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Offshore Wind – The Innovations and Opportunities

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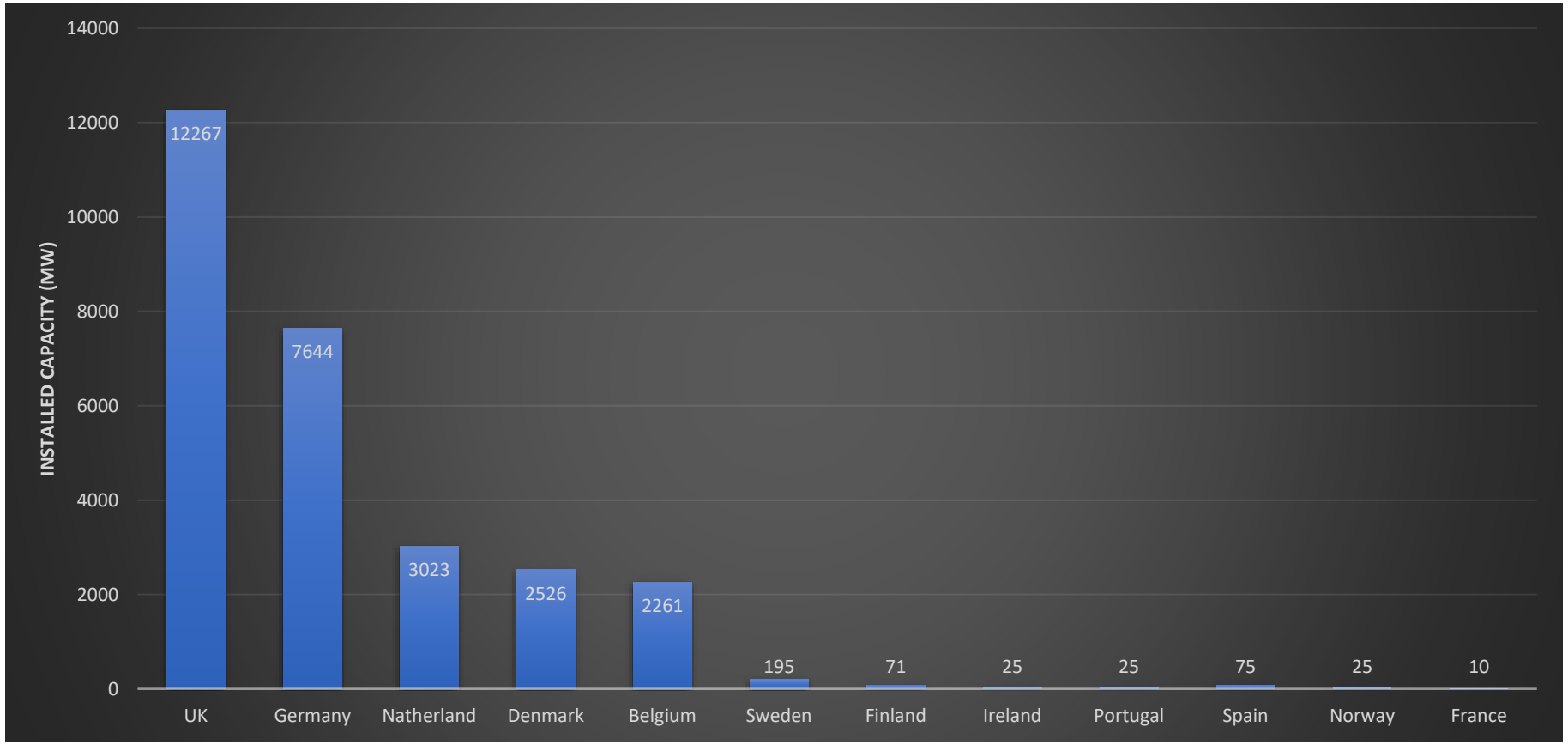
Credit: Equinor Hywind Floating Offshore Wind Farm

AGENDA

- Offshore wind industry development
- ORE Catapult – a quick introduction
- Technology development trend

European Offshore Wind



European offshore wind installed capacity by country

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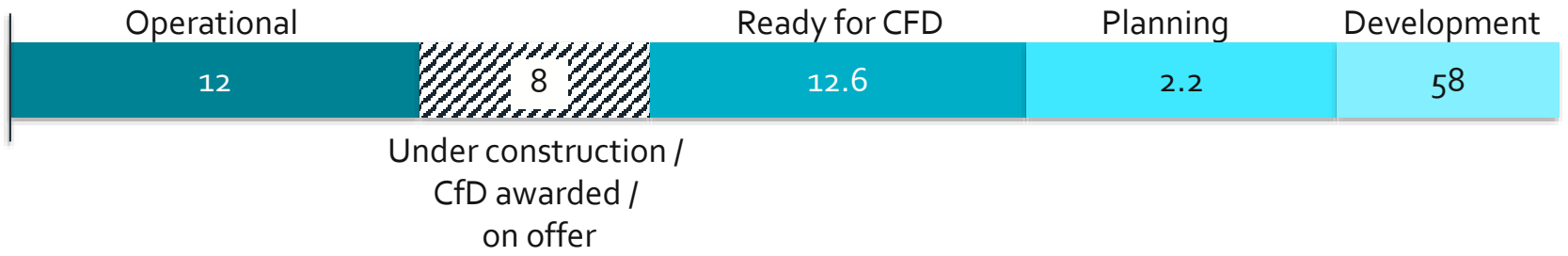
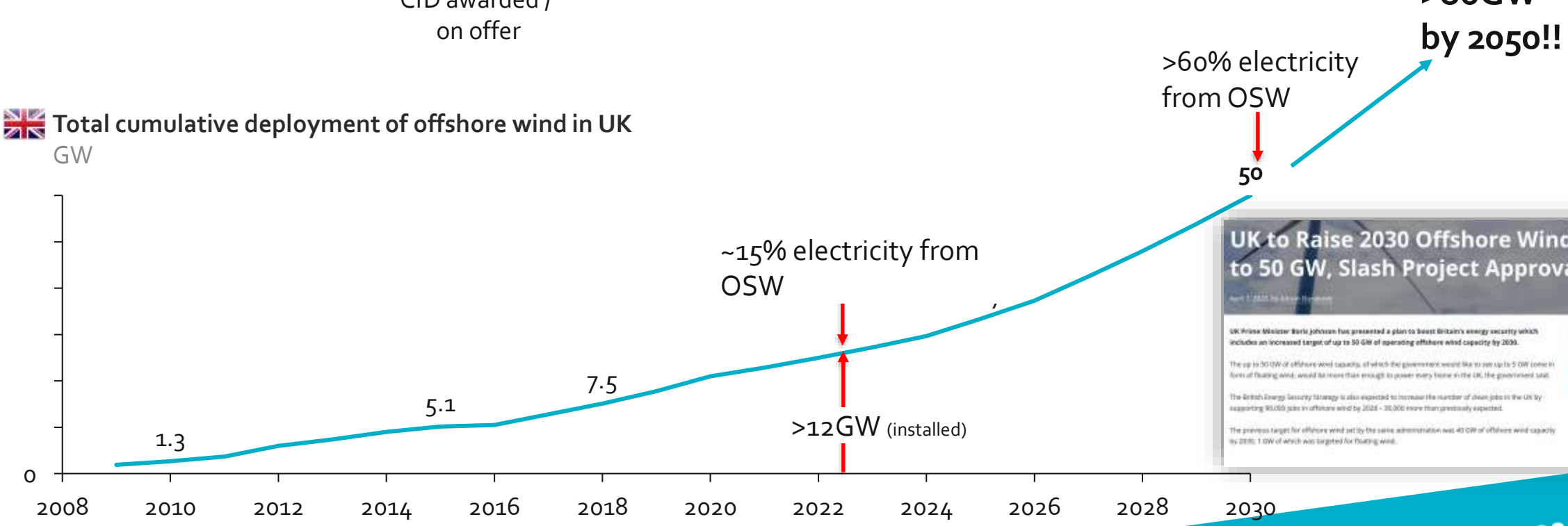
UK Offshore Wind

UK projects pipeline (2022)
GW



Total cumulative deployment of offshore wind in UK
GW



Source: ORE Catapult database

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Future Energy System will be more decentralised, multi-vector and rely on renewables

Current Energy System

- >12 GW of offshore wind
- Majority of properties heated by natural gas
- Fuel engine vehicles are the most popular
- ~40% Electricity generation comes from fossil fuels
- Meter reading send once every half a year

Future Energy System

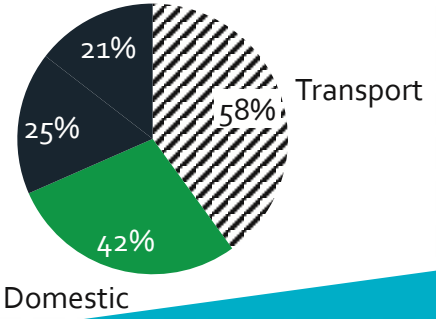
- Target 50GW of offshore wind by 2030
- Properties use electric heating or gas network converted to hydrogen
- All new vehicles are electric, hybrid or hydrogen-powered
- <20% of electricity generation comes from fossil fuels by 2030
- Smart meter reading send every half an hour

Outcomes

① **Intermittency of renewables will be largely overcome**

② **Offshore wind deployment can be bigger than we anticipate now**

Total primary energy consumption



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THE OFFSHORE RENEWABLE ENERGY CATAPULT

The UK's leading technology innovation and research centre for offshore renewable energy

Mission: to accelerate the creation & growth of UK companies in the offshore renewable energy sector.

8 UK Regional Centres

Aberdeen, Blyth, Fife, Glasgow, Hayle,
The Humber, Lowestoft, Pembroke Dock

3 UK Academic Research Hubs

Universities of Manchester
& Strathclyde – Electrical Infrastructure
University of Bristol – Blades
University of Sheffield – Power Trains

International Research and Innovation Centre

Yantai, China

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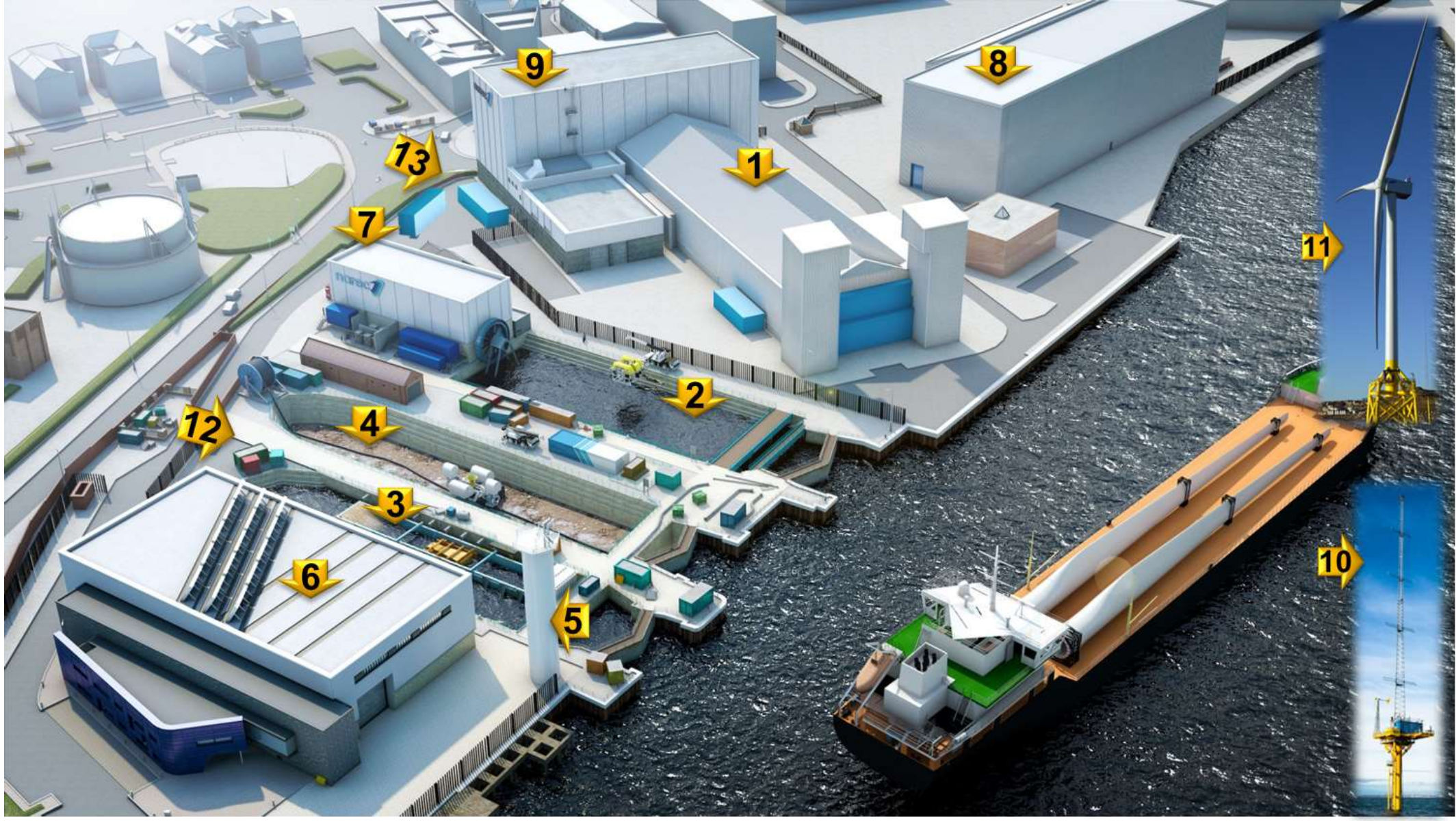
802 SMEs
supported
since 2013

556
Academic
collaborations
2013



Accelerate Tomorrow Technology Today

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BLADES

- Test & validate next generation 100m+ offshore wind turbine blades
- Develop and test innovative solutions for rain erosion (e.g. composite materials)
- Accelerate innovative blade designs and materials

FACILITIES:

100m and 50m Blade Test Halls

Blade Erosion Test Rig

Wind Turbine Blade Test Facility

POWERTRAINS

- Test & validate next generation 10MW+ offshore wind turbine powertrains
- Accelerate innovative powertrain technology, from Sub-1MW to 3MW
- Support development of critical powertrain components: bearings, gearbox, generator

FACILITIES:

1MW, 3MW, 15MW Powertrain Facilities

Wind Turbine Bearing Test Facility

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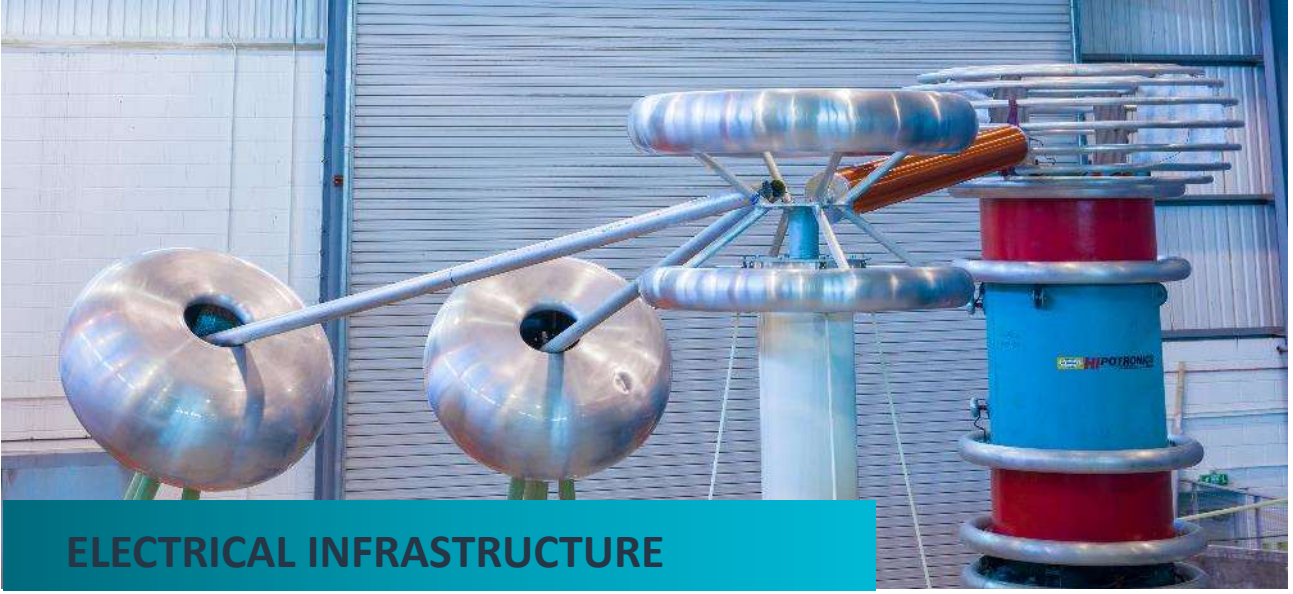


ELECTRICAL INFRASTRUCTURE

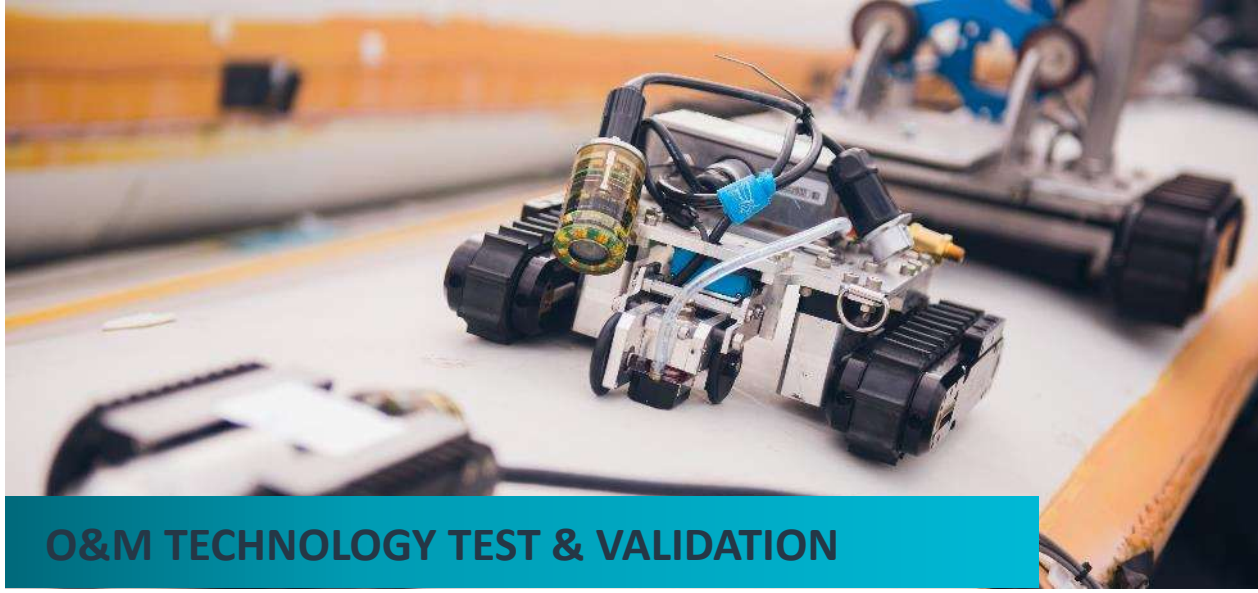
- Test & validate the market's largest cables - 66kV - through ageing, insulation breakdown and failure analysis
- Dynamic cable fatigue testing - for the future development of floating wind

FACILITIES:

HV and Materials Labs

Pre-qualification bays

Dynamic cable rig



O&M TECHNOLOGY TEST & VALIDATION

- Test robotics & autonomous systems (RAS) using controlled subsea dock environment, training tower (drones) and blades (blade inspection)
- Wet and dry controlled dock environment testing:
  - Cable inspection, protection and connection systems
  - Subsea & topside balance of plant

FACILITIES:

Subsea docks

Training tower

Blade sections

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Support Floating Wind – Dynamic Cable Test Rig

Qualification of dynamic cables for floating wind and tidal connectors

- **Mechanical + Electrical thermal + Wet test**
- Allows cable up to 250mm diameter
- Bending stiffness up to 120kNm
- 10 bend cycles per minute
- Simultaneous HV and heating testing
- Allow fully submerged in seawater

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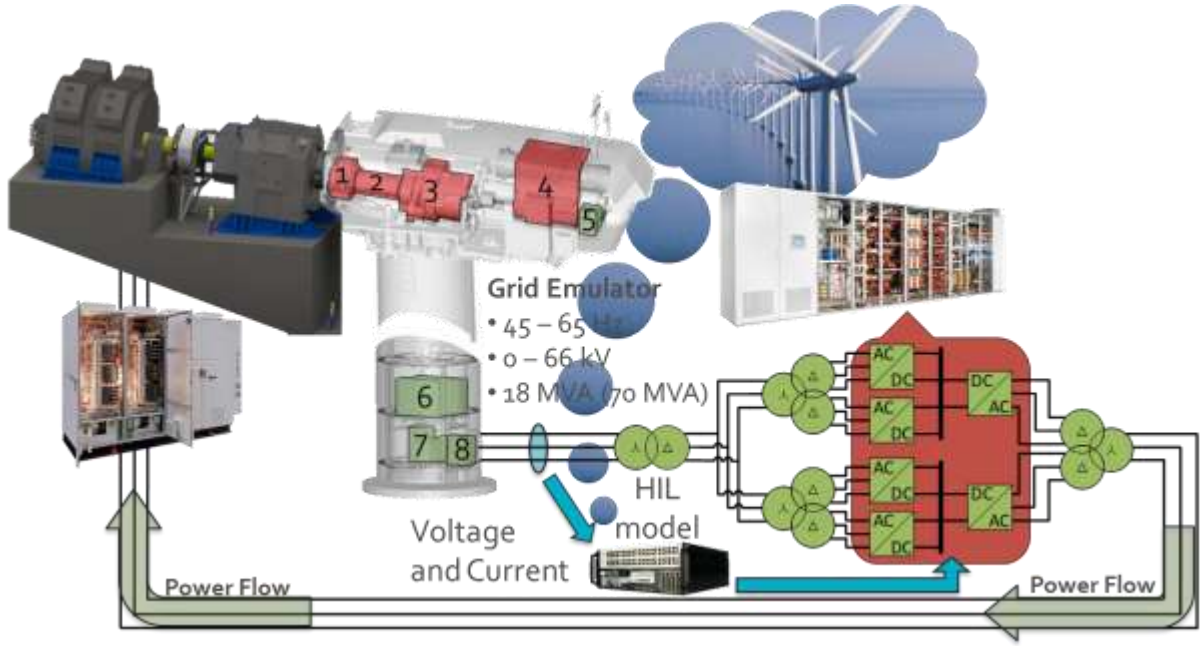
eGrid – an 18MVA Grid Emulator



Traditionally full scale tests are run in the field which has several disadvantages:

- **Time Consuming** - planning permission required, standards tests take years to finish
- **Costly** - replacing broken parts and updating designs is difficult
- **Weather Dependant** - have to rely on wind conditions at site ⇒ limited repeatability

15MW test rig + eGRid:

- Main Bearing
- Drive Shaft
- Gearbox
- Generator
- Central Controller
- Power Converters
- Transformer
- Switch Gear

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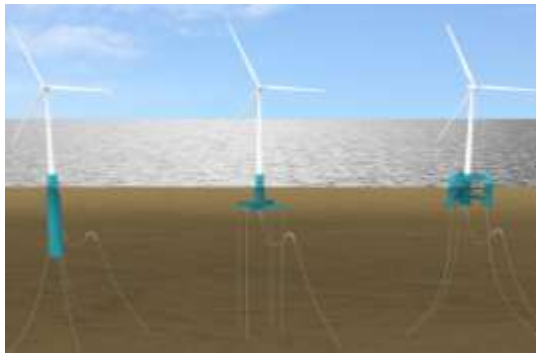
Current Innovation Interest in Wind Industry

Next Gen 20MW+ wind turbine



Floating Wind Technologies

Digital Twins Applications – Advanced Predictive O&M

Robotic & Autonomous Systems

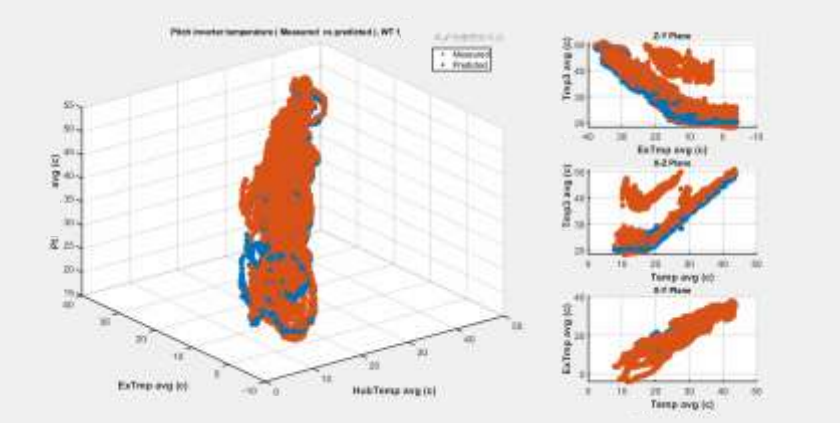
Additive Manufacturing

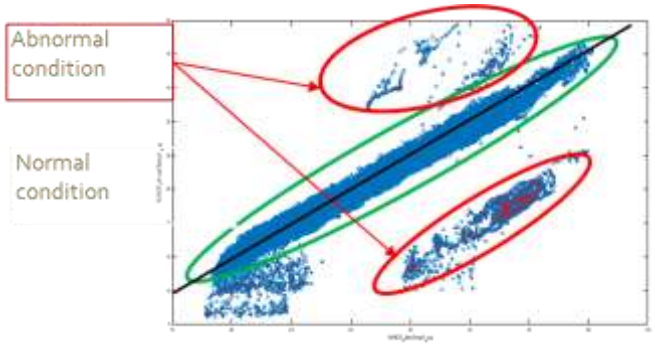
Energy Storage Solutions

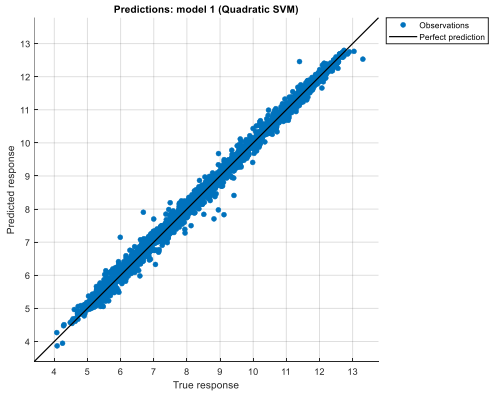
Digital Twin – AI/ML health monitoring solutions

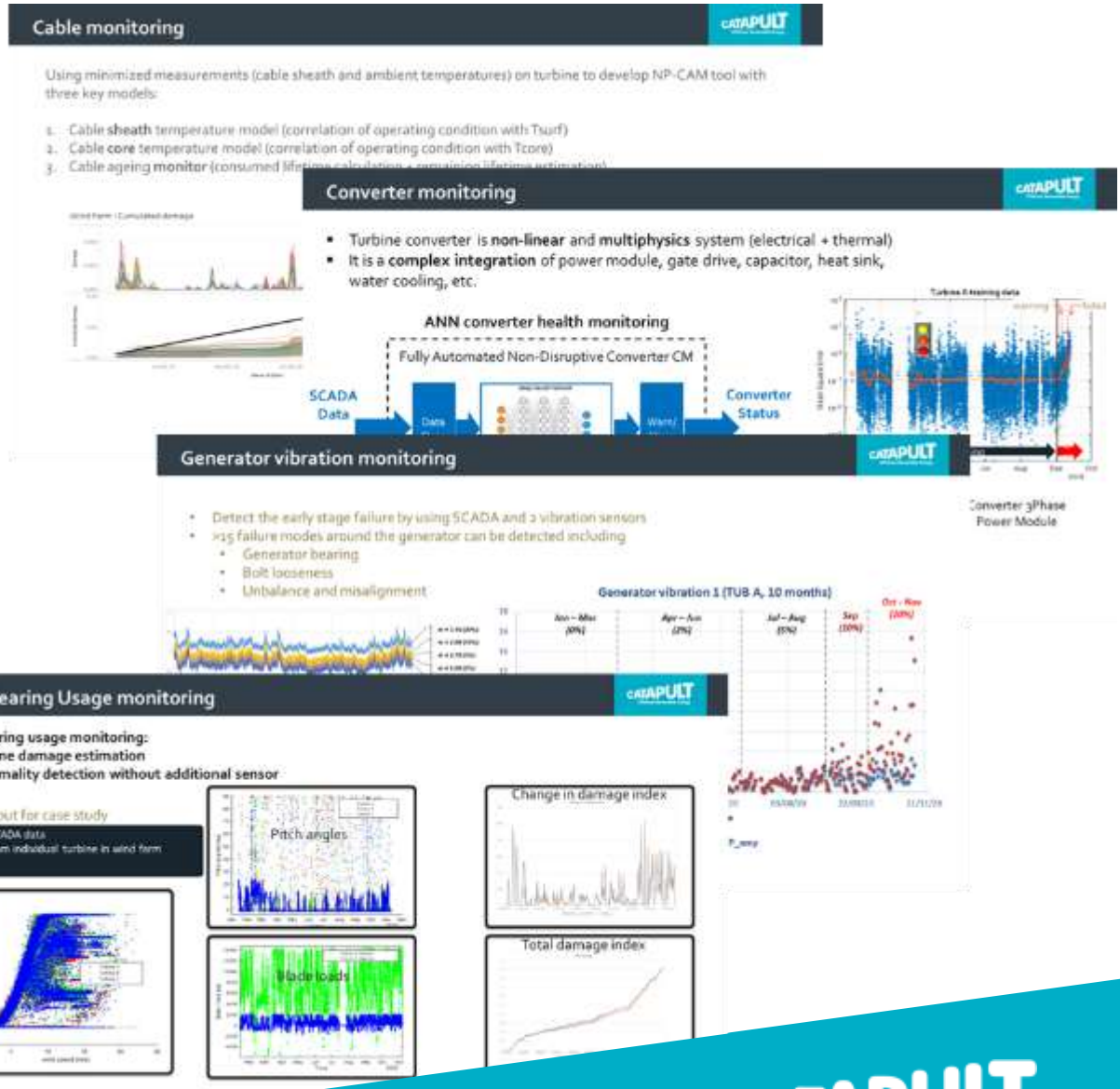
Pitch system health prediction & monitoring:

- **Higher than 97% of accuracy**
- **Abnormality detection without additional sensor**









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