Offshore Wind in Germany

Status and Prospects

Andreas Wagner
Managing Director
Stiftung OFFSHORE-WINDENERGIE
German Offshore Wind Energy Foundation

2014 GLOBAL OFFSHORE WIND
Glasgow, 11 June
German Offshore Wind Energy Foundation

- Founded in 2005 as an independent, non-profit organisation to promote the utilization and research of offshore wind
- Acquisition of **ownership rights (permit) of alpha ventus** (Sep. 2005) – moderated/accompanied process
- Platform for **offshore wind/maritime industry**, incl. **trade associations, policy-makers and research**
- Offices in Varel and Berlin (since Q4/2011)
- **Initiator** of studies/initiatives
  - **Cost reduction** study (Prognos-Fichtner, 2013)
  - **Energy system benefits** study (Fraunhofer IWES, 2013)
  - Collaborative WG between maritime industry and the offshore wind sector
- **Involved in various projects,** e.g. **OffWEA** - consultation, support and moderation
- **PR and public acceptance work**
- **International (EU) Projects**
alpha ventus (DOTI)
- Fully online since 04/2010
- 12 turbines, 60 MW total capacity
- Annual electricity production appr. 250 GWh
- 30 m water depth, 45 km distance to shore

Baltic 1(EnBW)
- Fully online since 05/2011
- 21 turbines, 48 MW total capacity
- 18 m water depth, 15 km distance to shore
- Annual electricity production appr. 190 GWh

BARD Offshore 1 (BARD/Ocean Breeze)
- Fully online since 08/2013
- 80 turbines, total capacity: 400 MW
- 40 m water depth, 90 km distance to shore
- 120 km HVDC sea cable

Riffgat (EWE)
- Fully online since 02/2014
- 30 turbines, 108 MW installed capacity
- 20 m water depth, 15 km distance to shore
- Grid connection delays (OWF completed in 08/2014)
Overview German Offshore Wind Farms
(Status Q1/2014)

- 616 MW operating (online)
- 2,324 MW under construction – meanwhile 2,667 MW (6/2014)
- 872 MW investment decision made – meanwhile 582 MW (6/2014)
Overview German Offshore Wind Farms (Status Q1/2014)

Operational
- alphaventus
- Baltic 1
- Bard Offshore 1
- Riffgat

Under Construction
- Borkum West 2*
- Meerwind Süd/Ost*
- Global Tech 1
- Nordsee Ost
- Dan Tysk
- Borkum Riffgrund 1
- Baltic 2
- Amrumbank West
- Butendiek

582 MW

2,647 MW

616 MW

* OWF construction completed – waiting for grid connection

Initiated by EEG 2009/12

Initiated by EEG 2014?

Initiated by ONEP?

>3,5 GW initiated by EEG 2009/12

Not initiated by EEG 2014?

20+ offshore wind farms fully permitted – almost 7 GW additional capacity
Offshore Grid Connection - a long line of delays, regulatory uncertainty and system change

Dec. 2006 §17 (2a) EnWG: TSOs obliged for grid connection, (in time!)
Oct. 2009 Position Paper by regulator est. criteria for offshore grid connection
Since 2010/11 Grid connection delays – up to 50-60 (+) months instead of 30.
TenneT letter to the government (7 Nov. 2011), raising liability and financing issues

Q1/2012 WG Accelerated Grid Connection (moderated by:SOW) - recommendations to govt. on how to overcome delays
Q3-4/2012 Draft bill for change of EnWG (on system change/liability issues) issued & adopted by govt., adopted by Parliament in late 2012

Jan. 2013 New EnWG enters into force, i.e. regulatory system change → Implementation Guidelines (BNetzA) on liability, capacity transfer,
April 2013 ONEP development by TSOs (OGDP)
Sep. 2013 Federal Election
Dec. 2013 Coalition Treaty - New Targets for RE, including Offshore Wind

Jan. 2014 ONEP 2013 published – enters into force
April 2014 Start of consultation on ONEP 2014 and on grid capacity allocation (with regulator)
Provision of timely(!) grid connection is a prerequisite to achieve government targets!
### Offshore grid connection projects – German North Sea

**Initial Offshore Grid Structure**

**HVDC cable routes & platforms**

<table>
<thead>
<tr>
<th>Project</th>
<th>Capacity (MW)</th>
<th>Year of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In operation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alpha ventus</td>
<td>60</td>
<td>2009</td>
</tr>
<tr>
<td>BorWin1</td>
<td>400</td>
<td>2010</td>
</tr>
<tr>
<td>Riffgat</td>
<td><strong>108</strong></td>
<td><strong>Feb. 2014</strong></td>
</tr>
<tr>
<td><strong>Under construction/ awarded</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BorWin2</td>
<td>800</td>
<td>2015</td>
</tr>
<tr>
<td>DolWin1</td>
<td>800</td>
<td>2014</td>
</tr>
<tr>
<td>DolWin2</td>
<td>900</td>
<td>2015</td>
</tr>
<tr>
<td>HelWin1</td>
<td>576</td>
<td>2014</td>
</tr>
<tr>
<td>HelWin2</td>
<td>690</td>
<td>2015</td>
</tr>
<tr>
<td>SylWin1</td>
<td>864</td>
<td>2014</td>
</tr>
<tr>
<td>Nordergründe</td>
<td>111</td>
<td>2015</td>
</tr>
<tr>
<td>DolWin3</td>
<td>900</td>
<td>2018</td>
</tr>
<tr>
<td><strong>Σ built / awarded</strong></td>
<td><strong>6,209</strong></td>
<td></td>
</tr>
<tr>
<td><strong>In tender phase/recently awarded</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BorWin3, BorWin4</td>
<td>1,800</td>
<td><strong>2019/20</strong></td>
</tr>
<tr>
<td><strong>To be tendered until 2023 according to O-NEP2013</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 addtl. DC-connections</td>
<td><strong>5,400</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: TenneT, 2013, updates SOW 2014
Support for renewable energy - specifies FIT, technology differentiation since 2000

Issues in the past for offshore wind (prior to 2009)

- No investments due to insufficient remuneration (9.1 ct/kWh)

EEG of 2008 (effective since 1st Jan. 2009)

- Increase of initial Feed-in-Tariff (FiT) to 13.0 ct/kWh, plus starter bonus of 2 ct, granted for 12 years after commissioning (for new OWF until 1st Jan. 2016)

EEG of 2011 (effective since 1st Jan. 2012)

- Compressed FiT: Option to claim a higher initial rate of 19 ct/kWh – granted for 8 years, afterwards FiT drops to 3.5 ct/kWh
- Applied for new OWF until 2017
  → Important boost for investment decisions

New challenges emerging in 2012/13:

- Grid connection issues and “Electricity price brake” debate (‘Strompreisbremse’) – Uncertainty about future of the Renewable Energy Act and RE targets

Sep. 2013 - Federal Election →

Coalition Treaty of Dec. 2013: new RE targets (incl. offshore wind) and EEG reform in 2014
EEG 2014 – Revised targets for OWE
(Govt. Proposal of April 2014)

<table>
<thead>
<tr>
<th>Year</th>
<th>IECP* of 2007</th>
<th>§ 3 EEG 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>10 GW</td>
<td>6.5 GW</td>
</tr>
<tr>
<td>2030</td>
<td>25 GW</td>
<td>15 GW</td>
</tr>
</tbody>
</table>

* Integrated Energy and Climate Programme of German Govt.

... but 2-year FIT-extension until Dec. 2019;

NOTE: After 2020, new tendering system for OWE proposed – For other RE tender scheme planned in 2017, based on outcome of PV (greenfield) pilot tender

<table>
<thead>
<tr>
<th>Degression of FIT</th>
<th>para 20 EEG 2012</th>
<th>para 26 EEG 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (base) model</td>
<td>7 % annual degression after 2017</td>
<td>in 2018: 0.5 €ct/kWh</td>
</tr>
<tr>
<td>Compressed FIT</td>
<td>No degression</td>
<td>in 2018: 1.0 €ct/kWh</td>
</tr>
</tbody>
</table>
Cost Reduction Potentials for OWE

Projection of levelized cost of energy (LCOE)

Site B, results in €cent/kWh, based on 2012 real terms

- Decommissioning
- OpEX
- Contingency
- Certification/Approval
- Installation
- Substation
- Internal cable
- Support structure
- Turbine

Learning Curve Effect caused by constant growth
→ economies of scale, increasing competition and growing turbine size

Key assumptions/study results

1. German Energiewende requires 800 TWh coming from wind and solar (by 2050) – can only be realized with large offshore wind capacities!

2. Offshore wind leads to reduced cost for flexibility measures → least-cost option by 2050

3. Offshore wind has considerable power plant characteristics – important for security of supply (provision of balancing power, high schedule reliability, etc.)

4. Stable and continuous expansion of offshore wind capacities required to harvest energy system benefits and cost reduction potentials

More information at:

Study launched in Nov. 2013, at EWEA Offshore 2013, Frankfurt
Offshore Wind Energy in Germany – An illustration of initial achievements

Positive operational results:
- **alpha ventus**: > 4,450 full load hours in 2011 (267 GWh) → 15% above expectations,
- **Baltic I** – similar results; turbine availability 98%
→ **Important contribution to energy system reliability!**

- **More than 1 bn Euro already invested** along German coast - Port infrastructure, production facilities (offshore turbines/components), construction vessels, (converter) platforms etc.
→ **Vast opportunities for maritime industries!**

- **10 billion Euro investment for Offshore Wind Farms** → 8 OWP under construction during Q1/2014

- **1/3 cost reduction potential possible by 2023** – provided a steady project pipeline is secured by stable, reliable framework conditions

- **18,000 jobs** created by 2012 (98,000 jobs in onshore wind)
→ **Need for new and adjusted professional/vocational training and university education!**
Lesson learned: Long lead times for OWF need to be reflected by legal framework.

Idealized (!) Project Schedule for an OWF in Germany:

- **Project development**: 4-6 Years
- **Construction**: 1-2 Years (Construction Permit), 2-4 Years (Financial Negotiations)
- **Operational Phase**: 20 Years (Commissioning)
- **Extension of operation**: 5 Years
- **Decomm.**: 1-2 Years

Total project lifetime: 27-37 years

→ Stable, **long-term political framework conditions** essential for investors, technology innovation and cost reduction!!!
Many thanks for your attention!

Andreas Wagner, CEO

Berlin Office
Schiffbauerdamm 19, D-10117 Berlin
Phone: +49-30-27595-141
Fax: +49-30-27595142
berlin@offshore-stiftung.de

Varel Office
Oldenburger Str. 65, D-26316 Varel
Phone: +49-4451-9515-161
Fax: +49-4451-9515-249
varel@offshore-stiftung.de

www.offshore-stiftung.de

More news & information (German/English)
Backup Slides

German Offshore Windfarms under Construction
> 2.5 GW under construction

Status Report, as of 1st June 2014
Amrumbank West (288 MW)

- 80 turbines (each 3.6 MW)
- **Start of construction**: April 2013
- **Expected start of commissioning**: Q1/2015
- **Grid connection delay**: > 12 months
- Construction progress: 30 foundations installed, Transformer station installed, Infield-cabling under construction
- **Estimated start of full operation**: Q3/2015 (depending on grid connection)
- **Water depth**: 19 - 24 m
- **Distance to shore**: ~ 40 km (north of Helgoland)
Baltic 2 (288 MW) – Baltic Sea

- 80 turbines (each 3.6 MW)
- **Start of construction:** July 2013
- **Expected start of commissioning:** End of 2014
- **Construction progress:**
  - Monopiles and Jacketpiles installed,
  - Jacket installation starting in mid 2014,
  - Turbine delivery, infield cabling in mid 2014,
  - Transformer station installation by end of 2014,
  - Installation of wind turbines in summer 2014
- **Expected start of full operation:** Spring 2015
- **Water depth:** 23 to 44 m
- **Distance to shore:** 32 km, north of Rugen
Borkum Riffgrund 1 (312 MW)

- 80 turbines (each 4 MW)
- **Start of construction**: 2013
- **Expected start of commissioning**: Autumn 2014
- **Construction progress**: 45 foundations installed
- **Expected start of full operation**: by early 2015
- **Water depth**: 28 to 32 m
- **Distance to shore**: 54 km (NW of Borkum)
Butendiek (288 MW)

- 80 turbines (each 3.6 MW)
- **Start of construction**: April 2014
- **Expected start of commissioning**: Middle of 2015
- **Grid connection delay**: 3 months
- **Construction progress**: 36 foundations installed, Transformer station installed, Infield-cabling starting in mid June 2014
- **Expected start of full operation**: End of 2014
- **Water depth**: 17 bis 22 m
- **Distance to shore**: 32 km west of Sylt, 53 km to mainland
DanTysk (288 MW)

- 80 turbines (each 3.6 MW)
- **Start of construction:** End of 2012
- **Expected start of commissioning:** Oktober 2014
- **Grid connection delay:** 12 months
- **Construction progress:** foundations and transformer station installed in 2013, infield-cabling 70% completed, Installation of wind turbines starting in Sep. 2014
- **Expected start of full operation:** Fall 2014
- **Water depth:** 21 - 32 m
- **Distance to shore:** 70 km west of Sylt
Global Tech I (400 MW)

- 80 turbines (each 5 MW)
- **Start of construction**: Middle of 2012
- **Grid connection delay**: 24 months
- **Construction progress**: transformer station installed, 78 foundations and 26 wind turbines installed
- **Expected start of full operation**: Autumn 2014 (BorWin II)
- **Water depth**: 39 to 41 m
- **Distance to shore**: 110 km to Cuxhaven (base port)
Meerwind Süd/Ost (288 MW)

- 80 turbines (each 3.6 MW)
- **Start of construction:** 2012
- **Expected start of commissioning:** 2013
- **Grid connection delay:** 24 months
- **Construction progress:** foundations, transformer station and offshore wind turbines completely installed since March 2014
- **Expected start of full operation:** October 2014
- **Water depth:** 30 m
- **Distance to shore:** 23 km NE of Helgoland, 105 km to Cuxhaven, 120 km to Bremerhaven
Nordsee Ost (295 MW)

- 48 turbines (each 6.15 MW)
- **Start of construction:** 2012
- **Expected start of commissioning:** Fall 2013
- **Grid connection delay:** approx. 24 month
- **Construction progress:** foundations, infield-cabling completely installed, Installation of wind turbines since May 2014
- **Expected start of full operation:** Spring 2015
- **Water depth:** 22 - 26 m
- **Distance to shore:** 32 - 45 km
Trianel Windpark Borkum (phase 1: 200 MW)

- 40 turbines (each 5 MW)
- **Start of construction**: Summer 2011
- **Expected start of commissioning**: End of 2012/Beginning of 2013
- **Grid connection delay**: 18 months
- **Construction progress**: OWF completely installed since 1st June 2014
- **Expected start of full operation**: Summer 2014
- Water depth: 29 to 33 m
- **Distance to shore**: 45 km north of Borkum