Offshore Wind in Europe’s future energy mix

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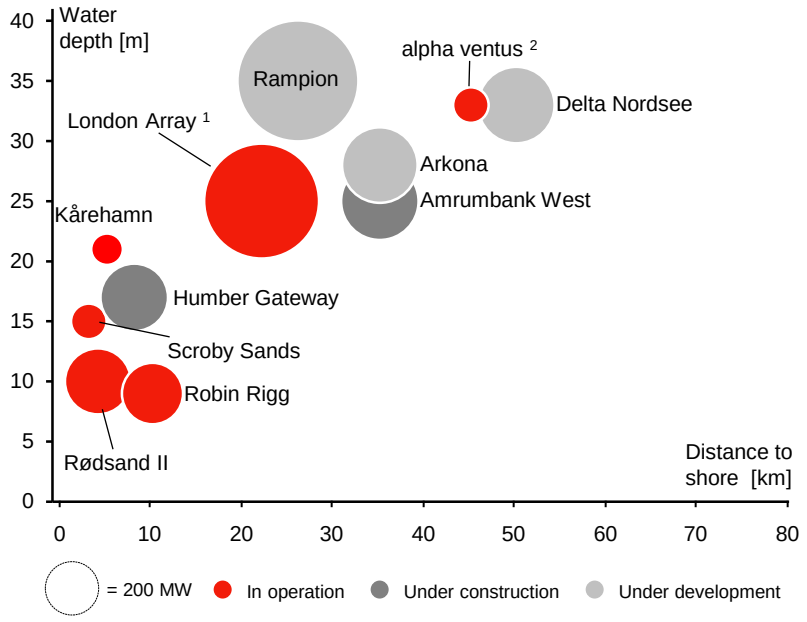
E.ON – one of the top 3 Offshore Wind Players

E.ON's offshore wind portfolio



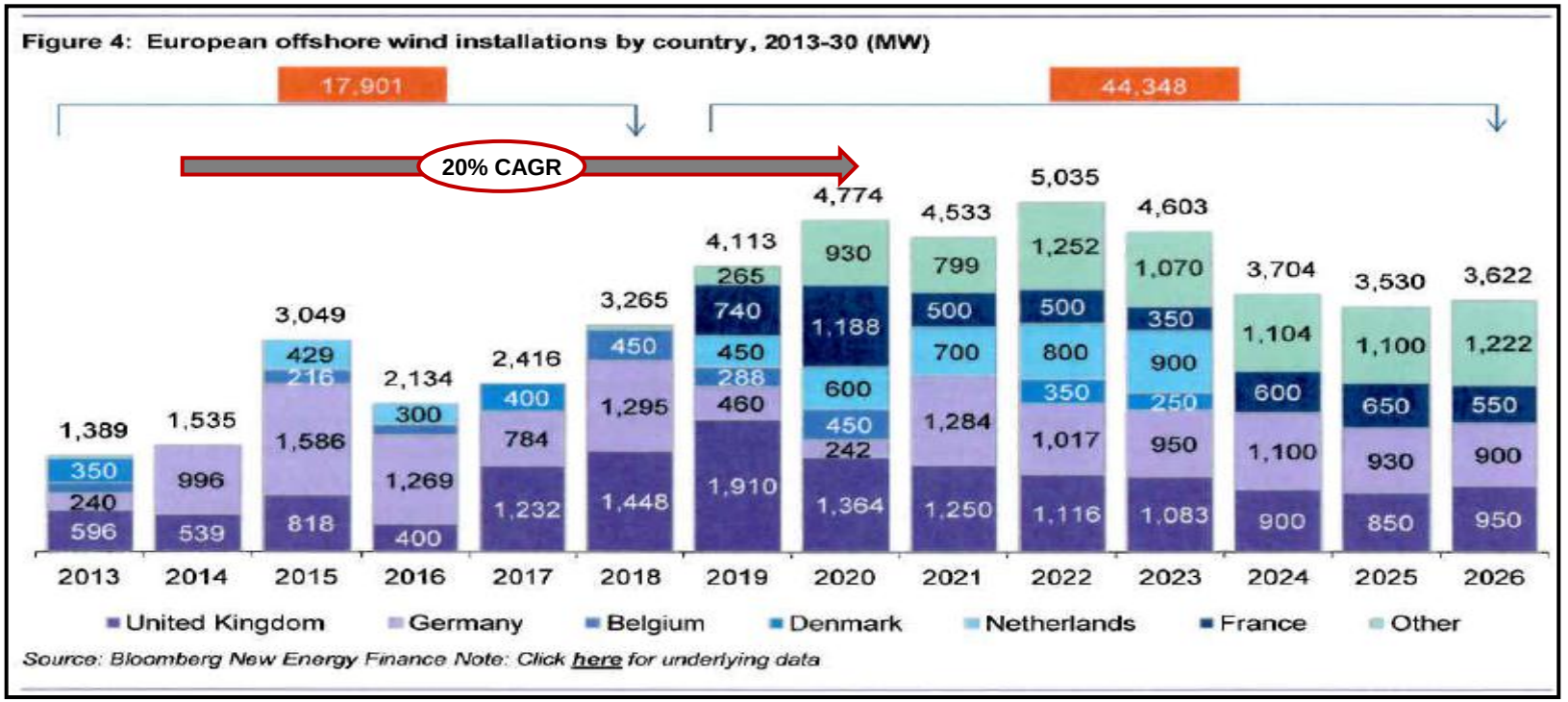
Key facts

- 500 MW (equity) in operation
- 507 MW under construction (~ 2bn € investment), coming online in 2015
- Assets/projects in UK, D, DK, SWE
- Operational experience since 2004
- Broad experience base: near shore / far shore, wind turbines from 2 to 5 MW, various foundation types
- Build&sell strategy to recycle capital and also partnering pre FID for future projects
- Target to reduce LCOE by 40% [3]

1 JV of E.ON (30%), DONG Energy (25%), CDPQ (25%) and Masdar (20%)
2 JV of E.ON(26.25%), EWE (47.5%) and Vattenfall (26.25%)
3 LCOE refers to Levelized Cost of Energy for projects going online before the end of the decade

Offshore Wind – a market with large growth predictions

- ~7.3 GW in operation[1], generating power for ~ 6.5 million homes
- 20% CAGR growth rates predicted (~6 GW in construction or FID taken)



But questions are being asked:

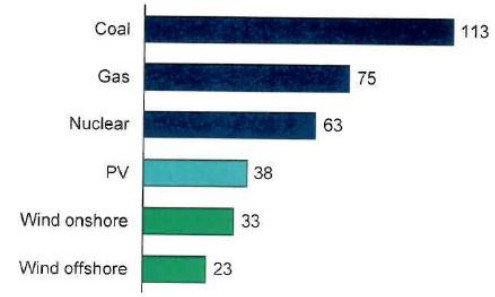
→ **Isn‘t it too expensive?**

→ **How does it fit into a sustainable and affordable future energy supply?**

1. UK: 4.3, DK 1.3, D 0.6, BE 0.7

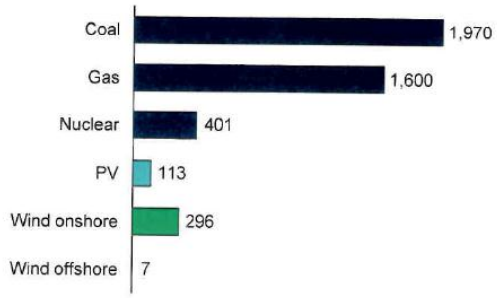
Offshore wind is still a young industry and costs are and will be coming down

Technology liftetime (years)



Source: Siemens

Installed global capacity (GW)

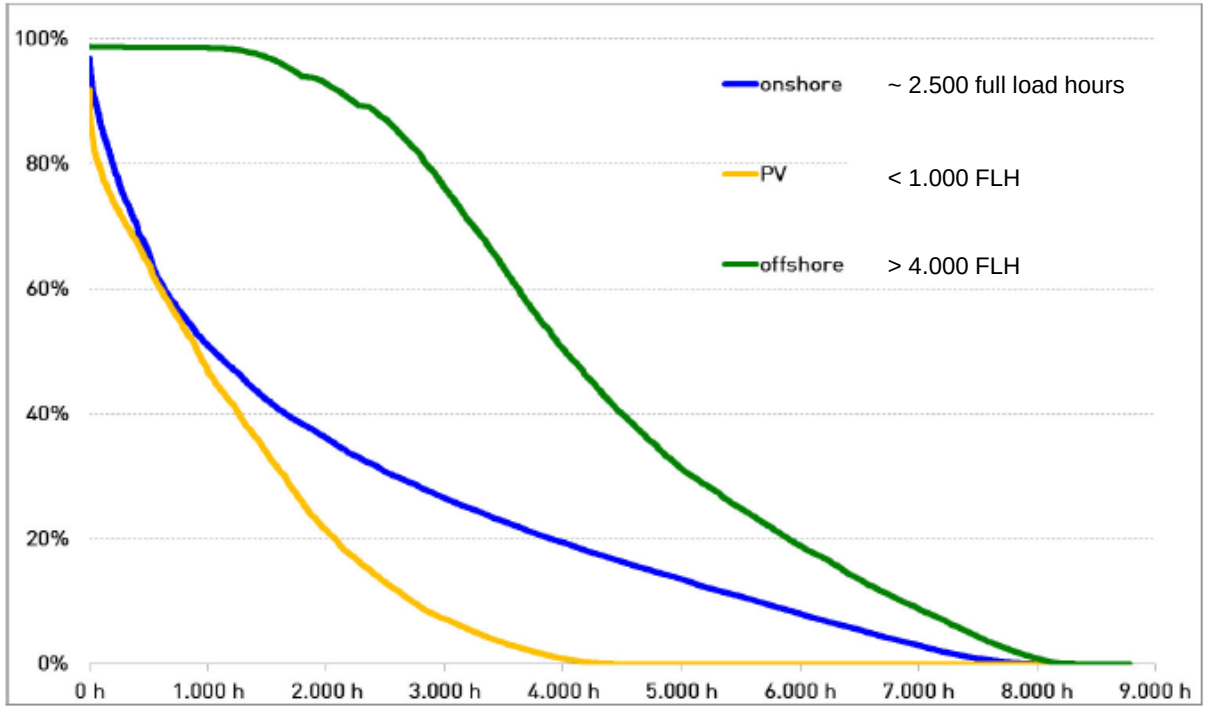


Source: Siemens, MAKE

LCOE improvements

Note: Unsubsidized LCOE
Source: MAKE

The key point: Offshore Wind has a high energy economic quality



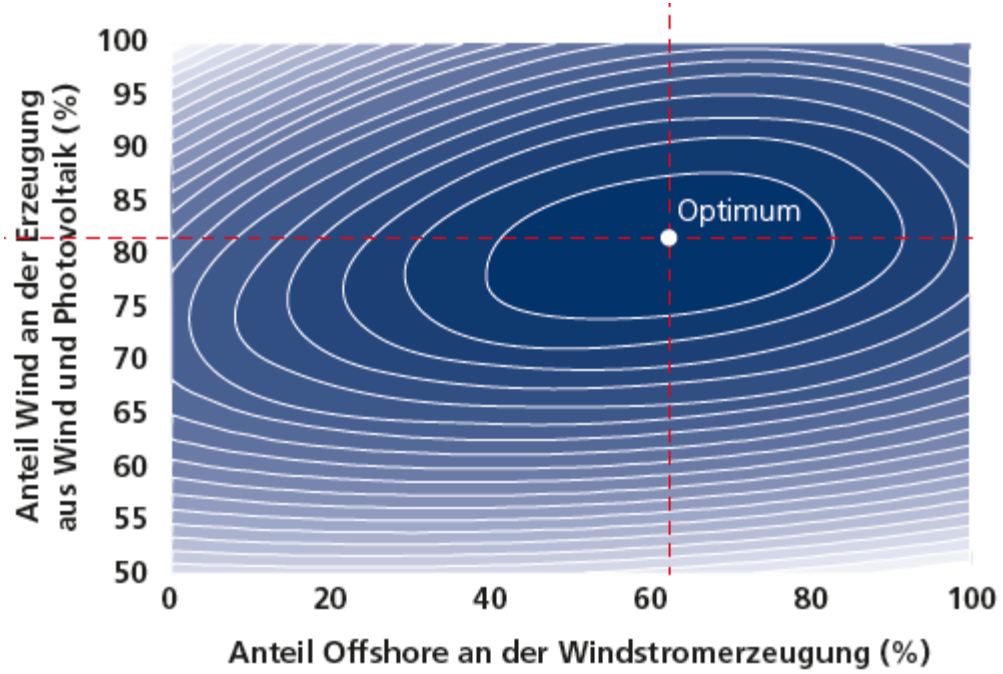
- Good predictability
- Higher contribution to energy supply/demand balance on an hourly/daily basis
- Lower requirement for backup or storage capacity

→ **Offshore wind causes less residual flexibility costs than other renewables**

In a high-renewables scenario, Offshore Wind will reduce the total energy costs versus cases with less Offshore (I)

Study on the future German energy supply by Fraunhofer Institute.

Base assumption: political target of 80% renewable energy supply in 2050



- There is a macro-economic optimum (total energy supply costs)
- This optimum requires a high proportion of offshore wind in the renewable power production – in reality being limited by the actual offshore potential

Key driver: Offshore Wind requires less flexibility costs

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Overview of the annual flexibility costs and levelised costs of electricity per year in the three scenarios for the year 2050

	Optimized growth scenario	Onshore growth scenario	Photovoltaics growth scenario
Back-up capacity (GW)	54,4	62,0	62,6
Investment costs – annuity basis (billions of euros)	1,8	2,0	2,0
Residual power demand (TWh)	53,4	68,9	81,8
Fuel costs for residual power demand (billions of euros)	4,8	6,2	7,4
Storage capacity (GW)	67,9	74,3	83,9
Investment costs – annuity basis (billions of euros)	3,2	3,6	4,0
Excess production (TWh)	20,3	35,9	51,2
Curtailment costs (billions of euros)	1,3	2,7	3,4
Cumulative flexibility costs (billions of euros)	**11,1**	**14,0 (+26%)**	**16,8 (+50%)**
Cumulative levelised costs of electricity (billions of euros)	**52,4**	**50,4**	**52,9**
Total costs for flexibility and power production (billions of euros)	**63,5**	**64,5**	**69,7**

- The optimum case with 32% offshore wind in the total renewable power production requires significantly less flexibility costs
- As a result, also the total power supply costs are lower by between 1 and 6 billion Euros per year

In an optimal high-renewables scenario for Germany, Offshore Wind has to play a major role

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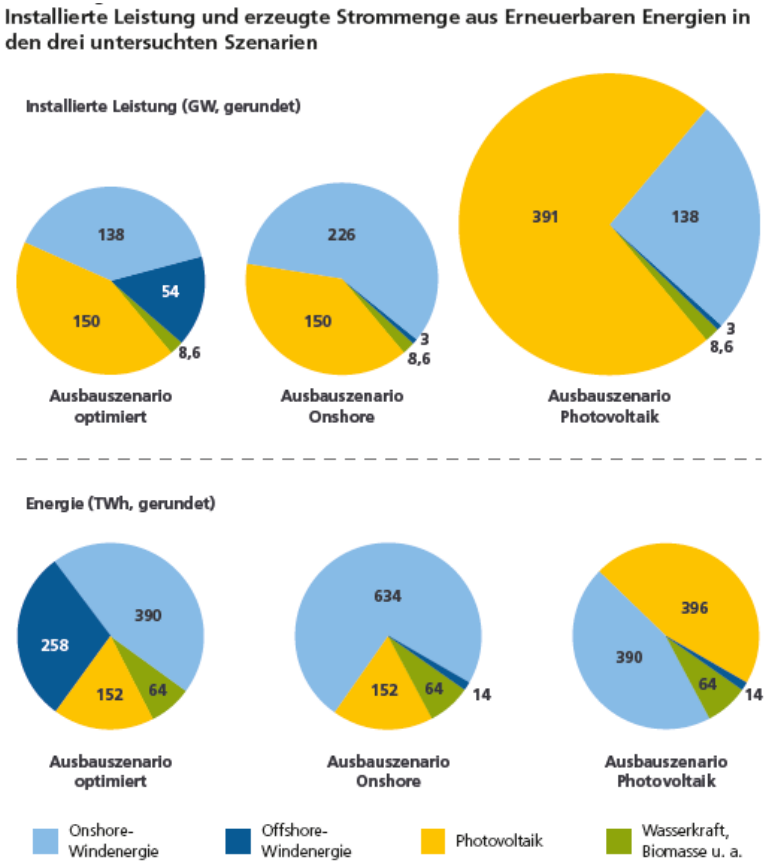

- The optimum scenario for Germany (2050, 80% of renewable power supply) requires 54GW of offshore wind
- In this scenario, offshore wind would contribute 32% of all renewable production


Vielen Dank für Ihre Aufmerksamkeit.
Thank you for your attention