# Fundamental



CURRENT THINKING ON...

# Smart meters

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Smart metering, though first proposed in the 1970s, has only come to prominence during the past decade. A reduction in the cost of the technology and the need to reduce carbon emissions have converged to make a viable business case. Commercial interest has now reached the point at which present and future investment in smart metering in the European Union has been estimated at €51bn, with potential financial benefits ranging from €14bn to €67bn.

In December 2009, the UK Department for Energy and Climate Change (DECC) announced its intention to roll out smart meters, accompanied by real-time displays, to all UK householders by 2020. This would impact on all domestic gas and electricity smart meters and will be rolled out by energy suppliers to every home in Britain by the end of 2020. This programme would also include small to medium enterprises (SMEs).

The main drivers for the roll-out are:

- **accurate meter readings as the energy company can read the meter remotely.** This means precise bills and an end to estimated meter readings and matching of direct debit payments to use;
- **lower bills.** Utilities will be more efficient and will be able to share with the consumer the reduction in customer service overheads and operation cost;
- **better knowledge of power outages.** The meter will tell the utility when the power fails. More importantly, the utility will know if power has not been restored to remote consumers when a fault is fixed;



- **the consumer can monitor the energy use of individual appliances.** This will provide an understanding of efficiency and allow optimisation of use or indicate if a more energy-efficient appliance would be beneficial;
- **energy generated from embedded sources such as wind or solar power presents an opportunity to sell surplus energy back to the grid.** This will allow the networks and the end consumer to better optimise the use of photovoltaic, wind turbines and micro-CHP;
- **flexible tariffs.** Utilities will be able to dynamically change the cost of electricity or gas at certain times of the day to match with the demand. Consumers will be able to alter their power use to match the lower tariff periods and life style.

To achieve a national roll-out is estimated that around 26m electricity and 22m gas meters will need to be changed to these new meters at a total cost of £7bn.

Large businesses will have an accelerated programme and have smart meters within five years. By any measure this is a major deployment programme with significant logistical challenges and only matched in the past by the roll-out of natural gas.

Some countries are already using smart meters. In Italy and Sweden the majority of homes already have one. The UK government believes we could all save around 5 per cent of our energy use. The savings come from the belief that changing behaviour patterns of consumers will decrease absolute demand, smooth demand peaks and cut emissions. In reality, not one kWh of energy will be saved by installing smart meters alone - it is only when consumers start engaging with their smart meters and modifying their consumption patterns that the energy efficiency goals of smart metering will be met.

## Confusion over purpose

A discussion of smart metering is often accompanied by a good deal of confusion about purpose and functionality, so it is necessary to start with a basic definition. First, they are the next generation of electricity or gas meters and are very different from the old-style dumb electromechanical meter (Ferraris electricity) which was invented in 1888.

The measurement means is electronic and they include a means of wide area network (WAN) communications. The WAN allows the meters to transmit and receive data to and from the energy supplier. Rather than providing a simple local summated reading they record multiple values such as four-quadrant energy and log data to a 30-minute interval.

It is not always necessary to replace a meter in order to achieve smartness. A 'dumb' meter can be 'smarted' by retrofitting it with communications capability and this is a less expensive option, for comparable specification. This is case where a gas meter provides a 'pulse'. For a gas meter this is attractive as the gas pipe is left intact and a lower skill level is needed to fit

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the device (logger). With larger gas meters the retrofitted device must be ATEX approved i.e. intrinsically safe.

When used in the home the meters can provide benefits beyond the WAN. They can also provide a link to a local display via a home area network (HAN). The HAN is for the benefit of the consumer and can be linked to the next generation of domestic appliances. To be complete a domestic smart meter comprises these two parts: the meter(s), and local display or Integrated Home Display (IHD). Potentially, the IHD could also link water meters. However, although it is technically possible, linking together such disparate utilities is a challenge.

## Educate and inform

The overarching aim of smart metering is to reduce energy consumption and associated consumption of carbon based fuels.

The primary means will be to educate and inform the consumer regarding their immediate and overall power consumption. In addition, it will give an indication of cost and CO2 emissions, and comparisons of energy use on a daily, weekly or monthly basis. Smart meters, combined with the local display, will empower customers to make choices on how much energy they use.

On 27 July 2010, the Department of Energy and Climate Change (DECC) and Ofgem jointly published a prospectus containing proposals for the delivery of electricity and gas smart metering in the UK.

This covers both domestic households and small and medium non-domestic sites and represents the joint views of DECC and the Gas and Electricity Markets Authority (GEMA). It consults on proposals in the following areas:

- design requirements of the smart metering system;
- central communications and data management; and
- an approach to rollout.

The prospectus also sets out a proposed timeline for the development and confirmation of the technical specifications. Under the proposed staged implementation approach the current expectation is that the technical specification will be confirmed by winter 2011 and licence modifications with rollout targets will be introduced in 2012.

Some of the key proposals from the prospectus include:

- a staged approach to implementation. Suppliers must install smart meters ahead of a central data and communications entity being established;
- an examination of opportunities for realising more ambitious, but achievable targets for the rate at which suppliers must install smart meters;
- Ofgem to introduce a package of measures in spring 2011 to provide for the continued safeguarding of consumers' interests;
- possible interoperability measures to give suppliers the confidence to install smart meters and ensure consumers can continue to switch suppliers in a straightforward manner;
- consumers should be able to choose how their consumption data is used and by whom, except where data is required to fulfil regulated duties;
- standardisation and co-ordination to promote competition so that customers can easily switch supplier;
- the creation of innovative opportunities and incentives, offering customers the best products and services and delivering the programme as cost effectively as possible;
- in a customer's home or business, the metering system will be made up of smart meters for gas and electricity; a 'home area network' to communicate between devices; and 'wide area network' equipment for communicating to the supplier.
- suppliers will need to provide domestic consumers with an in-home display giving real-time information on energy consumption in an easily understandable form;
- create a new licensed entity that will procure and manage contracts for a range of service providers to deliver the required data and communications services.

## Specification for roll-out

The energy industry is now fully engaged in defining the detailed specification and planning for roll-out. A number of stakeholders from industry are in the process of defining the detailed technical functional requirements document and means to collect and manage data.

DECC has divided the smart metering roll-out into domestic and smaller non-domestic sites – (electricity profile class 3 and 4 and non-domestic gas sites with consumption less than 732MWh per annum). However, the situation is not as simple as this and a number of stakeholders believe the thresholds are not logical and divide the market in an irrational way.




Larger organisations, particularly public sector organisations such as hospital, universities and local authorities that have grown their estates over many years, often have a mix of large utility supply points and a plethora of smaller supply points some of which are at small domestic level, for example, staff residence etc.

Although the term smart metering has been adopted by DECC in the commercial and industrial market, automatic reading of the meter is already a major tool to assist management of utility consumption and therefore carbon. When any utility meter (gas, water electricity, oil etc.) is automatically read and the data analysed a dumb meter effectively turns from an instrument for fiscal supply management into an essential tool for carbon management. The crossover between domestic and SME is grey area. Unfortunately, there is no simple solution and a lot of debate about where the thresholds should be.

## Awareness of price

It is intended that the data from the local in home display (IHD) makes the consumer much more aware of the price of their electricity or gas motivating them to take measures to cut their usage, for instance switching loads when not in use, installing better insulation and improving energy controls such as thermostats and timers. The average consumer is expected to save energy and thus reduce their bill by £25 to £35 per year. How well such displays perform will depend on how successfully they engage and maintain the interest of consumer. The potential for engagement will depend on the ability of the IHD to provide meaningful and useful information to the householders on consumption in real time and over time.

Nearly 4m British households currently suffer fuel poverty. With steeply rising energy prices, this number is likely to increase. Fuel poverty means being forced to spend more than 10 per cent of household income simply to keep warm. The UK specification for smart meters includes a requirement for functions to support the almost 6m households on prepayment meters. These include ways to

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add credit; costs, prices and tariffs for prepayment; and options for reducing self-disconnection.

Several mobile phone operators are interested in offering a service under which prepay users could transfer credit from phones to an electricity or gas account at supermarkets or through services such as Paypoint and Payzone.

Clearly this means all meters will need to include a means to disconnect the supply of gas or electricity. For non-prepayment, direct debit consumers, this could be an issue.

The secondary approach to energy reduction will be by using the data from smart meters to link to a smart grid.

## Intelligent integration

A smart grid is an electricity network that can intelligently integrate the actions of all users connected to it including generators, consumers to efficiently deliver a sustainable, efficient and secure supply of energy. To reduce dependence of fossil fuels there is a need to transform the electricity network, the way power is generated and how we consume electricity. Collectively this is known as demand side management. Demand side management refers to actions taken to reduce the energy demand by end users, for instance by increasing the price of electricity during periods of peak demand, energy efficiency measures, and using automated control of appliances such as fridges or charging electric vehicles when demand is low.

A smart grid, together with other elements of the new electricity system, such as smart meters, micro-generation of electricity by individuals and businesses, smart appliances and electric vehicles, will also offer consumers a whole set of new opportunities for greater control over and choice in how they use electricity.

The DECC/OFGEM prospectus outlines the development of meter standardisation and in particular a common open interface to meters as fundamentals to the Smart Metering Implementation Programme. The aim is to use open standards where possible.




## Meter Data - Open Standards

The most likely candidate for the meter is Device Language Message Specification (DLMS) a suite of standards developed and maintained by the DLMS User Association and has been co-opted by the IEC TC13 WG14 into the IEC 62056 series of standards. Along with COSEM or Companion Specification for Energy Metering DLMS/COSEM together form a common language so that meter manufacturers and users can extract and understand the data available from meters.

DLMS is managed by a user association and manages the standard as defined into a set of three specification documents: Green Book, Yellow Book and Blue Book. These are available from their web site (www.dlms.com).

## Wide Area Network

The WAN is essential and transmits meter reads to the utility or DCC. The most likely contender for the WAN is GPRS. This has the benefit of near ubiquitous coverage. However, it is not complete and for smart meters to be successful, every home must be included. In other countries the WAN has been fulfilled by dedicated radio networks or power line communication.

## Home Area Networks (HAN)

A home network or home area network (HAN) is a key part of the smart meter proposition. Simply, it is a residential local area network forming a domestic communication hub that links the smart meter and smart appliances. The HAN also allows remote communication with the head end system via a wide area network (WAN) for potential remote control of these appliances.

Integration of smart meters in the HAN provides for remote load control over multiple in-home enhanced appliances such as smart thermostats, energy displays, appliances and home management.

HAN connectivity is a key attribute for smart meters, but it comes with concerns for interoperability and open standards.

The assumption is the local communication will be low power radio using ZigBee (2.4GHz). This is a popular wireless mesh networking standard for connecting sensors, actuators, instrumentation and control systems. Zigbee works by "meshing" the devices. Because nodes in a mesh network naturally forward transmissions from more distant nodes, a mesh network will enable data to be transmitted over a much longer range than possible with a single point-to-point link as long as intermediate nodes are deployed along the way.

At this time there is some debate if ZigBee will work in all applications and trials are scheduled to take place to prove reliability in a range of domestic scenarios. The IHD is a fundamental part of the smart meter and if connection between the IHD and meter fails, then a key benefit to the consumer will be lost.

## Data Central Communications

The big question still to be resolved is who will run the network controlling the meters and what will this network actually look like? Will it be fixed line, wireless or a mixture of both?

Currently, the proposal is the data and communications will be the responsibility of a new industry-backed central communications body that will be established to handle all the meter reading data. The assumption is that the body will be appointed to the unique role of procurement and contract management for a predetermined time period. It will then be the role of this organisation to competitively procure the services needed to fulfil its role.

The success of smart meters will depend on acceptance by the domestic user. The cost of rollout is high and will ultimately be paid for by the energy consumer. In return, the consumer will expect to see a saving. But the savings and benefits will require consumers to change life style.

There are many issues still to be resolved regarding the smart grid –will it work, who will manage it and where will the savings come from? Will we move to electric vehicles and will there be a large-scale move to embedded generation?

Clearly there are many benefits to be gained from larger users using remote meter reading and such systems are already in operation today.

Only time will tell if the wide-scale investment in domestic smart meters is worthwhile.

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***Energy in Buildings and Industry*** and the Energy Institute are delighted to have teamed up to bring you this Continuing Professional Development initiative.

This is the seventh of ten modules in the eighth series and focuses on smart meters. It is accompanied by a set of multiple-choice questions. To qualify for a CPD certificate readers must submit at least eight of the ten sets of questions from this series of modules to ***Energy in Buildings and Industry*** for the Energy Institute to mark. Anyone achieving at least eight out of ten correct answers on eight separate articles qualifies for an Energy Institute CPD certificate. This can be obtained, on successful completion of the course and notification by the Energy Institute, for a fee of £15 (for members) or £25 (for non-members).

The articles, written by a qualified member of the Energy Institute, will appeal to those new to energy management and those with more experience of the subject. This new series of modules will run until the April 2011 issue.

The modules in the coming months will focus on: air conditioning; LEDs; and power quality. Should you miss any of the modules please let EiBI know (mark.thrower@btinternet.com) and we will send you the missing modules in 'pdf' format to you either by e-mail or on a CD. So far, the modules in the series focused on the CRC Energy Efficiency Commitment, insulation, heat pumps, training for energy management, district heating, and fuel cells.

The previous 70 modules from the first seven series are also available free of charge on CD.

**MARK THROWER, MANAGING EDITOR**

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Completed answers should be mailed to:

**The Education Department, Energy in Buildings & Industry, P. O. Box 825, GUILDFORD, GU4 8WQ**

## SERIES 8 MODULE 7: QUESTIONS

## Smart Meters

Please mark your answers on the sheet below by placing a cross in the box next to the correct answer. Only mark one box for each question. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet in ink, return it to the address below. Photocopies are acceptable.

**1 What is a smart grid?**

- ☐ A gas network
- ☐ An electricity network that can intelligently integrate the actions of all users
- ☐ A generator
- ☐ A supplier

**2. How much energy do governments believe smart meters will save?**

☐ 20 per cent ☐ 2 per cent ☐ 5 per cent ☐ -10 per cent

**3. What is the interval data period?**

☐ 10 minutes ☐ 30 minutes ☐ 1Ð hours ☐ 1 day

**4. What is the expected saving for a consumer?**

☐ £100-200 ☐ £5-10 ☐ £25-35 ☐ £50-100

**5. What is the threshold for large gas sites?**

- ☐ 273 kWh per annum
- ☐ 100kWh per annum
- ☐ 732MWh per annum
- ☐ 1,000MWh per annum

**6. What is a HAN?**

- ☐ Home Area Network
- ☐ Home Automation Node
- ☐ Empire from 206 B.C.
- ☐ A character from Star Wars

**7. What is a DCC?**

- ☐ A place in America
- ☐ Data Central Communications
- ☐ Direct Connected Centre
- ☐ Digital Concentric Community

**8. What is ZigBee?**

- ☐ A type of insect
- ☐ A person managing smart meters
- ☐ An open radio standard
- ☐ A name for a smart meter

**9. What does DLMS stand for?**

- ☐ Data Line Medium Specified
- ☐ Demand Limit Medium Specify
- ☐ Device Language Message Specification*
- ☐ Distribution Line Message Specification

**10. How many British households currently suffer 'fuel poverty'?**

☐ Nearly 4m ☐ 100,000 ☐ 1m ☐ 10,000