EnBW:

Multi Rotor Innovation
- Developers Perspective -

Olaf Beeg - Head of Wind Farm Engineering | HAW Multi Rotor seminar | October 2025

North Sea - Hohe See Wind Farm

Agenda

1. Introduction
2. Overview EnBW Offshore Wind
3. A successful Offshore Wind Farm
4. How to improve?

Presenter

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- Since January 2024 at EnBW
- 17+ years working in offshore wind

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Overview EnBW Offshore Wind

Offshore Wind Hamburg

- ~240 employees in HH of which ~200 employees in Offshore
- Part of the UNESCO World Heritage "Kontorhausviertel" district

Employees

EnBW Facts

Revenue
34,5 Billions €

EBITDA adjusted
4,9 Billions €

Employees
30 391

Installed capacity
11+ GW (of which ~60 % or 6,6 GW are renewables)

Electricity Grid
149 000 km

Gas network
31 000 km

Number of clients B2C & B2B
5,5 Millions

EnBW Office in Chilehaus Hamburg

2. EnBW Offshore Wind

Portfolio overview

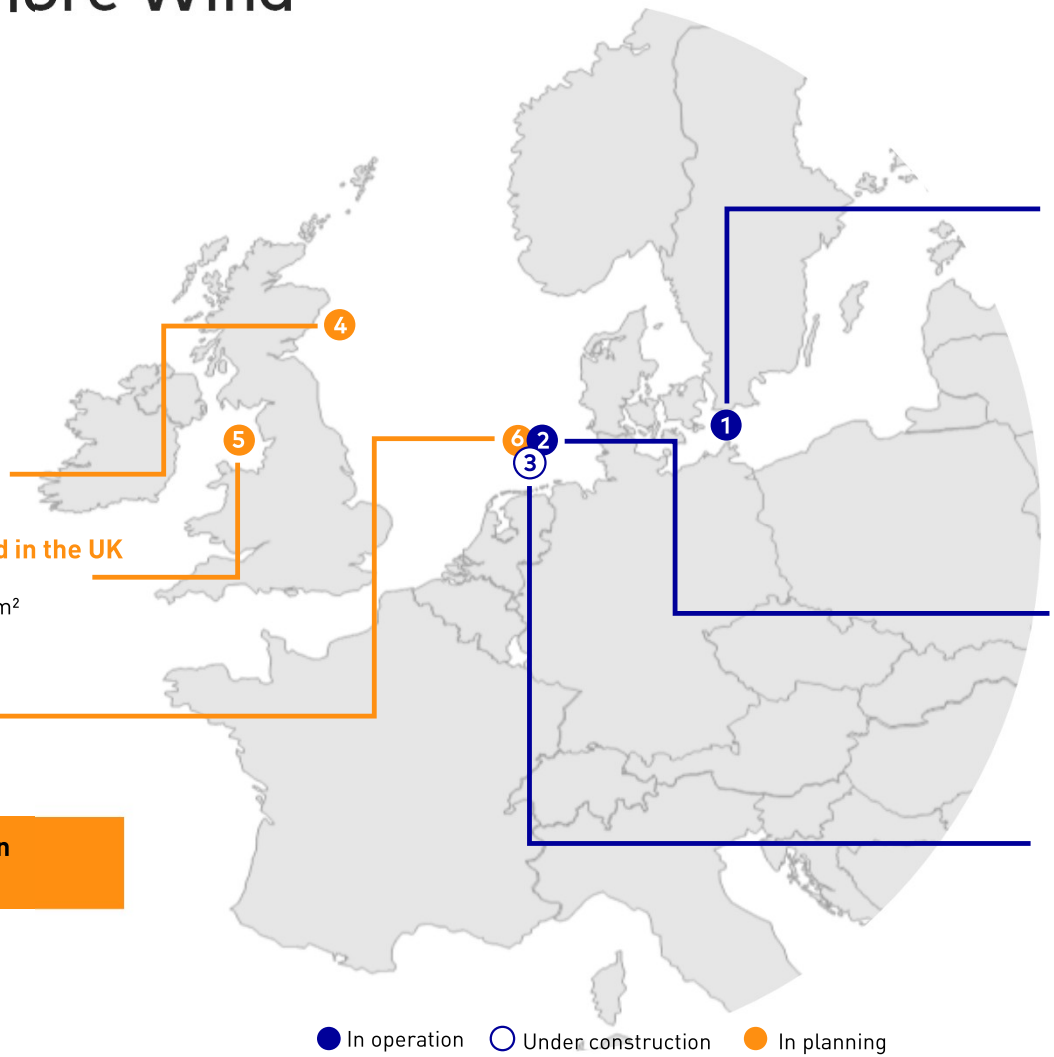
Projects under development:

4. Morven in Scotland
- **2.900 MW** on ~860 km²
- Joint Venture 50:50 EnBW with Jnbp

5. Mona and Morgan Offshore Wind in the UK
- **3.000 MW**
- Morgan: ~300 km² and Mona: ~500 km²
- Joint Venture 50:50 EnBW with Jnbp

6. Dreekant in Germany
- **1.000 MW** on 80km²
- Grid connection 2032

Multiple Auctions in preparation in international markets



Wind farms in operation

1. Baltic 1 (2011)
- **48,3 MW**
- 21x Siemens SWT with 2.3 MW output

1. Baltic 2 (2015)
- **288 MW**
- 80x Siemens SWT with 3,6 MW output

2. Hohe See (2019)
- **497 MW**
- 71xSiemens SWT with 7,35 MW output

2. Albatros (2020)
- **112 MW**
- 16x Siemens SWT with 7,35 MW output

Wind farm under construction

3. He Dreiht
900 MW
- 64x Vestas 15 MW
- In operation beginning of 2026
- 25 years of operation planned

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A successful Offshore Wind Farm

3. A successful Offshore Wind Farm from a developer's perspective

Copilot:

A **successful offshore wind farm** is typically defined by a combination of **technical performance**, **economic viability**, **environmental sustainability**, and **social acceptance**.

… and all planned, build and operated in a safe manner!

3. A successful Offshore Wind Farm from a developer's perspective

External factors

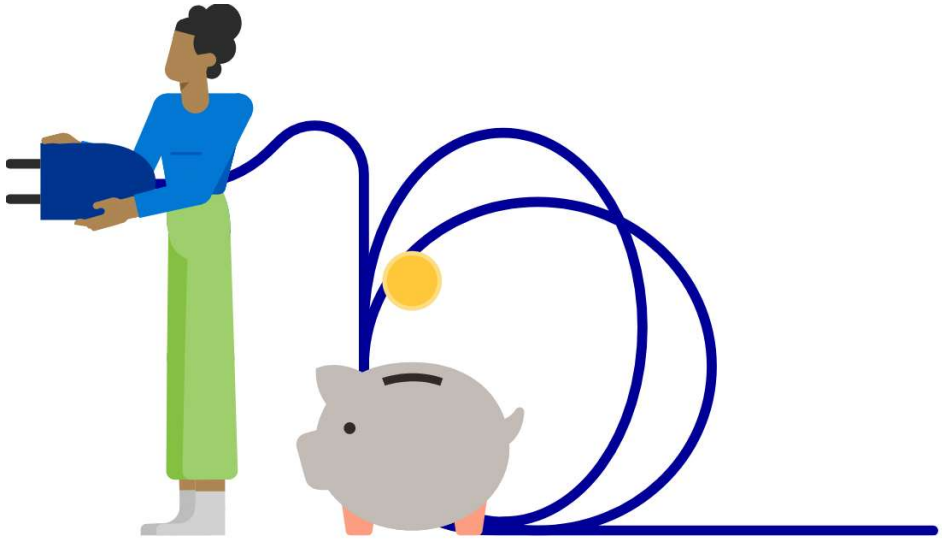
1. **Strong Policy and Regulatory Framework:**
   - Clear permitting processes
   - Stable long-term energy policies
2. **Grid Infrastructure and Integration:**
   - Reliable transmission systems
   - Sufficient grid capacity
3. **Bankable Project Structures:**
   - Access to financing partners
4. **Robust Supply Chain and Ports:**
   - Strong manufacturing and logistics capabilities
5. **Environmental and Social Considerations:**
   - Stakeholder engagement and community support
6. **Stable offtake sytems**
   - PPAs, CfDs

→ **Low risks, stable and reliable long term framework conditions**

3. A successful Offshore Wind Farm from a developer's perspective

Final Key Performance Indicators (KPIs)

1. **Annual Energy Production (AEP)**:
   - Total electricity generated annually.
   - Losses, availabilities
   - Indicates overall efficiency and profitability.
2. **Investment Cost per MWh (CAPEX)**
   - Development, Site Investigation
   - Engineering, construction, installation
3. **Maintenance Cost per MWh**: **(OPEX)**
   - Operational efficiency metric.
4. **Cost of Capital (WAC)**
5. **Levelized Cost of Energy (LCOE)**:
   - Average cost per unit of electricity over the project's lifetime.
   - Lower LCOE means better financial viability.
6. **HSE indicators**



3. A successful Offshore Wind Farm from a developer's perspective

EnBW

In a nutshell

DEVEX	**vs.**	**AEP**
CAPEX		**Offtake**
OPEX		
WAC		

→ **Business Case - Money**

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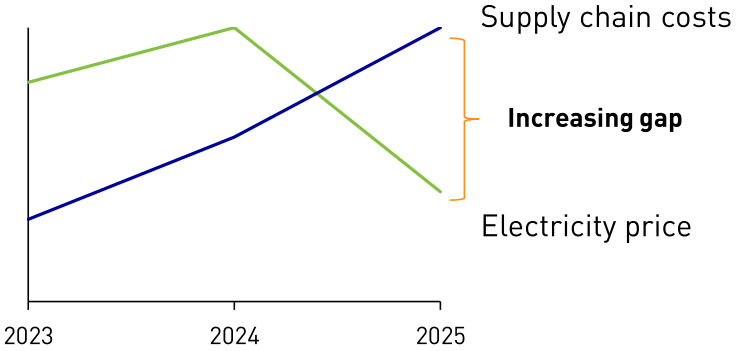
How to improve?

4. How to improve?

Some key focus areas for improvement inspiration

1. Increasing component cost
2. Decreasing returns
3. High fluctuation in electricity prices
4. Increasing amount of negative prices
5. No commercial scale, big size storage available
6. (cyber) security
7. Further offshore –> deeper waters –> floating wind?
8. Increasing wakes (internal, external, cluster)
9. etc.

Schematic representation of market conditions in the offshore sector



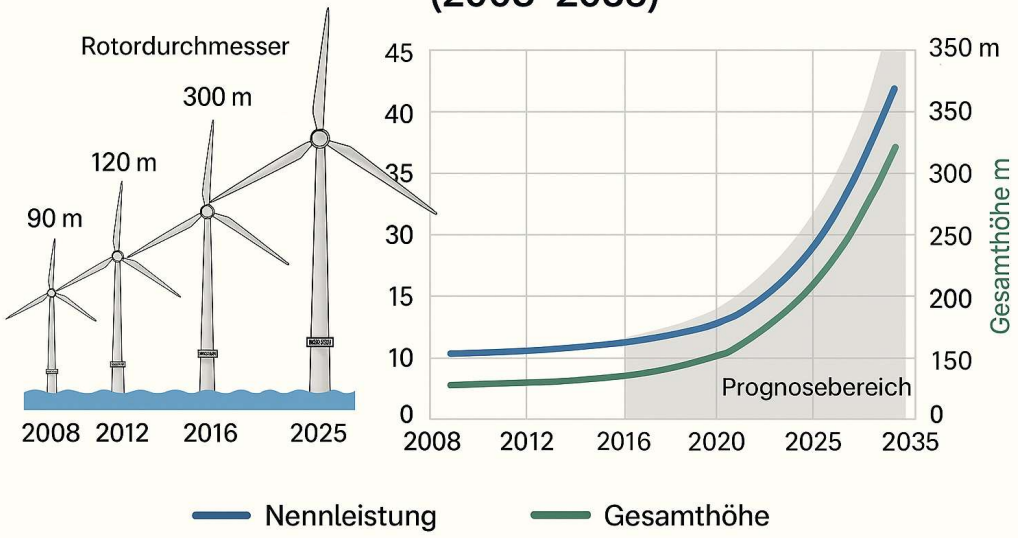
➢ **AND.....**

4. How to improve?

Even AI is not having all the answer.

.... Optimal turbine (size)?

- The bigger the better?
- > 20 MW – 300 m and beyond?
- “A 380” effect?
- 15 MW as industrial “working horse”?
- Upwind / downwind / vertical
- Or Multi Rotor solutions?



Your innovation ideas are needed to help our challenges!

Thanks for your attention!