Challenges with Offshore Grid Connections

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The German Government fosters the transformation to renewable energy generation and strongly supports the offshore wind development.

The legal and regulatory framework focuses on:
- timely building on command for on the spot requirements
- minimised environmental impact
- availability and efficiency
Long Distance and Large Scale Connection Concept

- Wind Turbines
- OWF Platforms
  - Transformers
  - Shunt Reactors
- AC Cables
- Conv. Platform
  - Switchgear
  - Transformers
  - Converter
- DC Cables
  - Offshore
  - Onshore
- Conv. Station
  - Converter
  - Transformers
  - Switchgear
- Onshore AC Grid

OWF Platforms

- Optimised number of cable systems
- Standardised interface to OWFs
- Partial redundancy via parallel systems
- Cost efficient solution
- Additional converter platform

TenneT

Conv. Platform

OWF Platforms

OWF 1

OWF 2

12-sm-zone

dikes

BorWin1/2

9th May 2012
## TenneT’s Offshore Grid Connection Projects

<table>
<thead>
<tr>
<th>In Construction</th>
<th>Capacity</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>BorWin2</td>
<td>800 MW</td>
<td>2013</td>
</tr>
<tr>
<td>DolWin1</td>
<td>800 MW</td>
<td>2013</td>
</tr>
<tr>
<td>DolWin2</td>
<td>900 MW</td>
<td>2015</td>
</tr>
<tr>
<td>HelWin1</td>
<td>576 MW</td>
<td>2013</td>
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<tr>
<td>HelWin2</td>
<td>690 MW</td>
<td>2015</td>
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<tr>
<td>SylWin1</td>
<td>864 MW</td>
<td>2013</td>
</tr>
<tr>
<td>Riffgat</td>
<td>108 MW</td>
<td>2012</td>
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<table>
<thead>
<tr>
<th>In Operation</th>
<th>Capacity</th>
<th>Completion</th>
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<tbody>
<tr>
<td>BorWin1</td>
<td>400 MW</td>
<td>2009</td>
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<tr>
<td>Alpha ventus</td>
<td>60 MW</td>
<td>2009</td>
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<table>
<thead>
<tr>
<th>In Development</th>
<th>Capacity</th>
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</thead>
<tbody>
<tr>
<td>DolWin3</td>
<td>900 MW</td>
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<tr>
<td>BorWin3</td>
<td>900 MW</td>
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<tr>
<td>BorWin4</td>
<td>900 MW</td>
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<tr>
<td>SylWin2</td>
<td>900 MW</td>
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<tr>
<td>DolWin4</td>
<td>900 MW</td>
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</table>

challenges with offshore grid connections
Challenges with Offshore Grid Connections (1)

Legal and Regulatory Framework

- high investment volumes
- build on command and on spot legal requirements
- lack of synchronisation between off- and onshore grid extensions
- limited cable corridors and construction windows
- request for unrealistic short realisation times and parallel licensing
- overload of suppliers, authorities and other stakeholders
Challenges with Offshore Grid Connections (2)

**Technical Risks**

- “new“ technology in a ”new“ environment
- lack of standardisation and references
- lack of construction and maintenance concepts
- grid stability and power quality

- risks for availability of the system and reliability of components
- risks for lifetime of offshore installations and life cycle costs
Biggest Levers for Acceleration and Reliability

Offshore Grid Plan
- planned pipeline of offshore grid connections
- planned cable corridors and platform positions
- synchronisation of off- and onshore grid planning
- standardised system requirements

Standardisation
- DC-connections to onshore: 900 MW, 320 kV
- AC-connections to OWFs: 150 MW, 155kV, ~ 20 km
- platforms: standards for certification
TenneT is Europe’s first cross-border grid operator for electricity. With approximately 20,000 kilometres of (Extra) High Voltage lines and 35 million end users in the Netherlands and Germany we rank among the top five grid operators in Europe. Our focus is to develop a north-west European energy market and to integrate renewable energy. Taking power further.

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