

GIS Professional

issue 33 : April 2010



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the smart grid



Above: Examples of Smart Grid command and control centres.
Courtesy of Intergraph.

GOVERNMENTS AROUND THE GLOBE acted quickly to initiate recovery programmes when the global economy took a dive at the end of 2008. Large sums of public money were committed to kick start economies, with a share aimed at infrastructure projects under the heading of 'Smart Grid'. The Smart Grid describes

the next-generation networks that offer new options and efficiencies in distribution of power and other utilities to consumers, both domestic and commercial. In practice there is a heavy focus on the power network. Investment

in Smart Grid initiatives also ticks other important boxes for governments – making sure that energy is not wasted and working towards a more sustainable future.

As well as the political will, there is big money available to support these projects. In the US, one of the first major acts of President Obama's new administration was the American Recovery and Reinvestment Act 2009. This authorised US\$4.5 billion for Smart Grid projects, of which

businesses may find themselves making minute-by-minute decisions on switching on their generators, either to power their factory, or sell to the grid. This closer connection to the consumer and greater involvement with the user of the grid has implications for the records maintained by infrastructure companies. What we used to call mapping the last mile is now crucial to understanding the connection of each consumer. Network managers need to know where occasional, distributed generation is entering the grid, whether from industrial sites or roof top solar panels, and the impact it has on the overall flow. It is clear that this new communications network creates demand for new technology, devices, software and services throughout the system – from the generation plant to the consumer's meter.

The advanced/intelligent/smart meter provides in many cases the first step in a Smart Grid implementation, and there are dozens of meter related projects already in progress. They can be seen across the US from San Diego Gas and Electric to Florida Power and Light, in Europe with Italy's ENEL and France's ERDF. Projects in Russia, India, China and Australia are all dealing with the challenge of installing and connecting a new meter in every supplied premise. Once in place,

GIS and the Smart Grid

The evolving next generation of power distribution networks will provide fertile ground for GIS argues **Christine Easterfield** of Cambashi Ltd, an industry analyst, market research and consulting company focused on the use of technology and particularly information technology.

US\$2.9bn had already been allocated by January 2010. A further US\$32bn was authorised for energy efficiency and renewable energy projects, of which US\$25.4bn has been allocated. In 2009, the UK government announced its plans to have every home in the UK supplied with a smart meter and, at the beginning of 2010, announced support of up to £100 billion for off-shore wind generation projects. There are similar patterns around Europe and the Asia Pacific region – power generation projects must have 'sustainability' qualifications and are expected to fit into a Smart Grid. Smart meters are the first stepping stone towards a Smart Grid, and that is what many early implementations are focused on.

these new meters can communicate with the supplier to enable variable tariffs for the consumer, monitor interruptions in supply (planned or otherwise), get an accurate picture of energy usage and ultimately deliver a more satisfying service. It also means that details of what power has been used at which rate is easily available to the consumer and the supplier's billing department, bringing an end to the estimated bill.

Where GIS can contribute Where does this leave GIS? Given that everything is somewhere, GIS should surely fit into endless niches relating to the implementation of Smart Grid projects.

There are a wealth of standard GIS applications used by the logistics and contracting companies engaged in, for example, the efficient deployment of smart meters. From straightforward routing for deliveries of the meters in the shortest time or distance, to mobile workforce tools that record where and what is installed, there is much for GIS to contribute. Just consider the capital projects that need to use GIS-based planning and design tools to build new network extensions and connect into the existing grid. Between energy generation and consumption is the transmission, distribution – and now communication – network. Upgrading the transmission and distribution infrastructure is a major part of improving efficiency in the network, as is managing capacity in the new



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Key technology shift Managing the energy grid in its traditional sense, as a one-way channel from source to sink, from generation to consumption, is all very well but a key technology shift with Smart Grid initiatives is enabling two-way communications that create the possibility of a dialogue between the consumer and the supplier. This results in a consumer who knows how much power they are using, and at what cost, and a utility that has better management and forecasting tools for its network. It enables prices to change in real-time, and blurs the distinction between supplier and consumer, enabling the consumer to become an occasional supplier as local generation facilities become a reality. Manufacturing

communications networks, but there is now a wider range of energy sources to be considered that will lead to re-engineering of the network to manage that supply. Distributed generation, micro generation, new renewable sources and the cleaning up of existing plant all have implications for network design, additional control equipment and new working practices. New investment in intrinsically clean generation technologies such as wind farms, hydroelectric and nuclear will be needed, with Carbon Capture and Storage, though largely unproven, providing a technique for making the plentiful coal stocks meet strict carbon limits.

The recent Smart Utility Conference, held in London in December 2009, provided a great forum for utilities to exchange ideas and it was perhaps surprising that the major GIS suppliers were not there.

Not that these suppliers are inactive. ESRI decided that it needed more information and, last year, they commissioned a survey that asked utility companies "Is your GIS Smart Grid ready?" Though completed in September, the survey results are still being collated to provide a detailed response to each of the two hundred and twenty six participants before being published more widely. The results are perhaps not too surprising – most ranked 'smart grid readiness' as strategic to their plans, though none has achieved readiness in all areas. The majority have issues keeping their data up-to-date, with around 25% having data over six months out-of-date, only 30% managing to update data within ten days of work completion and just 10% updating their GIS data within one day of work completion. Perhaps most telling is that less than 70% have a complete model of their primary network. "The survey results show that utilities see GIS as strategic to smart grid in terms of their data management and analysis, their field work, and of course situational awareness," says **Bill Meehan**, utility solutions manager for ESRI. "However, these same utilities acknowledge that the data in their GIS is not ready. Without accurate data, and GIS for monitoring things like demand response and consumer behaviour, smart grid could end up being a very expensive meter-reading system."

Geospatially oriented databases **Tony DiMarco**, Director of Utilities and Telecomms at Intergraph, explained their focus on infrastructure. According to DiMarco: "The data bases that contain the model of the energy delivery and telecommunications infrastructures are vital for the Smart Grid. The model happens to be geospatially oriented, which makes it important for locating facilities, deploying field resources to the right location, and geospatially enabling corporate information systems. However, the real value is the fact that it is a connected network model, maintained graphically, that supports various forms of engineering and operating analysis and is the basis for Smart Grid operations. It's all about the network. So, yes, I think there is a very strong tie between "GIS" and Smart Grid. But Smart Grid is not limited just to electricity. Telecommunications networks have always been "smarter". Now the wave of

automation is going to make electric, then gas, then water networks all smarter." Progress Energy in the US is a good example. They serve 3.1 million customers in the Carolinas and Florida, where the Intergraph GIS provides a foundation for the Intergraph OMS (outage management system) and their mobile workforce management system – connecting with circuit analysis programs to give a truly integrated picture of the utility's network.

One organisation that has a finger on many of the Smart Grid buttons is GE Energy. There the goal is to provide for every need along the supply chain from wellhead to toaster – covering each step from oil and gas exploration, extraction, power generation, transmission and distribution networks, meters, software, all the way to consumer appliances. Smart consumer appliances, of course! GE's initial focus is on making the existing grid smarter through a variety of different solutions, including: smart meters to monitor usage and empower consumers with the ability to control their consumption in response to changing energy prices, distribution volt/VAr control to improve power quality and reduce losses, predictive control algorithms to minimise the impact of intermittent power output from renewable generation sources and cutting-edge equipment prognostics to increase reliability and prolong asset life. These are embodied in four initiatives to support smart grid introduction that cover distribution operations, demand management, transmission, and asset optimisation. More recently they have added the 'Workforce and Engineering Design Optimisation' initiative, which draws on GE Energy's existing geospatial technologies of Smallworld and MapFrame and their workforce management solutions to become one of the pillars of their Smart Grid strategy. This initiative will focus on the planning and engineering of tomorrow's enhanced Smart Grid as well as the workforce that will build and maintain it.

John Eason, Director of Smart Grid Alignment for the GE Energy T&D business, proposes that "while much of today's emphasis is on increasing operational efficiency of the current system, utilities will soon begin to design their network around emerging Smart Grid standards and technology. As such, this ability to 'design for Smart Grid' will rely heavily on integrated planning and design applications including the GIS". Emerging technologies that promise to change the design of the Grid include large and small scale renewable energy sources, smarter meters, the rise of PHEV (plug-in hybrid electric vehicles), network battery storage and others not yet imagined.

The business challenges to be met in realising the many aspects of the Smart Grid provide scope for the whole sector to get involved. There are outstanding questions around standard protocols needed for network interoperability and communication – but with governments and utilities driving these projects on, the answers will emerge. For the resulting complex rollout projects – upgrading of back office systems, installing and improving communications networks and the logistics of installing a new meter in every property – planning and coordination tools and skills will be at a premium. It's a challenge I am sure we would all like the opportunity to take up.



Christine Easterfield is a principal consultant with analyst and research firm, Cambashi. She has over over 20 years experience in the software business, with roles in training, consultancy and, latterly, product marketing management. Her experience has been in asset management for the utility industry, assessing market needs and opportunities.
www.cambashi.com

For more information, contact:



PV Publications Ltd, publishers of *GIS Professional* magazine.

Tel: +44 (0)1438 352617

Email: editor@pvpubs.demon.co.uk

Web: www.pvpubs.com