

Conditions for nature friendly and circular decommissioning

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Offshore wind energy is developing rapidly and is becoming one of the main focal points for the generation of renewable electricity in Europe. The spotlight has been primarily on new windfarm deployments. Decommissioning of offshore windfarms (OWFs) at the end of their lifecycle has been relatively overlooked. Challenges not only encompass the absence of practical decommissioning experience but also the potential impact on local biodiversity and material use. Additionally, the current legal framework leads to the inability to make a proper assessment in favor of nature and natural resources when decommissioning takes place. To address these environmental challenges, it is crucial to take an integral approach and retain a long-term perspective.

Sustainable decommissioning

We define sustainable decommissioning as a decommissioning process that integrates the principles of nature conservation, restoration and circularity.

Dilemma: what happens after the end of life of offshore wind turbines?

Offshore wind farms can offer possibilities for under water nature by means of new habitats resulting from a lack of bottom disturbance and human-introduced hard substrate. Permits for offshore windfarms last between 25 to 40 years and full-removal has a risk of destroying this nature (see figure below). The current regulatory framework mandates the complete removal of all structures post-operation phase, restoring the seabed to its original state. This overlooks the potential impacts on biodiversity and ecosystem health. The challenge is to **strike a balance between decommissioning and meeting restoration and circularity targets**. We want to see the dilemma between full decommissioning, nature conservation and sustainable material use become more of a focal point in government and company policy.

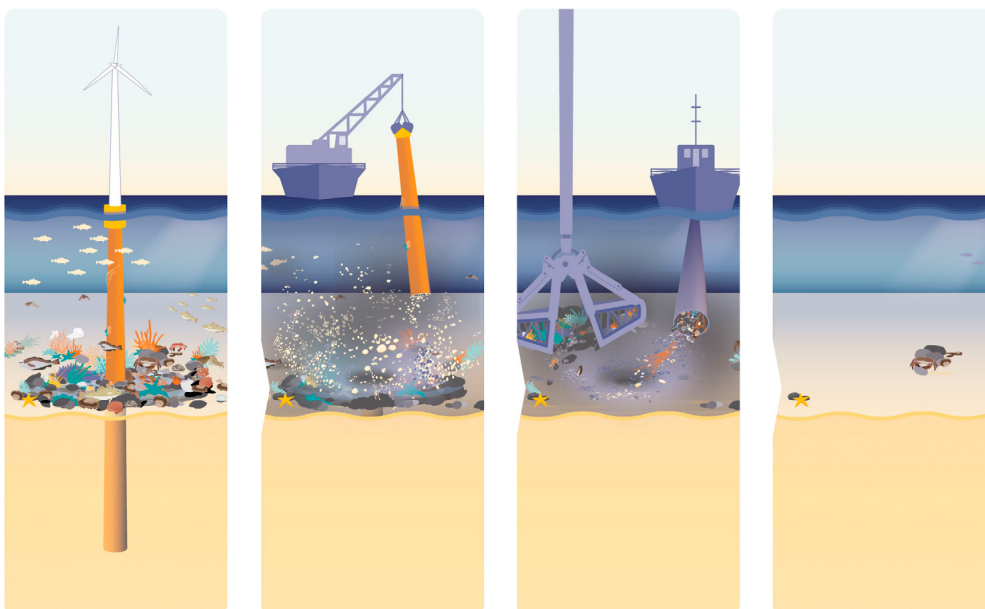


Figure 1: In the case of valuable nature, there is a risk of destruction due to full decommissioning

Starting points decision-making framework

To assess the choice between full or partial decommissioning

Partial decommissioning can, in certain circumstances, be a potential solution for nature disturbance after end of life of the Offshore wind farm. One of the dilemmas that arises in the decommissioning process is deciding if and which infrastructure to leave behind in order not to disturb the natural values that have developed.

To make a decision between full or partial decommissioning, several steps need to be taken:

- 1. Circular material use** that takes sustainable decommissioning into account should be the starting point.
- 2. Implement a standardised evaluation procedure near End of Life (EoL).** Outcomes of this evaluation should give clarification on the possibility of extended life span, the ecological value and the material value.
 - a) Identify steps taken to **extend the lifespan** of the wind turbine.
 - b) Evaluate the ecological and raw material value of the end-of-life offshore infrastructure and of the area as a whole. Whether partial decommissioning is desired should be **judged by a scientific, independent committee on a case-by-case basis**. If the ecological value provided by the infrastructure is insufficient, it must be removed in its entirety.
- 3. Assess decommissioning impact on ecologically important species and habitats.** If all ecologically important species are unaffected by the decommissioning process, then the infrastructure must be removed whilst applying mitigation measures for species that are harmed or disturbed by the decommissioning process.
- 4. Conduct a cost-benefit analysis of the repurposing of infrastructure.** Leaving the infrastructure in place may also affect other aspects, such as marine safety, or the potential release of hazardous materials or chemicals. Therefore, it is important to make **clear agreements in advance about who is responsible for the abandoned infrastructure after the operational phase**. Monitoring should take place to reduce risks of incidents after partial decommissioning.
- 5. Mitigate impact on ecologically important species.** When the identified ecological importance is impacted by the decommissioning process, mitigating steps need to be taken to preserve the ecological value on and around the infrastructure.
- 6.** If the decision is made to leave parts of the infrastructure behind due to high ecological value, steps should be taken to **legally protect the area** from other disruptive activities.

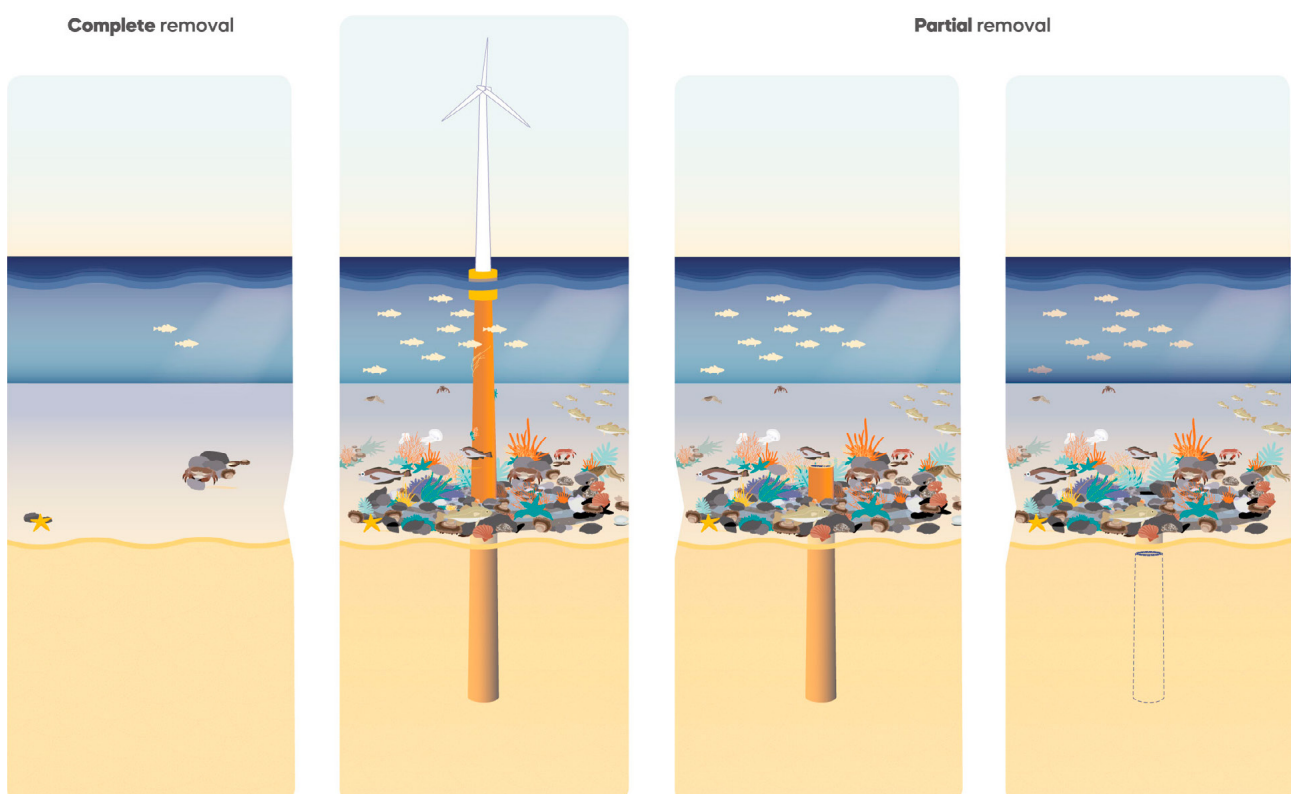


Figure 2: complete or partial removal of offshore wind turbines

Policy recommendations regarding partial decommissioning

We need to embed the subject of sustainable decommissioning interdepartmentally and internationally in laws, regulations, and plans to ensure that the goals of restoring nature and promoting circularity become achievable. To achieve the necessary conditions for the offshore sector to develop plans for sustainable decommissioning, we make the following appeal to policymakers in the EU and member states:

- Enhance **legal flexibility for partial decommissioning** to avoid ecological damage related to full decommissioning.
- Set up a decision-making framework to facilitate the **case-by-case assessment of ecological value** on infrastructure in offshore wind farms.
- Integrate decommissioning requirements in tenders to ensure that sustainable **decommissioning is incorporated in the design phase** of offshore wind farms.
- Take advantage of the decommissioning processes of the Dutch OWFs, Egmond Aan Zee (2027) and Prinses Amalia (2028), to gain valuable insights and **practical knowledge** for implementing partial decommissioning strategies.
- Ensure that **ecologically valuable areas are protected** from harmful activities after assets have been decommissioned and the area is no longer an OWF.
- Ensure that valuable and scarce materials can be extracted from the wind farms with **minimal impact on nature**.

Lifespan extension and standardisation

It could be desirable to design future OWFs in such a way that they can remain in operation for as long as possible and where the foundations can be reused. This leads to various dilemmas for policy and for OWF developers, but it is an essential step to drastically reduce the environmental impacts of decommissioning.

For lifetime extension and the reuse of foundations, we propose the following recommendations for policy:

- **Standardise designs** for wind turbines. This also includes setting a minimum life span requirement for wind turbine foundations, making them reusable and standardising the design to enable the replacement of wind turbines without disturbing the surrounding biodiversity (See figure 3).
- **Standardise the maximum and minimum tip height** of wind turbines. This is intended to stop the increase in size of wind turbines since we are reaching an optimal size when looking at costs and rated power. This ongoing growth adversely affects the costs of construction and materials and makes the repowering of high-capacity wind farms unnecessarily expensive. The most ideal standard when it comes to nature is not fully known yet, so we need sufficient flexibility with regard to the standardisation, monitoring and possibilities for adjustments based on scientific insights.
- **Increase interoperability** for wind turbine components. Set a standard for the use of connection methods for wind turbine components to lower installation and maintenance costs.
- Ensure **flexible permit extension** or longer permits to ensure that offshore wind farms are designed with a longer life span in mind.
- Standardisation requires an increase in **value chain transparency**. Active collaboration between industry stakeholders and governments is needed to develop effective standards for promoting responsible business conduct throughout the value chain, from extracting raw materials to the end-of-life stage.
- Ensure that any extra expenses associated with the lease of an offshore wind farm lot do **not hinder the achievement of broader objectives** related to nature and circularity.

By incorporating standards, working towards possibilities for partial decommissioning and identifying presence of valuable nature, we can work towards nature-friendly and circular offshore wind farms

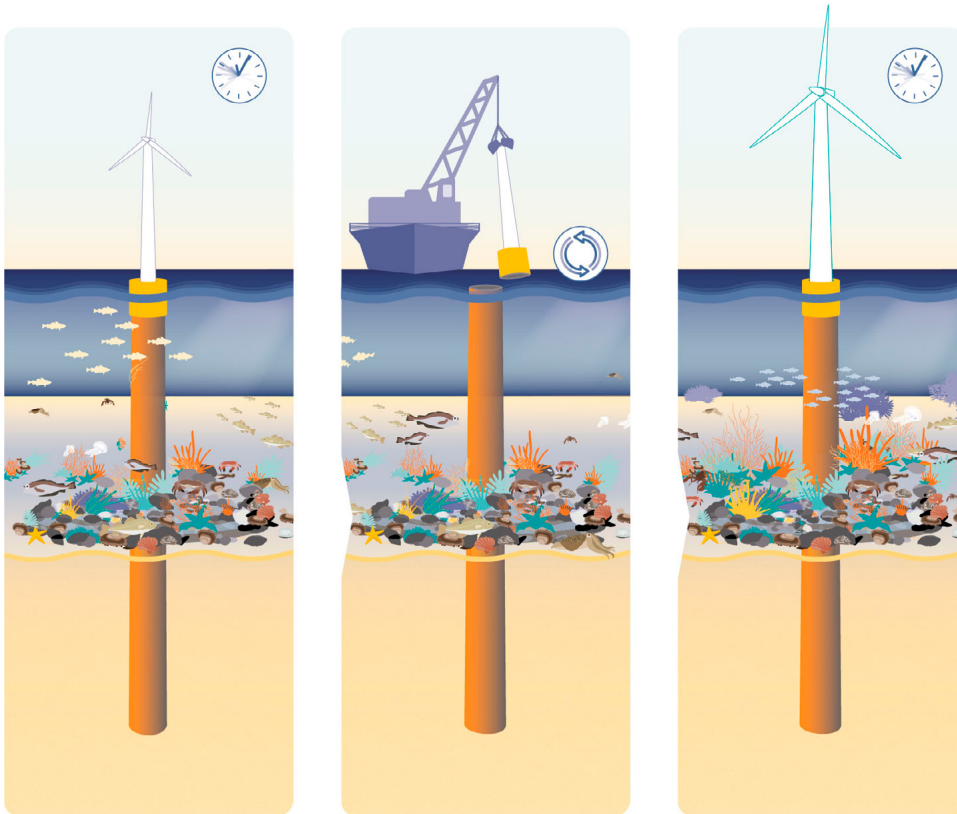


Figure 3: a schematic representation of life span extension of the wind turbine and the reuse of its foundation. The foundation is designed (overengineered) in such a way that it is suitable for a larger, modern turbine.

The two papers about sustainable decommissioning can be downloaded here:

- [Conditions for sustainable decommissioning of offshore wind turbines](#)
- [Towards sustainable decommissioning: the importance of lifespan extension and standardisation](#)

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