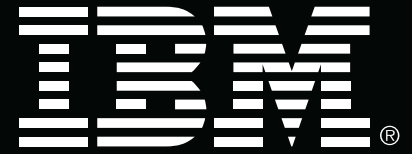


Smarter meters:

Better tools for tomorrow's energy



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Smart meters could change the way energy is supplied and consumed in the UK, but **suppliers and consumers will need to change** as well. For their true potential to be achieved, **smart meters need to be rolled out quickly and efficiently**, ready to adapt to future energy models, and with customers engaged from the start.



The UK has an energy problem. First, electricity demand could **outstrip supply by 2016**, if not sooner. Plants now under construction will buy some time but **large parts of Britain's ageing power infrastructure need an upgrade** in order to meet long-term demand, and this could **cost upwards of £200bn¹ by 2020 alone.**

Energy supply is driven by our consumption habits and these are very difficult habits to break. Peaking power plants – generally gas turbines – are used to meet peak demand as people come home from work, switch on lights and television, and so on.

These plants are not as efficient as those providing baseload supply, but it is not economical, and often not technically feasible, to meet peak demand with alternate, low-carbon sources of supply.

For example, if nuclear generation was used to meet peak demand, it would require the plants to be in constant operation, which is a very costly option. Alternatively, wind farms produce intermittent and relatively unpredictable supply, which does not solve the problem. Nor is it possible at the moment to store sufficient electricity throughout the day to meet the variable demand with a constant level of power generation.

And third, the relationship between energy consumers and suppliers is arm's length at best. Suppliers do not have the data they need on customer energy use to offer better pricing structures, while consumers risk wasting electricity because they have little understanding of how much energy they're using, when and what for.

The situation is compounded by population growth, urbanisation, the historic link between economic growth and energy use, and the proliferation of electrical devices. And there is the added pressure of climate change on industry and consumer alike, as legislation such as the UK's Climate Change Act moves us all towards a low-carbon future.

Consumer engagement is crucial to developing new collaborative energy solutions with utilities, but most consumers consider initiatives like smart meters solely as a way for utilities to save money. Consumers do not yet understand that this approach could help secure energy supply, reduce emissions and keep price rises as low as possible.

How can the general population be convinced to change its energy habits, from how and when power is used, to the amount of energy required? How can this be done quickly enough to avoid brown outs, spiralling energy costs and constraints on our economic prosperity? How can any solution anticipate and cope with the inevitable changes coming to the UK's energy mix? Ultimately, how can the relationship between energy suppliers and consumers be brought closer together?

SMARTER CONSUMPTION

Smart meters could help minimise the possible shortfall between the UK's energy supply and demand, by putting power back in the hands of the consumer.

Smart meters include digital displays that feature detailed energy use and its cost, in real time. Mass deployment of these devices would bring detailed

14%

– the anticipated increase in domestic UK energy costs in the next decade

energy consumption data into the open for the majority of consumers for the first time, in a way they could understand and act upon with ease.

For example, as they discover how much power they are using and how much it costs to operate their dishwasher or water heating during peak hours, people may be inclined to adjust their consumption patterns.

According to some estimates, making this data available to consumers could reduce consumption by an average of six per cent, rising to 10 per cent in some consumer groups – though questions remain whether this reduction is sustainable over the long term.

Smart meters make it possible to automate major appliances in the home, such as washing machines to take advantage of things like Time of Use tariffs. Enabling two-way communications between smart meters and intelligent household appliances, from washing machines to water heaters, allows consumers to be more efficient with their own power consumption, or indeed for the utility or energy service provider to manage elements of the consumer's usage in return for lower bills.

Changing consumption patterns, introducing more intelligent appliances, and encouraging better demand management among consumers will help reduce overall and peak demand. This will take some of the pressure off suppliers to introduce more capacity, reducing the need for a large and immediate investment in power stations and networks. All of these need to be exploited in order to make the most of smart meters.

Smart meters have the potential to change the way people consume energy for the better, but only if people are taken willingly on the journey to a new energy future.

IBM® worked with energy company Nuon on a pilot programme among 500 Amsterdam households to test a wireless smart meter-based energy management system². Energy use was monitored, targets set and consumption patterns were influenced by various "beyond the meter" services. For example, a device was placed between the sockets and appliances that showed energy use and offered advice on how to reduce consumption. Heating could also be turned up or down via the internet or mobile phone, and the system included a special button for switching off all unnecessary appliances.

Based on the results from an earlier test, the anticipated average savings in Amsterdam were approximately €200 per year for an average household.

Developments such as these will become increasingly important in years to come. A report³ by Ofgem, the British energy regulator, states that energy bills could rise by between 14 and 60 per cent over the next ten years and that there are doubts over the security of future power supplies. These could result from a combination of factors, from steadily growing demand and limited supply to the

closure of most of the UK's nuclear power stations and heavy fossil fuel plants.

The UK Government's Department for Energy and Climate Change (DECC) claims that smart metering could reduce energy bills by an average of £28 per household by 2020⁴. These savings could be even larger in households that are proactive about reducing energy use in conjunction with smart meters⁵.

Smart meters will also help to enable new feed-in tariffs designed to increase microgeneration, with householders selling surplus energy back to the grid. Such tariffs are much more difficult to implement without the ability to measure microgeneration cheaply and quickly, which smart meters provide.

And with the majority of our power still expected to come from carbon-emitting power stations – at least until the new nuclear power stations are complete and renewable options like offshore wind are up and running – lower consumption will help to curb emissions. It's a win-win-win scenario for consumer, supplier and environment alike.

SMARTER SUPPLY

Smart meters could be a game-changer, which is why DECC wants them in every home by 2020, monitoring both gas and electricity use. They are seen as catalysts for change by industry and policymakers alike – change that

50m

smart meters will need to be installed in homes across the UK in years to come

should benefit a number of stakeholders. However, they also need to achieve critical mass before major changes such as flexible tariffs and Time of Use pricing can offer any significant benefits.

In addition, issues like the UK's commitment to reduced greenhouse gas emissions and the impending gap between UK energy supply and demand gap are both urgent. Smart meters need to be brought in sooner rather than later if their impact is going to be felt in time.

The industry can't afford to wait – a late start and a slow ramp-up will only cause further delays down the line, as well as adding to the cost. **Smart meters need to be rolled out quickly and efficiently in order to maximise their potential benefits – from cutting carbon emissions to bridging the looming energy gap – and minimise future rollout costs. What's holding things up?**

Some delay is understandable: smart meters require an industry model that is still evolving, as well as planning and financing the deployment and installation of over 50 million of the meters themselves. It means trying to standardise a technology that hasn't been fully designed, for use in global energy markets that are at very different stages in their maturity.

Managing the transition from today's architecture of customer and billing systems to a future model will be far more complex than just installing meters. The issue is not what tomorrow's smart meter world looks like, but how the

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industry manages the transition over the next decade, essentially operating two business models in parallel.

And as this transition is being made, how do suppliers improve the existing plumbing without introducing new leaks? How do they manage the deployment and operational transformation without allowing operating costs to jump? How do they avoid putting pressure on the end-consumer price and further squeezing margins in a traditionally low return business, and hampering capital investment?

These are big challenges, but they are not insurmountable. Other industries have moved from periodic to transactional relationships with the consumer – telecoms, retail, financial services – and come through the transition stronger than ever. And markets in other countries, including Italy, The Netherlands, the US and Canada, have managed mass smart meter deployments.

It's the kind of transition that will require smart programme design and management, innovation and flawless execution, as well as business analytics and modelling far beyond the current capacity of most utilities. These businesses will need to be able to handle and process vastly increased amounts of transactional data – at least 4,000 times as many records per consumer per year – which will require the types of computational power and information management seen today in banks and phone companies, rather than in energy suppliers.

Suppliers that manage the transition well will minimise costs, disruption and customer defection, and be able to capitalise on all the benefits of a smart meter strategy – and the potential benefits are many:

- Billing accuracy will be improved with no need for consumption estimates.
- Time of Use tariffs and flexible pricing structures will encourage consumers to use energy when it is at its cheapest for them and, by extension, for the supplier. This will help suppliers improve their margins.
- Customers will enjoy more informed decision making when changing energy supplier, becoming more engaged with the supplier in the process.
- Suppliers will gain detailed individual customer data with which they can produce more targeted marketing and develop so called “beyond the meter” services.
- There will be a noticeable change for suppliers in the management of volume and price risk.
- Fraud should be reduced, because it's harder to tamper with a smart meter and the granularity and timeliness of smart data will enable a step change in energy theft analytics and the management of consumer debt.

SMARTER ENERGY

Smart meters represent the first step on the path to a smarter energy grid, part of a fundamental change in the relationship between utilities and consumers. Instead of being disconnected from the day-to-day concerns of consumers, energy suppliers will become energy service companies. They will

Smart meters and the energy mix incentive

Smart meters are a key step in the move toward smart grids, which could be necessary to support the radically different energy mix of the future.

The UK's Climate Change Act requires an 80 per cent reduction in greenhouse gas emissions by 2050, and a significant percentage of Britain's current CO₂ emissions come from burning fossil fuels to generate electricity.

As a consequence, the UK government has confirmed its support of alternative energy options, including new nuclear power capacity and renewables⁶. In addition, the Crown Estate, owner of the UK's coastal seabeds, granted rights to energy companies in order to encourage the building of thousands of offshore wind turbines⁷.

Nuclear power, renewables, cleaner fossil fuels and even microgeneration – all of these options could offer a greener future and support the promise of security of supply. However, Britain's post-2020 energy mix is likely to turn conventional wisdom on its head, and systems will need to be in place to cope with that. A higher proportion of intermittent energy sources, such as wind power and solar energy, will demand an even more robust and flexible smart grid.

Smart meters do not automatically mean a smart grid, but they are important to the success of smart grids when it comes to active demand management and distributed supply for things like microgeneration and distributed renewables. As a consequence, they could become an essential ingredient in our low-carbon energy future.



provide complex home energy services, encouraging and helping customers to take control of their energy use.

Instead of being passive consumers of electricity, removed from the impact that their energy use has on the environment and the nation's energy system, people will become active managers of their consumption. They will become part of a large-scale distributed generation capacity, supported by demand management controls and services, and even electric vehicles that feed back into the grid. This relationship will help bridge the gaps between supply and demand, and smooth the peaks.

And instead of a demand-led system governed by broad consumption trends, the new model will be based around intelligent supply. It will combine smart metering technology, integrated planning tools and an intelligent grid. Real-time monitoring of supply, as well as advanced analytics and

10%

– average electricity bill savings per household in recent smart meter study

environmental modelling, will be introduced. This should open the door to new entrants to the market, providing home energy services that can compete with traditional retailers and encouraging greater competition. Ultimately, this will enable greater control and influence over consumption. This will become particularly important as more intermittent sources of power are introduced, such as wind and other renewables (see boxed text on preceding page).

It will also allow for more efficient power distribution as well as microgeneration. The resulting energy supply should be more sustainable and secure, with improved demand management and more control for customers over their energy spend.

The potential for this new model has been confirmed in IBM's recent work with the Pacific Northwest National Laboratory (PNNL), one of the US Department of

Hildebrand: managing the smart meter data flow

While the impact of smart meters on energy consumption could be massive, there remain technological hurdles to be overcome.

Based in the UK, Hildebrand understands the challenges involved. The organisation provides creative and technology consulting for service organisations and is at the heart of the Digital Environment Home Energy Management System (DEHEMS).

This EU-funded initiative is intended to develop and test a home energy management system for the home market, with the aim of reducing CO₂ emissions and electricity bills – a topic of considerable interest and importance to governments, citizens and the utilities sector across Europe.

Small, low-cost energy monitoring devices were installed at groups of homes in Birmingham, Bristol and Manchester in the UK, and Plovdiv and Ivanovo in Bulgaria. Each “living lab” provides access to real-world energy usage data, and allows researchers to study the behaviour of individuals and their attitudes towards energy management.

The project attracted the attention of the UK government, which had proposed a large-scale implementation of smart

meters to three million British homes. The sheer volume of data is a significant challenge: if three million homes are sending a new reading once every minute, that's 50,000 new database entries every second.

Hildebrand worked with IBM to come up with a solution, using database platforms specifically designed to handle “time-series” data (ie “pulses” of data arriving at regular intervals from one or more sources) and cope with high volumes of data. After completing proof-of-concept simulations, it was clear that managing such high volumes of data would not be a problem. Suddenly, energy monitoring for three million homes or more became a practical proposition.

The possibilities for a truly scalable energy monitoring solution are vast. This approach enables real time analysis of electricity usage for households or individual appliances, helping people make better decisions about energy efficiency. And it delivers high performance on low-cost hardware by leveraging unique time-series data management technologies.



Smart meters offer an opportunity for consumers and suppliers alike to **collaborate on a more energy efficient future**, but time is of the essence.

Energy's ten national research laboratories⁸. PNNL's Olympic Peninsula project – one of two studies conducted as part of a larger Pacific Northwest GridWise™ Demonstration Project – equipped participating homes with new smart meters, as well as intelligent thermostats, water heaters and dryers.

Homeowners could customise their devices, setting targets and limits based on use or economy. The software would automatically control thermostats and water heaters based on those limits.

Participants also received regular pricing updates, including Critical Peak Pricing, via the Internet. These updates included the price of electricity increasing by many multiples at times of network stress.

Consumers could save money by adjusting home energy consumption based on the needs of the grid and these savings were converted into real money kept by the homeowners. On average, participants saved approximately 10 per cent on their electricity bills.

The results of the year-long study concluded that participants became “an integral part of power grid operations on a daily basis – and especially in times of extreme stress on the electrical distribution system. A combination of demand response and distributed generation reduced peak distribution loads by 50 per cent for days on end. Over the duration of the study, participants who responded to real-time prices reduced peak power use by 15 per cent.”

The project demonstrated the potential of smart meters when used in conjunction with a new, intelligent energy system. It also showed that achieving significant benefits – such as demand reduction or the shift to off

peak and lower bills – requires more than just smart meters. It needs additional smart features such as intelligent appliances, Time of Use pricing and control-based demand management. Providing consumers with information is a big part of the puzzle, but is by no means sufficient to deliver the whole picture.

WHERE NEXT?

Smart meters offer an opportunity for consumers and suppliers to collaborate on a more energy efficient future, but time is of the essence.

In order to take advantage of this opportunity, suppliers and consumers alike must be able to harvest, manage and use the information that smart meters will provide.

Interconnected technology, integrated planning tools and intelligent networks will all play a part, introducing real-time monitoring of supply as well as advanced analytics and environmental modelling.

IBM's vision for smarter energy recognises the complex interrelationship between all of these issues. The first step is to bring together integrated devices – from smart meters to network analytics and distributed generation. This will in turn help to influence demand and change personal energy consumption, with smart devices working in collaboration with the grid. It requires reverse engineering a system that brings together the desired outcomes for the consumer with the challenges facing suppliers.

Doing so will help ensure a more sustainable, stable and secure energy supply, while offering customers more control over their energy spend. And hopefully go a long way to solving the UK's energy problems.



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76 Upper Ground
South Bank
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IBM Contacts

Jon Bentley

Partner, Innovation,
Energy & Environment
Leader, Smarter Energy
IBM Global Business Services
UK & Ireland
+44 (0)117 929 5962
jon.z.bentley@uk.ibm.com

Phil Spring

Partner, Utilities
IBM Global Business Services
+44 (0)7739 874 577
phil.a.spring@uk.ibm.com

William Siddall

Smart Meters Lead
IBM Global Business Services
UK & Ireland
+44 (0) 7843 325255
wsiddall@uk.ibm.com

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References

1. *Project Discovery: Options for delivering secure and sustainable energy supplies*. Ofgem. 3 February 2010. <http://www.ofgem.gov.uk/Markets/WHLMKTS/Discovery/Pages/ProjectDiscovery.aspx>
2. "Instant insight into energy consumption makes energy saving easier". Nuon. 13 July 2009. <http://www.nuon.com/press/press-releases/20090713/index.jsp>
3. *Project Discovery*. Op cit
4. *Towards a Smarter Future: Government Response to the Consultation on Electricity and Gas Smart Metering*. Consultation on Smart Metering for electricity and gas. DECC. Dec 2009. http://www.decc.gov.uk/en/content/cms/consultations/smart_metering/smart_metering.aspx
5. "Smart meters planned to cut electricity bills for millions of homes". *The Telegraph*. 2 Dec 2009. <http://www.telegraph.co.uk/finance/personalfinance/consumertips/household-bills/6706825/Smart-meters-planned-to-cut-electricity-bills-for-millions-of-homes.html>
6. "UK at forefront of a low carbon economic revolution". DECC. 15 July 2009. <http://www.decc.gov.uk/en/content/cms/news/pn081/pn081.aspx>
7. "£75bn for UK's biggest offshore wind programme signals new era for renewables" <http://www.guardian.co.uk/environment/2010/jan/08/uk-offshore-windfarms-100bn>
8. "Department of Energy putting power in the hands of consumers through technology" <http://www.pnl.gov/topstory.asp?id=285>