



HORSTMANN



Smart Energy Metering

In the residential market will ***User Interaction*** be enough to deliver major changes in consumption, or is *Automation* the key?

A White Paper from Horstmann Controls Limited and Digital Living Limited

Authors:
Dr Mike Patterson
Business Development Manager
Digital Living Limited
mikep@digitalliving.ltd.uk
www.digitalliving.ltd.uk

And

Andrew Deeming
Director of Engineering
Horstmann Controls Limited
adeeming@horstmann.co.uk
www.horstmann.co.uk

What's New in Energy Metering?

With volatile prices and uncertain long-term supply options, energy is now very much on the front burner.

In July 2006 the UK government published the conclusions from its major review of energy, which tackled the two major long-term energy challenges of climate change and the delivery of secure, clean energy at affordable prices, as the UK becomes increasingly dependent on imports for its energy needs. Measures that affect consumer behaviour are one of the topics that will be addressed by the implementation phase of the report.

Significantly, in December 2005 the European Parliament had passed the "Energy End-Use Efficiency and Energy Services Directive", so creating a new law mandating better standards of metering throughout the European Union.

This new directive requires meters and systems to measure accurately and frequently, customers' actual energy consumption, providing billing that is informative, sufficiently frequent and based on actual energy consumption as opposed to estimated readings. The Directive also imposes a general energy end-use savings target of 1% per year for nine years (2008-2017), with the overall target of 9% being met by the ninth year.

The impending implementation of the directive in the UK has created the impetus for industry investments. Additionally, Ofgem has proposed that energy suppliers need to be more innovative and rise to the challenge of delivering smarter meters that meet their individual customers' needs.

Hence, energy sales companies in the UK are presently considering how best to ensure that their customers are offered competitively priced metering and billing systems, to help them manage their energy usage.

What is the particular challenge for the UK Energy Sector?

Britain has a uniquely dynamic competitive market in gas and electricity, which, coupled with the fragmented ownership and operational structure of the UK gas and electricity infrastructure, makes the economic case for Automated Meter Reading (AMR) much less viable than in countries such as Italy, where there is vertical integration in customer and asset ownership/operation.

Also, the costs of meter reading are highly dependent on the legal requirements for frequency, and it remains the case that manual readings can still be economic where cheap labour is available to carry out this task, whether this be manual recording of data or facilitated in part by mobile wireless technology.

Critically, there is a need for industry agreements and standards of interoperability to ensure that assets and services are sustainable, and meter assets are not stranded by customer switching. The introduction of smart metering would require a significant change to the existing metering infrastructure and substantial investment to support sustainability.

What are the supplier benefits of Smart Metering?

Smart metering has been introduced overseas in order to reduce peak consumption, improve revenue management and limit non-technical losses. It provides highly accurate data that can be collected and analysed to inform suppliers about consumer needs. The potential to allow energy to be imported and exported to the grid, as required by renewable energy or other distributed domestic local generation, can be catered for by smart metering arrangements.

Using mobile telephony technology for example, advances in smart metering have improved functionality and the cost of data collection has been reduced. This is evident in the UK energy sector in the half hourly metering market and the same benefits could be achieved elsewhere in the energy market.

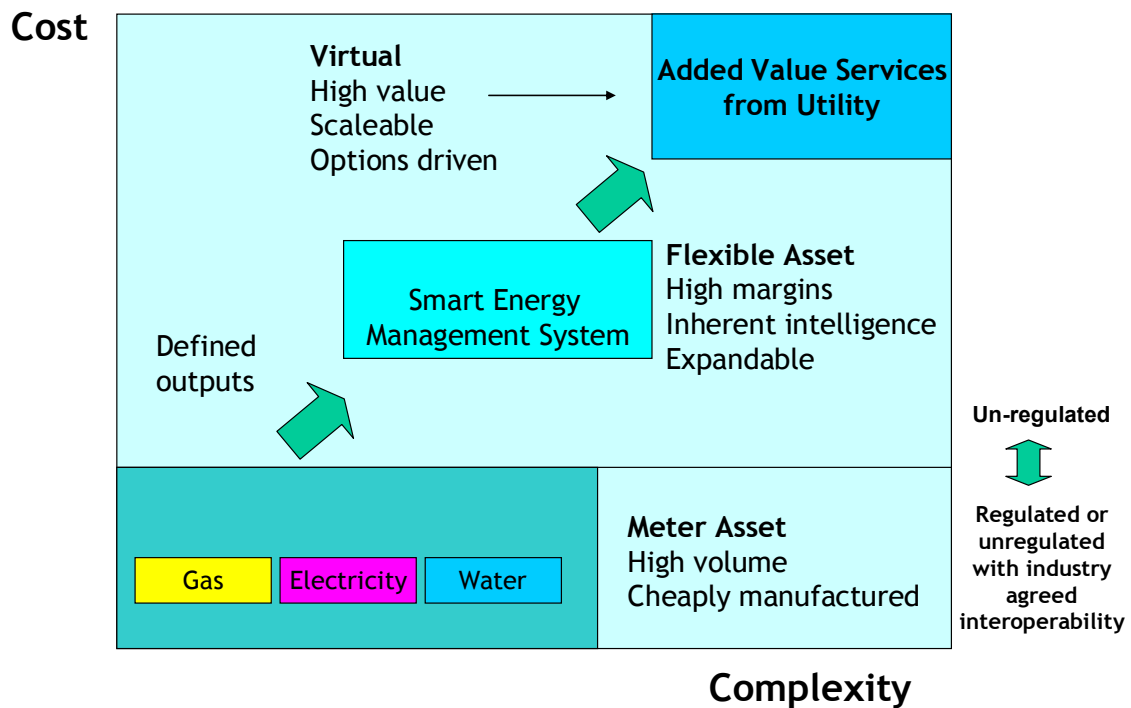


Figure 1: The future of Smart Metering?

What are the consumer benefits of Smart Metering?

Even though today's smart metering systems would eliminate estimated electricity and gas bills, for the reasons explained earlier, there has been minimal sector investment in modern metering. However, smart metering offers considerable benefits to consumers, benefits which are not part of the asset financing consideration.

Automatic meter reading (AMR) would allow greater accuracy of readings. When switching household energy provider, accurate and timely consumption data can be made available to the incumbent supplier to determine the correct charge to be made to the consumer, thus avoiding incorrect bills and lengthy delays to billing settlements.

There is a significant body of evidence that demonstrates that consumers' behaviour can change when they are regularly made aware of the amount, and in particular the cost, of energy they consume. Hence, another consumer benefit of smart metering is to have details of their energy usage provided to them in real time, thus enabling them to make informed choices as to which energy efficiency measure to take, and measure the resultant financial impact. Also, by understanding how consumption is affected by their behaviour, consumers can manage their household energy budgets much better.

But will consumers continue to monitor and adjust their consumption after the initial effort has been made? Can automation bring sustainable benefits to each householder without the need for constant intervention and manual monitoring? This is a key area of development for both Horstmann Controls and Digital Living and the trials work already conducted is indicating that the automation of certain functions and the inclusion of technologies such as wireless and mobile technologies, provide the key to achieving long-term savings and consumer acceptance.

What makes a Meter Smart?

Although there is no universal definition of a 'smart' meter, according to the consumer group Energywatch, the following functions are desirable:

- Display and record real time information on energy consumption that is available immediately or remotely to energy suppliers and consumers;
- Easy to understand, prominent display unit which includes:
 - Costs in £/p,
 - Indicator of low/medium/high use,
 - Comparison with historic/average consumption patterns,
 - Functions to allow data access via PCs, mobile phones,

- Two-way communication between energy suppliers and the meter to make it possible to switch tariffs, or pay as you go (pre-payment) provisions remotely;
- An internal memory to store consumption information and patterns;
- Export metering for micro-generators;
- Demand-side management options, such as tariffs which charge more at peak-demand times of the day and less for off-peak times;
- Inactivity monitoring and, in gas, real time monitoring of gas leaks and carbon monoxide emissions; and
- Provide data to suppliers to ensure:
 - Correct and timely bills;
 - Information on patterns of use – improving forecasting and wholesale purchase;
 - Targeted advice of efficiency measures to customers.

The Smart meter will need a two-way communication facility allowing the half-hourly consumption data to be sent to suppliers and consumers, by powerline, radio, phone, internet or SMS.

Smart Metering from Horstmann and Digital Living

Horstmann and Digital Living have collaborated closely over the course of 2005/6 to develop a novel Smart Energy Management System for homes and small commercial organisations. The system utilises state-of-the-art Horstmann metering products to provide a unique system that can be tailored to a broad number of applications. The system has been installed in two occupied demonstration homes in Leicestershire and Oxfordshire, where it has been under soak test and gathering rich streams of consumer behavioural data for over 9 months.

Installed in each home as the core of the system is a flexible gateway, a proprietary commercial device that is used as the vehicle to demonstrate the potential of smart metering and also to show how it is possible to integrate metering with other devices that provides a holistic approach to energy management. The gateway connects together devices such as fiscal electricity, gas and water meters, mini meters for white and brown goods, security and alarm systems, lighting systems, central heating boiler condition sensors, space temperature sensors, etc. The potential for such a system to monitor and then control energy usage is enormous.

Communications to the gateway are via a server, through either a Broadband or GSM connection providing half hourly consumption and electricity meter register data, as well as specified status and fault conditions. The technical architecture for the system is illustrated below.

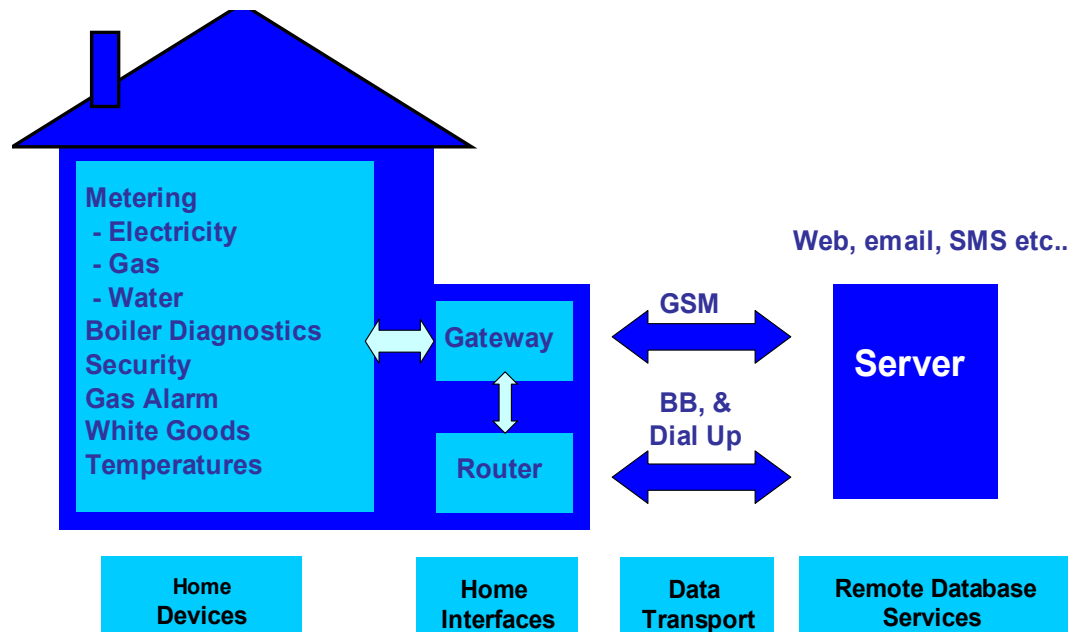


Figure 2: The Smart Energy Management Technical Architecture

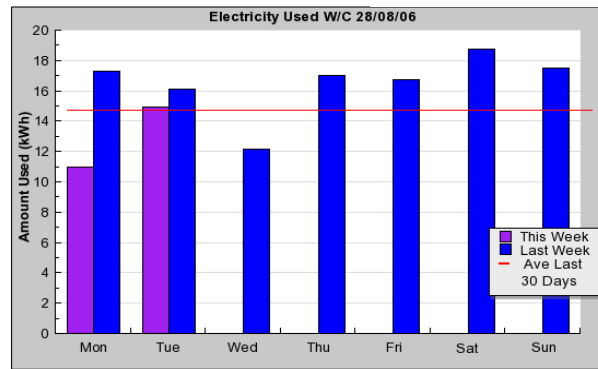
A differentiating element of the system is the Horstmann mini-meter for monitoring the consumption of plug-in appliances in the home, a unique feature. This facility enables the detailed usage of white and brown goods in the home to be profiled. Power Line Carrier (PLC) communications within the home are used to connect the fiscal electricity meter and mini-meters (White Goods Monitors) to the gateway. In the future, wireless technologies offering cheaper and more simplified connections will increase the appeal of integrated solution.

Data polled by the server is stored in either an SQL or Oracle database and a back-end system may be tailored according to the needs of the client. The customer interface is designed to be as simple as possible whilst incorporating as many as the desired Smart Metering features as possible. An example screen is shown below and further work is being conducted to establish the optimum ways of engaging consumers and providing what they need, where they need it and at the right time.

Units Used	25.94 kWh
Meter Reading	736.32
Estimated Cost for The Week	£7.00
Saving from Last Week	£0.57
CO2 Emission	13.10kg

Daily Electricity Use

Monthly Electricity Use



Units Used (kWh)	Average Day	Lowest Day	Highest Day
This Week	12.97	10.99	14.95
Last Week	16.52	12.18	18.78
Last 30 Days	14.72	10.40	20.43

Figure 3: User Interface

For practitioners, a much more detailed interface can be provided to allow monitoring of many thousands of end points and to produce performance graphs, estimate of costs, trends, etc. for single, multiple or groups of buildings. Some example screens are shown in the research section, which follows.

This novel system from Horstmann and Digital Living as the potential to provide detailed information to energy suppliers and consumers, as well as paving the way for innovative tariff options, including 'pay as you go' and time-of-use.

Smart Metering as a research tool

Between February and May 2006, detailed consumption research was conducted over the web for Digital Living by an MSc student at Heriot-Watt University. Using the SEMS system as a tool to analyse the energy usage of one of the trial homes, he concluded that:

- Defrosting a fridge freezer can save over 10% of its electricity consumption or about £10 per annum. More significantly, reducing the ambient air temperature by 4°C can have a more significant impact, saving more £22 per annum. Hence, the modern practice of building refrigerators and freezers into fitted kitchen cabinets requires adequate ventilation to avoid a massive deterioration in efficiency.
- Switching off a new digital television set left on stand-by can save typically between 35% and 55% of its electricity consumption, with annual savings of up to £14.

- Combination gas boilers that have a hot water pre-heat facility can waste 4.5 times more primary energy than a new digital television set on stand-by.

The SEMS system will be utilised by another University for a remote energy management project during 2007 to 2010 and installed in many homes to gather further data into appliance usage across a broad spectrum of appliances.

The Way Ahead?

The soon to start Smart Metering trials being conducted in the UK will address many things but primarily whether consumer behaviours will bring about a lowering of domestic energy usage, through providing the consumer with information on their consumption. This might be through more information on the bill, or through some form of monitor at a convenient point in the home. When the trials report it may conclude that more information does not sufficiently influence the consumer to reduce energy and a major deployment of Smart Metering will not be supported by the government. It may also conclude that Smart Metering is the way forward and a major rollout plan initiated by suppliers who are already building plans to ensure interoperability.

Horstmann Controls and Digital Living are providing a look into the future today by developing connectivity within the home and connectivity to/from the home to provide sustainable energy efficiency in a way that consumers in the second decade of the 21st century will expect. But the technologies and systems being developed are not just for those that own PCs at home or are major consumers. They can equally be implemented to assist the fuel poor and to help all stakeholders in the energy supply chain ensure they are best placed to manage energy on behalf of their customers and for the benefit of their shareholders and communities.