Smart Metering

The next step in implementation

INFORMATION PAPER

CER/07/198

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1. Introduction

1.1. Previous consultation

Earlier in 2007 the Commission for Energy Regulation (the Commission) published[1] a consultation paper entitled "Demand Side Management & Smart Metering". The paper considered measures that would encourage residential and SME customers to use electricity more efficiently and thus reduce their energy costs and emissions to the environment. The consultation paper looked specifically at the prospects for introducing time of use tariffs as a measure to change customer behaviour. The role smart meters could play in the introduction of time of use tariffs was considered together with other benefits a smart metering system could bring. The consultation paper contemplated the cost and benefits of a smart metering programme albeit principally on a qualitative basis.

Comments were sought on the general matters raised in the paper but also on eight specific questions that related mainly to the consequence of changes in customer behaviour that could flow from the introduction of time of use tariffs. Twenty one submissions were received from interested parties. Their responses to the specific questions raised are summarised below.

1.2. Purpose of paper

This paper starts from the position that smart metering is an inevitable technological development. However, the technology could be utilised in many different ways by different parts of the electricity supply chain. In particular benefits could emerge for network owners in their metering of supplies and their management of the distribution system, the operation of supply businesses through a capability to reduce debt and manage demand, an impact on customer usage that makes the operation of generation and networks more efficient, and furthering government policies for reducing emissions. There may also be opportunities for the incorporation of other utilities once a smart metering platform has been established. Currently the manner in which these possibilities interact to maximise the economic benefit for the customer remains unclear.

In addition to reviewing the responses to the previous consultation this paper proposes a framework in which the future scope of smart metering arrangements that will replace conventional electro-mechanical metering can be established. The framework is intended to permit the various potential applications and their interactions to be investigated so as to establish the boundaries that should be placed on the functionality required of any system. In this context the project will serve to structure a project on which technical and system developments that are optimal in the context of the Irish electricity market can be developed, and the prospects for incorporating gas metering and potentially measurements for other areas to be explored.

[1] CER/07/038

2. Background

2.1. Technical background

Smart meters are a modern system of metering that has the potential to change significantly the way in which many of the activities of electricity supply are undertaken. The metering can include a range of functions and capabilities including:

- Display and recording of real time information
- An internal memory that will store previous patterns of consumption and allow trends and comparisons to be discerned
- Distinguish between the import and export of electricity
- Undertake two-way communication with a central processor that would permit the use of the data for billing and other purposes, such as risk management
- Receive instructions to switch designated circuits, or all supplies to premises.

Smart metering needs to be viewed as a system rather than a single device. Many of the benefits that are attributed to smart meters will require not only measurement and collection of data but also the ability to access, process, store, and retrieve that data. Thus in considering the adoption of smart meters the limitations of other systems in the value chain need to be taken into account in determining the functionality that can be ultimately utilised.

2.2. Energy efficiency

It has been estimated that EU energy consumption is around 20% higher than can be justified on economic grounds. This has led to the view that there is a large potential for unrealised economic energy savings which can be realised through energy services and other end-use efficiency measures. In pursuit of this objective the European Commission adopted EU Directive EC 2006/32 on 5th April 2006. Article 13 of this Directive requires that where technically possible and prospectively economic, energy metering should record the time of use and customer billing should be sufficiently comprehensive so as to enable the self regulation of energy consumption. The Directive came into force on 17th May 2006 and must be implemented by Member States by 17th May 2008.

Smart metering is believed to be one technology whereby end-use energy efficiency can be encouraged, and thus emissions of greenhouse gases reduced as a measure to combat climate change. In the UK preliminary trials by the Carbon Trust indicated that making small businesses aware of the time of day energy costs produced a 7% reduction in carbon emissions as customers reduced their consumption of electricity. The recent UK Energy White Paper has proposed that smart meters should be provided to all but the smallest businesses over the next 5 years as a means of further reducing CO_2 emissions.

In Ireland, the Agreed Programme for Government refers to the installation of smart meters in every house in the country over the next five years.

3. Commission Decision

The Irish retail electricity market can exploit its unified approach in the provision of meters and the processing of metered data. Compared with some other electricity markets it thus offers better prospects of devising an optimal functionality for a smart metering implementation programme.

3.1. Commission's Decision

The Commission has decided to work with ESB Networks, suppliers and other stakeholders in structuring and implementing the role out of an optimally designed universal smart metering programme that will embrace all aspects of smart metering relevant to the Irish electricity market. The functionality required by different parts of the market, and the benefits that will arise are likely to be different in each sector of the energy market. The Commission has also decided that micro-generators will be included in the assessment of the optimal design of a smart meter and its attendant processes (albeit the infrastructure for gathering their data may not be fully established).

3.2. Governance of programme

The Commission believes that the project should draw on the experience and expertise of a working group that embraces all stake-holders in the electricity and gas markets. The working group will operate under the direction of a steering group comprising:

- The Commission for Energy Regulation
- ESB Networks
- Department of Communication, Energy and Natural Resources
- SEI

The Steering Group will be chaired by the Commission. The working group will be an inclusive body but as a minimum it will contain representatives from:

- Commission for Energy Regulation
- ESB Networks
- Department of Communication, Energy and Natural Resources
- Sustainable Energy Ireland (SEI)
- ESB Customer Supply
- Independent Suppliers
- Bord Gáis Network Metering
- Customer groups
- Microgeneration representatives

Again, the working group will be chaired by the Commission.

The working group will undertake specific investigations and studies into all aspects that could be associated with the technology, technical feasibility, supporting systems and customer behaviour, in order to justify the appropriate approach to adopt, and assist implementation. The Working Group will develop position papers for consideration by the Steering Group. It is the role of the steering group to indicate those areas where specific study or research are needed, make decisions on the various recommendations from the working group and to guide the progress of the project.

The scope of the working group studies will cover functionality associated with the design and operation of the metering and the collection of the data, the management of networks, the activities of the supply businesses, the provision of information to customers and their likely response; especially in the context of improved energy efficiency. The paragraphs below detail some, albeit not all, of the aspects that the working group would need to address.

3.3. Meter design and data retrieval

- **Meter design.** Currently there is no universally adopted specification for the design of a smart meter. The functionality that is required within the meter needs to be carefully defined including its capability for communication, local data storage and retrieval, and processing. The access to the meter (use of split terminal covers) will be a peculiar attribute of the Irish market.

- **Architecture.** The general configuration of the communication arrangements for gathering data recorded by a smart meter is for there to be local area network (LAN) over which data can be fed to a "concentrator" and then for a wireless network (WAN) to communicate data back to a central processor. Having gathered the data a number of possibilities then exist for how the processed information could be used by the supplier and returned to the customer. The most economic arrangement and technology for this general design will need to be identified and its application linked to particular geographic areas.

- **Meter testing.** Testing of candidate meters will need to be conducted to prove their capability and establish their performance prior to large scale roll out.

3.4. Network functionality

- **Remote meter reading.** An obvious attribute of a smart metering system is its ability to dispense with conventional meter reading practices. The recording and remote collection of interval consumption data presents an opportunity for its use for a variety of applications including the accommodation of import and export for micro generation installations.

- **Remote connection/disconnection**. The ability to allow electricity to be cut off or restored remotely would obviate need for visits by field staff. It may also be appropriate to contemplate functionality whereby supplies could be given at a reduced capacity which might support circumstances where there were debt collection problems.

- **Fault monitoring**. ESB Networks might also consider the prospects for detecting faults by monitoring the status of smart meters.

- **Theft**. Smart meters have the ability to be equipped with tamper detection facilities. Software that can detect abnormal trends in consumption would also be a functionality that would help prevent theft and measure losses more accurately.

- **Quality of supply measurement.** Smart meters could also be used to record outages and supply quality such as voltage abnormalities at different locations.

3.5. Supplier functionality

- **Time of Use tariffs**. Assessing the impact of time of use tariffs on customer behaviour will be a key requirement of this phase of the implementation plan. The ability of tariff design to impact customer behaviour is central to encouraging energy efficiency and reduced emissions. However, the effectiveness of tariff design in achieving this goal needs to be tested.

- **Meter displays.** Although often assumed, smart meters do not naturally provide a display of information to the customer. The nature of such displays and the information customers would find useful also requires further research. Local processing capability, such as the inclusion of tariff rates for individual suppliers, or the ability to calculate trends and predictions is a further area where there are a range of possibilities.

- **Pre-payment**. The replacement of credit with pre-payment arrangements could have a significant impact on the bad debts seen by suppliers and thus on the costs borne by all customers. Smart meters may offer opportunities for more frequent billing of customers and thus reduced periods of credit.

- **Control of local circuits.** The ability to energise and de-energise premises was included in the networks functionality, but the prospects for controlling individual circuits in a customer's premises might also be a functionality of use to a supplier. Under the Single Electricity Market suppliers will need to manage the risks of exposure to pool prices. Controlling customer load through agreed demand management arrangement could provide an economic method of managing an exposure to pool prices at times of high prices or in the event of an excursion in SMP.

- **Accuracy of billing.** Improvements in the use of measured rather than estimated data, and the accuracy of that data, should substantially reduce the level of queries and the need to re-bill customers. Quantification of the reduced load on call centres and the consequent lower billing costs would need to be explored to assess the benefit that would accrue from this aspect.

3.6. Other utilities

- ***Other Utilities.*** Once established a smart metering system would provide an obvious vehicle for extending the arrangements to other utilities. Gas metering would be an obvious addition but there may also be piggy-back applications in other areas such as the gas market and home security.

- ***Energy efficiency.*** The role smart meters can play an important role in improving the efficiency of electricity use through changes in customer behaviour in response to price. However, the introduction of smart metering could provide routes to improved energy use through a messaging capability or measurement of the efficiency with which various applications (e.g. water heating) were achieved.

- ***Reduced Emissions.*** Although usually construed as being capable of measuring energy use a smart meter system could display directly to customers the carbon footprint (CO_2 emissions) of various activities. This would be particularly the case if a system were designed to handle the measurement of both gas and electricity.

- ***Capacity Margins.*** Demand side effects are generally thought to be of use to energy suppliers but producers could also make use of such arrangements to shave peak demands or as a substitute for operating peaking plant with high variable costs. The prospects for this might also be assessed.

- ***Fuel poor and vulnerable customers.*** Smart metering could also provide information to social services that would enable the support of vulnerable customers, either through the provision of restricted supplies at times of financial hardship, or simply by monitoring the status of their supplies.

3.7. Timescales

ESB Networks has devised a project that is intended to identify the technological possibilities and prospects for creating a smart metering infrastructure. The Commission is now establishing the working and steering groups before the end of November 2007, and asking the working group to report on the scope of potential applications prior to the initiation of any smart

meters being installed by ESB Networks. The ESB Networks programme currently envisages the first meters being installed during April 2008. Accordingly the working group will be required to produce its initial views on the various application described above by the start of March 2008.

3.8. Summary

The above paragraphs have indicated that a smart metering programme has the potential to bring a wide range of prospective benefits to network operators (either as the owner of network assets or as a provider of metering system), supply businesses, customers, and government in the pursuit of wider policy objectives. The breadth of possibilities requires that the purpose of the first phase of any implementation programme is to identify the scope of functionality that is desirable for any system, and the speed with which it can be deployed. The identification of relevant timescales in this wider programme will need to take cognisance of the systems with which smart metering must integrate and the availability of the hardware and software that is seen as appropriate.

4. Consultation responses

4.1. Parties responding

The interested parties who responded to the consultation paper were

- Surface Power Technologies
- Smart Utility Meters (London)
- MW Consulting (Miami)
- Glen Dimplex Group
- AMPY Metering Ltd
- Bord Gáis Network Metering
- ZPA Smart Energy
- Bord Gáis Energy Supply
- Tochar Technology Ltd
- Gemserv
- Actaris Metering Systems
- Power and Gas Ventures Plc
- Airtricity
- ESB DSO
- Combat Poverty Agency
- ESB PES
- Sustainable Energy Ireland
- Eirgrid
- ESBIE
- Dublin Institute of Technology – Dept. of Electrical Services Engineering
- National Consumer Agency

Their comments on the specific questions raised are summarised below.

4.2. Introduction of 'Time of Day Prices'

Should attention be focussed on the development of time of day prices for domestic and small business customers? The Commission suggests that this form of pricing provides customers with the greatest opportunity to change the way in which they use electricity.

4.2.1. Respondents' comments

All respondents supported the development of time of day prices as a way of influencing end use. Concerns were raised over the lack of flexibility that certain vulnerable groups may face and the additional costs this could create. One respondent suggested that benefits from demand side management may disguise structural inefficiencies, whilst another raised the risks involved in creating a new tariff structure, which could lead to multiple peak periods being created and therefore additional costs added to the generation of power.

4.2.2. Commission's view

The Commission notes the support, in principle, for the introduction of time of day prices. The Commission intends to use the project framework it is proposing to explore a number of different tariff structures in order to establish an optimum structure that creates practical incentives for customers to manage their consumption in the most efficient manner. It is not thought that demand side management will impact generation security adversely. The project should reveal any prospective risks that arise from a new tariff structure creating multiple peaks in demand.

4.3. Price Differentials

Are customers sufficiently concerned about the cost of electricity to change their consumption patterns as suggested? What level of response is realistic? What price differentials are required for customers to change the way in which they use electricity?

4.3.1. Respondents' comments

The majority of respondents felt that customers are sufficiently concerned about their electricity costs to change their pattern of consumption but they need to see savings in their bills first. The need for customer education and a creative marketing campaign was emphasised in a number of the submissions.

One respondent highlighted the connection between customers concerns with energy consumption and the wider environmental impact. Despite this, some respondents indicated that the demand for electricity is price inelastic and significant price differentials will be required to change behaviour. Others noted that elasticities will vary for different consumer groups, such as those on low incomes. Vulnerable groups who are incapable of changing their consumption patterns would need to be protected from the impact of large price differentials.

Many respondents stated that any new tariff structure proposals should be cost reflective. Penal prices should be avoided since these would lead to economic rents for suppliers. However, one respondent suggested that cost reflective tariffs may not be sufficient to encourage demand reductions. A number of respondents thought that assessing a measure of price elasticity in Ireland would require a detailed study. One respondent was concerned that the erosion of price differentials after a successful redistribution of the electricity load would undermine the basis of any investment that a customer may have made in equipment to manage demand.

4.3.2. Commission's views

The consensus amongst respondents that customers are sufficiently sensitive to electricity prices to change their pattern of consumption provides a starting point for the introduction of time of use tariffs. The Commission believes that a

programme of education and marketing is a key aspect to the successful introduction of time of use tariffs.

If there is a levelling of demand as the result of a strong customer response to the introduction of a new tariff structure, then the tariff will subsequently adjust to reflect this. This scenario still results in savings for those who originally changed their pattern of consumption and these customers will be better placed to capture the benefits in any future evolution of the tariff structure either from their investment in adaptable devices or their flexibility in consumption.

Within the project framework a specific study could be used to establish the price elasticity of different customer groups, and explore demand reduction rates as part of the overall demand side management objectives.

4.4. Desktop Assumptions

Are the assumptions included in the Commission desk top analysis reasonable?

4.4.1. Respondents' comments

Respondents generally agreed with the assumptions behind the Commissions' desktop study. The lack of long term data from other smart metering programmes was noted by a number of respondents.

A number of respondents thought that other benefits had not been incorporated and the case for smart metering would be improved with their inclusion. Examples included improved outage management and better credit control by the Distribution System Operator. Others questioned the extent of the benefits in the area of theft, losses, and bad debt reduction, and emphasised the annual costs involved in running Smart Meters such as IT maintenance and data collection.

One respondent questioned the assumed savings in transmission costs that would arise from reduced demand since changing patterns of demand might actually require system reinforcement. There was a general view that more detailed analysis was needed to identify the net benefits of smart meters.

4.4.2. Commission's views

The Commission notes the broad agreement with the assumptions on which the desktop study was based. The identification of the additional benefits identified by respondents is helpful in the development any further studies.

4.5. Choice & phasing of 'Time of Day Tariffs'

Should customers have a choice of opting for a time of day tariffs or should they be mandatory? Should they be phased in over time or introduced in one go?

Should all suppliers in the market be required or encouraged to offer time of day prices to customers?

4.5.1. Respondents' comments

There was a dichotomy between respondents on the whether the introduction of time of use tariffs should be mandatory. The first view was that it would be inappropriate for the Commission to require independent suppliers to offer a certain type of tariff. Prices should be cost reflective and any distortion to this had the prospect of creating economic rents for the supplier. Generally both customers and suppliers should be able to exercise choice in the structure of their tariffs.

The alternative view was that time of use tariffs should be mandatory so as to support the case for a roll-out of smart meters. It was noted that a mandatory approach would provide a level playing field for competition amongst suppliers remove barriers to entry to the market that might otherwise exist. One respondent thought that it may be necessary to provide support for vulnerable customers if time of use pricing were universal.

Respondents felt that the phasing-in period should be as short as possible so as to minimise the costs of operating parallel systems, although the phasing-in period should allow ancillary service providers to test their systems One suggestion for the priority of implementation should be (i) all new connections, (ii) all meter replacements, (iii) generators, and then on a geographical basis. Another suggested a geographic basis starting with the largest loads or by customer bands.

4.5.2. Commission's views

Whilst accepting that time of use tariffs will be essential to changing customer behaviour the Commission is of the view that, in the longer term, competition should allow the most appropriate structure to emerge. The study framework proposed above could be used to investigate the likely response of customers to different time of use tariff designs that would help inform suppliers as to the most appropriate structure. A programme of education and marketing would be an essential aspect to the introduction of time of use tariffs. There may also need to be a period where customers would need to be provided with dual bills that would show the differences between charges under the old and new tariffs.

4.6. Winter Summer Differential

What is the best way of dealing with the fact that time of day pricing may lead to higher winter bills and lower summer bills compared to a customer on a flat price? Note that both pay the same amount over the year.

4.6.1. Respondents' comments

A number of respondents suggested that this difficulty can be overcome by the use of flexible payment schemes that can smooth out energy costs over the year, although it was also noted that any expenditure smoothing options would undermine the principles behind the application of time of day tariffs.

One respondent suggested leaving it to competition between suppliers to encourage the necessary communication with customers and to overcome tariff hopping. It was also suggested that a fixed hook-on charge could overcome the switching problem between a flat and a variable tariff.

4.6.2. Commission's views

The Commission agrees that suppliers should be able to facilitate flexible payment schemes for those customers who see benefit in such arrangements.

4.7. Rollout of Smart Meters

Should there be a mandatory roll out of smart meters to all customers? If so, should the approach be one where all new connections and customers transferring accounts have smart meters installed from a certain date and thereafter a roll out applied to all other customers on a geographic basis?

4.7.1. Respondents' comments

The majority of respondents agreed with a mandatory roll-out of smart meters so that the benefits could be maximised. The roll-out programme proposed by the Commission was also received favourably by the majority, with a time period that would be as short as possible. One suggestion was that a fast roll-out programme would be 5 years.

Concerns over the IT and communications infrastructure requirements for roll-out were voiced by a number of respondents. One respondent suggested the introduction of prepaid enabled meters should be given priority. Another suggested that international experience had shown a roll-out based on size of customer demand was the most efficient.

4.7.2. Commission's views

The Commission welcomes the support for the mandatory rollout of smart meters. Whilst there may be occasions when the functionality in smart meters would remain unutilised this would appear unavoidable. The choice should always be there for the customer to make use of the functionality when appropriate.

The approach proposed in the consultation paper would appear to offer the prospect of a practical and cost effective programme. Offering smart meters to

customers on a request basis would tend to detract from the efficiency of any programme and thus increase implementation costs.

4.8. Smart meters for Micro-generation first

Should smart meters be installed for customers with micro generators in advance of a decision on the roll out of smart meters to customers in general?

4.8.1. Respondents' comments

A number of respondents were supportive of this suggestion and highlighted the complementary nature of micro-generation and smart meters. One respondent highlighted the legal obligation required by European Directive 2003 RES-E to provide for the recording of financial benefits & carbon values of micro-generation.

Others thought it unnecessary to give micro generation priority treatment. This form of generation was not viewed as particularly common and thus special treatment was unwarranted. Another suggested a roll-out at the time of connection of micro-generation.

4.8.2. Commission's views

This Commission believes that micro generators should be included as a priority group in any implementation programme. The wider issues of metering micro generation will be considered in a forthcoming decision paper.

4.9. The recovery of Smart Metering costs

While over the longer term the benefits derived from smart metering may equal or outweigh costs, it is likely that the costs of installing and operating these meters will be higher than the benefits provided in the early years. How should these costs be recovered? Should they be smoothed to reflect costs and benefits over time, charged as they occur or should customers be required to make some up front contribution?

4.9.1. Respondents' comments

Most respondents suggested that the costs of installing smart meters be recovered through distribution charges as for existing metering, with the ownership of the meter remaining with ESB Networks. Only one respondent favoured an initial contribution. However, another respondent was concerned that an initial charge would impact vulnerable customers adversely.

4.9.2. Commission's views

Existing arrangements for metering would continue with the introduction of smart meters. Ownership of the meters would remain with ESB Networks and the costs of the programme would be recovered as part of the distribution use of system charge. This does not preclude the possibility of initial charge in some circumstances.