Modelling Uncertainty

in Electricity Capacity Planning

Anne Ku

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ABSTRACT

Capacity planning has always been subject to major uncertainties, but privatisation of the U.K. electricity supply industry (ESI) has introduced the additional risks of business and market failure. To meet these broader modelling requirements, two radically different approaches characterised by ***model synthesis*** and ***flexibility*** are investigated.

Ideally, by using more than one technique, model synthesis should be more capable of meeting the conflicting criteria of comprehensibility and comprehensiveness. The noticeable trend of building bigger energy models supports this view in practice. A case study based modelling experiment was conducted to compare replications of traditional approaches with prototypes of synthesis. The conclusion from this is that the pursuit of greater model comprehensiveness through model synthesis is an elusive and ultimately impractical objective.

Rather than rigorous modelling for completeness, flexibility introduces an entirely different treatment of uncertainty. Flexibility has received much attention lately, but its usefulness is under-researched in modelling uncertainty for this context. In this respect, flexibility is studied 1) as a decision criterion, 2) as a feature of the modelling approach, and 3) in contrast to robustness.

Although intuitively appealing, flexibility is a vague and multi-faceted concept that requires much clarification before further application. A cross disciplinary review identifies its close relationships with more established concepts, the conditions under which it is useful, and the necessary elements in its definition. These elements translate into indicators for measuring and modelling flexibility. Practical guidelines for the operationalisation, structuring, and assessment of flexibility are developed from this conceptual framework and supported by examples specific to the UK ESI.

The seemingly feasible answer of model synthesis is fraught with conceptual and operational difficulties. The less obvious concept of flexibility offers a more promising and useful framework. Instead of modelling uncertainty for completeness, this thesis promotes modelling flexibility for contingency.

To my parents,

James and Lucy,

complementary but not always compatible

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Chance favours the prepared mind.

- Louis Pasteur (1822 - 1895)

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