

Project title	Mathematical modelling of storage and demand-side management in power systems
Principal supervisor	Ben Mestel
Second supervisor	William Nuttall , Toby O'Neil
Discipline	Applied mathematics
Research area/keywords	Energy, differential equations, electricity networks
Suitable for	Full time applicants

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 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 the storage of electrical energy and the use of demand-side management to even out variations in supply and on suitable mechanisms to incentivise service providers.

The aim of the project is to develop differential-equation models of electrical power systems with a particular emphasis on the role of storage, demand-side management and price in a smart grid and on grid resilience and security.

Following a review of the smart grid and energy systems, and of electrical storage and demand-side management, you will develop and study numerically several mathematical models, taking into account demand-side management, storage, price and system requirements.

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

Background reading/references

- B.D.Mestel, *Can price be an effective regulator of a power system? A differential-equation modelling approach*, pre-print 2018.
- 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 OU Library as an e-book)
- Institution of Mechanical Engineers, *Energy storage: The missing link in the UK's energy commitments*, 2014.
<https://www.imeche.org/docs/default-source/reports/imeche-energy-storage-report.pdf>