



Wind of Change: The challenges presented by end-of-life wind farms

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In recent years, both European and German legislators have been promoting the expansion of renewable energy both by creating a favourable legal environment and by facilitating public funding of renewables of all kinds – wind, solar, biogas etc. Wind farms – both off- and onshore – have proven to be the backbone of this energy transition, at least in Germany. As increasing numbers of wind farms reach the end of their operational life, the question of whether operators are obliged to dismantle wind turbines (WTs) is being raised with increasing urgency and if so, what exactly such dismantling obligation implies. One of the most pressing challenges in this context is the recovery and recycling of rotor blades.

Dismantling obligation *onshore*

No statutory dismantling obligation: There is no general statutory obligation to dismantle end-of-life onshore WTs. Depending on their size and the year in which their permit was granted, onshore WTs are either subject to the Federal Emissions Control Act (*Bundes-Immissionsschutzgesetz* – **BImSchG**) or the building codes of the individual German federal states. Neither the BImSchG nor the building codes

contain any general obligations to completely remove WTs. Where WTs present a risk or are derelict, authorities may, however, require that they be dismantled.

Dismantling obligation based on permits or planning law: The individual permits granted for the WTs or the planning law applicable to the individual location may impose comprehensive dismantling obligations. In this context, we distinguish between:

- WT's in outskirt areas (*Außenbereich*), i.e. in areas not covered by a zoning plan (*Bebauungsplan*), which should as a general rule be kept free from buildings and structures; and
- WT's in inner areas (*Innenbereich*) (i.e. areas either covered by a zoning plan or areas of developed land which appear as a coherent district).

Permits for the WT's located in outskirt areas are usually only issued in conjunction with obligations (i) to dismantle the WT's after their operational lifetime and (ii) to deposit security for the dismantling work. The permits may also include more detailed decommissioning obligations in the individual case.

WT's located in inner areas may, but do not necessarily have to be subject to dismantling obligations. A dismantling obligation may, however, be specified in the permits granted for the WT's or the stipulations in zoning plans. Any such obligation may also entail an obligation to deposit security for the dismantling work.

Security: Decommissioning security usually takes the form of either a (bank) guarantee or registration of a public easement (*Baulast*). In individual cases, a contract may have to be concluded with the authorities. The method for calculating the security varies, but usually the amount of security depends on the hub height, the installed capacity or the total investment costs, for instance. The permits usually stipulate a specific sum that must be provided as security.

Land-use agreements: Any land-use agreement concluded with property owners may include an obligation to dismantle and recover the WT's at the end of their operational lifetime. This depends on the contractual arrangement in the individual case.

Dismantling obligation *offshore*

For offshore WT's in the German exclusive economic zone, the legal situation is much clearer compared to onshore wind farms.

Dismantling obligation: Under the German Offshore Wind Act (*Windenergie-auf-See-Gesetz – WindSeeG*), an obligation to dismantle WT's is directly laid down in the law. WT's must be dismantled

if their permit becomes invalid, which is in particular the case if the permit expires and is not extended. Usually the permitting authority, the Federal Maritime and Hydrographic Agency (*Bundesamt für Schifffahrt und Hydrographie – BSH*), includes the dismantling obligation in the permit, specifying that WT's must be dismantled and duly recovered/disposed of when the permit becomes invalid or if a WT is not operated anymore due to damage or destruction.

Security: Statutory law provides for detailed rules on security which the BSH is entitled to request (and does in practice request) to ensure that sufficient financial means are available to cover the dismantling costs. The BSH must regularly review the amount of the security to ensure that it is still appropriate. If it identifies that the security is no longer sufficient, the BSH will set a deadline of six months maximum within which the increased security must be provided.

Scope of the dismantling obligation

Onshore: The scope of the dismantling obligation can be specified in the permits issued for the WT's or in an applicable zoning plan. However, in our experience, such provisions are still relatively rare. In the absence of any detailed rules, the scope of the dismantling obligation generally relates to the removal of all components and associated facilities of the WT's, such as grids and paths. Furthermore, any ground sealing (*Bodenversiegelung*) must be removed in such a way that, for example, rainwater can seep away again. This may require the removal of the foundations of the WT's.

If a land-use agreement includes specific dismantling obligations, any such contractually agreed scope of dismantling may have to be taken into account.

Offshore: Statutory law refers to a number of criteria which must be taken into account, in particular hazards for the maritime environment and the safety of maritime traffic. Against this background, the extent to which a WT must be dismantled depends on the circumstances of the individual case.

The WindSeeG does not currently include any details on the extent of dismantling, but states that the BSH will decide on the scope of dismantling when issuing

the corresponding official decision, taking into account the generally recognised technical and scientific standards, as well as other factors. This means that certain risks exist as to the scope of the dismantling obligation in the future.

According to today's view on dismantling obligations, complete dismantling (including the excavation of the base) may not necessarily be required. In many cases, leaving parts of the WT in the sea will cause less damage to the maritime environment than complete dismantling.

In addition, the WindSeeG provides that the Federal Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft und Klimaschutz*) can set further requirements in terms of the scope of dismantling by means of a legal ordinance (*Rechtsverordnung*).

Addressees of dismantling obligations

WT operator: Generally speaking, the addressee of any dismantling obligation is the operating entity of the WTs which holds the respective permits for their operation.

Risks for shareholders: On the other hand, *shareholders* of an operating entity are usually not obliged to perform any dismantling actions. However, the shareholders of an operating entity may bear financial risks if they issued a security.

Land-use agreements: If a land-use agreement includes a dismantling obligation, the contracting party to such agreement is generally obliged to dismantle the WTs. This is often the operating entity. Similar obligations may arise from public-law agreements with municipalities or other authorities.

Recovery of rotor blades

The operating entity is responsible for the professional recovery (recycling) of the WTs, which will become an increasingly relevant topic for the industry – and thus also for the German legislator. The most challenging component in terms of waste is the fibrous composite material contained in the rotor blades.

Recently, for example, the German legislator proposed in an early draft bill to amend the WindSeeG that offshore WTs whose rotor blades had a particularly high recycling rate would have a better chance of being granted an award by the Federal Network Agency (*Bundesnetzagentur*). Although this proposal did not come into force, it underlines that the recyclability of components of WTs is of particular importance to the legislator and might be promoted one way or another in future legislative acts.

For the recovery of WTs, several pieces of legislation have to be taken into account. These include in particular the Closed Cycle and Waste Management Act (*Kreislaufwirtschaftsgesetz*), which stipulates that waste may, as a general rule, only be disposed of if it cannot be recovered, and the Commercial Waste Ordinance (*Gewerbeabfallverordnung*).

In simple terms, the fibrous composite material contained in the rotor blades is a material with certain fibres embedded in a polymer matrix, either as glass fibre reinforced plastic (“**GFRP**”) or carbon fibre reinforced plastic (“**CFRP**”).

- For GFRPs, a number of recovery processes are available. However, none of these have been able to fully establish themselves on the market yet. For example, GFRPs may be recovered in the cement industry, where the organic compounds may be used as a substitute fuel (energy recovery) and the mineral compounds as cement material (material recovery).
- The situation is even more difficult for CFRPs. CFRP waste is currently recovered by means of pyrolysis to recycle the carbon fibres. This has not yet caught on in the market, however. Research is currently focusing on further developing the pyrolysis process, but other processes, such as the metabolism of CFRP by micro-organisms, are also being intensively researched.

In summary, the recovery of rotor blades is not only technically very complex but can also trigger very high costs – and therefore substantial financial risks.

Outlook

Dismantling obligations, and the recovery of rotor blades in particular, are to be considered carefully in the project development phase and when investing in wind farms. Traditionally, dismantling and recovery have generated financial risks rather than economic opportunities. However, this may change in the future: Supply chain uncertainties are currently fostering investments in innovative recycling technologies, such as recovering the magnets used in WT generators. Such magnets are made of rare earths which are becoming increasingly scarce due to their wide scope of application in course of the energy transition. The EU appears to have recognised the opportunities associated with such new recycling technologies: In the recently published draft for an EU Critical Raw Materials Act, the EU aims to oblige parties

marketing such magnets to label their products with certain important information on their recyclability. In addition, the aim is that the Commission should be able to adopt delegated acts after 31 December 2030 to lay down minimum shares for recovered critical raw materials (such as neodymium, nickel and cobalt) that must be present in the magnets incorporated in certain products (such as wind energy generators). These planned measures demonstrate that the EU is keen to secure its own independent supply of critical raw materials through recycling. End-of-life WTs may therefore transform into valuable assets – particularly if they can contribute to an independent EU supply chain for critical raw materials.

Nevertheless, for the time being dismantling and recovery obligations (including the risk that authorities demand increased security) still needs to be taken into appropriate account.

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