

Smart Metering: A technology whose time has come?

A ClickSoftware White Paper

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Introduction

Definitions of what exactly smart metering is vary. But most utility people, whether they are in electricity, gas or water, agree that taking utility metering from the rudimentary systems we see today to another more sophisticated and interactive level will bring real benefits right across the business, across the value chain, to customers—and to the environment too.

This white paper takes as its cue two significant developments in the evolution of smart metering. One is the announcement of a series of government-supported smart-metering trials, which will begin across Britain in early 2007. The other is the successful completion of the rollout by energy company Enel of smart electricity meters across the whole of Italy.

Both of these developments could finally usher in an era of smart metering across Europe and beyond. But any new technological breakthrough has costs and, thus, needs to be justified. What are the benefits of smart metering—and what appetite do utility companies and their customers have for it?

ClickSoftware identifies five major areas of utility operations in which the introduction of smart metering can deliver clear benefits to utilities and their customers: demand management, better billing and customer service, facilitation of embedded micro generation, easier switching of suppliers, and better network management.

Smart metering and demand management

As we will see, there are a number of reasons to deploy smart metering. In Britain, though, the catalyst for the imminent smart-metering trials has been demand management.

The UK's Government Energy Review of 2006 stated the need for greater energy efficiency as one of the central planks of future energy policy. The premise is that one way to reduce carbon emissions from the generation of electricity is to use less electricity in the first place—the adage that the greenest power station is the one that you don't need to build.

Easy energy efficiency measures make economic sense to customers and have usually already been carried out. Deeper energy-saving initiatives need incentives. The UK Treasury announced funding for energy efficiency in its last budget, and these funds were transferred to DTI and Defra in the summer of 2006.

The decision was then taken with regulator Ofgem to use the funds—£11 million—to partly fund a series of smart-metering trials, with financing of up to 50 percent government money.

These trials will explore how it might be possible to use smart metering as a tool for altering customer behavior so that customers use energy more wisely. Smart metering enables utilities to offer innovative tariffs that can lop off peak demand, perhaps avoiding having to bring extra power generation online.

Smart metering also enables customers to better judge how their energy use can be managed.

Smart Metering, better billing and smarter customer service

Utility billing has long been an issue in Britain and elsewhere in Europe. Billing is often estimated because meter access can be difficult, and it is often wrong.

Inaccurate billing hits utility revenue streams, makes financial planning difficult, complicates customer debt management and collection, and annoys customers. This is bad enough in monopoly markets where customer dissatisfaction costs money. In competitive markets, it can mean losing customers.

The desirability of improving billing and customer service to energy and water customers has just been given a new imperative in Europe. From 2008, a European Commission Directive will require energy companies to supply more and better quality information to customers about their energy usage, and smart meters are the obvious way to achieve this.

Customers may be happier if they can monitor their energy usage more easily, using LCD displays wirelessly linked to their meter and located on an accessible appliance such as a fridge. More sophisticated technologies could even turn devices off or down, or switch tariffs and suppliers depending on ongoing usage patterns.

Of course, whether customers will tire of this level of information about something as relatively mundane as energy, and revert to indifference after a few weeks or months, remains to be seen.

The completion of the Enel meter program in Italy and the three-year smart-metering pilots about to start in Britain will soon start to indicate the longevity of changes, if any, to customer behavior as a result of easier control over their energy consumption, better billing and, one hopes, better customer service.

These should all be a consequence of the improved data for and about customers' energy use available as a result of smart metering.

Smart metering facilitates micro generation

As we move toward a lower-carbon, greener and more sustainable energy market in response to the twin threats of climate change through carbon emissions and security of supply, locally distributed (or embedded) micro generation is seen by many policymakers as a key part of the future energy mix.

This type of generation could take the form of local or district combined heat and power (CHP), micro-wind or solar power, or domestic CHP.

However, with electricity transmission and distribution designed for flow one way from large centralized power stations down to customers at the end of the line, micro generation needs a new approach to the relationship of the customer to the distribution system.

The meter is key. Conventional electricity meters measure electricity coming in to the customer. Micro generation, though, could mean that customers are generating more electricity than they need and, therefore, wish to export it out into the grid.

Smart meters enable customers to do this. Two-way interaction is essential if the electricity distribution system is to become active, rather than the inactive one-way system it is today.

Smart meters could then not only tell customers what they have spent on their electricity consumption, but also tell them what they have earned from their electricity generation too.

Smart metering helping cleaner switching and interoperability

With the arrival of competitive retail markets the ability to switch suppliers effectively has become a real issue. Too often the process of switching suppliers has been troubled by error and delay.

Smart metering can help the switching process by allowing the provision of better and more up-to-date data. But this potential benefit could be compromised by the issue of meter ownership. If an incumbent supplier invests in a smart meter and the customer then switches, what happens to meter ownership? This question of interoperability is one which needs to be addressed in the forthcoming UK smart-metering trials.

Here, the experience of the Enel program does not apply to the interoperability issue, as Enel is vertically integrated, and domestic electricity supply is not competitive.

Smart metering and network management

So far we have seen some of the potential benefits of smart metering in the retail space, for both energy suppliers and customers. But smart metering can benefit other parts of the electricity value chain too.

Smart metering can also help to reconcile the quantity of electricity going into the transmission and distribution systems with the amount being consumed at the customer end.

This means more accurate information will be available about transmission and distribution losses, theft, and fraud. This latter benefit will have been a factor in Enel's decision to roll out smart meters in Italy.

Smarter operations of transmission and distribution will be a prerequisite of any move toward distributed micro generation. We have seen how smart metering will operate at the customer end of distributed generation, but an active electricity grid will need more sophisticated balancing and management down the line.

Paying for smart metering

The potential of smart meters to positively impact energy companies through better quality and quantity of data about who is consuming electricity, how much, where and when is widely recognized across the electricity industry. The benefits beyond the retail interface may be less well known. Customers will also welcome anything that takes them away from inaccurate, disputed or estimated billing—although whether they will also alter their behavior in terms of their energy consumption patterns is not yet known.

However persuasive these arguments, any widespread adoption of smart metering could flounder on several key issues: data management, technology and cost.

An immediate consequence of widespread smart meter adoption is an increase in the amount of data energy companies—and customers—will have about energy consumption. Data is only useful if it can be accessed, interpreted, stored, referenced and then acted upon. Smart metering, therefore, is only going to be a useful tool if it is harnessed to an effective, robust and transparent data management system.

Technology has been cited as a potential challenge. The more sophisticated smart meters have, by nature, more that can go wrong. Again, the Enel and UK pilot experience will be valuable test beds of smart-metering technology. It should be noted though, that while smart meters are considerably above and beyond conventional metering technology, they have been a reality for a few years now, and most people in the electricity industry do not usually cite technology as a major obstacle to smart meter deployment.

Cost, though, could be. At a recent metering conference in Copenhagen, a survey of delegates showed support for customers to pay more to have smart meters installed, though they also thought the amount customers would be willing to pay would be small. With the costs of supplying and installing a smart meter being between 100 and 200 euros (depending on the sophistication of the device), this could be a significant issue.

It is also the case, though, that existing meters will have to be replaced anyway at some stage—in the UK some 15 million meters will soon be obsolete. As we will see below, this can be the opportunity to roll out better, smarter technology.

From a customer viewpoint, the case needs to be made for cost-saving benefits that will deliver a payback over a reasonable amount of time. This is the same sort of argument that is made for fitting home insulation or installing domestic solar panels.

So what is the current position in terms of smart-metering technology in practice?

Northern Ireland

Northern Ireland Electricity (NIE) was faced with the challenge of replacing some 80,000 prepayment meters. NIE wanted to encourage greater use of prepayment meters to address customer-debt issues, and so chose replacement technology based on a meter with a separate customer interface unit.

The result was that NIE now has 175,000 prepayment customers out of a total of 700,000 customers. This is having a beneficial effect on debt management and cash flow, and the meters are proving to be popular with customers—especially as the company has been able to offer customers a 2.5 percent reduction in charges.

Consumption has been reduced by 2 to 3 percent, and the new tariff has opened up the possibility for three different tariffs that have the potential to affect customer behavior by managing load to avoid times of higher charges. Environmental benefits of this are

significant in Ireland, where peaks are often met by bringing in less environmentally friendly generations.

According to Energywatch, “NIE has not identified any significant degree of self disconnection and indeed has been able to tailor the use of extended credit to help groups such as one-parent families.”

Ontario

The Ontario Energy Board (OEB) has introduced a requirement for electricity companies to introduce a basic smart-metering system to measure how much electricity a customer uses each hour of the day.

Through wireless technology, data is transferred daily to the local electricity distributor who is then able to use the data to charge customers on the basis of the times when the electricity was actually consumed. The intention is for customers to have access to consumption data by telephone or Internet the following day.

The OEB has said that the optimal smart-metering system will vary “according to factors such as customer density and geography.” Systems adopted must be based on two-way communications with an open network interface at the connection to the wide area network, in order to improve interoperability.

The OEB anticipates that retailers and other energy services companies will be able to offer “enhanced services for a fee to those customers who desire extra functionality as it becomes available on these systems.”

Enhanced functions could include customer display, integration with load control systems, interface to smart thermostats, voltage monitoring, earlier payment, load limiting and remote cut-off.

The Ontario implementation plan projects that all new and existing customers of licensed distributors in Ontario—residential and small commercial—will have some type of smart meter by 2010. The OEB says it “intends to introduce a regulated price plan for residential customers with smart meters, with prices which vary according to time of use.”

The capital and operating costs of the smart-meter systems will be added to the distributors’ base rates and will be charged to customers. The costs of the old meters that are stranded can then be recovered. Overall, the exercise will cost \$2.3 billion, with each meter costing around \$600. Over a five-year period, this would add around \$10 a month to consumers’ bills.

The aspiration of the OEB is to use smart metering to affect customer behavior to the extent that it is able to phase out polluting coal-fired generation.

Enel, Italy

This is perhaps the highest profile rollout of smart metering to date. Italian electricity utility Enel began a program of smart-metering installation for all its 30 million customers in 2002.

Enel's expressed aim was to use smart metering to provide improved customer service by reducing metering errors and maintenance time, and by offering varied tariff structures with lower energy costs for off-peak consumption.

The system Enel chose to adopt was advanced automated meter management (AMM), which integrates metering, billing and contract management. By 2005, it had installed 30 million AMM meter systems.

Enel now claims to be able to respond to 98 percent of requests or complaints from customers within twenty-four hours. It can detect and repair outages more quickly, preventing revenue loss, and customers who consistently fail to pay their bills can have their electricity switched off or restricted, further mitigating losses to Enel.

Enel is now able to offer pricing and tariff structures that offer discounts for weekend and evening use, which will enable it to reduce peak loads. It also intends to use smart meters to sell "carbon neutral" power from its growing renewable generation capability to environment-minded customers.

Enel claims the meters will pay for themselves "within a few years," while customers are benefiting from lower prices. Enel is obliged by the regulator to return any savings it has accrued through demand reduction to customers. It now plans to install smart meters in other countries where it operates, notably Spain and Romania.

Sweden

Electricity utilities in Sweden have to introduce automatic meter reading for customers by 2009. A number of companies are active in pursuing AMM-type solutions, including mobile phone providers, such as Vodafone, which is working with meter manufacturer Actaris.

In 2004, Slovenian manufacturer Iskraemeco won a contract to provide more than 150,000 meters, including a complete system for remote meter reading.

British Gas Business

British Gas Business has begun to introduce a new range of products and services linked to smart meters. It now offers the technology for business customers to have their meters read remotely and gives them access to detailed usage information to enable them to monitor, control and plan their energy use.

It offers three levels of service: Smart Standard, which reports collected energy meter readings on a monthly basis; Smart Plus, which offers remote collection of meter readings, plus the use of an online energy management tool to review energy usage (electricity and gas); and Smart Frequent, with half-hourly electricity reads, next-day data availability, and hourly gas reads with weekly data analysis.

The tipping point—the EEC and European Legislation

The Energy Efficiency Commitment

The UK Government's Energy Efficiency Commitment (EEC) obliges all domestic electricity suppliers to save a total of 130 TWh of fuel-standardized lifetime-discounted energy benefits during the course of EEC 2 (2005-2008). This is the equivalent of 0.7 MtC of carbon emission savings by 2010.

Energywatch says that in 2005, 1.5million electricity meters and 1 million gas meters were replaced with smarter technology. This typically can result in a 5 percent reduction in consumption, which adds up to a reduction in annual carbon emissions equivalent to approximately 6 percent of the savings to be produced from EEC2.

European Legislation

European legislation is also working in favor of smarter metering. Article 13 of the European Commission's Energy Efficiency End User Directive contains proposals to ensure that consumers "are provided with competitively priced, individual meters that accurately reflect the customers' actual energy consumption and actual time of use."

From the UK, Energywatch "made representations to the commission supporting this clause with the proviso that the cost burden on consumers would be reasonable." This would mean that in the UK, instead of a nationwide meter-replacement program along the lines of the Italian model, smart meters would be installed during all replacement activities and for all new connections.

The spirit of the directive, in essence, is to make it easier for consumers to use information and price signals to change their behavior and so reduce consumption and costs.

The Measuring Instrument Directive provides a Europe-wide approach to the “standardization, accuracy and allowable tolerances” of ten different categories of measuring instruments, of which gas and electricity meters are two.

It is likely to result in higher tolerances for meters and greater levels of in-service monitoring of meters. Should some existing metering stock prove to be unacceptably inaccurate, it will give weight to the argument that metering stock needs improving.

Finally, the recently published European Green Paper on energy efficiency states: “There is a lack of effort to allow for consumers to understand the price of their energy consumption.

“A real-time metering system (so-called smart meters) could bring down consumption at times when the electricity price is high.”

Europe, then, is taking a more prominent role in an energy agenda, which aims to reduce consumers’ energy costs, promote energy efficient behaviors and assist vulnerable households.

Smart meters—the must haves

As the momentum builds, there may be pressure for a more closely defined pan-industry view of what a smart meter is. Currently, as we have seen, there is no universal idea of what a smart meter actually is, other than its principle function of measuring consumption.

However, there is a range of recognizable smart functions. They include:

- displaying and recording real-time information about energy consumption that is available immediately or remotely to energy suppliers and consumers;
- providing an easy-to-understand and prominent display unit, which includes costs in pounds and pence, an indication of low, medium and high use, a comparison with historic and average consumption patterns, and a function to allow data to be accessed via PC or mobile phone;
- allowing two-way communication between the energy supplier and the meter to make it possible to switch tariffs, or prepayment provisions, remotely;
- having an internal memory to store consumption information and patterns;
- exporting metering for micro generators;

- providing a demand-side management option, such as tariffs, which charge more at peak-demand times of the day and less for off-peak periods;
- monitoring of inactivity and, in gas, real-time monitoring of gas leaks and carbon-monoxide emissions;
- providing data to suppliers to ensure correct and timely bills, as well as information on patterns of use, including improved forecasting and wholesale purchase, and targeted advice on energy efficiency to customers.

This means that characteristics required of smart meters are probably a clear display, providing half-hourly, weekly or monthly information on consumption and cost; an internal memory to store the half-hourly data for at least a year; a communication facility (radio, phone, Internet or SMS) for two-way communications; and the ability to be upgraded—future-proofing to cope with domestic micro generation, for example.

Barriers in the UK

In a report last year, Energywatch suggested that there were three barriers and recommendations to the introduction of smart metering in the UK, which may well be applicable elsewhere.

It said, “Consumer churn raises the fear among suppliers of creating stranded assets. We therefore recommend a review of meter ownership arrangements, and the possibility of transferring this to distribution network operators and transporters in gas, as is the case in many other energy markets worldwide.” This would also overcome the interoperability issue but looks unlikely to happen.

Secondly: “The lack of any requirements for smart meters, or perceived benefits to any single agent in the energy industry, has seen the continuation of the installation of non-smart meters. We therefore recommend requiring that all new and replacement meters are capable of showing time-based consumption in terms of cost and kilowatt hours and of being read remotely.”

Finally: “Lack of common standards in terms of what such technology should include may have caused uncertainty. We therefore recommend the development of guidance and requirements for minimal standards, such as data transfer protocols.”

Energywatch called upon the government, Ofgem and the industry to deliver a pathway that might lead to the widespread adoption of smarter meters and smarter energy consumers. And they did—in the form of the soon-to-start UK demand management trials.

Rolling it out—the challenges in the field

If smart metering makes sense at all, then it makes sense to roll it out as widely as possible. Its benefits should be incrementally magnified if the roll out is as near universal as possible. But such a program of installation would present challenges in terms of workflow, skills, availability of assets, logistics and field force management.

A comprehensive smart-metering program across the UK would involve overcoming a number of hurdles.

1. Who would be responsible?

Depending first upon which part of the energy value chain owned the meter function, there would then be a question of how the work of sourcing meters, installing them, disposing of old meters efficiently, and then coordinating data functions would be handed out. Good contractor management is key here.

2. Where would the new meters be sourced?

It is important to establish the ability of manufacturers of proven smart-meter technologies to build and deliver equipment on time and on budget. This means tight supply chain management from the beginning.

3. How would the installation process be coordinated?

Rolling out a comprehensive smart-metering program would be akin to the conversion of Britain's millions of gas customers to North Sea Gas in the 1970s. It could be that undertaking an operation like this on a large scale, rather than on a replacement-only basis, as some advocate, would actually make the operation more efficient and easier to plan. Nevertheless, workflow planning and execution will need to be world-class in order to ensure that customers do not have their supplies interrupted. Customer expectations from this sort of operation are also, rightly, far higher than in the 1970s.

4. How could customer contact be as good as possible?

Positive dialogue with customers during a meter replacement program needs to be present. Anything less than first-class customer service could mean customers finding yet another reason to switch their suppliers. The potential for a meter replacement program to aggravate customers is there and must be addressed so that the customers feel they are getting an enhanced service, not a time consuming irritant.

5. How can the old meters be disposed of in a sustainable way?

Mountains of discarded electricity and gas meters could easily turn into a public-relations nightmare. Any replacement campaign needs to transparently show the old meter stock being disposed of in an environmentally friendly way—or being recycled elsewhere.

6. How can the field force's activities be coordinated in the most efficient manner?

Rows of vans clogging up streets, missed appointments, workers revisiting sites because of unfinished business—all are costly and can send an energy company's image and profits plummeting. Before, during and after installation, workforce management needs to be razor sharp.

7. Aftercare

Inevitably some customers will struggle with their smart meters. Some equipment may malfunction. An aftercare program must be in place and sustained for more than just a few weeks after smart meters are installed. This is especially relevant, since the correct functioning of the smart meter is even more important than it was for the older meter it replaced; customers and energy companies need to have a very high level of trust in the meters, since the readings will often be used to charge for electricity, using time-varying tariffs. This trust will only be achieved by a combination of ensuring meticulous and complete installation with clear explanations, transparent billing mechanisms, and fast and knowledgeable service.

8. Data capture

A smart meter is of little use if the data it captures is mishandled, both at the energy company and customer end. Investments in data capture and use at the energy company's end must match investment in the meters themselves. And, investment in showing customers how to get the best use from their smart meters is essential too. A further use of data capture would be to identify evidence of failures or inefficiencies anywhere along the chain of electricity supply, and rapidly dispatch maintenance teams to the site of the most likely cause.

Conclusion: the UK trials—the way ahead?

As we have mentioned above, the DTI and Ofgem have called for the establishment of a number of demand-management trials across Britain, most of which will include a smart-metering component.

A key driver behind the trials is energy efficiency and behavioral change to reduce consumption with both an environmental and fuel-poverty benefit. The three-year period of the trials should provide enough data to demonstrate whether customers change their behavior or whether they reduce consumption initially and then lapse over time back to old habits.

From the industry's point of view, the trials will be good opportunities to examine different smart-metering capabilities and technologies, and the crucial data management issues that lie beyond the meter itself.

A decade and a half ago, water meters were trialed in a similar way, amid much skepticism, where there were but a handful of metered water customers. Today, in some of the more water-scarce parts of England, water-meter ownership is very high.

Today, the number of smart electricity and gas meters across the world, with exceptions like Italy and Sweden and parts of the US, is not high. But in the UK, before the three years are up, there could well be indications from the trials that with benefits to electricity companies, customers and the environment, smart metering is indeed an idea whose time has come.



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