The significance of a meshed offshore grid in the North Sea from an energy-economic perspective - The German experience

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German Offshore Wind Energy Foundation

NorthSeaGrid Workshop: Interconnected Offshore Grid – Barriers & Solutions Bremen, 18 June 2014
Side Event of WINDFORCE 2014

Overview

1. **Stiftung OFFSHORE-WINDENERGIE**

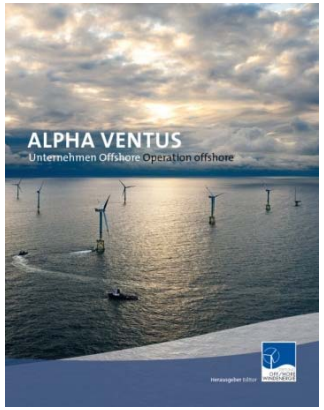
2. Status of Offshore Wind Energy Development in Germany

3. New Regulatory Regimes for Offshore Grid Connection
   - EnWG
   - BFO
   - O-NEP

4. Conclusion

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

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German Offshore Wind Farms Operational and grid-connected (Q1/2014)

alpha ventus (DOTI)

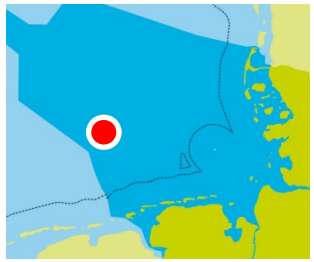
- Fully online since 04/2010
- 12 turbines, 60 MW total capacity
- Annual electricity production appr. 250 GWh
- 30 m water depth, 45 km distance to shore

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)

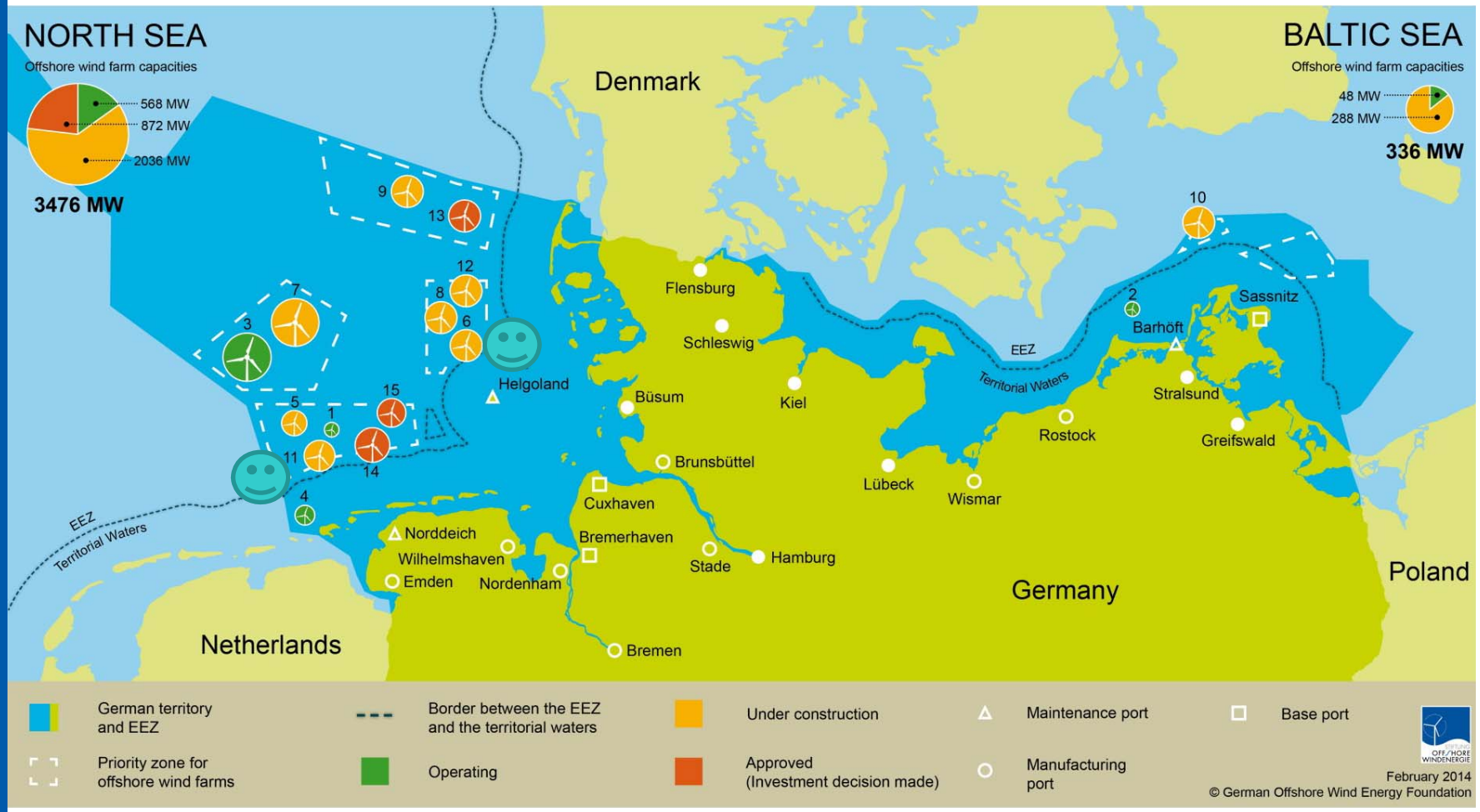
- Fully online since 08/2013
- 80 turbines, total capacity: 400 MW
- 40 m water depth, 90 km distance to shore
  120 km HVDC sea cable



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)
- 2324 MW under construction – meanwhile 2,647 MW (6/2014)
- 872 MW investment decision made – meanwhile 582 MW (6/2014)

Overview German Offshore Wind Farms
(Status Q2/2014)

> 3,5 GW initiated by EEG 2009/12

Initiated by EEG 2014?

Initiated by ONEP?

Operational

- ✓ alpha ventus
- ✓ Baltic 1
- ✓ Bard Offshore 1
- ✓ Riffgat

616 MW

Under Construction

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

2,647 MW

* OWF construction completed – waiting for grid connection

FID made

Gode Wind I & II

582 MW

FID open

Veja Mate
Deutsche Bucht
Albatros I
MEG Offshore 1
Nordergründe
Sandbank
Nordsee One
Borkum Riffgrund 2
Borkum Riffgrund West 1
Wikinger
Arkonabecken Südost
Trianel Windpark Borkum (2.BA)

3,341 MW

FID open

Nördlicher Grund
Hohe See
HeDreiht
Kaikas
Delta Nordsee 1
Nordsee Two
Nordsee Three
West

3,650 MW

2010 - 2014 — ***Commissioning***

2014 - 2015

2015 - 2016

20+ offshore wind farms fully permitted –
appr. **7 GW additional capacity**

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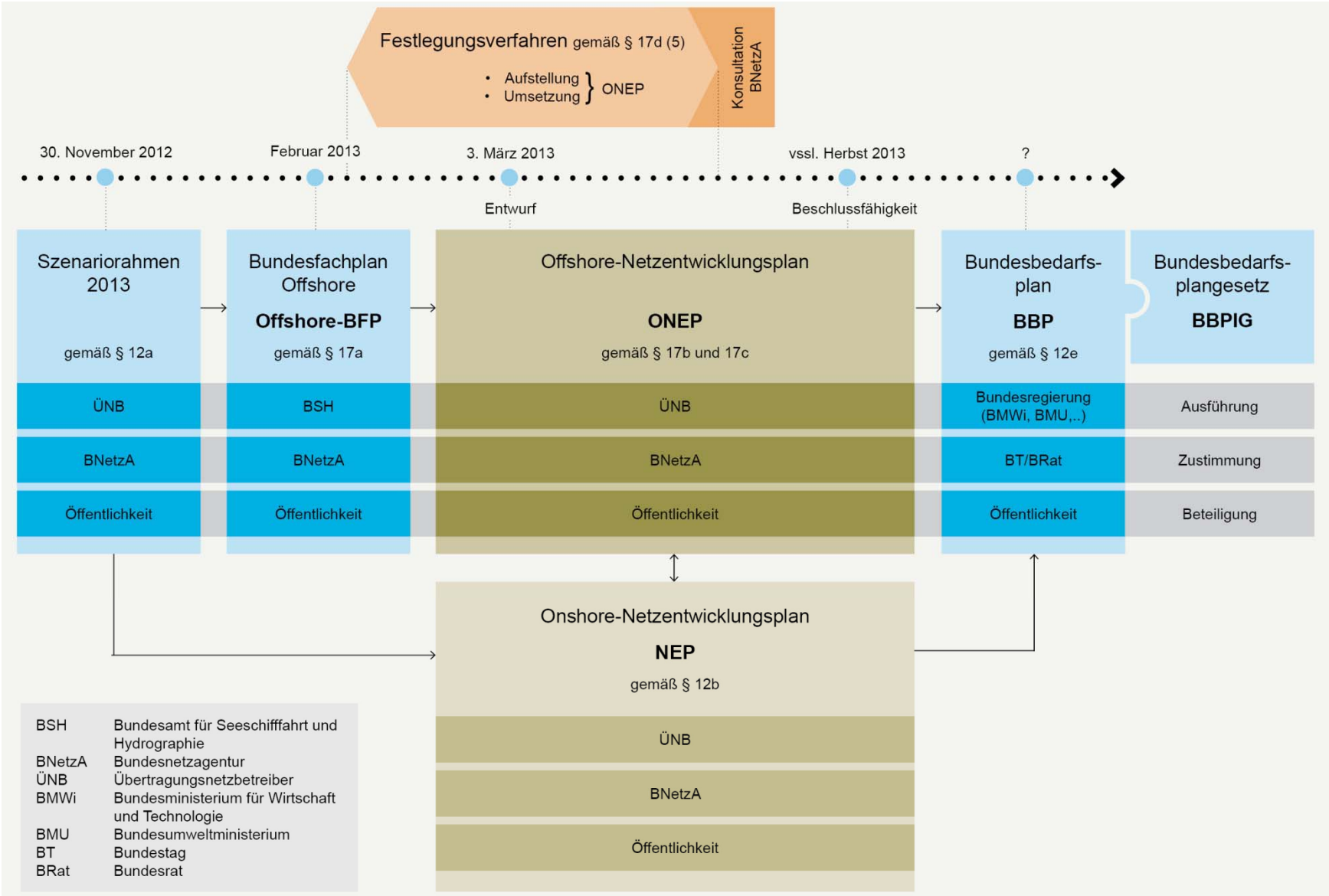
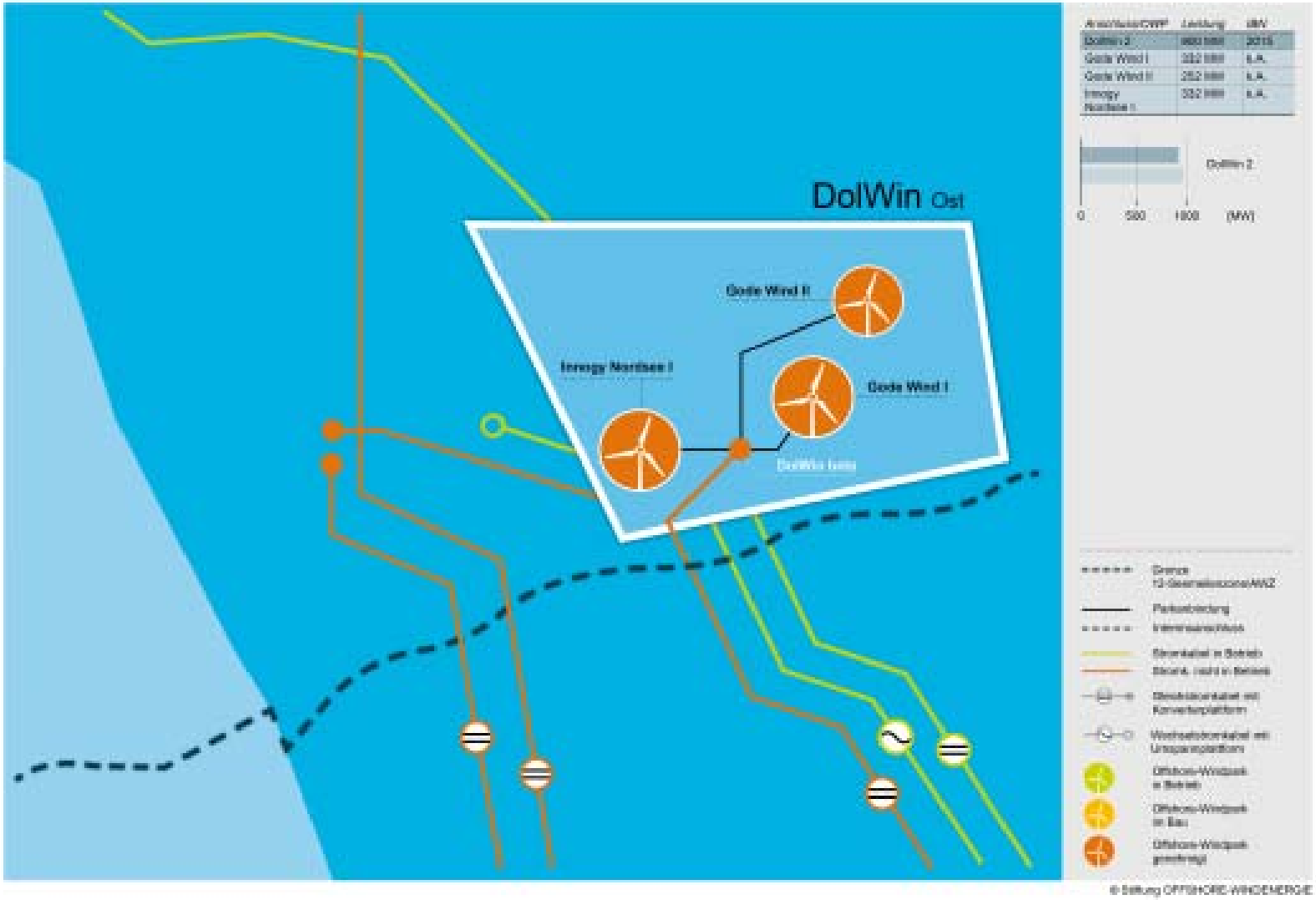
Offshore Grid Connection - a long line of delays, regulatory uncertainty and system change

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 months (as envisaged by PP of 2009); 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) proposed by govt. in summer, adopted by Parliament in late 2012
Jan. 2013	**New EnWG** enters into force, i.e. **regulatory system change** → Implementation Guidelines (BNetzA) on liability issues and capacity transfer consulted during 2013/14,
April 2013	**ONEP 2013** (OGDP) draft issued for consultation by TSOs
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 (with TSOs) and on grid capacity allocation (with regulator)*

EnWG 2013 – System Change for Offshore Grid Connection



Offshore Grid Development Plan (ONEP)
‚Start Grid' according to ONEP 2013



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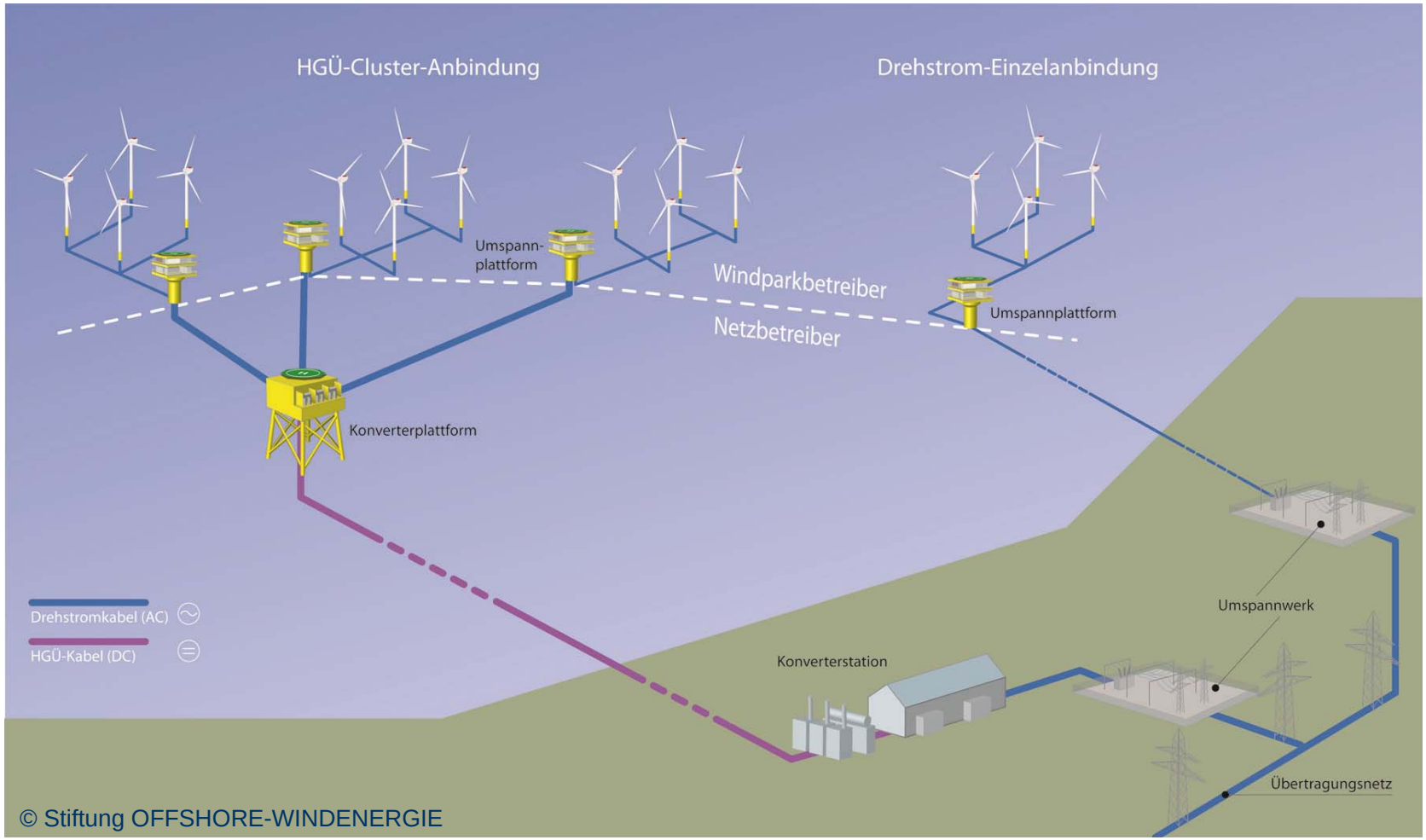
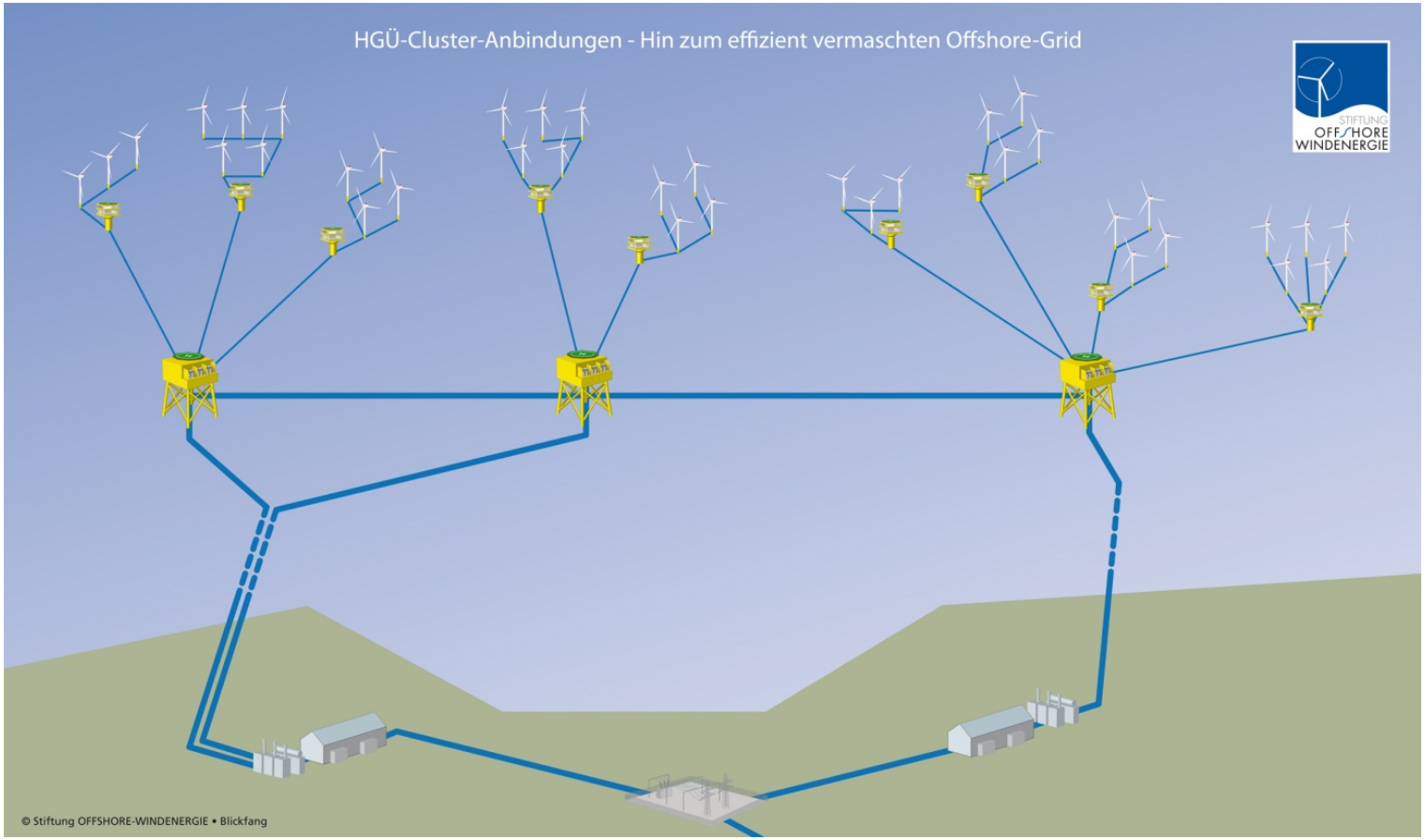
Start-Offshorenetz in der Nordsee gemäss erstem Entwurf Offshore-Netzentwicklungsplan 2013 | DolWin Ost

OWF cluster connection – a step in between radial grid and meshed grid design

Approach so far: individual (DC) grid (cluster) connections -
Contains substantial risk to energy system stability and economics



Future Perspective - Meshed Offshore Grid Stepped Approach needed



Aim:

Create a „flexible" offshore grid - ‚applied consumer protection!

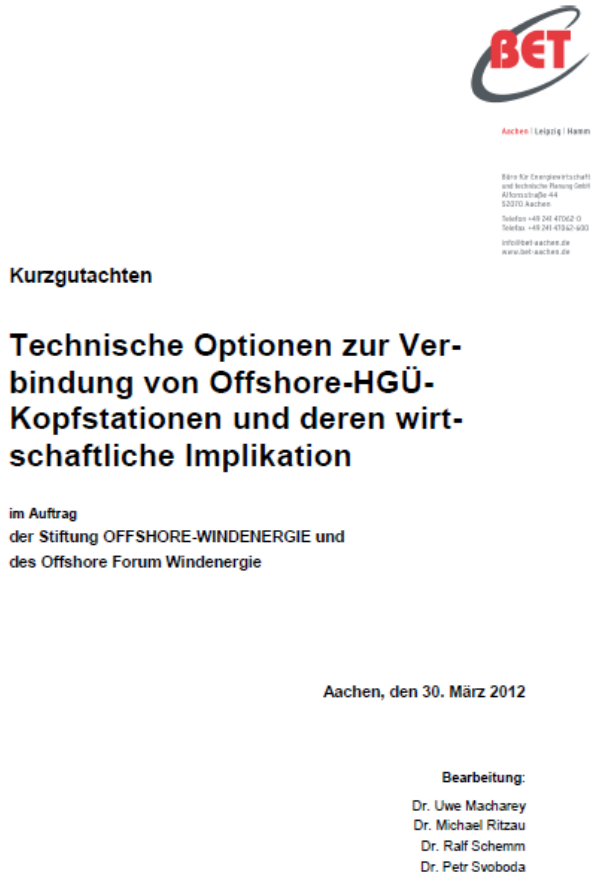
- Minimising grid interruptons and delays in grid connection
- Continuously ensuring **system safety and stability**
- Risk mitigation

→ **Can/should be implemented in the short/medium-term**

Risk mitigation strategies for offshore grid (para 17f EnWG)

Risk mitigation strategies are available (acc. to state of the art) - have to be considered by TSOs (part of O-NEP):

- ***Realisation Schedules*** (part of O-NEP, acc. para 17d EnWG), incl. option to prioritise certain grid connections
- ***Grid connection management*** and temporary grid connection measures require technical implementation and cost allowance by the regulator
- ***Meshed grid*** (connection of various OWF clusters/converter stations) – ensures system stability in case of damage/failure of a DC cable/platform (**see BET study on economic benefits**)


Kurzgutachten

Technische Optionen zur Verbindung von Offshore-HGÜ-Kopfstationen und deren wirtschaftliche Implikation

im Auftrag
der Stiftung OFFSHORE-WINDENERGIE und
des Offshore Forum Windenergie

Aachen, den 30. März 2012

Bearbeitung:
Dr. Uwe Macharey
Dr. Michael Ritzau
Dr. Ralf Schemm
Dr. Petr Svoboda

Risk mitigation strategies have been incorporated in the EnWG

Objective: *Optimise system economic and technical solutions and reduce potential liability exposure.*

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Energy System Benefits of Offshore Wind

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
5. Further significant cost savings can be achieved by the European collaboration on a North Sea offshore grid for BE, DE, DK, GB, N, and the NL. Making use of cross-border balancing capacity and increased electricity trade **decreases the total residual load for all of the North Sea countries by 16 percent** → from 98 GW to 82 GW

Fraunhofer IWES

FRAUNHOFER INSTITUTE FOR WIND ENERGY AND ENERGY SYSTEM TECHNOLOGY

THE IMPORTANCE OF OFFSHORE WIND ENERGY IN THE ENERGY SECTOR AND FOR THE GERMAN ENERGIEWENDE

Summary

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More information at:
http://www.offshore-stiftung.com/60005/Uploaded/SOW_Download|FraunhoferIWES_OffshoreStudy_ExecutiveSummary.pdf

Study launched in Nov. 2013,
(EWEA Offshore 2013, Frankfurt)

Realising cost reduction potentials requires active commitment and participation of all stakeholders

Recommendations for:

→Policy and Regulatory Environment

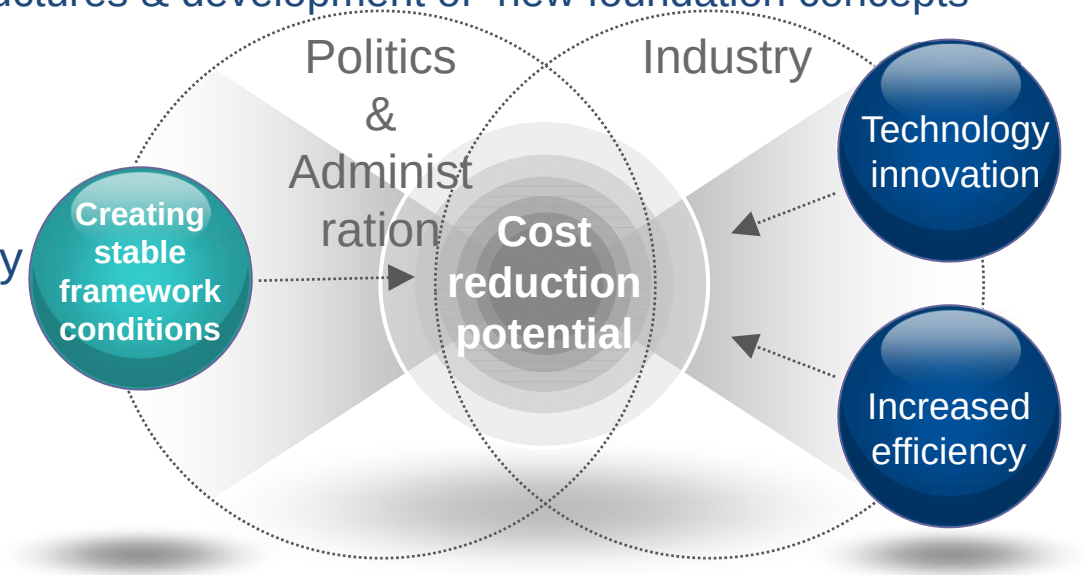
- Stable legal and policy frameworks to ensure dynamic market development → **key requirement/prerequisite**
- Common standards for components and for grid connection
- Simplified criteria for certification and permitting

→ Industry (developers/technology suppliers) to accelerate techology innovation:

- Optimised system (plant) technology to maximize energy yield/operational hours
- Optimised existing support structures & development of new foundation concepts
- Improve installation logistics
- Intensify R&D efforts

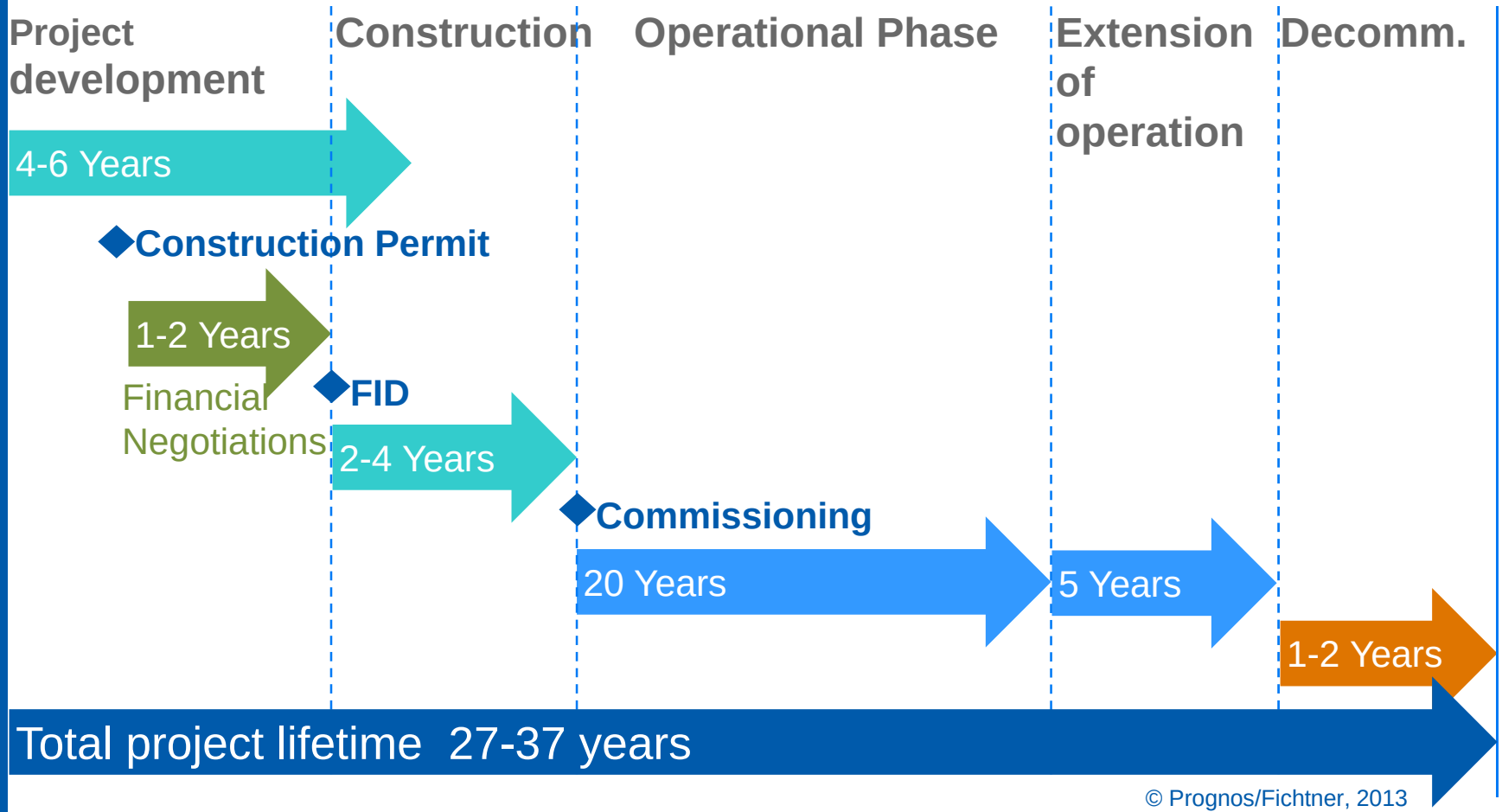
→ Industry to improve efficiency

- Develop joint concepts for installation/O&M (pooling)
- Accelerate serial production efforts (incl. automation)



Long lead times for OWF need to be reflected (large power plant schedules)

Idealized (!) Project Schedule for an OWF in Germany



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

Conclusion and open questions for debate

- **Financial barriers:**
  How can TSOs ensure a sustainable financing of grid investments?
  (both offshore and onshore, e.g. overlay-grid).
  Need of a strong and capable organisational structure – ensure system stability and proper management of the ‚Energiewende‘, e.g. creation of a national O-TSO /European (North Sea) OFTO?
- **Regulatory and Technical barriers:**
  Systematic (step-by step) approach to accelerate implementation, e.g. *long-term grid planning incl. meshed grid, standardisation and implementation schedules* contribute to:

  - Substantial *reduction of risk exposure* in case of grid failures/damages
  - Creation of a *flexible and stable (offshore) grid* by common technical standards and regulatory provisions
  - Substantial *reduction of downtime/repair times* by spare parts management (studies by MARSH and Deutsche. WindGuard, 2012)

  → Helps creating **improved conditions for financing/insurance** for (offshore) grid connection systems (DC) and OWFs.
- **Demonstration projects** on a bilateral/trilateral basis needed (with EU support) **to prove technical feasibility, identify and deal with regulatory barriers**
  → take into account long lead times of offshore projects and resolve regulatory/financial barriers separately and more long-term

Many thanks for your attention!

Andreas Wagner, CEO

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More news & information (German/English)

OFFSHORE-WINDENERGIE.NET

Backup Slides

Legal Framework for Offshore Wind
A short History of the EEG (RE Act)

Support for renewable energy - specifies FIT, technology differentiation since 2000

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

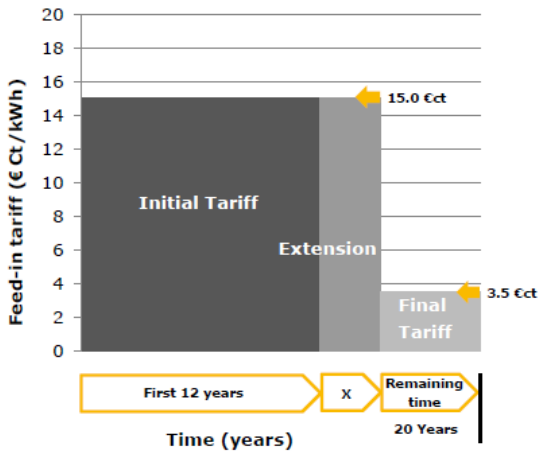
- ➢ No investments due to insufficient remuneration (9,1 ct/kWh)

EEG of 2008 (entered into force on 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 commissionig (valid new OWF until 1st Jan. 2016)

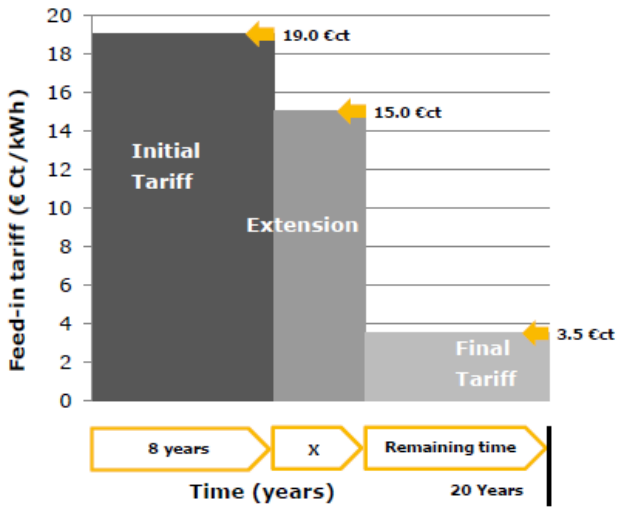
EEG of 2011(entered into force on 1st Jan. 2012)

- ✓ **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

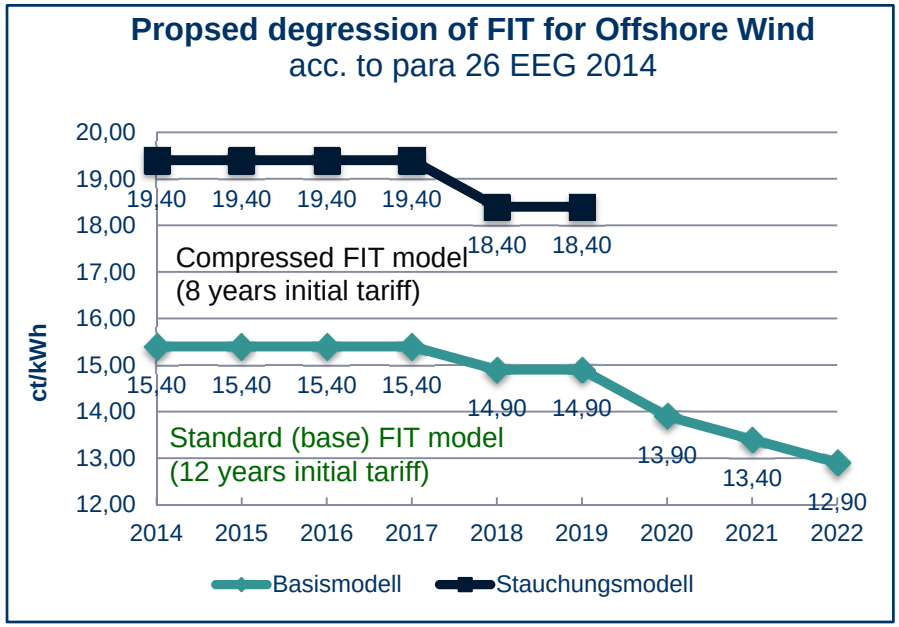
Sep. 2013 - Federal Election → Grand Coaliton – Coalition Treaty of Dec. 2013: **new RE targets** (incl. offshore wind) and **EEG reform in 2014**



EEG 2014 – Revised targets for OWE
(Govt. Proposal of April 2014)

Year	IECP* of 2007	§ 3 EEG 2014
2020	10 GW	6,5 GW
2030	25 GW	15 GW

* 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 in 2017, based on outcome of PV (greenfield) pilot tender

Degression of FIT	para 20 EEG 2012	para 26 EEG 2014
Standard (base) model	7 % annual degression after 2017	in 2018: 0,5 €ct/kWh in 2020: 1,0 €ct/kWh
Compressed FIT	No degression	in 2018: 1,0 €ct/kWh

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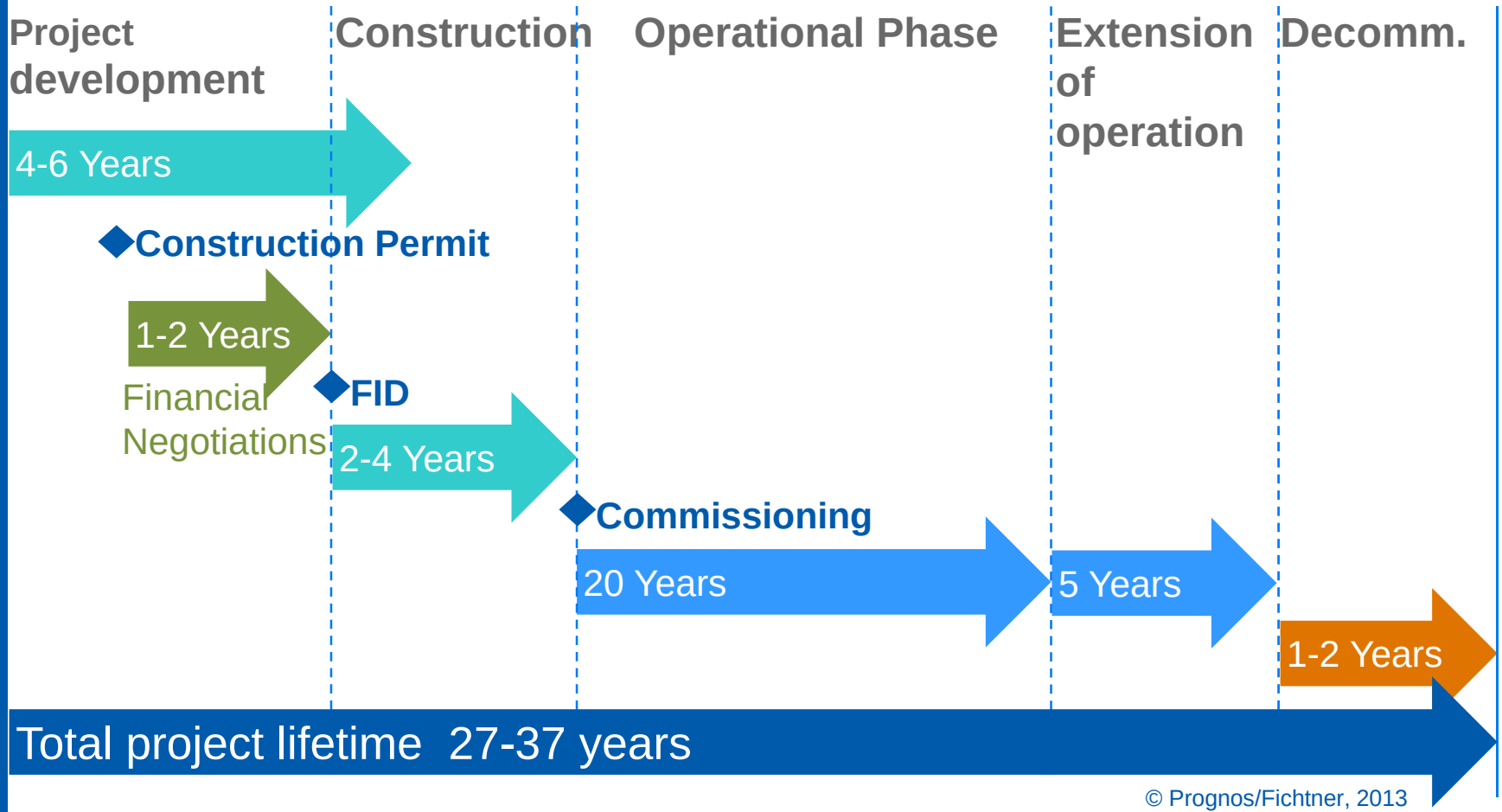

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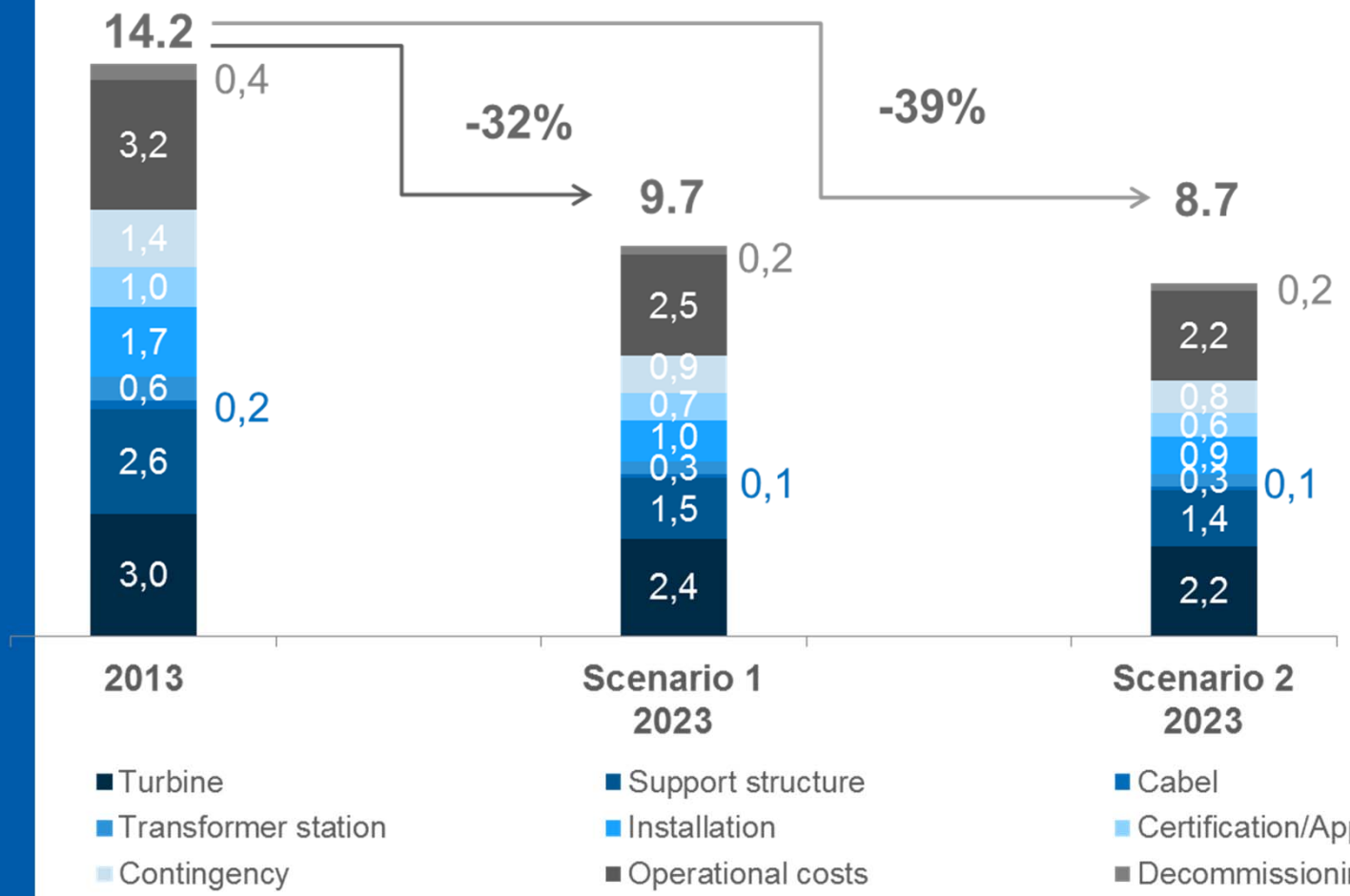
Cost Reduction Potentials for OWE

Projection of levelized cost of energy (LCOE)

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



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

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

More at: http://www.offshore-stiftung.com/60005/Uploaded/SOW_Download|PRESSRELEASEStudycostreductionpotentialsofoffshorewindenergy.pdf

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