ReWind
Designing in circularity at the lowest cost
MASTS 2023
Captain Stephen Norman – Business Development Director
Agenda

1 – Circularity and planning for Decom
2 - What is ReWind?
3 - Insights
A proud legacy of safeguarding life, property, and the environment

- 156 years
- 142,000 employees
- 100,000 customers
- 100+ countries
- 5% invested in R&D of annual revenue

- Ship and offshore classification and advisory
- Energy advisory, certification, verification and monitoring
- Software and digital solutions
- Management system certification, supply chain and product assurance
Global installed wind capacity to grow by over 650% by 2050

The Market Today

Wind Europe forecasts that over 13GW of wind capacity will be decommissioning by 2030

The Future Potential

World grid-connected electricity generation by power station type

Units: PWh/yr

Source: Wind Europe Repowering Forecast November 2023

Source: DNV ETO 2023
Risk transfer vs Financial Modelling

Cost/investment

Project Initiation
Design Process
Specify
Execute

Operational, financially successful, Project

Retained Risk
Reduce Risk
Avoid Risk
Risk Register

Insurance Transfer of Risk

Certification process, standards, what has been done before

Financial Modelling, cost versus benefit

Verification, contracts, experience and track record

Insurance, broker, underwriter, MWS capability

Cost/investment

Time/schedule

Project Initiation
Design
Specification
Installation
Commissioning
Operation

MWS capability

Operational,
Risk transfer v Financial Modelling in Decommissioning

- Financial Modelling, cost versus benefit
- Certification process, standards, what has been done before
- Verification, contracts, Experience and track record
- Insurance, broker, underwriter, MWS capability

Cost/investment

Project Initiation → Design Process → Specify → Execute

Retained Risk → Reduce Risk → Avoid Risk

Risk Register

Insurance Transfer of Risk

Financially successful, Life extension/Decom

designs, testing, operation, decommissioning

Certification process, standards, what has been done before

Experience and track record

Insurance, broker, underwriter, MWS capability

Project Initiation → Design → Specification → Installation → Commissioning → Operation

Decommissioning
Lifetime Utilisation

Can the assets be refurbished, are the replacement parts still available and what is the cos v benefit of like for like intervention?

Are we convinced that we have reached end of life for the asset? What are the removal costs and how do we offset those at the earliest stages to understand our future liabilities? Have the assets been designed for removal?

Are the structures able to take alternative models and if so, what does this do for the O&M strategy equally for the remaining fatigue live of the structure. Is replacement compatible with the electrical design or are further mods required?
UK SAFETY CASE REGULATIONS – The Verification Process
What are the biggest considerations governing life extension choices?

**Onshore**

**Scope:**
- Permitting conditions, repowering
- Roads, crane pads, cables, foundations, substation, met masts, site buildings

**Methodology:**
- Crane and machinery costs, labour costs
- Turnkey decommissioning or multi-contract
- Resale, recycling or landfill
  - Minimise cost or maximise circularity

**Offshore**

**Scope:**
- Environmental considerations
- Foundations, scour, protection, cables, offshore substation, piles below seabed

**Methodology:**
- Vessel day rates
- Time to dismantle and transport components
- Availability of material processing at port
These are the most difficult tasks, according to 100+ industry professionals

- Sustainable end-of-life planning (58% of those surveyed)
- Achieving maximum recyclability (74% of those surveyed)
- End-of-life cost forecasting (68% of those surveyed)
# When do you need a decommissioning business model?

<table>
<thead>
<tr>
<th>Year</th>
<th>-5-0</th>
<th>0-20+</th>
<th>20-35</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Development</strong></td>
<td>![Checkmark] Generate decommissioning costs and circularity rates for:  - Land lease agreements  - Permit and auction applications  - Project financing</td>
<td>![Dollar] Provide decommissioning cost estimates for:  - Annual audits compliance  - Decommissioning bond updates</td>
<td>![Recycle] Plan and execute decommissioning projects at the highest circularity level for the lowest cost</td>
</tr>
</tbody>
</table>

## Optimise to

- Minimise decommissioning costs
- Or
- Maximise circularity
ReWind ensures success and saves time at every phase of the renewables project life cycle.

• **FINANCIALS** - Calculate the decommissioning cost and residual value of renewables projects with our market-leading materials database and cost models

• **PROJECT PLANNING** - Identify project planning, bidding, and reporting inputs such as asset material breakdown, project circularity rate, and decommissioning costs

• **SUPPLY CHAIN** - Discover local decommissioning partners and new recycling methods through our supply chain database - an industry first!
The material composition of your wind farm

Over 80% of a wind farm’s materials are metals

<table>
<thead>
<tr>
<th>Material</th>
<th>Weight</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>147.46</td>
<td>62.88%</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>42.25</td>
<td>18.02%</td>
</tr>
<tr>
<td>Copper</td>
<td>3.95</td>
<td>1.68%</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2.63</td>
<td>1.21%</td>
</tr>
<tr>
<td>Rare earths</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Glass fibre</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Epoxy Resin</td>
<td>4.59</td>
<td>0.58%</td>
</tr>
<tr>
<td>PUR/PVC Foam</td>
<td>0.63</td>
<td>0.27%</td>
</tr>
<tr>
<td>Balsa Wood</td>
<td>0.88</td>
<td>0.37%</td>
</tr>
<tr>
<td>Epoxy Gelcoat</td>
<td>0.50</td>
<td>0.21%</td>
</tr>
<tr>
<td>Silicon</td>
<td>0.40</td>
<td>0.17%</td>
</tr>
<tr>
<td>Other</td>
<td>14.02</td>
<td>5.98%</td>
</tr>
<tr>
<td>Total Weight</td>
<td>234.50</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

**Cirularity Rate:** 61.08%
The decommissioning scope is the largest cost driver

**Full Decommissioning**

- Choose project
- Select providers
- Define scope
- Summary

**Turbine removal only**

- Choose project
- Select providers
- Define scope
- Summary

The decommissioning scope includes:

- Access roads to be removed?
  - Yes
- Are there foundations beneath the road to be removed?
  - Yes
- Are the local crane pads at each turbine base to be removed?
  - Yes
- Are there foundations beneath the crane pad to be removed?
  - Yes
- Do the cables need to be removed?
  - Yes
- Deeper reclamation of foundation required than 1 m below ground?
  - Yes
- Is there a top-soil storage area on site possible?
  - Yes
- Does the substation need to be removed?
  - Yes
- Is the met mast to be removed?
  - Yes
- Any other building or constructions on site?
  - Yes
- Building to be removed?
  - Yes

Include scrap value of wind farm

**Cost Analysis**

- Deassembly cost
- Removal cost
- Material disposal cost
- State disposal cost
- Foundations removal cost
- Cable removal cost
- Removal of other on-site constructions
- Access roads removal cost
- Crane pads removal cost
- Frangible cost
- Project overhead cost
- Turbine metal scrap value
- Total

Include scrap value of wind farm
Modelled in ReWind based on 15 x 2MW turbines and associated infrastructure in the UK
# Offshore decommissioning costs

## Cost categories and percentages of total cost:

<table>
<thead>
<tr>
<th>Cost category</th>
<th>% of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dismantling and transportation of offshore wind turbines</td>
<td>29%</td>
</tr>
<tr>
<td>Removal of array cables</td>
<td>7%</td>
</tr>
<tr>
<td>Preparation for removal of foundations</td>
<td>3%</td>
</tr>
<tr>
<td>Removal of foundations</td>
<td>17%</td>
</tr>
<tr>
<td>Removal of export cables</td>
<td>2%</td>
</tr>
<tr>
<td>Removal of offshore substation</td>
<td>20%</td>
</tr>
<tr>
<td>Overhead costs</td>
<td>21%</td>
</tr>
<tr>
<td>Scrap value</td>
<td>-21%</td>
</tr>
</tbody>
</table>

Figures based on ReWind software usage May – October 2023

[Graph showing the percentage distribution of costs]
ReWind’s is used throughout the full wind farm life cycle

<table>
<thead>
<tr>
<th>Year</th>
<th>-5-0</th>
<th>0-25</th>
<th>30-35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>Project Development</td>
<td>Ongoing operations</td>
<td>Decommissioning</td>
</tr>
<tr>
<td>Customer</td>
<td>Wind farm developers</td>
<td>Wind farm owners and operators</td>
<td>Wind farm owners and operators</td>
</tr>
<tr>
<td>Segment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers</td>
<td><img src="#" alt="Orsted" /> <img src="#" alt="SOURCE GALILEO" /> <img src="#" alt="vågrønn" /></td>
<td><img src="#" alt="Orsted" /> <img src="#" alt="sse" /> <img src="#" alt="nergia" /></td>
<td><img src="#" alt="Invenergy" /> <img src="#" alt="sse" /> <img src="#" alt="nergia" /></td>
</tr>
</tbody>
</table>

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Testimonials

“We joined ReWind as we saw exciting potential in this new service from DNV. ReWind’s easy to use, market-leading decommissioning and recyclability software provides material breakdown assessments of our wind farms, along with automated decommissioning cost assessments. We believe the industry-leading platform will enable us to calculate the residual value of our assets and maximize the circularity of our projects, whilst unlocking significant time savings.

We have been impressed with the support and customer centric approach of the ReWind team as they continue to develop the service based on our feedback.”

Senior Circularity Specialist

“ReWind offers a comprehensive process, with an end product that’s presented in a very user-friendly format. Some key areas were identified to address at various stages of a project, including development, construction, operation and end of life. It is also a valuable tool for assisting with end of life financial accruals. ReWind gives a very thorough assessment of recyclability options for your assets and considerations to take on board – it’s a highly recommended process to complete.”

O&M Engineering Manager
ReWind

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