
***School of Computing, Engineering, and the Built Environment***
**Edinburgh Napier University**

# PHD STUDENT PROJECT

## Funding and application details

**Funding status**: Self funded students only

**Application instructions:**
Detailed instructions are available at https://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/

*Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.*

## Project details

**Supervisory Team:**

- DIRECTOR OF STUDY: Dr Pablo Jaen-Sola (Email: P.Sola@napier.ac.uk)
- 2ND SUPERVISOR: Dr Jill Miscandlon

**Subject Group:** Engineering & mathematics

**Research Areas:** Engineering - Mechanical Engineering, Offshore Engineering, Structural Engineering

**Project Title:** A Circular Approach to Manufacturing Sustainable Powertrains for Wind Turbines

**Project description:**

The School of Computing, Engineering and the Built Environment, “SCEBE”, at Edinburgh Napier University, “ENU”, is a portal for research and knowledge transfer that has contributed extensively to develop and promote renewable and sustainable energy devices in the UK and abroad over the last 30 years. Through the expert services that the School offers industry has been supported in meeting the demanding energy challenges and government requirements.

A fully funded 3-year PhD position is available in "SCEBE" to work with a team of experienced researchers. Multi-MW electrical machines for renewable energy devices are currently facing a series of issues that can be solved if they are considered at an early stage of the design process. “If we know the requirements, we can design for them”. Those issues are as follows,

- An increase in turbine size has lead to significant increases in material usage and manufacturing lead times. This increase in size also introduces evident logistical challenges.
- An increasing requirement for the service life to be extended.
- Finding reuse and recycle viable options is a must in order to reduce the assets carbon footprint.

Advances in the manufacturing sector will enable changes to the design, manufacture and assembly of powertrain components, which will in turn help address the issues mentioned above. Due to an increase size and an increase in volume of wind turbines, manufacturing routes will need to be optimised in order to meet demand. From a sustainability viewpoint, exploring the options for the reuse of different components will be essential, and can be achieved by defining the requirements for each component, including equivalent stress, thermal loading, etc,. through the life and calculating the projected life cycle. Reuse of materials and components is an important goal within the sustainability discipline, but can only be optimised at the design stage.

This PhD topic will bring together key aspects of manufacturing research and circular economy principles to design sustainable future powertrains. This will include techniques such as Design for Manufacture, Life Cycle Analysis and Life Cycle Costing.

Three different institutions will collaborate in this project led by "ENU" - Edinburgh Napier University, the National Manufacturing Institute of Scotland and the UK Offshore Renewable Energy Catapult. This collaboration will ensure the alignment of the project with the sector necessities and will open the door to explore further opportunities with key private organisations.

**References:**


[1] P. Jaen-Sola, “Advanced Structural Modelling and Design of Wind Turbine Electrical Generators”, Ph.D. Thesis, Wind Energy Systems DTC, University of Strathclyde, Glasgow, 2017

[2] L. Touw, P. Jaen-Sola and E. Oterkus, “Towards an Integrated Design of Direct-Drive Wind Turbine Electrical Generator Supporting Structures”, in Wind MDPI 3 (3), 343-360, 2023

[3] J. Miscandlon et al., “A Manufacturing Driven Design Methodology to Lightweighting of the Structural Elements of a Permanent Magnet Electrical Machine Rotor”, IEEE Access, DOI: 10.1109/ACCESS.2022.3214305

[4] D. Tiwari et al., “A Review of Circular Economy Research for Electric Motors and the Role of Industry 4.0 Technologies”, Sustainability 2021, 13, 9668. DOI: 10.3390/su13179668


## Candidate characteristics

**Education:**

A first-class honours degree, or a distinction at master level, or equivalent achievements in Mechanical engineering, Structural engineering, Manufacturing engineering, Aeronautical engineering

**Subject knowledge:**

- Mechanical design
- Manufacturing techniques

**Essential attributes:**

- Experience of fundamental mechanical engineering applied to renewable energy devices
- Competent in design and modelling of mechanical/structural components
- Knowledge of Life Cycle Analysis
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

**Desirable attributes:**

- Interest in Sustainable Energy Engineering