Views & Experiences

# Environmental Assessment for Wind energy

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Netherlands Commission for Environmental Assessment

# Introduction

Onshore and offshore wind power are fast-growing sources of renewable energy that can help in mitigating climate change. Wind energy is also associated with adverse environmental and social impacts.

This *Views & Experiences* publication outlines how Strategic Environmental Assessment (SEA) and Environmental and Social Impact Assessment (ESIA) can help in avoiding and mitigating impacts associated with wind energy on land and at sea.

## A fast growing market

**Wind power is considered as one of the key technologies in addressing some of today's greatest challenges like energy security, climate change, and other negative consequences from air pollution (UNEP 2016).**

In 2022, renewable energy sources accounted for 29,1% of electricity generation globally, and since 2010 the largest growth in this renewable electricity has been driven by solar and wind energy (IRENA 2024). By 2050, wind power is expected to supply more than one-third of total electricity demand, representing a nearly nine-fold rise compared to 2016 (IRENA 2019). After several leading countries in Europe, large investments are being made in other regions like Asia (especially India and China) and North America. Africa is expected to be a key market for rapid onshore wind deployment in the next three decades. This growing interest in wind energy is causing rapid technology developments; in the last 20 years, the turbine capacity raised from 500 kw to 5 or 6 MW for onshore wind farms and from 1 MW to 20 MW for offshore wind farms. At the same time, also the turbine and blades increased in size significantly. It is therefore important to understand the issues linked with wind energy facilities and address these in their planning and operation.

# Issues
# linked with wind energy

A wind power plant is not only constituted by the turbines and their foundations but also by the internal cabling and an electrical substation. From the substation a connection is made to the (mostly national) high power grid. In particular for offshore, this connection and the landing and substation onshore is sometimes included in the project and sometimes excluded.

The production, construction, operation and decommissioning of wind energy facilities, and its associated infrastructure can have both positive and negative environmental and social effects. Especially when multiple facilities are situated in close proximity to each other, the cumulative impacts thereof need to be well understood and addressed. Several guidance documents and key references exist for the planning and impact assessment of wind energy (see page 10). The following issues are often reported:

***Noise* |** Most offshore turbines are placed on monopiles. Hammering of monopiles into the seabed creates high noise levels which can have a devastating effect on nearby benthos and to sea mammals even on large distances.

***Nuisance* |** In particular onshore wind turbines create a certain degree of noise and shadow flickering which can cause nuisance to dwellings in the surroundings. This is sometimes linked to health issues as well.

***Visual impacts* |** Onshore and near shore wind farms tend to require more space than other forms of power generation. Their presence may be perceived as disturbing the character of land- and seascapes and lead to a decline in the value of land and assets.

***Biodiversity* |** The removal of vegetation for wind farms and maintenance of roads for operations can lead to the loss, degradation and fragmentation of natural habitats. Most onshore wind farms are placed in one line, often forming a barrier to the movement of birds and bats. The blade rotation of turbines and transmission lines can expose birds and bats to the risk of collision and electrocution.

Offshore, this barrier and collision impact can be much bigger since offshore wind farms are often considerably larger than onshore wind farms. This can lead to a significant decline in coastal breeding birds as well as migrating birds and bats. Some fish may be negatively affected by electrical radiation coming from the cables. Also, offshore wind farms may change hydrodynamic and morphological conditions of the seabed and potentially affect benthic communities and fish species.

***Impact on other users and functions |*** Offshore wind farms may influence or hamper existing or future perspectives of other functions of the sea. These functions include ferry routes, shipping lanes (collision risk of boats), fishing areas, aviation, nature protection areas, electrical and data cables, oil and gas explorations and military exercise zones. Onshore wind farms may impact existing or future housing areas, roads, railways and other infrastructure.

***Resource use |*** Depending on the model, wind turbines tend to be predominantly made of steel (66-79%), followed by fibreglass, resin or plastic (11-16%), iron or cast iron (5-17%), copper (1%) and aluminium (0-2%). Possible re-use (circularity) of these materials should preferably be an important element in decision making. Although most common wind turbines do not rely on them, some have permanent magnets that contain the rare elements neodymium and dysprosium. Mining of these materials can have significant effects on natural habitats or human health in other parts of the world.

***Social resistance |*** When placed near residential areas or where the space is competing with other uses like fisheries, wind farms can meet opposition. Especially when residents nearby wind farms face negative impacts, whilst they do not benefit from the initiative, social resistance may be fierce.

**Possible negative impacts, associated with wind energy**

noise

nuisance

visual impacts

biodiversity loss

resource use

other users and functions

social resistance

# Avoiding and mitigating **impacts of wind energy**

Negative effects of wind farms can to large extent be avoided or mitigated with the help of SEA and ESIA. Both tools inform strategic plans and projects in relation to siting, technology and design, as outlined in Table 1
(page 11).

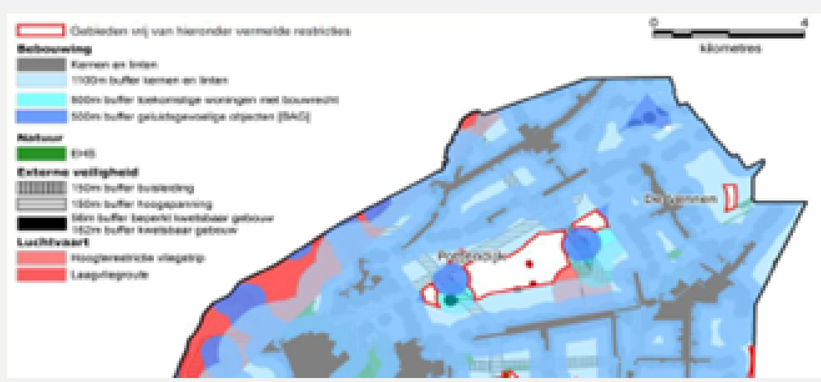
## Selecting the right location

Many negative impacts of wind farms are associated with their location. This is for example because onshore areas with high wind energy potential often correspond with habitats or migratory corridors for birds and bats. Or because local communities living in the vicinity of the wind farm do not feel heard in decision making.

SEA helps selecting the right location at the early policy and planning stages. It does so by informing decision makers about which areas are suitable or should be eliminated due to conflicting uses or need for resettlement, biodiversity values, social sensitivity or other outstanding values or risks. An SEA process helps defining the criteria that guide and ease the selection of locations and provides the framework for the subsequent ESIAs and potential resettlement.

*Example of a constraints and opportunities map (or sensitivity map) showing suitable areas for wind energy (white areas surrounded by red line) whilst eliminating others.*

ESIA report for Wind energy Emmen 2015)



## Good design and mitigation

SEA generates information to define conditions and standards to design wind farms in a way that impacts are maximally reduced. This can for example relate to the (maximum) number of turbines and their heights, the minimal distance to residential and/or sensitive areas, and their integration into the surrounding landscape.

Once the location for a wind farm is selected, the next step is to come to a good project design. During this phase, an ESIA can compare different alternatives on siting of the turbines and power lines, numbers, technology, sizes, heights, and layout of turbines. For onshore wind, this information can help determine more precisely what distance to houses will avoid or minimise nuisance and will ensure adherence to prevailing noise and shadow flicker norms. It can also show the best micro-siting choices in relation to the routing or burying of power lines, or what adaptions in the configuration of wind turbines will reduce the risk of collision and barriers to species' movement.

For offshore wind, noise criteria may lead to new installation techniques of monopiles.

Also, appropriate monitoring techniques, detection or radar technologies and temporarily stopping energy production when migrating birds are passing are measures that can be considered to minimize collision risks and impacts on bats and birds.

The ESIA informs authorities about the acceptable impact boundaries, measures that are appropriate to avoid and mitigate impacts, and about the indicators to monitor these impacts when the wind farms are operational.  Mitigation measures may include detection or radar technologies and procedures for shut down of the turbines during bird migratory periods or actual bird activity.

In addition, making turbines visible to birds, marking transmission lines with bird diverters, acoustic deterrents are other possible strategies to reduce the numbers of collision. And finally, in the ESIA process, proposals for sustainable sourcing and the recovery and reuse of materials can be integrated.

*Wind turbine with a detection system at the windpark Krammer in Province Zeeland. The turbines shutdown whenever a bird, such as the protected white-tailed eagle, is within 600m range from a turbine.*

(Source: Omroep Zeeland 2022)

## Improved dialogue and decision making

By establishing a positive dialogue with stakeholders in the early stages of developing plans and projects, policy makers and project owners will be able to take stakeholder views, interests and concerns into account in key decisions. Well organised participation in SEA and ESIA processes can contribute to better design, more social acceptance and a feeling of local ownership of wind energy projects. SEA and ESIA processes can also be used to compare and discuss the different options of local participation and benefit sharing in the operation phase of a wind farm.

In the Netherlands, the Dutch Climate Agreement (2019) included a chapter on public participation in renewable energy projects and established the aim for a share of 50% of citizen ownership in onshore renewable energy projects. As a result, various approaches to (financial) benefit sharing can now be observed across different initiatives, varying from local ownership, local shareholders, to combined ownership with a wind developer.

### Circularity in offshore wind farms

In ESIAs more and more attention is given to circularity. The construction of a windfarm and the wind farm itself requires a wide variety in materials of which some materials are not available on earth in large quantities. Since a few years offshore wind permitting in the Netherlands has included circularity as a selection criterion for developers boosting the market to ensure these possibilities.

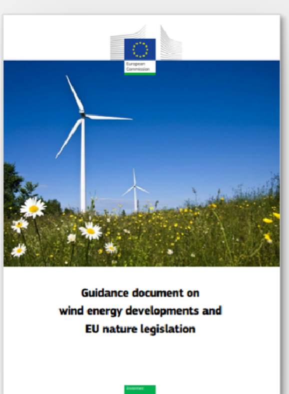
# ESIA and SEA for offshore wind **in the Netherlands**

A national policy target of the Netherlands is to increase offshore wind capacity in the Dutch Exclusive Economic Zone to 70 GW by 2050.

This requires the installation of a large number of wind turbines in wind farms (varying between 700 MW to 2 GW in capacity). These wind farms will take a lot of space on the North Sea and may, during operations, lead to adverse effects on the ecology both above water (like birds/bats) and under water (like sea-mammals and benthos).

Through both SEA and project ESIAs, maximum impact boundaries have been set to ensure the long term protection and improvement of species under and above water. For instance, noise restrictions for hammering monopile foundations became much stricter over the years. Bat and bird monitoring systems and protection measuresincreased substantially to ensure sustainable ecological ecosystems. Through permitting rules and requirements for type of foundations, the Government of the Netherlands has even been able to ensure the increase of endangered benthos species.

*Some authoritative resources on wind energy development*

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| Main decisions | Added value of impact assessment |
|---|---|
| **National policies (energy development)** | **Strategic Environmental Assessment** |
| • Energy supply mix and the role of renewable energy<br>• National goals and targets for wind energy<br>• Ambitions and goals for sustainability in the energy sector | • Assess goal attainment under different energy mix alternatives<br>• Analyse consistency, synergies and trade-offs with other policies<br>• Provide information on spatial, environmental and institutional constraints and opportunities<br>• Engaging stakeholders in early decision making<br>• Finding gaps, conflicts or synergies in the regulatory and policy framework |
| **National and regional plans for renewable or wind energy** | **Strategic Environmental Assessment** |
| • Mapping and preliminary selection of areas for wind energy development<br>• Regional targets for energy production in the different areas<br>• The framework of principles for development (size/design of wind farms, spatial integration, collaboration, stakeholder engagement etc.)<br>• Sustainability ambitions (e.g. on landscape, nature and social/financial benefits, circularity) | Inform the selection of suitable locations by showing social, environmental, physical and safety constraints and opportunities<br>• Reveal gaps in norms, standards and regulations that need to be put in place<br>• Inform principles and sustainability ambitions for development: e.g. : minimal distance to dwellings and between the turbines, possible mechanism for financial benefit sharing (onshore); minimum distance to other functions at sea, maximum noise levels (offshore)<br>• Assess cumulative impacts<br>• Highlight main social and environmental concerns and provide a framework for doing ESIAs at project level<br>• Engaging stakeholders in early decision making |
| **Wind energy projects** | **Environmental and Social Impact Assessment** |
| • Selection of the site and design<br>• Project target for energy production<br>• Benefit sharing agreements with local communities | • Eliminate areas for siting based on environmental and social perspectives and conflicts with other functions<br>• Engage surrounding communities in design and mitigation for more local ownership and acceptance<br>• Study different alternative turbine positioning, size, heights, numbers to inform final design on:<br>◦ The lay-out that fit best in the surrounding landscape<br>◦ The minimal distance to dwellings and type/size of turbines to avoid or minimise nuisance from noise or shadow flicker<br>◦ How to avoid/minimise bird and bat collisions and (offshore) benthos, fish / sea mammals disturbances<br>◦ Maximise positive impacts<br>• Define specific mitigation, compensation and offset measures to adhere to required norms and standards for noise, shadow flicker, biodiversity:<br>◦ Curtailment agreements<br>◦ Noise management agreements (changes in stance and speed of blades) |

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