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Energy Transition Seminar: an intro to offshore wind

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Emma Harrick

Head of Energy Transition and Supply Chain

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Offshore Wind – What, why, where and when

Chaired by Andrew McCallum, Founder and CEO, Aspect

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Isla Robb

Director

EC20 Limited

Scottish Renewables

Energy Transition Seminar

Offshore Wind
What, why, where and when

scottish renewables

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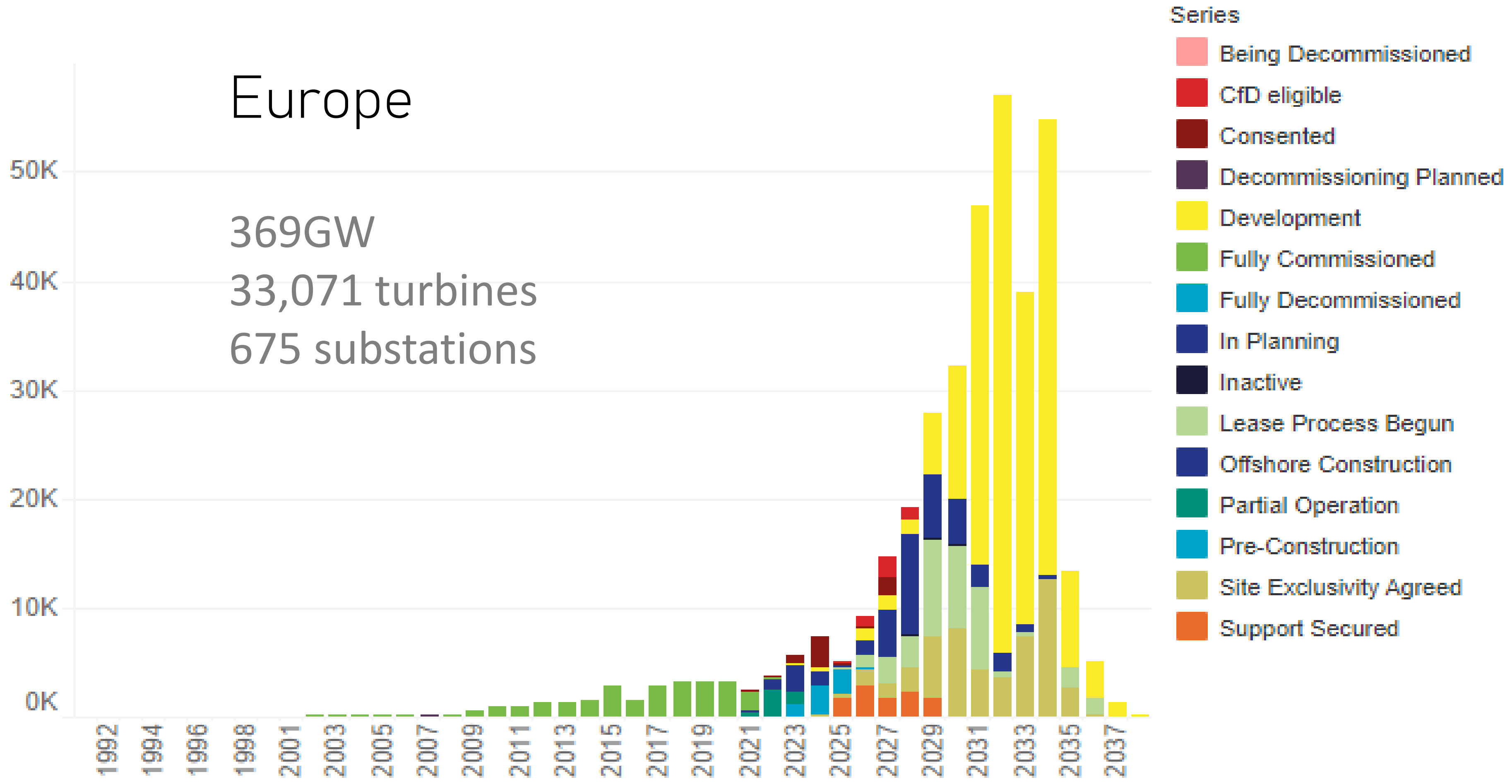
EC20 is offshore wind, the supply chain and business development. We are Energy Connect.

The scale of the opportunity is massive



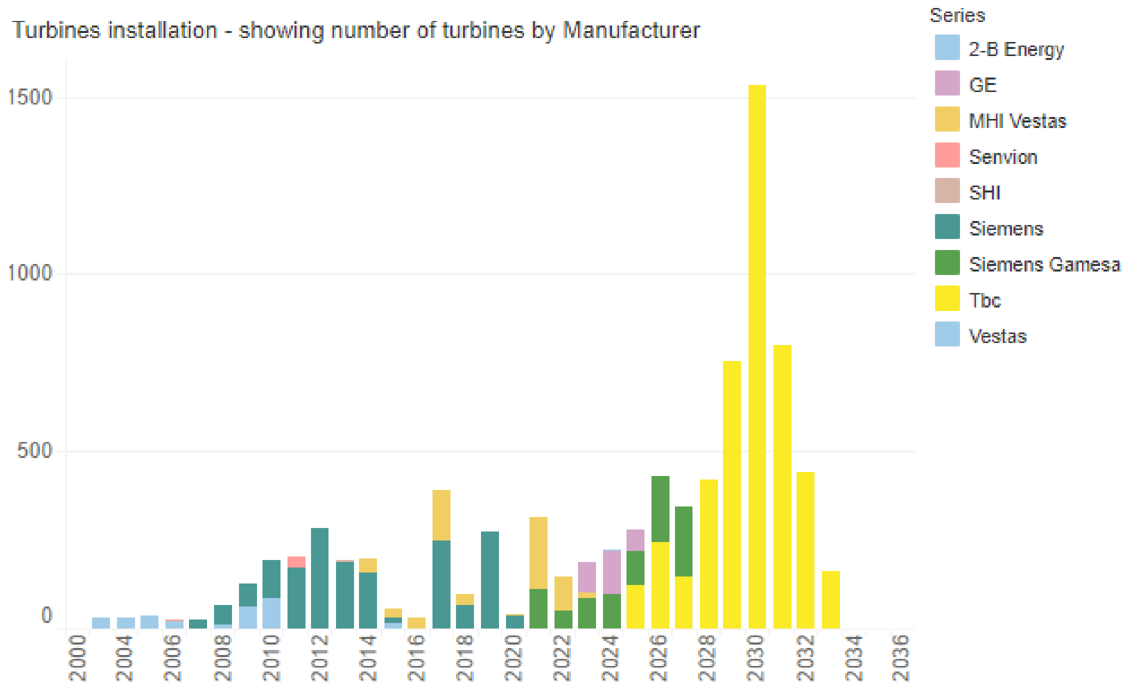
In the UK

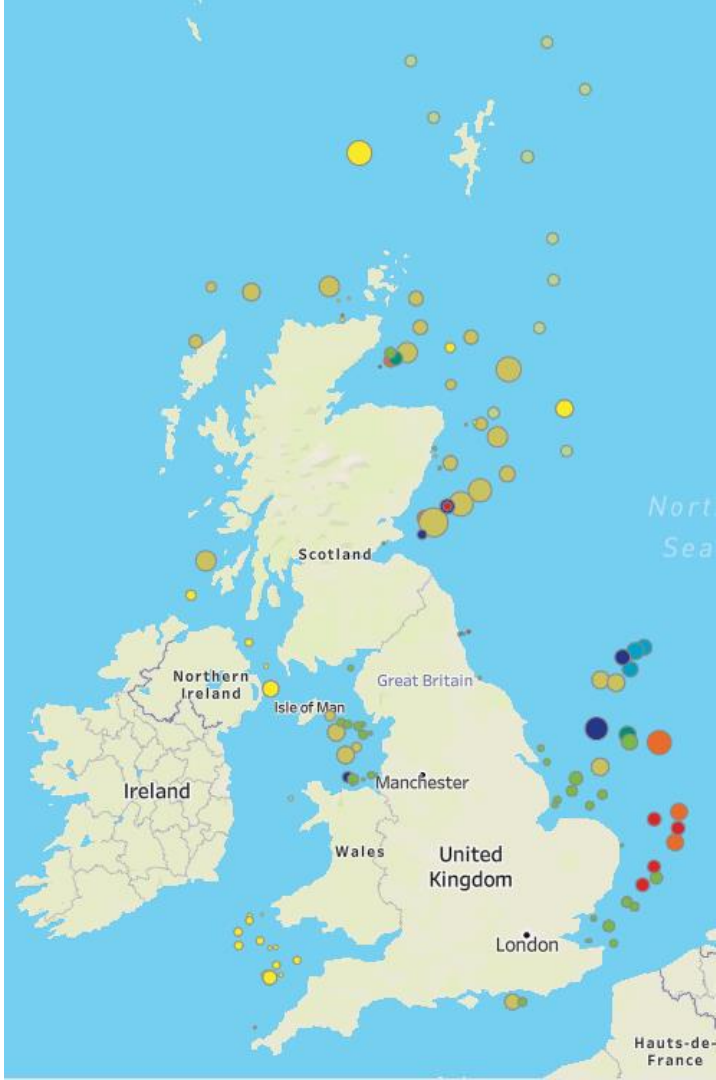
93GW

8,339 Turbines

183 Substations

Turbines installation - showing number of turbines by Manufacturer



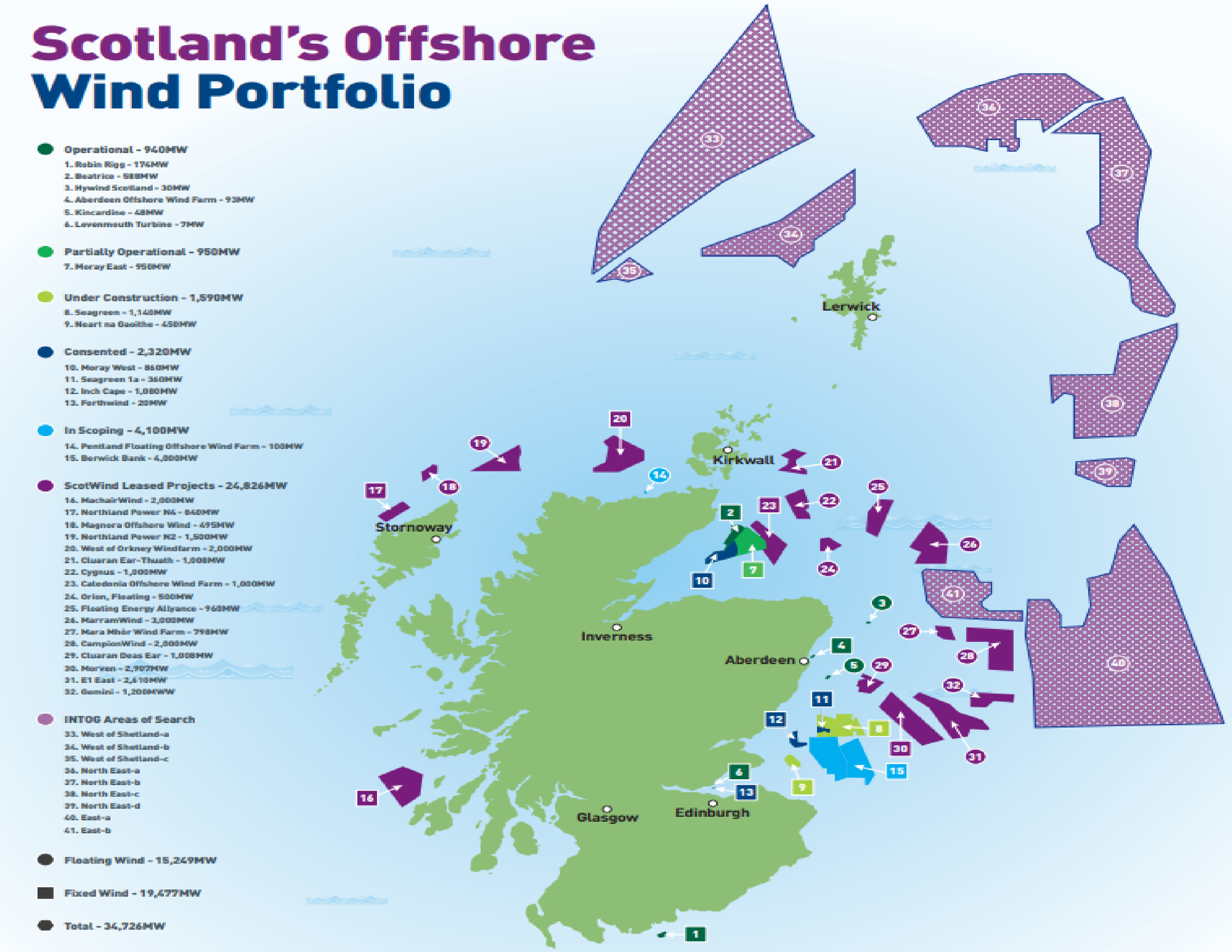


In Scotland

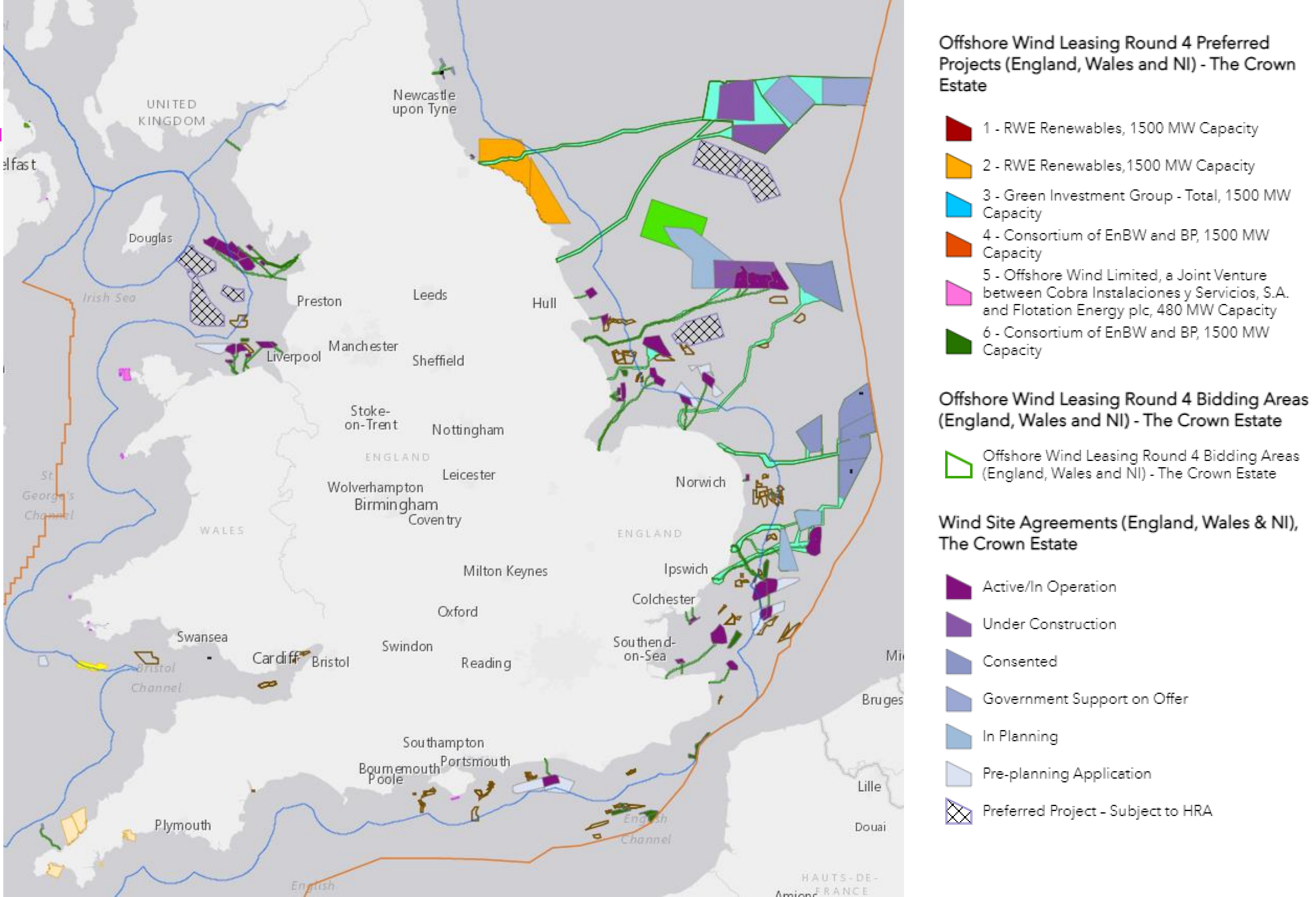
ScotWind

INTOG

Clearing

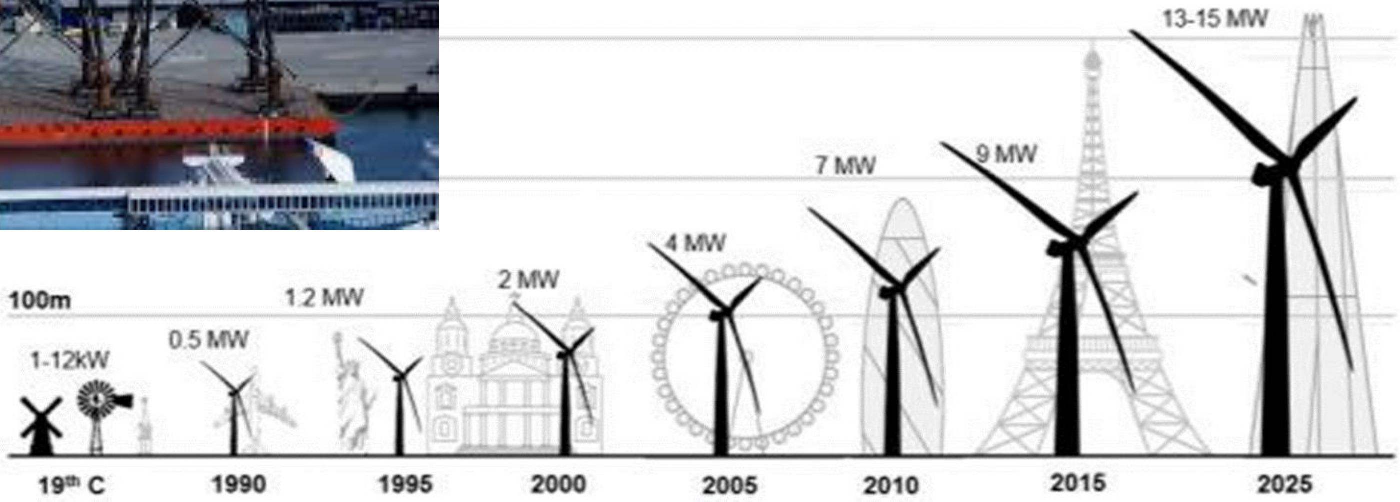


England &
Wales sites.



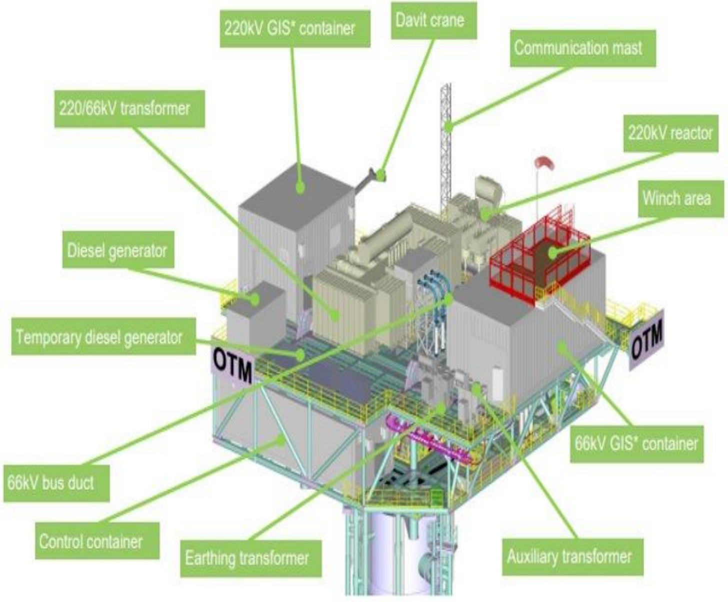
Challenge/ Opportunity

SCALE

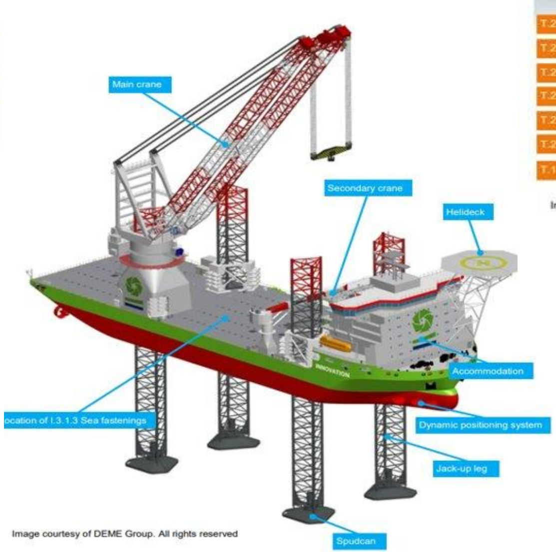


Opportunities across the phases & the wind farm

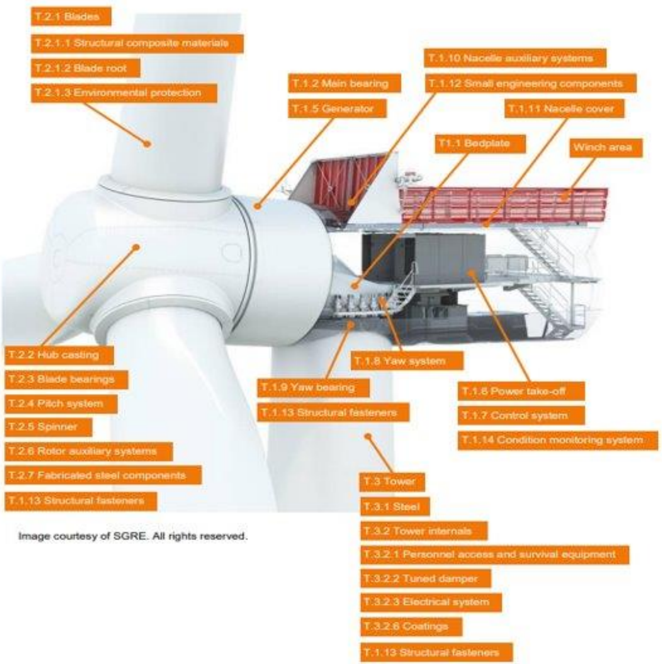
1. Site selection and feasibility
2. Scoping and consultation
3. Planning application and consenting
4. Construction
5. Operation and maintenance



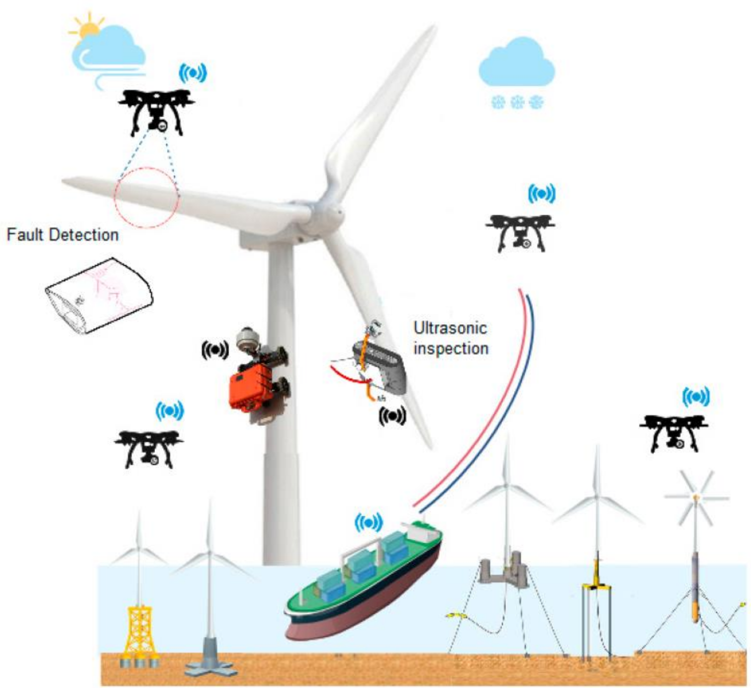
An offshore wind turbine installation vessel

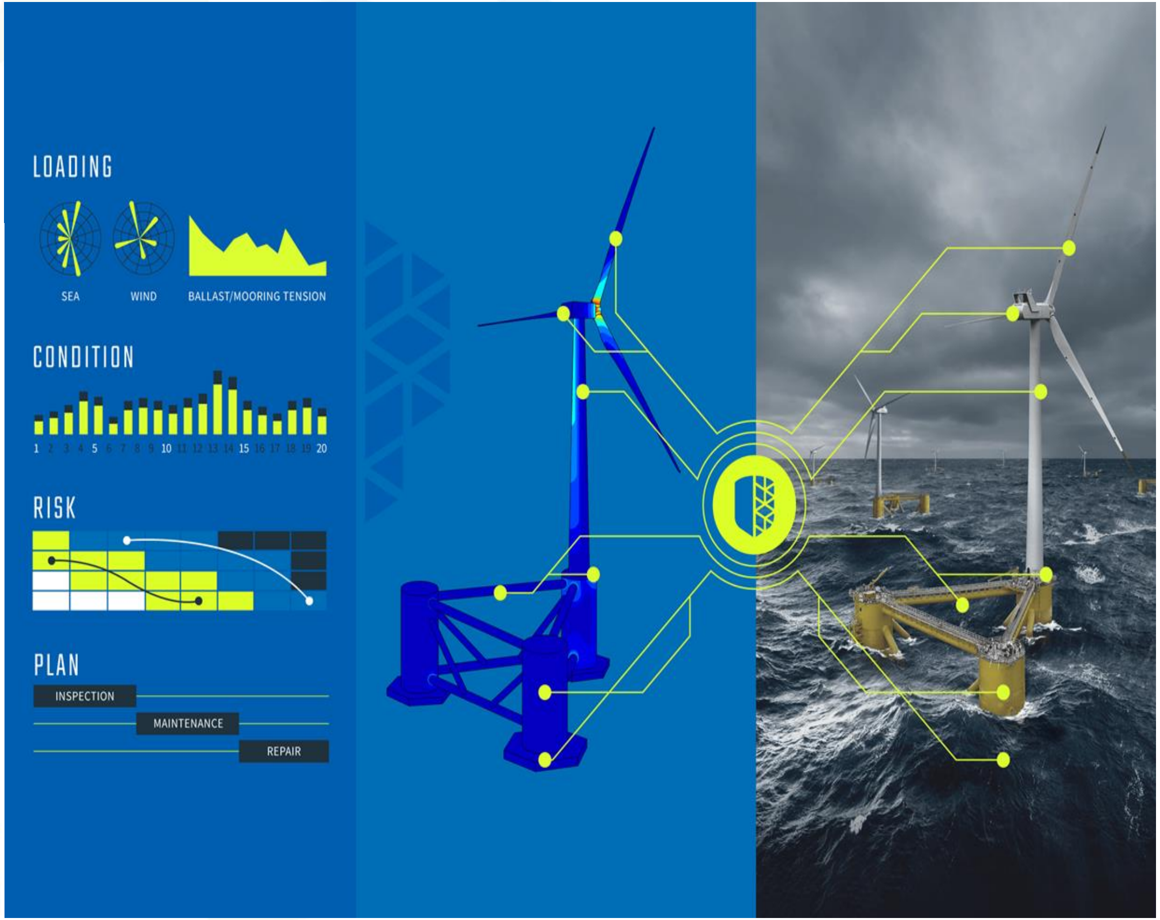


An offshore wind turbine



Data, digital, innovation





Local Content – who wants to know?

Everyone

Detail of commitment
Project size and location
Ownership structure
Project Milestones
Core components
Written Summary
% UK Content
Low carbon footprint in supply chains
Supply chain development
Visibility of opportunities to suppliers
Contracting strategy and procurement process
Promote new entrants and SMEs
Coordinate supply chain activity
Supply chain infrastructure
Alignment with local economic strategies
Community engagement
Developer investment in R&D
Suppy chain partners investment in R&D
Innovation and novel technologies
Innovative business processes and methods
Market information on skills
Project recruitment and hiring strategy
Apprenticeship, trainee and scholarship
Number of jobs: UK and RoW
Workforce equality of opportunity
Health and safety standards
No modern slavery or labour exploitation

Thank you

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Energy Transition and Offshore Wind

Mamdud Hossain, PhD, SFHEA, FIMechE, CEng

Professor, Future Energy Technology

Dr Taimoor Asim, FHEA, CEng

Senior Lecturer

School of Engineering, RGU

How are we here?

- Climate Change Act 2008 – a binding target to reach net-zero emissions by 2050
- The Climate Change (Scotland) Act 2009 commits Scotland to a “Net Zero” emissions target of 2045. This includes a 56% reduction by 2020, 75% by 2030 and 90% by 2040 against the baseline.

Ten Point Plan for a Green Industrial Revolution – November 2020

- Plan 1: Advancing Offshore Wind
  - 40 GW of Offshore Wind and 1 GW of Floating Offshore Wind by 2030
  - £20bn of private investment
  - £160 million of government investment in modern ports and manufacturing infrastructure
  - 60% UK components in Offshore Wind projects
  - Savings of 21 $MtCO_2e$ emissions between 2023 and 2032 or 5% of 2018 UK emissions

Net Zero Strategy: Build Back Greener Oct 2021

- The policies and proposals for the power in the Net Zero Strategy will:
  - Up to 59,000 jobs in 2024 and up to 120,000 jobs in 2030
  - Additional public and private investment of £150-270bn
  - Fully decarbonise power system by 2035
  - 40 GW of offshore wind by 2030
  - 1 GW of floating offshore wind by 2030 – backed by £380 million overall funding for offshore wind

British Energy Security Strategy – Updated April 2022

- Increasing the pace of deployment by 25%
- 50 GW of Offshore Wind by 2030 and 5GW of innovative floating wind
- 90,000 jobs by 2030

Current Offshore Wind Capacity

- More than 10GW of cumulative installed capacity across 38 sites.
- There is a further 5GW in pre-construction,
- Plans for a further 11GW.
- Share of electricity generation: Q1-2021 -13.3% and Q1-2022 – 14.9%

What is Offshore Wind Technology?

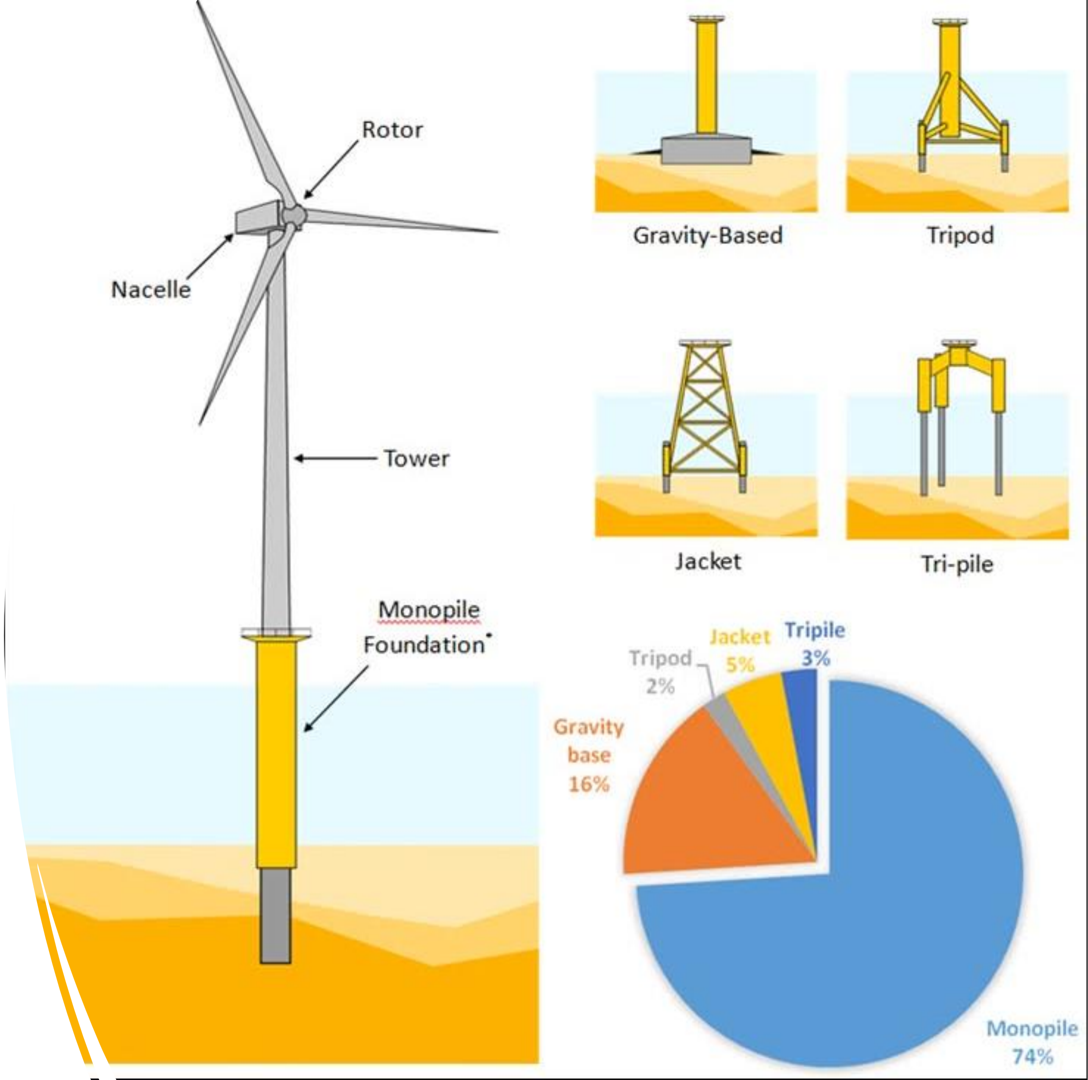
- After installation of Kentish Flats, an elderly coupled complained in *The Times,* they could not walk the beach anymore because the wind generated by the turbines made it impossible for them to keep their balance.
- Just be clear: a turbine does not generate wind by using electricity; its generates electricity by using the wind as the energy source to turn the rotors.
- A wind farm comprises a number of wind turbines and is situated where the mean wind speed is favourable.

What are the advantages and disadvantages of offshore wind power?

- Advantages:
  - Distance from local populations; cancelling worries about noise and impact on local environments
  - Space to dramatically increase the number of wind farms and thus clean energy
  - Job creation
  - Cost effective - £37/MWh
- Disadvantages:
  - Worries about the effects on birds and marine life
  - Some potential disruption during infrastructure creation

What are components of an Offshore Wind Turbine?

- The tower
- The nacelle
- The rotor
- Foundation



Installation of a Offshore Wind Farm

- The first step is to deliver components to an onshore assembly site at a harbour:

1. Foundation
2. Tower sections
3. Nacelle
4. Rotor

Onshore Assembly

- No onshore assembly: all components transported and installed one-by-one at offshore
- **Tower assembly: tower sections are assembled**
- **Assembly of two blades and the nacelle**
- Assembly of three blades and the nacelle – requirement of the deck area is huge.

Offshore transport

- Floating vessel stabilised with mooring lines
- Floating vessel equipped with motion compensated crane – deep water
- Jack-up barge – shallow water

Offshore Installation

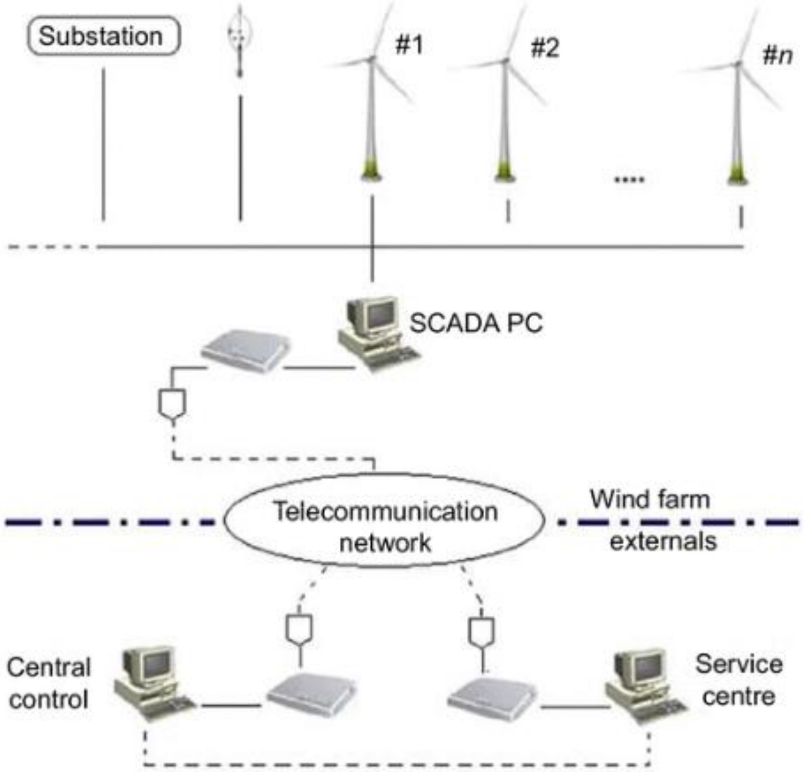
- Foundation installation – monopiles, jackets and tripods, gravity-based
- Turbine Installation – lifted and placed on top of foundation and bolted
  - Tower
  - Nacelle
  - Rotor
- Substation installation
  - Offshore substation – jackets or gravity based foundation, complete substation lifted and placed on the foundation
  - Onshore substation
- Cable installation
  - Array cables – 1 to 2 m under the seabed – trenching ROV
  - Export cables – buried deeper near shore – larger cable laying vessels and trenching ROV

Operation and Maintenance

- Offshore weather has significant influence of the O&M
- Offshore WT maintenance is a very young industry field – no purpose designed vessel available
- Either Wind Farm Installation vessels – oversized and not available for maintenance work
- Oil and Gas Jackup- expensive and not suitable i.e. cranes are small and legs are short

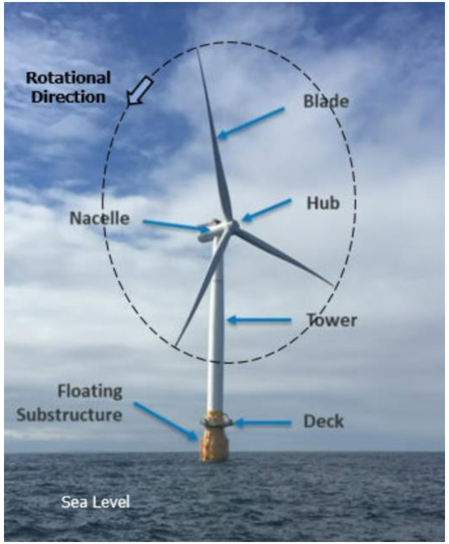
Condition Monitoring

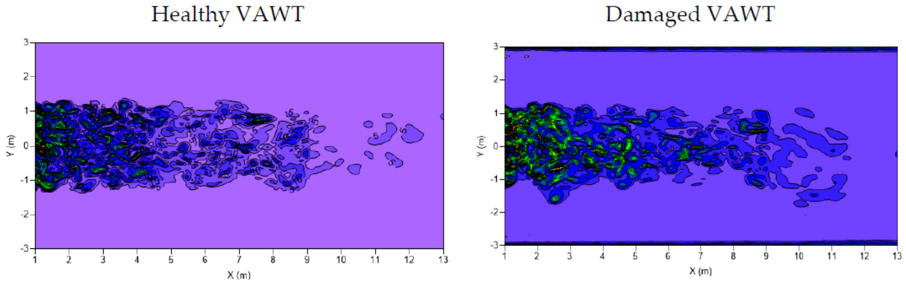
- The supervisory control and data acquisition (SCADA) system monitors, signals and alarms usually at 10-min intervals to reduce the transmitted data bandwidth from the wind farm.



Wind Turbine Research at RGU

- Onshore and offshore wind turbines
- Vertical axis and horizontal axis wind turbines
- Performance Characterisation
  - Torque and power analysis
  - Healthy Vs damaged wind turbines
  - Wake dynamics
  - Blades erosion
  - Start-up dynamics (on-going)
  - Acoustic analysis
  - Proper orthogonal decomposition
  - Reduced order modelling (on-going)



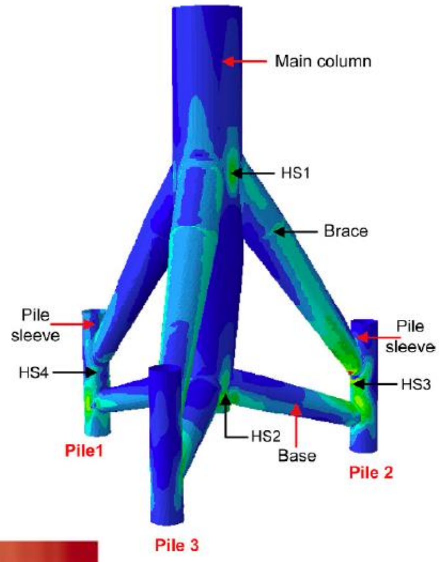


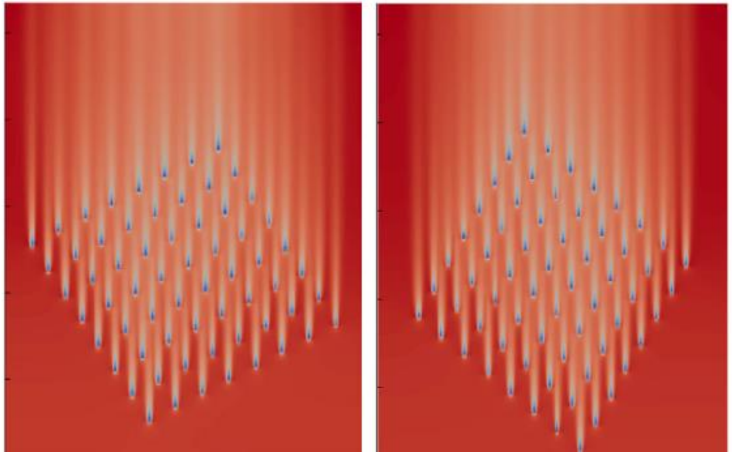
Wake dynamics (vorticity)

Wind Turbine Research at RGU

- Structural Integrity Analysis
  - Stress-strain analysis
  - Aero-hydro-elastic analysis (on-going)
  - Goal-driven optimisation
  - Corrosion analysis
  - Monopile Vs lattice structures
  - Mooring cables VIV*
  - Foundation/soil scouring
- Maintenance strategies
- Hydrometeorological analysis
- Wind turbine farms

Stresses in lattice

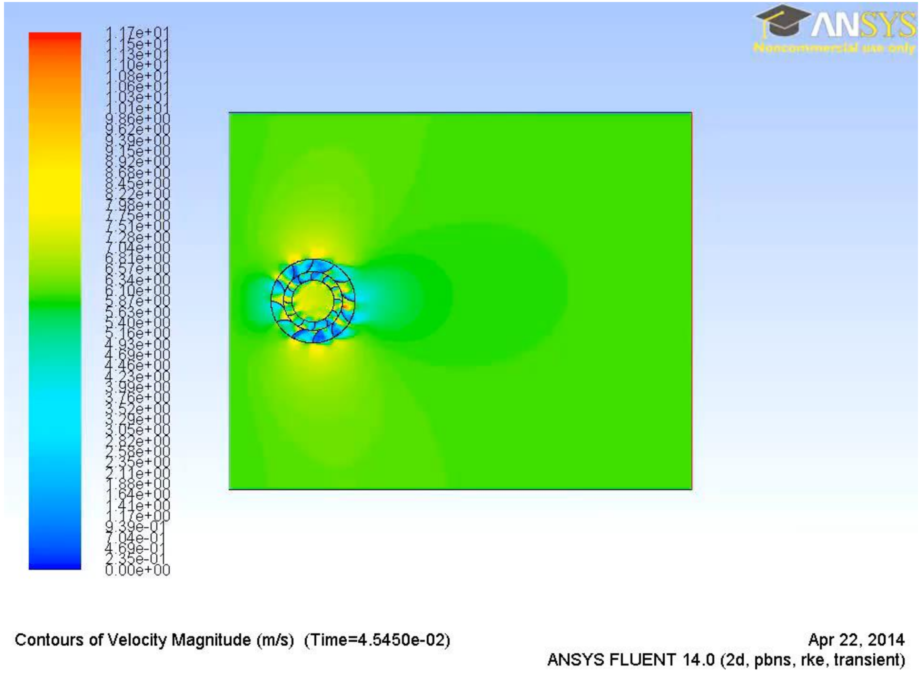


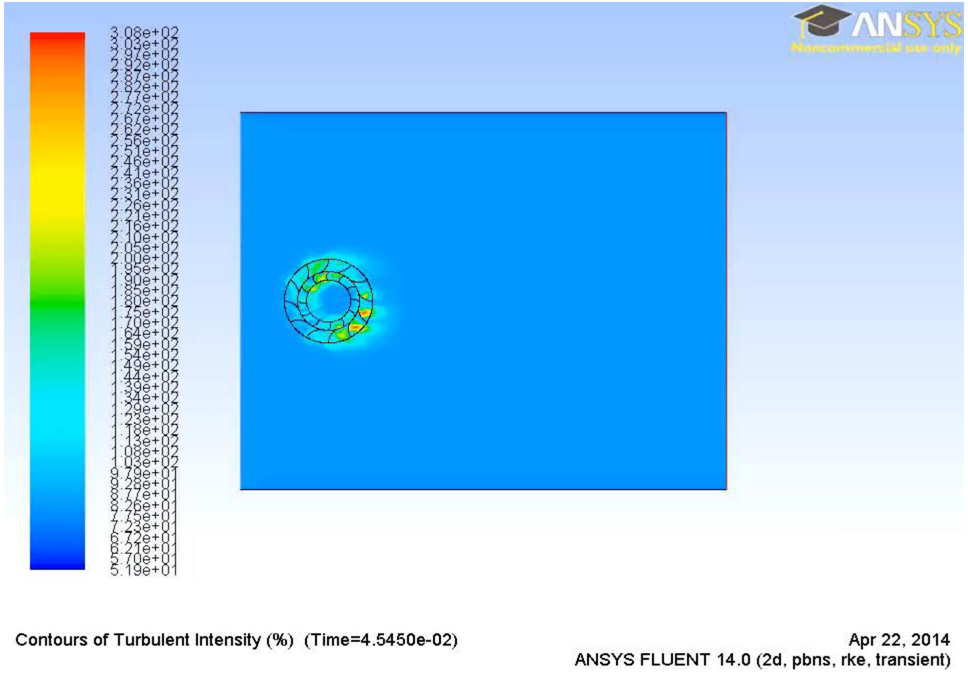


Farm arrangement

*vortex induced vibration

Wind Turbine Research at RGU





Recently Published Scientific Articles

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Article

Parametric Analysis Using CFD to Study the Impact of Geometric and Numerical Modeling on the Performance of a Small Scale Horizontal Axis Wind Turbine

Muhammad Salman Siddiqui [1,*,†], Muhammad Hamza Khalid [2,†], Abdul Waheed Badar [3,†], Muhammed Saeed [4,†] and Taimoor Asim [5,†]

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† These authors contributed equally to this work.

Abstract: The reliance on Computational Fluid Dynamics (CFD) simulations has drastically increased

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Article

Effects of Damaged Rotor on Wake Dynamics of Vertical Axis Wind Turbines

Taimoor Asim * and Sheikh Zahidul Islam

School of Engineering, Robert Gordon University, Aberdeen AB10 7GJ, UK; s.z.islam1@rgu.ac.uk
* Correspondence: t.asim@rgu.ac.uk; Tel.: +44-1224-262-457

Abstract: Vertical Axis Wind Turbines (VAWTs) are omnidirectional turbomachines commonly used in rural areas for small-to-medium-scale power generation. The complex flow observed in the wake region of VAWTs is affected by a number of factors, such as rotor blades design. A damaged rotor significantly alters the flow field in the wake region of the VAWT, degrading its power generation

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Review

A Review of Recent Advancements in Offshore Wind Turbine Technology

Taimoor Asim [1,*], Sheikh Zahidul Islam [1], Arman Hemmati [2] and Muhammad Saif Ullah Khalid [2]

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2 Department of Mechanical Engineering, University of Alberta, Edmonton, AB T6G 1H9, Canada; arman.hemmati@ualberta.ca (A.H.); mkhalid1@ualberta.ca (M.S.U.K.)
* Correspondence: t.asim@rgu.ac.uk; Tel.: +44-1224-262457

Abstract: Offshore wind turbines are becoming increasingly popular due to their higher wind energy harnessing capabilities and lower visual pollution. Researchers around the globe have been reporting significant scientific advancements in offshore wind turbines technology, addressing key issues,


Any Questions?

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Founder and CEO, Aspect

Isla Robb
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Offshore Wind – Practical steps to success

Chaired by Iain Sinclair, Director of Renewables & Energy Transition, Global Energy Group

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