



Project title	Mathematical problems of storage in power networks
Principal supervisor	Ben Mestel
Second supervisor	William Nuttall
Discipline	Applied mathematics
Research area/keywords	smart grids, energy systems, electricity storage, stochastic and deterministic modelling
Suitable for	Full time students, working closely with your supervisors on a day-to-day basis.

Project background and description

The increased use of varying and unpredictable renewable and low-carbon energy sources such as solar, wave and wind power will increasingly require an intelligent electricity network, the so-called smart grid, in which consumers regulate their own power consumption as well as providing power back into the network with small-scale generation.

A major challenge of renewables is storage of electrical energy, with traditional methods such as pumped storage reservoirs unlikely to provide sufficient storage capacity to even out variations in supply. The advent of electric and hybrid vehicles provides a new, potentially significant method of large-scale energy storage, which together with a smart grid may ameliorate these deficiencies of renewables.

The aim of the project is to develop models of electricity storage in electric and hybrid vehicles as part of a smart grid.

Following a review of the smart grid and energy systems, and of electrical storage, you will develop a hierarchy of models, starting from a single consumer building to a smart network of consumers and producers, taking into account price, carbon usage, and system requirements.

The project will draw on both stochastic and deterministic modelling as well as simulation, as appropriate.

Background reading/references

- The Smart Grid: An Introduction. How a smarter grid works as an enabling engine for our economy, our environment and our future, US Department of Energy, <http://energy.gov/oe/downloads/smart-grid-introduction-0>
- J. Momoh, Smart Grid: Fundamentals of Design and Analysis, 2012 Wiley-IEEE Press (available from the Open University Library as an e-book)
- Salvador Acha, Tim C. Green, and Nilay Shah, Optimal Charging Strategies of Electric Vehicles in the UK Power Market, https://workspace.imperial.ac.uk/urbanenergysystems/Public/Acha_ISGT_2011.pdf
- <http://www.lowcarbonfutures.org/projects/energy-systems/energy-storage/about-energy-storage>