It's got to work: the engineering detail in modelling electric power systems

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Complex physical systems on which society is increasingly dependent must, as far as possible, be made to work safely and reliably, and this depends to a very large extent on accurate modelling and simulation. The option of building and using models simply to illuminate policy debate or act as 'intuition amplifiers' does not exist; success or failure of modelling can be seen very quickly through whether the system being modelled delivers what is intended. For a power system, failure shows itself through 'the lights going out' or catastrophic failure of equipment leading to injury or death.

This talk briefly reviews power system engineers' approaches to the modelling of electricity systems and how they have developed into the suite of techniques commonly used today. It highlights a number of developments that are challenging existing approaches. These include the increasing use of renewables which introduces additional variability and uncertainty to the operational planning and scheduling of plant on a power system and significantly changes the nature of the equipment and its dynamics. Moreover, if heat and transport are decarbonised through electrification, power system engineers will face greater challenges in planning and operation of the system than they have faced in decades.

There has been growing interest in so-called 'smart grids' as a way of accommodating changes to the nature of power systems and delivering an acceptable reliability of supply at least cost. Many of the ideas are not new in themselves but are expected to have a great many more instances which presents challenges in respect of understanding of their interactions.

The talk concludes by outlining some of the techniques that are beginning to be brought across from computer science into power systems and which promise to contribute to the management of uncertainty in power system planning and operation. However, it also issues a challenge to utility managers and regulators to act now to improve the quality of data exchanged between parties and develop and retain expertise to set up and use models, and to academics who may have a significant role to play in enabling the transition to the future power system.