Decom Offshore Wind Farms

Lessons Learned and Challenges

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VATTENFALL

Agenda

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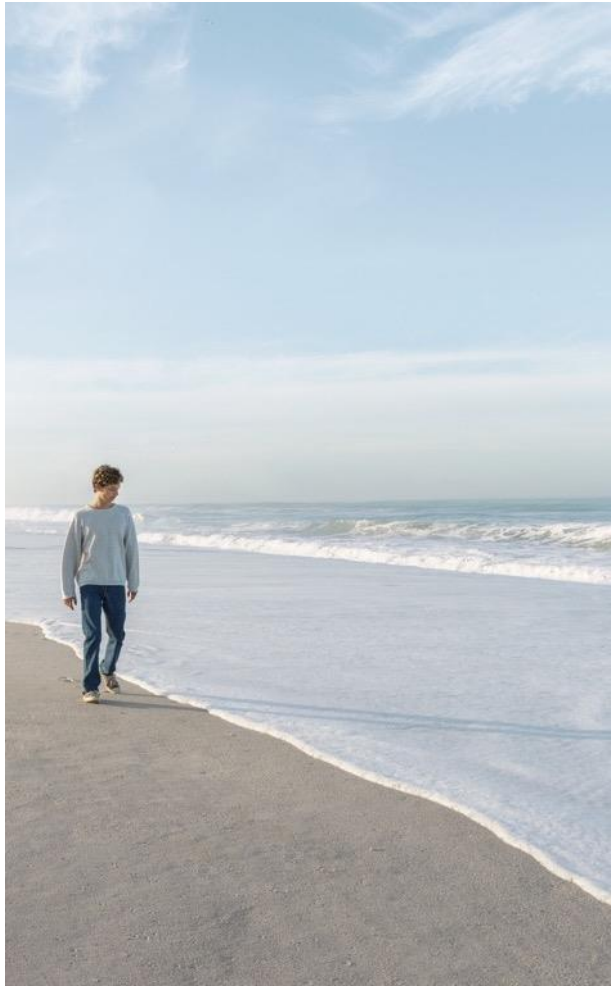
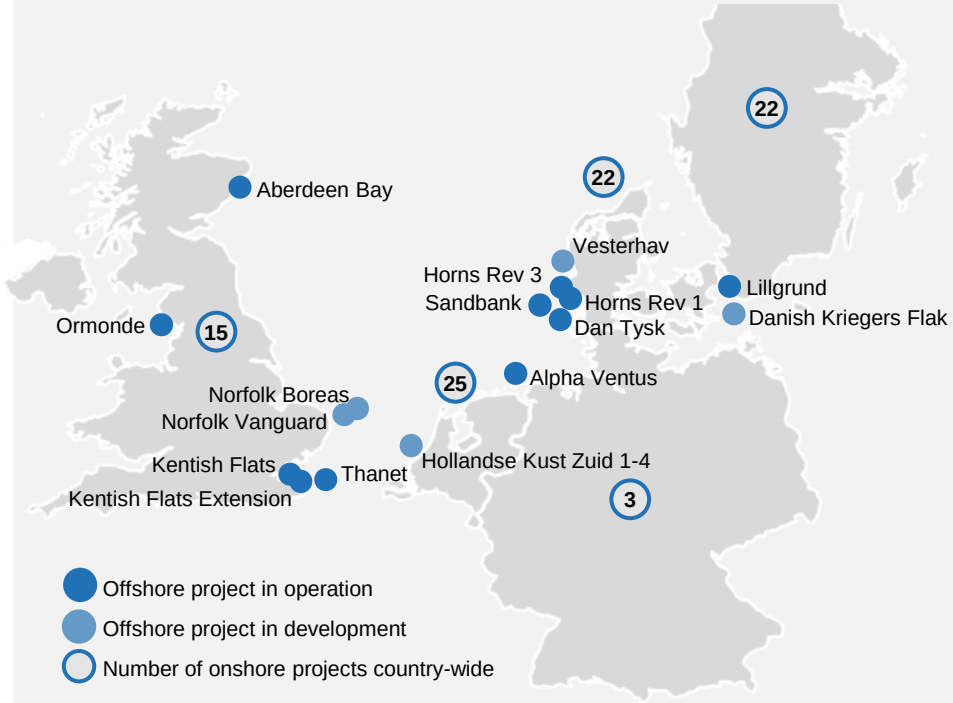
2. Marine Logistics and Installation
3. Pipeline of OWF’s ready for decommissioning
4. Track record decommissioning OWF’s
5. Lessons Learned
6. Transition from past to “present”
7. Transition from “present” to future
8. Challenges in OWF Decommissioning
9. Questions



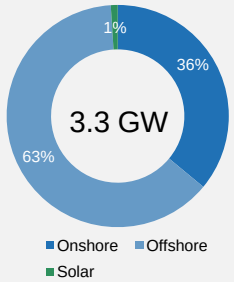
Vattenfall Offshore Wind

Geographical overview

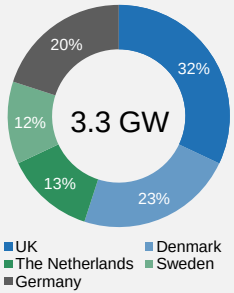


Operating assets

Split by type of generation



Split by geography



Under construction and pipeline

> 3 GW	Wind projects under construction
> 6 GW	Wind projects in development
> 1 GW	Solar projects in development
60 MW	Batteries pipeline

as of June 2020

Decommissioning is part of the Marine Logistics & Installation department

Marine Logistics & Installation

Marine Logistics & Installation is, the center of competence in the areas of offshore installation, offshore construction and logistics solutions for offshore installation and maintenance, within the backbone of Engineering.

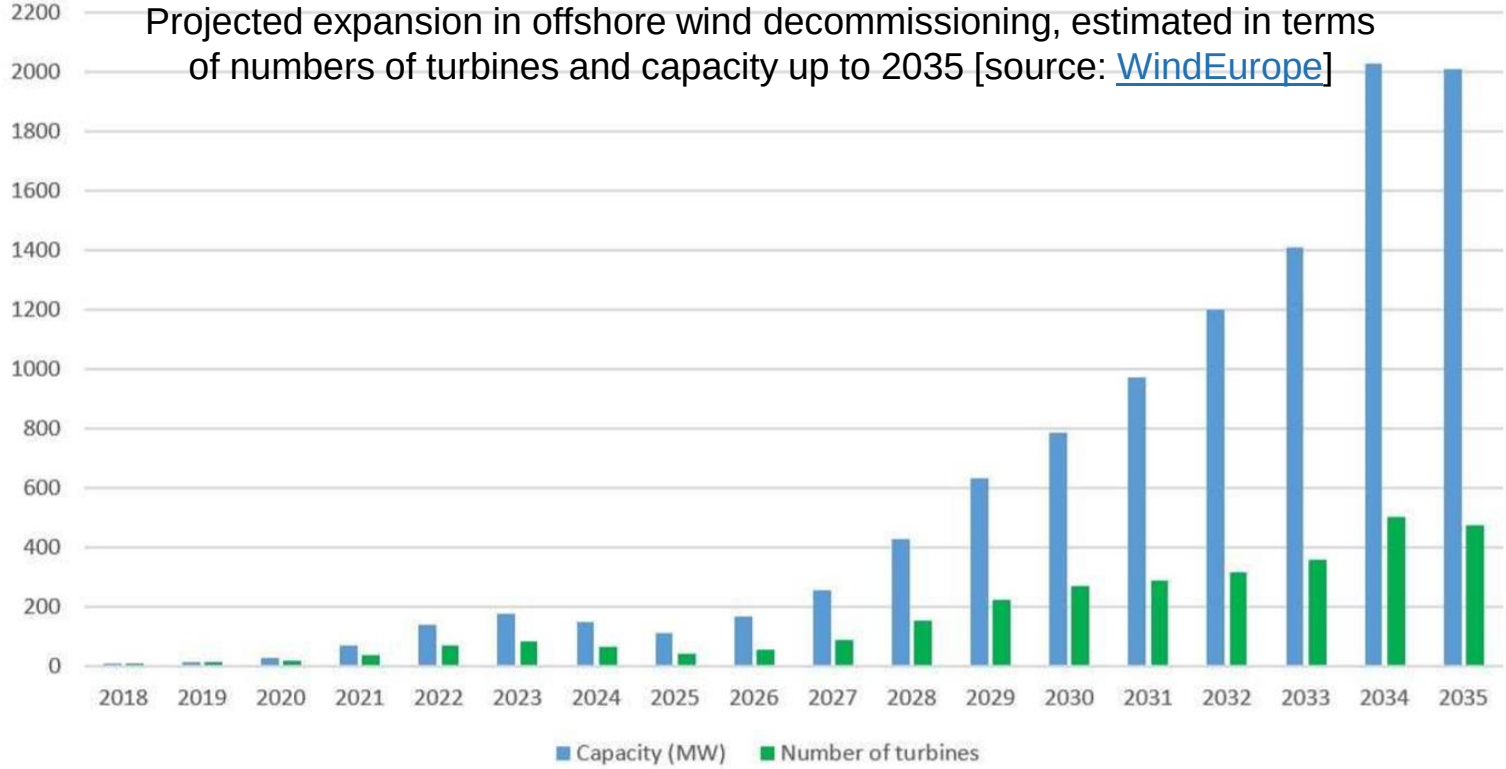
*"We are engaged from the early phases of a development project, in supporting the business cases, developing the building blocks for the development portfolio, the installation, construction and maintenance of an offshore wind site and finally **decommissioning** of the wind farm"*

Marine Logistics & Installation aim to be a trusted and engaged partner for both internal as well as external customers and suppliers.

Look ahead of decommissioning Offshore Wind Farms

Pipeline of OWF's ready for decom (1/2)

Projected expansion in offshore wind decommissioning, estimated in terms of numbers of turbines and capacity up to 2035 [source: WindEurope]



Look ahead of decommissioning Offshore Wind Farms

Pipeline of OWF's ready for decom (2/2)

Currently developers focus on Lifetime Extension (LTE) of running assets

▼

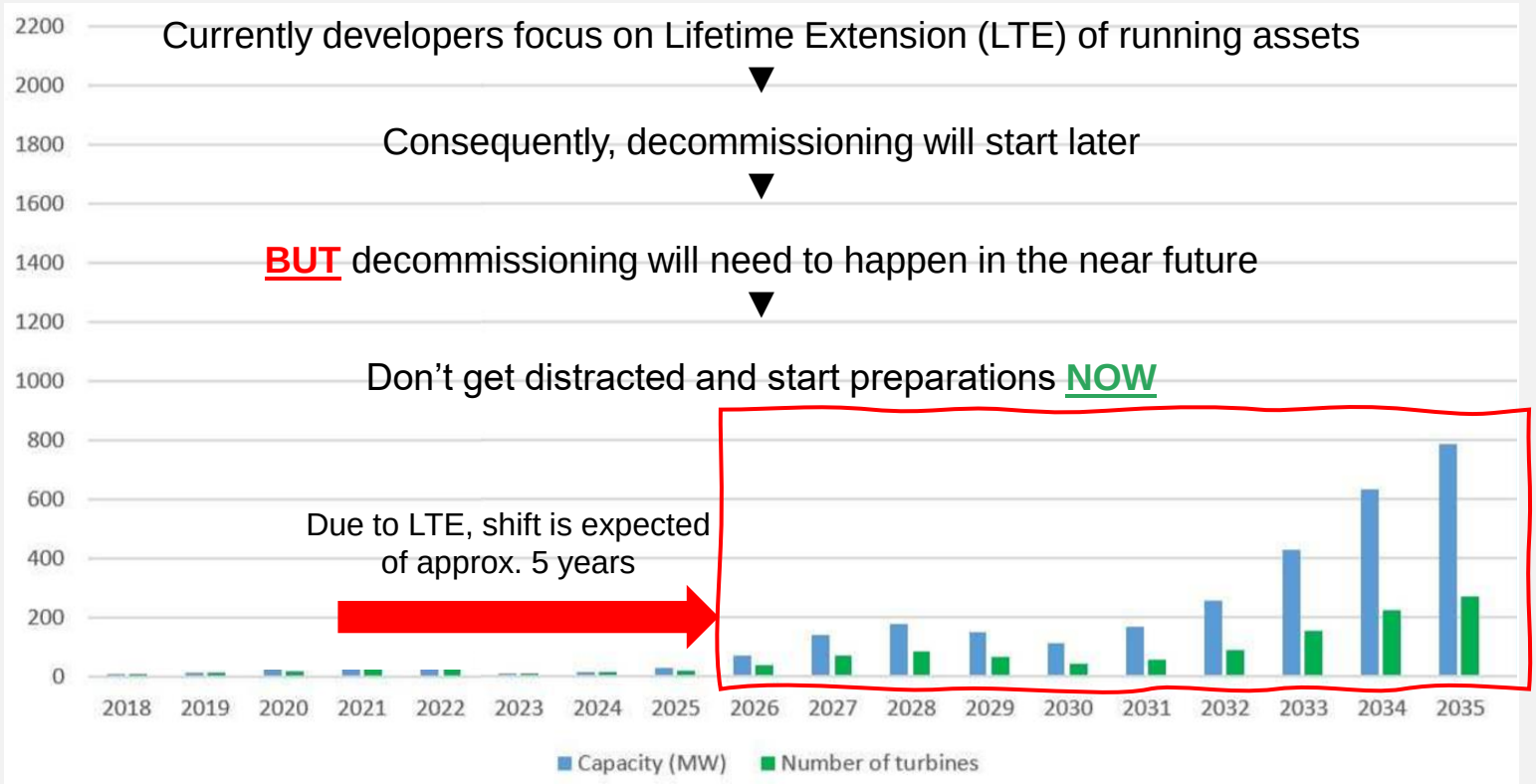
Consequently, decommissioning will start later

▼

BUT decommissioning will need to happen in the near future

▼

Don't get distracted and start preparations **NOW**



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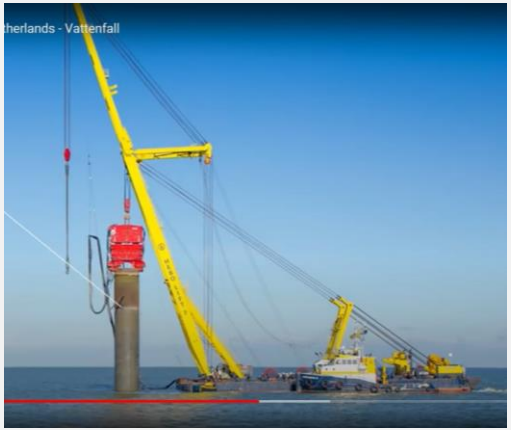
Track record decom OWF's

Yttre Stengrund

- 5 WTGs (NEG Micon 2 MW)
- Commissioned in 2001
- Decommissioning 2015 – 2016
- Monopile cut above seabed



Lely Wind

- 4 WTGs (0,5 MW)
- Commissioned in 1992
- Decommissioned in 2016
- Monopile fully removed

Utgrunden

- 7 WTGs (Enron 1.5 MW)
- Commissioned in 2000
- Decommissioned in 2018
- Monopile cut below seabed

Lessons Learned

Key Takeaways

Start the dialog early.

Create detailed information package.

Allow for flexibility in your contract.

Reflection on how decommissioning of offshore wind will develop

From past to “present” (1 – 9 years from now)

Utgrunden OWF

Horns Rev 1 OWF

- Size of components more or less the same
- Increase in scope (now including OSS / scour protection)
- Step change in quantities (from 7 WTG’s per OWF to 80 – 100 WTG’s per OWF)

Reflection on how decommissioning of offshore wind will develop

From “present” to future

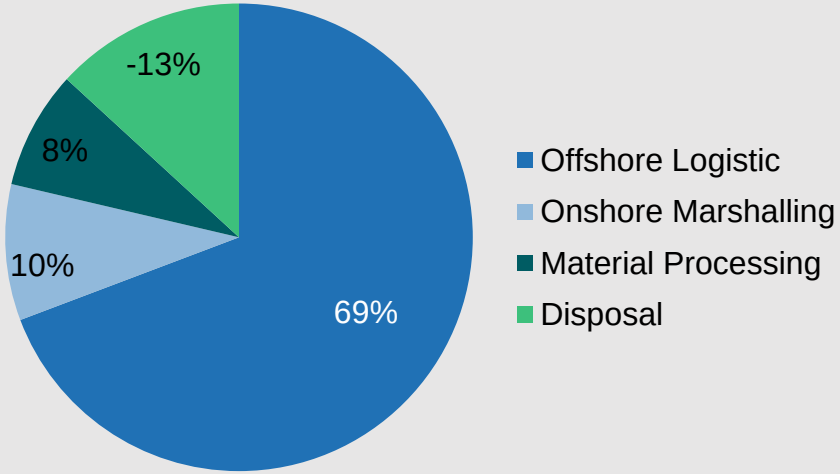
Parameter	Monopile
Diameter	~4 m
Length	~30 m
Mass	180 – 230 mT

Parameter	Monopile XXL
Diameter	~11 m
Length	~100 m
Mass	2,000 – 2,500 mT

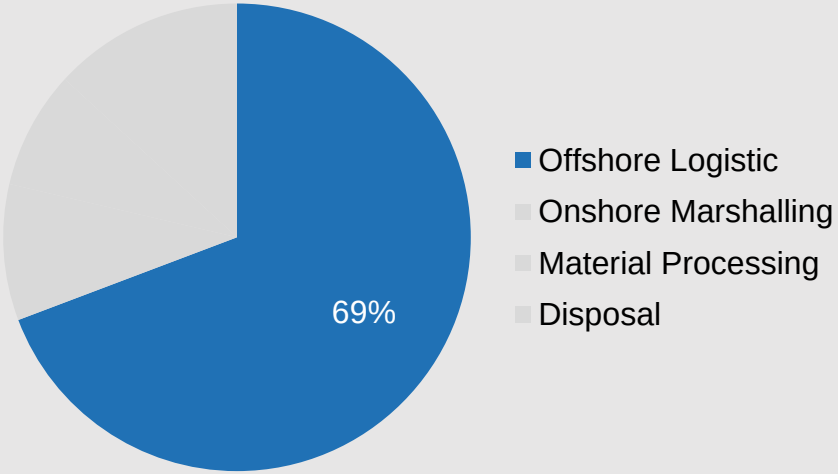
- Quantity of WTG’s more or less the same
- Step change in size of components

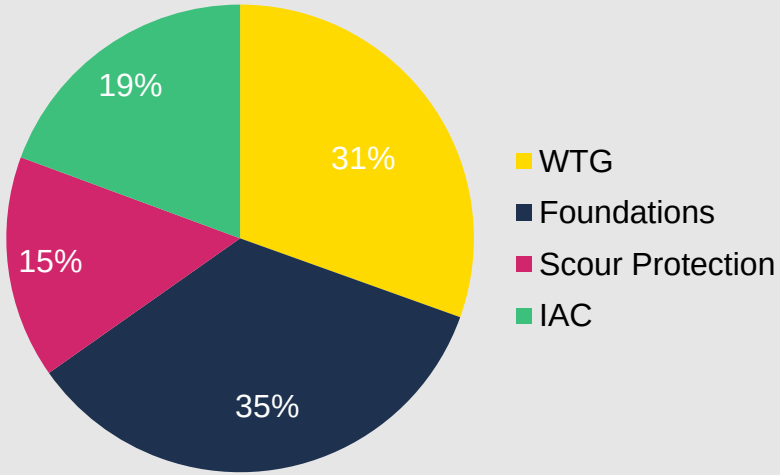
Challenges

Decom Cost Breakdown



Decom Cost Breakdown

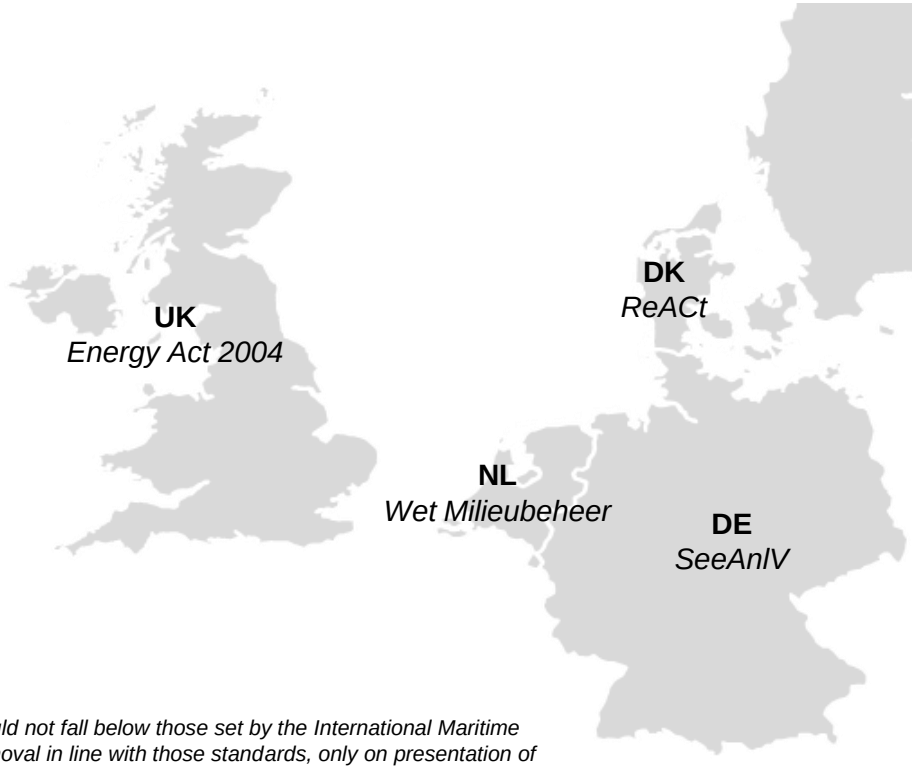




Challenges

Regulatory Framework

- What must be removed? / Remain in-situ?
  - Germany – remove scour protection & cables, foundations partly
  - UK* – remove scour protection & cables, foundations partly
  - NL – enhance scour protection for artificial reefs (Nature inclusive design) decommissioning under discussion, cables to be removed, foundations full or partly removal undefined
  - DK – scour protection to be left in situ or remove, cables remove or buried safely, foundations partly



* 2019 Scotland/UK Guidance "*7.2.2 The standards for the removal of offshore installations should not fall below those set by the International Maritime Organisation (IMO) in 1989 (or successor standards). BEIS will consider exceptions from full removal in line with those standards, only on presentation of compelling evidence that removal would create unacceptable risks to personnel or to the marine environment, be technically unfeasible or involve extreme costs.*

Challenges

Removal Methodology

- Planning 25 - 30 years advance
- Uncertain Vessel Availability
- Uncertain Removal Technology

source: offshoreWIND.biz

source: GS SEACON


“
What’s happening with all the blades?
”
source: Bloomberg Green

Challenges

Blade Recycling

- Goal: be a driving force to reach 100% recycling of wind turbine blades
- Technology development through collaboration

source: WFB Wirtschaftsförderung Bremen GmbH

Thank you

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