



## Angles on smart grids

**This week we review a book *Smart Grid, Integrating Renewable, Distributed and Efficient Energy*, edited by our collaborator Perry Sioshansi.**

The term “smart grids” is widely referred to as a concept, but exactly what it means, how it might work and what the benefits are not always so clear. In this collection of contributions from a diverse range of international authors the idea and its applications are held up and examined from many different perspectives. The book covers four main areas; setting the context for smart grids; the growing role of renewable and distributed generation; smart infrastructure, prices and devices; and a section looking at case studies, applications and pilot projects.

Sioshansi presents his own smart grid definition: “any combination of enabling technologies, hardware, software or practices that collectively make the delivery infrastructure or the grid more reliable, more versatile, more secure, more accommodating, more resilient and ultimately more useful to customers”. He explores the reasons why investment in smart grids is likely to increase rapidly over the coming years. The current grid is out of date, designed as a one way conduit for energy which assumed load was a given, with metering limitations placing severe restrictions on how electricity could be priced, meaning that consumers were effectively disengaged from what happened on the upstream side of the meter.

Yet the growth of peak loads, such as from greater use globally of air conditioning, means undifferentiated tariffs can be difficult and expensive to serve. Expansion of renewable and distributed generation has created new technical and commercial issues and growing interest in energy efficiency and the potential for self-generation and much greater demand elasticity among consumers and also creates new challenges.

Whether customers will “buy it”, however, is “among the biggest and most challenging pieces of the smart grid puzzle”. A number of smart metering projects have already encountered significant consumer backlash, and this “may be the tip of the iceberg”. But Sioshansi argues that the benefits of smart grids are real and potentially significant, particularly in addressing climate change through integrating a growing percentage of clean renewable energy resources as well as a better balancing of energy and load.

First contributors explore aspects of the concept, scope and evolution of smart grids. Stephen Healy and Iain MacGill pick up the theme of the position of the consumer in a world which includes smart metering, dynamic pricing and more advanced communications. They argue that using their full potential will require a very different relationship between end-users and the electricity industry and that the historic supply-side emphasis of the industry substantially underplays the potential for further constructive end-user engagement. The emergence of more localised smart grids and distributed energy options, often owned and operated by consumers, could see a return to the situation operating before the consolidation of large-scale integrated grid supply where there was more of a shared enterprise approach. They suggest ultimately the notions of supply and demand “sides” may become anachronistic.

Two pieces consider ethical and equity issues smart grids raise. Ahmed Faruqi looks at the ethics of dynamic pricing. He argues that fixed, flat tariffs and simple bills made sense and could be justified in the context of a declining cost industry reaping the benefits of massive economies of scale in generation and declining fuel costs. But the current context of rising costs and pressures to

invest in energy efficiency, fuel conservation and greenhouse gas emissions equity requires that prices reflect costs and therefore those who cost more to serve should pay more; and efficiency requires that price signals convey the scarcity value of electricity to all consumers and encourage curtailment of peak loads and their possible shifting to off-peak hours.

Frank Felder looks at the equity implications of smart grids and the distribution of costs and benefits, including the implications of the compulsory nature of smart grids. He argues the obvious solution is to provide customer education, choice to customers and additional consumer protection, but that the smart grid discussion has devoted too little effort to figure out how to provide customers with choice.

Turning to the supply side, contributors examine the evolution of renewable energy sources, distributed generation and micro-grids and various options to match intermittent generation with storage and flexible loads on the demand side. This includes an exploration of the potential for storage technologies to address the challenges of increasing intermittent generation by W. Maria Wang, Jianhui Wang and Dan Ton, which concludes that optimal technologies will need to be specific to the application and notes that increased distributed renewable generation has triggered an evolution from centralised to distributed storage.

The role of micro-grids, which effectively provide another level in the hierarchy of grid systems, is championed by Glen Platt, Adam Berry and David Cornforth, who claim that they hold great potential as a transition between current methods of system operation and truly dynamic smart grids. They argue micro-grids can address internally issues such as intermittency, storage management and load control. In addition they claim that micro-grids could offer a route to a smart grid with high renewable generation penetration and dynamic load management without dramatic changes to the wider distribution system or its operation. The potential for integrating renewables through direct load control and demand-side response is explored by Theodore Hesser and Samir Succar.

The book then focuses on the growing role of smart infrastructure, smart meters and devices, and smart prices to support smart and efficient energy utilisation. Chris King and James Strapp address some of the major information technology challenges facing industry participants in implementing smart grid initiatives. They argue that success requires a transformation of traditional approaches, with the emphasis on sharing data and communications networks and avoiding “point” solutions that support only a single department or business process.

A series of contributions take a close look at what smart grid technologies mean from the customer’s viewpoint. These include a study of how large commercial and industrial customers respond to dynamic prices in California, where hourly interval meters have been installed for large industrial and commercial customers. It finds customers will respond to critical peak pricing when substantially above their normal levels.

An interesting piece by Patti Harper-Slaboszewicz, Todd McGregor and Steve Sunderhauf looks at smart metering in a domestic context and points out that there is a wide gap between what consumers want to do and what industry experts and vendors are expecting customers to do. They suggest that convenience and ease of use and privacy will strongly influence how and when the smart grid is invited into homes, which requires an understanding of how to turn industry’s need for consumer engagement into reality on the ground.

The book concludes with a series of case studies that examine pilot projects and experiments of the smart grid concepts and technologies, including how the PJM market in the US, under which market participants establish a price for electricity by matching supply and demand, has created a significant role for demand participation, and a study of integration of wind power and the charging of electric vehicles in New Zealand.

Sioshansi's own conclusion is a little downbeat. While smart grids offer exciting opportunities, saving, benefits and a host of features and functionalities, they are simply beyond the capabilities of the existing grid. "It is abundantly clear that many remaining obstacles have to be overcome and pitfalls avoided—technical, regulatory, financial and behavioural to name a few—if we are to achieve the full potential benefits of smart grids", he concluded.

**Perry Sioshansi is a specialist in electricity sector restructuring, and he has been actively involved in discussions in a number of developed, developing and transition economies. He is founder and president of Menlo Energy Economics and is the editor and publisher of *EEnergy Informer*.**

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