

Offshore Wind crossing Sectors



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Introduction

ONP Management GmbH

- Founded in 2014
- Employees: 28
- Technical advisory office focusing on offshore wind
- Involved in development & construction of offshore wind projects around the globe
- All our senior experts have extensive experience in offshore wind
- Headquarter: Hamburg (Germany)
- Shareholders: Zech Group, Bremen (70%), Managing Partners (30%)



- Employees: >9.300
- Turnover: € 2.13 Bn (2016)

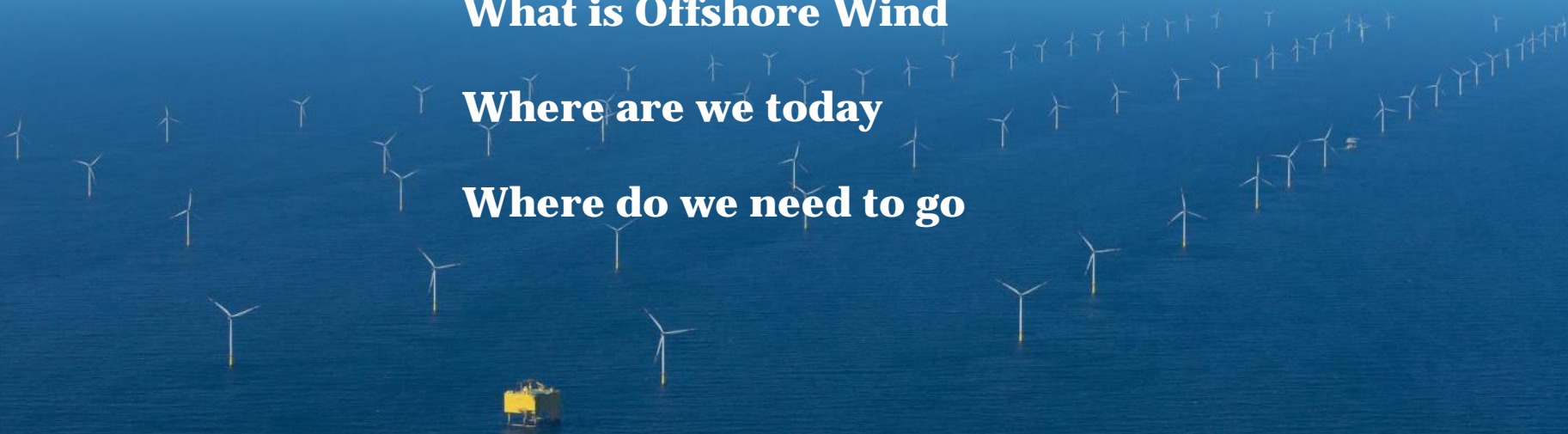
Introduction

How to Cross Sectors - from Offshore Wind to Hydrogen?

What is Offshore Wind

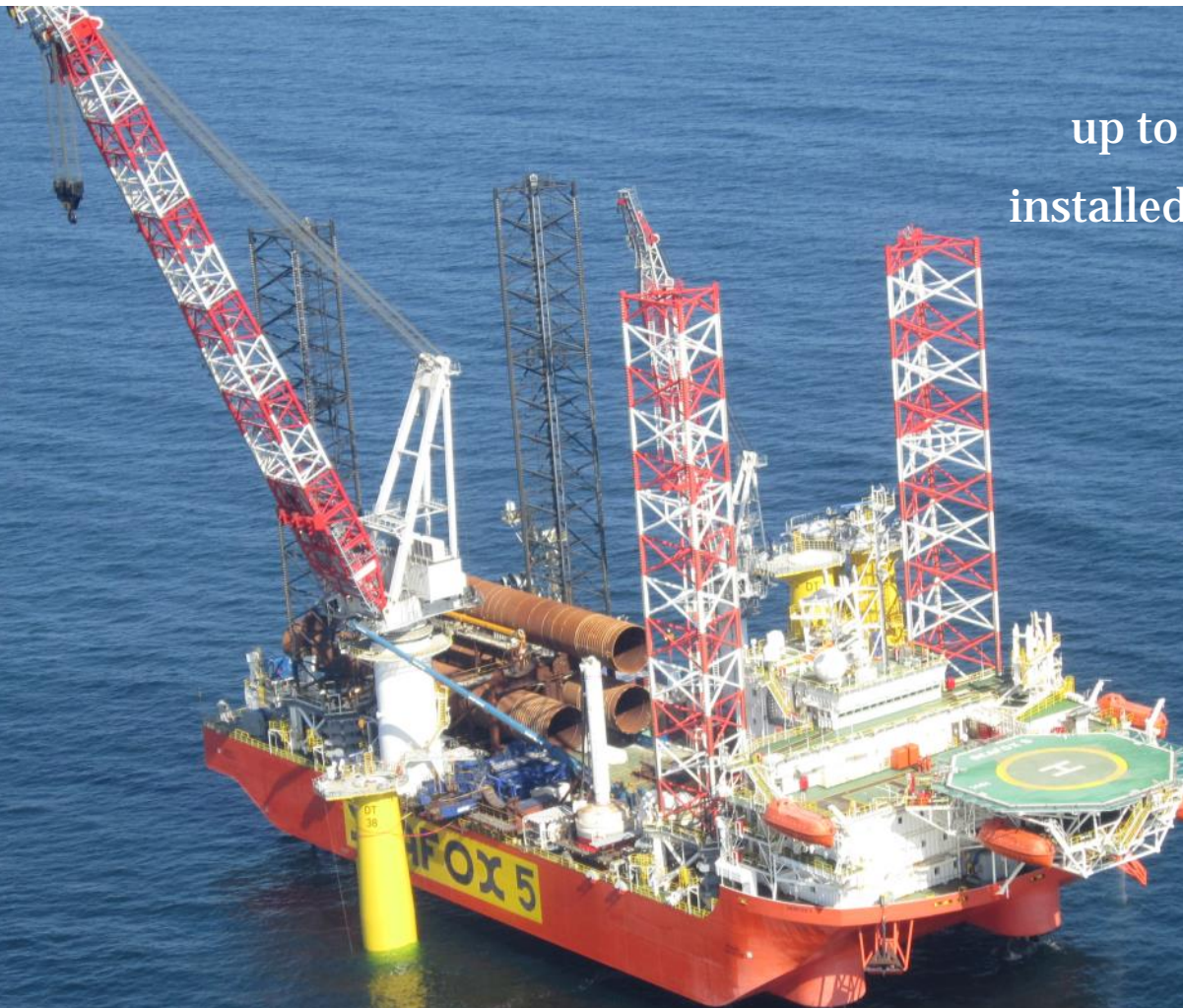
Where are we today

Where do we need to go



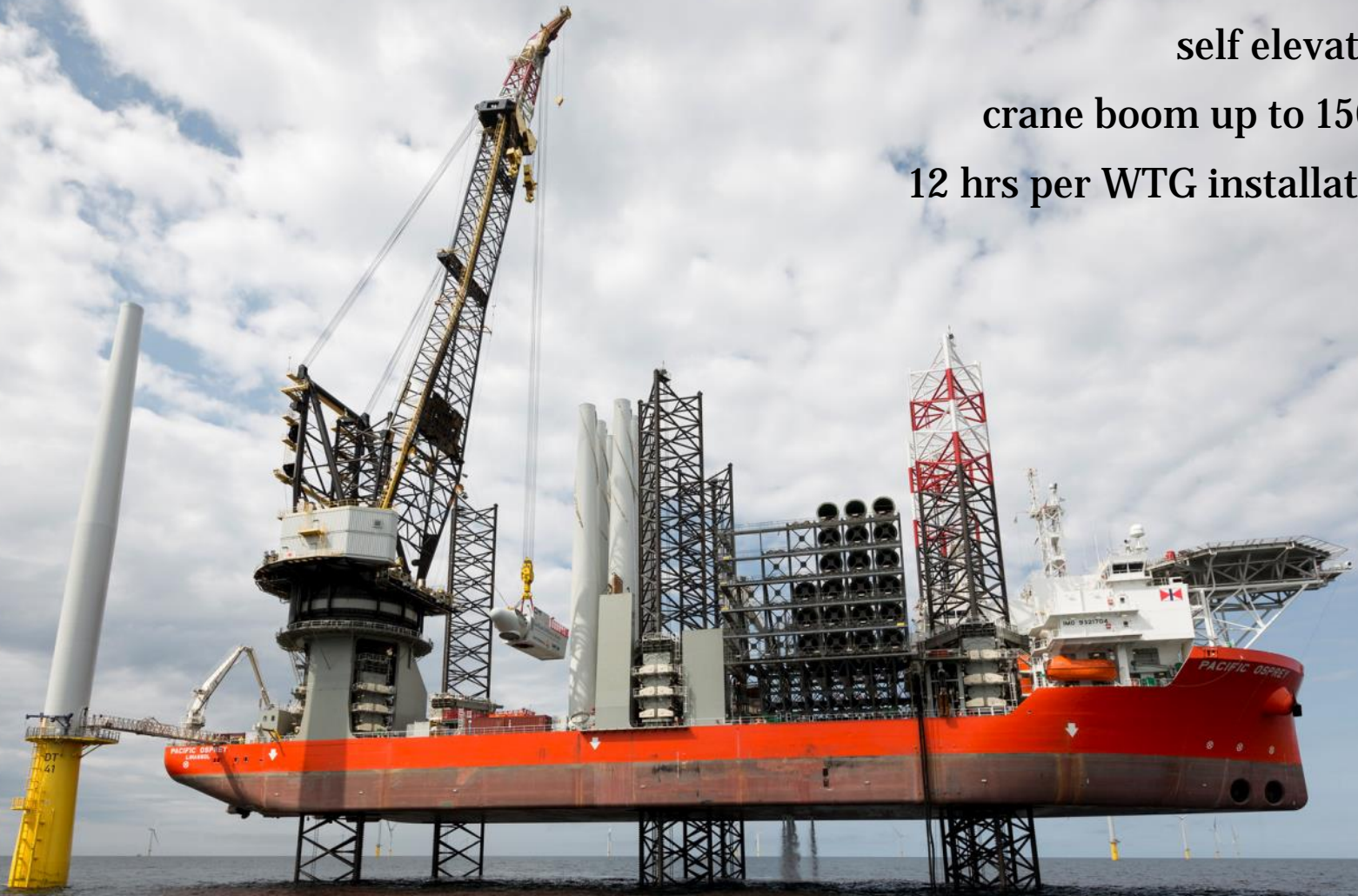
Foundations

up to 1500 tons
up to 50 m water depth
installed in less than a day



Vessels

self elevating
crane boom up to 150m
12 hrs per WTG installation



Wind Turbines



up to 8 MW
total height 200 m
rotor diameter 160 m

Transformer Stations at Sea

combining up to 3 wind farms
DC conversion
only 1% transmission losses



Export Cables



reliable connection
more than 200 km
AC or DC

Where are we today?



Energy Transition

A success Story

“National Grid can confirm that for the past 24 hours, it has supplied GB's electricity demand without the need for coal generation.”

NG Control room 21.04.2017

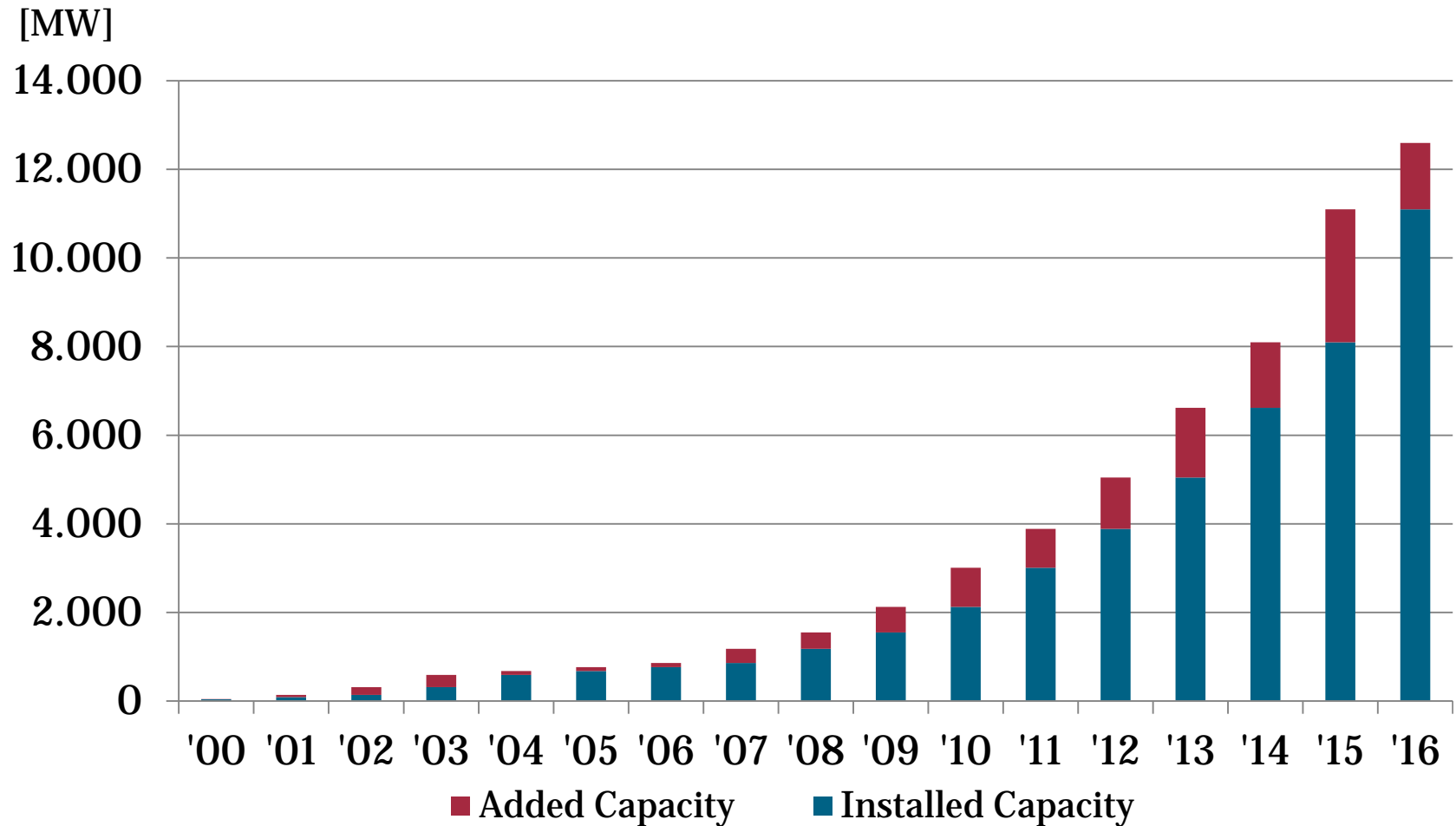
“Based on own consumption wind delivered 110 % energy to Schleswig Holstein”

IWR, 5.12.2016

“In October 2013 the (UK) Government agreed (...) to guarantee it (the nuclear power station Hinkley Point) a price of £/MWh 92.50(103 €/MWh ...) over a 35 year period.”

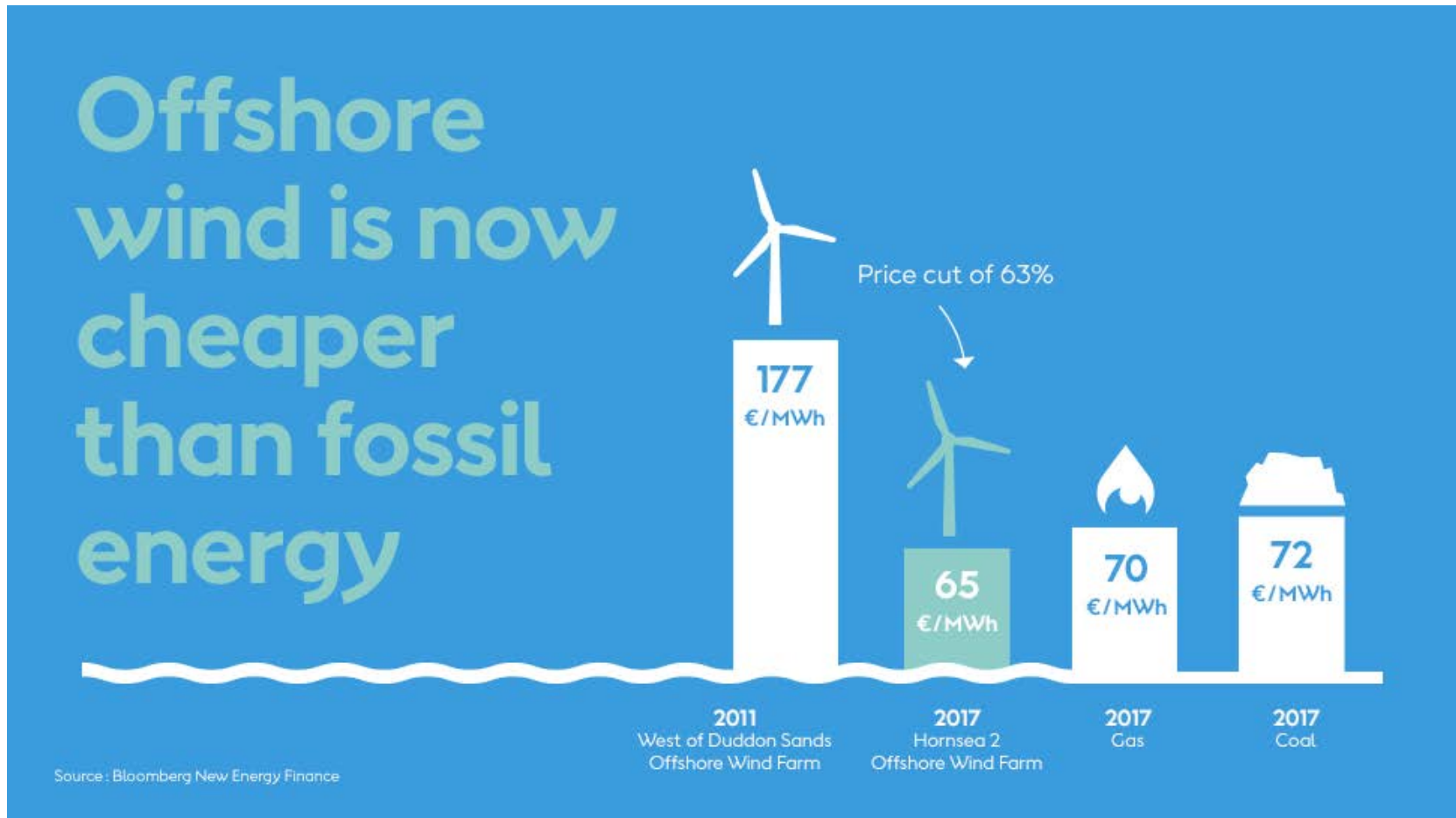
The Telegraph, 13.06.2016

European Offshore Wind Development



Source : <http://www.offshorewindindustry.com/news/offshore-wind-installations-stabilise-2014>

Price Development

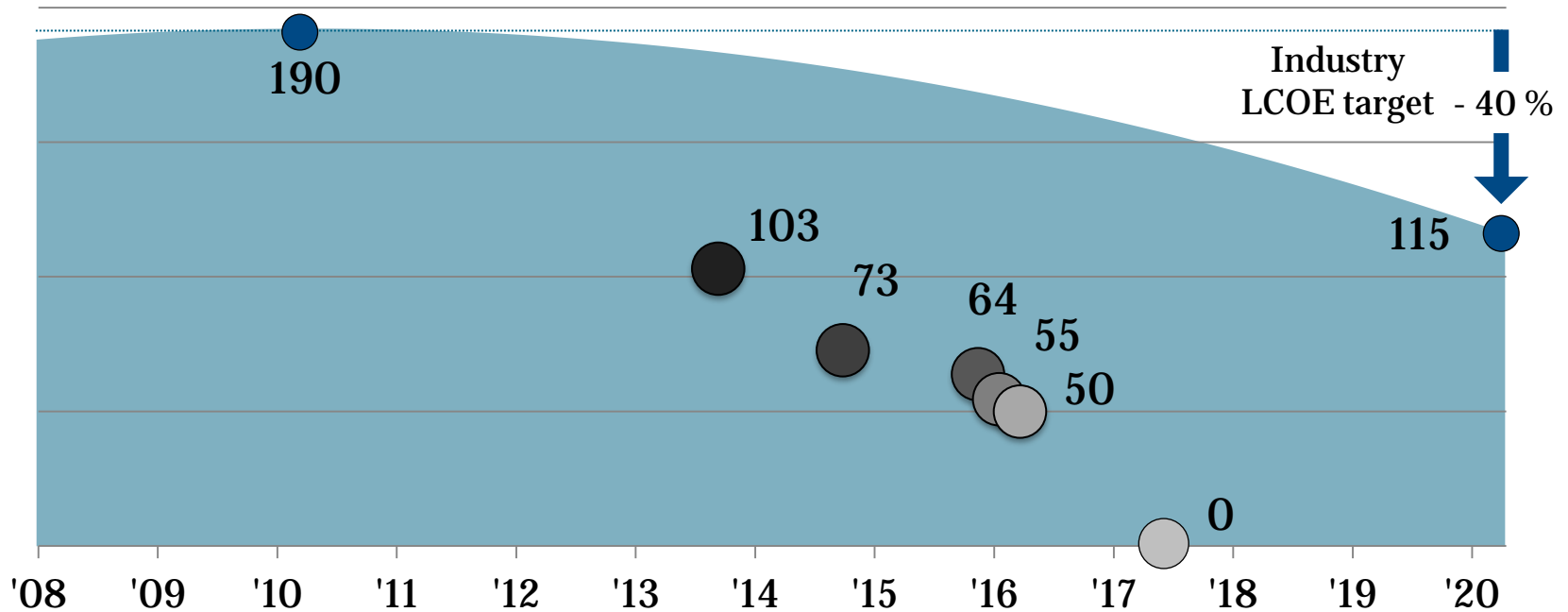


Price Development in Offshore Wind

Moving towards market parity

Price Development

[€/MWh]



Price Development Factors

Turbine Size

Wind Farm Size

Reducing OPEX

Low Cost of Capital

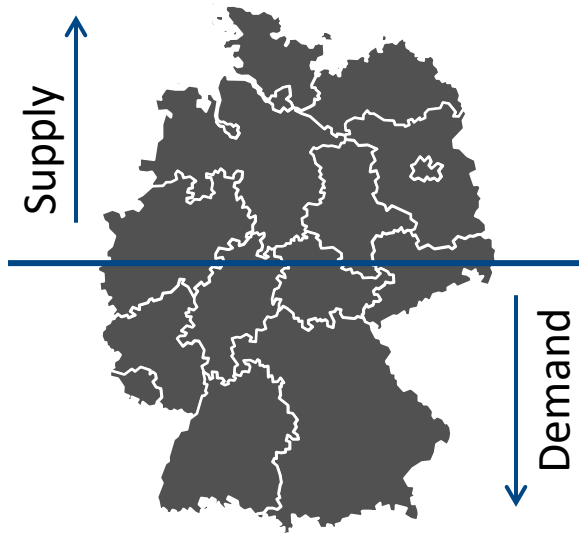
Timeline

Bet on the future

Electricity Price Forecast
Technology Development
Raw Material Price

Decoupling of supply and demand

Distance and time



Demand increase in the south –
supply increase in the north



Short term fluctuating

Annual re-occurring pattern

- Wind high in the winter, low in the summer
- Daily PV fluctuation

➔ Grid Expansion, Peak supply needed & Curtailment increasing

Challenges

Negative Prices

„X-mas storm delivers negative electricity prices“

Energate, 28.12.2016

„A total of 35 hours with negative prices peaking at -67 €/MWh on and around x-mas. This is a result of the combination of low demand, lots of wind and unflexible must-run capacity.“

CEE News, 2.01.2017

„Annual production from wind energy is curtailed on average by 1,7 %. (...) due to peak shaving “

Netzentwicklungsplan Strom, BNetzA, 2017

Negative Prices

26.12.2016

- Typically over x-mas
- Low consumption
- High wind



Source: EPEX (European Power Exchange)

Lost Production

Grid capacity curtailment in 2016

Energy produced - 81.1 TWh



Energy curtailed - 1.4 TWh



Compensation Payment

280 mill EUR



Hydrogen Production

32 t

Grid Connection on Land

- transmission lines 10 – 15 years
- Costs are high
- NIMBY
- Interconnections



Source: VDE / Übertragungsnetzbetreiber

Where do we need to go?



Targets of European energy policy



- Increase share of Renewables in Europe by 2030
 - Move from previous target of 27 % to 30 %
 - Wind will double its today capacity of 160 GW
- Target to further reduce CO2 emissions
- EC targets to increase interconnector capacity from 10 % (2020) to 15 % (2030)
- Power-to-heat

Power-to-Gas

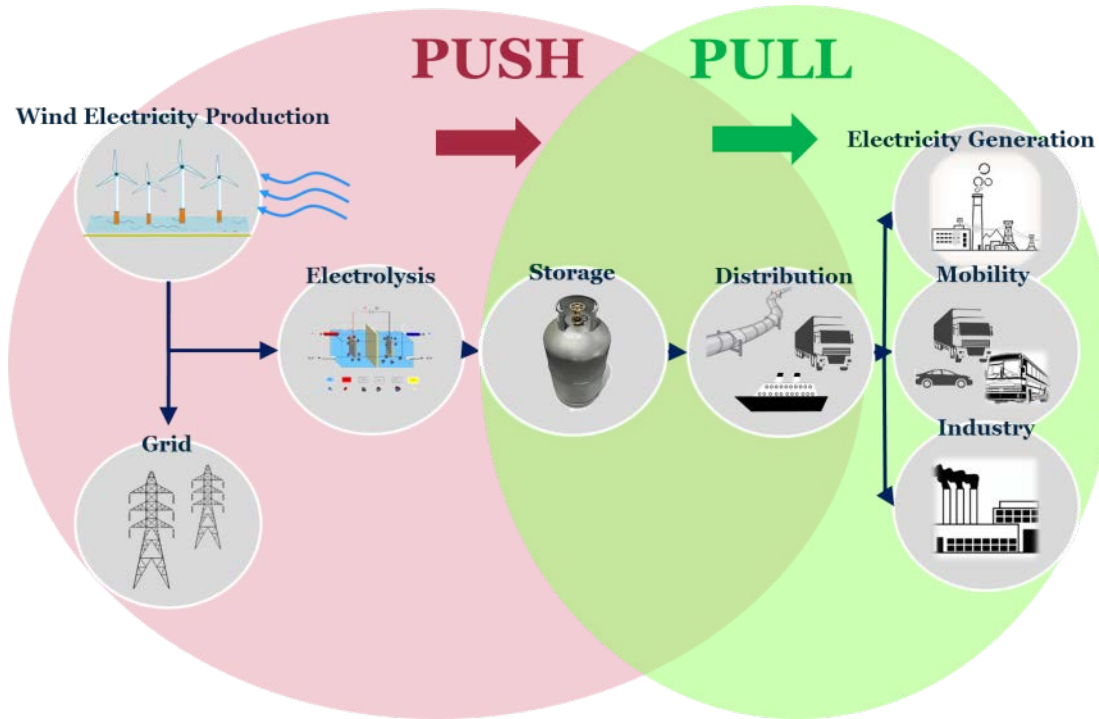
Comparison of Storage Technologies

Item	Pump Storage	Batteries	Hydrogen
Environmental Impact	Significant vast landscape modification	Medium earth metals demand and possible pollution	low
Safety	high	high	medium
Efficiency	High with large altitudes	high	low

- Prioritized usage of pump storage and batteries due to higher efficiencies
 - pump storage in Germany: 40 GWh - eq. to 1 hour of full load production of wind
- Hydrogen for large amounts of energy and longer storage periods
 - theor. capacity for H₂ gas storage in Germany: 1.700 GWh

Power-to-Gas

Economic Review and Analysis



PULL-Factor

- Industrial applications
- Mobility
- Power Supply for Island Solutions

PUSH-Factor

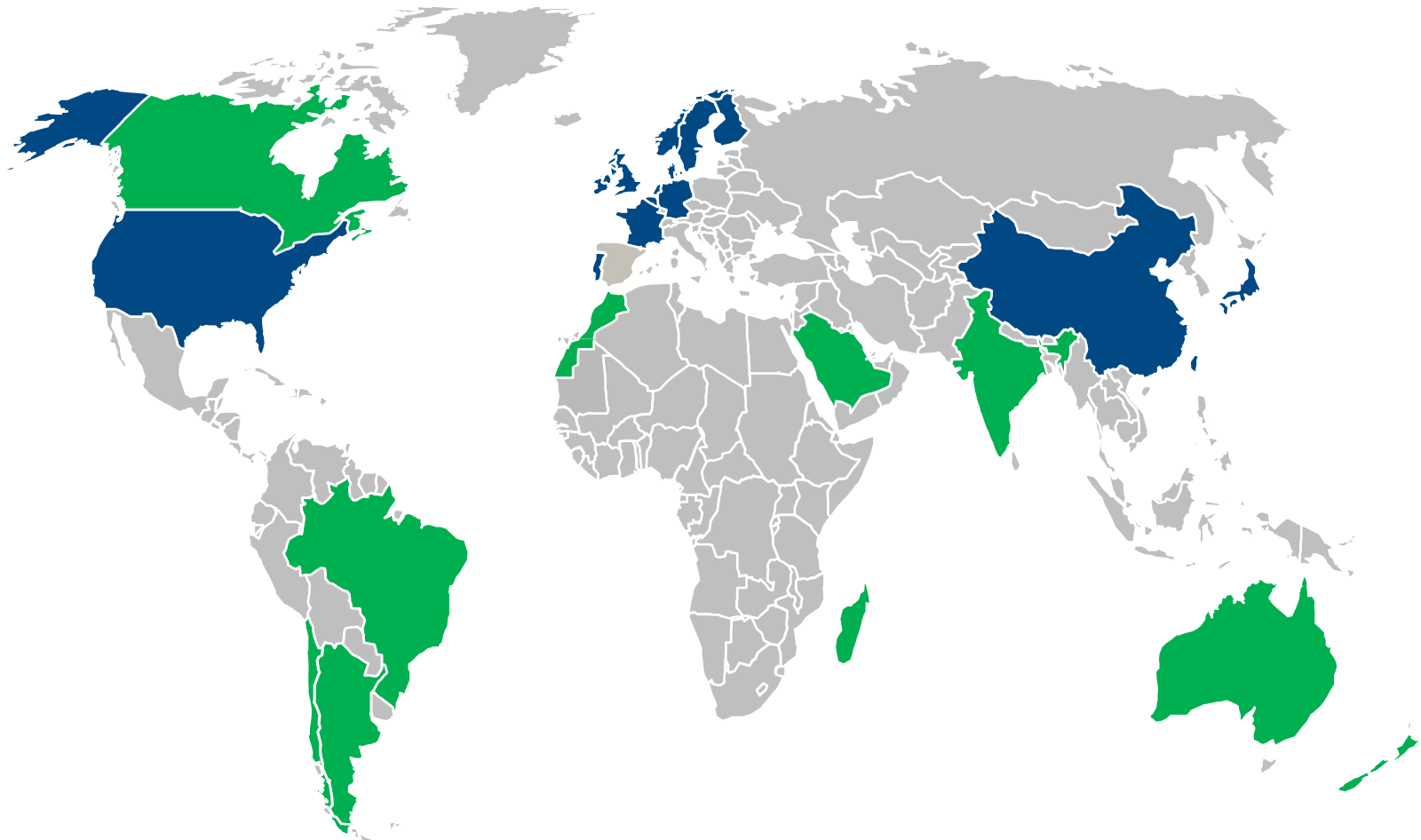
- Balancing fluctuating renewables
- Power-to-gas production
- Storage of electrical energy
- Power-to-gas distribution

How to Cross



- Transmission fee revoked
- Renewable feed-in-tarif
- Increase interconnections
- Enhance fossil peak-power
- Demand Management

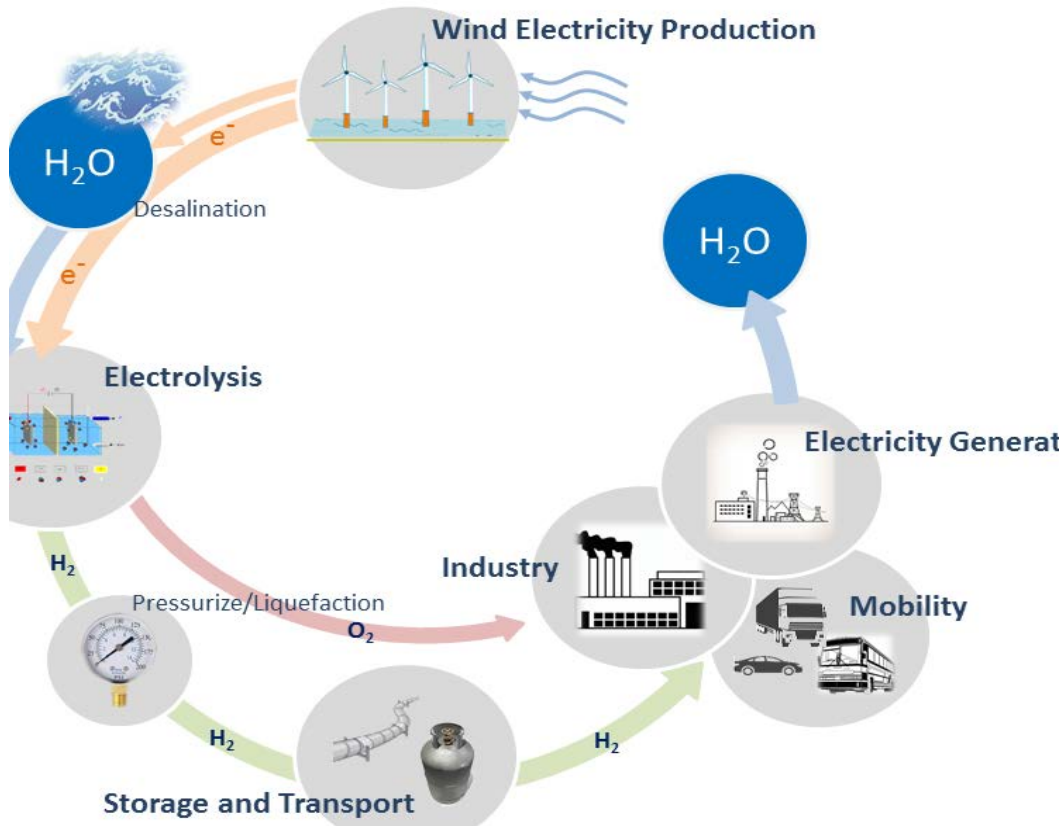
Offshore Wind worldwide



Established Offshore Wind Potential Countries

Power-to-Gas

Hydrogen from Wind Power - A Closed Loop Energy Carrier



- Increase share of renewable energy
- Capacity of wind energy and solar energy will significantly rise
- Reduction of dependency of energy import
- Energy storage system important in weak grid systems
- Requirement to reduce the CO₂ emission and other harmful pollutants in all sectors
- Hydrogen appliances suitable in
 - Industry
 - Mobility
 - Energy supply

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