


GLOBAL WIND ENERGY SHIPPING AND LOGISTICS

SUPPORT INDUSTRIES FOR WIND ENERGY: SHIPPING AND LOGISTICS EXAMPLE

MARCH 10, 2015, EWEA OFFSHORE 2015, COPENHAGEN

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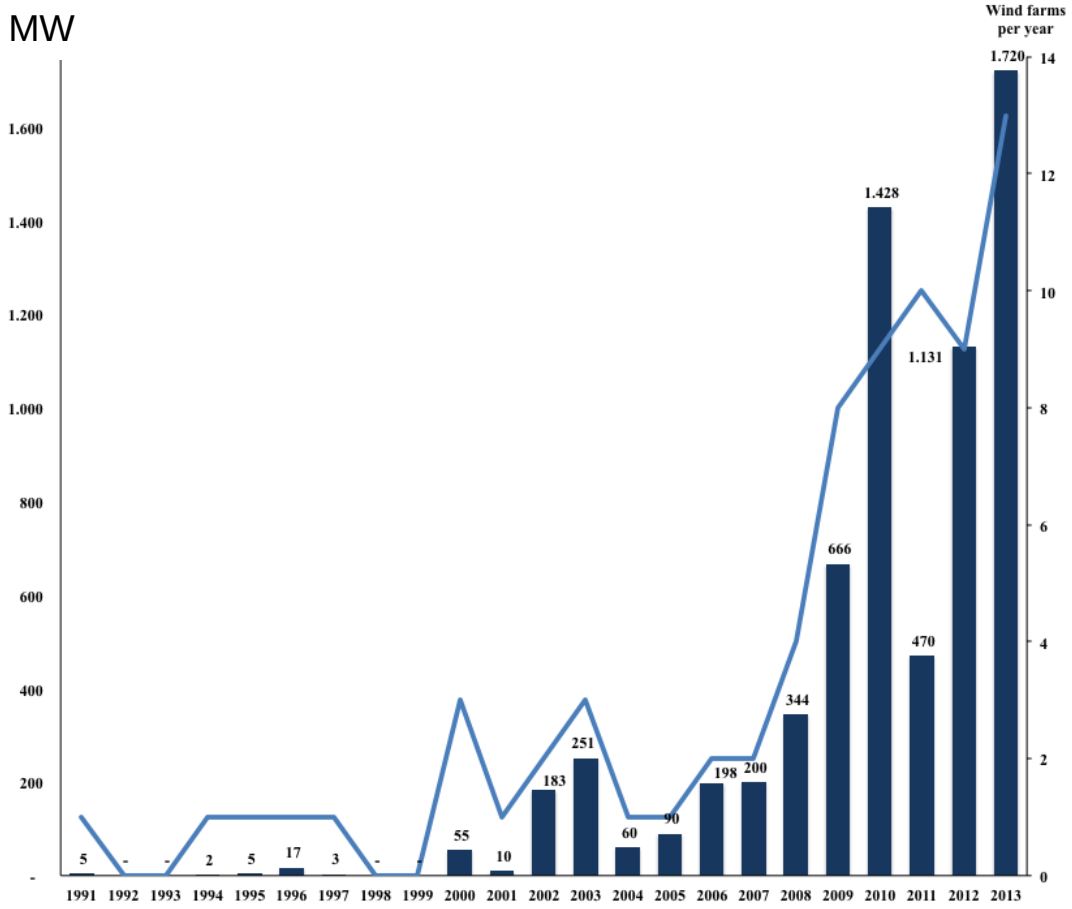
Number of offshore annual MW and wind farms installed up to and including 2013



Year	MW installed	Number of wind farms
1991	5	1
1992	-	0
1993	-	0
1994	2	1
1995	5	1
1996	17	1
1997	3	1
1998	-	0
1999	-	0
2000	55	3
2001	10	1
2002	183	2
2003	251	3
2004	60	1
2005	90	1
2006	198	2
2007	200	2
2008	344	4
2009	666	8
2010	1.428	9
2011	470	10
2012	1.131	9
2013	1.720	13

Source: BTM Consult a part of Navigant (2014a) and own construction

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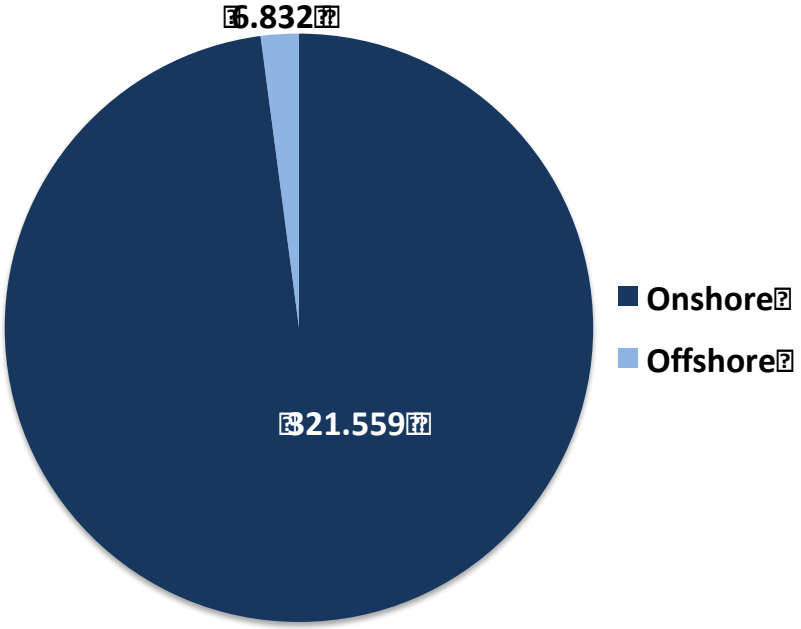
5 critical offshore wind factors

1. Distance to shore
2. Water depth
3. Number of wind farm turbine positions
4. Weight and dimensions of WTG and foundation
5. Seabed conditions

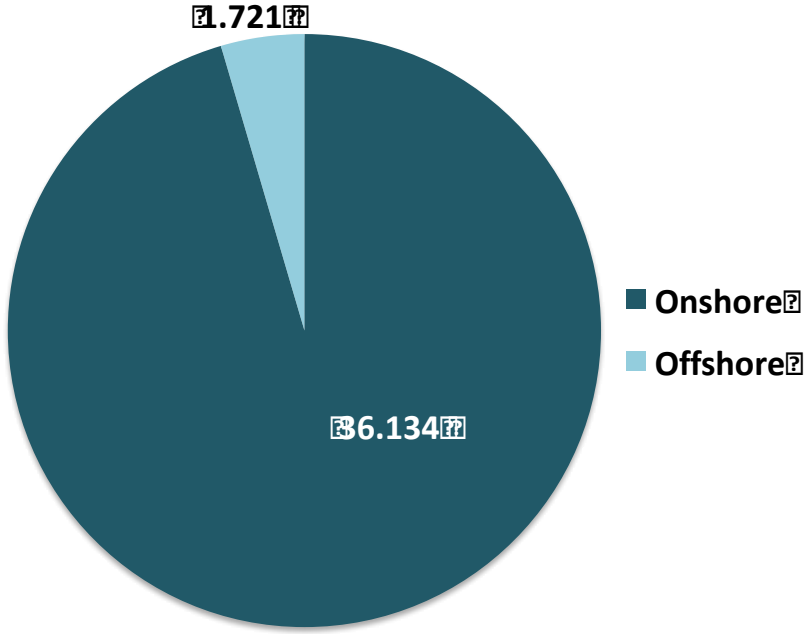
- ✓ Near shore
- ✓ Offshore
- ✓ Far offshore

Onshore and offshore distribution

Cumulative distribution ultimo 2013 (MW)



Installed distribution in 2013 (MW)



Source: BTM Consult a part of Navigant (2014a) and own construction

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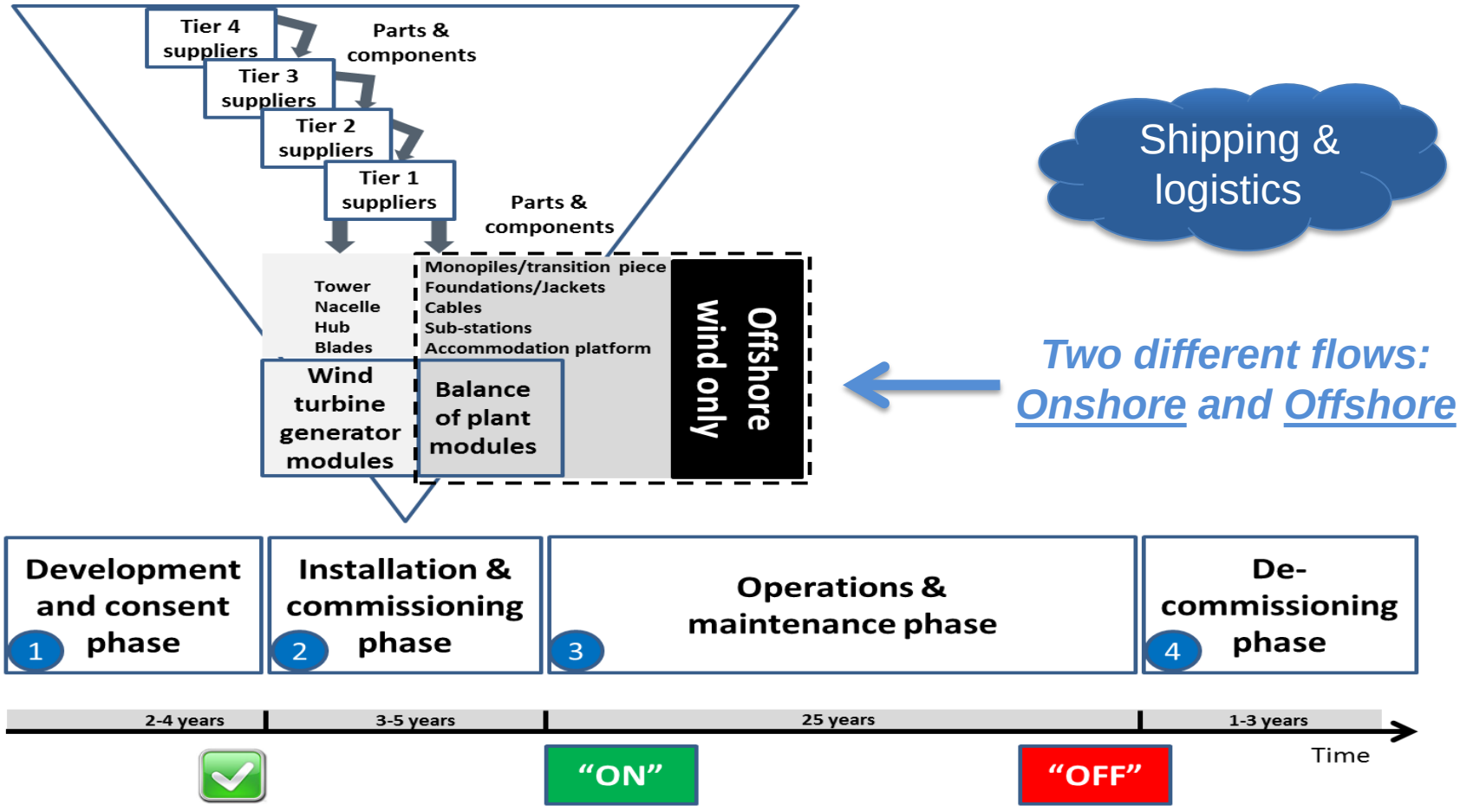
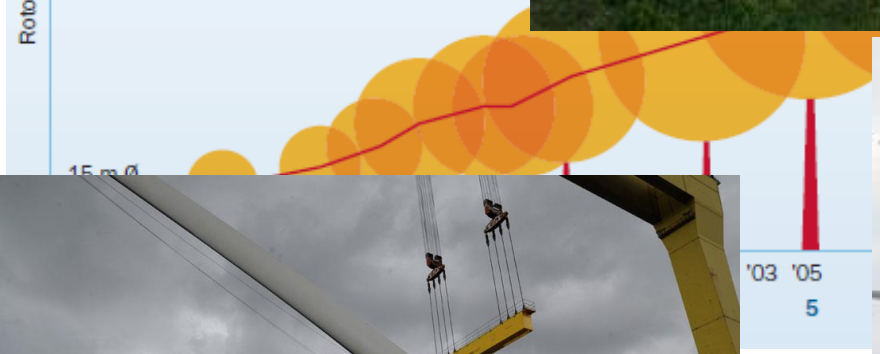
End-to-end life-cycle focus



Source: LogMS conference paper, 2013, Singapore 2013, Poulsen et.al.

Race for larger WTG output
- and importance of shipping/logistics/SCM



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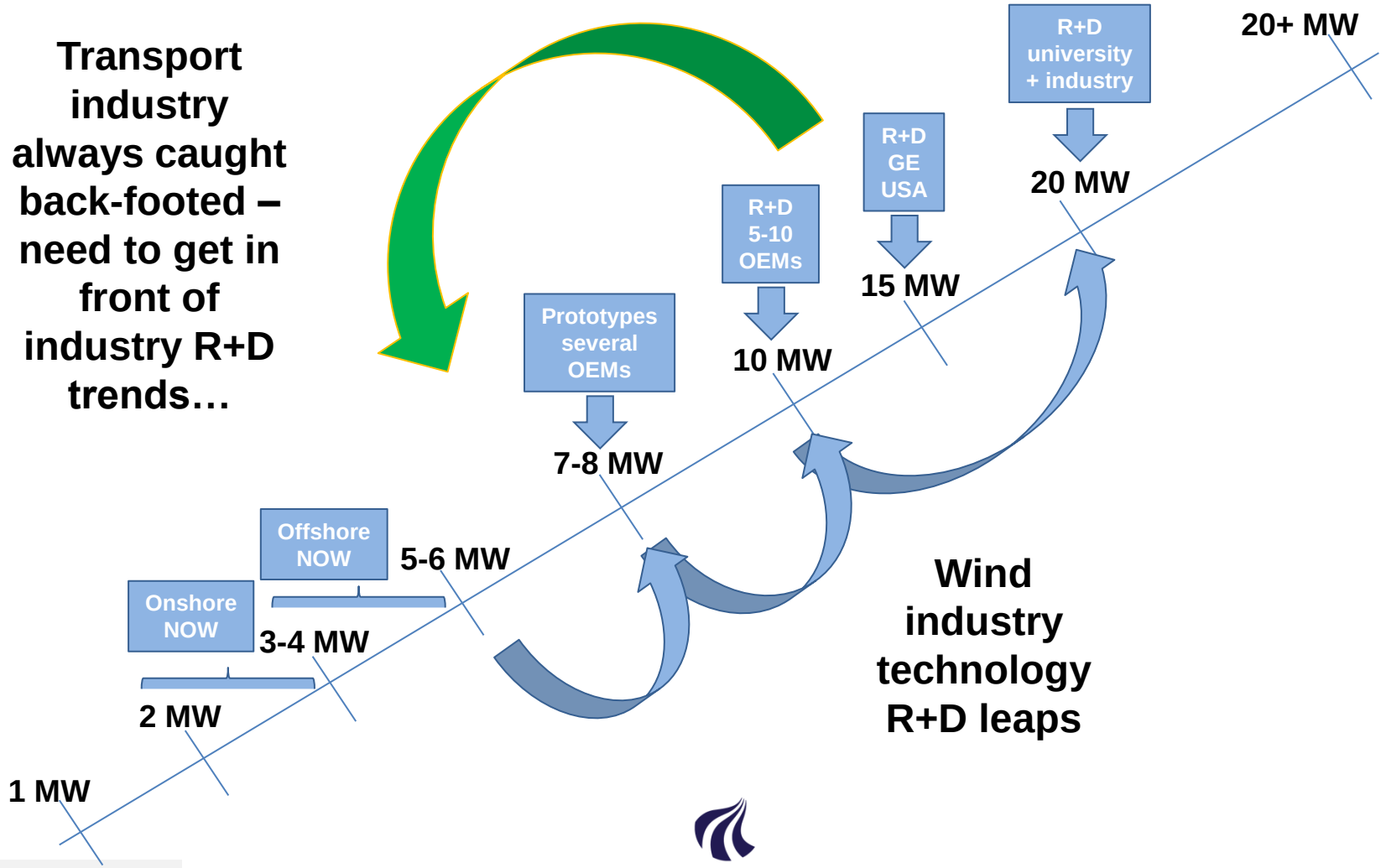
Source: Upwind Project (design limits and solutions for very large wind turbines) and Aalborg University Copenhagen photos

Research and development (R+D)



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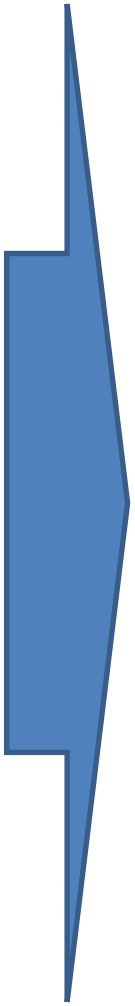
Key differences offshore/onshore

- Bigger WTG output
- Bigger size
- Heavier weight
- Quality (corrosion, wind, water)
- Balance of plant modules (foundation, cables, substation, etc.)

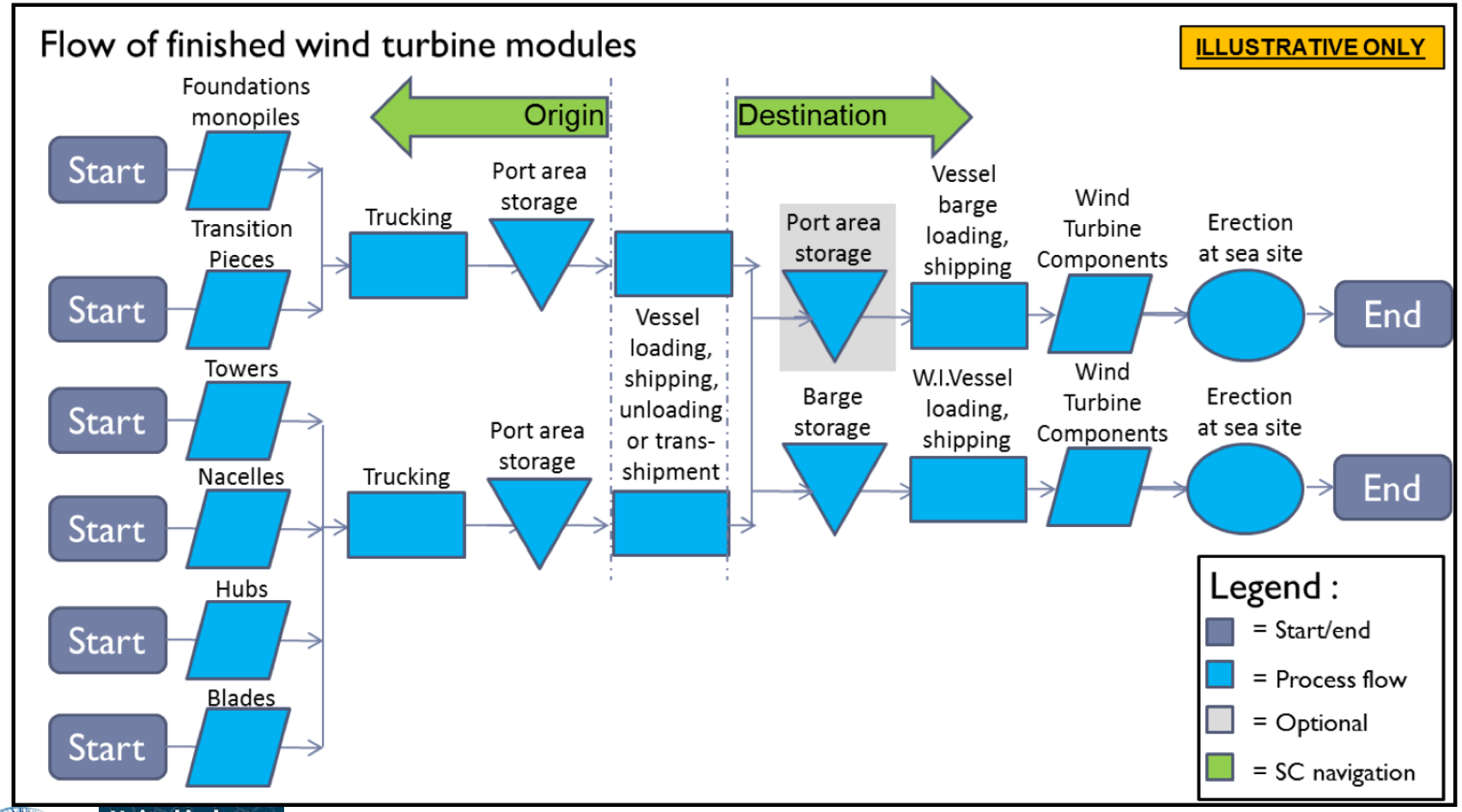


Offshore wind is more costly

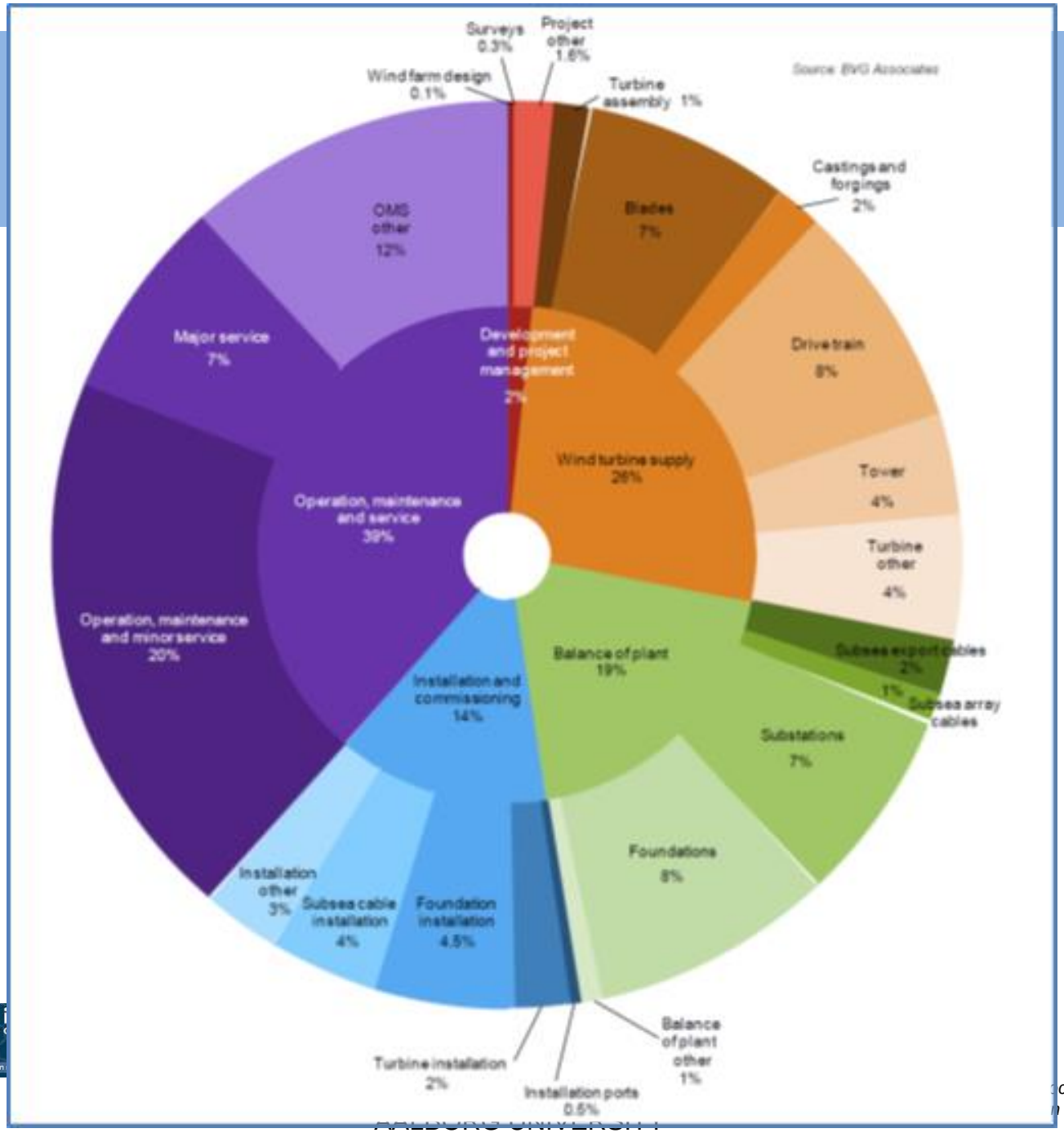
Dimensions – Logistics challenges

Source: Danish Shipowners' Association, courtesy Siemens Wind Power

Outbound I&C offshore double-port supply chain set-up



Source: Own construction using Chambers et al (2010) framework



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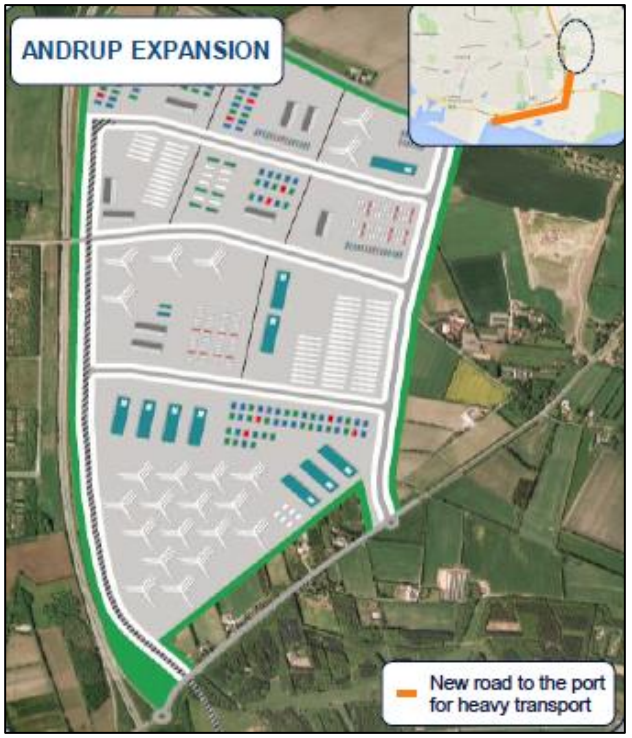
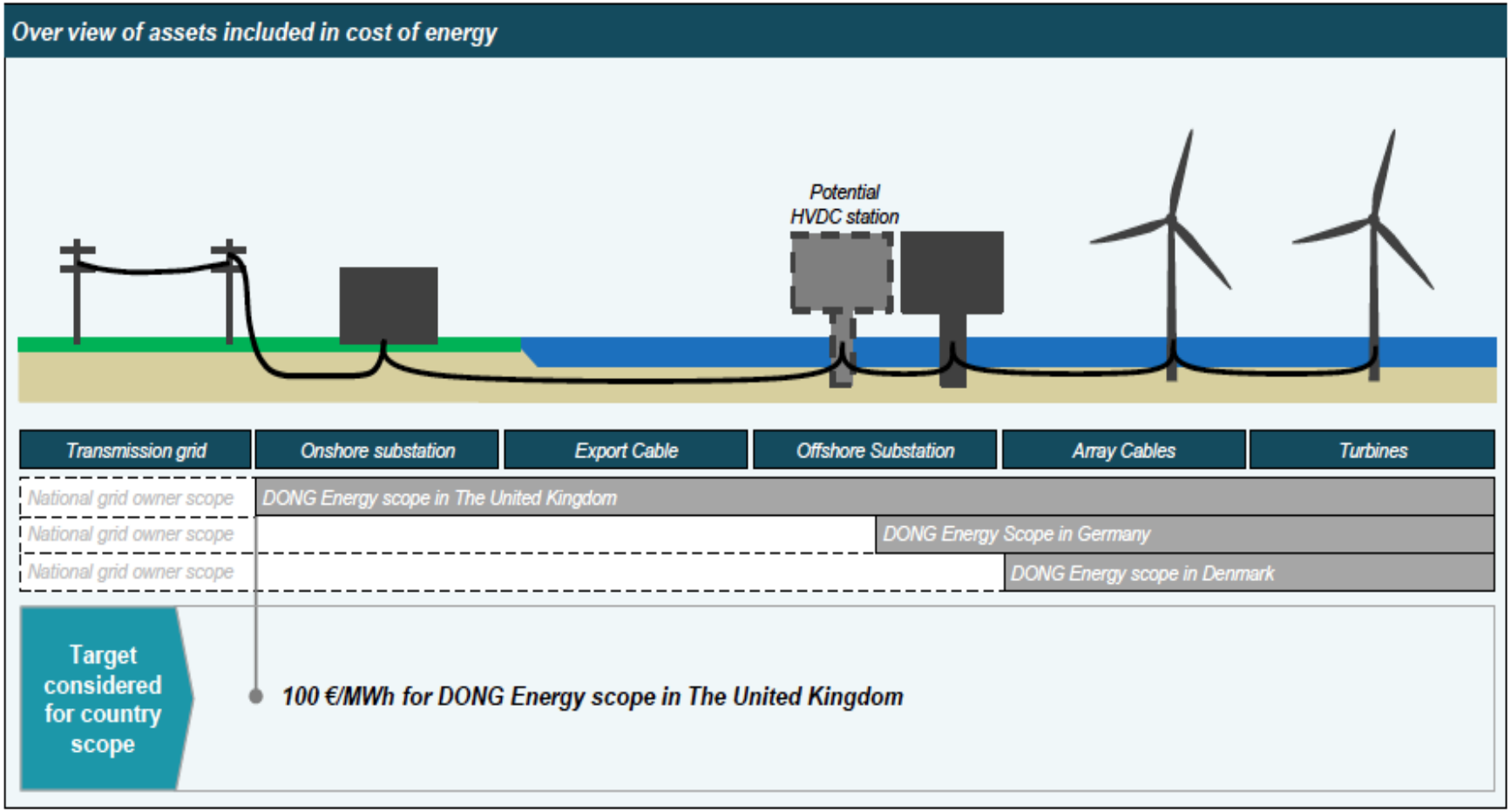
“Build it and they may come?!”



Port of Esbjerg is a lone example of an industry player that has been ahead of the industry and is now harvesting the benefits from this strategy

Source: Port of Esbjerg

Different ways to estimate LCoE



Source: DONG Energy

Involved parties...

Freight forwarders:
- Global
- Regional
- Local

Ocean transportation and related:
- RO/RO ("Roll-on/Roll-off")
- LoLo ("Lift-on/Lift-off")
- Short-sea/regional operators
- Tug/barges and landing crafts ("LCTs")
- Multi-purpose vessels ("MPV")/Floating cranes
- Container vessel operators
- Safety vessels, work boats, and crew/hotel vessels
- Special vessels like offshore wind turbine installation and cable laying vessels

Ports

Storage:
- Warehouses
- Yards
- Storage areas

Rail

Specialty trucks

Land based cranes

Utilities | **Operators** | **OEM's** | **EPC companies** | **SWF**

Extent of services

Sharing best practices
- China's need for offshore wind

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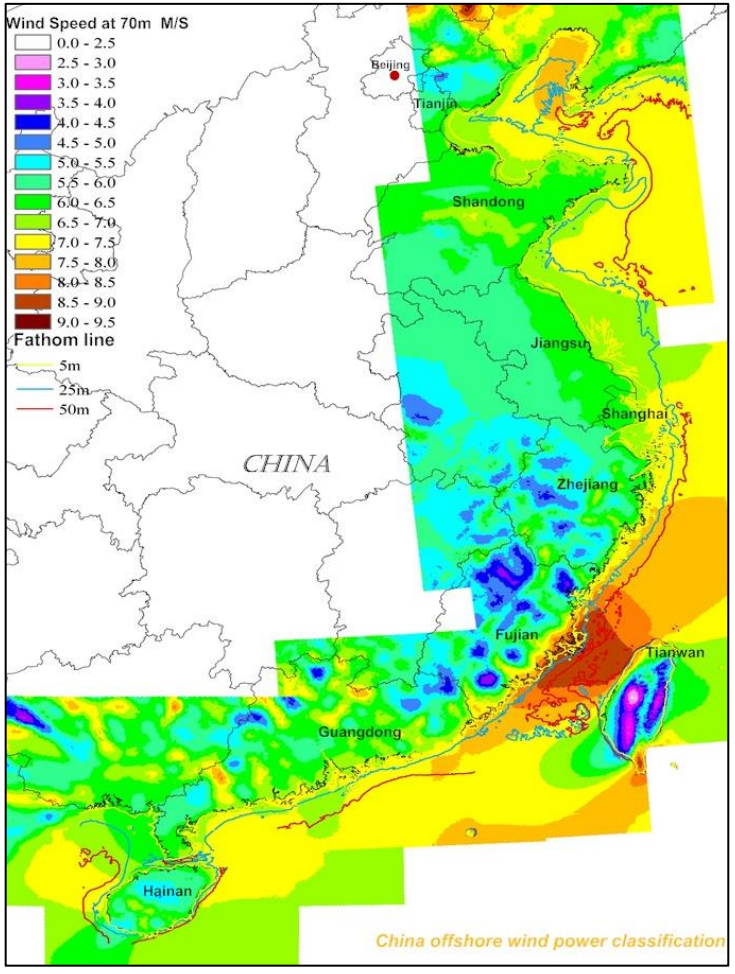
Wind resource map of China

- **18.000 km long coastline**
- **From shoreline to water depth of 20m = 157.000 km²**
- **Assuming only 10%-20% is suitable for offshore wind and the use of an average 5 MW WTG´s**

→ 100-200 GW offshore capacity

Offshore resources in China are spread across:

- **Jiangsu**
- **Zhejiang**
- **Fujian**
- **Shandong**
- **Guangdong**
- **Shanghai**

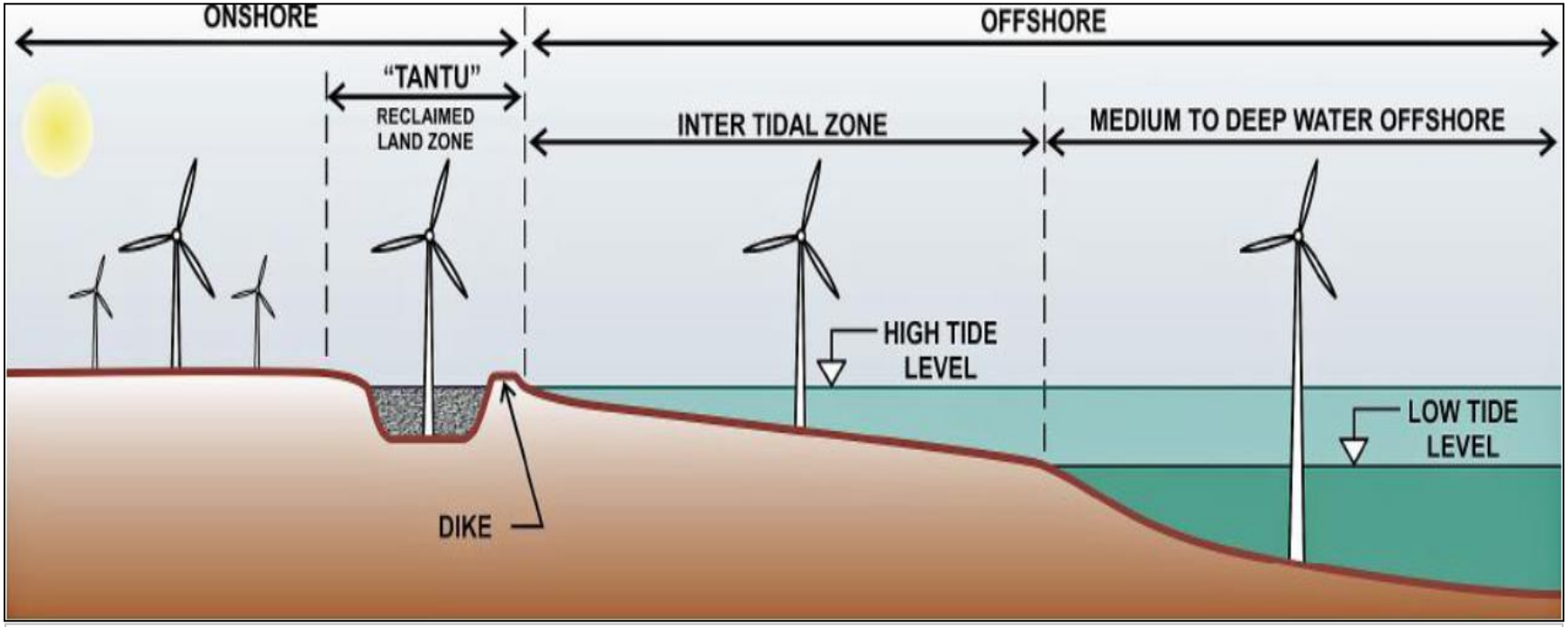


2020 target: ~~30~~ GW offshore wind

10 GW by 2020

Source: Own analysis, BTM Navigant and data from National Climate Center of the China Meteorological Administration, June 2010

Partnerships between industry and academia - needed across boundaries and geographies

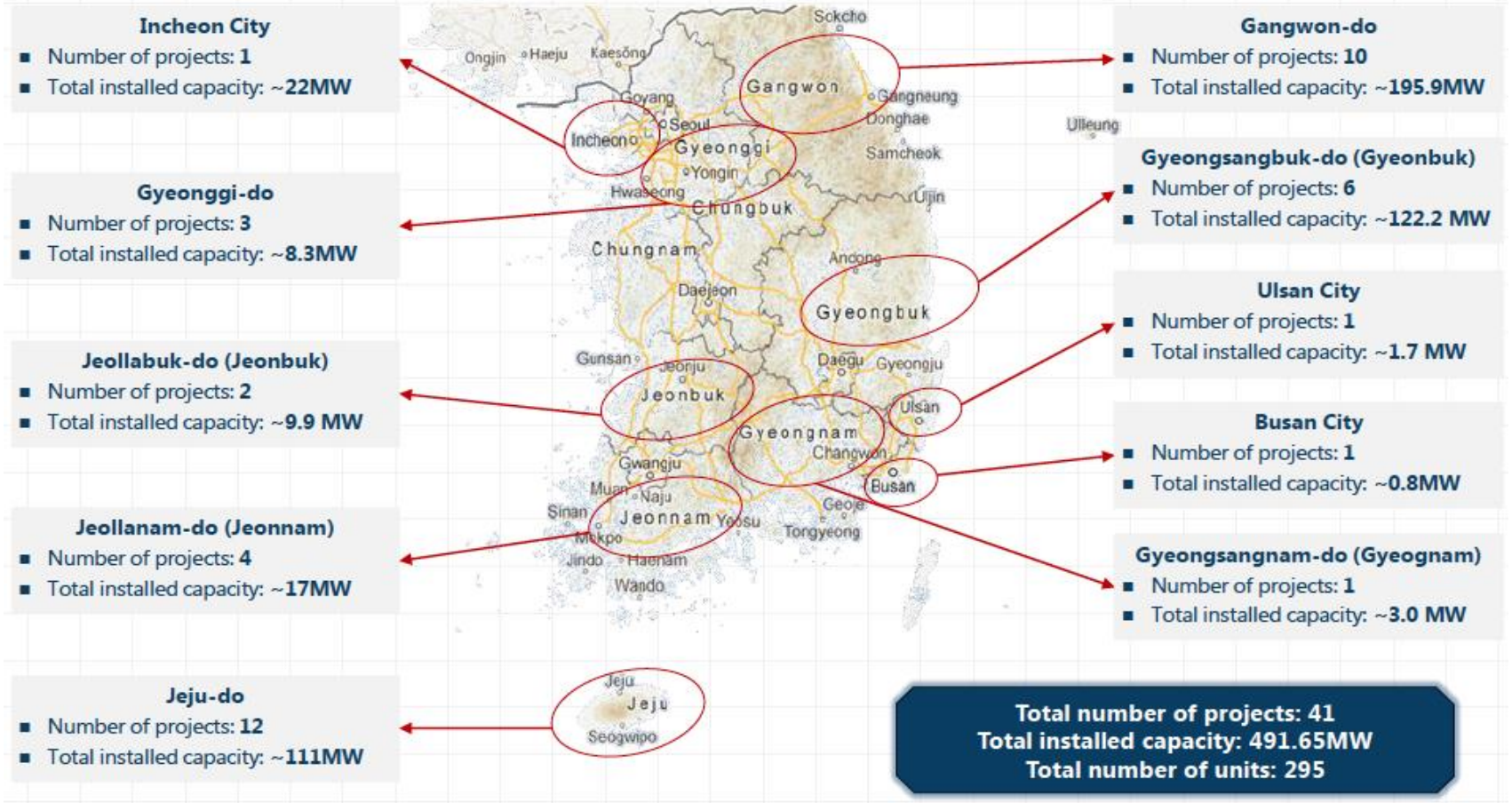


Example Jiangsu Dafeng project (installation by Guodian/CCCC JV):

- 30 km from shore, Western part of farm will have riverbed exposed during low tide
- Eastern part of farm will need WTIV's to be permanently jacked up out of the water
- Requires different kinds of vessels than in Europe

Source: NEA & World Bank (2010), BTM Consult part of Navigant & Poulsen (2012), and first author research

Continuous improvement
South Korea status(onshore and offshore)



7.5 GW home market offshore wind target by 2030

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Source: Korea Wind Energy Association (2013)

Key points of today

- Wind market has developed significantly on a global basis
- Especially offshore wind is costly and must get to levelized cost of energy parity to eliminate subsidies
- Technological developments are critical including H2020 support
- Also support industries need funding

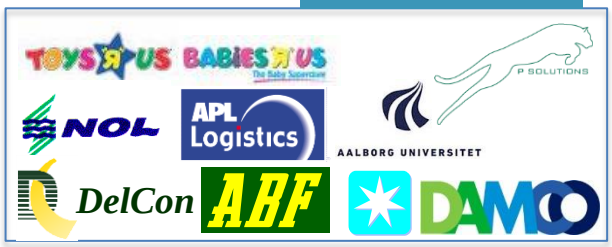
Conclusion – innovation boost

- Levelized cost of energy will go down simply by step-changes in technology
- Logistics makes up 10-20% of the end-to-end wind farm life-cycle costs
- Demands on the logistical chain are ever increasing as wind components become ever larger and heavier
- Joint industry / university / government R&D within shipping and logistics is required under H2020 going forward

Thank you – Thomas Poulsen

Aalborg University, Copenhagen Campus
Department of Mechanical and Manufacturing Engineering

Past employers



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Select consulting clients

Research interest:
Global wind energy shipping and logistics

Background:
25 years of global shipping, logistics, and SCM experience having lived in 8 different countries working at practical, strategic, general management, and consulting level

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