Smart metering in the UK

Policy, technology and market drivers

A discussion paper

FINAL

Manchester Business School

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Report Contents

1. BACKGROUND AND METHODOLOGY

This report was completed as part of a wider study to examine changes to the policy framework in relation to smart metering within the UK energy market. The study was completed by Professor Margaret Bruce of Manchester Business School on behalf of Generis Technology Limited, a provider of software and services in relation to meter data management, in order to provide strategic market knowledge.

At the time of writing the preliminary draft version of this report, BERR[1] was due to release the conclusions of its second consultation exercise in relation to the potential roll-out of smart metering in the UK and this could clearly affect the content of this report. BERR had also commissioned Mott MacDonald to carry out a Cost Benefit Analysis which was not publicly available at that time. However, BERR had placed all of the non-commercially sensitive parts of all responses to the consultation on its website so whilst BERR's conclusions were unknown at the time of writing the first report, the responses and views of a wide range of stakeholders are known. In addition the conclusions and responses to previous BERR and Ofgem consultations were available.

BERR has now released its conclusions to the consultation along with a mini-consultation on smart metering roll-out cost-benefit together with the full analysis by Mott MacDonald. These have been taken into consideration within this report and the report has been re-structured to reflect the options left on the table for evaluation in the light of the consultation response.

The study methodology included:

- Interviews with key organisations including BERR, Defra, OFGEM, ERA, Elexon
- Scrutiny of the extensive and comprehensive responses to three key national consultations[2] and other related policy consultations
- Analysis of reports presented as evidence for consultations e.g. The Frontier Economics and the Sustainability First reports
- Analysis of whitepapers, reports and other documentation in relation to smart metering on the world-wide stage
- Interview with key energy industry players and other stakeholders

This report represents an analysis of the widest possible scope for planned changes and identifies five key areas that need to be recognised and considered if an effective policy is to be implemented. The capital cost alone for new meters is in the order of £2 to £3 Billion, with potentially another £2 to £3 Billion in installation costs on top of the asset value of the mechanical meters being prematurely removed from service of around £500 Million. This is confirmed by estimates from Frontier Economics for Centrica that the ERA Regional Franchise approach costs are of the order of £6 Billion.

[1] BERR is the Department for Business Enterprise and Regulatory Reform, formerly the Department of Trade and Industry (DTI). The change occurred within the timeframe of the policy analysis, referred to as BERR throughout this document.

[2] Ofgem, Domestic Metering Innovation Consultation, February 2006; BERR Energy billing and metering, Changing customer behaviour First Consultation, November 2006; BERR Energy Billing And Metering, Changing Consumer Behaviour Second Consultation, August 2007.

2. POLICY BACKGROUND

It has long been recognised that in order to manage a resource effectively it is first necessary to measure its consumption; as the cliché suggests "*If you don't measure it, you can't manage it."*

The desire to reduce the impact from domestic energy consumption of the emission of carbon dioxide (both direct from combustion in the household and indirect from power station emissions) in order to reduce its impact on climate change, has led to EU policy and a UK Government Vision which sees smart metering as a fundamental building block in domestic energy reduction. The Government's Vision can be seen in recent speeches, for example:

> *"For every household over the next decade, there will be the offer of a smart meter that will allow two-way communication between the supplier and customer, giving more accurate bills and making it easier for people to generate their own energy through microgeneration and sell it onto the grid,"*
>
> **Gordon Brown, Speech on Climate Change (19 Nov 07)**

The use of a smart meter has been shown to be a key tool in the reduction of domestic energy use. In fact, smart metering for industrial users is recognised in the Energy Whitepaper as having one of the highest cost benefit cases on the whole marginal carbon abatement cost curve.

EC Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services (known as the "energy services directive" or "ESD") also sets out requirements in relation to energy billing and metering which, as a Directive, need to be transposed into each Member State's own legislation. BERR's August 2007 consultation document contains draft regulations designed to do this as The [Electricity Billing and Metering] Regulations, 2007 and The [Gas Billing and Metering] Regulations, 2007.

It is important to recognise that a smart meter is not a low energy technology in itself since it does not reduce consumption per se. However, its role in providing accurate and timely feedback to the householder has been shown in a variety of small scale pilots to be pivotal in achieving energy reductions.

In addition, pilot trials by the energy firms themselves and the analysis of their own business operations shows that there can be clear benefits from the use of smart meters, benefits which also, on the whole, benefit consumers. The back office costs of managing customer enquiries about estimated bills is a major one and this, coupled with the costs of reading meters manually, provides a potential and real direct cost saving as a motivation for the implementation of smart meters. This is before any carbon cost benefits are factored into the equation.

These benefits are dependant on an investment in smart metering which is substantial since not only are the costs for smart meters higher than the current traditional or "dumb" meters but there is also any cost of an accelerated programme of meter replacement. That is not to say that left to its own devices the market would never adopt smart metering. Natural levels of meter replacement run very simply at approximately 5% per year, giving an average asset lifetime of 20 years (some say the average is closer to 17 years) and within this there are approximately 5.9 million pre-payment meters. These have a higher cost-to-serve and therefore represent an attractive commercial proposition for replacement with smart meters capable of two-way communication.

Smart metering has already been taken up by energy companies in different parts of the world including Holland, Italy, Australia and some US states frequently driven by a clear cost benefit to energy providers. However, it is important to recognise that there are some factors which make the analysis of a policy shift to smart metering more complex for the UK.

There are three background factors to consider in relation to the possible roll-out of smart meters in the UK energy markets:

- The competitive market structure
- The extent of pre-pay and token meters
- The issue of fuel poverty

The UK energy market has been through a long and extensive set of changes in order to make it more competitive for the consumer than its prior incarnation as a national and natural monopoly. This process has taken over 20 years and seen widespread change in the domestic market including separation of generation, transmission and distribution, retail and even metering activity. These changes have, on the whole, brought reductions in bills for the consumer, although these are not always perceived due to general increases in wholesale energy prices.

The competitive metering market with the creation of separate meter operators and meter readers does mean that there are key issues to be taken on board when considering the policy in the UK. There are several competitive boundaries including Meter Asset Manager (MAM), Meter Readers (MR) and Meter Operators who carry out a wide range of Meter-Related Services including the provision, installation, commissioning, inspection, repairing, alteration, repositioning, removal, renewal and maintenance of the whole or part of the Supply Meter Installation.

The UK market also has a relatively high level of non-credit customers with pre-payment meters. In all there are an estimated 5.9 million pre-payment meters in use in Great Britain (around 13 % of domestic meters). This comprises 2.1 million gas PPMs - 10% of domestic gas customers and 3.8 million electricity PPMs - 15 % of domestic electricity customers. It is recognised that these meters have higher cost-to-serve than dumb meters for credit customers (i.e. customers paying in arrears on receipt of a bill).

Fuel poverty is also of particular concern in the UK and there has been strong representation from fuel poverty and other interested groups setting out their concerns that smart meters might also affect those in fuel poverty. There is particular concern about the elderly who might struggle to understand the information provided by a real time display, for example, and for whom many might already be using too little energy.

Finally, it is important to recognise the context for the UK drive towards smart metering. There are many other areas on the policy agenda including the Climate Change Bill and the Household Supplier Obligations and CERT which are clearly going to have a major impact on the structure and nature of the UK energy markets in particular.

3. INITIAL POLICY SCENARIOS UNDER CONSIDERATION

There were originally three headline policy scenarios under consideration which were covered as part of this analysis relating to proposed changes in relation to smart metering and customer feedback of energy consumption (excluding billing) in the UK domestic energy market. These were:

1. Do Nothing

2. Advocate the supply of Real Time Displays to domestic premises

3. Advocate the supply of Smart Meters to domestic premises.

This study has not examined in any detail the proposed changes under the Energy Services Directive (ESD) in relation to domestic billing nor does it dwell on the issue of smart metering in the business sector, especially for SMEs.

3.1. Do nothing

The outcome of the BERR consultation made it clear that the Government's vision, coupled with the Energy Services Directive (ESD) means it is highly unlikely that the Do Nothing scenario would be a realistic option. The Government's policy plans are far wider than simply a response to the ESD. The Government's vision includes smart metering via the Energy White Paper, the Climate Change Bill and there are also strong targets planned for carbon emissions reduction from the domestic sector which will be implemented via the household supplier obligations.

As mentioned in the previous section, the "do nothing" scenario would not automatically lead to no implementation of smart meters in the UK, that is to say the continuation of "dumb for dumb" meter exchange. It is likely that over time, the 5.9 million pre-payment meters would be switched for smarter systems as it is already cost effective to do so.

In conclusion, smart meters are the first step of many planned changes in response to climate change for the domestic sector and it is highly unlikely that the do nothing scenario will be a palatable solution. In fact overall the energy industry says that it welcomes the idea of a mandate for smart metering.

3.2. Real Time Displays (RTDs)

The term Real Time Display (RTD) is used within the EU Directive to mean some additional device, remote from the meter itself which is able to provide feedback to householders on their energy consumption. This in turn allows householders to understand their energy consumption profile and magnitude of usage woth more precision and to recognise their impact of changing behaviour and consumption from domestic devices. This technology is also called an Electricity Display Device (EDD) or a Visual Display Unit (VDU).

It is frequently stated that the benefits of RTDs are essentially a sub-set of the benefits of smart metering. This is not exactly true, smart meters do not have to come with a remote visual display device to provide feedback to consumers enabling them to, of their own volition, try to reduce consumption of energy. However, it is clear that the cost of supplying these devices, along with installation and support for the consumer has an opportunity cost which could delay and even defer spending on smart metering. It is also important to recognise that the majority of RTD are currently for electricity only.

The EC Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services (The "ESD Directive") has two clear areas of interest – metering and billing – although the emphasis of this document is on the metering side. Article 13 of the Directive calls for billing to "accurately reflect the final customer's actual energy consumption and that provide information on actual time of use". This has been interpreted to mean some form of real time display, possibly coupled with a smart meter. (For the full text of Article 13 of the ESD see Appendix One).

The use of a clip on or retro-fit, relatively low cost real time display device is one solution that has been put forward for this. The solution is already available to householders who wish to buy one but there are however genuine concerns from the industry about RTD. These are numerous and include the fact that RTDs have:

- less accuracy than the current domestic meter
- a lack of synchronisation with the actual meter reading leading to a possible disjoint with billing
- to be installed, meaning that there are possible health and safety issues if consumers are left to do this themselves
- suitability for electricity metering only, not gas which can be a considerable proportion of a typical domestic premises energy consumption.
- some maintenance needs – who pays for and changes the battery?
- scope for stranding – if one supplier provides the device and a householder chooses to switch supplier then the RTD will effectively be stranded.

There is also the question of who will take up RTD if their provision is based on requests. It is hard to predict how many householders will avail themselves of this option and, as Ofgem point out, this could lead to poorer customers subsidising wealthier ones.

Fundamentally, the key consideration in relation to Real Time Displays is the Opportunity Cost for their provision. A mandated programme of provision would see the industry being diverted away from more expensive but more beneficial smart metering.

Apart from the makers of RTD, there is very little support for real time displays in preference to full smart metering. In fact David Taylor MP, in his response to the BERR second consultation summarises the general feeling for these as "a damaging distraction". A selection of quotes from the consultation responses is enough to show this widespread agreement:

"… the proposal to require suppliers to provide electricity clip on visual display units for an interim period is a costly intervention that is unlikely to deliver any benefits and will distract suppliers and delay the introduction of smarter meters. We are particularly concerned that offers of a free display are likely to be taken up disproportionately by better off customers but the costs will be paid for by all customers including poorer and more vulnerable customers."

Ofgem response to BERR

"We firmly believe that there is no requirement under the Energy Services Directive (ESD) to provide real-time display devices for a two-year period pending the full roll-out of smart meters."

Scottish and Southern Energy (SSE) response to BERR

3.3. Domestic Smart Metering

During the course of this study it has become clear that there are many factors that need to be taken into consideration when analysing a policy-driven or mandated approach to the implementation of smart

metering within the domestic sector. The use of smart meters has many cited benefits including energy (and consequentially carbon) reductions, reduced cost to serve customers and more satisfied customers due to accuracy of reading. (For a more complete list see Appendix Two) and yet there is little clarity due to policy uncertainty and ongoing technical and commercial uncertainties.

All of these benefits along with the costs for any chosen approach are pertinent to any evaluation of the best course of action to implement smart metering. By "best course" we are implying that it should be possible to identify an approach which minimises industry and consumer cost and impact whilst maximising benefits, minimising customer inconvenience and maximising the potential for carbon savings. This is a tall order and it is inevitable that some degree of satisficing, is likely[3].

3.4. Implications of BERR's April second consultation response

BERR's consultation response has narrowed the options on the table for taking smart metering and related activities forward.

In essence, the "do-nothing" scenario is no longer an option and BERR has also proposed not to move forward with mandatory RTD providing that domestic smart metering is on the cards. BERR has put forward a range of policy options for the implementation of domestic smart metering in Great Britain and these are discussed in more detail in the next section.

It is clear that there are many factors that need to be taken into consideration when exploring the best course of action for smart metering and these are considered in more detail in subsequent sections including an analysis of three different levels of complexity for a domestic smart meter roll out.

[3] Herbert Simon, who coined the term satisfice as a hybrid of "satisfy" and "suffice" for the situation where people do not or cannot search for an optimal solutions.

4. PROPOSED OPTIONS FOR DOMESTIC SMART METERING

The BERR consultation response and associated Impact Assessment for consultation outline a number of possible routes forward for smart metering and these are summarised as:

1 No domestic smart metering mandate but a better billing and displays policy

2a Mandated 10-year roll out of Automated Meter Management specification smart meters within existing market structures

2b Mandated 10-year roll out of Automated Meter Reading specification smart meters within existing market structures

2c Mandated 10-year rollout of 'smart box' technology (equivalent to Automated Meter Reading meter specification) within existing market structures

2d Mandated new and replacement roll out of Automated Meter Management specification smart meters within existing market structures

3 Mandated 10-year roll out of Automated Meter Management specification smart meters in a regional franchise market model

Other options were also mentioned as having been considered by BERR including:

- Smart metering rollout through electricity Distribution Network Operators and Gas Distribution Networks
- Infrastructure provider for a 10 year rollout
- Indirect Government mandate

The smart metering policy options (2a-2d and 3) can therefore be contrasted as follows:

Option	Market Structure	Meter technology	Timescale	Period of rollout
2a	Existing	AMM	10 years	2010 – 2018
2b	Existing	AMR	10 years	2010 – 2018
2c	Existing	Smart Box	10 years	2010 – 2018
2d	Existing	AMM	20 years (maximum)	2010 – 2030
3	New	AMM	10 years	2012 - 2020

Table 4-1 – Summary of key distinctions between policy options for domestic smart metering

N.B. From the period of rollout dates it can be seen that the actual period for a nominal 10–year rollout is actually 8 years. For option 3, this 8-year period commences two years later than the other scenarios to allow adequate time for legislative changes to the market structure and for the creation of a coordinating body/ bodies based on a regional approach.

4.1. Meter Types

As Table 4-1 in the previous section shows, there are essentially three different smart metering technologies being discussed. These are AMR, AMM and Smart Box. The crux of any major and certainly national project for smart metering is the wide range of technical decisions to be made. Within the IMAG definition of a smart meter there are many complex technical decisions to be made in terms of the approach to be taken. Whilst we take the view that these choices are not insurmountable it is important also that these choices are not rushed. Parallels with any standards war, the often-cited VHS versus Betamax and the more recent HDDVD versus Blu-ray show how complex these decisions are.

The fundamental requirement of any technology choice for smart meters is that it works but also that there is interoperability between different meters. Any standards-based decision is akin to the problem of "picking winners" and also to ensure that there is some element of future proofing in an area, especially meter communications, where there is a considerable rate of innovation and progress. In essence and in order to de-risk the implementation of smart meters there is much to consider apart from whether each technology is suitable for all houses – both those in cities and those in rural areas – for example whether the GSM mobile phone network will still be operational in 15 to 20 years. So the major concern for such a big ticket technology choice is the threat of obsolescence.

As an example for communication there is the choice of a communication from the domestic premise to the supplier or data intermediary e.g. GSM, SMS, PLC, PSTN, and also the local communication between the gas and electricity meter e.g. M-Bus, Zigbee and ZWave. There has already been considerable work on this but the concern is that there is flexibility of approach both in relation to radio spectrum frequency and also in terms of technical data standards and protocols. There is also the issue of backwards compatibility as the technology progresses and also the expected lifetimes of the technology.

"Although no detailed modelling has been done it is not unreasonable to assume the following scenario would occur:

The initial technology choices would become outdated after say 5 years, rendering the original cost model obsolete e.g. GSM overtaken by WiMAX. This will also consign the associated systems to legacy status; this therefore also has the potential to strand assets and necessitate multiple systems which will have to run in parallel."

PRI response to BERR

The Association of Meter operators point out, interoperability works at three levels – 1) Technical – local (in-house and between meters (gas and electric), 2) Technical – wide (from the house to some network to the retailer) and 3) Commercial (between retailers on Change of Supplier)

There are also issues in relation to changes to the balancing and settlement code (BSC) and other industry adjustment systems and also in relation to meter data messaging protocols.

"Without changes to industry data flows, energy suppliers and service providers will not automatically know:

a. Whether a meter is in-fact a smart meter
b. The identity of the asset owner for the installed smart meter
c. What type of smart metering equipment is installed and whether it is supported
d. What the data protocol is used to communicate data
e. What communications the meter has or can support"

TruRead response to BERR

"Interoperability is best met at the "head-end" of communications systems, by meter data management systems (MDMS). By this means, any number of technologies can operate concurrently with no need for constant redevelopment of central billing systems. Most competitive meter operators already have a flexible MDMS in place and are capable of interfacing to all major billing systems."

Siemens Energy Services response to BERR

It is also important to note that AMR, AMM and Smart Box technologies do not automatically have to come with a remote Real Time Display device.

4.2. Approaches to the domestic roll-out of smart metering

As Table 4-1 shows, there are essentially two different approaches to smart metering technologies being discussed one set of approaches is within the existing market structure and the other approach is based on developing an alternative market structure around the idea of regional franchises.

The business as usual approach or non-mandated approach has already been discussed and concluded that up to 6 million domestic meters might be naturally replaced by energy companies due to their high cost to serve. However, in order to buck that natural level to more widespread coverage it is likely that this will only come through some form of mandate from Government. There are several ways in which this could be mandated directly, as follows:

- New and replacement
- New and replacement and on request
- Accelerated

There are two options that have been covered extensively under the accelerated scenario, the default Market /Supplier Hub mechanism and a scheme put forward by the ERA for an administered approach via Regional Franchising.

In addition, it is has been suggested that if Government mandated monthly meter reading then this would create a massive incentive for smart metering since the costs for 12 visits to each household per year would be dramatic and would tip any payback analysis for smart metering. This does not consider the issue of practicality, especially the potential perception of intrusion.

These three scenarios are now discussed in turn but it is critical to recognise that the fundamental questions under Complexity 2 in section 5 have a massive effect on any cost benefit calculations. For example, if the biannual visual health and safety check remains a requirement then any cost benefit from Automated Meter Reading resulting from the avoidance of the cost to send out a meter reader in person will be halved – i.e. it will still be necessary to send out someone in person to carry out a health and safety check every two years.

A dual fuel approach to meter switching clearly creates an enormous cost benefit in terms on one visit being necessary for every household rather than two separate visits.

4.2.1. New and replacement

Under this mandated approach any new build domestic property would be fitted from the start with smart meters. The current replacement cycle for dumb meters would be converted to replacement by smart meters. Under simple industry averages this would take up to 20 years but has the advantage of fitting into the industry's current schedule of activity.

In essence, the marginal costs for this would be the marginal capital costs for each smart meter with the only other marginal costs being the communication costs for the meter along with any systems needed to interrogate meters.

It is also likely that pre-payment meters would be switched on an accelerated basis as there is a clear commercial case to do so. This would help to create more critical mass for smart metering.

4.2.2. New and replacement and on request

This is the same scenario as 4.2.1 but with additional upfront loading to allow those householders who would like a smart meter to have one sooner than the natural meter replacement cycle.

This has the benefit that those who are most keen to use a smart meter to reduce their energy consumption will be able to self-select. It is also likely that there will be an element of "conspicuous consumption" of wanting a smart meter because it is a fashionable thing to have.

This option has not been put forward under BERR's policy options so it is not discussed further.

4.2.3. Accelerated Smart Meter Rollout

The term accelerated is used to describe a mandate switchover to smart meters in any timescale shorter than the "natural" replacement rate. This is the only approach that would meet the letter of the Government's vision in which a timescale of "within 10 years" is used.

There are two different approaches to accelerated smart meter installation under discussion:

1. a market led model with each energy company being responsible for accelerating the roll out of smart meters (also called SHM or Supplier Hub Model)

2. a Regional Franchise Model (RFM) as put forward by the ERA which is also accelerated with the assumption that this could be completed with seven years.

	Accelerated Market Model	**Regional Franchise Model**
Regulatory Mandate	YES	YES
Additional Regulatory changes: 1) Complexity 2 issues 2) Other	 YES NO	 YES YES (Change of meter ownership, creation of regional and national franchise structures)
Dual Fuel	NOT EXPLICITLY (although some customers will inevitably take dual fuel from same supplier)	YES (Specified in RF model)
Timescale (proposed)	10 years (8 actual)	10 years (8 actual)

Table 4-2 – Summary of key distinctions between policy options for domestic smart metering

The regional franchise model has been developed by the ERA and, as shown in Table 4-2 above, would clearly require a fundamental restructuring of the sector.

"What we have learned from this experience is that today's unbundled metering model – with its numerous data flows, agent interfaces and databases - negates many of the inherent advantages of smart metering technology, characterised by instant 'machine to machine' communications."

British Gas response to BERR

"Given the relative lack of benefits (if any) that metering competition has delivered to date, its demise is a small price to pay. In enabling a smoother and more orderly roll-out of smart metering, the advantage of its removal are readily apparent."

RWE NPower response to BERR

"Policy uncertainty has been a key reason for the limited investment to date in domestic smart metering. Since mid 2005 Ofgem has been conducting a Competition Act investigation in relation to National Grid's domestic metering contracts and this has created great uncertainty within the metering market. Suppliers have publicly stated that they have suspended their competitive tendering activities until the investigation is concluded."

National Grid response to BERR

"In particular, we urge Government to rule out any reversal of metering competition so that the work needed to prepare for smart meter roll out can begin in earnest."

Ofgem response to BERR

"For domestic customers, government has signalled that it recognises the benefits of intervening to the minimum extent possible to deliver on its 10 year vision for smart meters. We would urge government not to adopt measures (such as the regional franchise model proposed by the larger suppliers) which are unnecessary to deliver smart meters and that would leave domestic customers to carry the risks associated with expensive meters and poor technology choices for decades to come.

Suppliers are entitled to argue that significant industry change and new areas of supplier co-operation may be required if we are to capture the key benefits of smart meters. However, this falls a long way short of making an effective case for abandoning the competitive market that is being established."

Ofgem response to BERR

"We do not support the ERA's proposals for introducing smart metering to the UK. The proposals go way beyond that which is required to implement a successful smart metering programme and potentially may damage supply competition and increase costs to consumers."

British Energy response to BERR

It is clear from these responses that the regional franchise model is not universally welcomed. Whilst it offers a way to reduce the costs of the installation and co-ordination elements of an accelerated smart meter rollout it will also require re-structuring the current market model along with the necessary legislation and regulation which will take time to achieve. It also requires a dual fuel approach to be mandated. It will be interesting to see whether BERR will recommend a route that is not supported by Ofgem.

4.2.4. Simple comparison of the main options

The relative rate of replacement for the four approaches is shown Figure 4-1 below.

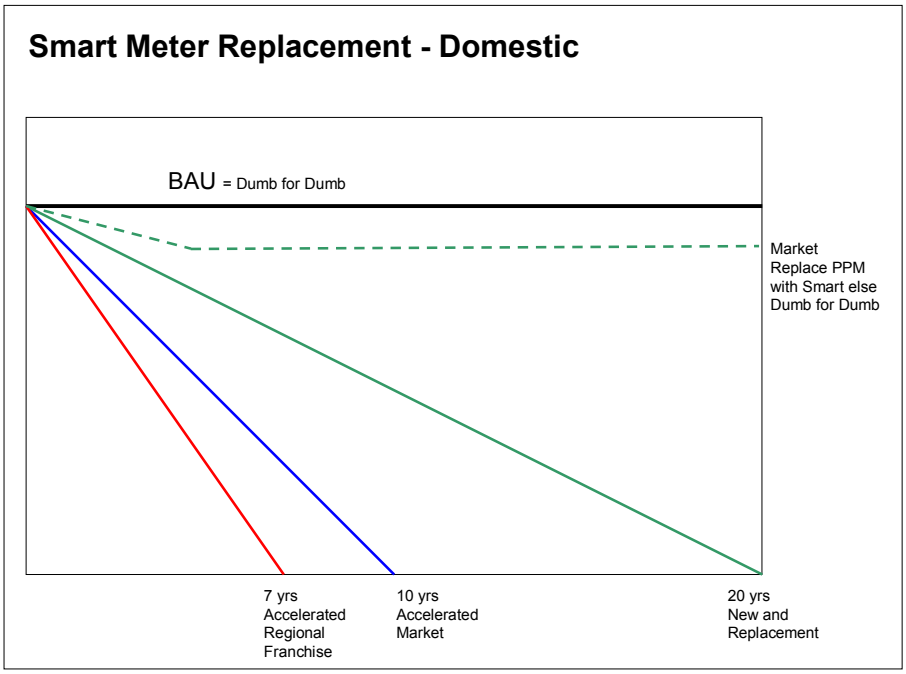

Figure 4-1 – Comparison of meter replacement rates

No attempt has been made to show the "new and replacement and on demand" line on this figure since it is not easy to predict the demand. It should also be recognised that either of the two new and replacement scenarios would have a steeper (i.e. faster) replacement rate since it is likely that these would include a slightly accelerated replacement of PPM meters since they generally have the highest cost to serve.

Given that any analysis of the cost-benefit case for smart meters will discount projected cash flows in order to reflect the time-value of money means that the timescale for the transition will have a dramatic effect on the final results. Clearly to get benefits within seven years will, ceteris parabus, have a better return than to get the same benefits pro-rata over 20 years. Conversely costs incurred far in the future if at the same real rate for a smart meter (and as some suggest at lower unit costs due to volume and technological improvements) will also be preferred. This is true even using an relatively low industry WACC[4] of 5%.

[4] Weighted Average Cost of Capital

5. COMPLEXITIES OF DOMESTIC SMART METER ROLLOUT

The original research carried out for this project identified and summarised the issues surrounding smart meter roll-out into five different levels of complexity ranging from the background context, through types of meter and approach to smart meter roll-out. These were not necessarily specifically categorised as such in the various consultations and responses. It is our view that each of these will have its own set of decisions and could clearly affect each of the other inter-dependant complexities.

The BERR consultation response and associated Impact Assessment for consultation outline a number of possible routes forward for smart metering. In essence, the proposed policy options provide additional clarity in terms of two of the five complexities identified ("Technical meter issues" and "Possible approaches to roll-out") and these have been removed from this section.

The three complexities under consideration in this section are:

Complexity 1 – Background context and scope

Complexity 2 – Baseline assumptions for roll-out

Complexity 3 – Wider issues especially risks and perceptions

The provision of more clarity and certainty within each area of complexity either from Government, Ofgem or the industry, will mean that it should be possible to identify a best course of action for the roll-out of smart metering to the domestic sector within a reasonable timescale and in order to reap the full potential of smart metering.

5.1. Complexity 1 – Background context and scope

There are several basic questions that still need to be answered if the analysis of potential routes for smart meter rollout is not to become an iterative process. It is likely that the answers to some of these questions will become clearer in the run up to October 2008.

5.1.1. What is a smart meter?

This question is of fundamental importance to any policy on smart meters. There is no single definition of a smart meter and so there are many different possible meanings ranging from a simple one-way device which enables remote reading of the meter (AMR) to a two-way device with complex functionality (AMM). A two-way AMM device which enables not only remote meter reading but also allows changes to the household's supply set up (switching from prepay to credit, changing time of use tarriffs or enabling remote disconnection etc.). In addition in order to comply with the ESD it is likely that a smart meter (whether one- or two-way) would also require a standalone Real Time Display to provide feedback to the householder. This is additional functionality in terms of any basic AMR or AMM smart metering.

The Industry Metering Advisory Group has provided a useful starting point for a definition of a smart meter but this has a list of seven different functionalities (under the main definition) which could comprise a smart meter. (See Appendix Three)

So a smart meter could provide two-way communication, or it could also have a remote real time display, or it could have the ability to export energy back to the grid from microgeneration, or it could have the

ability to take payment. However, it does not have to have all of this functionality. Clearly a domestic smart meter could be specified to have the highest possible specification to allow all of this functionality but this would a) add considerable cost and b) in many circumstances the additional technology would be redundant. Currently only about 15% of meters would require any form of payment system and the overall number of homes with microgeneration capability is small.

This was reflected in the consultation comments where Capital Meters stated that they believed that "the ERA has put forward a "highest common denominator" specification for Smart Meters which would inevitably and unnecessarily increase the cost of a Smart Meter roll out".

This range of meter capital costs is also recognised in the Mott MacDonald Cost Benefit appraisal for BERR where a spectrum of cost options including RTD only, dumb meter and smart box, basic meter, simple meter with local comms, BEAMA min spec and ERA min spec are compared for both electricity and gas. The difference between the BEAMA minimum specification and the ERA minimum specification for electricity is £40 per unit and for gas is approximately £48. This leads to a dramatic variation in potential costs when the overall scenario under consideration concerns around 45 million meters.

Of the policy options on the table the biggest decision is between AMR and AMM. 2-way meter operation via AMM will enable the development of innovative tariffs such as time of use along with the remote switching of meter payment types and the possibility of remote disconnection. A marginal cost benefit of AMM over the base costs (including installation) of AMR has not been considered as part of this analysis although these approaches are considered by BERR as scenarios 2a (AMM) and 2b (AMR).

5.1.2. Measuring Instruments Directive

This study has not looked in detail at the Measuring Instruments Directive but several consultees have mentioned MID. It is not clear how this could affect smart metering but it is interesting to note that BERR's consultation from 2005 on MID does say:

"Neither existing regulatory provisions or MID can deal with smart gas 'energy' meters*. Clearly, if the concept of technological domestic/commercial/ light industrial energy metering solutions (Smart Meters) becomes a commercial reality, an appropriate regulatory framework will need to be considered. This could be on a UK or a European basis and will be dealt with at the appropriate time.

* The gas energy bill consists of two fundamental parts: gas volume supplied and calorific value. Currently the gas meter measures gas volume, whilst calorific value is derived from measurements taken at entry points on the relevant part of the gas distribution system to which the consumer is connected. Smart gas 'energy' meters would be able to undertake all of these measurements at the consumer's supply point using a single measuring instrument."

DTI 2005, MID Consultation response

5.1.3. What should be covered by smart metering

Clearly the emphasis has been on electricity and gas in the discussion so far, although it is clear from the ESD and the BERR consultation that District Heating Systems should also be considered. There is also the question of whether Heating Oil should be part of the discussion although in their response the Oil Firing Technical Association (OFTEC) highlight the fact that heating oil customers are free to buy from any supplier and echoed the Government's own view that "the Government considers that it would not be practicable or helpful for suppliers to provide comprehensive and accurate information about previous use". According to figures from BERR the number of houses without a connection to the natural gas network in England is approximately 2.5 million.

The question of water metering is a complex one, since most domestic premises are not currently metered and water metering has been a political hot potato for some time. Although Defra ran a consultation on "Water metering in areas of serious water stress" in January 2007, smart metering was not really a part of that consultation.

5.2. Complexity 2 - Baseline assumptions for roll-out

There are some basic assumptions which require clarity before a proper cost benefit analysis can be carried out for smart metering. The regional franchising model, discussed in section 4.2.3 makes assumptions around these three issues but additional regulatory change would be necessary in order to resolve the question marks that still stand.

5.2.1. Meter ownership and stranding

"The greatest threat to maintaining an orderly market is to not effectively address the stranded asset risk of existing meters and associated infrastructure. This is rightly seen by the industry as the greatest impediment to the cost effective introduction of Smart Metering."

Capital Meters response to BERR

The ability of householders to switch supplier, whilst at the heart of the competitive market, does provide the greatest disincentive for smart metering. The scale of this is hard to gauge exactly, although Ofgem report that the monthly rate of switching in March 2007 was 332,857 for gas customers and 441,087 for electricity customers. This creates three issues in relation to the ESD – for billing it means that comparison data is more complex and for metering it means that there is the likelihood of asset stranding and also a requirement to pass data over to the new supplier. Traditionally this has been for end /start data but the question remains of how much data is needed to be passed over with smart metering. The numbers are also complicated by the fact that as well as Change of Supplier (COS) there is also Change of Occupier/ tenant (COO)

"On average a minimum of 35% of customers will not receive historical consumption data on their bills."

RWE Enpower response to BERR

As a confirmation of this, SSE reported in its response to BERR that its customer losses for 2006/7 were 12.4% for electricity and 15.9% for gas. Overall SSE gained customers but this gives an idea of the scale of the customer churn issue with resulting problems with asset ownership and also data handing.

Thus it is likely that some further work will be needed to establish a way forward in relation to stranding which could require regulatory change.

5.2.2. Health and safety checks

The need to relax the requirement to visually inspect meters every two years was frequently cited as a barrier to smart metering. Essentially if the biannual visual health and safety check remains a requirement then any cost benefit from Automated Meter Reading resulting from the avoidance of the cost to send out a meter reader in person will be reduced – i.e. it will still be necessary to send out someone in person to

carry out a health and safety check every two years incurring costs that have been assumed to have been saved under the current cost benefit analysis for smart metering.

There are currently requirements on distributors and meter operators who have primary obligations under the Health & Safety at Work Act and the respective Electricity and Gas regulations. Second, Ofgem's supply licence review will identify and remove any barriers in the supply license such as the requirement to manually read a meter every two years. Ofgem is already working with HSE to see if this requirement can be removed and/or amended without safety being compromised.

5.2.3. Dual fuel

The issue of smart metering for dual fuel is an important one. It is worth bearing in mind that according to Ofgem only about one-third of domestic customers currently have a dual fuel deal with their supplier. 47% of customers had a separate gas and electricity supplier in March 2007 and 20% of customers had electricity only. According to the Frontier Economics report, 58% of British Gas consumers currently do not have a dual fuel contract.

The costs of entry and installation of the smart meter will be incurred each time a meter is changed and for many homes with a gas and an electricity meter this of course could be reduced if a dual fuel approach is taken. However, whilst this is clearly true, there are other factors that need to be recognised in relation to a dual fuel approach to the switch to smart meters.

Whilst the case for a single visit to switch both electricity and gas meters is clear, there are factors (skills notwithstanding and discussed later) which mean that smart metering for gas generally carries more risks and less benefits.

Gas smart meters are higher cost and need their own power source since there is no electricity available to run the meter (and fuel cells to use the gas itself are not commercially available). Typically, in order to get a reasonable lifespan for the battery the gas smart meter is best suited for short range communications and has therefore tended to piggyback onto the electricity meter. However, this situation is changing as stand-alone smart gas meters with built-in, battery-powered communications devices start to appear.

The issue of a household potentially ending up with two separate real time displays, one for electricity and one for gas, is also important in terms of cost and customer experience. Whilst a dual fuel approach could remove this problem for about 50% of households it might be better to agree a common local data transmission standard to allow for one device which can display both consumption readings.

The basic assumption for the regional franchising model assumes that gas and electricity meters will be switched at the same time and is therefore a dual fuel approach. A combined Cost Benefit Analysis for Gas and Electricity meter therefore averages the real costs and benefits whilst possibly increasing the risks.

Finally, there is some possible complexity around non-dual fuel contracts since if the gas meter piggybacks its messaging off the electricity meter and if these are not operated on behalf of the same supplier there are some issues in terms of a data ownership and transfer.

Less attention has been paid to this issue possibly due to the emphasis on the Regional Franchise Model which assumes that the process will be rolled out for duel fuel.

5.2.4. Running Parallel Systems

Any approach to the introduction of smart metering will always necessitate retailers running two systems in parallel for a considerable length of time. This would not simply be IT systems but would also include on the ground meter reading and data collection. This would not present too major a problem to the

sector although as the pool of dumb meter stock reduces there would be a loss of economies of scale for supporting the legacy systems as their fixed costs are covered by fewer and fewer customers.

Technically there is no major problem however, and software systems like B-Smart from Generis are able to provide support for the energy retailers running both 'new world' and 'old world' meters in parallel.

"Running two infrastructures for an extended, and in this case unlimited, period (which could go well beyond twenty years with this option), would require dual field, IT, back office systems and customer support functions and lead to significantly increased costs, which would ultimately be borne by the end customer. The presence of two types of system is also likely to lead to additional customer concern and confusion."

United Utilities Metering response to BERR

"System level interoperability has the potential to use the existing market infrastructure and business processes. This provides for an evolutionary approach and remains valid after the deployment phase, therefore there should be a relatively small impact on IT infrastructure. Subsequently, these legacy systems can then be evolved to provide enhanced benefits based on the new technology available."

PRI response to BERR

"Many Suppliers currently operate multiple infrastructures to support their segmented customer base. At the current time we understand that most of the Suppliers are reviewing their "cost to serve" in light of the opportunities to refine their business processes through the introduction of Smart Metering."

Bglobal response to BERR

From the BERR consultation response:

> Section 7.9
>
> **IT development costs and running parallel systems**
>
> Respondents indicated that under any roll-out scenario it would be necessary for investment to be made in IT systems to support the functionality of smart meters. There would also necessarily be a period where suppliers would have to run parallel systems to support a) customers yet to receive a smart meter and b) those on smart. In addition some industry-wide infrastructure investment would be required. The length of time over which parallel systems run will depend on the roll-out model. Some of the impacts of running two systems outlined were: creates customer confusion and may affect service levels, delivery of new products/tariffs restricted to the smart customers only, higher administrative and management costs.

5.3. Complexity 3 - Wider issues especially risks and perceptions

The first four complexities covered in this report relate specifically to the preconditions necessary to and scenarios for a switch to smart metering. Most of the consultation responses have picked up on a range of points in relation to these. There are also many other issues that are very important for consideration and which have not had a sustained focus since they would not necessarily feature in any cost-benefit analysis for smart metering. Yet many of these are still critically important considerations for Government since they represent risks within the overall process.

The key ones that we have identified are:

- A national mega project
- Who pays
- Would people be willing to change meters?
- Skill shock for an accelerated roll out
- Data ownership, protection and protocols
- Manufacturing capability
- You can take a horse to water, but you can't make it drink
- Fuel poverty
- Real Net Carbon Benefits

There are many others but with likely smaller impacts. For example one interviewee mentioned that with 7 different meter types, the permutations for spares and repairs etc would be quite dramatic.

5.3.1. A national mega project

The scale of any accelerated roll out programme is vast. To give some comparison to Frontier Economics estimate that the Regional Franchising model will cost around £6Bn, this is around two-thirds of the budgeted cost of the 2012 London Olympics which were initially budgeted at around £3Bn and now stand at £9.4 Bn.

Any form of accelerated roll-out would likely have a bigger impact than has been covered in any analysis to date. One parallel which has been raised in interviews is the digital switchover of television broadcasting from analogue for television broadcasting. This has taken several years of awareness raising including a pilot switchover and is partly driven by the clear consumer benefit of additional digital content. Compared to smart metering, where the onus is on the supplier to access and change meters within the individual's home, there is clearly a greater potential impact. The Regional Franchise model talks of a street-by-street approach within regions backed up by focused advertising – the great unknown is whether the public would be willing to wait in for their meters to be changed en masse and also if this time needs to be recognised in any cost benefit analysis.

As United Utilities Metering put it in their response to BERR:

"A Franchise approach would deliver some theoretical scale economics for MOP's but the ideal of a house by house, street by street dual fuel roll-out programme is a rose tinted picture which will not happen in practice. The installation programme has been likened to that of the North Sea Gas switch over, however a switch to Smart would be very different. With the North Sea Gas changeover householders were faced with a situation where they would be left off supply if they did not grant access on the planned date of the change over. In addition far more households had at least one adult at home most days."

They also make the point that for them, "access rates for non consumer generated meter works can be as low as 50% to 60%." This would reduce the cost benefits for the regional franchising model where higher rates of access are assumed.

It is perhaps important to recognise, as one interviewee put it during this study, that the whole scheme could be seen as a "national beta test of the technology". Thus there a risks with the creation of a national mega project to roll out smart metering.

5.3.2. Who pays?

The costs for smart metering are clearly substantial and a key question has to be, who pays?

The Frontier Economics Report referring to the savings made by energy companies states that:

"It should be remembered that 'supplier' benefits will be expected to be transferred to customers, given the competitive energy supply market."

However, if this is the case then so, perhaps, will the costs. Using the Frontier figure of £6Bn for the regional franchise model equates to £222 per household (based on a figure of 24.7 million households). This is a substantial surcharge on the average bill although the cost will most likely be recovered over the lifetime of the meter.

5.3.3. Would people be willing to change meters?

There are essentially two parts to this concern. The first is a general one about intrusion of privacy and the fact that, in real time, it would be possible for someone within a supplier to identify if an individual householder was at home at any particular time. The Daily Express has already talked about "Gas and Electric Spies in the Home" and this kind of talk, coupled with stories from California of remote abilities to switch off or isolate consumption during peak loads might affect the general willingness to have a smart meter installed. There is even mention in Australia that Real Time Displays linked to smart meters could result in advertising being introduced into the home.

The second issue is one which relates to the ability to change tariffs and even disconnect the householder remotely. There may well be people who do not like the idea of this and who might therefore be reluctant to have a meter switched.

5.3.4. Skills "shock" for an accelerated rollout

The consequences of an accelerated roll out will have a major impact on the workforce required to carry out smart meter replacement. In particular, strain could be placed upon the supply chain in terms of skills. It is clear that even at the current rate of replacement, the existing meter installation technicians would need to be trained in order to be able to fit and initiate the new smart meters. Since this would be of people already in the industry it represents upskilling of the workforce.

If an accelerated process was implemented (and a 10-year accelerated rollout would be a doubling of current industry capacity) then, unless dramatic productivity improvements were made, the number of meter installation technicians would need to be doubled to meet twice the normal workload. This would mean bringing new people into the industry who would need to be trained in smart meter installation as well as the general and background training necessary to operate in this environment. There is also a third issue which is if a dual fuel route is chosen. Training, qualification and certification issues in relation to dual fuel have not been specifically investigated but it is likely that different frameworks apply in terms of safety and technical issues for gas and electric.

"Mobilisation of large workforce does not allow ramp up"

Meter Fit NW response to BERR

"CML estimates that there are currently a total of 1,200 gas meterworkers working for National Grid Metering and the CMO's. A 5 year rollout of 22m gas Smart Meters would need approximately 2,500 meterworkers each year. Therefore, a further 1,300 CORGI qualified, skilled meterworkers would need to be trained to start a mass rollout of gas Smart Meters. This will be an expensive exercise even if logistically possible."

Capital Meters response to BERR

Whilst this task is a large undertaking, it is not of itself necessarily insurmountable, but the additional time and effort does not appear to have been considered in detail. There is also the question of stability for those installers because an accelerated rollout would lead within a ten year period to a dramatic tailing off of workload for them. This in turn could create extensive unemployment of these (now skilled and qualified fitters), an externality which has not been taken into consideration. This is illustrated below.

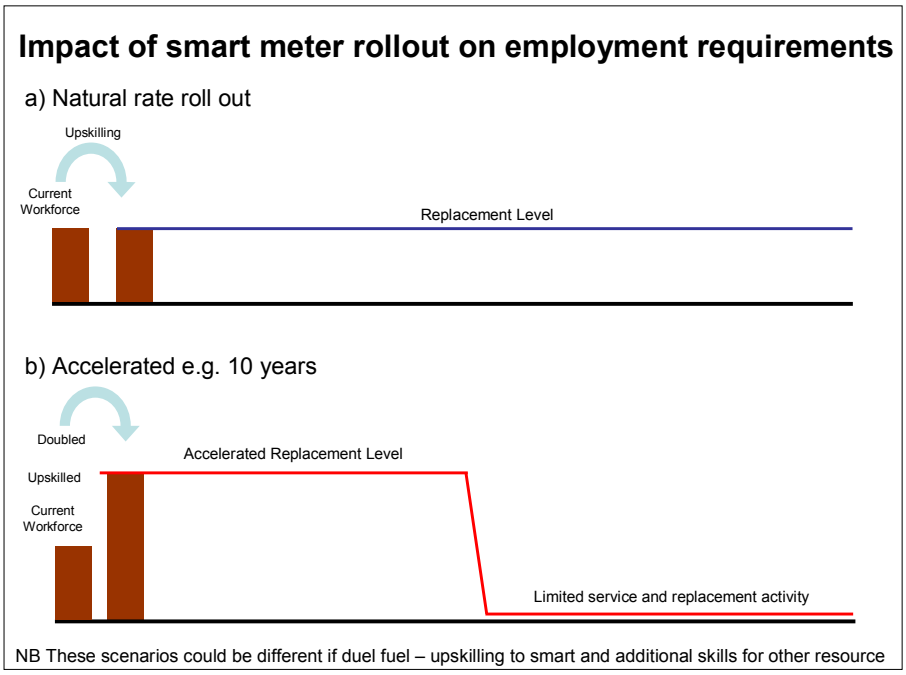

Figure 5-1 – Graphical representation of expected skills demand

5.3.5. Manufacturing Capability

There are perhaps similar concerns for the meter manufactures in terms of a bubble of activity and procurement followed by a 10 to 15 year lull in meter supply. This might dent smaller manufacturer's ability to survive and could also inhibit innovation.

5.3.6. Data ownership, protection and protocols

A key question that has yet to be resolved relates to the ownership and protection of individual customer consumption data. Smart metering enables large volumes of time-dependant data to be collected and suppliers are being asked to use historical data in order to provide a benchmark for billing.

The question of who owns this data and what legal frameworks will be necessary to permit the transfer of data between suppliers is a complex one. Currently there is already a set of messaging flows in order to facilitate a Change of Supplier and the question is raised as to if and how the old supplier will be required to transfer historic data to a new supplier. In addition there is the question of how data from one supplier's gas meter can piggyback through another's electricity meter to them.

Finally, a small problem, but potentially a worry for some is the theoretical ability for someone to establish remotely that a house is unoccupied due to its consumption profile.

"Smart meters will increase the amount of information that energy suppliers have about a household's energy consumption. This information will be communicated between the household, the supplier and third parties that collect or manage billing data. There are already existing data protection laws – designed

to protect consumers. Energy suppliers must abide by these laws and the relevant bodies should make sure these laws are adequately enforced – in relation to the information received from a smart meter.

Smart meters may also give rise to concerns over security issues – as it could be possible to assess whether someone is in or out of a property, for example. Energy suppliers need to ensure that polices are put in place to mitigate against this and that lessons are learnt from the banking and telephone industries to make sure the IT and communication systems are robust and secure."

National Consumer Council response to BERR

5.3.7. You can take a horse to water, but you can't make it drink

One of the largest areas of uncertainty in relation to smart meters is the propensity of consumers to use additional information from billing, smart meters and real time displays to effect reductions in energy consumption. This is the only critical factor for the determination of a business case that relates to the intended consequence of carbon emission reductions. It is very important to recognise that smart meters are not a technical fix providing energy consumption reductions, in fact they will actually consume more energy than a dumb meter. They are, however, an enabling solution for improved and informed energy management.

There is scant evidence for widespread reductions, those that are reported tend to be from localized and focused pilots where there is considerable scope for a Hawthorne Effect[5]. In the limited cases of national rollout of meters there has been a cost benefit from reduced fraud but no wholesale evidence of energy reductions.

According to e-Meter's response to Ofgem's DMI Consultation, evidence in relation to price sensitivity for Californian household consumers (Reiss and White) suggests that there are effectively two types of households with respect to electricity demand behavior - those whose use exhibits some price elasticity, and those who do not and are evidently price insensitive. They found substantial heterogeneity in households' price sensitivities and indeed 43% were inelastic to price increases. Whilst it is not easy to draw parallels for the UK it is likely that a similar picture would be found. On top of this there is the question of which households would be sufficiently motivated by the environmental benefit of energy reduction.

Smart meters are a way of providing feedback for behaviour change and for reducing non-systemic energy consumption – left on lights etc – rather than systemic energy consumption or waste through lack of or poor quality loft insulation, cavity wall insulation and secondary glazing.

5.3.8. Fuel poverty

Fuel poverty is a particular concern in the UK and there has been strong representation from fuel poverty and other interested groups setting out their concerns that smart meters might also affect those in fuel poverty. There is particular concern about the elderly who might struggle to understand the information provided by a real time display, for example, and for whom many might already be using too little energy.

Whilst not all of those using pre-payment meters will be in fuel poverty, there is likely to be a large number who are. It is important that consideration is given to reducing fuel poverty within any proposed changes and, as Ofgem pointed out, if real time displays are provided on request, then it is likely that the cost will be carried by the less well off consumers.

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[5] The Hawthorne Effect refers to the fact that there can often be a short-term improvement caused by observing worker performance which is unrelated to the methods being used to instigate productivity improvement.

5.3.9. Real net carbon benefits

One key area which has to be taken into consideration is the overall net carbon benefit from smart metering. Currently most of the assessment of any carbon reductions has been based on the potential energy savings made by householders as part of their own efforts to reduce consumption.

Although smart meters will consume slightly more energy than dumb meters there are also other changes to the overall carbon footprint of energy metering as a result of the switch. For example, it has been noted that there will be a reduction in vehicle emissions from the removal of meter readers once automatic readings are possible.

It is also important to recognise that an accelerated replacement scenario would also incur additional carbon emissions due to the "opportunity carbon" inherent in the current dumb meter stock for the remainder of its life.

6. CONCLUSIONS

Echoing the comments of David Taylor, MP, in his response to BERR's second consultation where he said "It is indisputable that smart meters would contribute to a reduction in the UK's carbon dioxide emissions", it is also indisputable that a seemingly small change in the scheme of things constitutes a very complex set of scenarios for consideration, each with varied costs and potential benefits.

It is perhaps important to recognise, as one interviewee put it during this study, that the whole scheme could be seen as a "national beta test of smart metering technology" and this should be a clear warning sign for Government. With up to £6 billion estimated to be necessary to effect a change to smart metering it is clear that this is a very expensive beta test and risks need to be properly recognised and managed.

We have identified three levels of complexity around smart metering and would like to echo the comments of Ofgem that "it [is] of utmost importance that government makes its policy decision on smart meter roll out only after a thorough and robust impact assessment that has been properly challenged through a rigorous consultation exercise" and "In the interim ruling out some policy options will allow the industry to move closer to implementation. Without this clear direction, the debate will drift and smart meter investment plans for domestic customers will be further delayed." The recent BERR consultation response has removed some of the scenarios that were on the table, especially mandating the provision of Real Time Displays but there are still five scenarios for domestic smart metering, each with its own costs, benefits and risks.

As one person put it, smart metering is not a technical solution it is a socio-technical problem and there is plenty of scope for unintended consequences and reduced effectiveness which could not produce the expected reductions in carbon emissions.

In conclusion, any accelerated switch to smart metering is likely to carry with it some risks that are not simply part of the core cost benefit analysis for the technology. Any national programme could meet with resistance from consumers, especially if prices are to be raised, and faces the possibility of backlash if things go wrong. Smart meter rollout represents an enormous political, technical and commercial challenge and it is critical that the wider complexities are taken into consideration in future plans.

7. APPENDIX ONE – ESD DIRECTIVE – ARTICLE 13

Article 13, Metering and informative billing of energy consumption, which states

1. Member States shall ensure that, in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating and/or cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use.

When an existing meter is replaced, such competitively priced individual meters shall always be provided, unless this is technically impossible or not cost-effective in relation to the estimated potential savings in the long term. When a new connection is made in a new building or a building undergoes major renovations, as set out in Directive 2002/91/EC, such competitively priced individual meters shall always be provided.

2. Member States shall ensure that, where appropriate, billing performed by energy distributors, distribution system operators and retail energy sales companies is based on actual energy consumption, and is presented in clear and understandable terms. Appropriate information shall be made available with the bill to provide final customers with a comprehensive account of current energy costs. Billing on the basis of actual consumption shall be performed frequently enough to enable customers to regulate their own energy consumption.

3. Member States shall ensure that, where appropriate, the following information is made available to final customers in clear and understandable terms by energy distributors, distribution system operators or retail energy sales companies in or with their bills, contracts, transactions, and/or receipts at distribution stations:

(a) current actual prices and actual consumption of energy;

(b) comparisons of the final customer's current energy consumption with consumption for the same period in the previous year, preferably in graphic form;

(c) wherever possible and useful, comparisons with an average normalised or benchmarked user of energy in the same user category;

(d) contact information for consumers' organisations, energy agencies or similar bodies, including website addresses, from which information may be obtained on available energy efficiency improvement measures, comparative end-user profiles and/or objective technical specifications for energy-using equipment.

Source: EC Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services.

8. APPENDIX TWO - BENEFITS OF SMART METERING

These have been taken from a wide range of references, sorted by area or locus of the benefit but not validated or quantified.

Locus	Benefit
Generation	Fewer resources needed Better scheduling Demand forecasts
Wholesale	Direct access settlement Demand forecasts Risk management Greater efficiency wholesale market
Transmission	Easier black start Network optimisation Load profiling / demand forecasts
Distribution	Outage detection Readiness for DG (Distributed generation?) Load profiling / demand forecasts Revenue assurance Less theft Asset management Load management Network operations Grid reliability Supply shortfalls Multi-directional power flows Increase in distributed energy sources
Retailers / MAP/Mop	Better cashflow/ less debt (working capital management) Less theft / fraud Revenue assurance Financial risk management Load management Customer service Call centre cost savings Billing operations Lower cost to serve Reduction in meter reading costs Reduction in prepayment metering costs Fewer complaints – misreads/ estimates Value added services – e.g. energy efficiency Asset management Meter reading / premise management

Retailers / MAP/Mop (cont.)	Enhanced IT for better data management Utility cost reduction Remote restriction of energy use – power outs and disconnection of defaulters Fast detection of disturbances in supply Peak shifting
Consumers	Informed and satisfied customers More accurate billing Better information Dynamic market effects – better switching and new offers Demand Reduction/ Demand Side management Microgen (2-way meter capability) Avoided capital investment Growth in sophisticated tariffs Energy saving through feedback of performance Consumers can switch more easily Home gateway?
Policy Makers	Compliance with EC Directive Wider policy goals in relation to climate change and Government's vision
Society / Environment	Reduced pollution Lower carbon emissions

9. APPENDIX THREE – IMAG SMART METER DEFINITION

Source: Industry Metering Advisory Group

[A smart meter is] A system for metering any residential energy or water supplies that:

A Measures consumption over representative periods to legal metrology requirements

B Stores measured data for multiple time periods

C Allows ready access to this data by consumers as well as by suppliers or their agents and at least one of the following functions:

i Provides analysis of the data and a local display of the data in a meaningful form to the consumer or as part of a smart housing solution. (This could be a real time display)

ii Transfers consumption data to the supplier or his agent for the purposes of accurate billing without requiring access to the home.

iii Provides a payment facility for one or more supplies.

iv Measures, and records information as to the continuity and quality of the supply and provides this and other data to the Distribution Network Operator for purposes of system operation, planning, and loss assessment.

v Permits remote control (e.g. interruption and restoration) of specific consumer circuits or equipment for the purposes of agreed load management.

vi Allows display of price signals for different time periods as part of a cost reflective tariff for the purposes of demand response.

vii Allows for remote change of tariff, debt or other rates for utility charging without requiring access to the home.

and, where a consumer has microgeneration equipment installed:

- Provides a facility to measure energy export and/or generation, where required for official purposes.