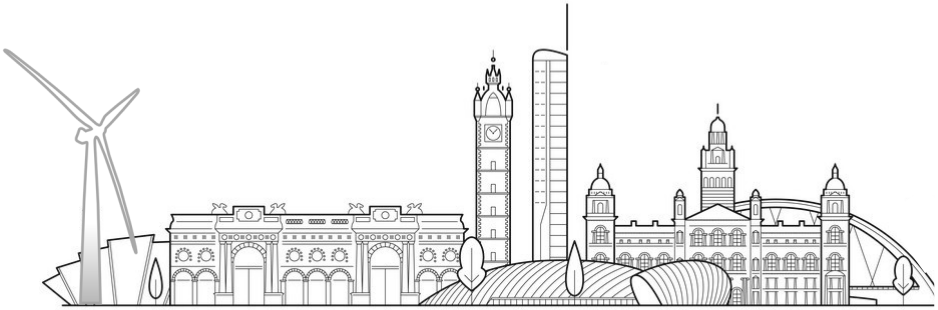
futureWind & Marine 2020



5th March 2020
University of Strathclyde, Glasgow

SSE Renewables

ScottishPower Renewables

Siemens Gamesa Renewable Energy

Cubico Sustainable Investments

BVG Associates

energy technology partnership

Wind & Marine Energy Systems CDT

University of Oxford

The University of Edinburgh

University of Strathclyde Glasgow

UKRI Engineering and Physical Sciences Research Council

Welcome

"I'd like to extend you a warm welcome to futureWind&Marine 2020, the eighth annual conference of the Wind & Marine Energy & Structures Centre of Doctoral Training (CDT). The conference committee have put in a lot of effort to ensure that today will be a success.

I hope that you find the variety of research discussed today interesting and enjoyable. Please talk to as many students as possible about their current research, future research interests and the activities that they are involved in outside their PhD work.

We encourage you to tweet about the event using #fwm20 and share as much about the event on social media!

Thanks go to our event sponsors today: SSE Renewables, Scottish Power Renewables, Cubico Sustainable Investments, Siemens Gamesa Renewable Energy, BVG Associates and ETP for making today possible.

And finally, thank you to Sofia Koukoura, Adam Stock and Abbas Kazemi Amiri (Strathclyde) and Roberts Proskovics (ORE Capatult) for helping with presentation practice."

Mathieu Kervyn De Meerendre, futureWind&Marine 2020 Committee Chair

Title Sponsor

sse Renewables

Additional Sponsors

SCOTTISHPOWER RENEWABLES

SIEMENS Gamesa RENEWABLE ENERGY

Cubico SUSTAINABLE INVESTMENTS

BVGassociates

Poster prize Sponsor

energy technology partnership

09:00	Registration desk opens	
09:30	**Conference Opens**	
	Welcome	
09:40	Keynote speaker (Dr Simon Gill)	
10:05	Headline Speaker (SSE Renewables)	
10:30	Elevator pitches	
10:50	Coffee break	
	Parallel Session 1	
	Condition Monitoring	**Wakes & Dynamic Structural Loading**
11:10	Industrial talk from sponsor Cubico Sustainable Investment	Industrial talk from sponsor Scottish Power Renewables
11:30	**Becky Corely** - Thermal modelling of wind turbine gearboxes for condition monitoring and fault detection	**George Elderfield** - Influence of the Low Level Jet wind phenomena on turbine loading and fatigue life in the North Sea
11:50	**Alan Turnbull** - Applications of machine learning in diagnostics and prognostics of wind turbine generators	**Nicola Grieve** - Wind turbine control strategies for mitigating tower fatigue loads using wind roses or wake detection
12:10	Lunch	
	Parallel Session 2	
	Power Systems & Control	**Blades**
13:20	Industrial talk from sponsor Siemens Gamesa Renewable Energy	Industrial talk from European Marine Energy Centre
13:40	**Ed Lucas** - Introducing the PFEC: A Novel Technology to Enable Low-Frequency AC Connections for Offshore Wind	**Grant Leishman** - An Investigation of Wind Turbine Blade Erosion due to Rain & Weathering
14:00	**Matthew Cole** - A comparison of curtailment strategies for reducing lifetime damage equivalent loads across a windfarm	**Gabriele Pisetta** - Fatigue loads alleviation by morphing blades for wind and tidal turbines
14:20	Coffee break	
14:45	ETP poster award	
14:55	Diversity (Dr Edward Hart)	
15:10	Panel discussion	
16:10	Closing remarks	
16:20	**Conference closes**	

Keynote Presentation

Simon Gill

Head of Whole System & Technical Policy
The Scottish Government

Wind and Marine in a net zero energy system

Scottish Government
Riaghaltas na h-Alba
gov.scot

Wind and marine technologies are a huge success story of energy policy in Scotland and the UK. For example, renewable generation located in Scotland displaced more than 11 M Tonnes of Carbon from the GB electricity system in 2017. To date these clean technologies have broadly been fitted into an existing electricity system that has adapted to accommodate them without fundamentally changing.

This will not be the case for the next decade. The electricity system will need to move from *low* carbon to broadly *no* carbon. That means changing some fundamental engineering principles on which the system is based. These include considering how we keep the system stable, how the system automatically identifies and responds to faults, and how the system restarts in the event of a catastrophic failure. As well as zero carbon energy we will need to delivery *sustainable security of supply.* Wind and marine technologies have the potential to play a major part in that doing that.

The other big challenges for the 2020s are about decarbonising heat and transport. How well set are wind and marine technologies for supporting that truly whole system transition? This talk will start from where we are today, and what wind and marine technologies do for the whole energy system in 2020 and it will explore what comes next.

Headline Presentation

Rob Cussons
Technology Manager
SSE Renewables

Technology game changers in renewables

There is a rapid convergence between the urgent requirements that renewable energy is being called upon by governments and the public to meet in terms of a net zero 2050 target, and its ability to economically fulfil these requirements as evidenced by the most recent UK CfD auctions. This talk will explore how technology is helping to make this possible and what opportunities and challenges still remain.

SSE Renewables is a leading developer and operator of renewable energy across the UK and Ireland, with a portfolio of around 4GW of onshore wind, offshore wind and hydro. Part of the FTSE-listed SSE plc, its strategy is to drive the transition to a zero-carbon future through the world class development, construction and operation of renewable energy assets. SSE Renewables owns nearly 2GW of onshore wind capacity with over 1GW under development. Its 1,450MW hydro portfolio includes 300MW of pumped storage and 750MW of flexible hydro. Its offshore wind portfolio consists of 580MW across three offshore sites, two of which it operates on behalf of its joint venture partners. SSE Renewables has the largest offshore wind development pipeline in the UK and Ireland at over 7GW.

Bio: Rob completed a PhD in Astrophysics at Darmstadt Technical University, Germany in 2008. He moved to Glasgow to join Airtricity, an Irish wind farm developer which had been acquired a few months earlier by SSE, and he has worked for them in a variety of roles ever since. He initially started in Resource Assessment, estimating the output of onshore and offshore wind farms and designing measurement campaigns. After leading the offshore team for a few years he moved into a role as R&D Manager coordinating SSE's involvement with joint industry projects and academic partnerships. He took a one year secondment to look at higher level Group Strategy for SSE plc before returning to the development arm of the company in a Business Development role. Since the establishment of the new dedicated SSE Renewables company, Rob has led the Technology Team within SSE Renewables' Engineering Department. The team's remit is to identify industry best practice and emerging supply chain offerings to achieve value engineering solutions: working across the project lifecycle to make our portfolio of renewable assets as competitive as possible.

Speakers

Charlie Plumley — Energy Analyst

Opening Up in the Wind Industry

(*Condition Monitoring Session)*

Companies stand accused of keeping data under lock & key and protecting their IP. Whilst this might sound sensible business practice, it can be damaging to the industry as a whole. Charlie will explore what he considers this unhealthy obsession with secrecy, and recount his own personal experience of opening up in the wind industry.

Ricardo Da Silva — Grid & Regulation Analyst

Flexibility from Variable Low Carbon Technologies

(Wakes & Dynamic Structural Loading Session)

Wind is meant to play an active role on network stability in a carbon free future. New enhancements and technologies are rising fast to cope with the decarbonisation challenges and provide the necessary services to ensure the system operates safe and secure. SPR is committed to a flexibility strategy to demonstrate the value of offshore and onshore wind to deliver benefits to the system and the customer.

Chris Briggs — Regional Innovation Manager

Innovation Engagements between Industry & Academia

(Power Systems & Control Session)

Chris Briggs is Regional Innovation Manager for Siemens Gamesa Renewable Energy in the UK, managing external innovation engagements with Academia, Technology Developers and Industry bodies in support of SGRE's Technology Roadmaps. His talk will focus on Industry's engagements with Academia on collaborative R&D projects, providing insights into what makes for good collaborations, what pitfalls to avoid, and what lessons Early Career Researchers can learn to improve their engagement with Industry.

Jonathan Lindsay — Operations & Technology Director at EMEC

Challenges of Operating on the Atlantic Margin

(Blades Session)

Jonathan will present the EMEC test site in Orkney and EMEC's latest project at the AMETS test site in County Mayo, Ireland.

Becky Corley

becky.corley@strath.ac.uk

Thermal modelling of wind turbine gearboxes for condition monitoring and fault detection

Historically, problematic gearboxes contribute to significant operation and maintenance (O&M) costs of wind turbines, due to frequent failure incurring significant costs for repair and lost revenue from high downtime. To prevent this, predictive maintenance can be implemented to optimise asset life and resources by continuously monitoring components and using this data to detect faults, to prevent unexpected equipment failure.

Existing fault detection research uses data driven machine learning techniques for failure prediction, but this is only possible when there is sufficient historical operational data available. In this work, a detailed understanding of the physics inside a gearbox is used for fault detection, when historical data is unavailable or to supplement data driven models.

This research uses a combination of theoretical thermal modelling, experimental temperature data taken from the University's gearbox test rigs and wind turbine operational SCADA data to bring together an in-depth understanding of a 'healthy' gearbox. This understanding can then be applied to detect abnormal gearbox operating conditions, to detect faults before it's too late and a failure occurs.

Prior to joining the CDT, Becky studied for a degree (MEng) in Mechanic Engineering with Sustainability at University of Warwick, with a year in industry at British Sugar in the Environment team and a summer placement at National Grid. She then joined the National Grid graduate scheme, in gas transmission operations before deciding to return to academia to pursue her interest in renewable energy.

Alan Turnbull

a.turnbull@strath.ac.uk

Applications of machine learning in diagnostics and prognostics of wind turbine generators

With intelligent data acquisition systems, cheap cloud storage, higher processing power and advances in big data analytics, the wind industry has started to capitalise on the potential O&M cost savings brought by advanced condition monitoring and asset management strategies. Increased wind farm capacity means there is a growing need for automated fault detection, which can flag issues in real time across an entire fleet, learn from previous experiences whilst minimising false flags and unnecessary downtime. With so much data now being gathered across multiple systems and platforms, understanding how to best use this data in isolation and collectively is becoming increasingly important.

The aim of this research is to develop data driven engineering methodologies to understand how machine learning models can be best utilised to detect wind turbine generator faults through SCADA and vibration analysis, and how multiple data sources and previous experiences of failure can be leveraged to increase diagnosis accuracy and help predict failure in similar machines.

Alan received a Masters degree in Aero-mechanical Engineering in 2013 from the University of Strathclyde. Prior to joining the CDT he spent 3 years in the offshore energy sector working in a variety of roles surrounding subsea engineering design, installation and remote intervention. Alan currently works as a Condition Monitoring Engineer at RES, where his focus is on condition monitoring of wind farms, improving diagnostic capabilities and prognostic model development.

George Elderfield

george.elderfield@strath.ac.uk

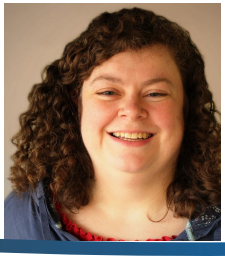
Influence of the Low Level Jet wind phenomena on turbine loading and fatigue life in the North Sea

Offshore LIDAR measurement campaigns in the North Sea have shown the presence of the low level jet wind phenomenon. This phenomenon is a deviation from the 'normal' model of the atmospheric boundary layer that is set out in the design standards for wind energy. Low level jets have unusual shear profiles and higher rates of veer along with different turbulence features. The goal of this PhD is to understand the characteristics of low level jets and their impact on loading of large wind turbines.

I have analysed two years of wind data taken from a LIDAR at a North Sea site and assessed the prevalence of low level jets as well as their characteristics. This data has been used to build wind flow models representing low level jet conditions to feed into an aeroelastic model. Using this aeroelastic model the impact of these conditions on the blades, tower and drivetrain are assessed.

With the increased focus on lifetime extension, accurate fatigue life estimates are essential. By quantifying the fatigue damage experienced in unusual wind conditions, this PhD works towards this goal. Helping to reduce risks for wind farm owners, operators and investors alike.

George received a MEng degree in Aeronautical Engineering from the University of Glasgow in 2016. He then joined the CDT in the same year and begun his PhD in collaboration with SSE. His research interests cover: Wind Analysis, Turbine Loads, Meteorology, and Boundary Layers.



Nicola Grieve

nicola.grieve@strath.ac.uk

Wind turbine control strategies for mitigating tower fatigue loads using wind roses or wake detection

Wind turbines experience cyclic loading leading to fatigue damage, which can significantly reduce the life of the wind turbine. By designing wind turbine controllers, which have the objective of reducing or mitigating wind turbine tower fatigue, the life of the wind turbine could be increased.

Controller strategies tend to rely on only a few simple inputs. By increasing the input data, and providing more information to the strategy, the wind turbine controller can be modified in order to increase adaptability and predictability. A hybrid advanced blade controller will be designed using the new strategy inputs. Due to the dynamic coupling between the blades and the tower, fatigue loads in the tower will be reduced.

Two inputs are considered.

The first input is based on the results of an anomaly detector. The embedded extended kalman filter, predicts the various aspects of wind conditions and wind turbine behaviour. Using the predicted values, the wake can be identified from anomalous results in these values.

The second input is based on the question “How does the shape of the wind rose influence tower fatigue life? A simple closed form solution was developed which combines the wind rose probabilities of mean wind speed and mean wind direction, with fatigue analysis based functions, primarily Palmgren Miners rule. The results of this solution allow the point on the tower’s circumference with the maximum fatigue damage, and the value of the maximum damage to be identified. A lifetime extension potential index has also been developed using the results of the closed form solution.

Nicola received her BEng (Hons) in Mechanical Engineering and Energy Engineering from Heriot Watt University (2008) and her MSc in Energy Futures (in Renewables) from the University of Aberdeen (2010). Nicola has completed an engineering project in a distillery, and worked for both a wind turbine consultancy, and an engineering services consultancy concentrating on sustainability projects. Prior to joining the CDT, she completed an MSc in Wind Energy Systems at the University of Strathclyde. Nicola’s research interests are wind turbine control, fatigue loads and lifetime extension.

Ed Lucas

edgar.lucas@strath.ac.uk

Introducing the PFEC: A Novel Technology to Enable Low-Frequency AC Connections for Offshore Wind

Low frequency AC transmission has been proposed for the integration of distant offshore wind farms, offering a compromise between HVAC and HVDC. The advantages in transmission distance due to the reduced power losses over AC, and an improved fault-handling capability over DC suggests that there is room for this technology in the wind industry. However, research and industrial trends have favoured the continued use of HVDC connections despite growing concerns over cost and reliability.

The research within this PhD looks into developing novel technology to unlock the advantages of LFAC but without the downsides associated with large power electronic converters, providing instead a solution that is both robust and controllable. This technology is called the Partial Frequency Energy Converter (PFEC) and it combines the controllability of DC converters with the robustness of large electrical machines. The PFEC not only allows the integration of LFAC systems to the AC grid but it is also capable of providing inertia and stabilization to power systems. By using a combination of modern control techniques and a clever manipulation of electromagnetic fields, the PFEC exists as a fusion between old and new technology offering the advantages of both.

Edgar received a BSc in Mathematics from the University of Edinburgh and then began a career as an engineer in the solar PV industry. His love for renewable energy technology caused him to return to academia where he joined the CDT. His research interests include power systems and disruptive technology.

Matthew Cole

matthew.cole@strath.ac.uk

A comparison of curtailment strategies for reducing lifetime damage equivalent loads across a windfarm

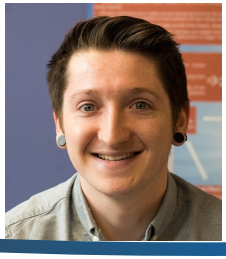
This research has been looking at using wind farm control to implement curtailment strategies, which reduce farm wide damage equivalent loads. For this, I have been using Strathfarm, the University of Strathclyde's in-house wind farm modelling software.

Through the addition of an augmented controller to each wind turbine in a wind farm, called a power adjusting controller (PAC), a wind farm controller can request a reduction in power for a specific turbine based on its operational information. The controller approaches used in Strathfarm are of a hierarchal, scalable but decentralised philosophy, with the PACs allowing each turbine to act with a level of autonomy.

Each PAC sends an estimate of the wind speed at each turbine to the central controller, which can be used to allocate curtailment across the turbines to reduce low frequency changes in the fore aft bending moment of each of the towers.

Through an extensive validation process, my research has shown that the implementation of this strategy reduces both tower and blade damage equivalent loads by 12.5% while curtailing energy capture by 5%. For comparison, other proposed curtailment strategies, such as equally distributing the curtailment, have reductions in damage equivalent loads of only 5% for the same level of curtailment.

Graduated with a First class degree in mathematics from Northumbria University in 2016 including a year in industry working as a data analyst for Lloyds Banking Group. A keen cyclist currently training for a 1000-mile ride through France and northern Spain in June.



Grant Leishman

grant.leishman@strath.ac.uk

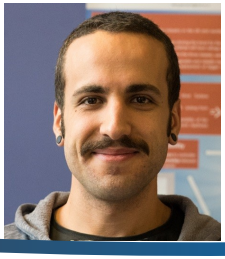
An Investigation of Wind Turbine Blade Erosion due to Rain & Weathering

Wind turbine blade erosion is a major issue in the offshore wind industry. During rainfall exposure, the rain droplets principally strike the leading edge of the blade which directly leads to the surface degradation. The presence of erosion damage and increasing surface roughness, significantly reducing the aerodynamic efficiency and structural integrity of the blade.

Additionally, the industry is seeing the length of wind turbine blades growing, with the current largest blade measuring 107m! (GE Haliade-X). As the blade size increases, generally, so does the tip speed of the blade – thereby increasing the impact velocity of each rain droplet on the blade, and hence the potential for increased and accelerated erosion.

During my PhD, I have developed a method for testing and examining the blade coatings at various stages of erosion and weathering, using an accelerated rain erosion test rig. This includes investigating changes in material properties of a range of industrial blade coatings, which are specifically designed to reduce erosion. The end goal is to use these measured material parameters as inputs to a computational model for erosion prediction.

Grant received his BEng(hons) in Chemical Engineering in 2013 before achieving an MSc in Sustainability Engineering in 2014. Prior to joining the CDT, he worked at a renewable energy consultancy which specialised in small scale (500kW – 3MW) onshore wind installations. Grant's research interests include materials characterisation, accelerated environmental testing and composite materials construction.



Gabriele Pisetta

gabriele.pisetta@ed.ac.uk

Fatigue loads alleviation by morphing blades for wind and tidal turbines

Wind and tidal turbines experience significant fatigue loading. This is caused by the continuous variations of the angle of attack and flow speed due to the inherent unsteadiness of the flow. Many unsteady phenomena are experienced by both wind and tidal turbines, due to tower shadow, yaw misalignment, blade oscillations, the shear layer and the wakes of upstream turbines. In some cases, the load fluctuations may result in fatigue failures, and thus they strongly affect the reliability and the cost of the whole device. Therefore, it is essential to understand how to mitigate fatigue loads to help manufacturers to design blades capable of withstanding a longer life, which will ultimately reduce the Levelised Cost Of Energy (LCOE) for wind and tidal energy production.

In this presentation, I consider the loads on a tidal turbine operating in a shear flow, and I introduce a novel blade design to reduce the load fluctuations. I show that a blade with a flexible trailing edge can mitigate the fluctuations of the blade root bending moment, without affecting the mean torque, and thus the power generated by the turbine.

These results show the potential of a flexible structure to alleviate the fatigue loads arising on a turbine, and they underpin the development of more sophisticated models of flexible blades.

Gabriele received his Master degree in Aeronautical Engineering in 2016 at the Politecnico di Milano. In October 2016, Gabriele joined the CDT Wind & Marine Energy Systems, and in October 2017, he started his PhD project within the VOILAb research group on gust alleviation by morphing blades for wind and tidal turbines.

Research Posters

Variable speed control with a magnetic power split device for tidal stream turbines, investigating a more reliable power converter.

Adam Harris — adam.harris@ed.ac.uk

Machine Learning for Wind Turbine O&M

Conor McKinnon — conor.mckinnon@strath.ac.uk

Modelling of Wind Turbine Main Bearings.

James Stirling — j.stirling@strath.ac.uk

Computational Modelling of Blade Erosion: A Coupled Peridynamic and Discrete Element Method Approach.

Kinan Bezem — kinan.bezem@strath.ac.uk

Accessing Revenues from Firm Capacity with Wind Farms in Great Britain: A Benchmark.

Leo May — leo.may@strath.ac.uk

Research Posters

energy technology partnership

Assessment of error and uncertainty of a novel flow measurement tool for tidal turbine applications.

Marilou Jourdain De Thieulloy — marilou.jourdain@ed.ac.uk

Application of Wide-BandGap Power Semiconductors in Wind Energy Power Converter.

Marlee Basurto Macavilca — marlee.basurto@ed.ac.uk

Weak grid integration of renewable energy using impedance estimation and adaptive control techniques.

Mathieu Kervyn De Meerendre — mathieu.kervyn@strath.ac.uk

A comparison of electrical systems for multi-rotor wind turbines.

Paul Pirrie — paul.pirrie@strath.ac.uk

Offshore wind farm optimisation: turbine placement, cable layout and energy storage.

Peter Taylor — peter.taylor@strath.ac.uk

Research Posters

energy technology partnership

Assessing cumulative displacement of seabirds at offshore windfarms in the North Sea.

Rebecca Hall — rebecca.hall@strath.ac.uk

Aerodynamic Modelling of the X-Rotor Offshore Wind Turbine Concept.

Abhshek Thapa — abhishek.thapa@strath.ac.uk

Floating Wind Turbine Maintenance Requirements, Strategies and Floating Crane Design.

Brian Jenkins—brian.jenkins@strath.ac.uk

Floating Tidal – Investigations of Optimal Floater Design with Respect to Hydrodynamic Responses and Turbine Loads.

Callum Guy — callum.guy@ed.ac.uk

Advanced non-destructive testing (NDT) of manufacturing blade defects: Moving towards fully-automated inspections in large-scale blade manufacturing.

Euan Duernberger — euan.duernberger@strath.ac.uk

Research Posters

Investigating the operational reasons for wind turbine underperformance.

Fraser Anderson — fraser.j.anderson@strath.ac.uk

Improved physical understanding of gust-wing interaction using the Impulse Method.

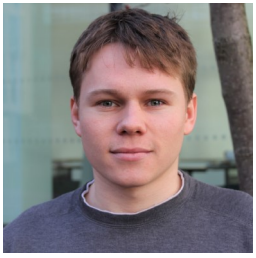
Geethanjali Pavar – g.pavar@ed.ac.uk

Getting to Net Zero: Lifetime and Avoided Emissions of Floating Wind & Marine Energy Systems.

Iain Struthers — iain.struthers@ed.ac.uk

Stability and control of VSC-HVDC connected to weak grids and multi-terminal systems.

Jenny Morris — Jennifer.f.morris@strath.ac.uk



Retrofitting wind farms with virtual synchronous machine control: techno-economic feasibility study of VSM and energy storage systems.

Sam Harrison — sam.harrison@strath.ac.uk

Research Posters

Missing data in forecasting.

Rosemary Tawn — rosemary.tawn@strath.ac.uk

Additional Posters

Student Interns

Kathleen Davies — Poverty Mapping in Sub Saharan Africa Using Night Time Lights

Kim Janovski — Graphical Interface for Wind Turbine Data Visualisation

Laura Karacic — The Green Salmon Farm

Student Societies

StrathWind Racing — Wind Powered Car

Don't forget to hashtag your favourite! #fwm20

Discussion Panellists

Elva Bannon

Senior Research Engineer
Wave Energy Scotland

With a background in Mechatronic Engineering (BEng) and Advanced Engineering(MEng), Elva has been involved in wave energy technology development since 2007, having worked on a number of different technology concepts both in Scotland and Ireland. Her main focus in these roles was on tank testing, data analysis and numerical model validation for scale model tests. She then spent some time as an engineering consultant developing a novel robotic system, leading the electrical integration team.

In addition to her core responsibilities within WES, Elva also sits on a Committee providing UK input to IEC/TC114 standards development, and advisory/ scientific committee role giving industry perspective to academic organisations including the EIMR conference series

Prof Ian M. Arbon

Ian is a Chartered Mechanical Engineer and Environmentalist, with an MSc in 'Renewable Energy and the Environment' and an MBA. Formerly MD of several engineering-sector manufacturing companies, he now runs Engineered Solutions, a Sustainable Engineering and Management consultancy, based in Scotland.

Ian is a Fellow of Institution of Mechanical Engineers (IMechE); having chaired its Energy, Environment & Sustainability Group and its Renewable Power Committee, for the past few years he has spearheaded the Institution's work in 'Waste as Resource', 'Energy Storage' and 'Heat Energy'. he has been a Visiting Professor in Alternative Energy at Newcastle University and Module Leader for 'Energy Policies, Politics and Ethics' and 'Wind and Hydro Energy' on its REFLEX and REEM MSc courses since 2006; he has been an Honorary Professor in Sustainable Energy at the University of Glasgow since 2010 and has taught state-of-art MEng/MSc courses on 'Energy from Waste' and 'Energy Storage'. In January 2019, he was appointed as a Visiting Professor at the Centre for Energy Policy at the University of Strathclyde, where he is also currently teaching an MSc course on Gas and Steam Turbines.

Discussion Panellists

Prof Keith Bell

University of Strathclyde

Keith Bell joined the University of Strathclyde in 2005 having previously worked as a researcher in Bath, Manchester and Naples and as a system development engineer in the electricity supply industry in Britain. He was appointed to the ScottishPower Chair in Smart Grids in late 2013 and became one of the co-Directors of the UK Energy Research Centre in 2014. In July 2018, along with Ian Cotton, he became Scientific Director of the Electrical Infrastructure Research Hub established by the University of Strathclyde with the Offshore Renewable Energy Catapult and the University of Manchester and, in April 2019, became a member of the Committee on Climate Change. He is an invited expert member of CIGRE Study Committee C1 on System Development and Economics, a member of the Executive Board of the Power Systems Computation Conference and a member of the Executive Committee of the IET Power Academy, an initiative to promote electric power engineering as a graduate career in the UK.

Neil Douglas

Director
BVG Associates

Neil joined the management team of BVG Associates as a Director in the spring of 2017 and heads up our business in Scotland, with a focus on providing strategic advisory services to wind energy industry. Much of the work that Neil leads within BVG Associates is focussed on the globalisation of offshore wind.

He has over 25 years of experience in renewables, with specific expertise in the design, development and operational management of wind energy projects, including asset management strategy, performance engineering, technical due diligence and risk analysis for onshore and offshore wind farms. He also has extensive knowledge of asset management systems and technology, wind lidar and wind resource analysis.

Neil joined BVG Associates after more than two decades with Natural Power and holds a Masters in Energy Systems and the Environment from the University of Strathclyde.

Wind and Marine Energy Systems CDT

The Centre brings together the leading UK research groups in Wind energy at Strathclyde University and Marine energy at Edinburgh University.

The overall aim of the Research Centre is to meet the needs of the **fast growing wind and marine energy industry** by providing high calibre PhD graduates with the specialist, generic and leadership skills necessary to lead future developments in wind and marine energy systems.

A formal programme of training and research is completed to develop and enhance students' **technical interdisciplinary knowledge**, and broaden their understanding of the social, political and economic contexts of wind power and marine energy systems.

The CDT is the only academic centre with an accredited graduate scheme for achieving chartered status by both IMechE and IET, administered by students through their Professional Engineer Training Scheme (PETS).

With expertise unrivalled in the UK, the Centre's multi-disciplinary research teams are working closely with industry to help develop its global position in the field and meet ambitious **renewable energy targets**.

Professional Engineers Training Scheme

The Professional Engineers Training Scheme (PETS) CDT helps students to develop a wide skill set, including competencies in areas out-with their PhD research.

The scheme is overseen by the PETS Committee, a body of 9 CDT students elected each year at the PETS AGM in March. The PETS committee is integral to the students' experience while at the CDT.

Being elected to a role on the PETS committee is valuable for students because it offers unique opportunities to gain chartership competencies in areas which would normally be difficult to obtain in a research environment, such as team management and leadership skills.

Funding for the Centre for Doctoral Training in Wind and Marine Energy Systems and Structures

In February 2019 the CDT won £6m funding from the Engineering and Physical Sciences Research Council (EPSRC) for another 5 cohorts of students, allowing us to recruit and train 70 more doctoral students.

This new centre joins together two successful CDTs – Wind and Marine Energy Systems and Renewable Energy Marine Structures – along with their industrial partners. It is a collaboration between the universities of Strathclyde, Edinburgh and Oxford, which will create a comprehensive, world-leading centre covering all aspects of wind and marine renewable energy, both above and below the water.

It will produce highly skilled industry-ready engineers with multidisciplinary expertise, deep specialist knowledge and a broad understanding of whole-energy systems. Our graduates will be future leaders in industry and academia world-wide, driving development of the offshore renewable energy sector and helping to deliver the Government's carbon reduction targets for 2050. This will help ensure that the UK remains at the forefront of this vitally important sector.

An important aspect of the centre's plans is the involvement of a large number of industrial partners. 23 of the studentships will be funded by industry with support from Armour Edge, Atkins, Atlantis, Eire Composites, EON, Fraunhofer IWES, Fugro, Orsted, Ramboll, Siemens Gamesa Renewable Energy and Wood. The remaining studentships have been committed by the EPSRC and the three universities.

UNIVERSITY OF OXFORD

THE UNIVERSITY of EDINBURGH

University of Strathclyde Glasgow

Call for Research Proposals

Mini-Projects:

Each 1st year student carries out 2, 8 week mini-projects which run towards the end of the training year. This helps the students to get a flavour of different areas of research.

Call for proposals: 1st project—**April 2020**. 2nd project—**June 2020**.

PhD:

PhD topics are pitched to students between August and September, after their mini-projects.

Call for proposals: **June 2020**

The CDT has an open environment, designed for and encouraging of interaction with industry and other academic institutes. The PETS committee are always looking for speakers to come in and share their expertise with our students, and in return will endeavour to make the trip as valuable as possible for our visitors.

If you are interested in joining or working with the CDT, please contact the CDT Administrator, Drew Smith drew.smith@strath.ac.uk.

Visit us online "Wind and Marine Energy Systems CDT".