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Onshore vs Offshore

KTP - Wind Turbine Decommissioning

The Salvage, Decommissioning & Wreck Removal Workshop
Circular economy and offshore wind – Starting with the end in mind.
05/12/2023

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UNIVERSITY of STRATHCLYDE
ADVANCED MATERIALS RESEARCH LABORATORY

UKRI Innovate UK | Knowledge Transfer Partnerships

Content

- Background on decommissioning
- Challenges
- Possible solutions

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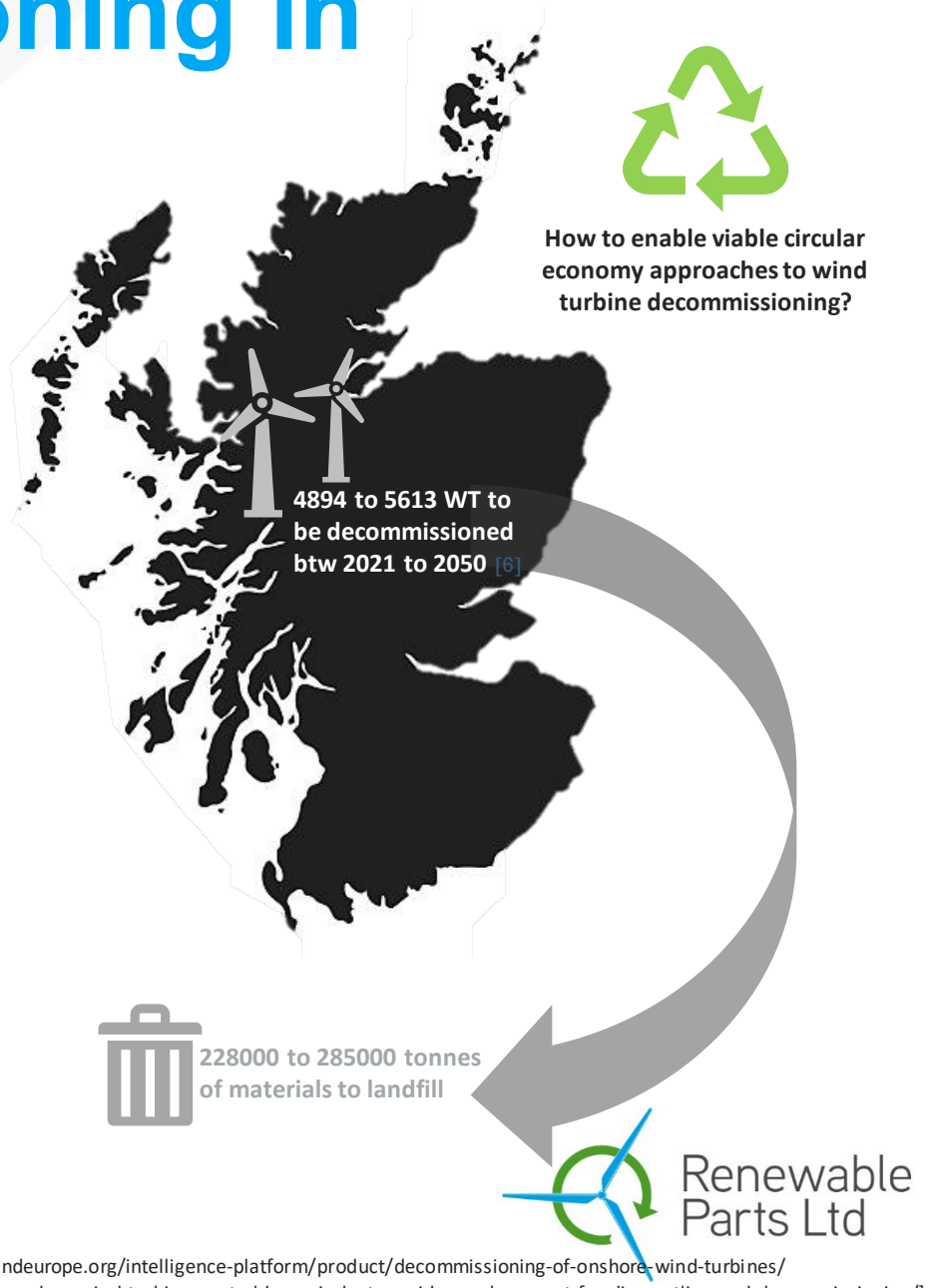
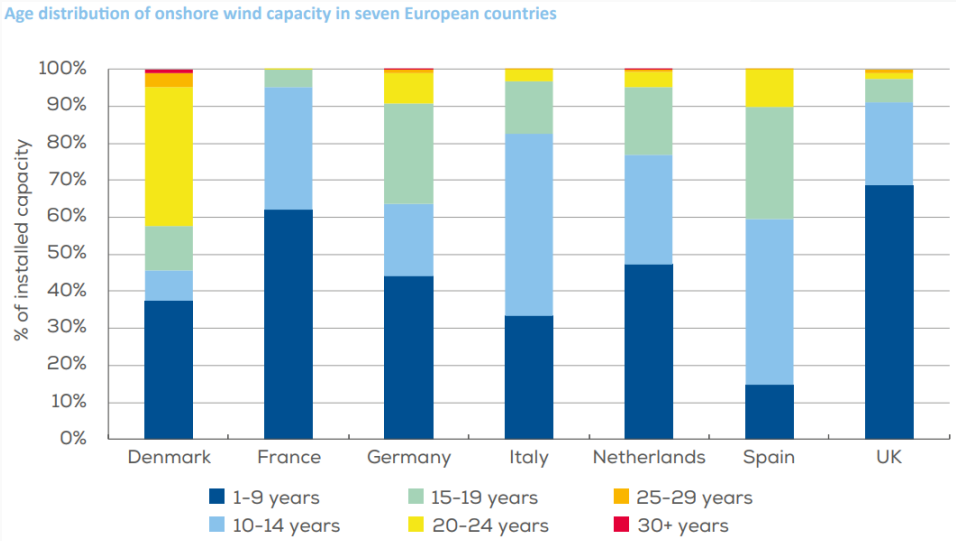
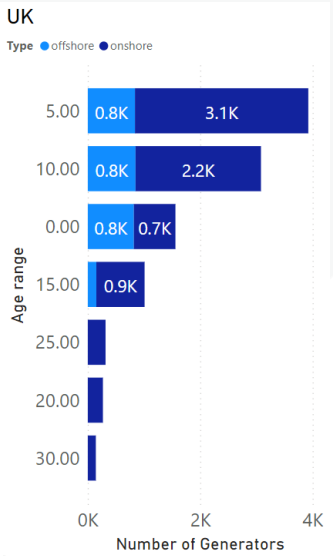
Wind turbine decommissioning in context

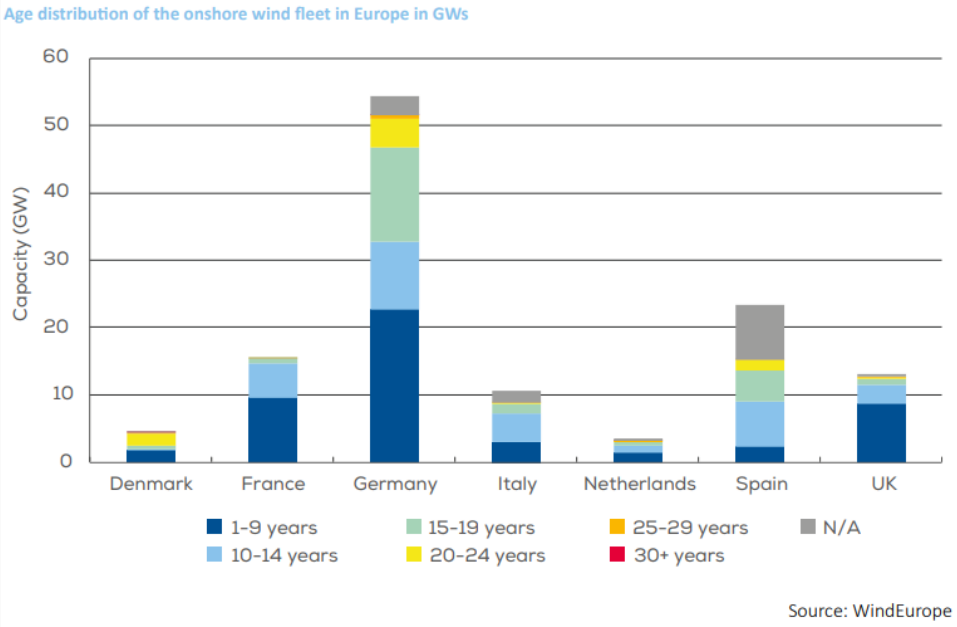
- UK is a top location for wind power [2], set to expand by 15.2GW by 2026 (4.4GW onshore, 10.8GW offshore)
- 11,090 wind turbines (WT) in the UK (totaling 24.6 GW capacity), of which 2,297 as offshore wind turbines [1]
- Europe had in 2021, a total of 236 GW capacity (207 GW onshore and 28 GW offshore) [5]
  - In 2021, it decommissioned 396 MW and commissioned 515 MW of repowered capacity [5]
  - This onshore capacity inc. 34,000 WT with >15y (eq. 36GW capacity; of which 9GW are 20-24y, 1 GW are >25y)[3]
  - Some EU countries with much older installations
- Operational lifetime of 20-25 years (some on 35y) for onshore WT [3]
  - 50% of Europe's wind farms expected to have their lifetime extended by 5-10 years (post 20y) [4]
- According to Wind Europe, there is a **massive market for decommissioning of onshore wind over the next decade** [3]
- **Green decommissioning options likely to be key to the credentials of the industry in the long term**



(1) UK Wind Energy Database, Renewable UK, [www.renewableuk.com/page/UKWEDhome] 06/03/2022
(2) Xi et al. 2009. Proceed National Acad Sci USA 106(27): 10933-10938.
(3) Wind Europe 2020. Decommissioning of Onshore Wind Turbines. Industry Guidance Document. 53pp. Published 20 November 2020. Available at [https://windeurope.org/intelligence-platform/product/decommissioning-of-onshore-wind-turbines/
(4) Wind Europe 2020 . What happens when wind turbines get old? Press release. Available at [https://windeurope.org/newsroom/press-releases/what-happens-when-wind-turbines-get-old-new-industry-guidance-document-for-dismantling-and-decommissioning/]
(5) Wind Europe 2022. Wind energy in Europe 2021 Statistics and the outlook for 2022-2026. 40pp. Published February 2022. Available at [https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2021-statistics-and-the-outlook-for-2022-2026/]
(6) Zero Waste Scotland, The future of onshore wind decommissioning in Scotland. 64pp. Published April 2021. Available at [https://www.zerowastescotland.org.uk/research-evidence/future-onshore-wind-decommissioning-scotland]



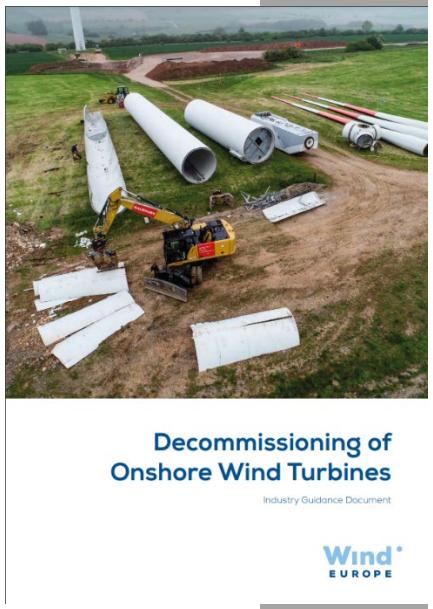




Source: WindEurope

Wind Europe 2020. Decommissioning of Onshore Wind Turbines. Industry Guidance Document. 53pp. Published 20 November 2020. Available at [https://windeurope.org/intelligence-platform/product/decommissioning-of-onshore-wind-turbines/

Zero Waste Scotland 2021. The future of onshore wind decommissioning in Scotland. 64pp. Published April 2021. Available at [https://www.zerowastescotland.org.uk/research-evidence/future-onshore-wind-decommissioning-Scotland]



Key findings

- Around 5,500 turbines will be decommissioned in Scotland (Based on sites that were either consented, in construction or operational in 2020);
- By 2050 onshore wind decommissioning in Scotland could have generated between 1.25M - 1.4M tonnes of materials
- By weight, the biggest material waste arisings from wind turbine decommissioning will be ferrous metals (steel, iron) which are currently exported for recycling.
- The forecast includes over 60,000 tonnes of fibreglass and 90,000 tonnes of resin + balsa, materials all currently landfilled

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Circular economy approach

- Reuse: give turbines and their parts a second lease of life
- Remanufacture: bring turbines and their parts back to life
- ~~Alternative use~~

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Regulations

- No harmonised regulation around wind turbine/farm decommissioning in the EU
- Each country has their own rules and regulations, mostly referring to EU Waste Framework Directive (2008/98/EC)
- Only standard existing on the topic is DIN SPEC 4866-2020: “Sustainable dismantling, disassembly, recycling and recovery of wind turbines” – which pushes for parts reuse/recovery and highlights recycling as the last resource

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What are the challenges

Market Value & Demand

- What is coming available?
- Second hand market?
- Spare parts?
- Locations?

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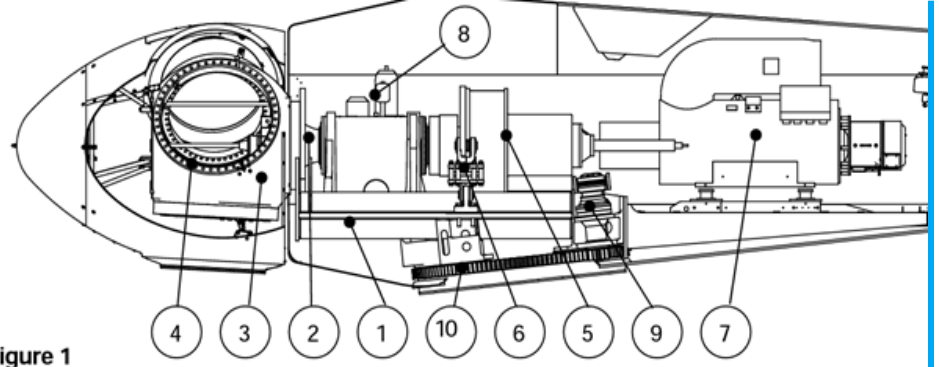
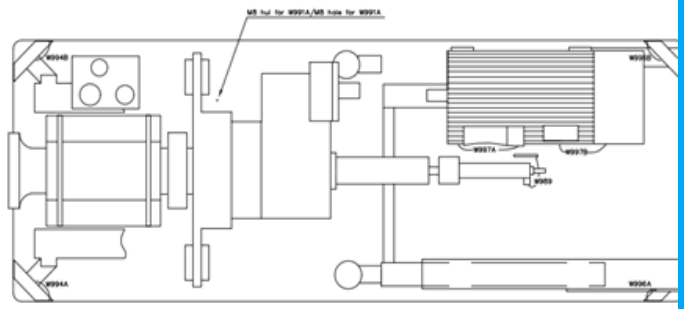


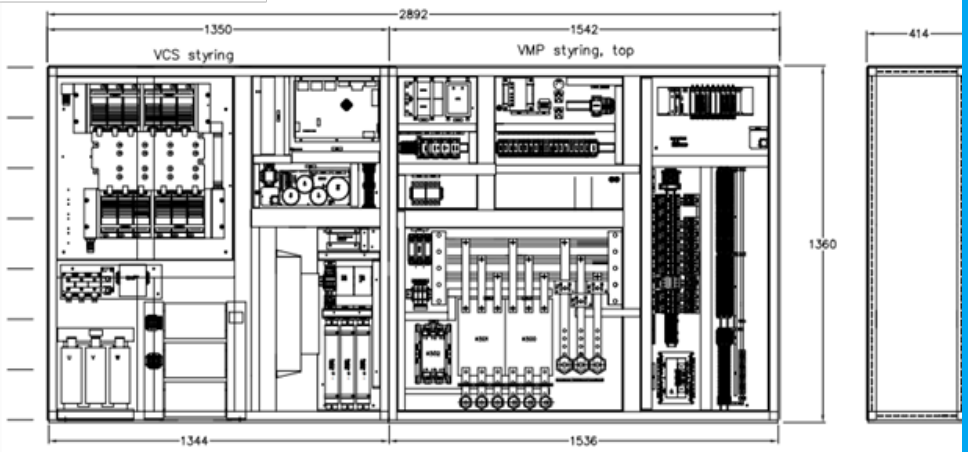
Figure 1

Structure of turbine

1	Nacelle bed plate	6	Gear tie rod
2	Main shaft	7	Generator
3	Blade hub	8	Hydraulic power station
4	Blade bearing	9	Yaw gear
5	Gearbox	10	Yaw ring

Table 1





Technical Info

- Conditions?
- Detailed Bill of Materials?
  - Data source?
  - Trustworthy?
- Compatibility?
  - How many models does it fit?
  - Trustworthy?

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Logistics

- How do we achieve it?
  - External contractor?
  - Partners?
  - Capability build up?
  - Mergers?
- Transport?
- Handling & Storage?
- Processing?

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Remanufacturing

Mechanical?

Power Electronic?

Electrical?

Hydraulic?

Electronic?

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Key common challenges

- Data availability
  - Market
  - Use
  - In-service conditions
- Info and Data sharing
  - Owners
  - Accessibility
  - Integrity and trustworthiness

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Possible solutions

- Open collaborations
- Third party hosting the shared data and anonymizing it for everybody to use for good.

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Thank you for your attention