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Department	School of Engineering and the Built Environment
Supervisors	Fadi Kahwash; Jubair Ahmed
Funding Status	Funded PhD Project (Worldwide)
Application Deadline	14/04/2022
Project Title	Design and implementation of a robust energy management strategy for a hybrid renewable energy system supplying electrical and thermal energies

PROJECT DESCRIPTION

Combining more than one renewable energy generator (e.g. wind turbine and PV panels) and energy storage is called Hybrid Renewable Energy System (HRES). Given that different renewable resources are complementary, adopting HRES can have many benefits, such as increased capacity factors and reduced CO2 emissions. However, due to the atmospheric condition dependency and continuous variation in energy production from renewable energy make it difficult to ensure a balanced supply and demand between energy supply and loads demands. In an ill-prepared system, large mismatch between supply and demand can cause either large amount of electricity to be dumped or shedding of loads in absence of energy supply. To address such concern a well optimised energy management system is required to supplying electrical and thermal energy using a coupled HRES system. This project aims to design such optimised energy management system to monitor and regulate the energy flow from HRES to electrical and thermal load.

The candidate will work on developing an optimal strategy to minimise dumping of energy and reduce cost of energy by coupling electrical and thermal systems at the design stage. Initially, theoretical model will be developed and tested numerically to provide a proof of concept. Extensive modelling and optimisation will take place. In the second phase, the model will be benchmarked and validated experimentally.

Academic qualifications

A first degree (at least a 2.1) ideally in Mechanical, electrical or control engineering with a good fundamental knowledge of renewable energy topics.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental Energy modelling
- Competent in Optimisation techniques
- Knowledge of electrical and thermal renewable energy technologies
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Programming of micro-controllers; experimental methods;

Indicative Bibliography

1. Kahwash, F., A. Maheri, and K. Mahkamov, *Integration and optimisation of high-penetration Hybrid Renewable Energy Systems for fulfilling electrical and thermal demand for off-grid communities.* Energy Conversion and Management, 2021. **236**: p. 114035.
2. Olatomiwa, L., Mekhilef, S., Ismail, M.S. and Moghavvemi, M., 2016. Energy management strategies in hybrid renewable energy systems:

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	A review. Renewable and Sustainable Energy Reviews, 62, pp.821-835. 3. Lv, T. and Ai, Q., 2016. Interactive energy management of networked microgrids-based active distribution system considering large-scale integration of renewable energy resources. Applied Energy, 163, pp.408-422. 4. Byrne, R.H., Nguyen, T.A., Copp, D.A., Chalamala, B.R. and Gyuk, I., 2017. Energy management and optimization methods for grid energy storage systems. IEEE Access, 6, pp.13231-13260. 5. Mariano-Hernández, D., Hernández-Callejo, L., Zorita-Lamadrid, A., Duque-Pérez, O. and García, F.S., 2021. A review of strategies for building energy management system: Model predictive control, demand side management, optimization, and fault detect & diagnosis. Journal of Building Engineering, 33, p.101692.
Funding notes	This project may be funded by a scholarship of the School of Engineering and Built and Environment. Please see School-funded PhD scholarships - RESEARCH AND INNOVATION (napier.ac.uk) for information on the scholarships and how to apply for them."
Enquiries	For informal enquiries about this PhD project, please contact Dr. Fadi Kahwash f.kahwash@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process

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