ETIP Wind

EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON **WIND ENERGY**

Research and Innovation & driving Global offshore

January 2020

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Aidan Cronin

Executive Committee chair

This presentation is meant for debate only and does not purport to reflect the precise opinions, plans or strategies of any ETIPWind member.

Agenda

1. ETIPWind?

2. Where is Offshore Wind heading to in Europe?

3. EU Research & Innovation Offshore Wind

4. Global offshore wind - perspectives

What is ETIPWind?

OUR OBJECTIVES

Reduce costs

Facilitate system integration

Reinforce European technological leadership

Ensure first-class human resources

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Outlook on Offshore Wind in Europe

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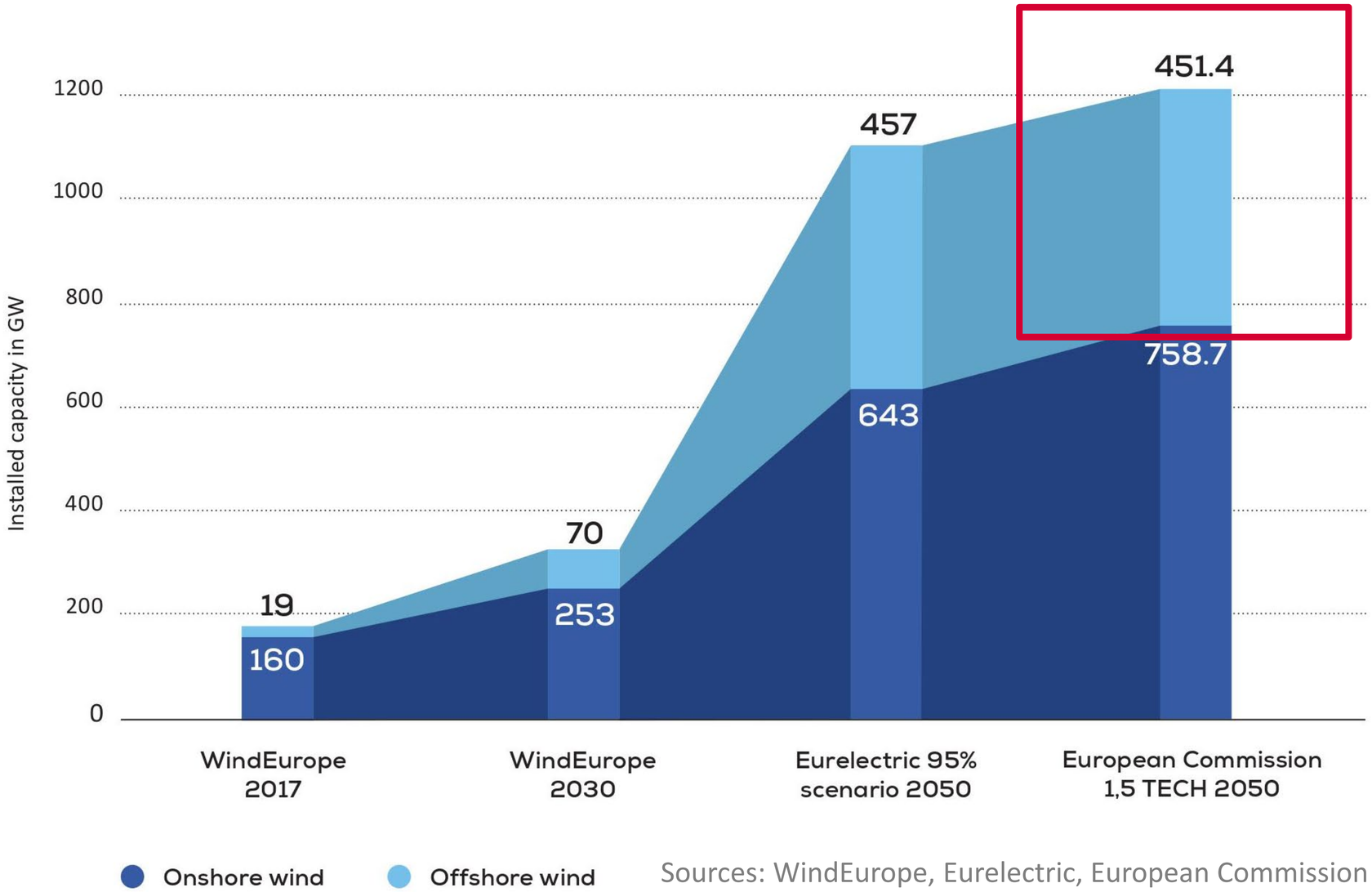
PROJECTED WIND CAPACITY 2050



HIGH POLITICAL AMBITION FOR OFFSHORE WIND

Sources: WindEurope, Eurelectric, European Commission

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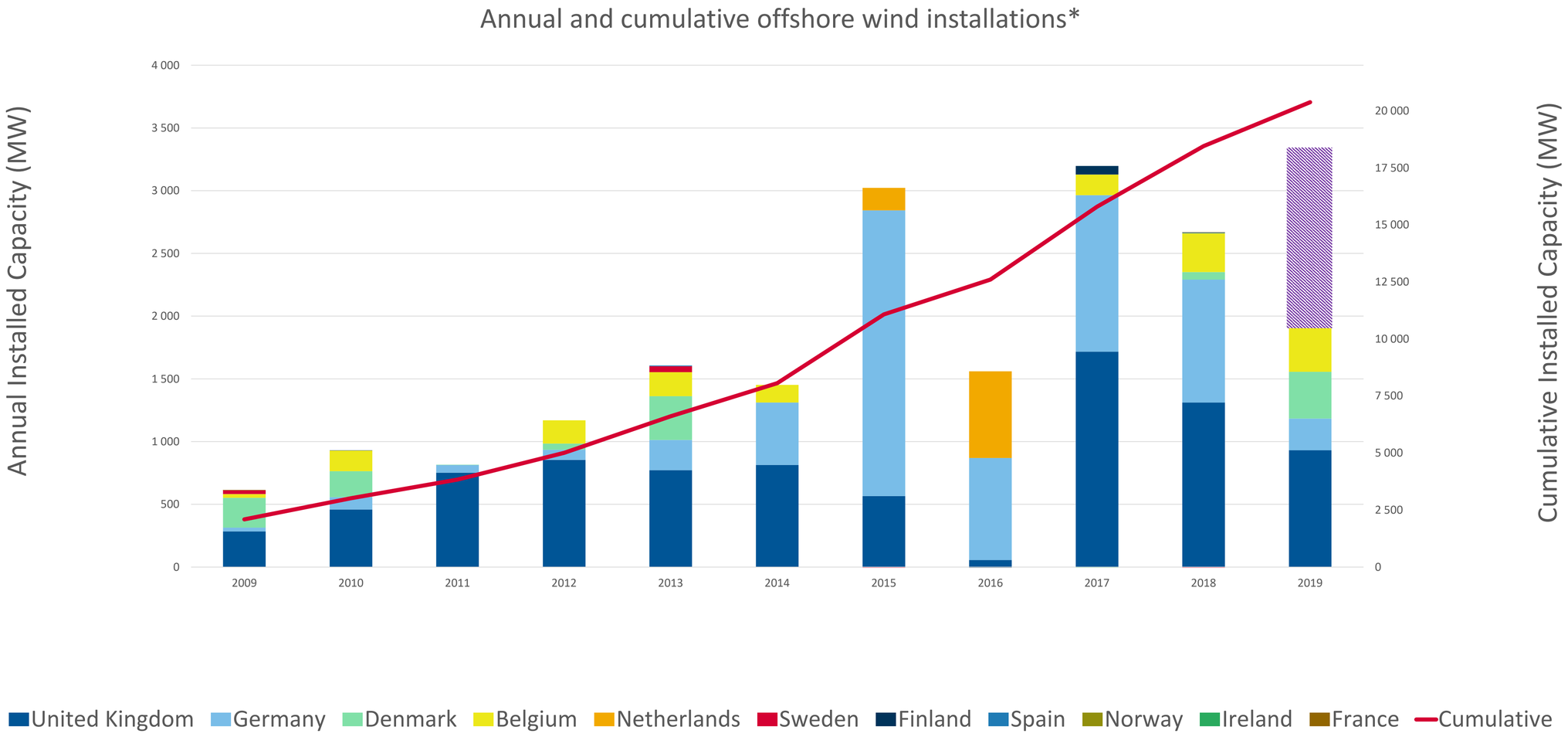
On track for a record year for offshore wind…



WindEurope forecasts a record 3,390 MW by the end of 2019.

Source: WindEurope

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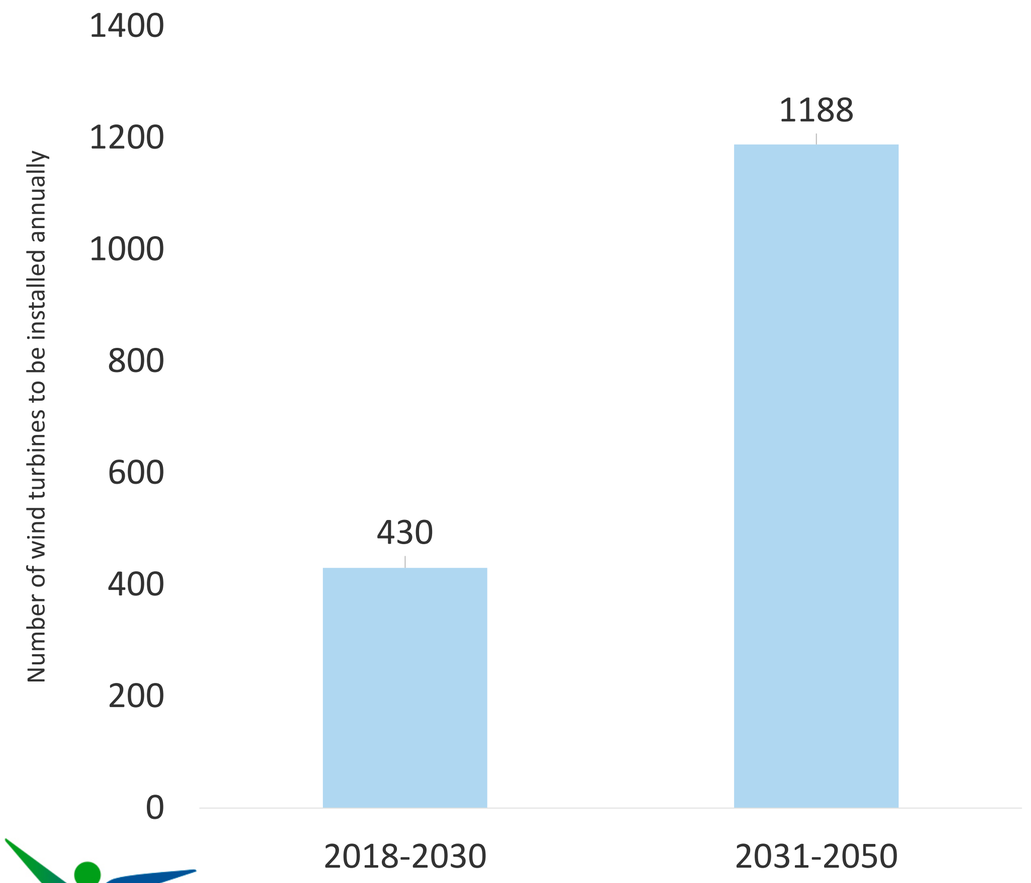
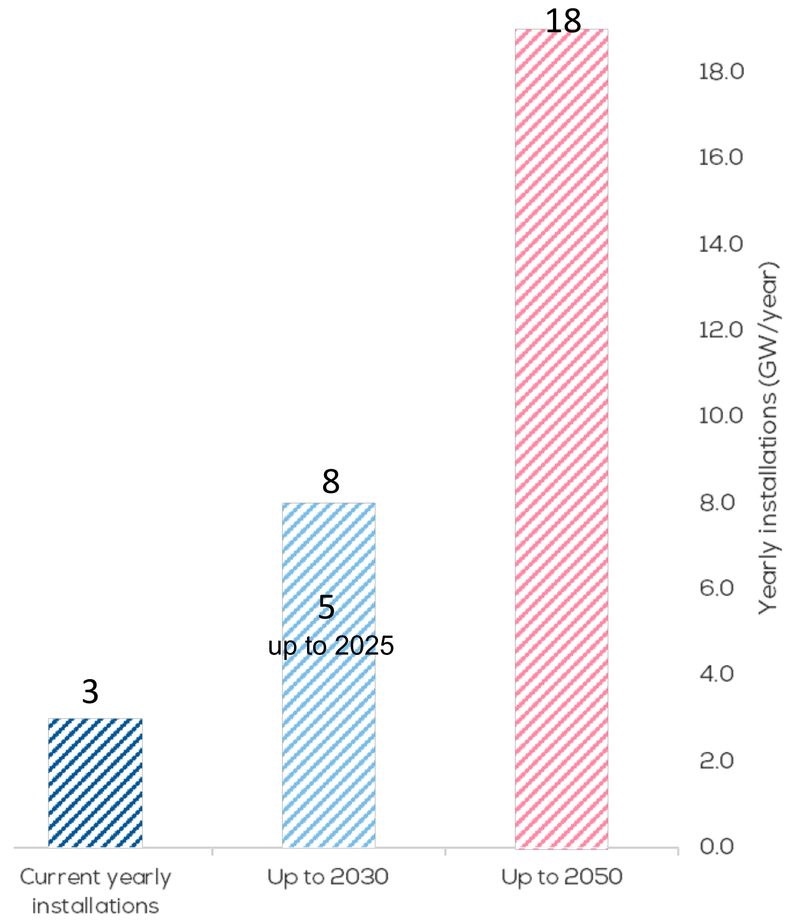
But annual offshore installations need to increase rapidly!

Number of turbines



Annual installed capacity



Source: WindEurope

Assumed average wind turbine nominal capacity: 10MW for 2018-2030 and 16MW for 2031-2050.

ETIPwind view on Research & Innovation needed to realise Offshore Wind potential

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Research & Innovation priorities 2020-2027

Technology Roadmap

- Grid & system integration
- Operations & maintenance
- Next generation technologies
- Offshore balance of plant
- Floating offshore wind
- Skills & human resources

Short-term 2020-2022	Medium-term 2023-2024	Long-term 2025-2027
• Integrated forecasting of power production & demand • Short-term energy storage	• Optimising transmission infrastructure	• Stable system with 100% RES
• Lifetime assesment and condition monitoring • Digital tools for control and monitoring	• Dynamic cable repair solutions • Digital solutions for smart operations • Predicting environmental parameters	
• Development and validation of components & materials • Blade recycling demonstration • Integrating wind energy in the surrounding natural and social environment	• Development of sustainable materials • Standards • Manufacturing processes	• Recycling methods for materials and components
	• Cabling and connections	• Cross-industry agreement and standards • Integrated optimised design plan • Verification of methods and procedures
• Lean production • Validation of design tools • Mooring and anchors • Dynamic electric cables • Control methods		
• Expand and harmonise wind energy teaching in Europe	• Boost wind energy higher education	
• Long-term energy storage	• Quantification of system services • Sustainable hybrid solutions	
• Robotic inspection and repair methods	• Decommissioning strategies and technology • Solutions for operating in extreme conditions	
• New transportation methods for large components	• Sensor technologies, diagnostics and response • Next generation generators • Noise reduction • Reliability of components	• Disruptive technologies
• Data availability & sharing • Serial production – analysis of substructure production processes	• Material durability and protection	
	• Integrated design process in supply chain	• Park level control
	• Joint academia-industry educational programmes	
• Multi-cultured wind farms • Modelling future system needs		
		• Supply chain logistics (decommissioning)
	• Floating installation, assembly and heavy maintenance	

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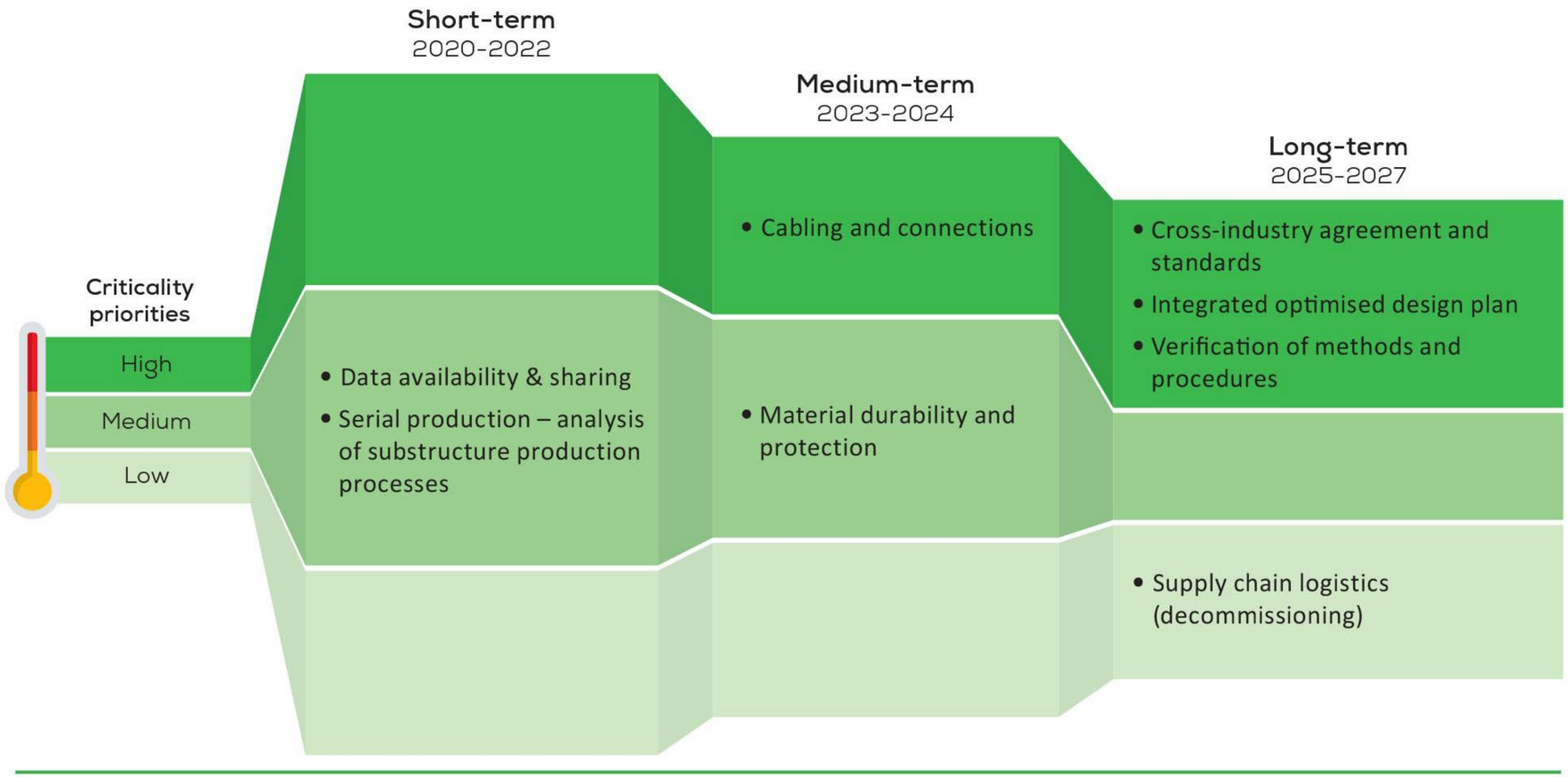
Offshore balance of plant



Research & Innovation action areas for offshore balance of plant

Cabling and connections

Medium-term

High priority

Description and scope

Cables are the most pivotal and weakest link in transferring offshore wind power to the grid. If the cable fails, power production drops and this affects the economic value of offshore wind. Most cable failures are due to one of the following 5 major causes: fatigue due to erosion of the support sand; failure of cable structure; damage from incorrect installation; manufacturing problems; and damage from ship anchors. There is a need for a new generation of high tensile light cables for floating offshore units. There is also a need to develop lead-free High Voltage Direct Current (HVDC) and High Voltage Alternating Current (HVAC) cables using new sealant technologies.

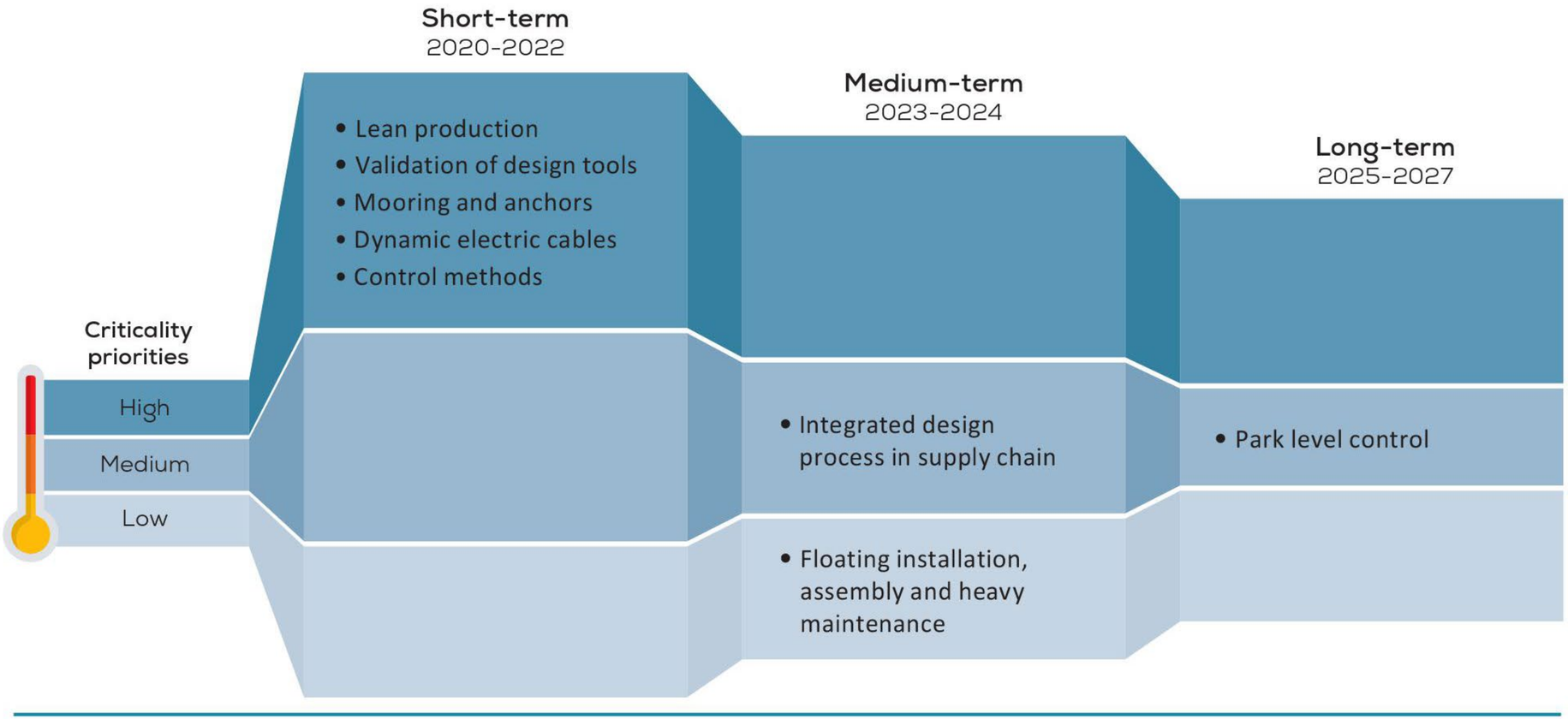
Recommended research actions

- Develop cables resistant to strain when support sand is washed away. Sensorise cables to warn of this in advance.
- Optimise materials and structure of cables to make them fit for purpose and reduce the high price.
- Develop automated repair systems for large array and export cables.
- Develop a new cable suitable for floating wind farm connection.
- Develop audio/optical-based ship monitoring and damage system to pre-warn and prevent damage and/or identify culprit of damage.
- Develop lead free HVDC and HVAC cables using non-metallic seals.

Milestones

- Develop new cable technology to reduce failures by 90 % by 2024.
- Develop new floating-ready cable technologies by 2024.
- Develop lead-free cables by 2024.

Floating offshore wind



Research & Innovation action areas for floating offshore wind

Lean production

Short-term

High priority

Description and scope

Production of substructures for floating wind turbines are costly. This production methodology is adopted from the oil and gas industry, characterised by "one-off" production series and a lot of costly work. Cost reduction of floating offshore wind substructures depends on effective automated production of the different parts. Optimisation and standardisation of the different parts could reduce the cost of substructures significantly.

Recommended research actions

- Develop new material qualified for structure elements, mooring lines and electrical cables.
- Design and develop post efficient building elements for floating offshore wind turbines.
- Standardisation of transport methods and assembly.
- Support the development of high precision manufacturing lines of floating platforms for more efficient mass production.

Milestones

- Designs to have global reach for yards.
- Best practices for optimisation and production of floating wind substructures and components such as coned cylinders, pressure resistance of marine structure components, stiffness of towers and substructure, connections between columns and pontoons, bracing column/pontoon connections and anchors.

Floating installation, assembly and heavy maintenance

Medium-term

Low priority

Description and scope

Deepwater offshore wind sites exclude use of traditional jack-up vessels for assembly, installation, and heavy maintenance. Floating-to-floating solutions need to be further developed for use in floating offshore wind developments. These solutions will allow for efficient installation and heavy maintenance at site and help to reduce capital expenditure (CAPEX) and operational expenditure (OPEX).

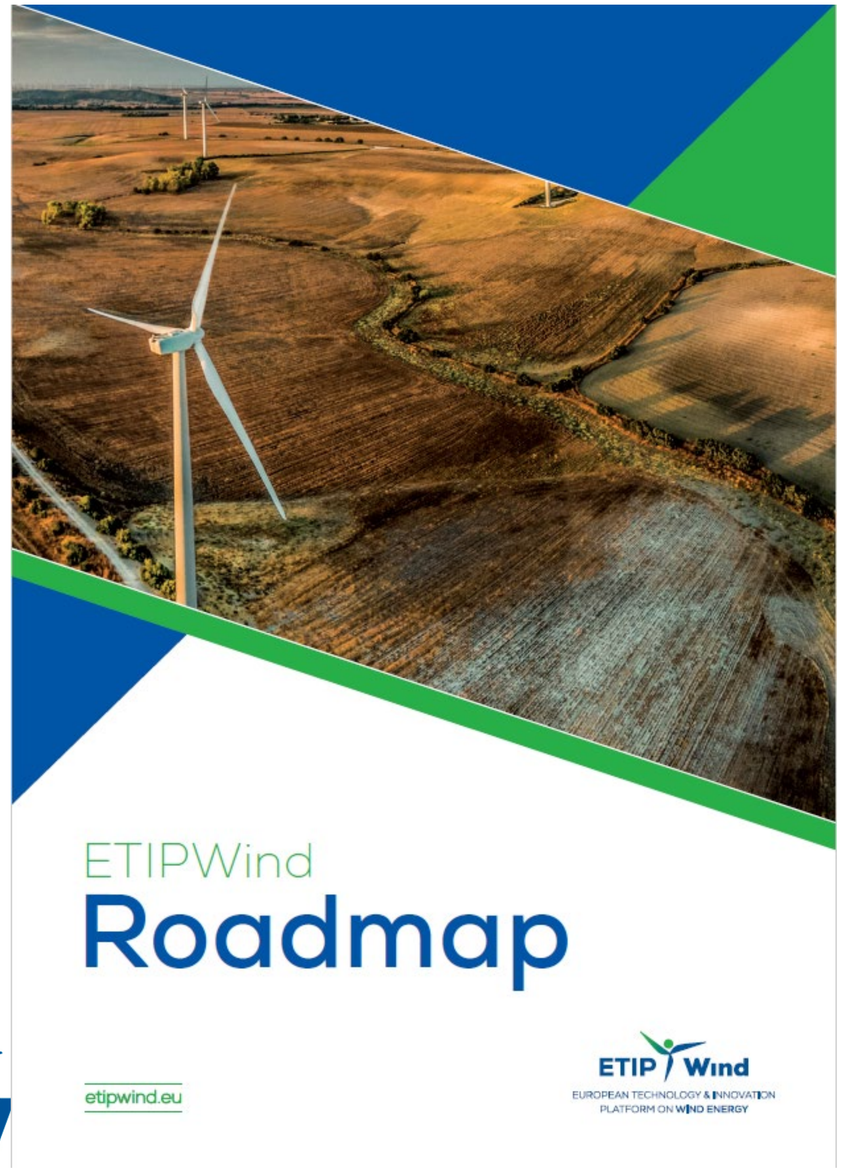
Recommended research actions

- Floating-to-floating motion compensated lifting operation.
- Assess loads on components during crane/lifting operations.
- Adaptable substructures for float over installation or to avoid heavy high-lifts, (e.g. telescopic designs, ... etc.).
- Adapt Rotor-Nacelle-Assembly to allow for large tilting such that blades, nacelle and tower can be assembled horizontally on the ground, towed out, then flipped up vertically offshore for installation.
- Flexible and Rigid Body Dynamic modelling for improved marine operations.

Milestones

- Enable floating-to-floating lifting at 1,5 HS and 10 m/s wind.
- Software tools able to simulate six degrees of freedom motion compensation.

Explore the ETIPWind Roadmap

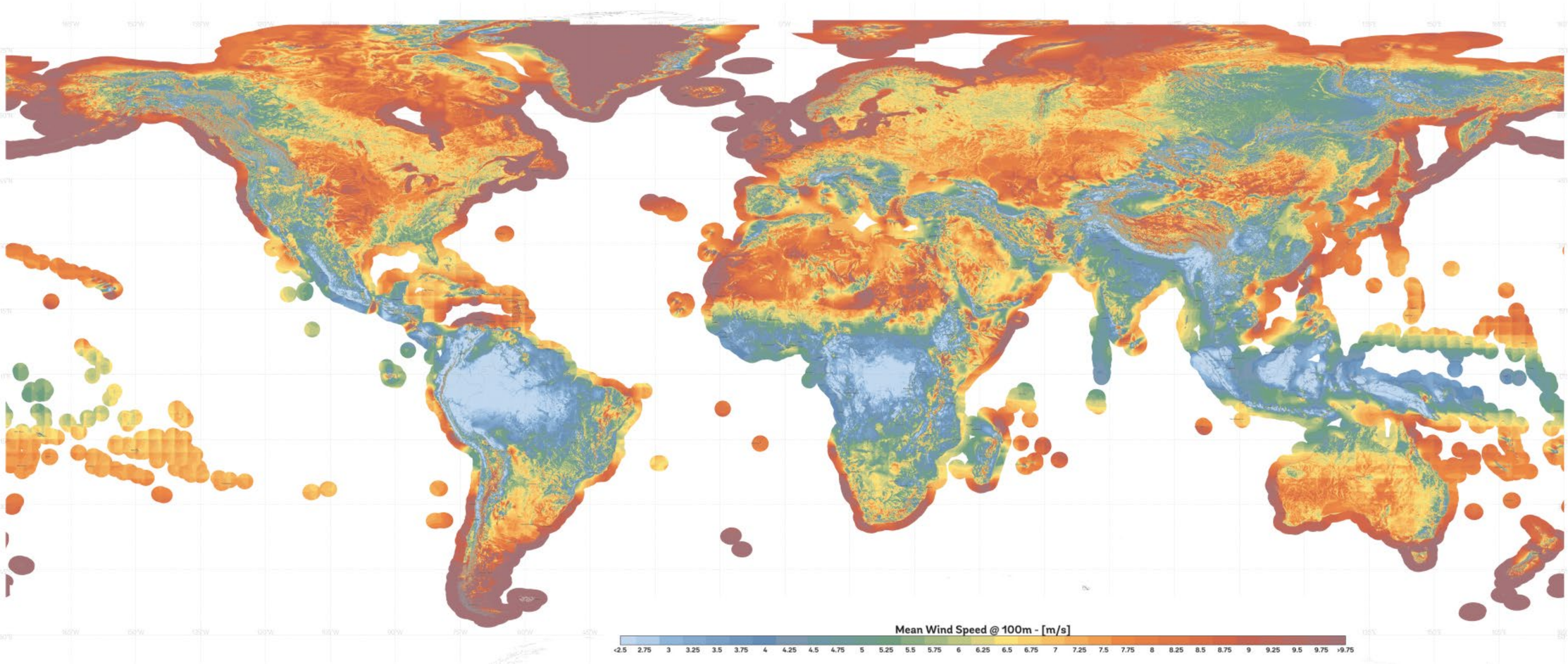


https://etipwind.eu/roadmap/

The Global Perspective

Offshore wind is huge – Copenhagen big on dreams need reality of delivery

Potential to deliver 18 times global electricity demand (IEA)



https://globalwindatlas.info/downloads/high-resolution-maps/World

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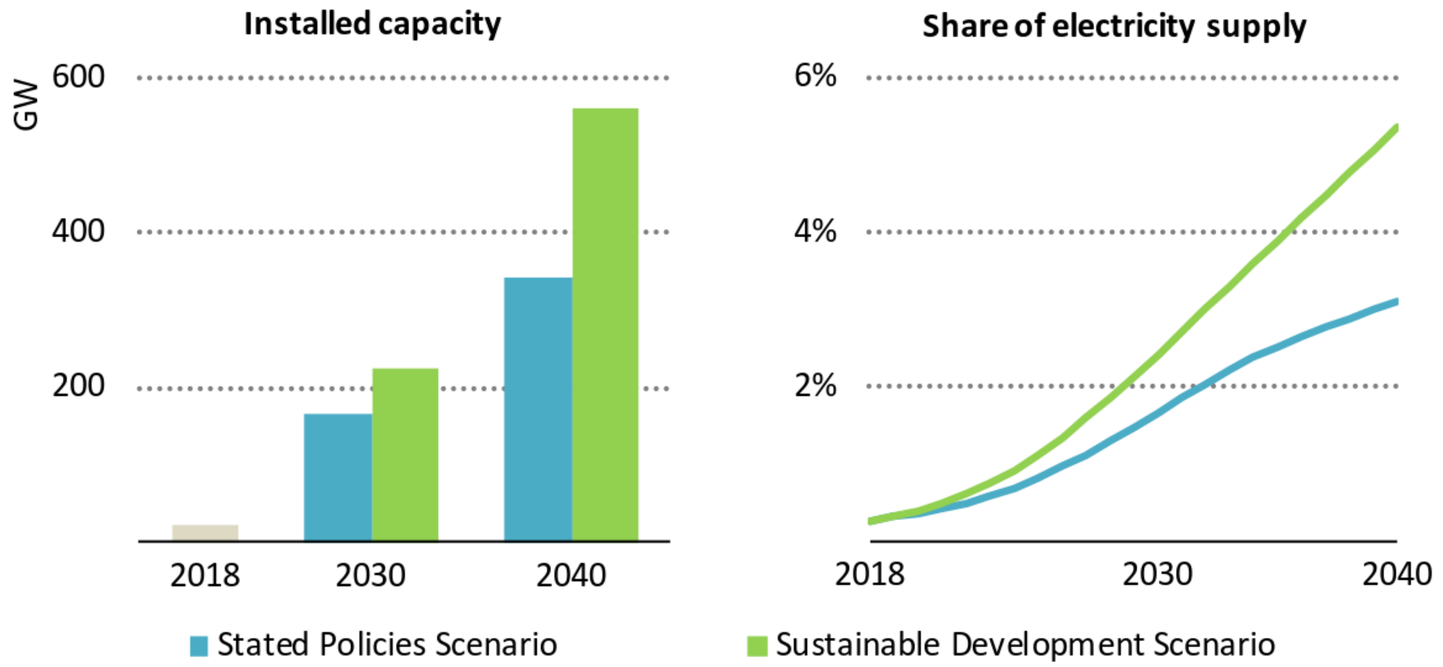
IEA Offshore wind outlook 2019 – OF = Tiny share of total energy consumption

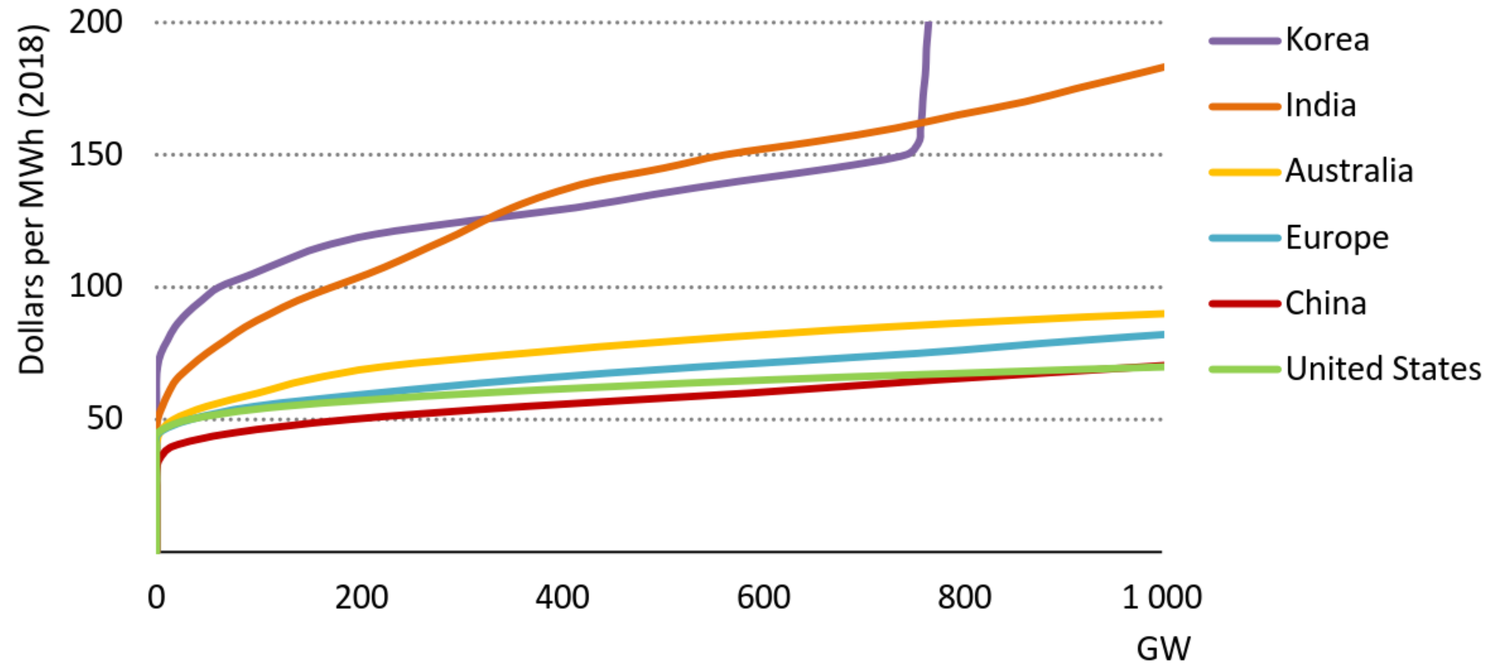
Figure 9 ▻ **Projected global offshore wind capacity and share of electricity supply by scenario**



Global offshore wind installed capacity increases by fifteen-fold in the Stated Policies Scenario, raising its share of electricity supply to 3% in 2040

Industrialized floating tech can change this dramatically
Difficult to replicate the EU experience curve

Figure 28 ▷ Offshore wind potential supply curves by region



Based on near-term costs, at least 1 000 GW of offshore wind potential is available for less than $80/MWh in China, Europe and United States

Needed Technology accelerators

- Low cost high quality floating offshore – lower installation cost than ON
  - Mooring systems
  - Cable
- Transmission – Lots of power with nowhere to go
  - HVDC – 4 variants that are not compatible today
  - Power to x – huge investment – H2 or NH3 – Barge transport
  - Large DEMO´s needed to reduce perceived risk
- How big is too big
  - Talk of 20MW machines – possible yes – profitable ??
  - Need to cover 30 years plus lifetime
- Storage is coming to a street near you - price not efficiency will drive this

The Chinese approach to R&I - North China Power University

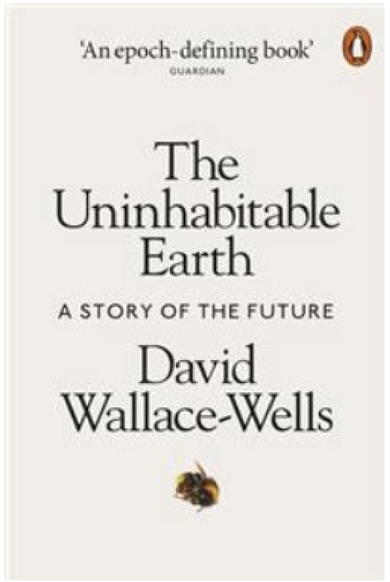
- Well financed University all inclusive. State Grid Corp of China and Government involved– all power technologies represented
- High participation of young women close to 50%
- Risk is relative – ability to test, fail and learn quickly – Open technical reports – City Books
- Patent nesting and national champions
- Open data sharing
- Quality a continuing process – can do attitude
- No lobbyists to muddy the water

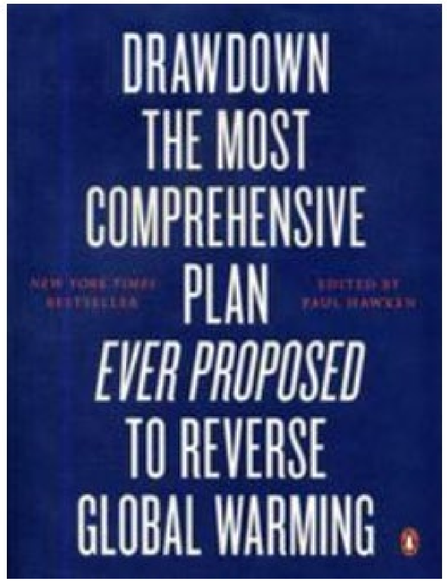
GLOBAL Challenges need Global Co-operation

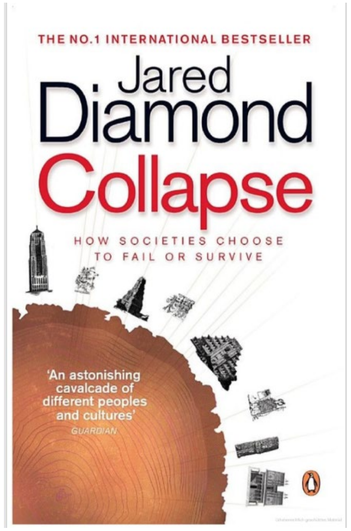
The future of fossil fuels

- Oil and gas strictly controlled
  - Combustion severly limited
  - Dawn of the composite age –
    - Japan a house last 1 generation – Future Composite based
    - Digital design of customized polymers
  - Polymers that conduct electricity - where are they?
  - Composites substitute metals and other load bearing materials
- Offshore coming onshore
  - Increase in flooding prompts development of semi floatable infrastructure based on composite technology
    - Affordable floating technology will be needed due to sea level rise and increased super storm activity

Some light reading







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Offshore wind can deliver huge amounts of needed clean, green particle free power.

Today this is a dream.

You in this room can through your research and innovation make it a reality.

Failure to deliver this potential would be a huge travesty

Thank you for your attention