QUB – Mechanical and Aerospace Engineering 2018-2019

Title:	**Optimal integration of joint energy and power services to determine true strike price of offshore wind**
Lead supervisor:	Dr Aoife Foley, School of Mechanical & Aerospace Engineering, Queen's University Belfast **Email: a.foley@qub.ac.uk with queries**
Industry partner:	Dr Des Farran, Servusnet Informatics Ltd.
Academic partners:	Dr John Doran, Letterkenny Institute of Technology Dr Jimmy Murphy, MaREI, University College Cork
Qualification & skills acquired:	PhD, this research project will enable the successful student to acquire valuable experience of simulation tools and offshore wind power. All of which are highly sought after within industry.
Project links	• This project is part of the Bryden Centre, which has been funded under the European Union's INTERREG VA Programme. • The Bryden Centre will create a 'virtual centre of competence' that will support industry-led applied/pre-commercial collaborative research on a cross-border, interregional basis that is focused on two specific forms of renewable energy: bioenergy and marine renewable energy. • Please see the website for more information: https://www.brydencentre.com/
Entry requirements:	• A minimum degree of 2:1 (or equivalent) in one of the following areas is required: Engineering, Science, IT, Mathematics or a closely related subject area. Candidates must be able to demonstrate a significant level of mathematics and/or data analysis in their primary degree area. • It would be desirable to have some understanding and knowledge in the areas of modelling or data analytics. • Good computer skills are desirable as the project will involve computer modelling, simulations and analysis of results. • For non-native English speakers, English language proficiency is essential so please refer to http://www.qub.ac.uk/International/International-students/Applying/English-language-requirements/
Funding details:	• Funding is for 39 months and covers full university tuition fees for UK/EU students and a stipend of £14,553 per annum. • There is also the opportunity to undertake teaching and demonstration duties to earn a further £1,500 per annum. • International (i.e. non UK/EU) students would be required to pay the balance in tuition fees, currently in the region of £15,500 per annum; details of international fees are available on the QUB website: http://www.qub.ac.uk/International/International-students/International-tuition-fees/
Closing date:	27th July 2017
Anticipated start date:	September 2018
Application portal & details:	Make your application online at https://dap.qub.ac.uk/dapprd/portal/user/u_login.php Include the following with your application: • Curriculum Vitae with names and contact details of two referees, • Undergraduate transcripts and IELTS/TOEFL certificate (if non-native English speaker) • 2 page project proposal with an outline project plan based on the project details overleaf.

Project details:
Offshore wind farms should, like other generators, contribute to supporting all power system operations. This should technically, financially and economically place offshore wind power on the same level playing field as fossil fuel generation in terms of the delivery of joint energy and power services to the grid, opening revenue streams for wind farm owners that reduce and eventually eliminate dependency on support mechanisms, subsidies and feed in tariffs. Joint energy and reserve markets or primary frequency response services for renewable energy are discussed by Gonzalez et al (2014) and Foley et al (2013). The key challenges are (i) to find an optimal way to design the necessary joint markets or energy and ancillary services, allowing offshore wind power (and other renewables or demand response more generally) to declare their ability to support power system operation, though under uncertainty; and (ii) to define optimal offering strategies for offshore wind farm operators in such markets. This calls for a practical optimization tool that fully account for wind forecast uncertainties, regulatory and market constraints, strategic behaviour of the market participants, opportunities for storage and operational reliability constraints involved in power system operations.
The aim of this project is to develop a realistic offshore wind market cost optimisation model of the UK and Irish electricity markets in PYOMO. PYOMO is a collection of open-source optimization-related Python packages that supports a diverse set of optimization capabilities for formulating and analysing optimization models. PYOMO is open source, thus the model of the SEM and BETTA will be freely available to all unlike the existing models which require access to proprietary software. This is cost prohibitive for many academics and companies. The model will capture the mathematical complexity of the Irish and Great Britain (i.e. SEM and BETTA) wholesale electricity systems. These markets will be analysed as a comparative test system to predict the true strike price of offshore wind, and place a value on the services that offshore wind can provide to the power system. **The research aims to guide offshore wind power (and other marine energy) developers in terms of their strategic business planning and development with the aid of a robust practical optimization model of the Irish and Great Britain (i.e. SEM and BETTA) wholesale electricity systems.**

Project deliverables:
- A robust techno-economic model to act as a guide for offshore wind power and marine energy developers
- An industry-academia technology transfer workshop
- A public engagement event/talk to disseminate findings
- Impact nationally in terms of growing offshore expertise base in Scotland, Ireland and Northern Ireland
- 2 conference papers
- 2 journal papers