



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://www.napier.ac.uk/research-and-innovation/research-degrees/how-to-apply>

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: Simon Powers (Email: S.Powers@napier.ac.uk)
- 2ND SUPERVISOR:

Subject Group: Computer science

Research Areas: Artificial Intelligence, Energy Technologies

Project Title: Using multi-agent systems to help households reduce peak electricity consumption in ways they perceive as fair

Project description:

The UK and the EU have both recently updated their legislation to put net zero emissions targets in place for 2050. This requires moving away from using fossil fuels for energy generation, and moving towards renewable sources such as photovoltaic cells and wind turbines. Doing this on a national scale is difficult, because the amount of energy a renewable source generates depends on weather conditions, making it very challenging to balance supply of energy with the total demand for it. However, it is easier to solve this problem on a local scale. This has led to governments starting to advocate for community energy systems, where a

community owns and manages its own renewable energy sources, and uses as much of its own locally generated energy as possible.

For a community energy system to work effectively, the community often needs to reduce its total peak electricity consumption, so that all of it can be met by its own renewable sources. This involves households adjusting the times at which they use high-powered appliances such as washing machines, dishwashers, and electric heating, so that they are not all using them at the same time. Traditional approaches to this have been based on time of use pricing – a utility company sets peak and off-peak hours, and charges households more to use their appliances in peak hours, with the aim of discouraging them from doing this. However, this approach has not been successful in the UK in widely shifting energy usage patterns (e.g. we are still facing the prospect of blackouts this winter because peak consumption is too high). And moreover, time of use pricing inherently discriminates against households on lower incomes.

This project will develop alternative approaches, drawing on theory from social science to develop agent-based protocols for reducing peak electricity consumption in a way that people perceive as treating them fairly. These are based on the idea that each household can have an agent running on their smart meter, into which they can input their preferences for when they would like to run their appliances. Their agent then negotiates with the agents of other households to come up with an allocation of times that satisfies each household's preferences as far as possible, while reducing peak consumption. The project will develop and test several such protocols in simulation, and perform online user studies to test how fair people find them.

References:

Candidate characteristics

Education:

A second class honour degree or equivalent qualification in Computer Science

Subject knowledge:

- Multi-Agent Systems
- Artificial Intelligence

Essential attributes:

- Experience of fundamental techniques in algorithm design and analysis.
- Competent in software development.
- Good written and oral communication skills.
- Strong motivation, with evidence of independent research skills relevant to the project.

Desirable attributes:

- Enthusiasm for working at the interface of computing, engineering, and social science.