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Bulletin

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THE COSTS AND BENEFITS OF "SMART" ELECTRICITY METERS

All over the world, "smart meters" are replacing the traditional devices used for measuring domestic electricity consumption. Work carried out by Frontier in retail electricity markets around Europe helps to illuminate the advantages of a technology that enables domestic electricity prices to be varied in real time. This bulletin weighs these advantages against the costs of rolling out new technology across a large customer base, developing a framework that can be adapted to other metered utilities.

The standard electricity meter installed in domestic premises has not changed a great deal over the past 50 years. It records consumption of electricity over time, but is not capable of recording exactly when the electricity was used. For domestic customers, refinements of this basic system have been fairly crude – the introduction of cheaper night-time tariffs for storage heating, for example. However, in a number of countries, including parts of the UK, advances in technology are beginning to allow techniques that have been used for some time to manage demand by big industrial users to be applied to domestic energy users as well. →

Traditional meters have one big advantage – they are cheap to buy and install. Their widespread use has, however, a number of disadvantages.

- **The high cost of meter-reading.** Someone has to visit every residence, in order to read its meter or consumption has to be estimated.

- **A lack of information about the consumption profile.** The price of wholesale electricity may change every 30 minutes, but the meter in domestic premises only records cumulative consumption. In order to charge a retail electricity supplier properly for the electricity it takes on behalf of its customers, wholesalers have to estimate the time profile of final domestic consumption.

- **An inability to send time-related price signals.** Since the existing domestic meters do not record when electricity is actually consumed, suppliers cannot vary customer prices to reflect changes in the cost of electricity through the day.

So-called "smart meters" offer solutions to these problems and provide additional benefits. They can be read remotely, removing the need for meter-reading visits or estimation. They can record information half-hourly, providing information about the consumption profile. And some new metering technologies support two-way communication – providing a means by which electricity companies can seek to manage consumption by large numbers of customers.

Since electricity privatisation in Britain, larger industrial and commercial customers have used meters that record consumption half-hourly. These have given businesses the ability and incentive to manage their consumption in response to the price signals they receive – and they have responded. Other countries have had domestic electricity meters that allow a degree of real-time pricing for some time. For example, Electricité de France's TEMPO tariffs use a special meter with six registers, for three day-time and three night-time periods. The price in each period can be set high (on up to 22 winter days), medium or low, and this is indicated to the consumer in advance on the previous evening by a red, white or blue display light. Some appliances can be automatically switched on and off according to a programme chosen by the consumer.

Recently, the pace of change has accelerated in a number of domestic markets.

- Northern Ireland Electricity (NIE) has introduced the Home Energy tariff option based on information gathered by a smart meter in a customer's home.

- In Italy, Enel is replacing 30 million standard meters with new meters which will allow two-way communication over power lines and using the mobile phone network. The system will allow the use of a flexible tariff structure, put an end to estimated readings and bills (and in doing so facilitate supplier changes), avoid the need for profile estimation, improve information on network losses and, in the future, allow communication with gas and water meters as well.

- In Sweden, new legislation requires monthly electricity bills to be based on accurate consumption information – effectively mandating the introduction of smart meters that can be read remotely. About 5 million meters are due to be installed by 2009.

- The Government of Ontario has established targets for the installation of 800,000 smart electricity meters by the end of 2007; these must be installed for all Ontario customers by the end of 2010.

- The Essential Services Commission of Victoria in Australia has decided to require the installation of interval meters by stages between now and 2013.

- In July 2004, the California Public Utilities Commission (CPUC) ordered the three large investor-owned utilities in California to submit business plans for the

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deployment of smart meters. If the business cases, based on the expected level of operational and demand responses, support the introduction of smart meters, then the CPUC is expected to approve it. This announcement followed a pilot scheme, which indicated that customers responded to new tariffs by switching and controlling their consumption, and that they welcomed the opportunity to have greater control.

COSTS AND BENEFITS

Smart meters are obviously more expensive than the traditional variety. However, their costs have been falling over time, and this has focused policy-makers' minds on the possibility of change. This requires proper analysis of the potential impact on both economic efficiency and the environment. Plainly there would also be social policy issues with respect to the up-front costs of installing meters and the effect of real-time pricing on the lowest income groups, which lie outside the scope of this bulletin.

Economic efficiency

There are a number of benefits to set against the high cost of a smart meter roll-out.

- **A substantial and immediate reduction in the cost of meter reading.**
- **In the medium term, a reduction in the cost of handling customer enquiries.** Bills based on estimated readings are a major source of customer enquiries. (In the short term, however, there might well be an increase in enquiries as customers learn how to use the new meters).
- **More effective demand management by suppliers and system operators.** At present, demand forecast errors or other shortages are covered by buying expensive peak supplies or balancing services; smart metering would provide them with new tools.
- **Greater scope for innovative tariffs.** Retailers could offer tariffs which signal the changing cost of consumption throughout the day, encouraging customers to shift consumption to times of the day when electricity demand is low ("peak shaving").
- **Greater "allocative efficiency".** Over time, peak shaving should reduce the level of network and generation investment needed to meet domestic demand. (This, in turn, may have knock-on effects on the debate about sources of energy.)
- **Greater competition in the retail energy market.** An increased range of tariffs, and increased sensitivity to prices induced by changes through the day, may make domestic customers readier to change suppliers.

Environmental consequences

There are obvious environmental benefits from any reduction in the need for power generation capacity that may flow from "peak shaving". But the scale of these benefits will vary between countries, depending on the pre-existing pattern of demand. For example, if demand growth is relatively slow (as in Britain), the benefits from peak shaving may be modest. If, on the other hand, demand is expected to grow rapidly (as in Italy, where an increasing appetite for air-conditioning is fuelling demand growth), smart metering and the ability to shift customer demand to off-peak periods and even to control customers' demand can play an important role in moderating that growth.

The environmental impact of smart metering will also depend on the fuel mix and energy policies in the country concerned. Suppose, for example, that peak shaving does not decrease total energy demand but simply redistributes it around the clock. If an open cycle gas turbine that is used at peak times is no longer needed, but there is greater demand for combined cycle gas turbines to meet higher off-peak demand, then the environmental benefits may be small.

Worse still, if the efficiency gains from smart metering lead to lower average energy costs and prices, these may result in higher rather than lower consumption – with adverse

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environmental consequences. Hence, care needs to be taken in the way environmental benefits are treated in any cost-benefit analysis.

COULD IT HAPPEN IN BRITAIN?

Nonetheless, thoughts are beginning to turn to the use of smart metering in the rest of the UK. Ironically, however, the market reforms that have already taken place in this country may actually inhibit such technological innovation.

In Britain, the meter is the responsibility of the supplier. This arrangement was put in place with the idea of encouraging competition in the supply of meters. The problem is that only a proportion of the benefits of smart metering (meter reading efficiencies, enquiry savings, some of the demand management benefits) would accrue to the supplier, who would meanwhile face all of the costs. In contrast, in a competitive market, customers would gain from the reduction in average costs flowing from peak shaving. Moreover, since in the UK domestic customers can, at least in theory, change supplier every 28 days, the period in which suppliers have to achieve a payback from the investment in smart meters may be discouragingly short.

In much of continental Europe the network operator is responsible for metering. In Italy, for example, the installation programme was undertaken by the regulated network business and funded in the same way as any network expansion or reinforcement.

This is one approach Britain could follow to encourage smart metering. Essentially, this would mean abandoning the notion of competition in the provision of meters, bringing the responsibility into the network businesses. Such an unwinding of previous policy would, however, need to be added into the cost-benefit equation – and would leave the decision in the hands of monopoly network operators and the regulator.

A more market-oriented approach would be to shift the responsibility for meter provision to the customer. Assuming solutions could be found to issues of technical compatibility, and also assuming that any new supplier was required to take on a meter that customers had installed, then it would be left to:

- *customers* to decide whether their ability and willingness to respond to price signals made the investment worthwhile over a sensible timescale, and to choose between different forms of smart metering: and
- *suppliers* to decide how to price efficiently and competitively.

This would be more consistent with the overall drift of liberalised energy market policy in the UK. By avoiding compulsion, it would also significantly reduce the public policy risks. However, the cost per consumer of a partial roll-out would probably be greater than the unit cost of a universal programme.

CONCLUSIONS

Technological advances in smart metering certainly look as if they offer the potential for significant economic gains and environmental benefits, on a scale that will depend on the characteristics of the electricity market in question. A full evaluation of the costs and benefits is needed, to help policy-makers decide whether these benefits can be delivered in Britain, what changes in the regulatory framework are needed, how the change can be used to shape the pattern of energy demand and what social policies would be needed to enable low-income groups to share in the benefits. Moreover, the framework outlined in this bulletin has a still wider application, since it can, of course, be adapted to the analysis of other metered utilities as well.

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