



A new approach to assessing the value of demand side management and storage in reducing costs for electricity system operation and investment (JSP206/02)

An extension of a new methodology for assessing storage in reducing costs for electricity system operation and investment (JSGP306/13)

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RA: **Dr Paul V. Johnson**

Nov. 06 – Sep 07, £80K (Seed-corn funding)

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Project Objectives

- To apply modern financial mathematics model energy/energy-storage issues
- Application to demand-side-management issues
- Formulate *partial differential equations* (PDEs) to describe these issues
- Efficient solution of PDEs
- To develop decision rules for optimal energy usage




Project Status and achievements to date

- PDE-based approach: *millions* of times faster than conventional (Monte Carlo) simulation approach
- Permits (stochastic) optimisation to be performed
- Methodology: applicable to many storage issues – what is the value of storage?
- EPSRC funding (£176K) recently secured



Key Outcomes benefiting the North West Region

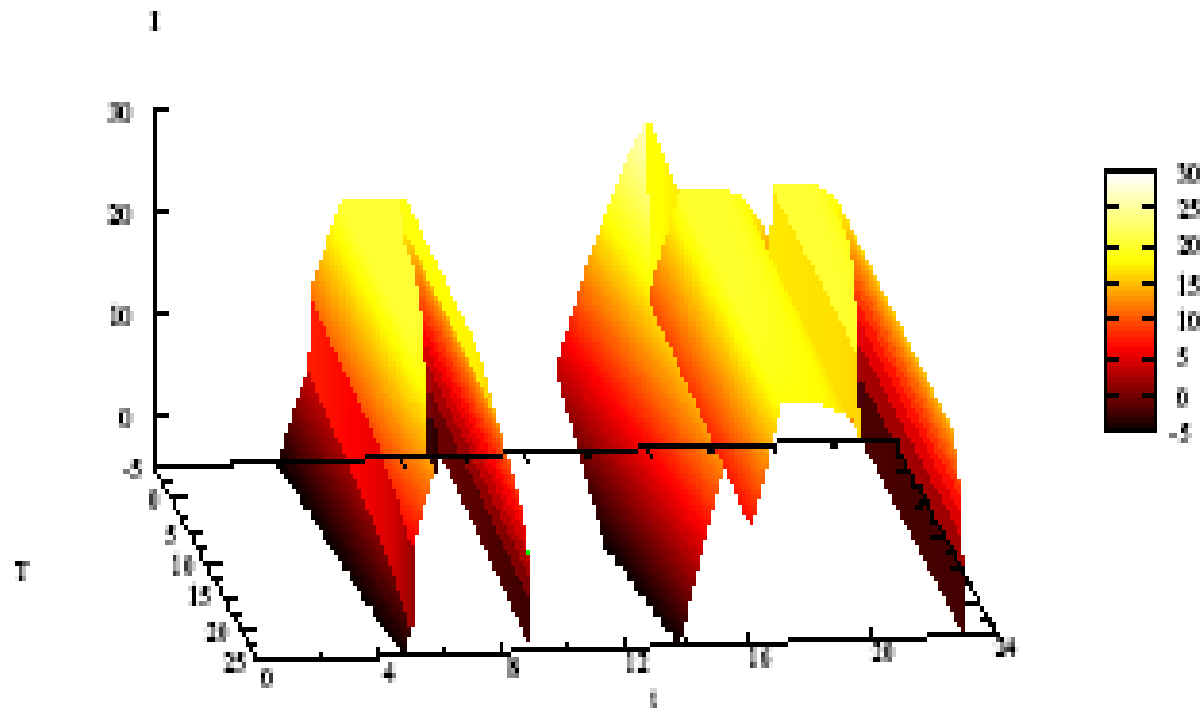
- Seed funding has started a new energy-research group in the region, now self-sustaining (Duck and Howell new energy entrants, with expertise respectively in mathematics and financial modelling : our RA, Paul Johnson, is developing powerful optimisation tools)
- New methods can benefit any area, including North West
- Can be used to assess the scope for policy change in NW on insulation, thermal mass, energy pricing
- Matched with survey data, can assess the scale of commercial opportunities in these fields in the NW
- Now have links with a group at Imperial College (our joint bid to E.ON for £600K is now with referees)
- Research collaborators include British Energy and BP Alternative Energy

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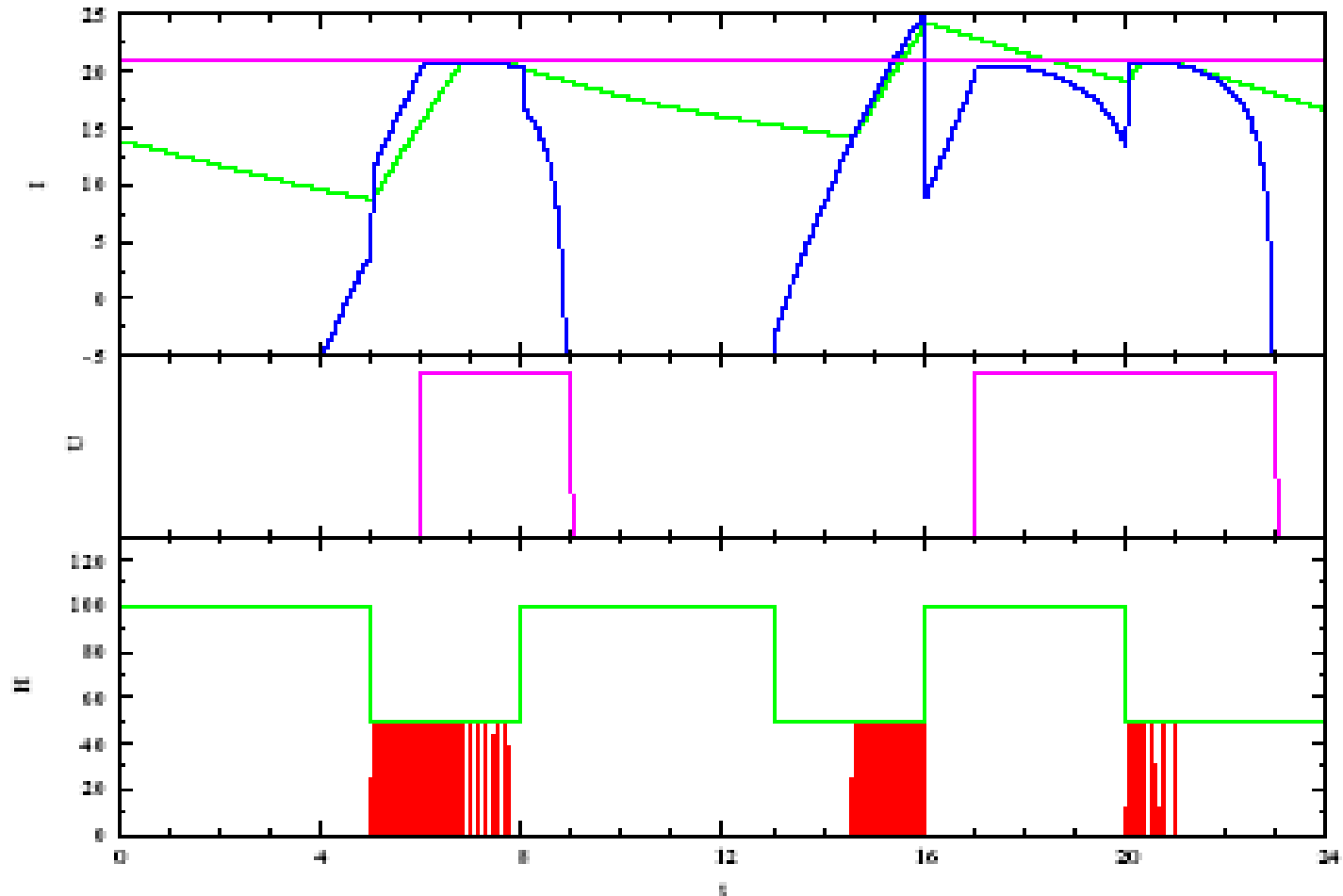
Standard heat dynamics – heat leaks away from the space

- How soon to heat the space, given quadratic discomfort, changing prices, cyclical plus stochastic external temperature, discontinuous occupation?
- Non-optimal solution needs one equation with only 7 terms
- Optimal solution needs an auxiliary equation with only 2 terms

Optimal policy is continuously variable, with time of day and [random] external temperature



How the optimal policy works during one simulated day





For more information

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Preprint:

www.ma.man.ac.uk/~duck/energy_storage/storage.pdf