according to the site, species and season specificities and on a case-by-case basis. Mitigation measures should be commonly agreed between the wind energy developer or asset owner and the permitting authorities and need to take into account cost-effective alternatives.

- **Wind energy can be developed in or adjacent to NATURA2000 (special protected areas, special conservation areas, sites of community interests) provided that all appropriate impact assessments are done in line with European and national legislation.**

- **Member States should reconsider how they interpret the EU Birds and Habitats Directive**. Particularly, when applying a precautionary principle for halting wind energy deployment in Natura2000 or other designated areas.

- **The wind industry has contributed to the creation of a significant body of knowledge on wind turbine impacts on wildlife and supports technology innovation.** The sector encourages strategic discussions with stakeholders to better inform planning and mitigation decisions.

INTRODUCTION

There are over 160 GW of installed wind power capacity in Europe. Wind energy already meets 11% of the EU's power demand, with high penetration levels in several countries (Denmark 37%; Ireland 27%, Portugal 25%, Spain 19%; Germany 16%; UK 12%). Wind power installed more capacity than any other form of power generation in Europe in 2016, accounting for 51% of total new power capacity installations[1]. Industry is confident that technology cost will further decline provided there continues to be a robust market for renewables in the EU.

Wind energy is a reliable and affordable energy source, which benefits European electricity consumers. It also makes an important contribution in increasing energy security and reducing fossil fuel import bills. Wind energy is one of the most efficient solutions to reduce emissions in the power sector. It drives decarbonisation while contributing to economic growth in many countries proving it will continue to be a leading solution against climate change globally.

However, at a local level, conflicts may arise between renewables and nature conservation. **The wind industry makes continuous efforts to understand, document, disseminate and reduce its impacts on the environment**.

This paper outlines WindEurope's position on wind energy in relation to climate change, biodiversity and ecosystem services. The paper provides industry, policy makers and civil society organisations with relevant and practical information on:

- **The application of the mitigation hierarchy** to reduce wind turbine impact on **wildlife (Avoid – Reduce – Compensate – Offset);**
- **Best-practice supported by case study examples**;
- **WindEurope recommendations** on better integrating climate, energy and nature conservation policies.

Research on the subject is ongoing in both academic and industry for a, this paper reflects developments up to November 2017.

[1] (Wind in power: 2016 European statistics, WindEurope).

Legislative framework: energy, nature conservation and climate

The adoption in 2009 of the EU's Renewable Energy Directive (EU RES Directive) marked the commitment of the EU towards innovative energy sources. In parallel, the EU has also adopted legislation which help ensure such renewable energy developments occur with environmental protection at their heart e.g. Birds and Habitats directives.

The European Union has set itself targets for reducing its greenhouse gas emissions progressively up to 2050. The EU RES Directive sets a binding target of 20% final energy consumption from renewable sources by 2020. Renewables will continue to play a fundamental role in helping the EU meet its energy needs beyond 2020. In 2014, EU Heads of State and Government committed to new renewable energy target of at least 27% of final energy consumption in the EU by 2030 as part of the EU's energy and climate goals for 2030. Furthermore, more ambitious targets are already under discussion within the European Parliament, as the current targets do not fit to the level of ambition set in the Paris Agreement. WindEurope advocates for a renewable energy target of at least 35% RES to 2030.

At EU level, several laws protect nature and biodiversity. In particular, the EU Birds and Habitats Directives have proven to be the cornerstone for protecting Europe's natural capital. Moreover, the European Commission's guidance document 'Wind energy developments and Natura2000', supports regulatory bodies on how to ensure that the development of wind farms also in Natura2000 or adjacent areas is compatible with the objectives of the EU's Birds and Habitats Directives. On top of the above, it is mentioned that the 7th general Union Environment Action Programme to 2020 (EAP) sets a number of priority areas where more action is needed. Natural capital conservation and low-carbon economy constitute major pillars of the EAP.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. The Paris Climate agreement gives investors a clear sign that high-carbon assets are not viable in the long run and offers new opportunities for the wind energy industry both in and outside Europe.

REDUCING CLIMATE CHANGE USING WIND ENERGY

There is consensus among scientists that climate change affects biodiversity and that it is a likely to become one of the most significant drivers of biodiversity loss by the end of the century[2]. Rising global temperatures triggers more extreme weather. This degrades ecosystems on land and in the sea, with the consequent loss of biodiversity. Protecting biodiversity preserves these valuable ecosystems, which roughly capture half of the carbon dioxide emissions generated from human activities[3].

Wind energy and other renewables contribute to the conservation of biodiversity through the decarbonisation of the electricity supply, which reduces climate change globally. Specifically, wind energy:

- **Reduces CO_2 emissions.** It displaces a combination of combustion-fired plants for electricity generation which cause CO_2 and other greenhouse gas emissions. In 2016, wind energy saved 279 million tons of CO_2 (Mt CO_2) in Europe[4].
- **Returns 30 to 40 times more energy back to society than it consumes over its lifetime.** This is equivalent to a 6-12 months energy payback time depending mainly on site conditions and turbine type[5].
- **Is highly recyclable.** Most components of a wind turbine such as foundation, tower, components of the gear box and generator are already recyclable when disposed. Around 80% of the metal used in wind turbines is suitable for recycling without quality losses. Nevertheless, wind turbine blades are more challenging to recycling due to the materials used and their complex composition[6].
- **Uses no water for power generation.** Unlike wind farms, thermal power plants withdraw significant amounts of water for cooling purposes, mostly from surface water sources. The type of cooling technology[7], as well as the overall efficiency of the power plant determine the amount of fresh water withdrawn and consumed[8]. Most water is returned to the ecosystem, but often at a different temperature. This constitutes "thermal pollution" which affects organisms in the aquatic environment, particularly fish and crustaceans. Impacts could include deaths due to impingement (trapping of larger fish on screens), entrainment (drawing of smaller fish, eggs and larvae through cooling systems) and the change in ecosystem conditions brought about by the increase in temperature of the discharged water[9]. On the other hand wind power plants use very little water, mainly to wash the wind turbine blades. However in many cases rain water is enough.
- **Avoids air, water and soil pollution.** Air, water and soil are the three natural resources most vulnerable to pollution. Changes to these elements can result in long-term biological and chemical imbalances that affect the quality of the environment. Wind energy has very limited emissions of SO_X, NO_X, CO_2 or particles matter during its operation (20-25 years life time) when compared with fossil fuel technologies.

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[2] Biodiversity and climate change: Making use of the findings of the IPCC' Fifth Assessment Report, Secretariat of the Convention on Biological Diversity United Nations Environment Programme,2016
[3] UNEP, 2009
[4] WindEurope, 2017. Wind energy in Europe. Scenarios for 2030
[5] Vestas, 2016
[6] WindEurope 2017, Discussion paper on managing composites blade waste
[7] There are 3 main types: direct or once-through, wet-tower and dry cooling. In general once-though technologies are the most efficient and have a low cost of capital, wet-tower technologies withdraw less water but consume more, while dry cooling use very little water but have a high capital cost.
[8] (World Energy, Outlook, 2016).
[9] (World Nuclear Association, February 2017).

Table 1 The water-energy nexus

Energy sector	Water withdrawals (bcm)	Share of total water energy withdrawals (%)	Water consumption (bcm)	Share of total water energy consumption (%)
Power generation	**351**	**88**	**18**	**37**
Fossil fuels	230	58	13	28
Nuclear	112	28	4	8
Renewables*	9	2	1	1
Wind	0	0	0	0
Primary energy production	**47**	**12**	**30**	**63**
Coal	11	3	10	22
Oil	8	2	6	13
Natural gas	2	0	2	3
Biofuels**	26	7	12	25
Total	**398**	**100**	**48**	**100**

Source: World Energy Outlook, 2016

**Renewables include: Wind, solar PV, CSP, bioenergy and geothermal*

*** Refers to irrigated crops grown as feedstock for biofuels*

WIND ENERGY AND WILDLIFE

In spite of the crucial contribution from wind energy to avoid climate change, there may be conflicts arising between its deployment and nature conservation at a local level. Wind energy may have impacts on habitat loss or habitat fragmentation, there may be birds and bats collisions with wind turbines[10] and in the case of offshore wind energy, there may be impacts on marine mammals during the construction phase of projects. However, many of these issues are mostly solved with appropriate sited and well-designed wind farms.

In fact there is a clear hierarchy of measures to follow in order to avoid or minimise impacts of wind turbines to wildlife. These are the so-called "mitigation hierarchy": **Avoid – Reduce – Compensate - Offset.** The following section describes these steps in more detail referring them to the examples included in the annex of this paper.

Also, **national and sometimes regional strategic impact assessments** are effective ways for managing the potential impacts of wind power on wildlife and the environment. The industry supports these through allocating considerable resources into feasibility studies that clarify nature conservation interests in and around wind farm development areas. These form the basis for Environmental Impact Assessments (EIAs), which in turn determine the necessary and appropriate mitigation measures in close dialogue with authorities and stakeholders.

[10] https://awwi.org/wp-content/uploads/2017/07/AWWI-Wind-Wildlife-Interactions-Summary-June-2017.pdf

STEPS TO MINIMISE WIND TURBINE IMPACTS ON WILDLIFE

1. AVOIDANCE

The first step of the mitigation hierarchy comprises measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on biodiversity. For wind energy projects this may include taking out parts of the development area.

EXAMPLES:

- The Beinn an Tuirc onshore wind farm case study in Scotland (page 12)
- The Panachaiko wind farm case study in Greece (page 13)

2. REDUCTION

This step includes measures to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided as far as it is practically feasible (including direct, indirect and cumulative impacts). There is a number of measures available today that limit the effect of wind farms on the wildlife and are applied when necessary. More techniques are under development too. But in general, impacts to birds and their habitat can be reduced during wind farm planning and siting.

Operational curtailment has been used as a last resort measure to reduce bat collisions[11]. But this has to be commonly agreed between the wind energy developer or asset owner and the relevant authorities. A number of key factors should be assessed first: All biological, weather and climate related aspects, such as the confirmed presence of species in the wind farm area, knowledge about their behavior around wind turbines, wind speed, temperature, precipitations and timing of the day need to be fully understood. After careful analysis of all available data, tailoring the curtailment level could be proposed, but only after other more practical mitigation options have been discarded.

Measures to reduce underwater noise from piling of offshore wind farm foundations into the seabed, may include acoustic deterrent devices, soft-start/ramp-up, as well as reducing the noise propagation[12]. These measures require deep understanding of the marine environment and the complex interactions with offshore wind farms.

EXAMPLES:

- Increasing hub heights as a means to reduce bird fatalities in the North Sea (page 14)
- The application of technology innovation at appropriate sites in Greece (page 14)
- Effects of offshore pile driving on harbour porpoise abundance in Germany (page 14)
- The Pioneer Trail wind farm case study in the USA (page 15)

3. COMPENSATION

For the remaining unavoidable impacts, appropriate compensation measures must be applied, distinguishing between two types of compensation; these are referred to as “restoration compensation” and “replacement compensation”.

EXAMPLES:

- The Beinn an Tuirc onshore wind farm case study in Scotland (page 12)
- Peatland restoration at wind farm sites in Scotland (page 14)

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[11] (Edward B. Arnett, et al., Synthesis of operational mitigation studies to reduce bat fatalities at wind energy facilities in North America, 2013).

[12] Miriam J. Brandt. Et al., Effects of offshore pile driving on harbour porpoise abundance in the German Bight, 2016

4. OFFSETTING

While in some jurisdictions compensation and offset are synonyms, according to the Business and Biodiversity Offsets Programme biodiversity offsets is "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented. The goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity on the ground with respect to species composition, habitat structure and ecosystem services, including livelihood aspects*[13]".

PRINCIPLES FOR MITIGATION MEASURES

There is not a "one size fits all" mitigation option available. The mitigation hierarchy needs to be tailored according to the site, species and season specificities and on a case-by-case basis. Mitigation measures should be commonly agreed between the wind energy developer or asset owner and the permitting authorities. Industry advocates for the following principles for mitigation measures:

- **Measures should be site specific** due to different baselines, resources;
- **Mitigation measures should be commonly** agreed between the wind energy developer or asset owner and the permitting authorities and **should take into account cost-effective alternatives**;
- **Measures should be agreed on a case-by-case basis** and in dialogue with relevant stakeholders;
- **Measures should be practicable, appropriate and realistic;**
- **Measures should be flexible, dynamic and adaptive;**
- **Measures should not be considered in isolation** and should take into account the proved benefits of wind energy against the perceived and actual change to the wider environment;
- **Measures should not include no-go areas by default**. There are diverging opinions about the efficiency of exclusive protection zones for birds. Permitting authorities should not implement this as a general approach as this could create no-go areas for wind power by default.

EXAMPLES:

- The lesser kestrel case study in Spain (page 14)

AVOID RETROACTIVE CHANGES TO PERMITS

Retroactive changes to either a consented but not built, under construction or operational projects could have significant consequences on the business case or operability of a project. **Where an unforeseen or greater than assessed impact are observed or predicted the industry requests early and transparent collaboration with the relevant authorities so that the effect on the project can be appropriately considered.**

Such well-managed industry factors include but are not limited to: turbine availability, construction schedules, design and engineering options, supply chain are all factored in to the business case to ensure sound financial management of a project. Changes to any of these assumptions may have significant implications to a project and importantly if power purchase agreements are in place the stability, balancing and effective management of the electrical transmission and distribution network. Where major contracts have been placed retroactive changes can have significant impacts on the supply chain be it either changes in design, contract negotiation etc. all of which has the potential to delay project

[13] http://www.unepfi.org/fileadmin/documents/biodiversity_offsets.pdf

realisation and/or increase the cost of electricity. Furthermore, uncertainty in the development pipeline can have knock-on effects on the supply chain confidence.

WIND ENERGY IN OR ADJACENT TO NATURA2000 AREAS

Wind energy can be developed in or adjacent to NATURA2000 areas provided that all appropriate impact assessments are done in line with European and national legislation. The European Commission's guidance document 'Wind energy developments and Natura2000' clearly states that the Birds and Habitats Directives do not a priori exclude wind farm developments in or adjacent to Natura2000 sites.

Where wind farms could have a likely significant effect on Natura2000 areas, the authority determining the permit conducts a Habitats Regulations Assessment (HRA). If necessary additional mitigation measures may be required to permit the construction and operation of the wind farm.

However, many Member States choose to assert that designated Natura2000 areas are per definition 'no-go areas' for the development of wind farms. The EC's guidance document does include assessing the potential impacts of wind farm developments in designated areas. In most cases this is dealt with at a country level and based on the relevant wildlife species and their habitats.

Member States should reconsider how they interpret the EU Birds and Habitats Directive. Particularly, when applying a precautionary principle for halting wind energy deployment in Natura2000 or other designated areas. Moreover, **Governments should not apply this precautionary principle when knowledge gaps exists on the potential impacts of a specific project or a series of projects**. Particularly in the case of unknown cumulative or *in-combination* impacts**. It should only be applied in the case that it is adequately and undoubtedly documented that there is an irreversible significant negative impact on the environment and biodiversity from the implementation of a wind energy project.**

In this sense, cross-border collaboration between authorities is important to carry out overall assessment of cumulative effects across wider areas. The European Commission should therefore step up its efforts to offer appropriate advice on the interpretation that Member States give to its guidance document on wind energy and Natura2000. This would help in conciliating the achievement of climate, energy and biodiversity targets at national and EU-level.

STEPS TO FOLLOW WITHIN THE FRAMEWORK OF THE HABITATS DIRECTIVE

Paragraphs 3 and 4 of Article 6 of the Habitats Directive set out a series of procedural and substantive safeguards that must be applied to plans and projects that are likely to have a significant effect on a Natura2000 site.

1. SCREENING

The first step is to determine whether a plan or project should undergo an Appropriate Assessment. If it cannot be excluded that there will be a significant effect upon a Natura2000 site then an Appropriate Assessment must be undertaken.

2. THE APPROPRIATE ASSESSMENT

The purpose of the **Appropriate Assessment** (AA) is to assess the implications of the plan or project in respect of the site's conservation objectives, individually or in combination with other plans or projects. The Appropriate Assessment is performed by the competent authorities to determine whether or not the plan or project would adversely affect the integrity of the site concerned.

In doing so the AA should focus on the species and habitats that have justified the site's designation as a Natura 2000 site and should also consider all the elements that are essential to the functioning and the structure of that site. The appraisal of effects must be based on objective information.

3. RESULTS OF THE APPROPRIATE ASSESSMENT

The outcome of an Appropriate Assessment is legally binding. If it cannot be determined that there will be no adverse effects on the integrity of the Natura 2000 sites, even after the introduction of mitigation measures or conditions in the development permit, the plan or project cannot be approved unless the conditions of Article 6 (4) are met.

4. DEROGATIONS

Article 6(4) refers to opening a derogation procedure in the **absence of alternative solutions** and for **imperative reasons of overriding public interest (IROPI)**. If no alternative solutions exist and the adverse effects cannot be mitigated, the authorities can, in exceptional cases, decide if the plan or project should still be allowed to proceed on the grounds of imperative reasons of overriding public interest. If so, appropriate **compensation measures** must be identified and implemented to ensure that the overall coherence of Natura 2000 network is protected. It approach is done on a -by-case basis by the public authorities.

INNOVATION AND KNOWLEDGE GAPS

The industry supports technology innovation such as the development of high resolution visual/thermal cameras and avian radars that could improve monitoring of bird and bat activity around wind turbines. Deterrent devices could also help birds and bats to avoid wind turbines in some locations. These technologies could be used in specific locations and depending on site circumstances. Nonetheless, many are in a trial phase and are unproved in real world applications, especially in the case of bats and the marine environment. Therefore, governments should not impose mitigation measures by picking technology winners and losers, but by ensuring diligent research. That would ensure that the most appropriate technologies will evolve.

The wind industry has contributed to the creation of a significant body of knowledge on wind turbine impacts on wildlife. It has done so by performing pre-construction, construction and post construction monitoring. Several leading utilities have financed R&D activities on environmental protection and wind power over the years. Such, also looking at birds, bats and marine mammals. The amount of money allocated is in addition to the cost of the EIAs and the cost of the mitigation associated environmental monitoring programmes. Such contributions from the industry, as well as those made by public institutions, have increased the knowledge on birds and their behaviour around onshore wind turbines.

Developers and regulators should fully use this information to ensure EIA and HRA are as accurate as possible. They should also apply a pragmatic approach to the precautionary principle and check that mitigation measures are cost-effective and tailored to site-specific conditions.

Two examples of research projects are:

- **The DEPONS project** is an industry initiative that will bring new insights into the North Sea harbor porpoise in responses to underwater piling noise as well as their small and large-scale general movement patterns. This information will be fed into a model, which will provide an evidence-based framework for the assessment of wind farm underwater noise impacts[14].
- **The INTACT project** is a joint industry and government project developing measures and procedures to reduce the risk of bird – wind turbine collisions. It will test promising deterrent measures (contrast painting rotor blades, contrast painting tower bases, UV lighting, operational mitigation) and test and refine GIS-based micro-siting tools[15].
- **The Offshore Wind, Offshore Renewable Joint Industry Project (ORJIP)** was set up in 2012 by the UK Department for Business, Energy & Industrial Strategy, BEIS (then DECC), The Crown Estate, Marine Scotland and 16 offshore wind developers. The objective of ORJIP is to reduce the consenting risk for offshore wind farm developments funding research projects to better inform consenting authorities on the environmental risk of offshore wind.[16]

BEST PRACTICE SUPPORTED BY CASE STUDIES

The Beinn an Tuirc windfarm, Scotland case study

Appropriately sited and well-designed wind farms are unlikely to present a significant threat to bird populations. As mentioned in the previous section, mitigation should first begin in the planning phase when selecting a location for a wind farm, which should be in accordance with SEA, EIA, Habitats Directive and relevant national legislation. The authorities and the industry should identify appropriate mitigation solutions and develop these in line with the principles of environmental protection and conservation after consent is awarded. Sarah Rankin and Peter Robson, Senior Ecologists at ScottishPower Renewables made an Analysis of the Golden Eagle flight activity at Beinn an Tuirc windfarm 1997-2014, dating from February, 2016.

This analysis is an example of preventive planning, avoiding sensitive species and successfully implementing a Habitat Management Plan (HMP) as a form of mitigation is the Beinn an Tuirc onshore wind farm, located in Scotland. The wind farm has a total capacity of 30 MW and its construction started at the beginning of the year 2000. During the EIA process, a golden eagle territory was identified close to the wind farm, which led to a relocation of the wind farm site further to the south. Due to the proximity of the golden eagle, the developer, Scottish Power Renewables (SPR), was required to implement a HMP.

The HMP covers 1670 ha and involves the restoration of habitats to provide an alternative foraging area away from the main wind farm site. Comprehensive monitoring of the eagles was carried out prior to construction, during construction and during the operation of the windfarm. The developer investigated the response of the eagles to the presence of the wind farm and identified whether the mitigation measures were effective.

Results of the monitoring work carried out between 1997 and 2014 show that the eagles have neither collided with the turbines nor have they been displaced due to disturbance. They have shown no detectable change in the territory occupied. The removal of forestry from the area and subsequent restoration to heathland/blanket bog may have contributed to the eagle's success by expanding available habitat within their preferred hunting territory.

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[14] For more information on the project please go to: http://depons.au.dk/

[15] http://www.nina.no/english/Research/Projects/INTACT

[16] https://www.carbontrust.com/offshore-wind/orjip/

Aedán Smith, Head of Planning and Development at RSPB Scotland, said: "This pioneering 20 year study, which has helped assess the impact on golden eagles at Beinn an Tuirc windfarm, and the mitigation measures put in place for these birds by Scottish Power Renewables have been very much welcomed by RSPB Scotland. This study is a good example of a windfarm operator taking its responsibilities to the surrounding wildlife seriously and we need to see more long term studies of this sort taking place at operational windfarms across Scotland. Windfarms are a vital part of tackling climate change but they must be carefully sited to ensure that they pose as minimal a risk to wildlife and important habitats as possible, and that they are monitored to ensure any unforeseen impacts are identified and resolved."

More details on the golden eagle case study can be provided upon request.

The Burgenland region, Austria case study

Another example where the siting of wind farms have worked successfully took place in Burgenland, a federal state of Austria. In the northern part of Burgenland one of the biggest steppe lakes of Europe is situated; the region is equally one of the most important bird areas in Austria. This region presents a high wind energy resource potential, having some of the best sites to develop wind power in Austria.

With a clear commitment from policy makers for wind energy, a regional framework concept that acted as a planning instrument and inclusive stakeholder consultation processes, the region became a real success story in terms of wildlife and wind turbines co-existence. The planning instruments used refer to the zoning of suitable areas for wind power plants in an attempt to minimize predictable environmental impacts within the region.

This approach had several other beneficial effects, among them a high degree of planning reliability for operators of wind power plants and communities, a simplified decision making procedure for the provincial authorities and transparency for conservation organizations and the local population[17].

In only ten years, Burgenland built up enough wind power to cover 140% of the federal state electricity demand. The region is famous for the big number of migrating birds but also for the habitat of the sea eagle (*Haliaeetus albicilla*), the imperial eagle (*Aquila heliacal*) and the bustard (*Otis tarda*). Twenty years ago, both eagles have been extinct in whole Austria and the bustard was reduced to only 60 animals in total. Today both eagles have returned to this region (*H. albicilla* 48 breeding birds; *A. heliacal* 36 breeding birds) and the bustard population has grown up to 500 birds.

This sensational development of these bird populations was possible despite today's wind power capacity of 900 MW in this small region, with one of the biggest wind parks in Europe. The NGO World Wildlife Fund (WWF) provided a detailed analysis of this case study.

The Panachaiko wind farm, Greece case study

Another case of an appropriately sited wind farm inside a Natura2000 site is Panachaiko wind farm (southern Greece, Peloponnese region). The wind farm was installed in two phases (2006 and 2009), totals 48.45 MW (57 X 850 kW) and until October 2017 constitutes the largest wind farm inside a Natura2000 site in Greece.

During the development of the project, special ecological studies and bird surveys were conducted. Priority habitats and an aesthetic forest were identified under this process and excluded from any infrastructure work (platforms, roads etc.). After 10 years of operation, the outcomes of the yearly bird monitoring conducted have shown no collision incidents and no habitat displacement of the bird species.

More details on the Panachaiko wind farm case study can be provided upon request.

[17] WWF, Burgenland - a Best Practice example for a sustainable development of wind power in Austria, 2014

The lesser kestrel case study, Spain

An example that supports the identification of mitigation on a case by case basis is the unique mitigation developed at three wind farms in central-east Spain, operated by Iberdrola Renewables, Cerro del Palo, Cerro Calderon and La Muela I, in order to avoid or minimize lesser kestrel fatalities.

One specific mitigation measure used at the three wind farms was to superficially till the base (to eliminate weeds) of a number of wind turbines on each windfarm. After implementing this, monitoring happened during 2015 and 2016 with the aim of comparing the number of fatalities at tilled and non-tilled wind turbines. By limiting the presence of vegetation at certain turbines, the abundance of potential prey (insects) was reduced.

After monitoring the effects of the mitigation measure, data showed that turbine collisions with the lesser kestrels went down by 75% to 100% in all of the three wind farms. In fact, there were no collisions registered between 2015 and 2016 in the wind turbines with active mitigation. The results indicate that this mitigation measure is effective in reducing the number of raptor collisions, especially of insectivorous species.

More details on the lesser kestrel case study can be provided upon request.

Increasing hub heights as a mean to reduce bird fatalities, North Sea

In the North Sea, another specific mitigation measure used is raising hub heights. In a few instances predicted seabird collision risk has been highlighted as a potential constraint on windfarm development. In theory, an increase in the design clearance of turbines above sea level could reduce collision risks potential and help minimize these constraints.

The need for such mitigation has an additional consenting, engineering and cost implications that could potentially be offset by more powerful wind resource present at greater heights above sea level. The projects Hornsea 2 and East Anglia 3 in the North Sea have recently agreed consent conditions increasing the design clearance of at least some turbines within the array.

Peatland restoration at wind farm sites, Scotland

Another example of how project developers could compensate for disturbing the natural habitat due to wind farm development is the involvement of ScottishPower Renewables, a leading developer of windfarms in the UK with over 1 GW of installed capacity, in its restoration of peatland habitats on windfarm sites.

Acknowledging the sensitivities of development in some locations, ScottishPower Renewables has made a commitment to restore peatland habitats covering over 8000 ha across its windfarm sites[18]. Early results show that the techniques used have been successful in rehabilitating the peatland habitat.

The application of technology innovation at appropriate sites, Greece

An example of implementing technologically innovative mitigation measures is the case study of a 28.9 MW wind farm (34 X 850kW), located in northern Greece. Particularly, the wind farm is installed on Vanrountas Mt, next to Prespa Lake, which involves two Natura2000 sites, as well as a Ramsar wetland.

Due to the presence of the 20% of the global population of Dalmatian pelican (Pelecanus crispus) and Great white pelican (Pelecanus onocrotalus) in the broader area, and especially due to the fact that the

[18] http://www.iucn-uk-peatlandprogramme.org/peatland-gateway/gateway/case-study/bringing-back-blanket-bog-restoring-peatland-habitats-windfarm-s

pelicans use the wind farm site as one of their frequent passages to other wetlands, an automatic collision avoidance system was installed on 2013.

The system uses high accuracy cameras to identify the pelicans that fly in the area and in case of flying inside the risk collision area activates warning sounds and/or the stoppage of the wind turbines. During the monitoring period, no collisions have been detected.

Effects of offshore pile driving on harbour porpoise abundance in the German Bight

This study analyses the effects of the construction of eight offshore wind farms within the German North Sea between 2009 and 2013 on harbour porpoises (Phocoena phocoena). It combines porpoise monitoring data from passive acoustic monitoring using Porpoise Detectors (POD data 2010-2013) and aerial surveys (2009-2013) with data on noise levels and other piling characteristics. These data were analysed in detail in connection to pile driving activities, most of which occurred with application of noise mitigation techniques in order to reduce disturbance effects.

The full study can be accessed here: http://bioconsult-sh.de/site/assets/files/1573/1573.pdf

The Pioneer Trail case study, USA

An example of good cooperation between the permitting authorities and the industry in order to establish the appropriate mitigation to avoid bat collisions is the mitigation protocol developed for the Pioneer Trail wind farm, a project owned by E.ON in North America. The project comprises 94 x 1.6 MW turbines with a total capacity of 150.4 MW in Paxton, Illinois that entered commercial operation in January 2012.

During the development phase, a colony of Indiana bats[19] appeared several kilometres from the project site. Mortality peaks associated with wind turbines are believed to occur shortly before and during autumn migration[20]. Therefore, negotiations for obtaining the building and operation permit involved the United States Fish and Wildlife Service (USFWS).

As part of the agreed mitigation protocol and in order to get the permit, the following pre-conditions were established: feathering and increasing the cut-in speeds during migratory season, intensive baseline monitoring during early operational years and ongoing monitoring and count requirements during specific time periods. The reason to implement these measures was to prevent potential fatalities of endangered bat species migrating through the area.

The industry would like to stress that a curtailment order, when issued, is very site and project specific. Therefore the curtailment conditions that may be developed in the US, for example, would not necessarily be applicable or suitable for European projects, where the wind speeds are different, the present bat species are different, the size of wind farms is different as well as the weather and climate conditions. Any discussions regarding curtailment conditions for a particular site should be held between the project developer and the relevant permitting authorities.

More details on the Pioneer Trail case study can be provided upon request.

Should you have further input please notify us at Sustainability-Platform@windeurope.org.

[19] The Indiana bat is listed as an endangered species by the USFWS
[20] Karst Worlds: January 2012. Researchers to check health of Illinois bats. 20 January 2012.