Summary: Intervention & Options

Department /Agency: DECC	Title: Impact assessment of a GB-wide smart meter roll out for the domestic sector	
Stage: Consultation response	**Version: Final**	**Date: December 2009**

Related Publications: Consultation Impact Assessment of Smart Metering Roll out for domestic consumers and small businesses (April 2008) [http://www.berr.gov.uk/files/file45794.pdf], Baringa Partners reports on market model and risk (2009), DECC Consultation Document and Statement (2009).

Available to view or download at:
http://www.decc.gov.uk/en/content/cms/consultations/smart_metering/smart_metering.aspx

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What is the problem under consideration? Why is government intervention necessary?

Smart metering is a key enabling technology for managing energy systems more efficiently in the future, and providing new information and services to consumers which reduce costs and carbon emissions. In Great Britain, the provision of energy meters to consumers is the responsibility of energy retail suppliers, and subject to competition. It is expected that in the absence of a clear steer and intervention by Government, suppliers would roll out only minimal numbers of smart meters - because of the danger that their particular offering would become redundant when the consumer changed supplier. Government intervention is needed to ensure commercial interoperability and full market coverage. This will facilitate the capture of wider benefits to consumers, the environment, network operators and new businesses.

What are the policy objectives and the intended effects?

To roll-out smart metering to all residential gas and electricity customers by end 2020 in a cost-effective way, which optimises the benefits to consumers, energy suppliers, network operators and other energy market participants and delivers environmental and other policy goals.

What policy options have been considered? Please justify any preferred option.

This policy focuses on the mandated replacement of 47 million residential gas and electricity meters by end 2020. A range of policy options are considered, the main variants of which are:

- Energy retail suppliers retaining sole responsibility for metering provision (**option 1: competitive model)**
- Centralisation of some or part of the roll-out delivery (**option 2: centralised communications model;** and **option 3 fully centralised model).**
- Some responsibility also assigned to Distribution Network Operators (DNOs) and Gas Transporters (GTs) (**option 4: DNO-deployment model; option 5: Energy Networks Co-ordination model; option 6: Regulated Asset Ownership model.**)

Option 2 is the Government preferred option. The quantified net benefits are very close. A range of qualitative judgements around the different characteristics of the models is discussed in the Government response document which this impact assessment accompanies.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

The policy will be reviewed once the rollout of smart meters has been completed and a medium term review undertaken within 5 years of roll out start. As the roll-out progresses, particular attention will be paid to monitoring early behavioural responses to smart meters with the objective of feeding back any findings from this experience into the roll-out process. Detailed monitoring and evaluation of the policy will be set out during the design phase of the roll-out.

Ministerial Sign-off For consultation stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister: Lord Hunt

Date: 2-12-2009

Summary: Analysis & Evidence

Policy Option: 1 | **Description:** Mandated roll-out of smart meters under the competitive model by the end of 2020

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £5.76bn. Opex costs amount to £1.81bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £2.29bn.
£1.71bn	12	
Average Annual Cost (excluding one-off)		
£0.57bn		**Total Cost** (PV) £9.86bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £7.04bn and consist mainly of savings from reduced energy consumption (£4.49bn). Total supplier benefits amount to £6.32bn and come mostly from avoided meter reading (£2.68bn). Total other benefits amount to £1.37bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£1.04bn		**Total Benefit** (PV) £14.73bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base Year 2009	Time Period Years 20	**Net Benefit Range** (NPV) £0.07bn to £9.58bn	**NET BENEFIT** (NPV Best estimate) £4.86bn

What is the geographic coverage of the policy/option?	GB			
On what date will the policy be implemented?	2009			
Which organisation(s) will enforce the policy?	DECC/Ofgem			
What is the total annual cost of enforcement for these organisations?	£N/A			
Does enforcement comply with Hampton principles?	N/A			
Will implementation go beyond minimum EU requirements?	Yes			
What is the value of the proposed offsetting measure per year?	£0			
What is the value of changes in greenhouse gas emissions?	£1.36bn			
Will the proposal have a significant impact on competition?	Yes			
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large **n/a**
Are any of these organisations exempt?	no	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 | Decrease of £ 0 | **Net Impact** £ 0

Key: **Annual costs and** **(Net)**

Summary: Analysis & Evidence

Policy Option: 2	**Description: Mandated roll-out of smart meters under the centralised communications model by the end of 2020**

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £5.09bn. Opex costs amount to £1.57bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £1.98bn.
£1.40bn	12	
Average Annual Cost (excluding one-off)		
£0.51bn		**Total Cost** (PV) £8.64bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £6.99bn and consist mainly of savings from reduced energy consumption (£4.46bn). Total supplier benefits amount to £6.27bn and come mostly from avoided meter reading (£2.66bn). Total other benefits amount to £1.36bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£1.03bn		**Total Benefit** (PV) £14.62bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base Year 2009	Time Period Years 20	**Net Benefit Range** (NPV) £1.22bn to 10.67bn	**NET BENEFIT** (NPV Best estimate) £5.98bn

What is the geographic coverage of the policy/option?			GB	
On what date will the policy be implemented?			2009	
Which organisation(s) will enforce the policy?			DECC/Ofgem	
What is the total annual cost of enforcement for these organisations?			£N/A	
Does enforcement comply with Hampton principles?			N/A	
Will implementation go beyond minimum EU requirements?			Yes	
What is the value of the proposed offsetting measure per year?			£0	
What is the value of changes in greenhouse gas emissions?			£1.36bn	
Will the proposal have a significant impact on competition?			Yes	
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large **n/a**
Are any of these organisations exempt?	No	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of 0 **Net Impact** 0

Key: **Annual costs and benefits:** **(Net) Present**

Summary: Analysis & Evidence

Policy Option: 3	Description: Mandated roll-out of smart meters with the fully centralised model by the end of 2020

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £4.62bn. Opex costs amount to £1.50bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £2.10bn.
£1.52bn	12	
Average Annual Cost (excluding one-off)		
£0.47bn		**Total Cost** (PV) £8.22bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £6.67bn and consist mainly of savings from reduced energy consumption (£4.25bn). Total supplier benefits amount to £5.92bn and come mostly from avoided meter reading (£2.54bn). Total other benefits amount to £1.29bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£0.98bn		**Total Benefit** (PV) £13.88bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base Year 2009	Time Period Years 20	**Net Benefit Range** (NPV) £1.12bn to £10.12bn	**NET BENEFIT** (NPV Best estimate) £5.65bn

What is the geographic coverage of the policy/option?			GB	
On what date will the policy be implemented?			2009	
Which organisation(s) will enforce the policy?			DECC/Ofgem	
What is the total annual cost of enforcement for these organisations?			£N/A	
Does enforcement comply with Hampton principles?			N/A	
Will implementation go beyond minimum EU requirements?			Yes	
What is the value of the proposed offsetting measure per year?			£0	
What is the value of changes in greenhouse gas emissions?			£1.30bn	
Will the proposal have a significant impact on competition?			Yes	
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large **n/a**
Are any of these organisations exempt?	No	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices)			(Increase - Decrease)
Increase of £ 0	Decrease of 0	**Net Impact**	**£0**

Key: Annual costs and benefits: (Net) Present

Summary: Analysis & Evidence

Policy Option: 4 | **Description: DNO deployment model**

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £4.60bn. Opex costs amount to £1.52bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £2.07bn.
£1.49bn	12	
Average Annual Cost (excluding one-off)		
£0.47bn		**Total Cost** (PV) £8.19bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £6.71bn and consist mainly of savings from reduced energy consumption (£4.28bn). Total supplier benefits amount to £5.97bn and come mostly from avoided meter reading (£2.56bn). Total other benefits amount to £1.30bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£0.98bn		**Total Benefit** (PV) £13.98bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base	Time Period	**Net Benefit Range** (NPV)	**NET BENEFIT** (NPV Best estimate)
2009	Years 20	£1.22bn to £10.28bn	£5.79bn

What is the geographic coverage of the policy/option?	GB			
On what date will the policy be implemented?	2009			
Which organisation(s) will enforce the policy?	DECC/Ofgem			
What is the total annual cost of enforcement for these organisations?	£N/A			
Does enforcement comply with Hampton principles?	N/A			
Will implementation go beyond minimum EU requirements?	Yes			
What is the value of the proposed offsetting measure per year?	£0			
What is the value of changes in greenhouse gas emissions?	£1.31bn			
Will the proposal have a significant impact on competition?	Yes			
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large
Are any of these organisations exempt?	No	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of £0 **Net Impact** **£0**

Key: **Annual costs and** **(Net)**

Summary: Analysis & Evidence

Policy Option: 5 | **Description: Networks co-ordination model**

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £4.72bn. Opex costs amount to £1.52bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £2.12bn.
£1.53bn	12	
Average Annual Cost (excluding one-off)		
£0.48bn		**Total Cost** (PV) £8.36bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £6.71bn and consist mainly of savings from reduced energy consumption (£4.28bn). Total supplier benefits amount to £5.97bn and come mostly from avoided meter reading (£2.56bn). Total other benefits amount to £1.30bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£0.98bn		**Total Benefit** (PV) £13.98bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base	Time Period	**Net Benefit Range** (NPV)	**NET BENEFIT** (NPV Best estimate)
2009	Years 20	£1.05bn to £10.11bn	£5.62bn

What is the geographic coverage of the policy/option?	GB			
On what date will the policy be implemented?	2009			
Which organisation(s) will enforce the policy?	DECC/Ofgem			
What is the total annual cost of enforcement for these organisations?	£N/A			
Does enforcement comply with Hampton principles?	N/A			
Will implementation go beyond minimum EU requirements?	Yes			
What is the value of the proposed offsetting measure per year?	£0			
What is the value of changes in greenhouse gas emissions?	£1.31bn			
Will the proposal have a significant impact on competition?	Yes			
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large **n/a**
Are any of these organisations exempt?	No	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of £0 **Net Impact** **£0**

Key: **Annual costs and** **(Net)**

Summary: Analysis & Evidence

Policy Option: 6	Description: Regulated asset ownership model

COSTS

ANNUAL COSTS		Description and scale of **key monetised costs** by 'main affected groups'
One-off (Transition)	**Yrs**	Capital, installation, and IT costs amount to £5.09bn. Opex costs amount to £1.57bn. Other costs, including upfront communication costs, pavement reading inefficiency and legal and contractual costs, amount to £2.07bn.
£1.48bn	12	
Average Annual Cost (excluding one-off)		
£0.51bn		**Total Cost** (PV) £8.73bn

BENEFITS

ANNUAL BENEFITS		Description and scale of **key monetised benefits** by 'main affected groups'
One-off	**Yrs**	Total consumer benefits amount to £6.99bn and consist mainly of savings from reduced energy consumption (£4.46bn). Total supplier benefits amount to £6.27bn and come mostly from avoided meter reading (£2.66bn). Total other benefits amount to £1.36bn.
£0.0bn	12	
Average Annual Benefit (excluding one-off)		
£1.03bn		**Total Benefit** (PV) £14.62bn

Other **key non-monetised benefits** by 'main affected groups' Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching between suppliers and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice. Other non-monetised benefits include the potential benefits from the development of a smart grid.

Key Assumptions/Sensitivities/Risks: All numbers adjusted for risk optimism bias and under central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information and changes to them affect the benefits substantially.

Price Base	Time Period	**Net Benefit Range** (NPV)	**NET BENEFIT** (NPV Best estimate)
2009	Years 20	£1.13bn to £10.58bn	£5.89bn

What is the geographic coverage of the policy/option?	GB			
On what date will the policy be implemented?	2009			
Which organisation(s) will enforce the policy?	DECC/Ofgem			
What is the total annual cost of enforcement for these organisations?	£N/A			
Does enforcement comply with Hampton principles?	N/A			
Will implementation go beyond minimum EU requirements?	Yes			
What is the value of the proposed offsetting measure per year?	£0			
What is the value of changes in greenhouse gas emissions?	£1.36bn			
Will the proposal have a significant impact on competition?	Yes			
Annual cost (£-£) per organisation (excluding one-off)	Micro **n/a**	Small **n/a**	Medium **n/a**	Large **n/a**
Are any of these organisations exempt?	No	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices)				(Increase - Decrease)
Increase of £ 0	Decrease of	£0	**Net Impact**	**£0**

Key: **Annual costs and benefits: Constant** | **(Net) Present Value**

Contents

Evidence Base

A. Glossary of Terms

AMM – Automated Meter Management
AMO – Association of Meter Operators
AMR – Automated Meter Reading
COMMS – (Tele) Communications
CDU – Customer Display Unit (also known as clip-on)
DNO – Distribution Network Operators
EDD – Electricity Display Device (also known as clip-on)
GPRS – General Packetised Radio System
GSM – Group Special Mobile
GT – Gas Transporters
HAN – Home Area Network
IT – Information Technology
LAN – Local Area Network
MAP – Meter Asset Provision
MOP – Meter Operators
NG – National Grid
NPV – Net Present Value
O & M – Operation & Maintenance
OTA – Over The Air
PLC – Power Line Carrier
PPM – Prepayment Meter
PSTN – Public Switched Telephone Network
RTD – Real Time Display
SIM – Subscriber Identity Module
SM – Smart Meter
SMOF – Smart Meter Operational Framework
SMS – Short Message Service
SPC – Shadow Price of Carbon
SRSM – Supplier Requirements for Smart Meters
TOU – Time of Use (tariff)
VPN – Virtual Private Network
WAN – Wide Area Network

B. Introduction and Strategic Overview

Introduction

In the Energy White Paper (2007) the Government set out its expectation that smart electricity and gas meters would be installed within every home over the next decade. The Government consulted on proposals for taking forward proposed policies in its August 2007 consultation on metering and billing issues[1].

The Government's response to this consultation was published in April 2008[2] with the April 2008 consultation Impact Assessment on the roll out of smart meters to domestic and small business consumers which built on analysis and modelling by Mott Macdonald[3] and comments from stakeholders were requested.

Reports by Baringa Partners (formerly The Structure Group) on the treatment of risk in the economic analysis[4] and to define and evaluate potential market structures to underpin a roll out of smart metering[5] were then commissioned, and informed the May 2009 consultation and Impact Assessment of a GB-wide smart meter roll out for the domestic sector[6] (a separate IA was completed for the business sector).

Further work by Baringa and Redpoint, including a series of stakeholder workshops, has now appraised additional delivery model options which include greater involvement of network operators. The policy options, underlying assumptions and cost/benefit estimation model have been further updated in the light of this additional work undertaken and as a result of further information and supporting evidence received through the May 2009 consultation and otherwise.

The changes made to the analysis against the May 2009 IA are noted within the text of this Impact Assessment and for ease of reference an overview of the changes to input values is also provided at Annex 1; section F below sets out the optimism bias adjustment factors that have been applied, on the basis of Baringa's report on risk and optimism bias.

This assessment and the supporting evidence base confirm the Government's decision to proceed with the roll out of smart meters for domestic consumers as announced in October 2008[7].

Strategic overview

The UK Low Carbon Transition Plan was published in July 2009 and sets out the UK's plan for becoming a low carbon country: cutting emissions, maintaining secure energy supplies, maximising economic opportunities, and protecting the most vulnerable.

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[1] BERR, *Billing and Metering Changing Consumer Behaviour, Energy White Paper Consultation*, August 2007, http://www.berr.gov.uk/files/file40456.pdf
[2] BERR, *Government Response to Consultation Billing and Metering Changing Consumer Behaviour* http://www.berr.gov.uk/files/file45996.pdf
[3] BERR, *Impact Assessment of Smart Metering Roll Out for Domestic Consumers and Small Businesses*, April 2008, http://www.berr.gov.uk/files/file45794.pdf
[4] Baringa Partners, *Smart Meter Roll Out: Risk and Optimism Bias Project*, 2009
[5] Baringa Partners*, Smart Meter Roll Out: Market Model Definition & Evaluation Project*, 2009
[6] insert reference
[7] *House of Lords Hansard*, 28 October 2008, Column 1516

The Plan sets the strategic context for the roll-out of smart metering. By 2050 we need to deliver an 80% reduction in UK carbon emissions, and to meet demanding carbon budget targets during the interim period. We also need to ensure that energy costs are affordable to consumers, including vulnerable groups.
Smart metering will play an important part in supporting a range of different policies and objectives under the Plan, by directly helping consumers to understand their energy consumption and make savings, reducing supplier costs, enabling new services including to facilitate demand-side management which will help reduce security of supply risks and help with our sustainability and affordability objectives. Smart metering will also help deliver a future Smart Grid[8]. Smart metering is also expected to support a range of other policies such as greater deployment of renewables and electric vehicles.

The roll-out of smart metering therefore needs to happen on a timescale appropriate to supporting these various objectives and policies.

The Chief Economist has reviewed the Impact Assessment and considers that it provides a reasonable assessment of the costs and benefits of the leading options at this stage.

[8] The Government expects that a range of enhancements and new technologies will be applied to existing electricity networks, thereby enabling them to interact with generation and demand. This approach is known as smart grids

C. The issue

Although existing metering makes available accurate and timely information on actual time of use, in practice it provides less than perfect information for both consumers and suppliers. On average suppliers only know how much energy a household consumes after a quarterly (or less frequent) meter read and consumers are generally only aware of consumption on a quarterly, historic basis unless they take active steps to monitor the readings on their meters. In addition many of those quarterly reads may be estimates made by the supplier.

Consumers are not positively and actively provided with dynamic and useful information to enable them to easily manage their energy consumption. In addition problems with accuracy of data and billing create costs for suppliers and consumers, causing problems in terms of disputes over bills (complaints) and problems with the change of supplier process thereby possibly hindering competition.

Smart meters and the provision of real-time information help address these issues, enabling consumers and suppliers to access more information about energy use and cost. Smart meters provide for remote communication between the meter and the supplier facilitating, amongst other things, more efficient collection of billing information, the development of more sophisticated tariff structures and demand management approaches that could be used to further incentivise energy efficient behaviour by consumers and suppliers alike.

The benefits from a roll out of smart meters together with a visual display fall to a number of actors – to consumers (in terms of accurate bills, accurate and real-time information to enable them to manage energy consumption and potentially receive new services), to suppliers (in terms of more frequent 100% accurate information, reduced costs to serve) and to society (in terms of reduced carbon emissions). There are also potential benefits for network companies from the use, subject to appropriate controls, of data collected through smart metering to better manage the electricity network and to inform long-term investment in the network.

In the absence of Government intervention, it is difficult to judge whether a substantial roll-out of smart meters would take place. However, without a Government sponsored inter-operability agreement, meter owners face a large risk of losing most of the value of the meter when customers switch energy suppliers, and switching by customers is relatively likely to occur. A decision by Government not to intervene would probably result in a very limited roll out.

As part of the Third Package of Energy Liberalisation Measures adopted on 13 July 2009, EU Member States are obliged to "ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas and electricity markets" - in other words, to roll out some form of smart metering (subject to the results of an economic assessment)[9]. Given the importance of the assessment referred to in the Directives for determining the UK's EU law obligations, a further specific assessment of the costs and benefits of smart metering will be published nearer that date for the purposes of the Third Package. This will take

[9] However, the relevant provisions of Directives 72/2009/EC and 73/2009/EC (Annex I, paragraph 2) make it clear that this obligation, and the nature, extent and speed of any roll-out, are to be subject to the results of "an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution". This assessment must take place by 3rd September 2012.

account of any relevant changes in the available data and our assumptions about roll-out once some of the early stages of the project have been completed.

D. Objectives

The overall objective of Government intervention in the metering market is to deliver information on energy usage to consumers and energy suppliers in order to:

- bring about the transition to a low-carbon Britain; and
- ensure the supply of energy which is secure, affordable and efficient.

Smart meters will facilitate or make possible a range of outcomes:

Energy savings and related carbon savings: in terms of overall savings, raise awareness of energy consumption, in particular at peak time, as well as provision of accurate energy consumption data to consumers thus enabling consumers to reduce their consumption and suppliers to provide better targeted energy efficiency advisory services and other packages.

Accurate bills and consumption data: ensure consumers are aware of how much they consume; open up the possibility of more frequent billing which would enable consumers to better budget for their energy-related expenditure; removing problems associated with direct debits.

Improved consumer service and experience: this includes reducing complaints associated with billing and meter exchanges; reducing problems associated with data which cause exceptions in the change of supplier process and therefore difficulties for consumers; enabling consumers to access a wider range of tariffs; easier switching between pay-as-you-go / credit tariffs; and a reduction in the service costs associated with pre-payment meters.

Facilitating the development of demand management, improved network management and other innovative services and tariffs including time-of-use tariffs: smart meters will contribute to various energy market developments such as increased use of electric cars; increased intermittent energy supply as part of renewables deployment; reductions of peak demand and remote demand management to contribute to managing a potential future energy gap; detailed consumption data to enable better informed investment decisions, improved detection of losses etc, as well as lower overall consumption reducing pressure on the network.

Facilitation of wider policy goals: smart meters also facilitate measures in other policy areas for example increasing demand for energy efficiency measures and microgeneration. They may boost development of ‘smart homes’ more widely potentially improving management and networking of domestic appliances.

E. Option identification

As set out in the introduction this impact assessment builds on the analysis set out in the April 2008 consultation Impact Assessment. The focus here is on the domestic roll out of smart metering and on options to deliver on the Government's decision to proceed with a roll out of smart metering to the domestic sector. The further policy development work which has been taken forward since April 2008 including feedback from discussion with a wide range of stakeholders and the work commissioned from consultants has enabled the various options for the roll out to be further refined and updated. The variables around market model, meter functionality and interoperability, communications infrastructure and speed of roll out have been developed to inform the options for the economic assessment set out in Section F.

1. Market delivery model

The delivery of smart metering to GB domestic consumers will be a major infrastructure project. In October 2008 the Government announced its intention to mandate a roll out of electricity and gas smart meters to all homes in Great Britain with the aim of completing the roll out by end 2020. Changes to the current metering market structures will be required to underpin its successful delivery and to maximise benefits. We have examined six potential delivery models:

1. a fully **competitive model** – this is based on the current metering model where all obligations and elements of delivery (roll-out strategy, communications and metering) are supplier-led;
2. a **centralised communications model** – differs from the competitive model in that a national communication network is put in place to support smart metering. The provision and installation of meters is left to suppliers as in the competitive model;
3. a **fully centralised model** – differs from the centralised communications model in that in addition to a national communication network, regional (or national) monopoly providers are put in place for provision and installation of meters;
4. a **DNO deployment model** – differs from the centralised communications network in that Distribution Network Operators (DNOs) and Gas Transporters (GTs) are responsible for the provision of electricity and gas meters respectively rather than energy suppliers; DNOs would take responsibility for deployment strategy, installation and maintenance for both electricity and gas meters;
5. an **energy networks co-ordination model** – differs from the DNO deployment model in that DNOs and GTs are separately responsible for the provision, deployment strategy, installation and maintenance for electricity and gas meters respectively, but co-ordination is achieved so that electricity and gas meters are installed in one visit to the maximum extent possible; and
6. a **regulated asset ownership model** – differs from the centralised communications model in that DNOs and GTs are responsible for the provision of electricity and gas meters, but suppliers remain responsible for deployment strategy, installation and maintenance.

Detailed work to define and evaluate these models has been undertaken by Baringa Partners and has involved the participation of industry stakeholders[10]. Their reports

[10] Baringa Partners, *Smart Meter Roll Out: Market Model Definition & Evaluation Project*, 2009

are published alongside this Impact Assessment and their work has informed development of the assumptions used in the analysis and results.

The Government preferred option is option 2, a centralised communications model.

All models produce similar levels of net benefits, except the competitive model which offers significantly lower net benefits. This is mainly due to the inefficiencies and duplication in the roll-out of, amongst others, the communications infrastructure, and the higher redundancy of assets of consumers switching suppliers.

As the quantified net benefits are so close, the decision rests primarily on a range of qualitative judgments around the different characteristics of the models. The Government response document, which this impact assessment accompanies, discusses extensively these qualitative judgements.

2. Metering system functionality

This section sets out the high-level functional requirements for the smart metering system. This "minimum" functionality will ensure that smart metering delivers the wide range of anticipated benefits. It should be noted that there is no assumption about how the functionality is delivered i.e. whether within a "meter", modularly, or through some other technical solution.

Table 1 below sets out the high level functionality that we consider should comprise the electricity and gas smart metering systems and the underpinning capabilities these are expected to provide.

Table 1: Functionality of metering system

	High level functionality	**Electricity**	**Gas**
A	Remote provision of accurate reads/information for defined time periods - delivery of information to customers, suppliers and other designated market organisation	✓	✓
B	Two way communications to the meter system - communications between the meter and energy supplier or other designated market organisation - upload and download data through a link to the wider area network, transfer data at defined periods, remote configuration and diagnostics, software and firmware changes	✓	✓
C	Home area network based on open standards and protocols - provide "real time" information to an in-home display - enable other devices to link to the meter system	✓	✓
D	Support for a range of time of use tariffs - multiple registers within the meter for billing purposes	✓	✓
E	Load management capability to deliver demand side management - ability to remotely control electricity load for more sophisticated control of devices in the home	✓	
F	Remote disablement and enablement of supply - that will support remote switching between credit and pre-pay	✓	TBC
G	Exported electricity measurement - Measure net export	✓	
H	Capacity to communicate with a measurement device within a microgenerator - receive, store, communicate total generation for billing	✓	

For electricity it is judged that this level of functionality will deliver the policy objectives and benefits anticipated for smart metering across consumers, suppliers, networks and the environment. In addition this level of functionality aligns with wider policy developments around renewables, microgeneration, electric vehicles.

With respect to gas metering for the purposes of this analysis we have assumed that all smart gas meters are deployed with a valve. The cost benefit analysis we have undertaken demonstrates a positive case for these functional requirements. This includes a functionality to remotely enable and disable supply (this requires inclusion of a physical valve.) It is judged that this level of functionality will deliver the policy objectives and benefits anticipated for smart metering across consumers, suppliers and the environment.

An alternative approach – to not require the valve in all meters – is also considered in the analysis for the central communications model for comparative purposes. This level of functionality delivers a reasonable level of the benefits from smart gas metering including those around delivery of accurate data to consumers as well as removing the need for manual meter reads. Annex 3 provides further information on the background to the options selected for analysis. The final decision of this element of functionality will be taken in due course in the light of further detailed analysis.

Displays and provision of information: consumer engagement and action to save energy is central to the benefits case for smart metering. Access to the consumption data in real time provided by smart meters will provide consumers with the information they need to take informed action to save energy and carbon. The Government believes that free-standing real-time displays which provide real-time, near instantaneous feedback on consumption (in terms of energy, money or CO_2) can help to raise consumers' awareness of the energy they use and how savings can be made. In its May 2009 consultation document the Government set out its expectation that a standalone real-time display would be provided with a smart meter to ensure the full environmental and energy-saving benefits of smart metering are delivered – that is the assumption we use in this analysis, but this does not rule out additional approaches being taken to the delivery of information.

Interoperability: competition in the supply of gas and electricity requires that customers can easily switch to their chosen supplier. If not all smart meters are interoperable it may not be possible for an energy supplier to read the data from a meter installed by another supplier. It is important to note that interoperability is not an issue with non-smart meters as any meter can be manually read by any supplier. In addition to ensuring benefits are gained the framework of functional requirements will provide a first step towards ensuring interoperability in metering systems. If the metering systems used by different suppliers are interoperable, smart meters will also make an important contribution to ensuring that the switching process can be quicker and more reliable and all suppliers will be able to comply with their licence obligations and can retrieve data from all meters without having to visit premises or change a meter or other equipment. In addition to a specification of the minimum functionality of the metering system, the achievement of interoperability will require adherence to open data and communications protocols and is likely to be underpinned by a range of more detailed industry standards, preferably developed at an EU-wide level.

3. Communications infrastructure

Smart metering requires a suitable communications platform over which data can be securely uploaded and downloaded (e.g. consumption data transmitted for defined periods) in addition ad hoc remote configuration and diagnostics, software and firmware changes should be able to be made remotely. Potentially a number of different technology solutions could be used and the previous impact assessment considered a number of the possible options and hybrids of different approaches. We have not as yet made any decision on the solution or technology which will underpin the communications infrastructure. However, for the purposes of this analysis the decision has been taken to assume the communications costs of a currently available communications technology infrastructure, which can provide sufficient functionality. We have assessed costs based on a GSM GPRS solution. This simplifies the analysis as it does not entail the modelling of hybrid options and, using a currently available technology, reduces the level of cost risk attributable[11].

4. Speed of roll-out

The May 2009 consultation and impact assessment included 3 options (options 1 to 3 in this Impact Assessment) involving roll-out completed by end 2020, and one involving a new and replacement approach which take approximately 20 years. The May 2009 IA showed that the new and replacement approach would have a significantly lower NPV, and it would also result in a delay to benefits which will only result from the completion of the roll-out (such as switching off legacy systems). In view of the October 2008 announcement of the intention to complete the roll-out by end 2020 this option has been removed from the present analysis.

The economic modelling incorporates different lengths of the planning and preparation phase which is required before the actual installation of any meters. The effects of these variations are examined in the results section. It is also possible that a variety of alternative planning and roll out durations could be envisaged. We believe that the options we analyse show a number of realistic approaches to the overall delivery of smart meters.

A number of issues can be contrasted with different speeds of smart meter roll-out, and again these are valid for any variants of speed:

- **benefits (and costs)** come on stream sooner the faster the roll-out;
- with a longer roll-out the need for suppliers to **run two "back-office" systems,** one to support the old meter stock and one for smart meters, is extended and therefore costs are likely to be higher. Other non-supplier central systems, processes and bodies may also need to be maintained in parallel during this period e.g. Electralink's Data Transfer Network, Master Registration Agreement Data Flows Catalogue;
- any roll-out of smart meters will require equipment, a skilled labour force and availability of suitable meters to fulfil the roll out. In an accelerated roll out pressures on **capital costs and availability** may be increased as these will be required in a shorter space of time; and
- **stranded assets** – setting an accelerated deadline for a smart meter roll out will cause a certain proportion of electricity and gas meters to be removed before the end of their normal economic life. This will create costs for either the owner of the asset or suppliers, depending on the contractual arrangements in place.

[11] This is in line with the recommendations of Baringa Partners *Risk and Optimism Bias Project*

5. Options analysed

The variables assessed above have informed the Government's identification of the following options:

- Option 1: Mandated roll-out of smart meters under the **competitive model** by the end of 2020,
- Option 2: Mandated roll-out of smart meters under the **centralised communications model** by the end of 2020,
- Option 3: Mandated roll-out of smart meters with the **fully centralised model** by the end of 2020,
- Option 4: Mandated roll-out of smart meters under the **DNO deployment model** by the end of 2020,
- Option 5: Mandated roll-out of smart meters under the **energy networks co-ordination model** by the end of 2020, and
- Option 6: Mandated roll-out of smart meters under the **regulated asset ownership model** by the end of 2020.

F. Analyse the options

In this section we describe the main assumptions underpinning the analysis and the reasons for them with references to the evidence where appropriate. Further work has been undertaken since the April 2008 Impact Assessment to look at risk, market structure, functionality and communications. This further analysis has been undertaken by DECC and has been informed by the outputs of the externally sourced work of Baringa Partners. In addition we have received feedback from stakeholders on many aspects of the analysis throughout this period.

We have refined our assumptions and methodology on the basis of a critical examination of the evidence we have received and changes have also undergone a process of cross-government peer review. Differences between the assumptions used in this Impact Assessment and the one published in May 2009 are noted and explained within the text. For reference purposes Annex 1 provides an overview of the changes made. The assumptions are generally shared between the options under consideration, but where there are differences these are noted.

In general further analysis of the available evidence and stakeholder feedback since publication of the April 2008 impact assessment has led to downward revision of key assumptions, notably asset costs and adjustments for optimism bias factors. In these two areas we have been able to amass and cross reference information from various sources (including drawing on international experience). We have an improved evidence base for decision making and our understanding of the key issues and assumptions has increased. Overall the case for a roll out of smart meters to domestic consumers is positive in central scenarios (see results page 31); which contrasts to the initial partial analysis and Impact assessment published in April 2008.

The main assumptions used to calculate the costs and benefits of each option described in this section are:

1. Counterfactual/benchmarking
2. Asset costs
3. Benefits
4. Speed of roll-out
5. Other Key assumptions

It should be noted that within the economic model all up-front costs are annuitised over the lifetime of the meter or over the roll out period. The modelling assumes that a loan is required to pay for the asset, which is then repaid over the period. Following Government guidance a cost of capital of 10% has been assumed. The benefits are not annuitised but annualised that is they are counted as they occur.

1. Counterfactual/benchmarking

As set out in the April 2008 Impact Assessment a counterfactual case has been constructed. This assumes no Government intervention on domestic smart metering but includes the implementation of the policies on billing (primarily provision of historic comparative data) and displays set out in the August 2007 consultation on billing and metering[12]. It includes:

[12] A *'do nothing'* option is not analysed because policy implementation as described will continue

- the costs of the continued installation of basic meters,
- benefits from better billing,
- 5% of the predicted 2.8% consumer electricity savings from smart metering, is assumed to occur in the counterfactual world as a result of CERT and other delivery of clip-on RTDs.

It is difficult to judge whether any significant numbers of smart meters would be rolled out in the absence of Government facilitation. Suppliers or other meter owners are reluctant to install their own smart meters without a commercial and technical inter-operability agreement. Without such an agreement meter owners would face a large risk of losing a major part of the value of any smart meter installed. This is because there is a significant chance that consumers will switch to a different energy supplier who will not want or be able to use the technology installed earlier and will, therefore, not be willing to pay to cover the full costs – making the smart meter redundant. It is therefore reasonable to assume a counterfactual world in which no smart meters roll out over the period to end 2020: this is the assumption used in the headline estimates presented in this Impact Assessment. It is worth noting that the situation is different in the case of non-domestic customers (subject of a separate IA). The provision of smarter metering is already established at larger sites, and such metering, whether self-standing or retrofitted to existing meters, is increasingly being installed at smaller sites, particularly of multi-site customers. This reflects, among other things, the proportionately larger potential savings and lower stranding or redundancy risks from smart and advanced metering for larger consumers and the lower relative cost of the meters, as well as incentivisation of installation of smarter metering under the Carbon Reduction Commitment.

However, recognising that some level of smart meters may be rolled out, for illustrative purposes we have also considered a situation where smart meters are rolled out to a significant part of the residential population. A counterfactual scenario has therefore also been examined which reduces NPV benefit by just over £2 billion for each of the options under examination, hence without changing the ranking of options.

The scenario we have assumed is very conservative and assumes that a roll-out of smart meters in the counterfactual world would mean that energy suppliers roll-out first to those consumers which benefit more from it and hence a 20% roll-out of smart meters, in a competitive metering counterfactual world, results in a reduction in gross benefits of 30% and a reduction in costs of 20%. Even in this conservative scenario, the NPV of all options considered in the impact assessment is positive.

The cost of the continued basic meter installation is deducted from the costs for the smart meter deployment. This cost is deducted from the asset and installation costs of each option. As already mentioned the numbers of meters that can be fitted on a coordinated basis is also constrained by the fact that a certain number of meters have to be replaced in any case every year due to either breakdown or because they have reached the end of their operational life.

The benefits from better billing and displays policies result in a reduction in benefits for smart meters; these benefits are subtracted from the overall benefits for smart meters. An increase in take up of clip-on displays would therefore reduce the level of benefits accruing to smart meters.

2. Asset costs

Our underlying assumption for cost benefit modelling purposes is that the metering technology deployed will provide the functionality already set out. For the purposes of this analysis delivery of real time information is assumed to be through a standalone display which is connected to the metering system via a Home Area Network (HAN). It is assumed that a Wide Area Network (WAN) is also required to provide the communications link to the supplier and/or other market actor (e.g. in centralised delivery models this may not be a supplier). As explained above for the purposes of the cost benefit modelling we assume that the WAN communication is provided by GSM GPRS technology. This provides one realistic approach to the communications infrastructure and simplifies the analysis. In the cost benefit modelling we calculate the communications devices as separate to the meter specification.

Under all except for option 1 we assume that there is one WAN connection to a household and one display is provided. However under the competitive delivery model we assume there is one WAN and one display for households which receive gas and electricity from the same supplier, and for those which only have electricity supply. However where a household receives its gas from one supplier and its electricity from a different supplier we assume that there will be two WAN connections and that two displays will be supplied.

Capital costs

The tables below shows the capital costs of meter and communications assets used for the current analysis, all of which are unchanged from the May 2009 Impact Assessment.

Table 2: Capital Costs of Assets (£ per device)

	Electricity	Gas
Display	£15	£15
Meter	£43	£56

Table 3: Communications infrastructure (£ per device)

WAN (modem)	£15
HAN	£1 Electricity/ £3 gas

There are different costs associated with the HAN for gas and electricity because the former is battery operated.

Within the modelling it is assumed that due to technological advancement the costs of the meters will fall over time. This has been the experience with current meters and has also been seen in the international deployments of smart meters. We assume that costs fall by 1% per annum, resulting in 10% by the end of 2020. This reduction is split and is applied at three time points: 2010, 2017 and 2024.

Installation costs

We have retained the assumptions from the May 2009 Impact Assessment for installation costs; this includes a £10 per installation efficiency resulting from the dual fuel installation.

Table 4: Installation costs

Electricity only	Gas only	Dual fuel
£29	£49	£68

Operating and maintenance costs

Smart meter maintenance costs are uncertain, because an integrated solution including communication provision has not been tried in the British market. The assumption used in the April 2008 Impact assessment based on Ofgem[13] work assumed an annual operation and maintenance cost for smart meters of 2.5% of the meter purchase cost. No further substantive evidence has been brought forward on this point and we have therefore retained this assumption for the 2009 Impact Assessment.

For the operation and maintenance costs of the communication technology we assume – in line with the available evidence – these to be £4.8 per meter per year (annuitised) for the WAN devices. This is assumed to gradually decrease over the period of the roll out. The costs of operating and maintaining the HAN are assumed to fall within those for the meter as above.

Cost of capital

The costs of assets and installation are assumed to be subject to a private cost of capital, i.e. resources committed to assets and installation have an opportunity cost. That cost is fixed at 10% p.a. in the impact assessment. A number of stakeholders have suggested that their own rates of return are lower than this level. This relatively high rate has been chosen to ensure that the full opportunity cost of the investment is reflected in the impact assessment.

Some stakeholders have suggested that network monopolies may have a lower cost of capital than energy suppliers, and that our analysis should reflect this differential. It is true that companies operating in a less competitive environment are better protected from the risk of stranded investments than in a market where there is competition. However, the cost and stranding risks are transferred to consumers who are also deprived of the potential benefits of competition – better customer service, lower prices, greater choice and greater innovation in services. Therefore, our view is that the same cost of capital (10%) should be applied to all businesses, since monopolies will only be able to raise capital at a lower private cost if they transfer risk to consumers, thus yielding no net-economic-benefit for society overall.

A sensitivity analysis by Redpoint Energy is presented in Baringa Partners' report[14] published alongside this document. This presents an illustrative sensitivity analysis of potential cost of capital differences. We do not consider appropriate to take this into account as part of the impact assessment for the reasons set out above and also discussed in the Baringa report.

Energy cost

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[13] Ofgem, *Domestic Metering Innovation Consultation and supporting documentation*, February and March 2006

[14] Baringa Partners, *Smart Meter Roll-out: Energy Network Business Market Model Definition and Evaluation Project*, 2009

The smart metering assets will consume energy and after discussions with meter specialists we continue with the assumption that a smart meter would consume 1 w/h, and a display 0.6 w/h and the communication equipment 1 w/h. These assumptions are unchanged.

Meter reading costs

The April 2008 Impact Assessment set out the rationale for an equation to capture the decreasing efficiency of reading non smart meters as the roll out of smart meters proceeds – described as pavement reading inefficiencies. We subsequently made some modifications to this equation to better represent the increasing cost of reading non-smart meters as the total number of non-smart meters decreases. The assumption of the maximum additional cost of these readings has been increased and they increase exponentially to a limit of four times the existing meter reading cost. These reads are now treated as an additional cost per meter and the costs are spread across the roll out. As a result of these changes overall costs are lower than in the April 2008 assessment.

For the purpose of this analysis our assumption is that the current regime of two-yearly safety and tampering checks for gas and electricity meters remains in place. Smart metering functionality may remove the need for these inspections, but the relevant regulators and authorities will need to be convinced that the standards concerning safety and revenue protection are maintained before such a change could be made. Those discussions have not yet taken place and we therefore have no justification for removing the costs associated with these inspections.

3. Benefits of smart metering

Consumer benefits

Benefits from smart meters can be driven by changes in consumers' expected consumption behaviour. Two potential sources of change in average consumption behaviour may arise:

- a reduction in overall energy consumption as a result of better information on costs and use of energy which drives behavioural change, and
- a shift of energy demand from peak times to off-peak times.

Energy demand reduction

There remains a great deal of uncertainty about the likely response of consumers to the full roll out of smart meters. Although a number of international studies exist (summarised by Sarah Darby[15]), and these sometimes show dramatic behavioural changes from the introduction of real-time displays (average reductions in energy consumption of over 10%), it is difficult to transfer the findings to the domestic GB situation (because for example there is little use of air conditioning, a different counterfactual world, or different cultures and pricing regimes). The Energy Demand Research Project[16] has been funded by the Government to provide information on

[15] Sarah Darby, *The Effectiveness of Feedback on Energy Consumption*, April 2006

[16] The Energy Demand Research Project (EDRP) started in July 2007. Four suppliers are leading the project trials which are examining how energy consumers respond to better information about their energy consumption. The project is funded by £10m from the Government, matched by equivalent funding from the companies. Several interventions are being tested: smart meters, real-time display devices; additional billing information; monthly billing; energy efficiency information; and community engagement. There are a combination of interventions in around 42,000 different households and some 18,000 smart meters. The results should provide information on behavioural changes and their durability, a breakdown of observed reductions in consumption and an assessment of the impacts on

consumers' responses to a range of forms of feedback in Great Britain. The final report from the project is currently expected to be available in early 2011.

As a consequence most commentators have so far adopted relatively conservative assumptions. For example Ofgem's cost-benefit analysis[17] assumed a 1% energy saving from smart meters, which is at the lower end of the savings of 1-3% reported in the Owen and Ward[18, 19]studies (2006, 2007). Other studies have been more optimistic with Energywatch[20] giving a range of energy saving of 3.5-7%.
For our analysis we have assumed that the following gross annual reductions in demand will take place as a result of improved feedback on the use and cost of energy. The reductions are as follows:

- 2.8% for electricity (credit and PPM); 2% for gas credit and 0.5% for gas PPM.

We also apply sensitivity analysis to these benefits as follows:

- In the higher benefits scenario: 4% for electricity (credit and PPM), 3% for gas credit and 1% for gas PPM.
- In the lower benefits scenario: 1.5% for electricity (credit and PPM), 1% for gas credit and 0.3% for gas PPM.

Energy demand shift
Another potential source of change in consumption patterns through smart meters is a shift of energy demand from peak times to off-peak times. The rationale and our underlying assumptions on Time of Use (ToU) pricing have not changed since the April 2008 Impact assessment. We assume a 20% take up by consumers of the ToU tariff (in addition to the existing group using this option) and a resulting overall 3% electricity bill reduction and 5% peak use reduction for these customers; sensitivities are made on the take up at 0% and 40%.[21] Energy is valued largely consistently with guidance produced by DECC[22]. This includes consideration of the revised carbon valuation methodology, which was published alongside the Low Carbon Transition Plan.

Valuing avoided costs of carbon from energy savings

As part of Government's public service delivery agreement (PSA) 27[23] to lead the global effort to avoid dangerous climate change, we have valued the avoided costs of carbon from energy savings. Indicator 6 of the PSA is intended to show whether the UK is introducing cost-effective policies to reduce carbon emissions and, consistently with such agreement, we report on the impact of the smart meters policy in this section, and with some more detail in the carbon assessment in page 53.

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different households. See http://www.ofgem.gov.uk/Markets/RetMkts/Metrng/Smart/Pages/SmartMeter.aspx
[17] Ofgem, *Domestic Metering Innovation Consultation*, February 2006
[18] Owen and Ward, *Smart Meters in Great Britain: the Next Steps*, July 2007
[19] Owen and Ward, *Smart Meters: Commercial, Policy and Regulatory Drivers*, March 2006
[20] Energywatch, *Smart Meters – Costs and Consumer Benefits*, 2007
[21] These assumptions have not changed since the May 2009 Impact Assessment, but were incorrectly described in that document.
[22]DECC Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, May 2009
[23] HM Government, PSA Delivery Agreement 27, 2007 http://www.hm-treasury.gov.uk/d/pbr_csr07_psa27.pdf

For electricity, reductions in electricity use will mean the UK purchasing fewer EU ETS allowances and this saving is assimilated as a benefit. In our analysis and across all options, it accounts for Present Value (PV) £0.4bn to £0.5bn.

For gas, the value of carbon savings from a reduction in gas consumption uses the non-traded carbon prices under DECC's new carbon valuation methodology. This corresponds to a net reduction in global carbon emissions and corresponds to approximately PV £0.9bn for all options.

Reduction in carbon emissions

Over a twenty year period, we assume that as a result of a reduction in energy consumption, CO2 emissions reductions will take place in the traded and non-traded sectors[24]. The table below presents the CO2 emissions associated with the energy savings in the central scenario across options.

Table 5: reductions in CO2 emissions and energy savings

Option	Million of tonnes of CO2 saved – traded sector	Million of tonnes of CO2 saved – non-traded	Energy Savings – electricity (£bn, PV)	Energy Savings – gas (£bn, PV)
1	15	24	2.6	1.9
2	15	24	2.5	1.9
3	14	23	2.4	1.8
4	15	23	2.4	1.8
5	15	23	2.4	1.8
6	15	24	2.5	1.9

Valuing consumer time savings

The April 2008 Impact Assessment discussed the potential for valuing savings in consumers' time from the introduction of smart meters and we concluded that there was insufficient information to include any savings. We have received no further information since April 2008 and we have therefore not included any savings in this assessment.

Microgeneration

We have attempted to estimate the savings from using smart meters to deliver information from microgeneration devices by estimating the number of microgeneration devices that will be in use in 2020. After initial discussions we have made a conservative estimate of the number of units (about 1 million by 2020) and the saving (assuming a separate meter is not needed and its installation cost - savings per annum per meter of £0.12).

Supplier benefits

[24] Note that the impact of a tonne of CO_2 abated in the traded (electricity) sector has a different impact to a tonne of CO_2 abated in the non-traded (gas) sector. Traded sector emissions reductions lead to a reduction in UK territorial greenhouse gas emissions, but do not constitute an overall net reduction in global emissions since the emissions will be transferred elsewhere to member countries in the EU-ETS. The UK gains a cost saving from buying fewer emissions allowances, but these allowances will be bought up by other member states – the total size of the EU-wide 'cap' on emissions does not change during each phase of the EU-ETS. Non-traded sector emissions reductions will reduce both UK and global emissions.

Supplier benefits are the cost reductions that suppliers will see once smart meters are installed. The following are the main supplier benefits used in the Impact Assessment.

Meter reading

This assumption is unchanged from the May 2009 Impact Assessment. Smart meters will allow meter reading savings for all the suppliers once the roll-out is complete. We continue to assume that "avoided meter reading" will bring in benefit (cost savings) of £6 per (credit) meter per year in our central scenario taking into consideration both actual and attempted reads. We have also included another benefit linked to meter reading – "avoided site visit" these are avoided special visits to read meters or ad hoc safety-related inspection visits outside the normal cycle. Reductions in the requirements for these visits are assumed to give a benefit of £0.75 per meter per year.

Customer service overheads

Call centre cost savings are a result of a reduction in billing enquiries and complaints. Smart meters will mean the end of estimated bills and this is expected to result in lower demand on call centres for billing enquiries. This assumption is unchanged since May 2009 and we assume this cost saving to be £2.20 per meter per year in the central scenario (£1.88 for reduced inbound enquiries and £0.32 for reduced customer service overheads). No new information was gathered on this point and our assumption is based on previous supplier estimates that inbound call volumes could fall by around 30% producing a 20% saving in call centre overheads. Other consultation responses used similar cost assumptions for call centre cost savings.

Remote switching and disconnection

The meter functionality we assume will enable the remote enablement or disablement of the electricity and/or gas supply. The direct benefits associated with these capabilities are the avoided site visits and equipment upgrade costs. These are captured in the debt management and in the pre payment cost to serve savings. We also continue to include a further benefit of £0.5 per credit meter per year for the benefits of being able to remotely disconnect those consumers. As noted in the Government Response, the implementation programme will need to examine the existing protections for consumers and amend these where appropriate to ensure that consumers are properly protected.

Pre payment cost to serve

Smart meters are expected to bring savings in the cost to serve for consumers with pre payment meters (PPMs). These savings arise primarily from reduced maintenance and service needs. As set out in the April 2008 Impact Assessment we assume that the additional cost to serve consumers with PPMs are £30 for electricity and £40 for gas. The introduction of smart metering would reduce (but not remove all) those additional costs. Our assumption is unchanged from that used in May 2009 and is based upon consideration of consultation responses and evidence from Ofgem. The level of savings attributed to smart meters is 40%, representing an annual saving of £12 for each electricity PPM and £16 for each gas PPM.

Debt management

More accurate energy use information should help consumers better manage their energy expenditure, preventing large debts arising. This reduces supplier costs in managing and recovering debt. The benefit assumed in our modelling is £2.20 per meter per year, which reflects reduced inquiries related to change of occupier and change of supplier. Suppliers estimate that a 30% fall in inbound calls volume could result in 20% savings in call centres overheads.

Theft

The implementation of smart metering could reveal existing theft and allow suppliers to combat it better. Information provided suggested that this could reduce theft by 20-33% equivalent to £0.27 to £0.85 per meter per year. We continue to assume that the amount of theft is likely to decrease as suppliers will have access to more accurate and frequent data and will detect theft more quickly; however we also recognise that new methods of theft will arise. The assumption of a reduction of 10% or c. £0.2 per meter per year continues to be used in our central scenario.

Losses (Distribution)

We continue to assume that smart meters facilitate some reduction in losses and that the benefits per meter per year will be £0.5 for electricity and £0.1 to £0.2 for gas. This represents an initial assessment of the range of possible benefits to network operations made originally by Mott MacDonald[25]. Further work is needed to assess potential costs and benefits for networks in detail.

Switching Savings

The introduction of smart metering should allow a rationalisation of the arrangements for handling the change of supplier process. Trouble shooting teams employed to resolve exceptions or investigate data issues would no longer be needed. Suppliers will be able to take accurate readings on the day of a change of supplier, resolving the need to follow up any readings that do not match and instances of mis-billing would reduce. We continue to assume savings of £100m per year[26] (any additional systems costs are included in the IT and systems cost estimate).

Generation capacity investment

The assumed consumer energy demand shift to off-peak load could realise savings in investment in generation capacity. In our model we have assumed that the cost of additional investment in generation capacity is of £600 per additional kw of investment. If consumers shift to off-peak consumption some of the investment in generation capacity will be unnecessary, therefore realising savings to energy suppliers.

Intangible benefits

It has been possible to make a quantitative assessment of the benefits described above within the updated modelling for the 2009 Impact Assessment. However there remains a subset of benefits where the existence of smart metering may facilitate the uptake or management of new services or approaches to energy supply – especially in the medium to longer term. These remain generally unquantified but we consider they remain important potential elements or areas for future consideration.

Competition

It has been argued that the introduction of smart meters will have an effect on the competitive pressure within energy supply markets – in particular because smart meter reads providing accurate and reliable data flows will support easier and quicker switching between suppliers. In addition the information on energy consumption provided to consumers via displays will enable them to seek out better tariff deals, switch suppliers and thereby driving prices down. In addition the improved availability of information should create opportunities for energy services companies to enter the domestic and smaller business markets; and for other services to be developed, for

[25] Mott MacDonald, *Appraisal of costs and benefits of smart meter roll out options*, April 2008

[26] Based on estimates from Owen and Ward (2006)

example new tariff packages and energy services. Overall smart meters should enhance the operation of the competitive market by improving performance and the consumer experience, encouraging suppliers' (and others) innovation and consumer participation.

Longer term network management and demand-side load shifting
In the longer term more sophisticated approaches to management of the energy networks may be possible and the possibility of remote management of energy use or the network becomes real. It is difficult to quantify what the benefits of these changes (often described as Smart Grids) would be or the other opportunities which may flow from them, and further work is being undertaken to understand them. Smart metering could facilitate responses to future changes in energy demand (through, for example a greater take up of electric cars or the adoption of demand-side management approaches) which will entail more proactive management and pricing. In addition smart meters provide a platform for more effective management of the future grid where energy will come from a variety of sources – including some which may be more intermittent – and generation becomes more decentralised. There are potential benefits here from reduced overall demand and the smoothing of demand between peaks. In the longer term benefits may also be identified in this area which may contribute on security of supply objectives.

With additional renewable electricity being delivered predominantly by wind generation back-up generation is required to maintain security of supply. Smart metering with automated controls to switch load would reduce the need to bring on-line conventional generation and reduce the need for investment in backup generation.

Future energy products
It is likely that suppliers will profit from selling new energy products as a result of smart meters. This revenue could be of the order of £100m or more per annum from 2020. This will probably represent a benefit to suppliers only, not to society, as it is unlikely that the profits from these products will be passed onto consumers. We are currently unable to estimate the consumer benefit from these new products, therefore, to avoid a biased adjustment of estimates we have excluded the expected supplier profits from the analysis reported in this impact assessment.

4. Roll-out duration

Roll-out by end 2020

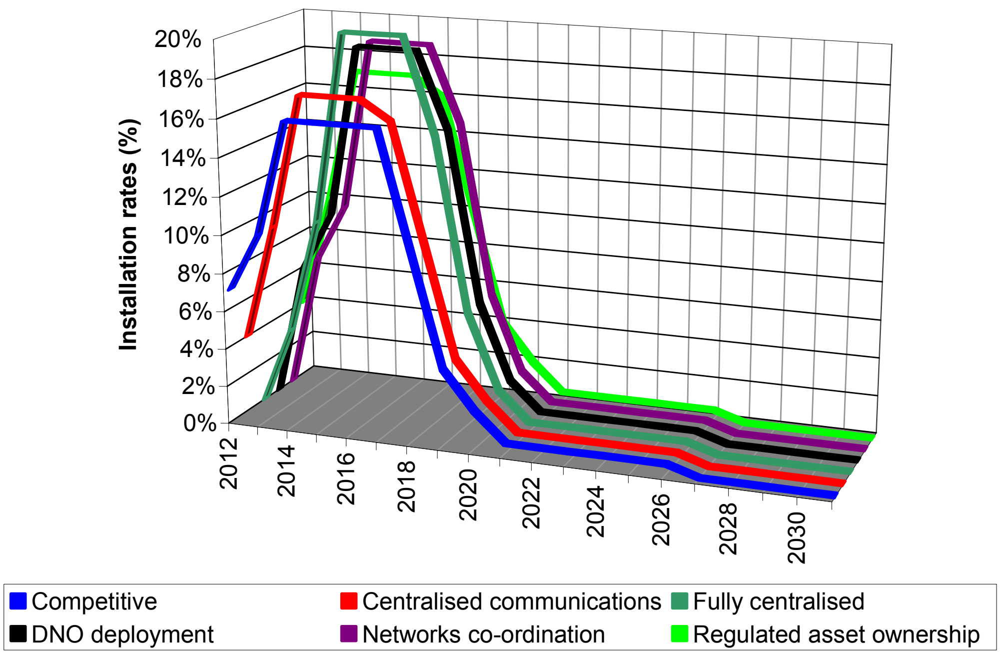
An accelerated roll out means that the benefits come on line more quickly and a more intensive approach would provide greater benefits of scope and scale and the necessity to run multiple back office systems would be reduced. Baringa's May 2009 report and further report on market models, which is published alongside this impact assessment, includes an extensive discussion of efficiency impacts between models.

However, costs would come on line just as quickly as benefits. Where timelines are shorter, higher capital costs might be expected as it would be necessary to acquire the equipment, competent labour and meters within a compressed period. And there would be inevitable stranding costs. Additionally the scope to adjust delivery and learn from mistakes is less – the time available to adjust being much shorter. There is potential for greater risk to consumers in terms of cost.

Our modelling varies the time period within which meters are deployed by delivery model. We assume that the different delivery models require different preparation period. The analysis we have undertaken assumes that:

- Under Option 1 – the **competitive model** – the preparation period is 2.5yrs and the period for meter installation is 9yrs,
- Under Option 2 – the **centralised communications model** – the preparation period is 3yrs and the period for meter installation is 8.5yrs,
- Under Option 3 – the **fully centralised model** – the preparation period is 4yrs and the period for meter installation is 7.5yrs,
- Under Option 4 – the **DNO deployment model** – the preparation period is 3.5yrs and the period for meter installation is 8yrs,
- Under Option 5 – the **networks co-ordination model** – the preparation period is 3.5yrs and the period for meter installation is 8yrs, and
- Under Option 6 – the **regulated asset ownership model** – the preparation period is 3yrs and the period for meter installation is 8.5yrs.

The roll out profiles used in our analysis are shown in the chart below (they are the same as those used by Baringa Partners for options 1 to 6).



It should also be noted that the numbers of meters that can be fitted on a coordinated basis is also constrained by the fact that a certain number of meters have to be replaced in any case every year due to either breakdown or because they have reached the end of their operational life.

5. Other assumptions

IT, legal and contractual costs

New IT systems for data management, settlement and storage are likely to be needed to underpin the roll-out of smart meters. We continue to assume a one off cost of around £12m for the new IT system across suppliers and an additional annual cost of £1m for operation and maintenance for the major suppliers. In addition there will be costs for legal, institutional and planning of the roll out, this relates to the governance and legal set up costs assumed for each model. For example, it includes amongst others costs like supplier contractual costs, testing of the infrastructure and conducting trials, and data protection and security policies[27]. Following consultation with Ofgem, these numbers have been slightly revised since the May 2009 Impact Assessment. These costs are summarised in the table below:

Model	Governance costs (£mn)
Competitive	195
Centralised communications	300
Fully centralised	535
DNO deployment	500
Energy Networks co-ordination	515
Regulated asset ownership	365

Competition

While we judge that the market models that include greater levels of competition may result in lower prices, it is difficult to quantify these competition-related reductions and therefore no attempt has been made to quantify these in this Consultation Impact Assessment. A competition Assessment is included in the Specific Impact Tests section at the end of this document.

6. Results

The results below are produced by running cost benefit estimation model using the assumptions outlined above. Within the model, the upfront costs are annuitised over either the lifetime of the device or over a 20-year period. The cost numbers are risk-adjusted, i.e. they have been adjusted for optimism bias (See section G on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios.

The previous version of the impact assessment included a column showing the average annual impact per meter (£) in Table 9. In the current version of the impact assessment, such column has been substituted for a more precise measure of the impact on energy bills of domestic customers (Table 11)[28]. This builds on existing DECC modelling on energy prices to estimate the impact on domestic energy bills in cash terms of the deployment of smart meters.

The options assessed are:

- Option 1: Mandated roll-out of smart meters under the **competitive model** by the end of 2020,
- Option 2: Mandated roll-out of smart meters under the **centralised communications model** by the end of 2020,
- Option 3: Mandated roll-out of smart meters with the **fully centralised model** by the end of 2020,

[27] Baringa Partners, *Smart Meter Roll-out: Energy Network Business Market Model Definition and Evaluation Project*, 2009
[28] Updated values of the average annual impact per meter are available for the central case in Annex 2

- Option 4: Mandated roll-out of smart meters under the **DNO deployment model** by the end of 2020,
- Option 5: Mandated roll-out of smart meters under the **networks co-ordination model** by the end of 2020, and
- Option 6: Mandated roll-out of smart meters under the **regulated asset ownership model** by the end of 2020.

Table 6: Central case results

	Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
Competitive Model	9.86	14.73	4.86
Centralised Communication Model	8.64	14.62	5.98
Fully Centralised Model	8.22	13.88	5.65
DNO deployment Model	8.19	13.98	5.79
Networks co-ordination Model	8.36	13.98	5.62
Regulated asset ownership Model	8.73	14.62	5.89

Table 7: Benefits by recipient

	Consumer Benefits £bn	**Supplier Benefits £bn**	**Other benefits £bn**	**Total benefits £bn**
Competitive Model	7.04	6.32	1.37	**14.73**
Centralised Communication Model	6.99	6.27	1.36	**14.62**
Fully Centralised Model	6.67	5.92	1.29	**13.88**
DNO deployment Model	6.71	5.97	1.30	**13.98**
Networks co-ordination Model	6.71	5.97	1.30	**13.98**
Regulated asset ownership Model	6.99	6.27	1.36	**14.62**

Table 8: Results showing sensitivities around benefits

	Total Costs £bn – central	**Total Benefits £bn**			**Net Present Value £bn**		
		Low	**Central**	High	Low	**Central**	High
Competitive Model	9.86	9.91	**14.73**	19.47	0.07	**4.86**	9.58
Centralised Communication Model	8.64	9.84	**14.62**	19.33	1.22	**5.98**	10.67
Fully Centralised Model	8.22	9.33	**13.88**	18.35	1.12	**5.65**	10.12

DNO deployment Model	8.19	9.40	**13.98**	18.48	1.22	**5.79**	10.28
Networks co-ordination Model	8.36	9.40	**13.98**	18.48	1.05	**5.62**	10.11
Regulated asset ownership Model	8.73	9.84	**14.62**	19.33	1.13	**5.89**	10.58

Table 9: Results showing benefits sensitivities

	Consumer Benefits £bn			**Supplier Benefits £bn**			**Other benefits £bn**		
	L	**C**	H	L	**C**	H	L	**C**	H
Competitive Model	2.87	**7.04**	11.13	5.72	**6.32**	6.92	1.32	**1.37**	1.42
Centralised Communication Model	2.86	**6.99**	11.06	5.68	**6.27**	6.86	1.31	**1.36**	1.41
Fully Centralised Model	2.72	**6.67**	10.54	5.37	**5.92**	6.47	1.24	**1.29**	1.34
DNO deployment Model	2.74	**6.71**	10.61	5.41	**5.97**	6.52	1.25	**1.30**	1.35
Networks co-ordination Model	2.74	**6.71**	10.61	5.41	**5.97**	6.52	1.25	**1.30**	1.35
Regulated asset ownership Model	2.85	**6.99**	11.06	5.68	**6.27**	6.86	1.31	**1.36**	1.41

The competitive model shows substantially lower net benefits than any of the other options by approximately £1bn. This is because even though benefits are maximised from an earlier roll-out, costs are considerably higher due to inefficiencies and duplication in the roll-out, for example on communications provision and installation.

The rest of models show relatively similar net benefits and even though the central communications model shows the highest net benefits the differences between models are not significant.

The fully centralised model offers lower costs as it minimises the cost of roll-out, however it has lower benefits as it has a later start date for the roll-out and hence benefits are delayed in time (see page 29). The regulated asset ownership model has very similar costs and benefits than the fully centralised model even though costs are slightly higher due to higher governance and contractual costs.

The DNO-deployment model has lower costs of roll-out than the central communications model due to a dual fuel installation and street by street coordination. However it has higher governance and contractual costs and the benefits are lower since the roll-out starts later. The networks co-ordination model has very similar costs and benefits than the DNO-deployment model, however it has slightly higher installation costs since full coordination between DNOs and GTs is not achieved.

Alternative approach to gas meters

As discussed in page 16 a variation of the central communications model has been assessed for gas metering. If the metering system has no valve – i.e. it does not include functionality to remotely disable and enable supply – this would reduce the asset cost for gas credit meters by £13 (the cost of the valve) to £43. Under the central communications model this would reduce capital, installation and O&M costs from £5.7bn to £5.2bn and total costs overall from £8.6bn to £8.2bn. However it would also reduce benefit levels because there are benefits from debt handling and remote disablement/enablement of supply for non prepayment customers (see remote disconnection and debt management – page 27) from £14.6bn to £14.2bn.

Table 10: Results of segregated approach to gas meters

Central comms model only	Net benefit (£bn)	Total cost (£bn)	Total benefit (central scenarios) (£bn)
Pre-payment meters have valve, credit customers have no valve, [29]	**6.03**	8.20	14.23
All meters with valve	**5.98**	8.64	14.62

7. Distributional impacts

a) Consumer impacts of smart meters

The costs to energy suppliers will be recovered through higher energy prices, although any benefits to suppliers will also be passed on to consumers[30]. However the reduction in energy consumption from smart meters will counteract this impact, leading to a net decrease in energy bills on average. The results below show the average impact on UK household energy bills. It is expected there will be variation between households depending on the level of energy they save and on how suppliers decide to pass through the costs.

The impact on consumers is shown for the model which has the highest NPV (centralised communications model) to give the range of possible impacts. The results are broadly similar to those presented in the previous version of the impact assessment, showing long term reductions in energy bills for dual fuel customers. For example, by 2020 we expect the savings on energy bills for the average dual fuel costumer to be in the region of £28 per annum.

Please note that the present bill impacts update the estimates presented in both the May 2009 impact assessment and the Low Carbon Transition Plan[31]. The Low Carbon Transition Plan estimated the joint impact of DECC's policies on energy bills, where the impact on domestic customers of smart meters roll-out was estimated to be of -£3 in 2015 and -£29 in 2020 for dual fuel customers. The revised model estimates presented in this impact assessment indicate that for the centralised communications model, the energy bill savings would be broadly similar (see Table 11).

[29] It is assumed that remote disablement functionality will be deployed to replace the current stock of pre- payment meters estimated to be about 2.1 million of the total 22.4 million gas meters
[30] For this analysis we have assumed that suppliers pass 100% of the costs and benefits on to consumers due to the pressures of the competitive market.
[31] HM Government, Analytical Annex, the Low carbon Transition Plan. http://www.decc.gov.uk/Media/viewfile.ashx?FilePath=White Papers\UK Low Carbon Transition Plan WP09\1_20090727143501_e_@@_uklctpanalysis.PDF&filetype=4

Table 11: Impact on domestic energy bills for a dual fuel customer

	Centralised communications (£)
2010	0
2015	-3
2020	-28
2025	-38
2030	-40

The price impacts of smart meters in the domestic sector are detailed in Table 12 below. The price impact per unit of energy is expected to be positive, but the reduction in energy consumption arising from the policy will mean that overall the average net impact on bills will be negative.

Table 12. Price impacts on domestic energy bills (central communications model)

	Domestic	
£/MWh	**Gas price impacts**	**Electricity price impacts**
2010	0.00	0.00
2011	0.04	0.13
2012	0.10	0.35
2013	0.24	0.87
2014	0.49	1.75
2015	0.61	2.24
2016	0.74	2.74
2017	0.88	3.32
2018	0.87	3.33
2019	0.80	3.09
2020	0.76	2.98
2021	0.69	2.74
2022	0.67	2.66
2023	0.65	2.59
2024	0.63	2.51
2025	0.62	2.44
2026	0.60	2.37
2027	0.58	2.27
2028	0.56	2.15
2029	0.54	2.00
2030	0.51	1.87

b) Remote switching

The proposed functionality requirements include enabling remote switching between credit and pre-payment. The Implementation Programme will need to examine the existing protections for consumers and amend these where appropriate to ensure that consumers remain properly protected. This work will need to cover a variety of issues, including rules relating to remote disconnection and switching between credit and pre-pay.

c) Stranding costs

Stranding costs are the costs incurred when a meter is taken out before the end of its expected economic life. This does not include the costs of removing old meters and installing new meters, but includes the costs from an accelerated depreciation of the asset (i.e. reduced length of the meter's life).This cost is dependent on the speed of the roll-out option; we assume it would be largely avoided in a new and replacement scenario, but costs would occur in a 10-year or shorter roll-out option (the basic meter life span is 20 years). In order to assess the impact of the different options we have made some simple assumptions with respect to stranding. These are as follows:

- meter asset value is based on the replacement cost of a basic meter;
- for assets provided by commercial meter operators, the stranding costs include a profit margin and annuitised installation costs since these are included in the annual meter charge;
- no installation costs are included for meters provided by Distribution Networks Operators since installation is paid upfront by suppliers;
- stranding costs for National Grid provided meters include 50% of annuitised installation costs to reflect the fact that prior to 2000 installation costs were annuitised in the meter charges, whereas after 2000 installation was paid up-front; and
- meter recertification continues during the deployment period.

All options would involve significant stranding costs and our estimates based on the assumptions above are that these costs would be around £0.75bn to £0.80bn. Stranding costs are not reflected in other parts of the analysis because they are considered to be a form of sunk costs i.e. costs already incurred but for the purposes of the analysis it is assumed that the costs of stranding will be passed on to consumers and the cost is therefore reflected in table 11 in the above section.

The total stranding costs over the period of a specific smart meter roll-out profile should be the same regardless of the order of meter replacement. Whilst specific contractual relationships between suppliers and meter operators may influence behaviours to an extent, we assume for the economic evaluation that there is no attempt to minimise stranding costs in the early years of the roll-out by replacing older meters first. Hence we assume that the age of the meters replaced (outside of the recertification programme) is the average age of legacy meters remaining in each year. Other things being equal (e.g. annual new meter installation numbers, rental arrangements, discount rates), suppliers are not expected to prioritise replacement on the basis of age of meter. To justify this finding it is worth considering two extreme scenarios, one where suppliers hypothetically target older meters first and a second where the youngest are targeted first.

Under the first scenario taking out older meters first could mean smaller termination fees in the early year, but it also means that younger meters remain on the wall. When the younger meters are finally replaced the supplier no longer has the opportunity to replace the older meters, so the termination fee in this later year is higher than it would have been if we had adopted the alternate strategy of replacing the youngest first. Adopting the second strategy would mean higher termination fees in early years, but lower fees in later years. Overall our termination fees will be the same in total with either strategy.

d) Administrative burdens on businesses

In looking at the installation costs of a managed programme of smart meters, we sought information from suppliers on the costs of notifying customers of the need to install new meters. The business as usual administration costs of installing dumb meters were initially estimated by PwC as £31 million. In the April 2008 impact assessment we discussed that in light of further information provided by suppliers on the costs of notifying customers of the need to install new meters. This information suggested that the admin burdens baseline could be reduced by an illustrative £25m per annum. We intend to look at this area further, including the impact of smart meters on this baseline, and estimates will be refined in due course. Therefore for the purposes of this impact assessment, we are taking a conservative assumption at this stage and assume no reduction in the original admin burdens baseline.

G. Risks

Costs: Risk Mitigation and Optimism Bias[32]

The roll-out of smart meters will be a major procurement and delivery exercise. The project will span several years and will present a major challenge in both technical and logistical terms.

There is a consensus that stakeholders do not explicitly make allowances for optimism bias in the estimates they provide for procurement exercises. By calling for pre-tender quotes for various pieces of equipment, suppliers are revealing the likely costs of the elements of smart metering and hence no further adjustment is necessary. However, historically, major infrastructure and IT contracts have often been affected by over–optimism and gone substantially over-budget, so we have adjusted the estimates for optimism bias, in line with guidance from HMT's Green Book.

After the publication of the April 2008 Impact Assessment, it was acknowledged that more work needed regarding the treatment of risk to the costs of a GB-wide smart meter roll-out. Baringa Partners were commissioned to consider these issues, in particular to provide:

- Assessment of the international and domestic evidence available,
- Development of a risk matrix based on the identification of key risks, their potential impacts and mitigation actions,
- Assessment of the sensitivity of these risks to market model and duration of the roll-out,
- Assessment of the treatment of risk in the April 08 IA, and
- Make recommendations, in light of the above.

The table below presents the treatment of particular cost categories under the May 2009 Impact Assessment along with justification. The presented treatments have been adopted for the current Impact Assessment.

[32] Baringa Partners, *Smart Meter Roll Out: Risk and Optimism Bias Project*, 2009

Table 13: Changes in treatment of risk by cost category

Cost category	Treatment	Rationale
Meter capex	15%	The level of costs has been extensively researched, buyers can protect themselves, trends of incremental cost reductions support a reduction but because smart meters haven't been deployed yet the full removal of the adjustment for OB is not justified.
IT and settlement capex	50%	Evidence supports the costs used and domestic experience warrants a proportionate OB adjustment, whilst bearing in mind the uncertainty surrounding the scope of system changes.
Installation	10%-20%	Domestic experience of installing smart meters (through the trials) and thorough quotes provided by suppliers indicate minimal optimism bias and warrant limited treatment, whilst bearing in mind the uncertainty surrounding the communication system to be chosen.
HAN capex	15%	In recognition of the tight functional relationship between HAN system and meter assets.
Comms capex	10% - 30%	For the competitive market model only because the communications costs provided do not include any contingency against obsolescence and under a competitive market model, suppliers would be exposed.

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[33].

Benefits: sensitivity analysis

Because of the scarcity of evidence on benefits (smart meters have only been recently rolled out abroad), sensitivity analysis has been applied to the main elements of the benefits. We ran the following sensitivities on the benefits:

[33] http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_supguidance.cfm#optimism

Table 14: Sensitivity analysis for benefits

	High benefits	Medium benefits	Low benefits
Consumer benefits			
Energy savings electricity	4%	2.8%	1.5%
Energy savings gas	3%	2%	1%
Energy savings gas PPM	1%	0.5%	0.3%
Shadow price of carbon savings	£30.6	£25.5	£23.0
Supplier benefits			
Call centre costs	£2.4	£2.2	£1.9
Meter reading	£6.5	£6.0	£5.5
Theft	15%	10%	5%
TOU take up	40%	20%	0%
PPM Cost of Serve	50%	40%	30%

It is worth noting that the energy savings and shadow price of carbon affect the total cost for each option due to the energy use by the devices, but the effect is minimal.

H. Enforcement

All of the options outlined in this impact assessment would be implemented via licence obligations. New licence requirements would be enforced in the same manner as existing licence obligations – by Ofgem as the gas and electricity markets regulator. Ofgem has powers under the Gas Act 1986 and the Electricity Act 1989 to take enforcement action including imposing financial penalties for breaches of licence conditions. Under the Competition Act 1998, Ofgem has concurrent powers with the OFT to bring an end to anti-competitive behaviour as well as impose financial penalties on licence holders of up to 10% of their turnover. Ofgem investigates any company which is found to be breaching the terms of their licence, acting anti-competitively, or breaching consumer protection law via a formal investigation. Investigations can be undertaken on Ofgem's own initiative or on the receipt of complaints or on referrals from other regulatory bodies.

I. Recommendation – Next Steps

These aspects are discussed in the Government response document which this impact assessment accompanies.

J. Implementation

These aspects are discussed in the Government response document which this impact assessment accompanies.

K. Monitoring and Evaluation

Detailed approaches to the monitoring and evaluation of the policy will be set out as part of the roll-out programme.

It is envisaged that as the roll-out progresses, particular attention will be paid to monitoring early behavioural responses to smart meters with the objective of feeding back any findings from this experience into the roll-out process. This way, adjustments to the roll-out programme can be realised in order to maximise the benefits from the smart metering roll-out.

Early results from piloting schemes are also expected to feed into a better monitoring and evaluation of the roll-out. For example, as part of the Energy Demand Research Project (see footnote 15), DECC has funded the piloting of smart meters to 18,000 homes, and consumers' behavioural response to the pilots will help monitor and evaluate the design and implementation of the policy.

Annexes

Annex 1 – Base assumptions and changes made

The table below sets out the base assumptions on costs and benefits within the impact assessment. Where changes have been made to the assumptions since the May 2009 Impact assessment these are shown and the basis for the change identified.

The main change to the quantitative results of the IA is the revised methodology on energy and carbon savings. This methodological refinement accounts for approximately £2bn of the additional benefits observed across all policy options when compared to the May 2009 IA. A substantial but relatively more modest change to the IA is the inclusion of generation capacity savings to the benefits derived from load peak shifting. This amendment adds approximately £250m in NPV to all policy options.

Table 15: Changes to base assumptions

COSTS		
Item	**Assumptions**	**Rationale for changes**
Governance and legal costs	Small revisions to the up-front legal and contractual costs	Further consultation with Ofgem on the breakdown of these costs
Various	Updating of the starting point for meter numbers	Availability of more up-to-date information from Ofgem
Split between one-off and recurring costs (Summary sheets)	One-off costs include the upfront elements of the communications costs, the upfront element of IT and legal/contractual costs and meter pavement reading inefficiencies.	The previous Impact Assessment did not distinguish between the one-off and recurring elements of some of the costs.
Annual average cost and One-off costs (Summary sheets)	Annual average cost is calculated in cash terms. One-off costs, even though split over 12 years, are presented in Net Present Value in year one.	Consistency with DECC's Greenhouse Gas Policy Evaluation and Appraisal Guidance.
BENEFITS (sensitivities applied – this table shows central case used)		

Consumer benefits		
Item	**Assumptions**	**Rationale for changes**
Energy savings	Revision of electricity and gas variable prices used in valuing energy savings	To reflect the latest set of DECC assumptions for these prices
Carbon saving	Revision of prices for carbon valuation and switch of the valuation of gas-related emissions from a Shadow Price to a non-traded emissions price	To reflect both the latest set of DECC assumptions and also the new carbon valuation framework published alongside the Low Carbon Transition Plan
Supplier benefits		
Item	**Assumption**	**Rationale for changes**
Peak load shifting	Inclusion of a price for generation capacity, in addition to those for transmission and distribution capacity	The previous Impact Assessment did not include generation capacity; it was agreed that this should be included in the current Impact Assessment
Other benefits		
Item	**Assumption**	**Rationale for changes**
None		

Annex 2 – Detailed results

Below are the detailed results from the model (in £million) for central case scenarios.

Option 1: Mandated roll-out of smart meters under the competitive model by the end of 2020

Total costs	**9,863**	**Total Benefits**	**14,725**
Capital	3,794	Consumer benefits	7,035
Installation	1,922	Energy saving	4,493
O&M	628	Load shifting	622
Comms upfront	1,147	TOU tariffs	361
Comms O&M	1,184	EU ETS	462
Energy	551	Global CO2 reduction	902
Disposal	39	Reduced losses	195
IT	42	Supplier benefits	6,319
Pavement reading inefficiency	292	Avoided meter reading	2,681
Legal and contractual	264	Inbound enquiries	964
		Customer service overheads	167
		Debt handling	983
		Avoided PPM COS premium	914
		Remote (dis)connection	223
		Avoided site visit	386
NPV	***4,862***	Other benefits	1,371
Average annual impact per meter (£)	3.7	Reduced losses	195
		Reduced theft	104
(Stranding costs	767)	Microgeneration	33
		Customer switching	1,039

Option 2: Mandated roll-out of smart meters under the centralised communications model by the end of 2020

Total costs	**8,641**	**Total Benefits**	**14,622**
Capital	3,509	Consumer benefits	6,990
Installation	1,539	Energy saving	4,464
O&M	623	Load shifting	617
Comms upfront	710	TOU tariffs	358
Comms O&M	942	EU ETS	460
Energy	547	Global CO2 reduction	896
Disposal	39	Reduced losses	194
IT	42	Supplier benefits	6,272
Pavement reading inefficiency	284	Avoided meter reading	2,662
Legal and contractual	406	Inbound enquiries	957
		Customer service overheads	166
		Debt handling	976
		Avoided PPM COS premium	906
		Remote (dis)connection	222
		Avoided site visit	383
NPV	***5,981***	Other benefits	1,361
Average annual impact per meter (£)	4.7	Reduced losses	194
		Reduced theft	103
		Microgeneration	33
(Stranding costs	755)	Customer switching	1,031

Option 3: Mandated roll-out of smart meters with the fully centralised model by the end of 2020

Total costs	**8,224**		**Total Benefits**	**13,875**
Capital	3,342		Consumer benefits	6,665
Installation	1,239		Energy saving	4,253
O&M	590		Load shifting	587
Comms upfront	669		TOU tariffs	339
Comms O&M	913		EU ETS	444
Energy	520		Global CO2 reduction	857
Disposal	38		Reduced losses	184
IT	39		Supplier benefits	5,922
Pavement reading inefficiency	151		Avoided meter reading	2,536
Legal and contractual	724		Inbound enquiries	906
			Customer service overheads	157
			Debt handling	930
			Avoided PPM COS premium	820
			Remote (dis)connection	211
			Avoided site visit	362
NPV	***5,651***		Other benefits	1,288
Average annual impact per meter (£)	4.3		Reduced losses	184
			Reduced theft	98
			Microgeneration	31
(Stranding costs	764)		Customer switching	976

Option 4: Mandated roll-out of smart meters under the DNO deployment model by the end of 2020

Total costs	**8,188**		**Total Benefits**	**13,975**
Capital	3,335		Consumer benefits	6,710
Installation	1,227		Energy saving	4,283
O&M	594		Load shifting	591
Comms upfront	674		TOU tariffs	341
Comms O&M	923		EU ETS	447
Energy	524		Global CO2 reduction	863
Disposal	38		Reduced losses	185
IT	39		Supplier benefits	5,967
Pavement reading inefficiency	158		Avoided meter reading	2,555
Legal and contractual	677		Inbound enquiries	913
			Customer service overheads	158
			Debt handling	937
			Avoided PPM COS premium	826
			Remote (dis)connection	213
			Avoided site visit	365
NPV	***5,787***		Other benefits	1,298
Average annual impact per meter (£)	4.5		Reduced losses	185
			Reduced theft	98
			Microgeneration	31
(Stranding costs	775)		Customer switching	983

Option 5: Mandated roll-out of smart meters under the networks co-ordination model by the end of 2020

Total costs	**8,359**		**Total Benefits**	**13,975**
Capital	3,335		Consumer benefits	6,710
Installation	1,351		Energy saving	4,283
O&M	594		Load shifting	591
Comms upfront	674		TOU tariffs	341
Comms O&M	923		EU ETS	447
Energy	524		Global CO2 reduction	863
Disposal	38		Reduced losses	185
IT	39		Supplier benefits	5,967
Pavement reading inefficiency	183		Avoided meter reading	2,555
Legal and contractual	697		Inbound enquiries	913
			Customer service overheads	158
			Debt handling	937
			Avoided PPM COS premium	826
			Remote (dis)connection	213
			Avoided site visit	365
NPV	***5,617***		Other benefits	1,298
Average annual impact per meter (£)	4.3		Reduced losses	185
			Reduced theft	98
			Microgeneration	31
(Stranding costs	775)		Customer switching	983

Option 6: Mandated roll-out of smart meters under the regulated asset ownership model by the end of 2020

Total costs	**8,729**		**Total Benefits**	**14,622**
Capital	3,509		Consumer benefits	6,990
Installation	1,539		Energy saving	4,464
O&M	623		Load shifting	617
Comms upfront	710		TOU tariffs	358
Comms O&M	942		EU ETS	460
Energy	547		Global CO2 reduction	896
Disposal	39		Reduced losses	194
IT	42		Supplier benefits	6,272
Pavement reading inefficiency	284		Avoided meter reading	2,662
Legal and contractual	494		Inbound enquiries	957
			Customer service overheads	166
			Debt handling	976
			Avoided PPM COS premium	906
			Remote (dis)connection	222
			Avoided site visit	383
NPV	***5,893***		Other benefits	1,361
Average annual impact per meter (£)	4.6		Reduced losses	194
			Reduced theft	103
			Microgeneration	33
(Stranding costs	755)		Customer switching	1,031

Annex 3 – Functionality: the cost/benefit build up of electricity and gas metering systems

In the April 2008 Impact assessment we looked at the costs of advanced (Automated Meter Reading or AMR) Meters and smart (Automated Meter Management or AMM) Meters. Little differentiation was made in the Impact Assessment between the benefits attributed to the functionality delivered by each.

In December 2008 we prepared an informal paper which attempted to allocate the costs of different levels of functionality to benefits. We suggested that for electricity:

- AMR functionality accounted for 72% of costs and delivered 69% of the benefits, and
- increasing functionality to AMM accounted for the remaining 27% of costs and delivered the remaining 30% of benefits.

And for gas:

- AMR functionality accounted for 57% of costs and delivered 74% of the benefits, and
- increasing functionality to AMM accounted for 43% of costs and delivered the remaining 25% of benefits

Overall our approach suggested that there were net benefits for both electricity and gas for all the levels of functionality. Discussion on the allocation of costs to benefits indicated that there was general agreement that, at a high level, the cost and benefit attribution to functionality was thought to be about right. There was some disagreement about the absolute numbers used rather than the relative attribution of benefits to functionality.

The costs used for electricity meters were broadly accepted. In addition a number of policy drivers were identified that pointed towards requirements for the full functionality set. The asset costs assumed for such a meter was £43 for the December paper. The further work by Baringa Partners confirmed this cost. This functionality option and cost assumption is used in the main analysis.

The costs used on gas were questioned especially around the AMM functionality and the inclusion of remote disablement of supply (requiring the inclusion of a valve in the metering system). Our December analysis had taken a conservative asset cost estimate for such meters as being £82 with the cost of a valve within this as £18. Evidence received from the work Baringa Partners have undertaken and from other sources suggested lower costs for both an AMM specified gas meter and for the incremental cost of the valve. The current Impact Assessment uses revised costs of £56 for the meter including £13 for the valve.

As part of the preparation stage for the roll-out of smart meters in the domestic and non-domestic sectors further analysis on the detailed functionality requirements of smart meters will be carried out, building on the initial analysis presented in the May 2008 impact assessment. A decision on whether to include functionality to enable/disable gas supply as part of the Government's high level requirements will be taken after further technical work.

Specific Impact Tests

Type of testing undertaken	*Results in Evidence Base? (Y/N)*	*Results annexed? (Y/N)*
1. Competition Assessment	No	Yes
2. Small Firms Impact Test	No	Yes
3. Legal Aid	No	Yes
4. Sustainable Development	No	Yes
5. Carbon Assessment	Yes	No
6. Other Environment	No	Yes
7. Health	No	Yes
8. Equality Impact Assessment (race, disability and gender assessments)	No	Yes
9. Human Rights	No	Yes
10. Privacy and data	No	Yes
11. Rural Proofing	No	Yes

Specific Impact Tests

1. Competition assessment

Consumers
From a consumer point of view it has been argued that the introduction of smart meters will have an effect on the competitive pressure within energy supply markets – in particular because accurate and reliable data flows may make the switching process easier and encourage consumers to seek out better deals, thereby driving prices down.

In addition the improved availability (subject to appropriate data controls and/or permissions) of more accurate and timely information should create opportunities for energy services companies to enter the domestic and smaller business markets; and for other services to be developed, for example new tariff packages and energy services, including by third party providers. Overall, smart metering should enhance the operation of the competitive market by improving performance and the consumer experience, encouraging suppliers' and others' innovation and consumer participation.

Whilst these effects are difficult to quantify in terms of the overall impact assessment it is important that consideration of the pro-competitive aspects of the delivery models are considered going forward.

Industry
Great Britain is the geographical market affected by the roll-out of smart meters. The products and services affected will be:

- gas and electricity supply;

- gas and electricity meters;
- provision of energy services (including information, controls, energy services contracting, demand side management) and smart homes
- meter ownership, provision and maintenance;
- other meter support services;
- communications services (e.g. telecommunications, radio communications).

In competition terms the roll-out would therefore affect:

- gas and electricity suppliers;
- meter manufacturers;
- meter owners, providers, operators and providers of ancillary services;
- energy services businesses and providers of smart home services;
- communications businesses.

As set out above in the main body of the IA, we have considered six main options for the delivery model to underpin the roll out of smart meters:

1. a fully **competitive model** – all elements of delivery are supplier led, generally utilising existing market structures;
2. a **centralised communications model** – a national communications network is put in place to support smart metering, but provision and installation of meters is left to suppliers; and
3. a **fully centralised model** – a national communications provider and regional (or national) monopoly providers for provision and installation of meters are put in place.
4. a **DNO deployment model** – Distribution Network Operators (DNOs) and Gas Transporters (GTs) are responsible for the provision of electricity and gas meters respectively; DNOs take responsibility for deployment strategy, installation and maintenance for both electricity and gas meters;
5. an **energy networks co-ordination model** – DNOs and GTs are separately responsible for the provision, deployment strategy, installation and maintenance for electricity and gas meters respectively, but co-ordination is achieved so that electricity and gas meters are installed in one visit to the maximum extent possible; and
6. a **Regulated Asset Ownership model** - DNOs and GTs are responsible for the provision of electricity and gas meters, but suppliers are responsible for deployment strategy, installation and maintenance.

The impacts in terms of competition on the different parties are expected to vary and are considered below for each delivery model.

Competitive model (all elements of delivery are supplier led, generally utilising existing market structures)

This option would have the least impact on competition. Suppliers would, as now, individually contract with various suppliers of meters and services. They would also contract individually for the provision of communications services. They would therefore retain the ability to differentiate their metering arrangements and services provided above the minimum level of functionality set for the smart metering system.

It is possible that suppliers might wish to achieve a degree of brokered co-operation on installation within this option. While this could be beneficial in terms of cost, it might have an effect on competition and would require careful consideration of any likely, possible or unintended effects. Ofgem would need to have oversight of any such arrangements, with regulatory action on this point being triggered by a complaint or other information coming to its attention.

Competition between energy suppliers will therefore be maintained under this model. There are however risks that under this model the change of supplier process could become more complex as the new supplier would have to take over and be prepared to manage the communication arrangements installed by the previous supplier. It is also possible that larger suppliers of metering and metering services would be better placed to take advantage of the new market for smart meters through economies of scope and scale and their current market positions.

Under this model third party access to and use of the smart metering infrastructure would be dependent on suppliers' agreement and would probably have to be achieved through commercial agreement. This could reduce opportunities for energy services businesses and smart home service providers, especially for small firms.

Access to data for third parties, e.g. network operators (subject to appropriate data controls and/or permissions) would require some degree of coordination between suppliers, but the facilitation of this access and rules governing it would not vary across the delivery models except in potential complexity i.e. the competitive market would need to have rules governing how data would be delivered by suppliers, whereas in the centralised models data could be expected to be accessible from a central service provider (subject to appropriate data controls and/or permissions) although that would depend on the way access controls were configured.

Centralised communications model (a national communications network to support smart metering is put in place, but provision and installation of meters is left to suppliers)

The impacts of this model on suppliers of meters and metering services should not differ from the impacts of the competitive market. However, it would have a more significant impact on communications providers. A new market function would be created to implement and manage communications infrastructure and data carriage. All suppliers would be obliged to use this service.

Providers of communications services could be contracted for fixed periods, locking-out competitors for that period. Competition could be maximised within the model by re-tendering for services on a frequent basis, but a balance would need to be struck to take account of the length of contract needed to achieve efficiencies.

All suppliers would be obliged to use this service, which would mean there would be limited opportunity for suppliers to differentiate through delivery of communications systems. It is possible that some suppliers would consider themselves to be disadvantaged by being compelled to use the communications services of the central communications provider.

Arguably, all of the options which include centralised communications could lead to improved supplier competition as a result of making switching between suppliers easier. This is because many of the complexities involved in switching involving numerous stages could be stripped away, making the process simpler, shorter and more robust, resulting in a faster and more reliable consumer experience and thereby encouraging more consumers to switch. Although this would depend on the extent to which any model required the centralised management of data rather than just the movement of data.

Fully centralised model (a national communications provider and regional – or national – monopoly providers are put in place for provision and installation of meters

This model raises more significant competition issues. Under this model, centralised regional franchises would procure, own and maintain meters, and provide the communications infrastructure. This would entail termination of the existing competitive meter market where suppliers have a choice of selecting metering service provision.

Providers of metering services and communications would be contracted for fixed periods and there could be bulk procurement of meters, with contracts for these going to various providers. Competition could be maximised within the model by re-tendering for services on a frequent basis, but on the other hand if re-tendering toook place part way through the roll-out it could provide an advantage to the incumbent service providers. A regional approach would allow for there to be comparisons of cost and performance across regions to maintain competitive pressure. Re-tendering may be an issue whenever it happens because whilst frequent re-tendering potentially increases competitive pressure it may also cause disruption in service delivery and potentially costs.

It is possible that this model would favour larger providers of meters and metering services in bidding for contracts, who could be better placed to deliver economies of scope and scale. This could also impact on the likelihood of new entrants to the market. Any centralised procurement arrangements would need to be devised to minimise any negative impacts on smaller suppliers and potential new entrants.

There would be limited opportunity for suppliers to differentiate through delivery of metering systems and associated energy services. It is possible that some suppliers would consider themselves to be disadvantaged by being compelled to use the services contracted by the franchise.

DNO deployment model – Distribution Network Operators (DNOs) and Gas Transporters (GTs) are responsible for the provision of electricity and gas meters respectively; DNOs take responsibility for deployment strategy, installation and maintenance for both electricity and gas meters; **and**

Networks co-ordination model – DNOs and GTs are separately responsible for the provision, deployment strategy, installation and maintenance for electricity and gas meters respectively, but co-ordination is achieved so that electricity and gas meters are installed in one visit to the maximum extent possible

These two models are essentially the same in terms of their impacts on the energy supply, metering and energy services markets, and are therefore discussed together.

These models reduce the amount of competition in metering by re-regulating meter provision, installation and operation activities, although it is possible regulated businesses could sub-contract with third parties for delivery of some of these services so some level of competition could be maintained. There would be a greater role for the regulator in these models who would have the challenge of setting a price control as well as appropriate incentives for customer service.

Meter asset provision and installation/operation services would remain the responsibility of the DNO/GT on change of supplier. This may facilitate a more straightforward change of supplier process. However, delivery of smart metering services is seen as a key point of differentiation particularly by some smaller suppliers, hence creating a level playing field for meter provision and installation via re-regulation is seen by them as having a negative impact on their ability to compete for new customers.

Regulated Asset Ownership model - DNOs and GTs are responsible for the provision of electricity and gas meters, but suppliers are responsible for deployment strategy, installation and maintenance.

This model reduces the amount of competition in metering by re-regulating meter provision, although it is possible regulated businesses could sub-contract with third parties for delivery of this service so some level of competition could be maintained. There would be a greater role for the regulator in this model who would have the challenge of setting a price control for meter provision.

Meter asset provision would remain the responsibility of the DNO/GT on change of supplier. This may facilitate a more straightforward change of supplier process. However, delivery of smart metering services is seen as a key point of differentiation particularly by some smaller suppliers, hence creating a level playing field for meter provision via re-regulation is seen by them as having a negative impact on their ability to compete for new customers.

Market Model-Neutral Impacts

There are some competition impacts which will not vary significantly by market model.

Speed of Roll-Out

One possibility is that smaller energy suppliers might be disadvantaged in a roll-out by being unable to obtain equipment and services at the same cost and rate as larger suppliers, and that this would be exacerbated by a faster roll-out. Similarly, if resources are scarce for all under a roll-out, small suppliers might be feel a greater cost impact than large suppliers. Such concerns have been expressed in a number of responses to consultations.

2. Small Firms

Impacts on small business consumers are considered in the impact assessments for non-domestic roll-outs.

There may be small firms affected by the domestic roll-out in the areas of:

- gas and electricity supply;
- meter manufacturing;
- meter operating and services;
- energy services and smart homes.

The competition test (above) notes that smaller energy suppliers could be disadvantaged in a roll-out by being unable to obtain equipment and services at the same cost and rate as larger suppliers. It may be necessary in the roll-out to ensure that suppliers are not unduly discriminated against in terms of access to metering and installation resources.

Most small suppliers provide either gas or electricity but not both. One view is that as the volume of smart metering increases there will be an increase in the dual-fuel supply share of the market although this is already a trend that is being seen in the market. It is difficult to assess whether this will be the case – the view is based on the projections of the types of dual-fuel-related offerings that suppliers will make in a smart metering world and the popularity of these. It is possible that small suppliers could therefore be impacted negatively unless they are, or become, dual fuel suppliers.

More generally, smart metering is expected to provide new business models for energy services which may have relatively low entry costs and regulatory restrictions if they do not involve the licensed supply of energy. Experience in other areas e.g. Internet businesses show that small firms may be highly competitive in such areas. Future decisions on e.g. the communications infrastructure, governance and data protection and access arrangements will need to promote a level playing field for small firms.

3. Legal Aid

The proposals would not introduce new criminal sanctions or civil penalties for those eligible for legal aid, and would not therefore increase the workload of the courts or demands for legal aid.

4. Sustainable Development

An objective of the roll-out is to reduce energy usage and consequently achieve carbon emissions.

Smart metering will provide consumers with tools with which to manage their energy consumption, enabling them to take greater personal responsibility for the environmental impacts of their own behaviour.

The roll-out can also contribute to the enhanced management and exploitation of renewable energy resources. The proposals would particularly contribute to the need to live within environmental limits, but would also help ensure a strong, healthy and just society [see health impact assessment] and would put sound science in metering and communications technology to practical and responsible use. The proposals would promote sustainable economic development, both in terms of enhancing the strength, and improving the products, of meter and display device manufacturers, and by increasing employment and raising skills levels in the installation and maintenance of meters and communications technologies. These benefits would also apply at a regional level, including regions with higher levels of economic deprivation.

5. Carbon assessment

Following DECC guidance[34], we have carried out cost effectiveness analysis of the six policy options in addressing climate change. The existence of traded (electricity) and non-traded (gas) sources of emissions means that the impact of a tonne of CO2

[34] http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx

abated in the traded sector has a different impact to a tonne of CO2 abated in the non-traded sector. Reductions in emissions in the traded sector deliver a benefit but do not reduce GHG, whereas reductions in the non-traded sector do actually reduce GHG emissions.

Cost effectiveness analysis provides an estimate of the net social cost/benefit per tonne of GHG reduction in the ETS sectors and/or an estimate of the net social cost per tonne of GHG reduction in the non-ETS sectors.

We calculate the cost-effectiveness of traded and non-traded CO2 separately:

Cost-effectiveness (traded sector) = (PV costs – PV non-CO2 benefits – PV traded carbon savings)/tonnes of CO2 saved in the traded sector

Cost-effectiveness (non-traded sector) = (PV costs – PV non-CO2 benefits – PV non-traded carbon savings)/tonnes of CO2 saved in the non-traded sector

The table below presents the present value of costs and non-CO2 benefits of each option as well as the tonnes of CO2 saved in the traded and non-traded sectors, the corresponding cost effectiveness figures and the traded and non-traded cost comparators (TPC and NTPC). The Cost Comparators are the weighted average of the discounted traded and non-traded cost of carbon values in the relevant time period. If the cost per tonne of CO2 saving of the policy (cost-effectiveness) is higher than the TPC/NTPC the policy is non-cost effective.

Table 18: Cost effectiveness

Option	PV costs (£million)	PV non-CO2 benefits (£million)	Million of tonnes of CO2 saved - traded sector	Million of tonnes of CO2 saved - non-traded sector		Traded sector cost comparator	Cost effectiveness - traded sector		Non-traded sector cost comparator	Cost effectiveness - non-traded sector
1	9,863	13,361	15	24		27	-264		63	-183
2	8,641	13,266	15	24		27	-339		63	-230
3	8,224	12,573	14	23		27	-342		63	-226
4	8,188	12,666	15	23		27	-328		63	-232
5	8,359	12,666	15	23		27	-317		63	-225
6	8,729	13,266	15	24		27	-333		63	-226

Table 18 shows how all policy options would save in the region of 15 million of tonnes of CO2 in the traded sector and 24 million tonnes of CO2 in the non-traded sector over a 20-year period. All options are cost-effective: in both the traded and non-traded sector, the cost per tonne of CO2 of abating emissions (cost-effectiveness) is lower than the cost comparator for both the traded and non-traded sector. In fact, all policy options are not only cost-effective but produce a net benefit of between £264 and £342 per tonne of C02 saved in the traded sector and of between £183 and £232 per tonne of Co2 saved in the non-traded sector.

There is no significant difference between most policy options in the size of the net benefit they produce. Option 1 however produces substantially lower net benefits per tonne of CO2 in both the traded and non-traded sectors.

6. Other Environment

A smart metering programme would have some negative environmental impacts. The first is the costs of legacy meters. Most significant among these would be the cost of disposal of mercury from gas meters, estimated at around £1 per meter. These costs would have to be met under usual meter replacement programmes, but would be accelerated by a mandated roll-out. The smart metering assets will consume energy and after discussions with meter specialists we continue with the assumption that a smart meter would consume 1 w/h, and a display 0.6 w/h and the communication equipment 1 w/h. These assumptions are unchanged. Gas meters would require batteries for transmitting data and some display devices may also use batteries. The batteries would be subject to the Directive on Batteries and Accumulators.

The Government's view is that the positive environmental impacts of smart meters clearly outweigh any negative impacts.

7. Health

The likelihood is that any health impacts of a smart meter roll-out will be positive. In so far as smart meters enable suppliers better to target energy efficiency measures, which confer health benefits to individuals – particularly vulnerable individuals – deriving from greater thermal comfort, the proposals would ultimately promote better public health, reduce GP appointments and hospital visits etc.

The communications technologies which are selected to support smart metering may produce radiofrequency signals (e.g. from mobile communications technologies). Some consumers have concerns about the impacts of these. In moving forward the Government, energy suppliers and communication technology providers will need to give further consideration to these concerns.

8. Human Rights

The smart meter roll-out may engage the following Convention rights: Article 1 of the First Protocol (protection of property); Article 8 (right to privacy); and Article 6 (right to a fair trial).

Article 1, Protocol 1 may be engaged because a Government mandate will entail changes to the existing market structure, which might constitute an interference with supplier licenses, and current meter owners' and providers' possessions. The impact may differ depending on the selected market model. For instance, maintaining the competitive market would have less impact on the existing market structure and meter ownership and operation than would a fully centralised model. However, DECC's views is that any interference would be in the general interest and proportionate to the benefits that this policy would accrue.

Article 8 may be engaged because smart technology will enable a supplier to receive detailed information about a consumer's energy use in his property. In addition, to roll out smart meters, installers will have to enter consumers' property. As the preparatory work under the smart meter Implementation Programme progresses the Government will need to continue to be satisfied that any interference with privacy is justified, proportionate and necessary, in accordance with human rights and European law.

Ofgem is responsible for enforcing the conditions of gas and electricity supply licences. DECC's view is that the existing enforcement regime under the Electricity Act 1989 and the Gas Act 1986 (which, for example, give licensees the opportunity to apply to the court to challenge any order made, or penalty imposed, by Ofgem), which would continue to apply during a roll-out of smart meters, is compliant with Article 6. In addition, as a public authority, Ofgem is bound by section 6 of the Human Rights Act 1998 to act compatibly with the European Convention on Human Rights. Article 6 may also be engaged in relation to the grant of any new licences under a centralised model. DECC's view is that a new licensing regime in the Energy Act 2008 would be compliant with Article 6.

9. Equality Impact Assessment (EIA)

The Government is subject to general duties for disability, race and gender equality. The current duties are:

- The Race Equality Duty is designed to ensure that public sector organisations actively promote equality of opportunity between persons of different racial groups, and to promote good relations between persons of different racial groups;
- The Disability Equality Duty is designed to ensure that public sector organisations promote equality of opportunity between disabled persons and other persons; promote positive attitudes towards disabled persons; encourage participation by disabled persons in public life and take steps to take account of disabled persons' disabilities, even where that involves treating disabled persons more favourably than other persons.
- The Gender Equality Duty is designed to eliminate unlawful discrimination and harassment and to promote equality of opportunity between women and men.

With regard to smart metering the April 2008 Impact assessment contained some early analysis of the potential equality impacts from a programme to install smart meters in every British household. This EIA develops the initial work recognising that there will need to be a further examination of equality issues once the full details of a smart meter roll out are established. The recent consultation has provided further information on this area, as described in the Government Response (question 14). This EIA therefore:

- Sets out the background to smart metering policy;
- Sets out the evidence gathered to date and the potential equality issues identified; and
- Describes the measures proposed to deal with these issues.

Assessing the impact of the policy

The 2008 Impact Assessment recognised that a domestic roll out of smart meters has the potential to adversely affect certain consumer groups. Responses to the 2007 Billing and Metering Consultation and the May 2009 Consultation on Smart Metering for Electricity and Gas by a number of consumer organisations, such as the National Consumer Council, confirmed that there are a range of potential consumer related issues. Since then the Department has continued to explore these issues with relevant stakeholders and have identified the following as the main areas of concern:

- Issues associated with the physical design and location of the smart meter/visual display and its usability for certain consumers.
- Issues in relation to the provision of information to consumers.
- This potential impact on certain vulnerable consumers of the installation of the smart meter which will require entry to all homes.
- The potential for the functionality of the metering system to be used in such a way that would be considered unfair or discriminatory (eg potential abuse of remote disconnection facilities)
- The potential for consumer confusion (particularly amongst the elderly) as a result of the greater range of energy tariffs and energy related information which will be provided with smart metering.

The evidence collected to date indicates the policy has the potential to impact most on the visually impaired and the elderly. Responses to the previous consultation and subsequent discussions with stakeholders led the Government to conclude that there was a compelling case for ensuring the design and location of the meter is suitable for all consumers, that risks to vulnerable consumers in relation to the installation of smart meters are minimised and that consumers are well informed both before and after the installation of smart meters. These arguments have been reinforced by responses to the May consultation.

Provision of information from a smart meter

Provision of information to consumers is a key element in ensuring the benefits of smart meters are realised. The policy is that this information will be delivered through a display device associated with the smart meter. This display must therefore be user friendly for all consumers. The evidence suggests that there are two potential equality issues with the display.

Firstly the location of the display will need to reflect particular consumer circumstances, for example consumers who use wheelchairs will need a display to be located at a suitable height. Secondly the design of the display itself. It is possible that consumers will need to be able to interact with the display in some way, rather than just simply view it. It is therefore important the display unit is suitable for the visually impaired, the deaf or those with particular dexterity issues.

In this context, the overarching responsibility for dealing with domestic consumer meter issues currently rests with the supplier. The Disability Discrimination Act (DDA) requires suppliers to provide an ‘equivalent service’ for those covered by the Act. With Supply Licence Conditions 26.2 and 26.3 requiring the licensee (the supplier) to provide information free of charge which enable blind, partially sighted, deaf or hearing impaired to ask or complain about any bill or statement of account or any other service provided to that consumer by the licensee.

The Government’s Response sets out our position that a stand-alone display should be provided with the smart meter. In our view the provision of a display is important to securing the consumer benefits of smart metering, delivering real time information to consumers on their energy consumption in a readily accessible form. Detailed requirements will be developed which will have to take account of disability issues, such as whether the display unit would have functionality in terms of providing ‘voice information’ for the blind/visually partially sighted, or have adjustments for the hard of hearing. If a mobile display unit is provided, then accessibility in terms of location should be less of an issue. However, any unit would need to be located in a suitably accessible location for individual consumers.

It may be necessary for industry wide agreements on the usability requirements of the display to ensure it meets all user requirements (for example larger sized buttons) and that a consistent standard is installed in all households across the country. This would require further consideration with relevant parties.

Information associated with a smart meter will not just be provided to the consumer via the visual display device. It is likely that energy suppliers (and possibly some third parties) will want to analyse the information collected by the meter and provide that analysis to consumers for the purposes of assisting them with managing their energy use or to sell them services. Some of this may be done via the display device or through other means such as email or traditional mail.

It will be important to ensure that this information is provided in a format suitable for individual consumers, especially with a potentially much wider range of information available as a result of smart meters. This includes those for whom English is not their first language (there are no statutory requirements other than for the Welsh language and nothing appears specifically in supply licences or codes). Again existing legislation and regulation will continue to apply but consideration may be required as to whether updated or revisions are required as a result of the roll out of smart meters.

Smart Meter installation

The domestic smart meter roll out will require a visit to every house in Britain to install the meter and any supporting infrastructure. There are potential issues for all consumers but stakeholders have highlighted in particular the need to ensure that vulnerable consumers, such as the elderly or disabled, are protected from potentially disreputable individuals seeking to capitalise on the situation.

Protections are already in place. The Utilities Act 2000, Schedule 4, paragraph 7 & 10 provides the key protections on access to property for maintenance, installation and disconnection. Specifically, Schedule 4, 7 (5) covers a required notice period to be given to the occupier (2 days) prior to entry. Schedule 4, 10 (4) states that a person may only exercise power of entry on production of some duly authenticated document showing his authority. Supply licence condition 26.1 (a), states that: “if a consumer who is of pensionable age, disabled or chronically sick requests it and it is appropriate and reasonably practicable for the licensee (supplier) to do so, the licensee must free of charge: agree a password with the consumer that can be used by any person acting on the licensees’ behalf or on behalf of the relevant distributor to enable that consumer to identify that person.” And supply licence condition 26.4 further requires suppliers to establish a ‘Priority Service Register’ which lists all of the licensee’s domestic consumers who are of pensionable age, disabled or chronically sick. However although the licence condition requires suppliers to establish a register to cover all vulnerable customers, customers need to register to be included. In reality it may therefore not cover all vulnerable customers. Once added the consumer must be given free of charge advice and information on the services available described in supply licence condition 26.

In addition to these provisions an element of the design of the roll out will be to explore establishing an accreditation scheme or certification mark for smart meter installers.

Creating consumer confidence and awareness will be a key element of successfully delivering smart meters. A central element of this will be to ensure that before a smart meter roll out commences that consumers are well informed about the purpose of installing smart meters, what the implications are for them and where to find other sources of advice and information. The section below deals with the communication aspects of the project.

Communication Campaign

As set out above rolling out smart meters across Britain will have direct implications for consumers, not least as it will require a visit to every home in order to install the meter and any supporting infrastructure. A smart meter will also directly change the way consumers receive information about their energy use and interact with their energy supplier. Ensuring consumers are well informed in advance of a smart meter roll out will be essential, as will ensuring there is adequate advice and support available once smart meters are installed.

We will work with organisations such as Consumer Direct, Consumer Focus, Citizens' Advice Bureau, Age Concern and a range of disability groups to explore ways to ensure information is provided in formats suitable for all consumers. We also envisage that local authorities, councils, support and police services may need to play a role.

Next steps
As we move towards the roll out of smart meters an element of the implementation work will be to ensure that all consumers' experience of the roll out and of smart metering in the long term is positive. An aspect of that work will be to ensure appropriate protections are in place to safeguard consumers especially the vulnerable. This EIA identifies some of the issues that require further detailed consideration and action. It also shows that significant regulatory and consumer protection regimes are already in place, which will need to be reviewed and where appropriate regulation updated in light of the wider decisions on the smart metering roll out.

10. Data and Privacy

Smart metering will result in a step change in the amount of data available from electricity and gas metering. Rules and safeguards will be required to ensure appropriate access to and protection of this data, and to ensure consumer confidence. These rules and safeguards will be reviewed as part of the work under the Implementation Programme. This work will need to look at a range of questions including what data can be captured, who should have access to the data and in what circumstances, how the data should be used and stored. Stakeholders, including consumer groups, will be fully engaged in this process.

This work, and in due course work by data controllers and data processors, will need to consider in detail:

- the definition of "personal" data
- consumers' rights to access their personal data
- data ownership
- suppliers' rights to charge for data access or provision of advice based on it
- the scope for access by other licensed gas and electricity companies, e.g. electricity distribution networks and gas distribution networks and transporters
- the scope for suppliers to hold data for non-supply purposes
- the scope for access to data on health and other public interest grounds by third parties
- the scope for access to data by third parties for commercial and marketing purposes
- data security in terms of both the transmission and holding of data
- physical security

The gas and electricity supply industries require and rely upon numerous, complex and substantial data flows, collection and management processes arising from the need to manage 25 million domestic electricity and 21 million domestic gas consumer accounts. The introduction of domestic supply competition between 1996 and 1998 required the establishment of new industry data transfer processes and thus data flows because of, among other things, the need to allow consumers to switch supplier. The subsequent introduction of competition in meter ownership, provision and management further increased the complexity of gas and electricity supply as a whole, and the nature and volume of data flows.

Some of the data to which suppliers and others have access is personal, such as bank account details[35], whilst other data relates to a meter or property, rather than an individual[36]. For the Purposes of the Data Protection Act (1998), both, or the combination of the two, would be likely to fall under the definition of “personal data” under the Act. Whilst a smart metering programme will not, in principle, affect this particular data, except to improve its accuracy, it will increase the volume of data collected, collated and analysed by parties within the gas and electricity industries. This will present new issues around data protection, privacy and security, and clarity will be required around what personal data is collected and why. The new arrangements may affect the annual notification about their processing of personal information made by data controllers to the ICO.

Because of the range of potential benefits of the smart meter programme, there may be a need for data – or greater volumes of data - to be made available to, and used by, particular industry parties, such as gas and electricity distribution networks which may require access to information to improve network management. There may also be scope for data to be made available (subject to appropriate data controls and/or permissions) to energy-service providers, within or outside the supply business, for further processing with a view to providing bespoke energy services and advice to consumers. Indeed, the provision of tailored energy efficiency advice and the consequent increase in domestic energy efficiency is one of the key benefits of smart metering. However, data subjects would need to be kept informed of the way in which their information is being used and due consideration would need to be given as to whether each additional use complies with the Data Protection Act. Data controllers would need to be certain that service users/customers are aware that their personal data is intended to be used for these purposes and ensure that meter data collection for these purposes is adequate, relevant and not excessive. Information from smart meters could potentially make it possible for a supplier to determine when electricity or gas was being used in a property and, to a degree, the types of technology that were being used within the property which could be used to target energy efficiency advice and offers of energy efficiency measures, social programmes etc to householders.

These potential uses will need to be considered and if necessary managed within an appropriate framework with rules and safeguards to ensure appropriate access to

[35] Suppliers will provide bills or statements for the use of gas or electricity. Information on use is derived from a meter-reading or an estimate of consumption. Bills are usually provided on a quarterly basis, although there are variations. Prepayment consumers usually receive an annual statement of their energy use and expenditure. There are also special arrangements for consumers with online accounts. For billing purposes, suppliers will usually have the name and address of the account-holder, which will often accord with that listed on the Electoral Register. Depending on payment method, the supplier will hold information about an individual bank account. If the property-owner is entitled to special services, such as the Priority Service Register or a free gas safety check, the supplier will also hold that information. Aside from the data they can obtain from their own meters, consumers’ usual additional access to data from suppliers beyond the bill is usually in respect of past energy use for accounts dispute purposes.

[36] Suppliers provide and measure supply through a meter linked to a property (not an individual), which has an asset number, known as an Meter Point Administration Number (MPAN) for electricity and a Meter Point Reference Number (MPRN) for gas. This is held by the supplier in respect of an individual account, and in all cases by the local distribution network operator (for electricity) or National Grid or an independent gas transporter (for gas). Consumers can access their MPAN or MPRN details by using the MPAS database. Meter information does not, except in tandem with other information, identify an individual

and protection of this data in accordance with the Data Protection Act, and to ensure consumer confidence.

Beyond this, there may be scope – particularly as a roll-out develops or once it has been completed – for using the smart metering communications infrastructure to enable a variety of other services, such as monitoring of vulnerable householders by health authorities or social services departments. If this were to prove the case then data flows and consent arrangements would need to be clear and consideration would need to be given as to whether such additional uses of data were practicable and desirable, and would meet appropriate rules and standards including the Data Protection Act. This would need detailed consideration, consultation and the establishment of rules, at an appropriate point in the policy design and delivery process.

In terms of potentially intrusive non-physical behaviour unrelated to data, smart metering potentially offers scope for remote intervention such as dynamic demand management, which is designed to assist management of the network and thus security of supply. This could involve direct supplier or distribution company interface with equipment, such as refrigerators, within a property, overriding the control of the householder. The privacy and other consumer implications of such activity would need to be fully considered and addressed.

In addition to data privacy, physical privacy issues will require consideration. Installing smart meters will, for a period, increase the number and duration of visits to homes and businesses. Meter-providers currently enter property to install a new meter at the end of the certification period of the existing meter, but any accelerated roll-out of smart meters would significantly increase the total number of meter exchanges and home visits. Because smart metering technology is more complex, and because of consumers' lack of familiarity with the technology, more visits may be required to address problems that arise. Conversely, home visits by meter-readers will decrease over the period. Depending on the functionality of the meter, home visits to disconnect supply will largely end.

Gas and electricity suppliers have substantial experience in handling data, and in meeting the range of legislative requirements attached to it, which lie within the Data Protection Act 1998 (DPA), which, inter alia, addresses an individual's right of access to data and the limits on data that companies may hold, and s.105 of the Utilities Act 2000, which contains provisions about the disclosure of information.

As part of the implementation phases Privacy Impact Assessments will need to be conducted by the policy designers and those responsible for data under the roll-out. Similarly, a DPA Compliance Check will be needed for the project as a whole and by individual actors. In respect of data and privacy issues, the design and delivery of the project will, therefore, be taken forward in close co-operation with the Ministry of Justice and the Information Commissioner.

11. Rural proofing

Smart meters should address the problems attached to "difficult to read" meters, which may at present lead to those in rural areas receiving fewer actual meter readings. The scope for introducing different payment methods for smart prepayment meters would assist those in rural areas who find key-charging or token purchase difficult. The opportunity, through smart meters, to provide more targeted and tailored energy efficiency advice would also assist those in rural areas, including those in "hard to treat" dwellings. There may need to be attention given to the timing of roll-out to rural consumers who are often single-fuel, in relation to the rest of the population.