SMART METERING WORKING GROUP

REPORT

Executive summary

The establishment of the Smart Metering Working Group (SMWG) was announced by Patricia Hewitt (then Minister for E-Commerce) on 26 April 2001. Its remit was "to consider how "smart" metering technologies can be applied in the energy arena and report, with recommendations, in September (2001)." This report recommends that, subject to securing necessary funding from the public and/or private sectors, pilot studies should be set up to establish how far smart metering can best contribute to development of the domestic energy market and to the Government's social, environmental and security of supply objectives for energy policy and towards its e-agenda.

Smart meters have the potential to offer a number of consumer benefits including better information and control of energy use, new service opportunities for companies and other organisations, enhanced power network management facilities, and alternative connection to digital services – benefits very much in line with DTI's aim to get UK businesses to the future first. These benefits can also contribute to Government objectives to reduce emissions, keep energy prices competitive, and to encourage electronic trading.

Whilst acknowledging that meters can only ever be a means to an end, this report outlines the opportunities that could arise from the widespread application of new metering technologies. Better information from a meter could help consumers to save money and contribute to emissions reductions. Although ultimately dependent on consumer reactions, our analysis, based on limited UK information, has shown that reductions in domestic consumption of 5-10 per cent are possible and that smart metering could have the potential to deliver, on an annual basis:

- reductions in domestic fuel bills by an average of £24

and, if applied in all households,

- reductions in overall UK gas and electricity consumption of around 2%; and
- reductions in carbon emissions of around 2½ million tonnes.

The reductions could be larger if smart meters were allied with energy efficiency advice and support from energy suppliers and more so if they enabled the introduction of time of day tariffs in the domestic sector that reduced peak electricity demand.

The report identifies the barriers that have prevented the spread of smart metering, such as the cost to consumers, lack of standardisation of meter types, and energy suppliers' reluctance to let current meters become obsolete. It also, however, identifies a number of market drivers that could assist its adoption in the future, including the development of domestic generation (PV or Micro CHP) requiring a more sophisticated form of metering.

To help balance these potential benefits against the uncertainties about whether smart metering could develop and thrive commercially, we propose that, subject to securing the necessary funding from the public and/or private sectors, a number of pilots should be run to establish the costs and benefits to companies and consumers (including the fuel poor), and to quantify how smart metering would help us meet our environmental, social and security of supply objectives. These pilots would help us to understand why smart meters have not been developed commercially so far, whom they might benefit, whether there is potential consumer demand for them and, if so, whether there is a role for Government to work with the industry to commercialise them. We envisage that the participants in these pilots would include small or micro businesses as well as domestic consumers, in order to establish the costs and benefits for this sector too. There may be a need to notify the pilot to the EU in order to gain State Aids clearance.

1. INTRODUCTION AND CURRENT MARKET

1.1 All gas consumers and all but a few electricity consumers are legally required to take their supplies through an appropriate meter, creating a potential metering market in the UK of around 45 million units for the domestic sector alone. Until now, meters have always been provided alongside gas and electricity supply though the growth of competition in the energy industry as a whole has lead to an increasing focus on the costs of metering services and a trend to contract out to third parties, often electronics companies. This puts suppliers in a position to determine the metering products and services they want, which in a competitive market, could affect their ability to retain or win new customers.

1.2 Despite the technology being available, however, smart or advanced metering has not taken off in the consumer market and there may be a number of barriers that have prevented it from doing so.

- The market for advanced meters remains unproven and this could be a significant barrier in a market in which volume of customers would tend to bring the price down. A recent South Staffordshire Water trial of advanced metering found that although customers valued enhanced services (such as leak detection, innovative tariffs etc) they were not prepared to pay extra for the meter.

- Energy suppliers pay around £800 million in total for metering and metering services each year (see Annex F for more information on comparative costs of smart and standard meters).

- Suppliers also face the risk that consumers may not meet their debts for the meter or services provided, a fear that is compounded by the ability of customers to switch their supplier at 28 days' notice, leaving the supplier to chase the debt (creating further expense). Ofgem has proposed that meters should be included in the definition of "other goods and services" in suppliers' licences, allowing them to establish a payback period within a fixed term contract.

- Lack of standardisation of types of advanced meter also creates risk: why should a customer install an advanced meter from one supplier only to find that switching to another supplier renders it and its services useless? Ofgem is convening a working group to address the need for standardisation whilst also retaining innovation and competition.

- The effect of price control on the ex-PES and Transco distribution networks has the effect of incentivising them to deliver existing services as efficiently as possible to maintain their margins. They are reluctant to risk developing innovative or more asset-intensive services, especially those that would render current assets (existing working meters) obsolete.

1.3 Set against these barriers, however, are a number of drivers for change in the market:

- Competition in the energy supply market has so far been based primarily on price comparisons between suppliers. As the opportunities for companies to cut costs with efficiency gains and erosion of margins diminish, competition may begin to focus on factors other than price alone. Energywatch is developing a performance assessment matrix that will allow consumers to make judgements on suppliers based on quality of service in areas such as sales practices, billing, etc. Over recent years utilities have also started to diversify into other service areas such as insurance, personal finance and telecommunications and it may be that advanced or smart meters could offer the opportunity to introduce new service packages that could help to differentiate a supplier from its competitors.

- As the potential for marketing micro-generation (such as photovoltaics and micro-CHP) in the domestic and small commercial market grows, this will also require changes to the relationship between suppliers and customers, especially in the way that billing takes account of any electricity exported by the customer. Current domestic metering arrangements are not adequate to cope with this and unless suppliers base their bills on demand profiling, a more sophisticated form of two-way metering will be needed.

- The effect of NETA has been broadly to expose suppliers and traders to the cost of their own imbalance position, rather than spreading those costs across all trading parties. Increased accuracy of consumption data from up-to-date remote meter readings could help suppliers to minimise their imbalance costs, perhaps passing these savings on to the consumer.

- There is no legal impediment to prevent consumers from making their own metering arrangements, so it is possible that metering services could be provided direct to customers.

- The Energy Review being conducted by the Performance and Innovation Unit (PIU) at present is likely to focus increasing attention on energy efficiency and technology innovation.

1.4 Whilst technology exists to provide a range of facilities and services through a meter, the customer demand for these remains unproven and the Staffordshire Water trial would indicate that customers would not be willing to pay extra simply for remote meter reading. In the domestic gas and electricity supply market, a substantial majority of consumers have not switched supplier, despite the potential annual savings to be made from doing that. In the UK, consumers have no tradition of involvement in metering and little appreciation of the technologies and associated costs. Suppliers could also benefit from use of these meters, through better ability to manage demand and by billing their customers more accurately. So both consumers and suppliers would need to be persuaded that paying explicitly for advanced meters would be worth the potential reductions in energy use or new value added services that they would be able to access through the meter. As with other energy efficiency investments, the adoption of smart meters may be hindered by a number of market failures including:

(a) imperfect information, in that households and small businesses are unaware of the scope to improve energy efficiency and reduce emissions;
(b) lack of access to capital; and
(c) better information on the cost of a smarter meter than resulting savings in energy use.

Other barriers may include:

(a) regulatory barriers, for example, energy companies perceive that they cannot enforce long term contracts with customers;
(b) uncertainty about the return on investment in meters as energy prices change; and
(c) uncertainty about duration of residence if the meter is not portable to a new address.

2. TECHNOLOGIES AVAILABLE

2.1 The term 'smart' can describe several levels of functionality distinct from the 'dumb' meter that sits under the stairs and is periodically read by a meter reader noting gross consumption data from a digital or (still frequently) analogue display mounted on the meter itself. There is some overlap of functionality (in part due to the increasing prevalence of modular design) but for the purposes of this report 'smart' metering technology is categorised in terms of 'display', 'remotely read' and 'internet' capabilities. These are outlined below with fuller descriptions at Annex C. This report covers meters for both gas and electricity though clearly there is a difference between the functions that would attach to each meter. For example, ability to measure exports could be one of the functions available on an electricity meter, but would not be needed on a gas meter. There might also be a wider range of added value functions and services available on an electricity meter. Gas meters, however, would be likely to be associated with important reductions in consumption through better use of heating controls.

Display meters

2.2 The simplest of the 'smart' meters, display meters allow consumers to monitor energy consumption in money terms rather than kWh. A small consumer unit, typically utilising a LCD display and conveniently sited, enables consumers to keep track of energy use in real time. The consumer unit can be combined with a keypad or smartcard reader making it an ideal solution for token or token-less pre-payment systems. The latter systems lower the costs associated with running non-credit systems and could result in a lowering of the higher tariffs usually paid by non-credit customers. Small scale demonstrations of this technology suggest that allowing consumers readily to monitor energy consumption, and combining this with energy efficiency advice, lead to reductions in energy usage of around 5-10%. This type of meter would be suitable for use for both gas and electricity.

Remotely read meters

2.3 There are a number of 'intermediate' smart metering technologies that can obviate the need for manual meter reading by communicating energy consumption and/or usage data to the energy supplier. This can be accomplished by power line signalling (PLT) or fixed radio links (some implementations utilise short-range radio links that poll data when 'pinged' by mobile readers). This Automated Meter Reading (AMR) can significantly reduce business costs by obviating the costs of manual meter reading, and by obviating the need to issue estimated bills thereby significantly reducing the cost of dealing with queried bills. This could provide important benefits to consumers by offering up-to-date and accurate billing information, removing the danger of unexpectedly high bills arising from correcting estimated readings. Many of these meters have duplex communications capability that facilitates remote setting of tariffs, disconnection and reconnection (subject to safety regulations/requirements). Typically used for credit customers they can also be coupled with 'keypad' technology for pre-payment applications. There would, however, be employment/re-deployment implications for the meter-reading industry.

2.4 This class of meter is ideally suited to 'net' metering applications, that is they can track energy import and export and convey these data in real time to metering service providers, suppliers or distributors. These meters could be ideally accompanied, for pilot purposes, with the use of small-scale generation like Photovoltaics (PV) or MCHP, either in a domestic or small commercial context.

Internet meters

2.5 Technologically these are currently the 'smartest' meters and possess all the functionality of other meters and have a built in modem. Alternatively powerline technology can relay data to a concentrator (typically at sub-station level) where it is transferred to TCP/IP format (Internet protocol). These devices easily accommodate automated meter reading but can also communicate with other devices around the home - or anywhere on the Internet. This enables remote appliance diagnostics, telecare[1] and telesecurity service delivery, and facilitates on-line transactions (eg purchasing, voting). There are issues associated with security so these devices are secure (typically to on-line financial transaction standards). Currently available technology has bandwidth similar to that achievable through a PSTN dial-up connection but this will soon be superseded by broadband systems that exploit xDSL and interactive TV connectivity. These functions are more likely to be associated with electricity meters than with gas meters.

---

[1] Telecare is the remote provision of various care and monitoring services for the elderly, sick or disabled. Services include home environment monitoring, fire prevention, flood protection, temperature sensing, gas and carbon monoxide sensing, as well as alarm triggers either worn or installed in the home.

3. POLICY BENEFITS

3.1 The kinds of technology described above could provide a number of opportunities for energy suppliers to improve the quality of consumption data, to enhance their services to consumers, and also for other IT service providers (and also Government) to communicate with those who do not possess another means of digital communication. Smart meters are only a means to an end and there remains significant uncertainty about the effects that their use could have in practice. For that reason, we are proposing that pilot studies should try to ascertain whether there are worthwhile benefits to consumers or companies and if so, to quantify what they are. Some of the possible benefits are discussed below and some information from international studies on similar themes is at Annex D.

What are the benefits and how do they link to Government objectives?

3.2 The following PSA Targets for 2001-4 are all relevant to the benefits that could be achieved through smart metering:

i. Ensure competitive gas and electricity prices in the lower half of the EU/G7 basket while achieving security of supply and social and environmental objectives;
ii. Improve the environment and the sustainable use of natural resources including by reducing greenhouse gas emissions by 12.5% from 1990 levels and moving towards a 20% reduction in CO_2 emissions by 2010 (jointly with DEFRA);
iii. Make and keep the UK the best place in the world to trade electronically, as measured by the cost of internet access and the extent of business to business and business to consumer transactions carried out over e-commerce networks.

3.3 Smart metering is also relevant to the Secretary of State's overarching objective for the Department to help UK business get to the future first, as well as her priority to take an active approach to "greening" business. This is described in more detail below.

<u>Saving energy, managing demand, cutting bills and reducing emissions</u>

3.4 Studies have indicated that consumers who were better informed about their energy consumption through smart meters could make energy savings of around 5-10%[2]. Although this represents a fairly modest saving in terms of the average bill (around £24 per customer per year at current prices), it could contribute significantly to the Government's emissions reduction targets if take-up were substantial. Better information about cost (perhaps displayed on the meter or itemised on the bill) could help consumers to budget their consumption but the benefits could be maximised if meter provision were to be combined with suitable energy efficiency advice and support from the supplier. There could also be significant scope for changing tariff structures too. The effects in relation to the energy usage of the fuel poor are

---

[2] "A Review of the energy efficiency and other benefits of advanced utility metering", by EA Technology for BEAMA and DEFRA.

uncertain. The technology, if allied with suitable tariff and payment options could allow some of the (mostly fuel poor) customers who use the more expensive prepayment meters, to transfer to a standard (smart) meter. This could be programmed to enable the customer to transfer between different tariffs without having to change their meter.

3.5 Smart meters, if allied with half-hourly metering in the domestic market, could also offer energy suppliers better ability to manage consumer demand. This could be done by advising customers in advance of the periods of peak pricing and enabling them to adjust their energy use (where possible) to minimise consumption at those times. Alternatively, suppliers could manage customers' energy consumption more directly, using more sophisticated meters, by switching individual appliances on and off. This could help to ease pressure on the network at peak times and, at times of extreme demand (such as a very cold winter) this could prevent the network stresses that in the past have resulted in interruptions to supply for some customers.

Enhancing services to the consumer

3.6 A meter using more sophisticated communications technology could encourage the development of energy services or at least enhanced services from energy suppliers perhaps in the form of specific advice to the customer about efficiency or even direct management of their consumption by the supplier.

3.7 Examples of the services that could be offered include:

- showing the customer the ways that energy is consumed around the house e.g. through appliances or light bulbs left on unnecessarily or through equipment kept on standby;
- analysing electrical circuits or appliances to pick up faults or performance deterioration (e.g. a freezer needing defrosting);
- provision of micro-generation facilities to enable the customer to generate their own electricity and potentially to export the excess (subject to agreement terms with the supplier);
- giving immediate warning to the supplier of power cuts or changes in voltage, rather than relying on customers to phone in to report them (particularly useful in rural areas); and
- offering other messages or advice to customers from the supplier.

3.8 Even more sophisticated applications could involve connection to the internet, connection to household appliances (with some ability to control them or at least switch on and off to allow remote load shifting by the energy supplier), ability to take "swipe" card payments for services or other on-line communication. We understand from meter manufacturers that the technology exists to enable most things, but is of course dependent on price. More sophisticated options would be more expensive but may offer the potential for greater energy savings and more value added services. Their viability will depend on the value of these benefits compared with the extra cost but if a market could be established, rising demand and increasing volumes of sales could bring prices down for all. This report will propose that, subject to securing funding from the public and/or private sectors, some initial pilot studies could seek to establish whether a market could develop for such meters and the services they could enable.

Enabling the spread of small or domestic generation

3.9 The Embedded Generation Working Group's Report found a range of barriers to the spread of embedded generation (including domestic generation), many linked to the existing infrastructure. These barriers are exacerbated by the added complication that current domestic metering arrangements were not conceived to take account of any electricity flow back to the Grid. The ability of domestic or small commercial customers to recover an adequate price for the electricity they export to the Grid would also be a key factor in encouraging more people to consider either PV or micro CHP. Currently the costs of connection and of half-hourly metering make installation of domestic/small commercial generation uneconomic. A meter offering an accurate, real time measurement of power flows both into and out of the premises and, crucially, at a lower cost than has been possible in the past could go some way to addressing these problems. Many of the more environmentally-friendly forms of generation are embedded so not only do they contribute to environmental objectives, but they can also enhance the diversity of power sources and in some cases reinforce generation capacity in areas of the Grid where it is weak. We propose that, if funding could be arranged from the public and/or private sector, metering pilots could be linked with MCHP pilots as well as existing PV trials.

An alternative connection to digital services

3.10 Home connections to the internet are typically through PCs, although these remain relatively costly and require a certain amount of IT expertise. It is likely that the home PC market is becoming saturated[3] and the increasing trend is for on-line connection via interactive TV. This lowers the knowledge threshold required but remains expensive and is not available in all parts of the UK. There is likely to remain a significant group for whom either existing option is unsuitable, unaffordable or unavailable. For these, a suitably equipped smart meter could offer a cheaper and less intrusive alternative while still offering a range of useful services.

3.11 Smart meters could offer home safety and security providers (including Local Authorities and charities) a new way of delivering telesecurity and telecare services (such as temperature monitoring, fire alert, gas leak detection, inactivity monitoring, etc) especially for vulnerable residents. It could also cover mainstream service delivery and extend to other general government services such as on-line voting.

4. ANALYSIS

4.1 As has already been set out, smart metering offers a range of potential benefits to energy customers and the environment. This includes benefits flowing from both reduced use of energy and changes in the timing of its use, thus reducing consumer bills and carbon emissions. Consumers would also benefit from an "internet under the stairs" and the services that this could generate. This section focuses on the energy related benefits.

[3] Gartner report.

4.2 One of the biggest benefits of smart metering could be greater awareness on the part of consumers about their energy use, which, allied with relevant advice and support from energy suppliers, could lead to changes in their behaviour in order to reduce consumption. Studies overseas indicate that quite crude forms of feedback on energy use - more frequent billing, comparisons of consumption with other households, use of graphics - could generate significant reductions in consumption. On the basis of such studies, EA Technology conclude[4] that 'an estimate of 5% saving is not unreasonable for the use of electricity for dwellings without electric heating but with electrical appliances, and up to 10% saving for dwellings with electric heating'. They suggest that similar responses from gas consumers to such feedback information could be possible. Savings from small commercial premises could exceed these domestic estimates.

4.3 In 1999, a 5% saving would have reduced the average UK domestic energy bill by £24 per year from £535 to £511. If all households had made similar changes, total UK gas and electricity consumption would both have fallen by 1.7 per cent. Savings in carbon emissions would be around 2.3 million tonnes per year. Evidence from the Energy Saving Trust's network of Energy Efficiency Advice Centres is that advice leads to householders taking action to reduce energy consumption by on average 7.5%. Two thirds of the savings arise as a result of investments in energy saving measures, while one third is as a result of behavioural measures such as turning heating down or turning lights off. Thus, behavioural measures result in reduction in household energy consumption of approximately 2.5%.

4.4 These estimated savings are based on feedback on energy use without smart metering. Smart metering offers the opportunity to provide consumers with better feedback and information in real time. Its potential impact on customer behaviour could, therefore, be substantially greater and a major purpose of pilots would be to establish how much greater.

4.5 The potential for smart meters to impact on fuel poverty is uncertain. As discussed in the previous section this technology could allow companies to offer customers an alternative to expensive prepayment meters if provided in connection with supporting services, or to bring down the costs of prepayment meters themselves. They could also offer a means for service providers (including local authorities, social services, or home security companies) to remotely monitor residents, if it proved to be cost-effective for these purposes. This could be as basic as monitoring whether energy was being used regularly by the resident, or at a more sophisticated level, could allow direct communication or visual contact.

4.6 In addition to influencing consumers to consume less through better information, suitable smart meters could encourage consumers to use less electricity when demand is high (where they had flexibility to alter their usage patterns) . This might take place through information that enabled consumers to use, for example, the washing machine in a less expensive period, though without variable pricing of domestic electricity according to the time of day, there is little incentive to do so.

[4] Ibid.

4.7 EA Technology[5] quote a small survey based on tariffs that varied by time of day, month of year, and between weekdays and weekends. This led consumers to make significant changes in their use of household appliances flattening the evening load peak and almost eliminating the morning one. Whilst overall energy consumption was not reduced, consumers' average bills were reduced by 8 per cent. The reduction in peak loads, if realised on a widespread scale, would reduce the level of electrical capacity that the country would need and reduce requirements for future reinforcement of the transmission and distribution systems.

4.8 Even bigger gains may be achieved with more advanced smart metering that involved communication between the meter and appliances to control the time of use of appliances, increasing the potential for remote load shifting. This could involve the washing machine switching itself on when electricity costs were lowest or the fridge holding off for short periods during peak loads. Loads that could be shifted with minimal inconvenience to households include the hot water tank, electric storage heaters, washing machines, tumble dryers, dishwashers, refrigeration. Control of these loads could potentially be by electricity companies subject to override by consumers.

4.9 If smart metering led to a substantial, UK-wide, reduction in peak demands in the morning and evening as load shifted to other times, this could reduce carbon emissions by up to 0.9 million tonnes, through the use of more efficient baseload generation. Management of demand also contributes to security of supply by reducing pressure on the network and helping to avoid problems and interruptions in supply.

4.10 Thus smart metering offers the potential both to reduce energy consumption overall and to shift peak electricity demands in the domestic sector to other times if combined with appropriate advice and services to customers. Potential savings in carbon emissions could total 2.5 to 3 million tonnes per year. Also, the reduction in electrical capacity that the country required and the reduced need for reinforcement of the transmission and distribution systems would, in the longer term, tend to reduce electricity prices.

4.11 Such projections are highly tentative because we have insufficient experience about what can be done. Moreover, metering technology is advancing to the point where much more can be done than previously, so making it the right time to undertake trials to gauge the real size of the potential benefits.

4.12 In conclusion, we think that smart metering could offer a number of benefits,

- To consumers, through reduced bills, new energy and internet services, more accurate billing (and budgeting);
- To the energy industry, through enhanced network management capabilities, enabling and encouraging the spread of small-scale generation, new service opportunities; and
- To local and central Government, contributing to environmental, social, security of supply objectives as well as e-commerce objectives.

[5] Ibid.

There would also be costs associated with smart metering, including:

- The supply and installation (including training of installers) of the meter itself (see Annex F on comparative costs of meter units);
- Running costs for the meter, data collection/analysis, billing changes and the cost of providing any new services;
- Network connections where meters were being installed alongside generation equipment (PV or MCHP).

Pilots could aim to assess the nature of these costs in order to enable more detailed cost/benefit analysis.

5. PILOTS

Organisation and Process for Smart Metering Pilot Studies

5.1 A comprehensive set of pilots could be based on a deployment of around 500,000[6] units (meters) and these would be spread among a population group (including a small proportion of small commercial customers) stratified by geography and other demographics. The aim would be to assess the costs and benefits of smart meters across a range of technologies and applications of varying sophistication. This would include their implications for:

- energy efficiency and emissions reductions;
- reducing fuel bills;
- new opportunities for customer services;
- management of demand and security of supply; and
- operating alongside existing distribution networks;

as well as any other impacts that the meters themselves may have, perhaps resulting from their manufacture, installation or use (for example if a meter were to require high standby power consumption this could offset any energy savings it might promote). It may be necessary to gain clearance for the pilots from the EU in order to avoid contravention of State Aids regulations.

5.2 If Government funding could be secured to support a pilot, we propose that the DTI would appoint a Smart Metering Project Manager to manage the process, organising the call for proposals, selecting and running the pilots and subsequently evaluating the results. Further details of these stages are at Annex E. The project manager would be advised by a consultative working group, chaired by a senior DTI official and incorporating membership from government departments, the industry and those actively involved in the day-to-day management of the pilots.

5.3 The project manager would need to determine the procedures for bids for the funds available - this would depend on the likely number, value and quality of the

[6] This would represent a sizeable and fairly expensive pilot, but a smaller and cheaper study could still offer valuable results.

bids – and the selection criteria, taking account of the views of the consultative group.

5.4 The pilots would be evaluated while in progress, as well as after their close, allowing early feedback to identify and resolve any problems that may arise. More details are in Annex E but examples of evaluation criteria include: technical evaluation and market potential (including cost effectiveness); customer reaction; energy, carbon and financial savings; benefits from other services; relevance to micro CHP and/or energy services; and impact on the existing distribution network. More details of the areas to be covered by the pilots are at Annex E.

6. CONCLUSIONS

6.1 On the basis of the evidence and analysis outlined in this report, the Smart Metering Working Group recommends that, subject to securing the necessary funding from the public and/or private sectors, pilot studies should be arranged to help determine whether the introduction of smart meters could result in benefits to consumers and companies and also help contribute to the achievement of Government energy and e-commerce objectives.

6.2 The limited evidence that is available about the way in which people respond to better information on their energy use seems to indicate that smart meters could enable:

- Real reductions in consumer bills of 5-10% or more;
- Reductions in energy consumption and carbon emissions;
- Reductions in peak electricity demands;
- Enhanced security of supply by reducing pressure on the network; and
- Increased use of new small-scale generation technology (such as PV and MCHP) with associated environmental and social benefits.

Thereby promoting Government objectives for a sustainable energy policy – in particular those relating to environmental and security of supply issues.

6.3 Smart meters could also act as potential digital gateways. The ubiquitous presence of utility meters could make them an ideal way to extend digital services into some homes and businesses in a practical and affordable way. Many countries are updating their infrastructure using these technologies. UK-based manufacturers produce for these overseas markets but there is a very low domestic base. As a result UK metering infrastructure is effectively saddled with fifty-year old technology. Many reasons are proffered including competitive pressures in a fragmented sector, the cost of the technology and poor appreciation of the benefits that could accrue.

6.4 Pilot studies of smart metering would help us to understand better:

- What benefits and service opportunities might be created and, where appropriate, quantifying the benefits;
- The potential for lowering fuel bills for domestic and small commercial customers;
- The costs of installing and maintaining smart meters;
- The potential impact on existing distribution networks;

- Whether a market could develop, under what conditions and whether incentives are needed (i.e. whether customers and suppliers value benefits enough to pay the going rate to get them and whether demand could be sufficient to bring down costs to enable widespread use); and
- To uncover problems or possibilities not yet considered.

ANNEX A

THE SMART METERING WORKING GROUP

Remit: To consider how "smart" metering technologies can be applied in the energy arena and report, with recommendations, in September (2001).

Terms of reference:

To consider how metering technologies can assist in the pursuit of DTI energy and information age objectives, specifically how metering solutions may

- Increase consumer control over expenditure on fuel;
- Increase the scope for demand side management in the domestic sector;
- Increase connectivity to the internet;
- Facilitate metering of domestic PV, small scale CHP and other forms of generation suitable for use at domestic level;
- Promote greater energy efficiency, energy services, CO_2 savings and help alleviate fuel poverty;
- Provide potential benefits for the balancing and settlement process; and
- Contribute to sustainability and address environmental concerns.

The SMWG will report to Ministers by the end of September 2001. The report will, where appropriate, make recommendations for further action.

Composition:

Chair:	Neil Hirst	Deputy Director General, Energy, DTI
Membership:	Geraldine Allison	Director, CII, DTI
	Alastair Keddie	Director, ENV, DTI
	Graham White	Director, ENP4, DTI
	Eoin Lees	Energy Saving Trust
	Virginia Graham	Ofgem
	Jeremy Eppel	DEFRA
	Steve Western	AMP Trust
	Graham Bryce	ENP, DTI
	Phil Baker	ENP, DTI
	Roger Lampert	ENP, DTI
	Geoff Hatherick	ENP, DTI
	Richard Foggie	CII, DTI

ANNEX B

THE CURRENT MARKET

Background

Legislation requires that all gas consumers and all but a few exempted electricity consumers must take their supply through an appropriate meter. Therefore the potential UK market for advanced meters roughly equates to the number of customers, or around 45 million units. However, as meters are a fundamental requirement, they have always been provided as part and parcel of gas and electricity provision rather than left for consumers to source. This saturation, combined will the relatively long life cycle of a meter mean that the potential market for meters may be limited to new connections and age related replacements, around 400,000 and 2 million per annum respectively (gas and electricity combined).

Following the privatisation of the gas and electricity industries, and subsequent separation between supply and network operation, meters (along with other capital assets) continued to be provided by the distribution network operator. As the distributor has no direct relationship with the consumer, they provide these meters to the supplier (in gas, via the shipper) who in turn provides the meter to the consumer. Although gas and electricity consumers have the statutory right to make their own metering arrangements few have chosen to do so to date. In June 2001, Ofgem sent out a metering liberalisation update letter to gas suppliers. Responses to this letter suggest the existence of asymmetric information currently within the metering market. In response to Ofgem's letter, suppliers stated that current consumer demand for meter ownership and consumers making their own metering arrangements were virtually zero and they foresee no demand for consumer ownership (domestic).

However Ofgem are also aware that the majority of the UK gas consumers (especially domestic consumers) are unaware of metering liberalisation, what it means to them, who can facilitate this process and how. Indeed some suppliers have stated that they have no processes set up to answer consumer queries on meter ownership.

Ofgem believe that the existence of imperfect information in the metering market adversely influences economic behaviour and the operations of the market by undermining the role of signals within a market that would ordinarily match supply to demand. Ofgem believe that this represents a market failure, perhaps necessitating regulatory intervention. Suppliers are also able to use an alternative to the network operator, for provision of metering services, though until recently have rarely done so.

An exception to this is the half-hourly market in electricity (around 100,000 sites) which has been open to competition since 1994. It has been possible for suppliers and consumers in this market to use alternative providers of metering and data services since this time, and indeed many half-hourly suppliers and consumers now do so. In essence a half-hourly meter is simply an industrial application of automated meter reading (AMR). On average suppliers pay almost £600 per annum for the metering services for each half-hourly meter point, made up of meter operation, data collection and data aggregation services.

Historical barrier to AMR

As the ex-PES and Transco distribution networks are monopolies, they are subject to a regulatory Price Control, limiting the amount of revenue they can earn from their services. Acting as a proxy for market discipline, the price control incentivises these businesses to improve efficiency in order to increase or maintain margins. However, as regulated monopolies, these businesses may not be incentivised to offer innovative or improved services, but rather a standard service at the least cost to them. Although metering is a contestable activity, the ex-PESs and Transco retain a de facto monopoly, therefore these services are also price controlled and subject to the same drivers. As the UK electricity and gas regimes traditionally require no more than a periodic meter reading (if that), the least cost solution is a basic meter, with a pedestrian read if and when access is available.

Although meters, and often meter readings, are provided by the DNO, they are actually the supplier's responsibility. Suppliers may require more meter read data to service their consumers than DNOs require for balancing as settlement. For instance in gas, meter readings are often taken but not submitted to Transco, or submitted but not recorded, because Transco only requires one read per annum for AQ purposes (Annual Quantity – used to derive transportation charges). The primary benefit of AMR is more frequent meter readings, though this is of limited value to DNOs, who are currently the predominant purchasers of meters. While benefits of a product or service do not accrue to the party who is paying for it, there is a disjointed value chain.

Metering charges have recently[7] become separately identifiable (and therefore avoidable) to suppliers. While the metering charge was bundled with the transportation or distribution charge, there was no opportunity to compare the charges of competing service providers, and until the incumbents charge could be avoided, little incentive to make alternative arrangements. Since these charges have become visible the industry has been actively pursuing metering competition and the largest gas and electricity supplier, British Gas Trading, recently announced its invitation to tender for the provision of its metering services. TXU Europe has followed suit and it is likely that other suppliers will follow.

Once suppliers are in a position to make their own metering arrangements they will be in a position to specify which products they want, rather than having to accept whatever is on offer. If the benefits of advanced metering outweigh the costs, it would be in suppliers interests to procure it, and they will have the opportunity to do so. Further, Transco has also announced its intention to separate its metering business from its core transportation activities. It is hoped that this will eventually lead to its metering business becoming deregulated and no longer subject to price controls. Therefore even those suppliers arranging their metering services through Transco will be able to obtain value-added services, subject to commercial agreement.

[7] April 2000 in electricity, October 2000 for domestic gas meters and April 2001 for I&C gas meters

Remaining issues

Many AMR technologies require density of consumers in order to be economically viable. In such cases this would require an accelerated meter replacement programme, effectively exchanging meters which would otherwise have remained in situ and earning revenue, perhaps for several more years. Anecdotal evidence suggests that PESs have demanded a dispensation for the loss of these revenues which, on top of the capital costs of the replacement meter and the operational costs of the exchange itself, have made the business cases of potential service providers less attractive.

Supply businesses are not in themselves asset intensive enterprises. Basically they are a brand name, a customer database, a billing system and a call centre, and even the latter two could be outsourced. Therefore some suppliers simply may not want any capital assets on their balance sheet.

Evidence suggests that suppliers are particularly reluctant to invest in meters as assets, because of the risk of stranding. A stranded asset could be described as an asset that is not earning revenue, whether it is lying in a warehouse, or in a consumer's home, unpaid for. For instance, the cost of provision and installation of even a basic meter may require a pay back period of many months. The more expensive the asset, the longer the pay back period. At present, the vast majority of domestic consumers are on an 'evergreen' supply contract, meaning they go on for an indefinite period. However, such consumers are also entitled to terminate their contact at 28 days notice, and even this period may eventually be reduced. This introduces a risk to the investment.

As the supply market is competitive, with many consumers switching every week, this has perhaps led suppliers to a view that they may only have 28 days to recover the costs of any investment in the consumer. Whilst this view is prevalent, it is probably unwarranted, as many consumers stay with their supplier for much longer periods (if not indefinitely). However, to further address these concerns, Ofgem have recently consulted on proposals to increase the contractual flexibility of suppliers. Many suppliers offer fixed term tariffs, which are linked to the provision of equipment such as energy saving light bulbs. The customer is then obliged either to see out the term of the contract or pay a termination fee. The crux of Ofgem's proposal is that advanced meters should be included within the definition of 'other goods and services' within the suppliers' licence, allowing them to use the payback period of such meters as the grounds for a fixed term contract.

The lack of standardisation of advanced meter solutions and type of data generated have been cited as increasing the risk of asset stranding following a consumer transfer. If the incoming supplier cannot utilise the advanced features of the meter they are of no value to them. The incoming supplier is therefore likely to offer the outgoing supplier only the price of a standard meter, or replace it with such a meter. This increases the risks of the outgoing supplier being unable to recover their sunk costs. Ofgem's metering strategy paper proposed the creation of an industry group to explore these issues. Respondents were generally encouraging and the 'Metering Innovation Working Party' will be convened shortly. However, many respondents pointed out that standards can actually restrict innovation and may be anticompetitive. Therefore, focus could perhaps centre on the interoperability of various solutions, rather than on the technologies themselves.

Drivers for change

Competition in the gas and electricity supplies is largely based upon price comparisons. However, it is unlikely that price competition alone is sustainable from a supplier viewpoint. Nor is it entirely desirable from the position of the customer. Energywatch wishes to encourage customers to take a view on potential suppliers based on quality of service across a number of areas, including sales practices, billing, etc. To date, suppliers have been able to offer keener tariffs by reducing costs and squeezing margins, largely by addressing the legacy inefficiencies of their monopoly status. The former PESs have also priced up to the level of their individual price controls, rather than reducing prices for their local customers. However, there may come a point at which price competition cannot be sustained simply by efficiency gains, and pressure will be placed upon margins. This could be sustained in the short term, particularly if Ofgem removes supply price controls in 2002 and allows the prices charged by the former PESs (and, as a result, the prices charged by their competitors) to rise. In the longer term however, there comes a point when greater shareholder value could be attained in alternative markets, and there will be pressure either to increase prices or withdraw from the market. Therefore, in order to remain competitive, suppliers must differentiate themselves from their competitors on factors other than price.

In recent years we have already seen energy utilities diversify into services such as insurance, personal finance and telecommunications, often offering a bundled package of services under the one brand. Metering offers scope for suppliers to differentiate themselves, either by improving an existing service, or by offering a value added service facilitated by advanced metering. For instance, suppliers could use the data obtained by remote meter reading to offer innovative products, such as ‘time of day’ tariffs tailored to particular types of consumer.

NETA effectively exposes suppliers and traders to the cost of their imbalance position, rather than smearing the costs across all parties to the Pool. In order to rectify imbalance positions, energy is traded in the short-term ‘spot’ market, with widely varying prices. Increased accuracy of consumption data, obtained via remote meter readings could allow suppliers to reduce these imbalance costs. These savings may in turn be passed through to the consumer, perhaps in the form of an AMR linked tariff. Such a saving, direct to the consumer, could lead to the emergence of a greater domestic demand side response and improve the functioning of the market.

Although consumers have the right to own their meter, suppliers have in the past been able to prevent such arrangements by refusing to supply such customers. The Competition and Services (Utilities) Act 1992 amended the Electricity Act 1989 to the effect that a supplier may only refuse if there are reasonable grounds for doing so. The Metering Liberalisation Date, as set out in Standard Condition 8 of the Gas Suppliers’ licence had a similar effect in gas. It is therefore feasible that metering services (including value-added services via AMR) will be provided directly to consumers.

South Staffordshire Water has recently undertaken a trial into AMR. The customers taking part in the trial welcomed the added functionality, such as leak detection, innovative tariffs etc. However, at the end of the trial, when asked if they would pay extra to keep the AMR device, all apparently declined.

Conclusion

The market itself would find solutions to many, if not all, of the perceived barriers to AMR taking off in the UK if there is enough demand. The marketing of these products and services to date appears to be production driven focusing on what the technology can do, with potential service providers not clear who their potential customers are and what they want. Evidence suggests that consumers are not willing to pay extra simply for a remote meter reading facility. The relatively in-elastic effect of price on demand for energy suggests that even the cost savings associated with improved energy-efficiency may not be a big enough selling point. AMR solutions must therefore be provided at a cost that the supplier is willing to pay for the meter read data, or offer value added service that the consumer is willing to pay for.

As part of any future project, further research could be conducted into customer awareness of AMR technologies, what services and products the market actually wants, and how much they are willing to pay for it.

AVAILABLE TECHNOLOGIES – EXAMPLES

1. 'Liberty' keypad/display meter

Liberty offers the benefits of flexible vending and credit transfer without the need for costly tokens and infrastructure. Credit is dispensed as monetary units, with the transfer being carried out by:

- encrypted numbers printed on a till receipt at a vending outlet;
- a 24-hour call centre;
- a modem or power line communications.

Liberty's programmable, easy-to-read LCD display provides access to a variety of information for both the consumer and the utility. A remote keypad and display unit (Freedom) allows consumers to enter credit and to access information from externally or remotely mounted meters. All of Liberty's features and functions are fully programmable via numeric sequences called "Customer Vending Codes" (CVC) which can be entered by the consumer at the same time as credit transfers.

Liberty is the potential solution for:

- Consumers who reside outside a utilities distribution network;
- Consumers who want to conveniently "pay as they go" for their consumption;
- Properties where meter reading access is a problem;
- Consumers with no credit history;
- Consumers who have difficulty paying their utility bill.

Flexibility through software enables Liberty to be fully configurable to meet current and future needs.

- Differential pricing allows utilities to charge different prices for credit/overdraft modes of operation or for excessive demands.
- A programmable emergency credit feature that removes the worry of running out of credit. Alternatively the meter can be programmed to limit load, offering a more sociable acceptable option to self-disconnection.
- Programmable load limiting provides an intelligent way of controlling consumers load, offering alarms and/or disconnection in the event of excess load.
- Prepayment and credit modes of operation can easily be interchanged via numeric codes (CVC's). This can be done by the customer, eliminating the need for costly site visits.

Liberty's encryption method employs a 20 digit numeric code. Numeric sequences (CVC's) can be used to transfer vended credit or programming commands. Comprehensive security features ensure that a dispensed number is valid for one transaction only and cannot be used on any other meter. The system will support time-of-use tariffs for flexible and cost effective energy management. Tariff switching can be performed as part of the normal credit dispensing mechanism by issuing additional customer vending codes (CVC). The security system ensures that consumers key tariff details into the meter before any further credit is accepted.

As well as its prepayment functions, Liberty provides additional functionality. Voltage, current, frequency, power factor and kWh are all measured and can be displayed. All currently known methods of fraud can be detected, flagged and/or compensated. Dispensing credit and providing customers with programming and diagnostics tools either at the dispensing outlet or from a call centre permits users of the Liberty to support their customers nationwide.

Liberty is available with up to two pulsed inputs for collecting other utility meter data such as gas and water. Coupled with two relay outputs and three separate electronic accounts, Liberty can act as a multi-utility prepayment system.

2. Remotely read meters

Radio Telemeter RTM –

Integrated measurement and control

The Radio Telemeter (RTM) combines 1 or 2 electronic meter elements with a fully featured Radio Teleswitch (RTS -- see below) and 1 or 2 load contractors to provide highly integrated, cost effective tariff and load control solutions.

Features:

- Approved to EN 61036 (IEC 1036) Class 2.
- Dual or single element options.
- Dual or single contractor options.
- Up to 8 time-of-use registers.
- RTS or internally programmed tariff control.
- Suitable for simple or complex tariff operation.
- Presettable RTS programmes.
- Accurate electronic metering.
- Forward and reverse energy metered.
- Highly sensitive and selective radio receiver.
- Large, easily readable LCD display.
- All features programmable via IEC 1107 standard 'FLAG' opto port.
- Non volatile memory storage.
- Boost facility on 'C' contractor.
- Master station software for system configuration.

Radio Teleswitch RTS -

Radio Teleswitch (RTS) family provides central control of time-of-use tariff and electrical loads. Operation is controlled by commands and programme schedules issued using BBC Radio Four transmissions.

The Radio Teleswitch System consists of Regional Control Centres where switching instructions are formulated, the Central Teleswitch Control Unit (CTCU) where these instructions are collated and scheduled and the BBC's Radio-Data Message Assembler. The RTS data is transmitted along with the radio programme audio signal via the BBC's long-wave transmitters at a frequency of 198 kHz. Finally the messages are received and decoded by the Radio Teleswitch receivers installed at the point of electricity supply.

RTS Receiver features:

- Unsurpassed radio reception performance.
- Communications port for diagnostics and programming.
- Non-volatile memory programmes storage.
  -Stored programmes allocated to weekdays.
  -Stored programmes allocated to weekends.
  -Stored programmes for up to 4 seasons.
- User configurable fallback programme.
- Soft start option - contractors open on power failure.
- Extensive contractor configurations and switch arrangements - 80 Amp, 25 Amp, 2 Amp, 2 Amp.
- Industry standard terminal layout with standard range of connection arrangements available, including 25 Amp voltage-free contacts.
- Installation fixing screws located under the sealed cover.

Radio AMR technologies

TransPondIT allows the utility to receive data from its meters remotely by collecting data from the meter and transmitting it to a data collection device, which may be mobile or fixed. TransPondIT is capable of detecting tampering and can transmit an alarm.

It can be fitted or retro-fitted, in minutes, to most water, gas or electricity meters including those from ABB, Invensys (including Sensus, Socam and Meinecke), Badger, Schlumberger, Master Meter, Hersey Meters, Metron-Farnier, etc. TransPondIT is available in 400 and 900 Series. 434 MHz for mainland Europe and Ireland, and 900 MHz for the USA, Australia & other markets.

HandTrackIT is a hand-held reader. It enables a pedestrian meter reader to walk down a street and collect readings from the TransPondITs via radio. The HandTrackIT system allows for a combination of visual and radio reads on one round, i.e. fitting the AT RAMAR radio to those meters which are difficult-to-read, while continuing to read some meters visually.

HandTrackIT is available in 400 and 900 series. 434 MHz for mainland Europe and Ireland and 900 MHz for the USA, Australia & other markets.

- It easily interfaces to most hand-held terminals, including Radix, Itron, Psion, Logicon, Telxon etc.
- It integrates to most route management software including those provided by Datamatic, Logicon, Itron, Radix etc.

FastTrackIT is a flexible and low-cost solution for the North American Utility Market, is a wireless, vehicle-based system designed for residential and commercial environments, as well as rural areas. In a typical situation, the meter reader is able to drive through the meter route at posted vehicle speeds to collect meter readings. Readings are collected and stored in the laptop. A simple graphical user interface provides status reports and graphs, which are easily navigated via the keyboard or the computer's anti-glare, touch-screen. The entire system is license exempt. Additionally, since it is a transmit-only system, there is no need to "interrogate" the MIU, keeping operator intervention to a minimum.

The FastTrackIT system is supplied with Retriever data collection software. Once the data message is received by the FastTrackIT Receiver, the meter reading information is processed and stored by Retriever data collection software on the PC. Retriever is ideal for allowing the meter reader to gauge his performance during a meter-reading round, as well as storing a virtually unlimited number of account readings. Data is stored in a simple, text-based, standard file format, which can be modified to interface with most popular route management or billing systems. Data is uploaded and downloaded via a 1.44 MB floppy drive, network card, or Zip drive.

Utilities that install the FastTrackIT system can expect significant productivity improvements over a direct read system. Additional benefits include improved meter reader safety, improved accuracy, fewer re-reads, and improved customer service. AT RAMAR's FastTrackIT system has proved to be cost effective, reliable, and flexible.

FastTrackIT is based on an open systems approach to AMR. The FastTrackIT system is compatible with many popular components, including: meters, route management systems, billing systems and personal computers. The system is widely supported by a network of third-party software and hardware providers in North America.

- It is compact and easily transportable from one vehicle to another.
- It allows for very fast data acquisition up to 25,000 meters per day.
- It helps reduce the cost of meter reading.

CellTrackIT is designed to collect data from water, gas, and electric meters by radio and is well suited to residential and commercial sub-metering applications, such as apartment blocks and industrial sites. Meter reading data is collected from a cluster of meters within a local environment. The data is stored in an on-site PC and can then be accessed via a telephone or pocket radio modem.

CellTrackIT is ideal for sub-metering applications and can interface to any standard wide area network - e.g. public telephone network. CellTrackIT software is responsible for controlling the operation of the system; the CellTrackIT software provides powerful tools for collecting data, troubleshooting, and reporting on system performance. Additionally, alert and status notification messages can be sent via e-mail at regularly scheduled intervals or at the time of incident to designated individuals.

- **Scaleable Architecture**: Repeaters enable the CellTrackIT system to operate on small and large properties cost effectively.
- **Diagnostic Tools**: Sophisticated software provides system management information, including tamper notification, leak detection, and signal strength.
- **E-Mail Notification**: Meter data can be accessed directly through a dial-up connection or via e-mail.
- **Standard Interface Files**: Standard ASCII data allows for easy integration to most popular billing packages.

- **Easy Installation**: Unlike other automated solutions, CellTrackIT does not require extensive wiring. Therefore, investments made in landscaping are protected.

3. Internet solutions

These are relatively recent innovations (first appeared c1999) centred around a consumer interface device (typically built around a telephone or keypad unit) that collects meter data (by short range radio or internal powerline signalling) and transmits these via a modem over the PSTN (public switched telephony system) to a host server.

The level of functionality is programmed into the interface device and can be updated or overridden by the host server. Readings can be polled, HH or real-time monitored and transmitted. The use of TCP/IP protocols easily facilitate the addition of devices (monitors, actuators and an increasing variety of Internet appliances) enabling services such as home automation, domestic energy management, telecare and telesecurity. Because information is transmitted over the Internet interface devices typically incorporate data security features normally associated with on-line financial transactions and could be readily adapted to facilitate on-line voting. Although the cost of the technology is not great, significant initial outlay is required to deliver additional services.

Currently the modems employed operate with a bandwidth of 56kbps - more than enough to handle meter reading and simple teleservices. The technology is developing rapidly however and solutions that interface through cable modem and xDSL connections are becoming available (with bandwidth up to 2Mbps). This broadband connectivity will enable the development of highly sophisticated - and initially potentially expensive - services.

INTERNATIONAL DEVELOPMENTS

Although our information is slight patchy, there are a number of trials or innovations introduced overseas in related areas that could inform our own policy developments.

Enhancing consumer information in Norway

The results of two separate Norwegian studies[8] that looked into the effects of various forms of enhanced billing information on the consumption of customers, show that this can have a marked effect on consumers' incentive to use energy efficiently. One study (using electricity bills) tested the effect of:

- showing a comparison between current consumption and that in previous years;
- more frequent (60 day) billing; and
- Using graphs on the bill to show consumption levels alongside energy efficiency tips.

The study found that these changes tended to produce average energy savings of 10% which were maintained once they had been established for the first year.

A second study tested the effects of various forms of enhanced billing information, including historical data. The results showed that the consumers were satisfied with the information and also showed an increase in the number of those who reduced thermostat settings at night or when they were away. When the same households were surveyed again, two years later, the results showed that consumption in these households had fallen by around 4%, while during the same period general residential consumption had increased by around 4%, suggesting that, overall, the sample households had effectively made savings of 8%.

Both of these studies suggest that, with better information about their energy consumption, consumers can be encouraged to take action to reduce waste. Although both of these studies were based on billing information, a more advanced meter with communication capability could, on a more continuous basis, display similar comparative billing information for customers, and also advice about reducing energy consumption while maintaining comfort.

Variable tariff rates in France

In France, EDF have introduced a new optional tariff for domestic customers, called "Tempo", with prices that vary according to the time of day and year[9]. It colour codes days according to price (blue for low, white for medium and red for high) and each evening, a customer display unit indicates the "colour" of the following day, usually linked to the weather. Customers can then reduce their consumption on the highly priced days and EDF can reduce peak demand (it was originally devised as a load-shifting scheme). The system also allows customers to take savings made during one

[8] For more details see EA Technology report, "A review of the energy efficiency and other benefits of advanced utility metering".
[9] For more details, see report cited above.

period as increased comfort in others, without increasing their overall spending. Although there was no information about whether this had also led to reductions in consumption or costs, Tempo is beginning to become popular with customers, after a rather slow start.

This experience suggests that customers are willing to adjust their energy consumption patterns in order to save money. Smart meters could enable suppliers to vary charges for energy according to daily price fluctuations, which could help them to manage demand and offset their exposure to risk under NETA. It could also save consumers money by allowing them to budget their consumption, making maximum use of cheaper periods.

Load management in Italy

Echelon Corporation and Enel SpA are co-operating on Enel's "Contatore Elettronico" remote metering management project. Enel will provide (over a three year rollout period) approximately 27 million Italian households with digital electricity meters, capable of being integrated into a complete home networking infrastructure. The Contatore Elettronico project is expected to allow Enel to offer consumers:

- more accurate and timely meter reading;
- innovative tariff schemes encouraging energy saving (subject to regulatory approval);
- an open delivery mechanism for other value added services offered by Enel or other operators.

The project will also allow Enel to monitor actual consumption in real time. The standard domestic tariff is based on a peak load of 3 Kw (premium 4.5 and 6 Kw tariffs are also available) but currently Enel has no way of determining whether individual customers are exceeding that load (reportedly a widespread practice). The project therefore entails a certain amount of revenue protection on Enel's behalf.

Net metering in the USA

Net metering has been enabled in the US in thirty states, with a number of federal bills proposed that would enable it throughout the whole country[10]. It has been used as an incentive to increase the amount of small embedded generation, particularly wind power and in most states the generation facility is subject to a cap of 40 kW or less. In general, however, take-up has been disappointing because at such a small scale, embedded generation is generally not as economic as supply from the Grid. In Minnesota, where net metering for generators up to 40 kW in size has been possible since 1983, only 105 customers have taken this option, creating a total capacity of around 2 MW and total sales to the utilities of around 660 MWh in 1998. The utilities are required to purchase monthly excess power at an average retail rate and the generator pays an ordinary service charge. This has not proved to be economical enough to encourage wider take-up.

[10] For more details see "Net Metering – a real world approach", Windpower Monthly, February 2000.

In Iowa, generators are not size-capped but face a different kind of problem, this time from administrative and cost barriers created by the local utilities who fear that small generation will reduce their profits or that their networks might need reinforcement to handle the new, small generators. A range of sizes of generation facilities have been established, from under 100 kW up to 660 kW, by customers including schools, hospitals and businesses, and the bigger turbines are able to produce power more cheaply than supply from the Grid. The rules require that payment for excess power fed back to the Grid is no higher than the "avoided cost" of generation (typically about $0.02/kWh) but generally plant has been designed to meet the customer's load as closely as possible.

This experience indicates that, even with the technology to allow small generators to meter power flows both into and out of their premises, other factors must also be addressed in order to make this form of generation economic and attractive.

ANNEX E

PILOTS: ORGANISATION AND AREAS TO COVER

If the Government were to contribute to the cost of funding pilots, DTI would appoint a Smart Metering Project Manager to manage all aspects of the pilots. The Manager would be assisted by a consultative group, including Government and industry representatives. The consultative group would advise on matters pertaining to the pilots, though industry representatives would not see individual applications, to avoid any conflicts of interest.

The first step for the Manager would be to consult with interested parties, in the light of the SMWG findings, with a view to refining the scope of the 3 pilot areas to be taken forward, communicating this to the market and generally raising awareness of the availability of DTI funding. This would lead to drafting of proposal specification(s) - either one overarching specification or three separate ones - to be put to the consultative group for review and approval. It would be important for the proposal specification(s) to be carefully developed accurately to reflect the SMWG's conclusions and the needs of the market, as it would determine subsequent operation of pilots and any roll out of smart metering technology.

The Manager would decide whether a competitive tendering process should apply to proposal selection. If funds were likely to be sufficient to support all projects that met the minimum criteria, there may not be the need for a competitive tendering process. However, this would be necessary if there were a possibility that the total value of qualifying bids would exceed the total funds available. Any competitive tendering process would need to comply with the requirements of the EC Public Procurement Directives and the call for proposals must be posted in the Official Journal of the European Communities.

<u>Objectives, methodology and outcomes</u>

The trials should be designed to test:

(a) the social, environmental and consumer benefits of the meters (such as ability to reduce bills, cut emissions, supply new services, create new consumer markets, bring more people on-line);
(b) the technical attributes (such as the performance of various types of meter, trials of autoswitching, delivery of internet services, interaction with existing distribution networks); and
(c) the likely costs both to companies and consumers of the installation and maintenance of various types of meter and of remote switching of appliances.

The trials should involve a cross section of society, covering for example, inner city housing, affluent suburban housing, rural areas and a new residential development. They would also need to represent the three technology types across each of the social sectors.

Outcomes of these trials could include the following:

i. power use and emissions in appropriate areas outside or previous to the trial compared with power use and emissions where smart meters were installed;
ii. an analysis of time shifting;
iii. analysis of passive and active use of the technologies by consumers;
iv. analysis of technical and any other problems associated with the installation and maintenance of meters;
v. analysis of the performance and efficacy of remote switching;
vi. costs of various units and the potential for reductions;
vii. analysis of the potential to standardise the technology and make it "futureproof";
viii. Consumer attitude towards the smart meter, measured over the period of the trial, including views about the individual aspects and services offered by each technology type and willingness to pay the going rate (or another rate) to secure them.

What size trial?

There has been some consideration as to what size of trial is necessary to demonstrate the potential of smart metering technologies. There are various measures of total population - 26 million homes (virtually all with at least one electricity meter), 16 million gas meters, a non-quantified but significant number of water meters and smaller numbers of heat meters. In total there are estimated to be around 75 million meters deployed in the UK. Currently electricity meters are swapped out at a rate of around 1 - 1.5 million annually.

In the generality, a significant sample of a few thousand meters would suffice. However the smart meter demonstrator is not concerned with a single attribute, rather three different classes of technology are to be tested and within each class a number of different technological solutions are available. The total population is further stratified by geography (urban, mixed, rural) and other demographics (such as pre-pay/credit, in-area/out-of-area). Rather than being an homogenous population, meters fall into one of approximately 100 strata. A truly representative trial would therefore need to take in up to a dozen technologies in sufficient numbers to take in different types of consumer in a variety of locations. However, to be realistic any trial should also be capable of being resourced by both the manufacturing sector and the supply/metering operating industries (and we would expect any Government funding to be matched on an equal basis by the industry).

A trial involving at least 500,000 units (meters rather than dwellings), embracing the range of technology types, has been suggested (by ECI, Oxford) as a level at which definitive results would be obtained. We can assume an average cost of around £150 per installation (see further details at Annex F). Funding would also need to cover reversion back to old meters at the end of the trial for any customers who wished to do this. Evaluation costs would be substantial as this is a large exercise that would require detailed and technical evaluation of its results. These added costs could push the average price per installation to around £200 which, applied to a sample of 500,000 meters implies a cost of £100 million. However, given the range of options available and the likely limitations on funds useful pilots could still be carried out on a smaller scale with more modest funding.

Examples of pilots

Display Meters

Proposals would be geared primarily at the alleviation of fuel poverty through relatively large scale deployment of smartcard or tokenless pre-payment in older metropolitan housing stock in less affluent areas. Proposals would need to be championed by supply companies and detail how the preferred metering solution would address fuel poverty (eg a conveniently located consumer unit displaying energy used in monetary terms). Bids should also include details of any supporting energy advisory services and projections of the anticipated reduction in consumers' bills. Also details on how negative effects (eg self-disconnection) would be monitored and managed.

Automated Meter Reading/Net Meters

Proposals would be geared primarily at reducing the ancillary costs of supply (costs of physically reading meters, elimination of estimated bill queries) and/or enabling net metering. Likely to be suitable for both in- and out-of-area, proposals should include how cost savings would be passed on to consumers. Net metering proposals would be likely to be suited to larger shared dwellings in the first instance. Proposals should also outline where trials would be coupled with the demonstration of embedded generation technologies.

Pilots should seek to quantify savings for consumers, and anticipated demand side management savings for the supply companies. A range of technologies should be encouraged (fixed, mobile wireless; powerline signalling; single and duplex communications channels). Proposals should also outline negative effects (displaced employment).

Internet Meters

Proposals would be likely to be geared at vulnerable (elderly, disabled) consumers, possibly in sheltered housing communities. Also appropriate to higher density C2DE housing where on-line access would not otherwise be available. Pilots should seek to demonstrate the delivery of additional services (telephony, telecare, telesecurity) and should therefore involve a wider range of service providers and integrators. As these solutions are relatively expensive, proposals should be supported by a strong business case and have a rigorous monitoring and evaluation mechanism built in.

Local authority and charitable foundations would be likely to be closely involved.

Assessment of proposals

Proposals would be assessed against the selection criteria proposed by the Manager and approved by the consultative group. Examples of selection criteria include:

- Does the pilot fit in to one of three broad categories;
- Is the technology tested elsewhere;

- What are the chances of success and potential market;
- What is the cost and partner funding;
- Does it present value for money;
- What is the extent of partner commitment;
- Does the proposal demonstrate appreciation of key issues related to smart metering;
- Have bidders specified a realistic forward plan if the pilot is successful and have partners made a commitment to continue;
- Does the proposal put forward a sound methodology;
- Does the bid include a commitment to meet the data requirements (with confidentiality agreements as necessary);
- What is the technical capability, capacity and relevant experience of the bidder;
- What are the risks associated with the proposal and how are these addressed.

Note: this is not an exhaustive list

It is proposed that an initial assessment be undertaken by the Manager with other representatives from the consultative group to identify a short list of preferred bids who would then be invited to present to the consultative group, to allow clarification of any areas of the proposals or further explanation. The project manager would make recommendations concerning which pilots to support, though senior DTI officials would be responsible for making the final decision on bids to go forward in the pilot project.

<u>Operation of pilots</u>

The Manager would ensure contracts are let in accordance with DTI's requirements and would be responsible for monitoring and overseeing the performance of contractors throughout the duration of the pilots. This would involve agreeing work programmes and timetables, reporting requirements, data collection, deliverables and ensuring adequate progress is being maintained. It is recommended that data requirements be specified as part of the proposal specification and selection process. It is possible that some essential data, for example billing data, may be commercially sensitive, therefore it would be necessary to address confidentiality issues at the time of contract letting.

As the pilots would be likely to take place over an extended period, perhaps up to 18 months if a full year of meter operation is to be monitored, there would be a need for ongoing involvement of the Manager. This would include site visits to witness first hand the operation of each pilot and attendance at any technology demonstrations. As a minimum, each contractor would be required to provide quarterly progress reports to the Manager and six-monthly progress reports, possibly including presentations, to the consultative group.

<u>Evaluation</u>

The evaluation would look at the results and lessons learnt from the individual pilots and the pilot project as a whole. It is recommended that the evaluation process run concurrently with the pilot studies to allow ongoing monitoring and evaluation of all stages of the pilots, including technical and practical issues of pilot operation as well as analysis of the final results. This would also allow the evaluation to feed back to the pilots, facilitating early identification and resolution of problems. The evaluation criteria for the study as a whole should be defined and approved by the consultative group at the start of the study and performance indicators specified for each criterion. Examples of evaluation criteria include:

- Technical evaluation and potential for market-wide application;
- Energy, carbon and financial (customer bill) savings;
- Fuel poverty benefits;
- Benefits from other services delivered (e.g. internet, home security);
- Customer perceptions of the technology and actions stimulated;
- Impact on Demand Side Management;
- Relevance to domestic CHP and/or energy services;
- Impact on existing distribution networks;
- Process of delivery /marketing by Suppliers;
- Competitive/Regulation barriers to progress;
- Cost effectiveness.

Note: this is not an exhaustive list

Evaluation could be undertaken by the Manager, if suitably qualified, or by another body with the relevant skills and expertise.

ANNEX F

COMPARATIVE COSTS OF 'SMART' VERSUS 'STANDARD' METERS

Meter type	**Costs**	**Comments**
Standard credit tariff	£50 - £70	combined cost of supply and installation.
Standard prepayment meter	£80 - £100	combined cost of supply and installation.
Smart 'Display' meter	£75 - £120	Supply and install. Includes cost of display unit. Potentially additional costs associated with pre-payment token systems.
Smart 'AMR/Net' meter	£100 - £170	Supply and install. Additional infrastructure costs eg wireless or powerline communications systems
Smart 'Internet' meter	£150 and upwards	Supply and install. Includes costs of TCP/IP stack. Additional infrastructure costs apply directly related to the number of additional services carried over metering system.

Note - cost estimates supplied by BEAMA. Currently no economies of scale in smart meters.