The Rich North Sea

Impact assessment of Offshore windfarms in the Netherlands

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MEMORANDUM

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1 INTRODUCTION

De Rijke Noordzee (English: The Rich North Sea) is a non-profit program focused on promoting nature enhancement and biodiversity in the construction and management of offshore wind farms. Since the start of the program in 2018, they have contributed to this objective through pilot projects, collaborations, and knowledge sharing, including internationally. For this purpose, an overview and analysis Dutch Environmental Impact Assessments for offshore wind has been drafted in this memo.

Objective

The objective of this memo is to detail the process of Environmental Impact Assessments (EIA) for offshore wind farms (OWFs) in the Netherlands regarding the nature-component, and to provide insight into the methods which are used to assess effects of OWFs on marine biodiversity. An overview of the governance (paragraph 2.1) and relevant legislation (paragraph 2.2), the methods used for several specific effect analyses (paragraph 2.3), and the way in which this leads to mitigating negative effects of OWF development (paragraph 2.4) is provided.

In addition, an overview is given of the necessary expertise, general timeline, and associated costs with these kinds of assessments (paragraph 2.5). Lastly, pros and cons of this approach are provided (chapter 3).

Table 1.1 Definitions used in this memo

Abbreviation	Term	Explanation
ALI-norm	acceptable level of impact	the ALI-norm refers to a threshold used in environmental assessments for offshore wind farms. It ensures that the cumulative impact of these projects does not adversely affect protected species over a 40-year period
EIA	Environmental Impact Assessment	report detailing the impact of a specific project on the environment. This report is required for permit application with substation environmental impacts. It includes a large number of environmental effects, including impact on nature and biodiversity
EMF	electromagnetic field	areas of energy created by electric charges, combining electric and magnetic forces that travel as waves, generated by both natural sources (Earth's field) and human-made devices like power cables
KEC	translated: Framework Ecology and Cumulation	Dutch framework to assess the cumulative impact of the Dutch rollout of offshore windfarms on protected species
MSFD	Marine Strategy Framework Directive	European legislative framework aimed at protecting the marine environment
OWF	offshore windfarms	group of wind turbines installed offshore

2 NATURE ASSESSMENT WITHIN AN EIA

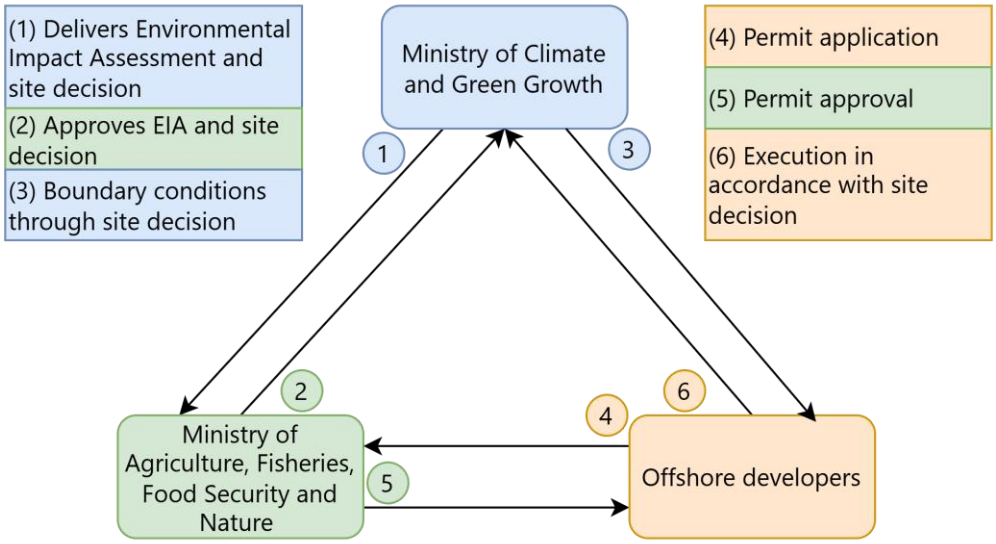
2.1 Governance and overarching process

The Netherlands has a unique set-up when it comes to EIAs for OWFs. The Dutch government is heavily involved in the EIA process and defines the scope of the EIA, including which location of the OWF to assess, what the required power output is, which turbine types could be used (for example 15 - 25 MW) and which foundation types could be used (for example monopile or jacket). A consultancy firm then performs the necessary research, and writes the EIA. This results in a bandwidth-EIA, in which the effects of the different alternatives are assessed (worst-case). Based on this, it is determined whether environmental effects occur, in which alternatives this is the case, and whether these effects are acceptable or require mitigation. This process is finalized in with site decision, which ultimately makes the boundary conditions the OWF must comply with definitive. In this way, the Dutch Government sets the boundary conditions for OWF development. At the same time, this gives the developer of the OWF a certain degree of freedom: developers can optimize the turbine types or exact layout of the wind farm, as long as they remain within the conditions of the site decision.

In the Netherlands, the Ministry of Climate of Green Growth initiates the EIA process. The EIA is approved by different ministries, chief amongst which is the Ministry of Agriculture, Fisheries, Food Security and Nature (figure 2.1). The EIA and draft site decision are released to the public, to allow for consultation. This allows for NGO’s, industry parties, or other stakeholders to provide input. They can put special emphasis on certain topics or correct for oversights during the EIA process.

The topic of nature is only one topic within the EIA, alongside topics like safety, archaeology, and other human use (not part of this memo).

Figure 2.1 Simplified overview of governance of offshore wind farm development in the Netherlands, with steps indicated in numbers



2.2 Process of nature assessment within an EIA

To be able to perform a nature assessment within an EIA, the following steps are usually taken:

1 **definition of the project**: this includes its objective, the location, and the bandwidth of alternatives;

2 **application of law and policy frameworks**: in this section, relevant policy and legal frameworks in the context of the project are listed. This includes area-based protection (relevant protected areas, nature reserves, National Parks, and their ecosystem components) and species protection (under national and international legislation). For this, an objective assessment framework is established for the project. Here we set clear definitions for acceptable and unacceptable effects, at an early phase of the project. We ask the client whether they agree with these definitions before we start the research. This allows for a more objective and transparent impact assessment. An example of such an assessment framework is provided in table 2.1;

3 **effect range**: based on the description of activities, the expected effects are defined and discussed in terms of intensity, spatial extent (area where an effect occurs), and duration (length of time the effect lasts), per project phase (pre-construction, construction, operation and maintenance, and decommissioning). Only the protected areas and species within the effect range will be included in the assessment;

4 **current state of natural values**: for each ecosystem component or species that may be affected by the development of the OWF, the current status as well as the historic trend is provided. This section is divided into:
- abiotic and ecosystem functioning;
- benthos, including reef systems;
- fish, including rays and sharks;
- marine mammals;
- birds;
- bats;

5 **impact-effect relationships:** now the specific protected species which may be impacted have been identified, we zoom in on specific impact-effect relationships. An overview of such relationships is provided in table 2.2;

6 **impact assessment**: based on the best available literature and methods, the impacts on protected areas and species are assessed. It is established how severe the impact on the species is, whether this can cause or further pressure a species or habitat in decline, and whether national and international laws and regulations are being violated. An example for this is given in paragraph 2.3.2;

7 **cumulative effect analysis**: in this step we cumulate the effect of the offshore wind project with the effects of other projects. Projects are included in the cumulative impact assessment when they have not been executed yet, but the expected effects overlap in time and/or space (see textbox in paragraph 2.3);
8 **mitigation**: in this section, mitigation measures are determined, to reduce negative impacts, or enhance positive opportunities for nature. In an EIA, the emphasis is put on the mitigation of the most severe effects; avoiding or reducing those impacts is deemed most effective (see paragraph 2.4);
9 **conclusion**: considering all (cumulative) effects, as well as the required mitigation measures, it is concluded whether the project (or which alternatives of the project) has an acceptable impact on nature.

It should be noted that some of these steps are executed iteratively and in parallel. For example, to know the relevant legal frameworks, you would also need insight in the effect range of your project. Defining the precise scope of an EIA is thus an iterative process.

Table 2.1 Example of Assessment Framework Marine Strategy Framework Directive (MSFD)

Score	Assessment compared to the reference situation	Criterion compared to the reference situation
--	strongly negative effect	strong negative effect on good environmental status, and because of this, the good environmental status cannot (or can no longer) be achieved (long-term/permanent effect)
-	negative	moderate effect on good environmental status, which has no substantial and/or only temporary influence on achieving good environmental status
0	neutral	no negative or positive effect on good environmental status
+	positive	moderate positive effect on good environmental status, which has no substantial and/or only temporary influence on achieving good environmental status
++	strongly positive	strong positive effect on good environmental status, and because of this, a good environmental status can be achieved (long-term/permanent effect)

Table 2.2 Overview of the potential effects per project phase and per activity on the different species groups/nature values. An x indicates there is a relationship between the effect and the species group; (x) indicates that it concerns only indirect effects

Physical effect	Defining activity	Benthic fauna	Fish	Marine mammals	Birds	Bats
construction phase						
underwater noise	pre-construction surveys and UXO detonation	x	x	x	(x)	
underwater noise	installation of foundations	x	x	x	(x)	
above-water disturbance	installation of foundations				x	
seabed destruction	installation of foundations, scour protection and cabling	x		(x)	(x)	
increased turbidity	installation of foundations, scour protection and cabling	x	x	x	(x)	
operational phase						
underwater noise	presence of turbine piles and maintenance vessels	x	x	x		
seabed alteration (disturbance)	scour protection and changes in use	x	x	(x)	(x)	
electromagnetic fields	presence of cables	x	x	x		
physical disturbance, including collision risk	presence of turbines				x	x
disturbance due to lighting	presence of turbine lighting				x	x
visual disturbance, including habitat loss and barrier effects	presence of turbines				x	x
decommissioning phase						
underwater noise	removal of foundations	x	x	x		
above-water disturbance	removal of foundations				x	
seabed destruction	removal of foundations, scour protection and cabling	x	x	(x)	(x)	
increased turbidity	removal of foundations, scour protection and cabling	x	x	x	x	

2.3 Methods and standards

In this section, we provide examples of the methods and standards used for assessing three of the effects presented in table 2.2, which are often given special attention in Environmental Impact Assessments in the Netherlands (notably: all effects presented in table 2.2 are usually part of the EIA):

- **disturbance of marine mammals during the construction phase**, as a severe negative effect due to loud impulsive noise, during the installation phase;
- **collision risk between turbine blades and birds during the operational phase;** as a severe negative effect during the operation phase;
- **effects of electromagnetic fields (EMFs) on rays and sharks**, as an uncertain effect during the operation phase.

The two severe effects could result in population decreases of sensitive species, requiring stricter mitigation. It should be noted that the most pressing effects differ per ecosystem. In other ecosystems, impact on the seafloor (for example reefs or seagrass), may be much more relevant, requiring different mitigation measures. Such points of attention should follow from step 4: Current State of Natural Values.

In a Dutch EIA, the disturbance of marine mammals and collision risk between turbine blades is researched in detail. A valuable tool in this is the Framework Ecology and Cumulation (in Dutch: KEC). A brief overview of the KEC is provided in the textbox below.

Text box KEC

In the Kader Ecologie en Cumulatie (KEC), research has been conducted into the potential combined ecological effects of existing and new offshore wind farms. This research considered the wind farms planned according to the supplementary roadmap for offshore wind energy, including the acceleration task in the North Sea Programme and international developments. The aim of the KEC is to determine whether all wind farms together could cause unacceptable negative ecological effects. Based on this, measures or standards can be included in site decisions to prevent or mitigate these negative effects. Such measures could, for example, involve limiting underwater noise from pile driving (so that fewer marine mammals are disturbed), or setting requirements for the turbines (to reduce the risk of collision fatalities among birds and bats). Additionally, the KEC identifies knowledge gaps that can be addressed in various research programs, such as the Offshore Wind Ecological Program (Wozep). In the effect calculations, the KEC focuses on those species for which significant effects are expected. These are:

1. **marine mammals** (harbour porpoises, harbour seals, grey seals): the effects of underwater noise on harbour porpoises and harbour and grey seals have been calculated in several steps. The assessment shows how many porpoises and seals are disturbed, for how many days, and what this means for the population during the implementation period of the roadmap;
2. **birds** (seabirds, coastal breeders, and migratory birds): for birds, the focus is on the effects of collisions between birds and wind turbines, and the loss of habitat due to the presence of wind farms;
3. **bats**: knowledge about bats at sea is limited. The origin, size, and population trends are largely unknown. In terms of presence, behaviour, and therefore the sensitivity of bats at sea to (among other things) operational wind farms, knowledge is still in its infancy. Based on expert judgement, estimates have been made of collisions and population sizes.

As a third example of topics addressed in EIAs, we provide a method for assessing a less known effect: the effects of electromagnetic fields from subsea cables on marine species, especially rays and sharks. The knowledge base for this effect is not as well developed as it is for underwater noise or collision risk. In paragraph 2.3.3, the method for assessing effects of EMF is explained, as an example on how to deal with uncertainty in impacts assessments.

2.3.1 Underwater noise effects during construction

Effects on marine mammals are dominated by the disturbance caused by underwater noise during the construction phase. Substantial power is required to drive monopile foundations into the sandy seafloor of the Dutch North Sea. The required piling leads to elevated noise levels, up to 70 km from the source, if not mitigated (Heinis et al., 2025). This has two effects: potential hearing damage (permanent and temporary), and disturbance (avoidance and masking of biologically relevant sound).

Direct hearing damage

The first effect is direct, permanent or temporary hearing damage. This occurs at (very) high received noise levels, and this can be avoided by deterrence methods before pile installation. In the Netherlands, emphasis is put on *soft-start* protocols, in which noise levels are gradually increased during each pile installation. In practice, vessel movements before turbine installation also deter marine mammals before installation.

Disturbance

The second effect is large scale disturbance. Individuals will swim away from the disturbance, draining energy and limiting foraging opportunities during that time. With very frequent, large-scale, disturbances, this may impact species to such an extent that it will lead to increased mortality and even population impacts. As a benchmark, effects need to be mitigated to the extent that there is 95 % certainty that the population reduction due to cumulative disturbance, will not be above 5 % (this follows European legislation). Through the KEC, the Dutch government has calculated how much disturbance (maximum) could be 'allowed' for the rollout of offshore wind in the Netherlands.

To be able to assess this benchmark, noise modelling is conducted for each windfarm. Input parameters are pile diameters, turbine locations, the noise limit which will be complied to during installation (currently in the Netherlands: 164 dB re 1 µPa2s SELss at 750 m from the source), a dose-response curve between noise levels and impact on species (from scientific literature), and species density maps. Then, the following steps are taken within the EIA:

1. **the noise propagation at each turbine location** is established, assuming the given noise limit;
2. **disturbance effect**: for each grid cell (each km^2), the disturbance effect is calculated as a product of the density of a marine species in the grid cell (for example 1 harbour porpoise/km^2) and the expected effect (for example 0.1, 0.5, or 1, based on the dose-response curve). This is summed, resulting in a total number of marine mammal disturbances (the so-called *marine mammal disturbance days*);
3. **population impact**: it is checked whether these values are within the limits set within the KEC:
   - if so, it can be concluded that negative effects on the population can be excluded;
   - if not, further research may be required: could the additional disturbance lead to population impacts? Here, we account for population trend and resilience of the population. If the population is under severe pressure, additional mitigation may be required, like further lowering of the noise limit (lower than the assumed 164 dB re 1 µPa2s SELss at 750 m from the source;
4. **suggest mitigation measures:** as stated in paragraph 2.1, the EIA sets boundary conditions for the developer. For achieving the noise limits, no specific measures are prescribed; the developer only must guarantee they comply with this norm. However, in the EIA examples of measures are provided, as well as substantiation whether it is reasonable to expect the developer to achieve this limit with currently available measures. Moreover, it is advised to combine several types of measures as this reduces noise levels over a wide spectrum of both high and low frequencies. Mitigation measures include:
   - alternative installation methods without the use of pile-driving;
   - noise dampeners;
   - noise mitigation screens;
   - double big bubble curtains.

Results in practice

In practice, having a set noise limit in the EIA and site decision forces developers to use noise mitigation measures (Bellman et al., 2020) or find alternative installation techniques. As the noise limits are part of the eventual windfarm permit, monitoring is required to prove that the developers comply. And as there is a push in the Netherlands to lower the noise limit even further, these techniques keep developing.

2.3.2 Bird collision modelling

Collison with turbine blades and birds causes direct mortality of birds. Given that sea birds are used to undisturbed flight paths, they may not be well adapted to avoiding collisions. This may lead to population declines.

Modelling of collision risk

The calculation of mortality due to collisions with wind turbines (the number of collision fatalities) among bird species is carried out using a stochastic Collision Risk Model (sCRM) implemented in the R package stochLAB (Band, 2012; Caneco et al., 2022; Jared, 2015). This model is considered the international standard for quantifying the expected mortality resulting from collisions with wind turbines. It includes parameters such as the number of bird flights per time unit crossing the turbines, the percentage of flights occurring at rotor height and the expected avoidance rate. The model is run a high number of times (10.000), leading to an estimation of the yearly mortality per species, including a confidence interval.

1 % norm

From there, the first benchmark is applied. If the yearly mortality is smaller than 1 % of the natural mortality of the population of the affected species, effects are assumed to be acceptable. Basically: the effect of the project is so small, in comparison to the natural mortality, that consequences for the population are unlikely. For species in which the expected mortality is >1 % of the natural mortality, a follow-up ecological assessment is performed.

Ecological assessment

Here, we dive deeper into effects on the populations. This comes down to an expert assessment whether the project could result in (further) population declines. We account for several aspects:

- **current population status:** does the species achieve the current conservation objectives? If not, all additional negative effects should be avoided and as such, mitigation may be required;
- **current population**: if the current population trend is negative, special consideration goes towards ensuring that conservation objectives can be met in the future, or mitigation should be applied;
- **cumulative long term population modelling**: this modelling includes testing against the *Acceptable Level of Impact (ALI-norm)*. Here we model how a population will develop with the presence of all Dutch OWFs and compare this with a situation without OWFs, over a period of 40 years. If there is a chance (>5 %) that the difference between the population developments is more than 5-30 % (species dependent, see (IJntema et al., 2025), the ALI-norm is exceeded. As such, additional mitigation may be required;
- **sensitive periods:** determine if species are especially sensitive in certain periods, such as during moult, breeding, or migration;
- **sensitivity analysis**: available models and data are not perfect. To account for this, a sensitivity analysis is performed, tweaking key data inputs and challenging results. If the data and outcomes are very robust, the need for mitigation is further emphasized.

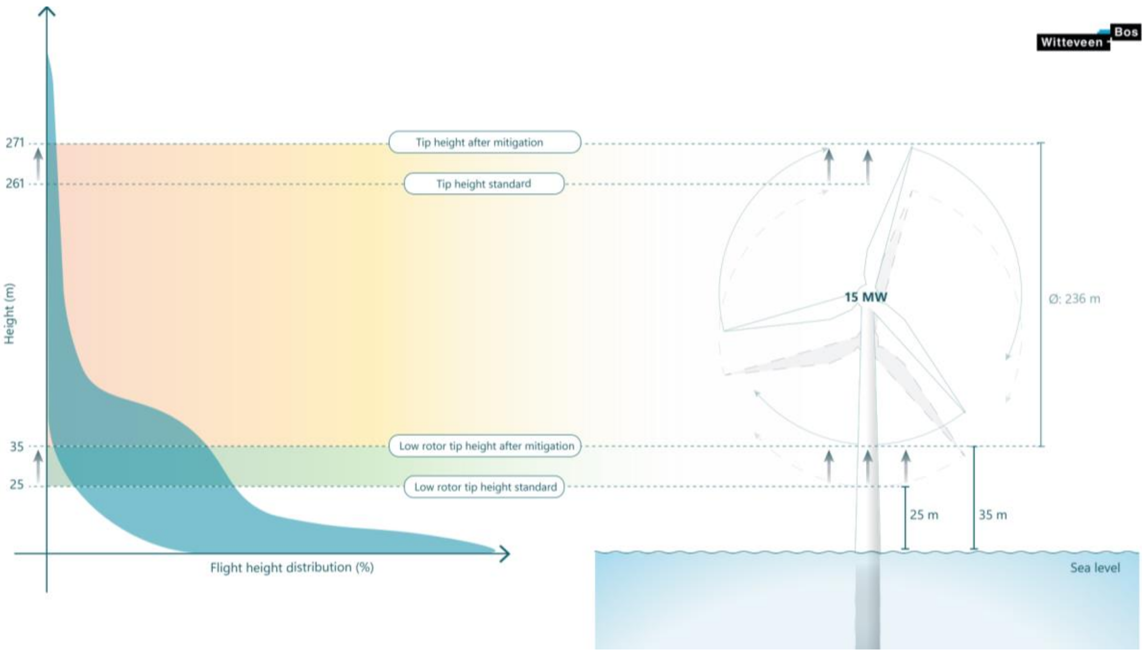
Mitigation

If, based on the Ecological assessment, mitigation is required, measures are suggested. These measures include:

- **increasing the lower rotor tip hight**: most birds fly relatively low to the sea surface. Increasing the airgap between the sea and the rotor directly decreases collision risk (figure 2.2);
- **seasonal curtailment:** reduction of rotor speed to <2 rotations per minute, during certain conditions. For example, millions of migratory birds cross the North Sea annually, mainly at high altitude. However, in poor weather or at night, birds fly lower, increasing the risk of collisions with wind turbines. These moments can be predicted with (weather) radar systems, allowing for targeted OWF curtailment;
- **individual turbine shutdown:** besides general turbine curtailment for migratory birds, individual turbines can also be stopped using camera systems that quickly detect and classify birds. If a high collision risk is detected for a vulnerable species, the turbine is stopped or slowed down.

Which mitigation measure should be taken is project specific. If a project has an impact on a large number of different species, a more generic measure should be taken. On the other hand, if only a single species is most affected, individual turbine shutdown may be most effective.

Figure 2.2 Conceptual representation of the mitigation measure lower rotor tip hight. The image is not to scale, and the probability distribution of flight altitude is indicative for different bird species, but the illustration does not contain actual data



Results in practice
In practice, this modelling approach has led a continuous development of effective mitigation. As of the first large OWF, seasonal curtailment (temporary shut-down of turbines) is obligatory (Staatscourant, 2016). This measure is tailored to avoid effects during peak seasonal migration. Most of the time, birds migrate at great altitude and only deviate from this in specific weather conditions (Machado et al., 2024; Smallwood & Bell, 2020). Only under these weather conditions, curtailment is implemented, making this measure highly effective and efficient. The protocol for this curtailment has been researched and optimised in the past 10 years.

For underwater noise, a limit of 164 dB re 1 µPa2s SELss at 750 m from the source is prescribed. As a result, OWF developers implement Double Big Bubble Curtains and additional measures if necessary, to meet this requirement. There is ongoing debate if a norm of 160 dB is feasible and will be implemented in the future.

2.3.3 Effects of electromagnetic fields

Subsea power cable (both inter-array cables, as well as export cables to shore) produce electromagnetic fields (EMFs). EMF may impact behaviour, navigation, physiological processes and embryonic development for many species, including rays and sharks (Hermans, Schilt, et al., 2024; Taormina et al., 2018).

Impact assessment
Based on cable characteristics (layout, design current, voltage, et cetera) it is calculated which area is under influence of the EMF from the subsea cables, with (based on literature) a lower limit of 5 nT (nanotesla). From there, a literature analysis is performed, to incorporate the latest insights in potential threshold values or dose-response relationships for sensitive species. In this way, it is established to which extend species may be affected by the EMF. Based on current knowledge, direct mortality is not expected.

However, there may for instance be an effect of embryonal development of certain shark species (Hermans, Maas, et al., 2024). The larger population effects are still largely unknown.

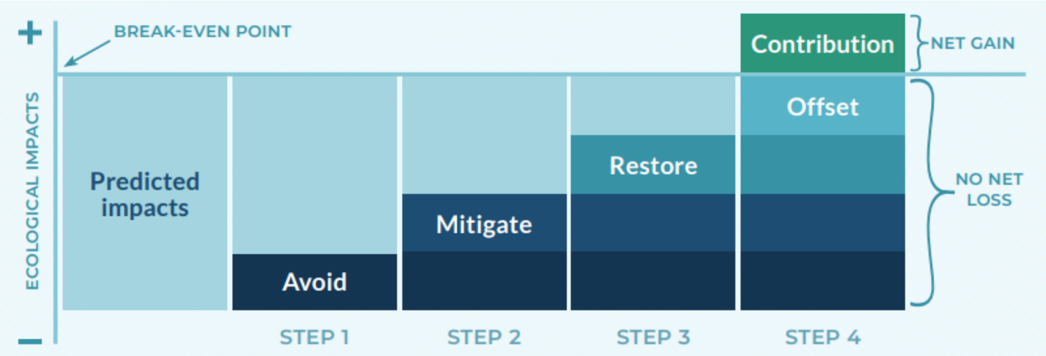
Precautionary approach
To be able to assess the impact when dealing with a lack of a solid knowledge base, the precautionary principle is applied: as environmental damage *could* occur based on available knowledge, but there is scientific uncertainty about this, governments are obligated to take 'proportional measures' (Dupuy & Viñuales, 2018; Smits, 2023). These measures can consist of research proposals, monitoring requirements, or physical measures. As knowledge of the potential impacts increases, this precautionary position may be altered.

Results in practice
The continuous attention that has gone to the knowledge gaps regarding the effects of EMF, has led to the initiation of multiple research projects (laboratory and field studies) in the Netherlands and Europe. In addition, the government has started to require wind farm operators to conduct monitoring to potential EMF effects, as has been the case for the owners of export cables for several years. Results are now used in EIAs for impact assessments, leading to more specified and knowledge-based assessments and recommendations.

2.4 Effective mitigation

In section 2.3, we have presented methods and standards to determine specific effects for marine mammals and birds. Also for other species, habitats, or areas, mitigation might be required. Key starting point is that objective criteria for impact assessment are formulated in advance (see paragraph 2.2). This results in a more effective assessment in which priority to the most sensitive species is provided. When proposing mitigating measures in an EIA, the following steps are followed:
- always follow the **mitigation hierarchy** (OCEaN, 2024) (figure 2.3), applying the following order:
  1. avoidance, such as no installations in or near high-biodiversity area's;
  2. minimisation and mitigation, see measures above;
  3. restoration, such as implementation of nature inclusive design (see The Rich North Sea toolbox). As of 2016, implementing nature inclusive design is obligatory in Dutch wind farms;
  4. offsetting, either onsite of offsite, e.g. investing in seagrass restoration projects;
  - The best scenario is if all impacts can be fully avoided. In practice, it is likely that parts are avoided, and parts are mitigated. If there is still no compliance with (inter)national legislation, restoration or offsetting might be required. And especially when working in degraded ecosystems, mitigating and compensating beyond solely the project impact is encouraged. This way, it can become possible to strive towards contributing to nature (net gain);
- **substantiate the impact of mitigation**, linked to your objective criteria, showing its effectiveness. We also show the effects of addition mitigation, to show involved parties how effective these measures could be;
- **combine** proven measures with innovative measures: proven measures are required to ensure effective mitigation. At the same time, technological developments may allow for innovative measures. In some Dutch OWFs, proven and innovative are combined, to allow for development of the innovation, while still safeguarding ecological limits;
- **monitoring the effectiveness of a measure**, contribution to the further substantiation of the measures.

Figure 2.3 The mitigation hierarchy, adapted from the Institute for Sustainable Development (source: OCEaN)



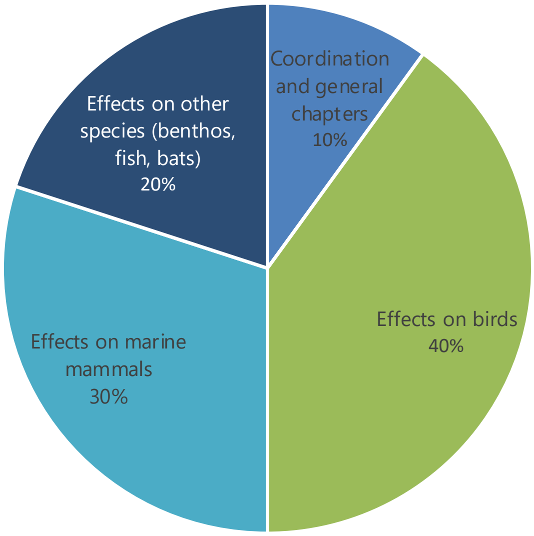
When (mitigating) measures need to be taken, governments or decision makers can prescribe these measures in different ways: either by requiring that a **specific measure** is taken, or that a **specific benchmark** is met. In the Netherlands, a specific noise limit during wind turbine installation is set, but it is not prescribed *how* this limit must be met. This leaves freedom to the developer to select the best available mitigation measures, currently available on the market. This does however limit the level of control the Dutch government has regarding the mitigation: they either need to validate the effectiveness in the field (by performing underwater noise measurements) or rely on measurements from the developer.

An example of a specific prescribed measure is bat curtailment. Here, the Dutch government requires shut down of turbines when predefined conditions are met. This system does not allow for any innovation or changes during the operation of the OWF. Both approaches have their pros and cons (see chapter 3).

2.5 Expertise, timeline, and costs

The extend of an EIA is very much dependent on a smooth process. If there are changes or unforeseen circumstances, the EIA-process may be substantially delayed. Such process changes have a much stronger impact on time and budget, than for example the size of the windfarm. The range of drafting an EIA is therefore 6-18 months. Similarly, the cost of nature assessment of an EIA by a consultancy firm is about € 100.000,00 to € 250.000,00, requiring about 750-1.850 person-hours. The allocation of different experts is provided in figure 2.4.

Figure 2.4 Expert allocation of nature impact assessment within Dutch OWF EIAs



This does not account for cost the government makes by facilitating the EIA-process or the wider extend of the preparation of the site decision. In practice, the time between the start of the EIA-process and the moment an developer starts installation is about 5 years: 1,5 years for the EIA, 1 year for finalisation of the site decision and tendering of the windfarm site, 2,5 years between granting of the windfarm site and the start of the construction phase.

3 PROS AND CONS

The Dutch approach to the nature-component of an EIA is unique, resulting in some pros and cons of a conventional approach in which a developer is directly involved in drafting an EIA. An overview of pros and cons as related to the different sections of this memo is provided in table 3.1.

Table 3.1 Dutch approach to the nature-component of an EIA

Topic	Approach (paragraph)	Pro	Con
governance and related risk and cost	the government is in the lead for the EIA (2.1 & 2.5)	with this set-up, the Dutch government provides high certainty for permit application (figure 2.1). This lowers risk to the developer. This risk reduction is much more valuable than the cost of the extensive EIA process	the developer has limited impact on the EIA, and has therefore limited impact on alternative selection of the EIA. The developer does not control cost of the EIA
process	the process as in 2.2	the process of the EIA is uniform and predictable, allowing for comparison between EIA of different projects	this uniformity may result in repetition between EIA and limited project specific information
mitigation	obligatory mitigating measures and further options are part of the EIA (2.1 & 2.4)	the Dutch government can set clear limited for mitigation and thus has much control over effect mitigation	the Dutch government may not be fully aware of implications of mitigation measures, as they cannot fully oversee cost for the developer. This may result in mitigation measures which are technically challenging or very expensive

Topic	Approach (paragraph)	Pro	Con
mitigation	prescribed mitigation objective (2.4)	allows developer to select best available technique or innovate	limits control by Dutch government and may require in field validation
mitigation	prescribed mitigation measure (2.4)	allows Dutch government control over measure	limits innovation and fixes measure over long time periods
time	timeline as in 2.5	this EIA process takes substation time, allowing for considering of all relevant environmental aspects	the EIA process may lead to slower rollout and development of offshore windfarms
standards	standards for the assessment of certain topics (underwater noise, bird collisions (2.3)	by providing clear standards, objectivity of the EIA is increased	standards may lack nuance or location specific considerations
data and models	required data and models from method as in 2.3	using data enables knowledge-based decision making	for the detailed impact assessment (such as bird collision), substation data is required. collective such data will take several years and significant efforts, at the same time, models may suggest false accuracy, where decisions are based on inaccurate or incomplete models. The model outcome is only as reliable as its input

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