Title: Smart meter roll-out for the domestic sector (GB)	Impact Assessment (IA)
Lead department or agency: DECC	**IA No:** DECC0009
Other departments or agencies:	**Date:** April 2012
	Stage: Consultation Response
	Source intervention: Domestic
	Contact for enquiries: Ferry Lienert / Matthew Carson (0300 068 6325/6966)

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

Lack of sufficiently accurate, timely information on energy use may prevent customers from taking informed decisions to reduce consumption and thereby bills and CO_2 emissions. The lack of accurate, timely information increases suppliers' accounts management and switching costs. Better information on patterns of use across networks will aid in network planning and development, including future smart grids.

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 is subject to competition. Although some suppliers are rolling out smart meters to a selection of their customers it is expected that, in the absence of intervention by Government, suppliers would roll out only limited numbers of smart meters. Government intervention to establish minimum technical requirements and a completion date 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.

The policy for smart meters therefore addresses the market failures in the energy markets described above (information asymmetries, lack of coordination and negative externalities from energy consumption).

What are the policy objectives and the intended effects?

To roll out smart metering to all GB residential gas and electricity customers 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.

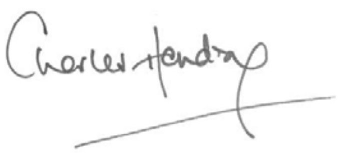
What policy options have been considered? Please justify preferred option (further details in Evidence Base)

This policy focuses on the mandated replacement of 50 million residential gas and electricity meters in GB through a supplier-led roll-out in the domestic sector with a centralised data and communications company. The March 2011 IA set out the overall approach and timeline for achieving this objective. The August 2011 IA considered a range of options to define the smart metering technical equipment in the home. This IA presents the economic impact of an implementation approach based on a two stage notification of the Smart Metering Equipment Technical Specification. Cost allowances have been added to reflect risks and uncertainties from early installations.

When will the policy be reviewed to establish the actual cost and benefits and the achievements of the policy objectives?	An early review of requirements for the roll-out to ensure delivery of benefits is expected to be carried out before 2014. Further evaluation of the policy will also be conducted (provisionally by 2018). (See section 12 – Post Implementation Review Plan)
Are there arrangements in place that will allow a systematic collection of monitoring information for future policy review?	The requirements for the collection of monitoring information that will contribute to the benefits realisation will be developed in the next phase of the Programme.

Ministerial Sign-off : ***I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) the benefits justify the costs.***

Signed by the responsible Minister. Date: April 2012



URN:12D/056

Summary: Analysis and Evidence

Price Base Year 2011	PV Base Year 2012	Time Period Years 19	Net Benefit (Present Value (PV) (£m)		
			Low: 419	High: 9,545	**Best Estimate: 4,840**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	NA		NA	NA
High	NA		NA	NA
Best Estimate	995		676	**10,850**

Description and scale of key monetised costs by 'main affected groups'

Metering equipment costs and its installation and operation amount to £6.10bn. Communications equipment costs amount to £2.46bn. IT systems costs amount to £1.06bn. Industry set up, marketing, disposal, energy and pavement reading inefficiency costs amount to £1.23bn.

Other key non-monetised costs by 'main affected groups'

N/A

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		821	11,251
High	0		1,489	20,413
Best Estimate	0		1,144	**15,689**

Description and scale of key monetised benefits by 'main affected groups'

Total consumer benefits amount to £4.43bn and include savings from reduced energy consumption (£4.39bn), and microgeneration (£36m). Total supplier benefits amount to £8.47bn and include avoided site visits (£3.08bn), and reduced inquiries and customer overheads (£1.04bn). Total network benefits amount to £884m and generation benefits to £738m. Carbon related benefits amount to £1.2bn.

Other key non-monetised benefits by 'main affected groups'

Non-monetised benefits include the potential benefits from the development of a smart grid. Smart metering will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) 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.

There are further non-monetised benefits to consumers. Smart meters will put an end to estimated bills, providing ease of mind to customers. The customer experience will also improve, especially for pre-payment customers, including easier and more convenient top-up methods and faster and more convenient switching between a credit and a pre-payment arrangement.

Key assumptions/sensitivities/risks

All cost assumptions are adjusted for risk optimism bias and benefits are presented for the 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. The numbers presented are based on the modelling assumption that the scope of the DCC will include data aggregation in the long term.

Direct impact on business (Equivalent Annual) £m)[1]:			In scope of OIOO?	Measure qualifies as
Costs: 799	**Benefits:** 909	**Net: -**110	Yes	£0 IN

[1] Aggregates domestic and smaller non-domestic roll-out. This approach has been agreed with the Better Regulation Executive.

Enforcement, Implementation and Wider Impacts

What is the geographic coverage of the policy/option?			GB		
From what date will the policy be implemented?			First tranche of regulations to come into force in November 2012		
Which organisation(s) will enforce the policy?			DECC/Ofgem		
What is the total annual cost (£m) of enforcement for these			N/A		
Does enforcement comply with Hampton principles?			N/A		
Does implementation go beyond minimum EU requirements?			Yes		
What is the CO_2 equivalent change in greenhouse gas emissions (for preferred option)?			**Traded:** 14.5MtCO2	**Non-traded:** 15.9MtCO2	
Does the proposal have an impact on competition?			Yes		
Annual cost (£m) per organisation (excl. Transition) (Constant Price)	**Micro** N/A	**< 20** N/A	**Small** N/A	**Medium** N/A	**Large** N/A
Are any of these organisations exempt?	N/A	N/A	N/A	N/A	N/A

Annual profile of monetised costs and benefits (undiscounted)*

£	2010	2011	2012	2013	2014	2015	2016
Total annual costs	0	0	55,894,570	106,103,155	233,305,849	457,082,114	704,183,297
Total annual benefits	0	0	37,321,076	78,266,296	169,611,411	431,828,668	720,926,837

£	2017	2018	2019	2020	2021	2022	2023
Total annual costs	898,522,259	1,052,773,232	1,064,627,351	1,054,644,128	1,026,408,115	1,015,578,187	1,003,970,655
Total annual benefits	989,366,794	1,255,733,607	1,402,927,550	1,438,765,581	1,486,948,805	1,514,980,129	1,553,847,344

£	2024	2025	2026	2027	2028	2029	2030
Total annual costs	996,314,638	987,725,584	977,712,842	965,067,888	949,759,779	936,098,850	921,426,712
Total annual benefits	1,600,935,569	1,642,991,811	1,664,874,599	1,705,602,046	1,736,043,677	1,773,343,469	1,811,649,300

* For non-monetised benefits please see summary pages and main evidence base section

Emission savings by carbon budget period (MtCO2e)

Sector		Emission Savings (MtCO2e) - By Budget Period		
		CB I; 2008-2012	CB II; 2013-2017	CB III; 2018-2022
Power sector	Traded	0	0	0
	Non-traded	0	0	0
Transport	Traded	0	0	0
	Non-traded	0	0	0
Workplaces & Industry	Traded	0	0	0
	Non-traded	0	0	0
Homes	Traded	0.03	1.68	4.88
	Non-traded	0.03	1.78	5.12
Waste	Traded	0	0	0
	Non-traded	0	0	0
Agriculture	Traded	0	0	0
	Non-traded	0	0	0
Public	Traded	0	0	0
	Non-traded	0	0	0
Total	Traded	0.03	1.68	4.88
	Non-traded	0.03	1.78	5.12

Cost effectiveness	% of lifetime emissions below traded cost comparator	100%
	% of lifetime emissions below non-traded cost comparator	100%

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Overview of tables

Glossary of Terms

ACEEE - American Council for an Energy-Efficient Economy
CAPEX - Capital Expenditure
CERT - Carbon Emission Reduction Target
CML - Customer Minutes Lost
CRC Energy Efficiency
CRM - Customer Relationship Management
DCC - Data Communications Company
DNOs - Distribution Network Operators
DPCR5- Distribution Price Control Review 5
EDRP - Energy Demand Research Project
ENA - Energy Networks Association
ENSG - Electricity Networks Strategy Group
ESCO - Energy Service Company
ESCOs - Energy Services Companies
ESMIG - European Smart Metering Industry Group
EV - Electric Vehicle
GHG - Greenhouse Gas
GPRS - General Packetised Radio Service
GSM - Global System for Mobile Communication
HAN - Home Area Network
IDTS - Industry Draft Technical Specification
IHD - In-Home Display
IT - Information Technology
LAN - Local Area Network
NPV - Net Present Value
O & M - Operation & Maintenance
Ofgem - Office of Gas and Electricity Markets
OPEX - Operational Expenditure
PPM - Pre-payment Meter
PV - Present Value
RFI - Request for Information
RTD - Real Time Display
SEG - Smart Energy Code
SMETS - Smart Meter Technical Equipment Specification
SMIP – Smart Metering Implementation Programme
SPC - Shadow Price of Carbon
ToU - Time of Use (tariff)
UEP - Updated Energy Projections
WAN - Wide Area Network

1 Introduction

1.1 Background and Strategic Overview

The Government set out its commitment to the roll-out of smart meters within its coalition programme[2]. This sets out the strategic context for the roll-out of smart metering alongside the establishment of a smart grid. The smart meter policy supports the broader Government programme for an increase in the EU carbon emission reduction target by 2020, through encouraging investment in renewable energy both locally and for large scale offshore wind developments, feed in tariffs and home energy efficiency via the Green Deal.

Smart metering will play an important part in supporting these policies and objectives, by directly helping consumers to understand their energy consumption and make savings, reducing supplier costs, enabling new services, facilitating demand-side management which will help reduce security of supply risks and help with our sustainability and affordability objectives. Smart metering is a key enabler of the future Smart Grid, as well as facilitating the deployment of renewables and electric vehicles.

Further, 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. For electricity, where the roll-out of smart meters is assessed positively, at least 80% of consumers should be equipped with intelligent metering systems by 2020. For gas, Member States are required to prepare a timetable for the implementation of intelligent metering systems.

The European Commission also published a draft Energy Efficiency Directive in June 2011, with a section on smart metering. This is currently being negotiated in European Council Working Group with the Danish Presidency aiming to complete negotiations in the first half of 2012.

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

The policy design phase concluded in March 2011 with the Government's Response to the Smart Meter prospectus, setting out the approach to delivering smart meters and a wide range of policy proposals for further consultation[3]. The end of the policy design phase also marked the beginning of the next Smart Metering Implementation Programme (hereafter the Programme) stage, Foundation. The objective of Foundation is to provide a solid basis for mass roll-out from the perspective of the range of parties with a stake in the success of smart metering as an end-to-end system. Foundation will also be used to establish a new central Data and Communication Company (DCC) which will provide a suitable communications platform over which data can be securely transmitted. Foundation is anticipated to run until Q3 2014 upon which mass roll-out will commence.

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[2] HMG, *'The Coalition: Our programme for government'*, 2010.
[3] http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1475-smart-metering-imp-response-overview.pdf

The analytical work over the three years of policy design and the first year of Foundation has been supported by cost benefit modelling and analysis from a range of sources, including Mott Macdonald, Baringa Partners, Redpoint Consulting and PA Consulting Group, and has been presented in a series of publications since 2008, among which a number of Impact Assessments (IAs)[4].

Alongside the March 2011 Response the Government also published an IA (hereafter March 2011 IA) which considered and arrived at decisions for:

- functionality of the smart meters solution, including meters, communications equipment and in home displays (IHDs);
- length of the roll-out period;
- scope and establishment of the central data and communications provider (DCC);
- implementation strategy for the mass roll-out, including the establishment of the DCC;
- and the obligations and protections that should be in place before DCC data and communications services become available.

Since then and with the start of the Foundation Stage, work has included developing a detailed technical specification for the smart meter equipment, building upon the Functionality Requirements Catalogue (the "Catalogue")[5] that was published alongside the Prospectus Response document. While the Catalogue provided stakeholders with the functional requirements, these would not, in themselves, have ensured interoperability between different pieces of smart metering equipment or back offices since the functional requirements could be delivered in a number of ways.

In early 2011, DECC established eighteen Industry Advisory Groups, under the Smart Metering Design Group (SMDG) to develop functional requirements into technical specifications. The technical specifications were intended to outline how the functionality would be achieved. The output of this process is called "Industry's Draft Technical Specifications"[6] and was published at the beginning of August 2011. Government sought views on it via the consultation document published in August 2011 - Smart Metering Implementation Programme: A consultation on draft licence conditions for the roll-out of gas and electricity smart meters[7]. An IA was also published alongside the consultation[8]. The present IA accompanies the Government's response to the consultation.

1.2 Rationale for Government intervention

Existing metering allows for a simple record of energy consumption to be collected, mainly by manually reading the meter. Whilst this allows for energy bills to be issued, there is limited opportunity for consumers or suppliers to use this information to

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[4] BERR, *Impact Assessment of Smart Metering Roll Out for Domestic Consumers and Small Businesses*, April 2008, http://www.berr.gov.uk/files/file45794.pdf and DECC, http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx

[5] http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1480-design-requirement-annex.pdf

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[7] http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2546-smip-consultation-rollout-180811.pdf

[8] http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2549-smart-meter-rollout-domestic-ia-180811.pdf

manage energy consumption. 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 do not have 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 disputes over bills (complaints) and problems with the change of supplier process, thereby possibly hindering competition and diminishing the customer experience.

Smart meters and the provision of real-time information help address these issues, enabling consumers to access more information about energy use and cost. Combined with appropriate advice and support, consumers will then be able to take positive action to manage energy consumption and costs. Smart meters provide for remote communication, facilitating, amongst other things, more efficient collection of billing information and identification of meter faults. Information from the meter, subject to appropriate data, privacy and access control, will assist in 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 an In-Home Display (IHD) 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 as a whole (in terms of reduced carbon emissions).

There are also benefits for network companies from the use, subject to appropriate data, privacy and access controls, of data collected through smart metering to better manage the electricity network and to inform long-term investment in the network and development of smart grids.

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 framework to ensure technical and commercial interoperability, 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. The provision of central communications provides greater efficiency for managing the connection and change of supplier processes for smart meters. A decision by Government not to intervene would therefore probably result in a limited roll-out. Either a lack of interoperability or a limited roll-out would impede the development of a smart grid and the speed with which new renewable generation could be accommodated.

1.3 Objectives

The objectives of Government intervention in the roll-out of smart metering through the Programme are:

- To promote cost-effective energy savings, enabling all consumers to better manage their energy consumption and expenditure and deliver carbon savings;
- To promote cost-effective smoother electricity demand, so as to facilitate anticipated changes in the electricity supply sector and reduce the costs of delivering (generating and distributing) energy;
- To promote effective competition in all relevant markets (energy supply, metering provision and energy services and home automation);
- To deliver improved customer service by energy suppliers, including easier switching and price transparency, accurate bills and new tariff and payment options;
- To deliver customer support for the Programme, based on recognition of the consumer benefits and fairness, and confidence in the arrangements for data protection, access and use;
- To ensure that timely information and suitable functionality is provided through smart meters and the associated communications architecture where cost effective, to support development of smart grids;
- To enable simplification of industry processes and resulting cost savings and service improvements;
- To ensure that the dependencies on smart metering of wider areas of potential public policy benefit are identified and included within the strategic business case for the Programme, where they are justified in cost-benefit terms and do not compromise or put at risk other Programme objectives;
- To deliver the necessary design requirements, commercial and regulatory framework and supporting activities so as to achieve the timely development and cost-effective implementation of smart metering, and meeting Programme milestones;
- To ensure that the communications infrastructure, metering and data management arrangements meet national requirements for security and resilience and command the confidence of stakeholders; and,
- To manage the costs and benefits attributable to the Programme, in order to deliver the net economic benefits set out in the Strategic Business Case.

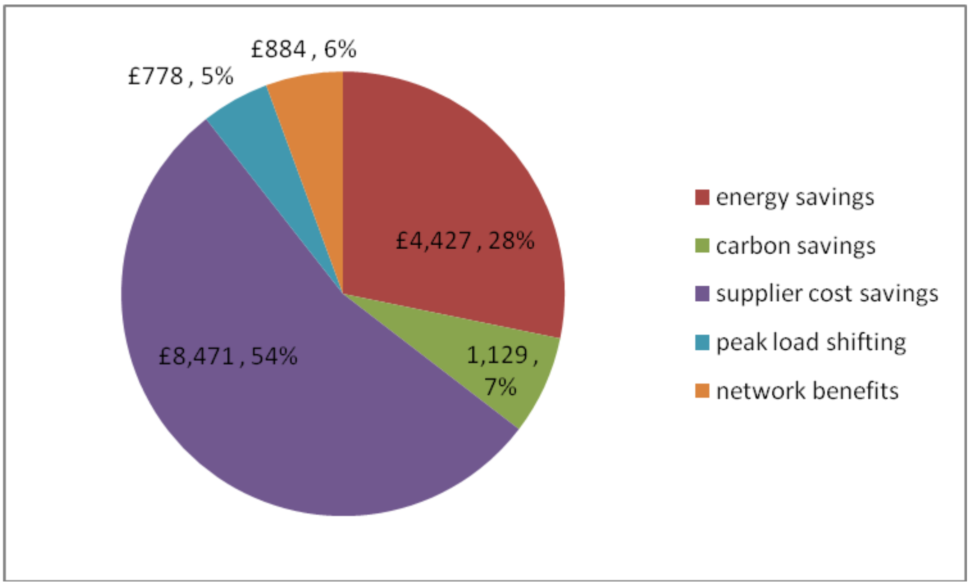
1.4 The Economic Case for Smart Metering

The cost benefit analysis of a mandated roll-out of smart meters has been carried out and developed over the last 4 years. The analysis and evidence base have been re-assessed and updated before any key Programme decision point. Cost and benefits have been quantified by collecting information from key stakeholders including industry, consumer groups and academia. The assumptions have been broadly consulted on and have been benchmarked against international evidence as well as scrutinised by specialists. The costs and benefits considered and the results of the economic assessment are set out at a high level below.

Benefits

With near real time information on energy consumption, consumers are expected to make energy savings through enhanced energy efficiency behaviour. This reduction in energy use also implies carbon savings, in the form of reduced European Union Emission Trading Scheme (EU ETS) allowance purchases for electricity savings and lower emissions from gas consumption. In parallel, smart meters will allow suppliers to make a range of operational cost savings. They remove the need for site visits to complete meter reads and are expected to reduce suppliers' call centre traffic, with fewer queries about estimated bills. In addition, smart meters are expected to make the consumer switching process cheaper and simpler, thanks to accurate billing and more streamlined interaction between involved parties. Suppliers should see improved theft detection and debt management; and consumers will also be able to play a role in avoiding debt accumulation with access to accurate, near real time energy information. Network operators will be able to improve electricity outage management and resolve any network failures more efficiently once a critical mass of smart meters has been rolled out; and they will be able to realise further savings from more targeted and informed investment decisions. By enabling time of use (ToU) tariffs which tend to shift a proportion of electricity generation to cheaper off-peak times, smart meters are also expected to generate savings both in terms of distribution as well as generation capacity investment. Though the associated benefits are not yet quantified, the roll-out will also facilitate the development of smarter grids.

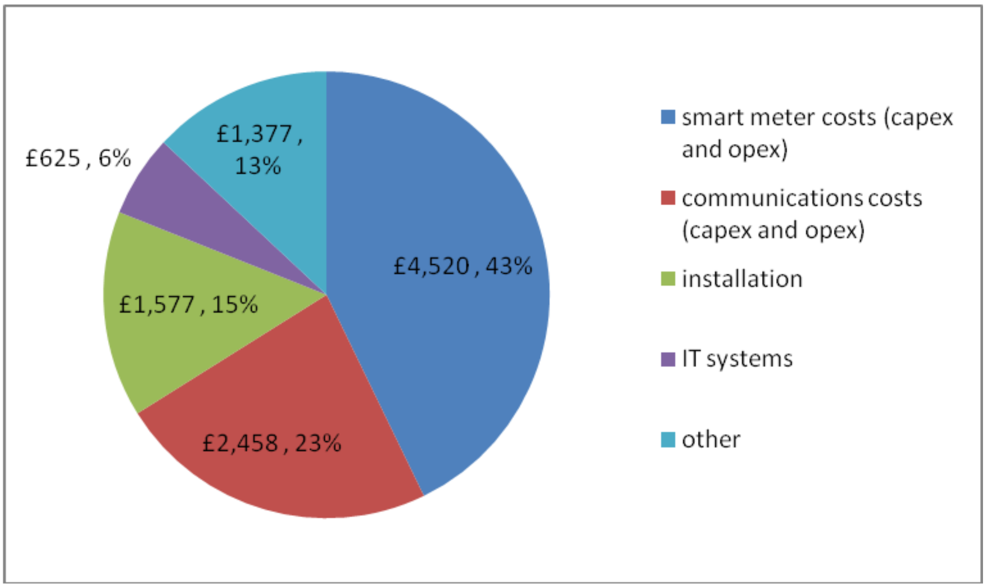
Figure 1-1: High level overview of benefits



<u>Costs</u>

Costs of the roll-out can be categorised as follows. Energy suppliers will be required to fund the capital costs of smart meters, In-Home Displays (IHDs) and potentially the communications hub that links the meter(s) in a property to the supplier via the Data Communications Company (DCC); they will also have to pay for the installation, operation and maintenance of this equipment. The roll-out of smart meters also implies upfront investment in supporting IT systems and the Data Communications Company (DCC), as well as their ongoing maintenance. Other industry participants such as distribution network operators (DNOs) will also need to upgrade their systems in order to integrate into the smart meter network. Further costs include the accelerated disposal of basic meters being replaced, the energy consumed by the smart meter equipment itself and the launch and support of a consumer engagement strategy. The analysis also consider the increasingly inefficient reading of dumb meters as the roll-out progresses otherwise known as ‘pavement reading inefficiency’.

Figure 1-2: High level overview of costs



Economic impact

With total expected present value (PV) costs of £10.9bn and total PV benefits of £15.7bn up to 2030, the net present value (NPV) for the domestic roll-out of smart meters in GB is estimated to be £4.8bn. As a result of consumers using energy more efficiently and suppliers passing through net cost savings, the roll-out is expected to reduce the average household electricity and gas bill by £25 in 2020, and by £40 in 2030.

1.5 Scope of this impact assessment

The present Impact Assessment (IA) accompanies the response to the August 2011 consultation and takes into consideration views received in consultation responses and decisions taken in light of those responses. It reflects a roll-out completion date in December 2019 and models the implementation route for the remainder of Foundation and mass roll-out with a two staged specification of the smart metering equipment.

The IA also supports the notification of the roll-out licence conditions and the Smart Meter Equipment Technical Specification (SMETS) to the European Commission, as per the requirements of the Technical Standards Directive (TSD). The TSD requires Member States to notify new technical regulations that impose restrictions on the characteristics of products. In addition, updated Programme planning decisions have been reflected in the cost benefit modelling underlying this document.

1.6 High level comparison to results in IA published in August 2011

Table 1-1: August 2011 results vs. April 2012 results

£m	**domestic IA**		
	NPV	total cost	total benefits
August 2011	**4,904**	**11,067**	**15,971**

April 2012	**4,840**	**10,850**	**15,689**
Difference	**-64**	**-217**	**-282**

NPV has remained largely unchanged in comparison to the IA published in August. Both total costs and benefit estimates have been reduced. This is mainly as a result of updated planning and roll-out assumptions. Fewer meters are expected to be in place by the end of 2014 than previously modelled, resulting in some benefits and costs from smart meters occurring slightly later in time.

All changes to this IA and their impacts on costs and benefits are set out in full detail in section 2.

2 Analytical section

2.1 New analysis

2.1.1 Overview

New analysis has been conducted to reflect developments in the evidence base following updates to input parameters, responses to the August 2011 consultation, as well as further dialogue with stakeholders.

Following the publication of DECC's latest updated energy projections (UEP) in October 2011[9] relevant modelling assumptions have been revised. Fossil fuel prices, carbon prices, carbon emission factors, energy consumption as well as household growth have been updated to account for the latest forecasts. In addition, as a result of moving into a new calendar year the present value base year has been changed to 2012, removing one year of discounting for cost and benefit flows.

Further work since August 2011 has resulted in an updated view of the Foundation Stage, with a staged approach to specifying technical requirements of smart metering equipment. This is also reflected in the latest Programme timeline and has been integrated in the modelling of the roll-out profiles in this analysis.

The main analytical change is an updated treatment of the costs of early meters, reflecting a more detailed understanding of some uncertainties around Foundation installations. Table 2-1 summarises the impact of these changes on cost and benefits.

Table 2-1: Summary of impacts

Domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	4,904	11,067	15,971	
exogenous and modelling changes	4,964	11,045	16,008	+60
updated planning and roll-out profiles	4,910	10,779	15,689	-54
cost uplift to early meters	4,840	10,850	15,689	-70
Total difference	-64	-217	-282	

Changes to the underlying assumptions are presented in section 10. Where updated evidence has been received but not resulted in a change of the analytical approach (for example in the area of the consumer engagement strategy) this is reflected in the evidence base section (section 3).

2.1.2 Changes in exogenous input parameters and updates to modelling

DECC's standard practice is for all policy appraisals to use a common set of up to date projections on energy prices, energy consumption, carbon factors and prices, as well as economic and population growth assumptions. These updates are important to reflect changes in the real world which have an impact on key projections and

[9] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/analytic_projs.aspx

assumptions. DECC published its yearly update to the projections in October 2011. To take account of these latest projections we have updated the input parameters for energy and carbon prices, emission factors, energy consumption and population growth. The most significant changes have been the updated projections for energy and carbon prices, both resulting in an increase in the benefits of the smart meter roll-out. Lower projections for population growth have had reducing impacts on both costs and benefits.

In addition the present value base year has been moved from 2011 to 2012, removing one year of discounting of the cost and benefit flows. This results in an increase of both gross costs and benefits, with the increase in benefits slightly outweighing the increase in costs.

Table 2-2: Impact of exogenous and modelling changes

Domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	4,904	11,067	15,971	
Exogenous and modelling changes	4,964	11,045	16,008	+60

The aggregate effect of the above changes has been an increase in NPV of £60m.

2.1.3 Updated Programme planning and roll-out profiles

We have updated the roll-out assumptions used for modelling costs and benefits to take account of the latest Programme planning assumptions. We have also accounted for individual energy supplier strategies towards roll-out where these have been made publicly available.

In February 2012 DECC launched a process to improve the understanding of energy suppliers strategies towards roll-out. This process is ongoing and we anticipate that such information will be used to inform the modelling of roll-out profiles in Impact Assessments in the future.

In order to allow the modelling of costs and benefits, we have stylised the roll-out period into three distinct stages. In each stage, assumptions have been made in regards to the roll-out strategy of energy suppliers. During the initial Foundation Stage the modelling assumes some suppliers roll out at significant volumes, but most are modelled to only conduct trials and move to a 'new and replacement' approach (i.e. install meters in new buildings and where a basic meter reaches the end of its lifetime and has to be replaced) towards the end of the period. Foundation is followed by mass roll-out, with an initial six months ramp up period to reach peak installation rates. These peak rates are retained until 90% of the customer base has received a smart meter, upon which the ramp down phase is reached and installation rates are progressively reduced.

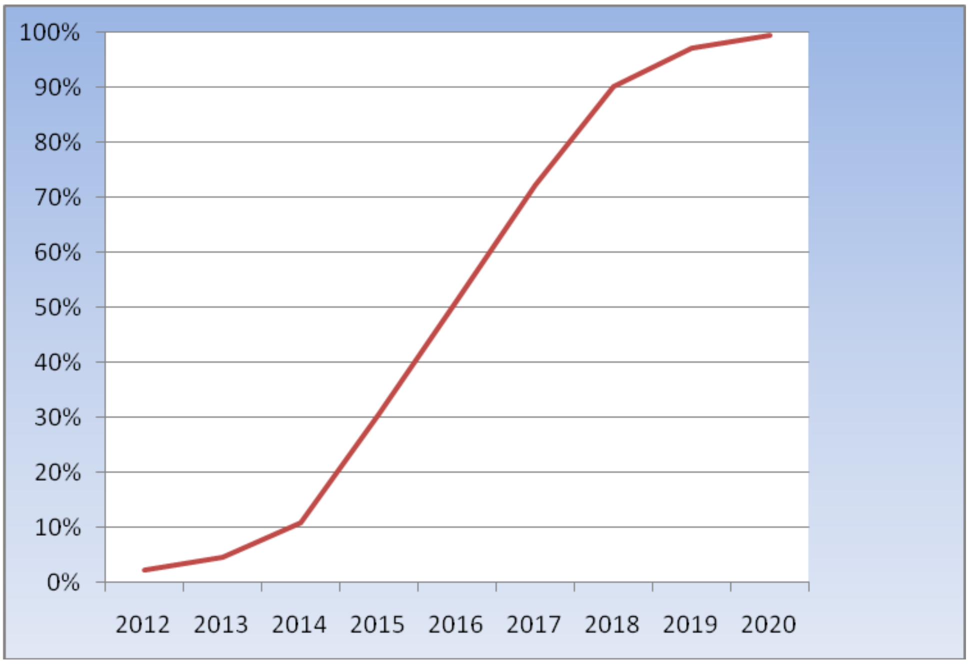
The revised planning assumptions envisage the central Data and Communications Company (DCC) to be operational from the end of Q3 2014, compared to a planning assumption of end Q1 2014 in the August 2011 Impact Assessment. This has been reflected in our latest modelling. The change in the planning assumption is mainly driven by the decision to procure DCC communications services in three distinct geographical areas rather than as one national contract as had been previously anticipated. The increase in complexity of the procurement exercise has driven additional activity and impacted the timescales for the award of service provider contracts, and the subsequent establishment of the DCC.

For most suppliers we model a uniform strategy prior to the establishment of DCC, with suppliers generally moving to a ‘new and replacement’ approach from the end of Q1 2014 when it is assumed that all the components of the enduring equipment – including the enduring communications components – will be known and available. This assumption on the timing of a move to a ‘new and replacement’ approach would represent a relatively risk averse strategy for suppliers from a commercial perspective. These assumptions will be tested further to inform the modelling of roll-out profiles in future Impact Assessments.

This approach to modelling roll-out results in a similar amount of meters expected to be installed ahead of the point in time at which DCC becomes operational – around 4.1m meters in the updated central profile compared to around 4m meters in the August 2011 IA. However DCC go live is now assumed to occur at the end of Q3 2014, whereas it was assumed to be operational from the end of Q1 2014 in the August IA.

For the last 10% of customers our assumptions remain unchanged to previous Impact Assessments. A proportion of the customer base is assumed to be hard-to-reach due to a range of customer and technical elements: long term vacant premises, repeated customer no access, lack of standard communication coverage and site specific safety issues. Uncertainty remains as to the nature and extent of this roll-out tail. Information provided by some energy suppliers indicates that it could take three years to complete smart meter installations among their hard-to-reach customer base. For modelling purposes, we assume that the yearly distribution of installations within this three year tail is 6%, 3% and 1% respectively. This reflects increasing complexity in resolving the most difficult customer and technical elements of the roll-out.

Figure 2-1: Roll-out profile



As mass roll-out is now assumed to start some 6 months later than in the August 2011 IA, both cost and benefits occur later in time, and are therefore subject to more discounting, resulting in a decrease in NPV of £54m. The peak installation rate required to reach the December 2019 completion date is estimated at 20.8%. This is based on a modelling assumption that having replaced 97% of the meter population with a smart meter equates to effective completion of the mass roll-out.

Table 2-3: Impact of updated planning and roll-out profiles

Domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	4,904	11,067	15,971	
exogenous and modelling changes	4,964	11,045	16,008	+60
updated planning and roll-out profiles	4,910	10,779	15,689	-54

2.1.4 Staged approach to the Foundation Stage

The August 2011consultation[10] sought views on the preferred delivery mechanism to implement the final policy decisions taken in March 2011[11]. Part of the final policy was an implementation strategy which set out the importance of the Foundation Stage ahead of mass roll-out. The Programme objective in this phase is to build consumer, business, market and regulatory readiness, providing a platform for a successful mass roll-out. This early phase of deployment is expected to deliver real live experience and early learning for the period of mass roll-out. To meet the

[10] http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2546-smip-consultation-rollout-180811.pdf
[11] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx

Foundation objective, Government stated plans to specify in licence amendments the Smart Meter Equipment Technical Specifications (SMETS) and to notify them to the European Commission under the Technical Standards Directive (98/34/EC). The publication of the Industry Draft Technical Specification (IDTS)[12] in August 2011 was an important milestone towards this objective, building a basis for SMETS and for ensuring interoperability of equipment deployed by different suppliers.

However, the IDTS did not reach a consensus on the standardisation of the Home Area Network (HAN), an important element of the smart metering equipment. A standards-based approach to HAN interfaces is important because it provides a platform for ensuring interoperability between equipment deployed in the home. This is particularly important in instances where a consumer receives gas and electricity from different suppliers, but is also relevant for the provision of products and services by Energy Services Companies (ESCOs), who will have certainty that additional equipment provided to the customer (e.g. an enhanced display) is compatible with metering equipment already in place. In the future this will also include the possibility to connect smart appliances to the smart meters HAN.

Responses to the August 2011 consultation have allowed the Programme to develop the delivery proposals and to scope in more detail the phases of the roll-out. In order for the Foundation Stage to progress Government will notify and, subject to the notification process, amend licences to refer to an initial SMETS without a specification for the HAN. Equipment complying with this initial SMETS will count towards suppliers' roll-out obligations. During this time further work on the development of an updated version of SMETS will progress. The mass roll-out of smart meters is expected to then begin from the end of Q3 2014.

The Programme is currently conducting trials to collate further evidence to support the specification of a standardised HAN. The trials will give an indication of expected coverage of different technologies. In parallel it is also gathering evidence regarding the availability and costs of different HAN solutions. An economic analysis of the expected coverage, timescales and costs for different HAN technology options will be undertaken to inform the selection of the HAN in the second SMETS solution.

A common specification is crucial for the delivery of the business case as it ensures that Smart Metering equipment performs certain minimum functions and that equipment is interoperable with the Smart Metering equipment installed by other suppliers and with the DCC.

The approach of a staged notification and its cost and benefit implications is considered in the next section.

2.1.4.1Treatment of uncertainty during early Foundation

There are a number of benefits from early roll-out activity, facilitated by the staged approach to Foundation. In particular it:

- maintains early momentum and allows a structured approach to roll-out during Foundation, with early meters meeting common standards
- generates learning from installations during Foundation at an operational and technical level as well as allowing the testing of alternative approaches to consumer engagement

[12] http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/2393-smart-metering-industrys-draft-tech.pdf

- provides early adopting consumers the opportunity to receive smart meters and realise benefits
- avoids unnecessary stranding of assets where suppliers take the commercial risk to install smart meters early (e.g. where existing meters need replacement)
- allows development of further evidence regarding a HAN standard without delaying overall progress
- takes some pressure off peak installation rates
- supports ambitious roll-out completion target

A number of potential risks arising from initial SMETS meters also have to be considered. These might result under some scenarios in cost increases and we reflect that through the addition of cost allowances to early meters. These allowances have been determined through a consideration of potential outcomes materialising and the likelihood of the event happening. Three areas have been identified for initial SMETS meters:

- Interoperability
  There could be potential difficulties arising from equipment utilised by different suppliers not necessarily being able to communicate with each other in light of the HAN not being specified. This may result in additional costs upon change of supplier (COS), but potentially also at point of installation for consumers that receive electricity and gas from different suppliers. In practice however, the range of HAN solutions in use by suppliers during Foundation is likely to be limited.

- Functionality differences
  Differences in functionality between the initial and the second SMETS are limited. The main difference envisaged at this stage is that outage notification functionality (formerly referred to as last gasp) will not be required from initial SMETS meters. Since the benefits that are driven by this functionality are subject to a critical mass of meters being available (see section 3.4.3.2 for further detail), an absence of this functionality from early meters could result in some delay in the realisation of outage management benefits. Under current modelling assumptions the assumed critical mass of 80% of meters is reached in 2018 as in previous IAs.

- DCC integration
  There is some uncertainty as to how meters installed before the DCC is operational will be integrated into the smart metering national system. This may result in additional costs if additional actions are required to bring such early meters into the DCC or if they have to be operated at greater cost outside the DCC. Further development of enrolment and adoption criteria by the Programme during the first half of 2012 will help mitigate this risk.

Only the last of these issues was identified in the approach to Foundation envisaged in the August 2011 IA. In the current IA previous cost allowances have been revised and updated to account for a staged specification of the equipment. The risk associated with this approach is now reflected as an increase in a number of cost items rather than as a separate and standalone cost[13].

[13] The cost item “Integration of early meters into DCC” that was presented in previous IA publications has therefore been removed from the summary table shown in section 11.

For the interoperability and DCC categories we consider how the risks could materialise in costs, and estimate what a worst-case scenario cost impact per meter would be. Under consideration of mitigating factors (both policy dependent and not driven by policy) a probability is derived, with which the worst case cost increase is weighted. The risk adjustments are applied to meters installed during the period in which the risk prevails. Any optimism bias uplifts already applied to that cost category continue to be considered (and are indeed increased by the risk uplift as well).

For the functionality differences – the lack of outage notification from initial SMETS meters – the impact is not translated into a cost increase factor but directly applied to the roll-out modelling. Meters installed ahead of availability of enduring SMETS meters will not provide outage notification functionality. This is modelled by adjusting the point in time from which network operators will have sufficient coverage of outage management functionality to realise savings. The critical mass of 80% assumed for modelling purposes is still achieved in 2018 under the current assumptions. Costs for the provision of outage notification functionality are excluded from early meters.

The table below sets out the uplift factors that are applied to initial SMETS meters. Section 9 contains the full analysis and underlying assumptions. It is important to note that the Government decision is not to mandate the roll-out of initial SMETS meters, but rather to allow sufficient flexibility so that energy suppliers which see a commercial case to start deploying volumes earlier can do so. This implementation approach helps maintain early momentum without delaying overall progress; provides early adopting consumers the opportunity to receive smart meters and realise benefits; and avoids unnecessary stranding of assets where suppliers take the commercial risk to install. Applying cost uplift factors to the early SMETS meters that we expect energy suppliers to roll out results in present value cost allowances of £70 million over the 2012 to 2030 period for the domestic roll-out when compared to the August 2011 Impact Assessment.

This is not to say that a two-stage specification approach to SMETS results in higher costs of £70m compared to an alternative approach. If suppliers decided to follow an alternative strategy, for example not rolling out any smart meters until the enduring SMETS were available, sensitivity analysis shows that this would result in a similar net present value to the scenario modelled in this IA. Whilst under such scenario there would be no cost uplifts to early meters, both costs and benefits would be delayed and subject to more discounting and higher cost uplifts for peak installation rates above 17% would be applied, resulting overall in the effects cancelling each other out.

Table 2-4: Cost uplifts to initial SMETS meters

Risk type	**Risk**	**Cost increase factor**
Interoperability risk 1	Costs upon change of supplier (incoming supplier might not be able / willing to support meter and therefore replace meter)	**15% uplift to:** **- Communications capex** **- Meter capex** **- IHD capex** **- Installation cost**
Interoperability risk 2	Double communications hub / IHD for single fuel installations	**15% uplift to:** **- IHD capex** **- Communications**

		capex
DCC risk	Early meters result in cost increase once DCC is in place[14]	**30% uplift to:** **- Communications opex**

Table 2-5: Persistence of early risks through time

	initial SMETS	**second SMETS pre-DCC go live**	**second SMETS post DCC go live**
Considered period	2012 – Q3 2013	Q4 2013 – Q3 2014	Q4 2014 onwards
Estimated number of meters	2.0m	2.1m	remainder of meter population
Interoperability risk 1	yes	no	no
Interoperability risk 2	yes	no	no
DCC risk	yes	yes	no

Table 2-6: Impact of cost uplifts to initial SMETS meters

Domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	4,904	11,067	15,971	
exogenous and modelling changes	4,964	11,045	16,008	+60
updated planning and roll-out profiles	4,910	10,779	15,689	-54
cost uplift to early meters	4,840	10,850	15,689	-70
Total difference	-64	-217	-282	

2.2 Further decisions taken in light of consultation responses

2.2.1 Communications architecture in the home

A central analytical question in the August 2011 IA concerned the configuration of the communications equipment in the home. A number of technically feasible options had been identified and Government sought views on two main proposals through the consultation:

1. *Government was minded to specify that fully integrated electricity meters and Communications Hubs will not comply with the SMETS.*
2. *Government was also seeking views on whether to mandate a single configuration of communications equipment: a separate Communications Hub without exchangeable WAN transceivers*

[14] This is not a risk specific to the staged Foundation approach and has been recognised in earlier IAs – pre-DCC meters had a number of cost escalation allowances built in.

Consultation responses were in very broad agreement with the first proposal on the basis that is would ensure future flexibility and minimise the risk of stranding of assets. It would also not be in line with the Prospectus response requirement of a WAN module that is replaceable without the need to replace the whole meter. A fully integrated electricity meter and communications hub will therefore not be permissible under the initial and the enduring SMETS. Only one response expressed support for the fully integrated approach on the basis that it would present the most cost effective solution if no communications technology change is assumed.

Regarding responses to the second question, a majority favoured giving suppliers flexibility over options for configuration of the communications hub. The principal reasons for supporting different configurations of the communications hub was that it allows for flexibility in installation, thereby minimising time on site. A one size fits all solution may lead to additional installation costs.

In light of the above fully integrated communications hubs (option 1 in the August IA) will not be permitted under SMETS. Further consideration of the available options has also brought to light that option 2 considered in August would result in considerable added practical, commercial and regulatory complexity in turn risking delay in delivery and cost escalation both for industry and the Government. The configuration of a replaceable WAN module integrated into the electricity meter will therefore not be permitted under SMETS. While it offers the lowest cost solution under a hypothetical replacement scenario the increase in complexity makes it in practice an unviable option.

Government proposes that the remaining options - intimate and fully separate Communications Hubs – will be introduced if a Communications Hub is defined in a future iteration of the SMETS. However, to reduce the number of variants and therefore complexity for suppliers, the interfaces between electricity meters and Communications Hubs for both separate and intimate options will need to be standardised by the industry. Standardisation will at a minimum need to cover the shape of the Communications Hub case (for the intimate option), the shape of the Communications Hub connector, the data connection protocols and power supply requirements. Replaceability of the WAN within the communications hub (option 4) would be optional.

For the initial SMETS and in absence of a standardised HAN a communications hub will not be mandated, but the Prospectus Response requirement that the WAN module has to be independently replaceable will remain in place.

Table 2-7: Overview of estimated costs for permissible communications hub configurations in the second SMETS

Communications architecture	Day 1 costs	Cost of replacement equipment	Installation cost at point of replacement
1. Fully Integrated	£22	£65 (day 1 plus electricity meter cost)	£29

2. Integrated with replaceable WAN	£25.5	£16.75	£29
3a. Separate Communications Hub with fixed WAN	£25.6	£25.6	£29
3b. Intimate Communications Hub with fixed WAN	£23.1	£23.1	£29
4. Separate Communications Hub with replaceable WAN	£29.1	£16.75	£29

The cost benefit modelling continues to assume the separate communications hub with a fixed WAN to be deployed. This represents a conservative approach and takes no account of lower costs where an intimate communications hub is deployed. Given uncertainty regarding which proportion of premises will ultimately receive which communications hub configuration, we model the standalone communications hub for all premises. Once the enduring SMETS is available, the more intimate architectures are deployed, the higher the overestimate of costs presented in this IA.

Please see the August 2011 IA for the full analysis of the different feasible approaches.

2.2.2 Outage notification

No new material evidence has been received through the consultation responses on the question of outage notification. Views continue to be divided regarding the case for requiring outage notification functionality in the smart metering equipment. Suppliers, who will bear the cost of this smart meter equipment based functionality, argue that they will not be the recipients of any of the benefits and are therefore critical of this requirement. Network operators have generally expressed supportive views in the responses.

On the other hand and in particular with a view to future demand patterns and a likely increased reliance on electricity supply, a reliable way of detecting and identifying power losses will become more important than might be the case now. With greater deployment of electric cars and heat pumps, the value customers attach to lost electricity supply – and the resulting willingness to pay for quality of supply improvements - is very likely to increase. Greater take up of time of use tariffs and a resulting increase in consumption at night time – both for heating and for EV battery charging purposes – will make an undetected loss of supply during the night much more costly than is currently the case. With expected increases in the amount of distributed or micro generation, a quick identification and resolution of network failures also becomes more relevant, as disconnected premises not only present lost consumption but also lost generation capacity in the future.

The Government has decided that outage management will not be included in the initial version of the SMETS. No new material evidence was presented with respect to inclusion of outage management capability in the smart metering equipment in the future. Dialogue with communications service providers has highlighted that options that do not require extra equipment in the metering equipment may still be possible. Therefore, the Programme will undertake further work with communication service providers to determine the most cost-effective way of providing outage management functionality by either adding additional requirements for smart metering equipment in future versions of the SMETS, or by an alternative means without adding extra equipment at the consumer premises.

For modelling purposes we will continue to utilise the August 2011 IA assumptions, both regarding costs and benefits. These are set out in full detail in the evidence base section. The component cost assumption for the delivery of the outage notification functionality is not applied to early meters (see section 2.1.4)

2.2.3 Cost erosion assumptions

The consultation sought views on the cost erosion assumptions currently used in the cost benefit modelling.

For modelling purposes it is assumed that, due to technological advancement, the costs of the meters and communications equipment will fall over time. Relative to 2012, we assume a 13.1% fall by 2024, representing a reduction in costs of approximately 1% each year. The assumptions about cost reductions over time are based on historic cost developments of traditional metering equipment.

Responses to the August 2011 Consultation largely supported these assumptions. Of the responses containing information relevant to the cost erosion assumptions, the majority expected either a higher erosion of costs than we assume or cost erosion in line with our assumptions.

Arguments that have been put forward to suggest that cost erosion could be higher than currently assumed include:

- Increased competition and price pressure on capital equipment as smart meters are deployed in more countries, production volumes increase and new manufacturers enter the market. Some responses expressed an expectation that global supply will ultimately outstrip demand.
- Economies of scale and learning effects from mass volume production will materialise and further reduce production costs of smart metering equipment.
- Cost erosion of communications components could be higher than for metering equipment.

The minority of responses that suggest lower rates of cost erosion included the view that the longer expected lifetime of smart meters relative to most consumer electronics will result in lower volumes and lower price erosion.

We retain our existing cost erosion assumptions because, on balance, available evidence suggests that these provide a conservative assessment of the cost erosion for meter and communications equipment.

3 Evidence Base

3.1 Overview

In this section we describe the main assumptions underpinning the analysis and the reasons for them with references to the evidence where appropriate. Further evidence has been received since the last publication of the IA in August 2011, mainly through responses to the consultation that the IA accompanied.

We have refined some of our assumptions on the basis of a critical examination of the available evidence. Differences between the assumptions in this IA and previous IAs are noted and explained within the text. For reference purposes section 10 provides an overview of the changes made since August 2011.

The case for a roll-out of smart meters to domestic consumers remains strongly positive in central scenarios (see results in section 4); the domestic roll-out has a positive Net Present Value (NPV) of over £4.8bn. Table 3-1 compares costs and benefits in this IA against those of the preferred option in the August 2011 IA. This decreases the value of the NPV published in the August 2011 IA from £4,904m to £4,840, by £64m.

Table 3-1: Costs, Benefits and PV (August 2011 vs. April 2012)

£m	**domestic IA**		
	NPV	total cost	total benefits
August 2011	**4,904**	**11,067**	**15,971**
April 2012	**4,840**	**10,850**	**15,689**
Difference	**-64**	**-217**	**-282**

The changes in costs are mainly driven by the updated assumptions regarding timing and roll-out profiles (see section 2.1.3) and new assumptions about risks from early meters (see section 2.1.4). Changes to exogenous input parameters also had smaller impacts on costs. The changes in benefits are also driven by updated planning assumptions and roll-out profiles, but also reflect updated exogenous input parameters and modelling changes, most notably moving the present value base year into 2012 and increases in projected fossil fuel and carbon prices.

The main assumptions used to calculate the overall impact of the roll-out described in this section are in the following categories:

1. Counterfactual/benchmarking
2. Costs
3. Benefits

These assumptions are then combined and modelled to provide cost benefit outputs (see section 4)

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% real has been assumed. The benefits are not annuitised but annualised, that is they are counted as they occur.

3.2 Counterfactual

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[15]. It includes:

- the costs of the continued installation of basic meters,
- benefits from better billing,
- 5% of the predicted consumer electricity savings from smart metering are assumed to occur in the counterfactual world as a result of CERT[16] and other delivery of clip-on displays. The assumption that real-time displays installed under CERT will deliver the same savings as those arising from the roll-out of smart meters is likely to underestimate the savings attributable to the smart meters roll-out. IHDs provided as part of the smart meter roll-out will have access to precise price information, a feature not provided by clipon displays into which a unit price of energy has to be inputted by the consumer / installer. Clip-on displays typically also cannot help monitor gas consumption, a feature that will be provided by smart meter IHDs. The smart meter roll-out will include the installation of the display (this has to be done by the consumer with clip-on displays, including input of the relevant tariff information) and in addition be supported by a consumer engagement strategy to ensure that energy consumption behaviour changes are facilitated.

It is difficult to judge whether any significant numbers of smart meters would have been 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 for modelling purposes a counterfactual world in which there is no smart meters roll-out: this is the assumption used in the headline estimates presented in this IA. This is supported by the fact that even though the technology has been available for a number of years, no significant numbers of smart meters have been rolled out prior to the announcement of a Government mandate. Following the Government announcement, some energy suppliers have started rolling out limited numbers of smart meters. We believe that this reflects individual energy suppliers' commercial strategies towards the mandated roll-out and that therefore even this reduced number of installations would have not occurred without the Government mandate[17]. We note however that such activities remain at the

[15] A *'do nothing'* option is not analysed because policy implementation as described will continue.
[16] Carbon Emissions Reduction Target.
[17] We estimate that approximately 500,000 smart meters may have been installed to date, approximately 1% of the domestic metering population.

suppliers' own risk ahead of equipment compliant with the initial SMETS being available.

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 those 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 existing incentives for the installation of smarter metering under the CRC Energy Efficiency Scheme.

Recognising that some level of smart meters may be rolled out in the domestic sector, for illustrative purposes we have also considered a situation where smart meters are rolled out to a significant part of the residential population. Such an illustrative scenario is outlined below and results in a reduction in NPV of £2.5 billion.

Under this hypothetical scenario, we assume that smart meters are voluntarily rolled out to a subpopulation of consumers at average costs but resulting in above average benefits. Suppliers would 'cherry-pick' those consumers that realise above average benefits from receiving a smart meter. This is modelled as a 20% reduction in costs in combination with a 30% reduction in benefits. Even in this extreme illustrative scenario, the NPV of the smart meter roll-out remains positive.

The cost of the continued basic meter installation is deducted from the costs for the smart meter deployment. 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.

3.3 Costs of smart metering

We classify the costs associated with the smart meters roll-out in the following categories: meter and IHD capital costs; communications equipment in the home installation costs; operating and maintenance costs; supplier and industry IT costs; DCC capital and operational expenditure; energy costs from smart metering equipment in the home; meter reading costs; disposal costs; legal and organisational costs and cost associated with consumer engagement activity.

No changes to cost assumptions have been undertaken since the August 2011 IA other than the cost uplift to meters installed under the initial SMETS as discussed in section 2.1.4.

In line with the design of the end-to-end solution and technical specifications, 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)[18]. It is assumed that a Wide Area Network (WAN)[19] is also required to provide the communications link to the DCC. In the cost benefit modelling we calculate the communications equipment as separate to the meter equipment.

3.3.1 IHD, meter, communications equipment and installation costs

The tables below show the capital costs of meter and communications assets used for the current analysis. These assumptions are unchanged since August 2011.

Table 3-2: Costs of equipment / installation in the home (per device)

Component	Cost
In home display (IHD)	£15
Electricity meter	£43
Gas meter	£56
Communications equipment	£25.6
Dual fuel installation[20]	£68
Total cost per dual fuel premise	**£207.6**

<u>In-Home Displays (IHDs)</u>

IHDs will have dual fuel functionality so any second supplier providing gas or electricity in a non-dual fuel home can use the IHD provided by the first supplier. It will be at any second suppliers' discretion whether they wish to provide a second display. This will allow for continued competition and customer choice. For modelling purposes only one IHD per household is assumed (except for initial SMETS meters where the risk for duplication of parts of the equipment is reflected in the cost uplifts that are applied – as set out in section 2.1.4).

No further evidence has been received regarding the costs of an IHD that is capable to provide the minimum functionality.

<u>Smart meters</u>

No further evidence has been received in this period of analytical work and therefore the meter cost assumptions remain unchanged to the August IA. Government will continue to review these assumptions as new evidence comes to light.
The total present value gross costs for IHDs and smart meters are £3,846m.

<u>Operating and maintenance costs</u>

No further substantive evidence has been brought forward at this point and we have retained previous assumptions for the present IA. The assumption used is an annual

[18] A HAN is a network contained within a premise that connects a person's smart meter to other devices such as for example and in-home display or smart-appliances.
[19] A WAN is a communications network that in this case spans from the smart meter to the DCC.
[20] The cost of a dual fuel installation is comprised of the cost of an electricity meter installation (£29), the cost of a gas meter installation (£49) and a dual fuel efficiency saving of £10.

operation and maintenance cost for smart meters of 2.5% of the meter purchase cost.

Operating and maintenance costs accrue to £675m in present value terms.

Communications equipment

We continue to use the communications costs assumptions presented in the preferred option of the August 2011 IA. The cost assumptions used for modelling purposes are reflective of a standalone communications hub. Both the initial as well as the enduring SMETS will permit other communications configurations, as long as they provide exchangeability of the WAN transceiver and the replaceable components are standardised. Some of the communications configurations which have been considered are estimated to have lower costs than a fully standalone communications hub. However, since the standalone communications hub presents the most readily available solution to achieving exchangeability and standardisation and in order to use a conservative estimate, we present the component cost scenario of modelling standalone communication hubs in all premises. This overestimates the communications equipment costs for premises where intimate communications hubs are installed.

Table 3-3: Breakdown of communication equipment component costs

WAN module	£15
Power supply unit	£2
Gas mirror	£4
Casing / seal	£1.1
HAN module	£2.5
Outage notification	£1[21]
Total cost of communication equipment	**£25.6**

Gross present value communications equipment cost are £1,146m.

Installation costs

We continue to use the installation cost assumptions previously used, including the assumption of a £10 efficiency saving if gas and electricity meters are installed at the same time in a dual fuel property. This reflects cost savings from installing two meters with a single visit to a customer's premise, for example because travelling costs are reduced or connectivity testing only has to be carried out once for the whole equipment.

Table 3-4: Breakdown of installation costs

Electricity only	£29
Gas only	£49
Dual fuel efficiency saving	-£10
Installation dual fuel	£68

[21] Contrary to other cost items and in light of continued uncertainty we continue to apply an optimism bias uplift of 150% to the cost of the outage notification component. This results in a de facto cost assumption of £2.75 for outage notification, after financing costs are taken into consideration.

In present value terms installation costs equate to £1,577m over the appraisal period.

Development of equipment cost over time

We continue to use the cost erosion assumptions used in previous IAs and model on observed cost developments over time for traditional metering equipment. This assumes a decrease in the costs of equipment deployed in the home of 13.1% by 2024 compared to 2012 levels. This erosion is applied to the costs of smart meters (electricity and gas), communications equipment and IHDs.

As set out in section 2.2.3, the Programme sought views through the consultation on the expectation of equipment cost development over time. As set out in section 2.2.3 we have retained previous expectations, although a large number of responses have indicated that the current assumptions are potentially low.

3.3.2 DCC related costs

DCC related costs are broken down into three broad categories:

- Data services and internal capital expenditure
  Initial or recurring investment that is required for the DCC and data service providers to offer services
- Data services and internal operational expenditure
  Ongoing costs that DCC and data service providers face to offer services
- Communications service charges
  Costs directly related to the provision of communications services

Data services and internal capital expenditure (capex)

Ahead of the March 2011 IA the Programme received several estimates for the IT capex required to establish DCC and its data services following a request for information (RFI) in 2010 issued to relevant industry stakeholders. These were typically close to the Programme's original estimates and we have held to these figures for DCC inception. For modelling purposes data services capex is adjusted to reflect that the scope of DCC may expand in the future to cover other activities (such as registration and data aggregation). No further changes to the DCC capex estimates have been made since the August 2011 IA.

A capital expenditure allowance is also made for initial set-up costs of the DCC. This allowance captures potential costs such as recruitment of staff, selection of premises or legal fees.

The gross present value cost of DCC capital expenditure is estimated to be £97m.

Data services and internal operational expenditure (opex)

The RFI issued in 2010 also covered operational expenditure that the DCC might face for the provision of data services. Responses to this request have informed the opex estimates used in the cost benefit model.

An allowance is also made for ongoing internal costs that the DCC might face. This captures for example costs of wages or rent of premises.

The gross present value of DCC operational expenditure is estimated to be £278m

Communications service charges

For the ongoing services charges for the communication technology that provides connectivity to the premises we assume – in line with the available evidence – these to be £5.30 per household per year (annuitised) for the WAN connection. This cost estimate includes an allowance for network security that enables secure communications.

Work carried out by Ofgem and the Data and Communications Expert Group in 2010 verified this against a mix of different technology solutions and established this to be an appropriate assumption. The costs are assumed to gradually decrease over the period of the roll-out.

In present value terms these costs amount to £1,312m over the appraisal period.

3.3.3 Suppliers' and other industry participants' system costs

Existing energy industry participants will have to make investments to upgrade their IT systems so that they are able to take full advantage of smart metering. Suppliers, network operators and energy industry agents are also expected to upgrade their IT systems.

These costs are broken down into three categories:

- Capital expenditure
- Cost of the interim IT solutions (before DCC is operational)
- Operational expenditure

Capital expenditure

Through the RFI in 2010 the Programme received a very broad range of figures for large supplier IT costs, including two significant outliers. The upper outlier was excluded on the basis that it represented counterfactual development associated with a new suite of systems. The lower outlier has been included, since this was a factor of the existing system suite, but has been increased to bring it closer to the other estimates. The overall figures were moderated to an average of £30m per large supplier. Figures for small suppliers and other participants were included as provided. Responses from other industry participants included network operators and existing industry agents.

It is important to note that some of the IT capital expenditure will be dependent on the scope of the DCC in place. For modelling purposes we have assumed that the vast majority of investment will be carried out with a "minimum scope" of DCC, with small incremental investments being made in later years as the additional functions of registration and data aggregation are added.

The Programme has not included specific smart metering IT refresh costs as smart metering changes are typically being applied to large scale Customer Relationship Management (CRM) and billing systems and market interface systems. The former are predominantly strategic investments by suppliers and will not be refreshed specifically for smart metering. Further, our expectation is that the introduction of DCC will provide major opportunities for market simplification which will be developed on the back of these systems, changing the scope and depth of these components.

The resulting present value for supplier IT capex is £300m, while the cost estimate for other industry participants' IT capex is £74m.

Costs of the interim solution

In the August 2011 IA costs of £30m for the interim solution until the DCC is established[22], were accounted for under the section "Legal, marketing and organisational". These have been kept unchanged, but are now considered and presented under supplier IT capex.

Operational expenditure

For modelling of suppliers' IT operational expenditure, the Programme has used an industry standard figure of 15% of total IT capex for initial opex for smart metering IT. This is reduced gradually to 5% by 2030. This is in line with best practice IT application and infrastructure management where ongoing performance improvement is a key feature of contracts and has been observed in IT systems of comparable scale and complexity. It also takes account of the points made above, that smart metering changes are typically part of a larger strategic system with its own established maintenance and support contracts and that these systems will be subject to ongoing change as DCC provides opportunities for market evolution.

For other industry participants' IT opex the Programme has utilised the responses received to the 2010 RFI.

The resulting present value cost estimates for suppliers' and other industry participants' IT opex are £228m and £85m respectively.

3.3.4 Cost of capital

While not presented as a separate cost item, 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. Following a conservative approach to the estimation of costs a capital cost of 10% p.a. real is estimated. 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 IA. If a lower interest rate was applied the net present value of the smart meters roll-out would increase significantly. For example,

[22] These costs reflect that before the establishment of DCC suppliers will have to adapt their back office systems to ensure commercial interoperability for smart meters installed prior to the mass roll-out.

reducing capital cost by just 1% increases the NPV by almost £400m, while an assumed capital cost of 5% increases the NPV by almost £2bn. As with other modelling assumptions, this conservative approach results in a potential underestimation of the net benefit of the policy. In effect such a conservative approach creates a safety margin over and above explicit risk allowances that are applied such as optimism bias uplifts.

3.3.5 Energy cost

Smart metering assets will consume energy, and we continue assuming that a smart meter system (meter, IHD and communications equipment) would consume 2.6W more energy than current metering systems. These assumptions are therefore unchanged.

The total present value of energy costs over the appraisal period is £708m.

3.3.6 Increased costs of manually reading remaining basic meters

The smart meter cost benefit analysis captures an inefficiency effect of having to manually read a decreasing number of basic meters as the roll-out of smart meters progresses. This is based on the rationale that, as fewer basic meters remain in place, it becomes more time consuming to read them (for example because travel times increase or because meter readers are in a particular area for shorter time periods, making revisits to a premise where no access had been gained more difficult). The April 2008 IA first 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. The May 2009 IA included 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 was increased and they increase exponentially to a limit of two times the existing meter reading cost of £3 – resulting in a maximum increase of £6 and resulting cost of a successful meter read of £9. These reads are treated as an additional cost per meter and the costs are spread across the roll-out. The assumptions underlying these costs have not been changed between the August 2011 and this IA.

The present value of these pavement reading inefficiencies is £220m.

3.3.7 Disposal costs

There is a cost from having to dispose of meters as they reach the end of their lifetime, including the costs of disposing of mercury from basic gas meters.

These costs would have been encountered under business as usual basic meter replacement programmes, but will be accelerated by a mandated roll-out of smart meters. The underlying cost assumption of £1 per meter has not changed since August 2011 and the cost-benefit model continues to reflect that meters would have had to be disposed of regardless of the implementation of the Programme and only takes into account the acceleration and bringing forward of the disposal over and above the counterfactual. The costs therefore are incurred earlier and are subject to less discounting. The calculation also applies the £1 disposal cost assumption to smart meters, with resulting costs for the first generation meters to be replaced from 2027.

PV costs amount to £12m. The approach has not changed since the August 2011 IA.

3.3.8 Legal and organisational costs

The August 2011 IA included a cost category covering legal, marketing and organisational costs, adding up to a total amount of £300m. We now present these costs in a more disaggregated way. Costs for the DCC interim solution of £30m have not been modified, but are now presented under suppliers' system costs (see section 3.3.3). Marketing costs are now included under the consumer engagement section below (3.3.9). The following table reflects these changes:

Table 3-5: Legal and organisational costs

	£m
Legal costs	30
Organisational (data protection, ongoing regulation, assurance, accreditation, tendering, Programme delivery, trials, testing)	140

3.3.9 Costs associated with consumer engagement activities

The March 2011 Government Response document made clear that it saw individual suppliers playing an important role in engaging their customers, but there was a strong support for some activities being carried out centrally or on a co-ordinated basis during mass roll-out to minimise risks around consumer benefits realisation and to enhance the cost-effectiveness of the roll-out.

The Programme has since carried out further work to better understand what underpins effective consumer engagement. This included the development of a behaviour change framework by COI, a series of stakeholder workshops and a Request for Information to suppliers on costs and benefits of central engagement (December 2011).

This work confirmed that there is strong support for a programme of centralised activities. Potential costs would not include costs of suppliers' own marketing activities e.g. brand positioning, which fall outside the scope of the smart meter roll-out and this IA.

The Consumer Engagement Strategy consultation document published alongside this IA[23] seeks further views on the arrangements to deliver centralised consumer engagement activities. In the light of this consultation, the IA will be further updated both in terms of activities and costs, and their expected impact both on consumer benefits and on other costs.

[23] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

The potential impact of consumer engagement on consumer energy savings is briefly discussed under section 3.4.1.1 below. The consumer engagement strategy has the potential to reduce some costs of the Programme, in particular those associated with installation visits. Part of its purpose will be in supporting suppliers' own communications by developing standardised communications material, messaging and a common brand to facilitate access, and managing PR risks by providing independent reassurance about privacy and/or safety, among others. All of these could increase the willingness of consumers to agree to installations and avoid the need for multiple visits.

Suppliers have found it hard to provide firm estimates or evidence on the likely benefits at this stage. In the absence of firm quantitative evidence we have not made any estimate of this potential benefit. Further evidence on the benefits of different types of consumer engagement will be collected in order to enable us to have a more informed assessment towards the end of Foundation. Our detailed approach to collecting this information will be published later in the Spring.

In present value terms, the overall estimate of the costs associated with this Programme amount to £87m[24] over the appraisal period.

3.4 Benefits of smart metering

We classify benefits in three broad categories: consumers, businesses (energy suppliers, distribution network operators and generation businesses) and carbon related. Benefits are categorised based on the first order recipient of the benefit. To the extent that businesses operate in a competitive market – in the case of energy suppliers – or under a regulated environment – in the case of networks – a second order effect is expected as benefits or cost savings are passed down to end energy users i.e. consumers. For example, avoided meter reads are a direct, first order, cost saving to energy suppliers. As energy suppliers operate in a competitive environment, we expect these to be passed down to consumers.

3.4.1 Consumer benefits

A range of consumer benefits is expected, including those around improved customer satisfaction and financial management benefits, which have so far not been quantified but will be the subject of further work and part of the benefits management strategy.

Significant benefits from smart meters can be driven by changes in consumers' energy consumption behaviour. Two potential areas 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.

3.4.1.1 Energy demand reduction

[24] Note that in previous IAs, these costs were presented in real terms. These are now presented in NPV terms.

There is a growing evidence base demonstrating that smart metering leads to energy demand reductions but also continued uncertainty about the precise level of response of consumers to the full roll-out of smart meters, which will depend on a range of factors. A number of large-scale international review studies exist, such as a review of 57 feedback studies in nine different countries by the American Council for an Energy-Efficient Economy (ACEEE)[25] which finds that on average feedback reduces energy consumption between 4-12%, with higher (9%) savings associated with real-time feedback. A further study by ACEEE[26] reported residential electricity savings from real-time feedback in the nine pilots reviewed ranging from 0 to 19.5%, with average savings across the pilots of 3.8%. One of the most promising results is that a small percentage of households in several of the pilots had large savings of up to 25%.
Sarah Darby[27] and Corinna Fischer[28] also show that feedback can result in dramatic behavioural changes with average reductions in energy consumption of over 10%. The recently published European Smart Metering Industry Group (ESMIG) report[29], a review of 100 pilots and 460 samples covering 450,000 consumers suggested savings from around 5-6% from interventions without IHD, to an average of 8.7% with an IHD.

Recent trials in European countries resulted in energy savings within the same range[30]. International studies also provide some evidence on the likely persistence of savings. The ACEEE study quoted above found that feedback-related savings are often persistent, including from the longer-term studies (12 – 36 months) considered. However given the differences of situation and approach between different countries, it is difficult to transfer evidence on levels and persistence of savings directly to the GB context.

The Energy Demand Research Project (EDRP) was a major UK project co-funded by the Government to provide information on consumers' responses to a range of forms of feedback, including smart meter-based interventions. The final report[31] provided substantial new evidence on the behavioural impact of improved energy information in the GB context. EDRP trials generally found that the combination of a smart meter with an IHD was associated with significant electricity savings. Levels of savings varied according to how the trials were conducted, however, trials that are more closely comparable to the GB roll-out showed statistically robust electricity savings of 2% to 4%. For gas, it was the provision of a smart meter rather than the IHD which was most significant in delivering savings, with savings of around 3%. This is in keeping with theoretical considerations that real time feedback is more relevant to electricity.

Also relevant is the evidence base around mechanisms and enablers for behaviour change, and the extent to which they are likely to be supported through the Programme design. Fischer (ibid.) found that higher savings are associated with

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[25] Erhardt-Martinez, Donnelly, Laitner, *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010.
[26] http://www.aceee.org/research-report/b122
[27] Sarah Darby, *The Effectiveness of Feedback on Energy Consumption*, April 2006.
[28] Corina Fischer, *Feedback on household energy consumption: a tool for saving energy?*, Energy Efficiency (2008) 1:79-104.
[29] The potential of smart meter enabled programs to increase energy and systems efficiency" Oct 2011, available at http://www.esmig.eu/newsstor/news-file-store/empower-demand.
[30] Electricity Smart metering Customer Behaviour Trials (CBT) Findings Report, Information paper, CER11080a, May 2011, Available at http://www.cer.ie/en/information-centre-reports-and-publications.aspx?article=5dd4bce4-ebd8-475e-b78d-da24e4ff7339). In Germany, a recent smart meter trial suggests savings of around 5% due to a combination of indirect feedback and energy efficiency advice. (See Schleich, J.' Klobasa, M.; Brunner, M.; Gölz, S.; Götz, K.; Sunderer, G. (2011), Smart metering in Germany - results of providing feedback information in a field trial, *ECEEE 2011 Summer Study*, Energy Efficiency First: The Foundation of a low-carbon society).
[31] See: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=21&refer=Sustainability/EDRP.

feedback which is: based on actual consumption; given frequently (ideally, daily or more) and over a longer period; involves interaction and choice for households; includes appliance-specific breakdowns; may involve historical or normative comparisons; and is presented in an understandable and appealing way. Darby (2010)[32] is another review which identifies *inter alia* the need to design customer interfaces for ease of understanding, and for guiding occupants towards appropriate action in order to reduce demand. The ACEEE study also concluded that achieving maximum feedback-related savings will require an approach that combines useful technologies with well-designed programs that successfully inform, engage, empower, and motivate people. ESMIG findings further confirmed the importance of consumer involvement and surrounding variables – over and above the supportive technology used or program structure. It highlighted the fact that the greater the variety and layering of engagement activities, the greater the impacts of roll-out.

From the evidence available to date, it appears that the levels and distribution of energy savings will be dependent on a number of factors, including: the effectiveness of consumer engagement approaches carried out by energy suppliers, energy services companies (ESCOs) and potentially other parties; the quality of design solutions (e.g. the quality and usefulness of in-home displays and minimum information requirements, developments in home automation) and enabling the development of energy tariffs and services which encourage or facilitate behaviour change.

Different elements of the Programme (e.g. the consumer engagement strategy, the IHD minimum requirements which allow scope for innovation, flexible provision for access to data within the home and via the DCC) will address these specific issues. In addition, retail competition and further steps to promote the Programme's objective of effective competition in all relevant markets (energy supply, metering provision and energy services and home automation) are likely to drive market developments which will support energy savings over time.

As noted above, the effectiveness of consumer engagement approaches is likely to influence the level and distribution of consumer energy savings. Plans are being developed for a central engagement programme as described in section 3.3.9, to supplement the engagement activities of individual suppliers. However, we are not yet in a position to quantify the magnitude of such impacts. Evidence will be collected from early roll-out installations and piloting of smart meters in order to enable us to have a more informed assessment towards the end of Foundation.

Overall, the GB as well as the international evidence shows that considerable savings are achievable. Cost-benefit analyses in other countries have adopted similar energy savings assumptions. Kema's cost-benefit analysis for the Dutch Ministry of Economic Affairs[33] assumes 6.4% electricity savings with direct feedback through an IHD (3.2% with indirect feedback), and 5.1% (3.7%) for gas[34]. The recent Irish CBA adopts a 3% electricity savings assumption to compute illustrative estimates of the change in consumer welfare resulting from the installation of smart meters.

Even though the Impact Assessment assumption on energy savings lies within the lower range of recent trials' results, they have not been revised upwards. This is

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[32] Darby, Sarah (2010) 'Smart metering: what potential for household engagement?', Building Research and Information 38: 5, 442-457.

[33] KEMA (2010)

[34] The CBA assumes options for refusing the installation of a smart meter due to recent changes in Dutch political circumstances, and the CBA assumes a 20% voluntary uptake of IHD.

because of the existing uncertainty on the precise level of energy savings at this stage of the analysis and caveats[35] in trial results to the whole population.

In light of our current analysis of the available evidence and given the underlying uncertainty, we retain a conservative approach and continue to assume that the gross annual reductions in demand will be 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 pre-payment meter (PPM)).
- In the lower benefits scenario: 1.5% for electricity (credit and PPM), 1% for gas credit and 0.3% for gas PPM.

Energy is valued consistently with guidance produced by DECC[36]. The energy baseline from which energy savings are calculated is consistent with the most recently published DECC energy projections accounting for a number of energy efficiency policies in place before smart metering[37].

A second source of change in consumption patterns enabled by smart meters is a shift of energy demand from peak to off-peak times. Even though this shift will likely result in bill reductions for those taking up ToU tariffs, bill savings for some customers may be offset by bill increases for other customers, as the existing cross-subsidy across time of use unwinds. Benefits from load shifting are therefore valued in the IA to the extent that they produce a resource benefit to the UK economy. This benefit falls as a first order benefit on various agents in the energy market, and hence it is discussed under the “business benefits” heading.

3.4.1.2 Microgeneration

We estimate the savings from using smart meters to deliver export information from microgeneration devices. We have done that by estimating the number of microgeneration devices that will be in use by 2020. We have made a conservative estimate of the number of units (about 1 million by 2020) and the savings per annum per meter (£0.12) that result from assuming a separate export meter and its installation cost are not needed.

3.4.2 Supplier benefits

The following sets out the range of benefits and cost savings the energy supply industry is expected to realise.

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[35] Caveats include the degree of representativeness of the samples, trials effects and scale effects for instance.
[36] DECC Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, October 2011: http://www.decc.gov.uk/assets/decc/statistics/analysis_group/122-valuationenergyuseggemissions.pdf
[37] Hence avoiding double-counting energy savings and accounting for policies’ overlap. Policies accounted for in the baseline are Warm Front, Building Regulations 2002 and 2005, EEC1,2 and CERT (excluding CERT +20%), and product policy tranche 1.

3.4.2.1 Avoided site visits

Currently energy suppliers have to visit their customers' premises for a number of reasons, namely to take meter reads and carry out safety inspections. The roll-out of smart meters will have implications for the requirement to carry out such visits in a number of ways.

- Regular visits

    - Regular meter read visits

Smart meters will allow meter reading savings for suppliers as soon as a basic meter has been replaced by a smart meter. We continue to assume that avoided regular meter reading will bring in benefits (cost savings) of £6 per (credit) meter per year in our central scenario taking into consideration both actual and attempted reads. This is reflective of the avoided costs of two meters reads per year under the regular meter reading cycle, for which meter reading operatives cold call premises in an area to read a meter and repeat to do so if access is not gained at the first instance. A cost of £3 per successful meter read is the cost figure that has been quoted by industry as the commercial rate that is charged by meter reading companies.

    - Regular safety inspection visits

The IA also takes account of additional costs for regular safety inspections of smart meters. The costs for these regular safety inspection visits in the smart world are £0.6 p.a. for 90% of meters and of £8.75 p.a. for the remaining 10% of meters.

Currently safety inspections are carried out as part of the regular meter reading visits and therefore carry little if any additional cost. While the Programme acknowledges that this is not necessarily reflective of the effort that should be undertaken to ensure safety of a meter, the model contains no incremental costs for safety inspections in the current counterfactual situation. This probably understates the current cost, but in the absence of evidence is used as a basis for modelling.

The Programme expects that the roll-out of smart meters will help facilitate a change in the underlying regime and that the current required frequency of one inspection every two years will not persist across the population of meters once smart meters have been installed. This will be subject to a decision by Ofgem and the Health and Safety Executive (HSE), but initial discussions with HSE have already indicated that it is willing to consider reform, subject to any changes being risk and evidence based and not resulting in any reduction in existing levels of safety. This adheres to the principles of better regulation and would directly reduce the regulatory burden placed on businesses.

For modelling purposes we have made assumptions on the costs to suppliers of carrying out safety inspections after the roll-out of smart meters. We assume a new risk-based regime with different requirements for different risk categories:

- Low risk group:
    - 90% of meters
    - Require a safety inspection every 5 years
    - Area based approach with £3 cost per successful visit

- High risk group:
    - 10% of meters
    - Require a safety inspection every 2 years (or 5% of meters every year)

- Approach of scheduled appointments with £17.5 cost per successful visit[38]

There is of course uncertainty around what proportion of meters might be considered high risk under a new safety inspection regime, but for modelling purposes it seems reasonable to assume that the population currently requiring special safety inspection visits (see next section) will continue to require dedicated costs at a greater frequency than the majority of meters (see special visits section).

- Special visits

Further assumptions with regards to “avoided special visits” are made. The analysis reflects benefits of £0.5 per credit meter p.a. from avoided special meter reads and benefits of £0.875 per meter p.a. from avoided special safety inspections.

- Special meter read visits:

We assume a benefit of £0.5 per credit meter reflecting the following activities in the current situation that will be redundant once smart meters are rolled out:

  - 5% of credit meter customers p.a. request a dedicated visit for a special read (e.g. because of bill disputes)
  - Such a visit costs £10, as access at first attempt is assumed

- Special safety inspection visits:

We assume a benefit of £0.875 per meter reflecting the following activities in the current situation that will be redundant once smart meters are rolled out:

  - 5% of the meter population p.a. requires a dedicated visit for a safety inspection
  - Such a visit costs £17.5, reflecting the requirement for repeat visits

The below table summarises the items discussed in this section and outlines the overall impact:

Table 3-6: Cost and benefit impacts from avoided site visits (per meter per year)[39]

Visit type	Current world cost	Smart world cost	Effect
Regular meter read	£6 per credit meter pa, £0 per PPM meter pa	None	saving
Regular safety inspection	No incremental cost	£0.6 per low risk meter pa, £0.875 per high risk meter pa	cost
Special meter read requested by customer	£0.5 per credit meter pa, £0 per PPM meter pa	None	saving
Special safety	£0.875 per meter	No longer required	saving

[38] This results from using the current commercial rate of £10 for an appointed special visit and reflecting that first time access rates will be below 100%. Only 50% of premises are expected to provide access at the first attempt, with 25% of premises each requiring a second and third visit. The same assumption is used for modelling the benefits from avoided special safety inspection visits in the current situation, further outlined below.

[39] Please note that the total cost row is not derived directly from the sum of the cost items. This also takes into consideration the proportion of credit and PPM meters.

inspection	pa	as captured under the risk based approach	
Total cost:	**£6.73**	**£0.63**	**cost saving of £6.10**

Avoided site visits account for £3,083m gross benefits in present value terms.

3.4.2.2 Reduction in inbound enquiries and 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 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 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.

In total gross benefits of £1,216m in present value terms are expected from reduced call volumes.

3.4.2.3 Pre-payment cost to serve

Smart meters are expected to bring savings in the cost to serve customers with pre-payment meters (PPM). These savings arise primarily from avoided site visits to replace credit with pre-payment meters and vice versa. While the number of pre-payment customers as a proportion of the total population has remained relatively constant over time, there is a considerable churn within this subpopulation of households switching to pre-payment or back to credit. In a simplified way this can be envisioned as a constant pool of pre-payment meters, with a customer only being equipped with a pre-payment meter as a previous pre-payment customer switches to a credit meter. Ofgem reported a total of around 500,000 PPM installations in 2010, which will be avoided once smart meters are rolled out and meters can be remotely switched between credit and pre-payment functionality.

In addition smart meters in pre-payment mode are likely to require less maintenance and service than current key meters since there is less mechanical interaction and there is no need to replace lost keys. Lastly, it might be possible to achieve some savings in the pre-payment infrastructure, for example through streamlining of the credit upload system as new payment approaches (over the phone or the internet) become possible or because suppliers might decide to manage payments in house.

Consumers on pre-pay could benefit if these operational cost savings were passed on as lower prices. In practice, pre-pay customers have already made some of those savings because suppliers have artificially lowered prepay tariffs towards standard credit levels. In so far as that process has involved cross-subsidy, part of the benefit of reduced prepay costs might fall back to the whole customer base. A single credit/pre-pay meter means that cost-differentials between standard credit and prepay tariffs will be substantially reduced without any need for cross-subsidisation.

We assume that the additional cost to serve consumers with PPMs are currently £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 August 2011. 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.

The present value of this benefit accrues to £1,063m.

3.4.2.4 Debt management and remote switching between credit and pre-payment

Smart metering can help to avoid debt – both on the consumer and the supplier side – in a number of ways.

For the consumer, information about energy consumption and cost implications communicated via the IHD can help to manage consumption and awareness of its costs. This can be used to avoid large energy bills and therefore the risk of debt arising.

For energy suppliers, two core functionalities will drive debt management benefits. On the one hand more frequent and accurate consumption data for billing purposes will enable suppliers to identify customers at risk of building up debt sooner and will enable them to discuss and agree reactive measures. The supplier might for example provide energy efficiency advice to reduce energy expenditure or might offer a different payment arrangement or develop with the consumer a debt repayment plan. Bills based on remote meter reads and therefore actual energy consumption will also avoid large arrears where customers receive a succession of estimated bills. It will also allow more timely adjustments to direct debits where customers currently pay a fixed monthly / quarterly amount and any over- or underpayments are only settled at the end of the year.

On the other hand, debt management benefits will be delivered by the ability to remotely and promptly switch a customer onto a pre-payment arrangement. Current consumer protection will remain in place (and might indeed be strengthened further by Ofgem) and there is no expectation that consumers will be forcibly switched to pre-payment. It will however be possible for the supplier to discuss sooner with an indebted customer potential reactive measures including the offer to switch to a pre-payment arrangement. An indebted customer might already under current circumstances eventually receive a pre-payment meter, but once smart meters are in place this will be possible sooner. This is both because a payment issue can be identified earlier and also because the actual switch to pre-payment can be exercised quicker as all the required equipment is already in place in the customer's premise. There is also only a minimal cost to the supplier in making the change between the payment type. With easier payment arrangements for PPM more customers may opt for PPM if they are having difficulty managing their payment. We do however not model an increase in PPM customers over time.

The avoidance of debt (both in terms of the total amount of outstanding charges and the duration for which customers remain indebted) reduces the working capital need of suppliers. Since provision of this working capital is not free (it could be utilised elsewhere and therefore carries opportunity costs), reducing the working capital requirements equate to an operational cost saving that suppliers can realise and consequently pass on to consumers.

We estimate the per (credit) meter saving from better debt management to be £2.2 per year, resulting in a present value benefit of £1,044m.

3.4.2.5 Switching Savings

The introduction of smart metering will allow a rationalisation of the arrangements for handling the change of supplier process. Trouble shooting teams employed to resolve exceptions or investigate data issues will 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 misbilling will reduce.

As outlined in section 3.3.2, the Programme carried out an extensive request for information in 2010 to determine the costs and benefits that the energy industry expects from the establishment of the smart metering system and the DCC.
The main category of benefits examined through this Information Request relates to customer switching. The Information Request asked for views of the potential scale of this benefit and the extent to which the benefits are contingent on DCC providing a centralised supplier registration system covering both electricity and gas.

Suppliers were asked to estimate the value of benefits that could be realised and to comment on the factors which could constrain the realisation of benefits. The benefit estimates provided included the potential benefits of reducing the complexity / cost associated with interfacing with a variety of registration agents when a customer switches suppliers. If a potential DCC activity resulted in the transfer of functions from suppliers' agents to DCC (e.g. data aggregation), suppliers were asked to estimate the costs that would be avoided. Network Operators and Metering Agents were asked to provide evidence on the extent to which each option will facilitate the realisation of customer switching and related benefits (e.g. the avoided costs of handling registration-related queries from energy suppliers).

Following analysis of responses to the request for information, we now consider customer switching benefits of £3.11 per smart meter per year where the scope of the DCC includes registration and data aggregation functions. Where the scope of the DCC includes registration, benefits of £2.22 per smart meter per year are considered and where the scope of the DCC covers only the minimum scope, benefits of £1.58 per smart meter per year are considered. Before the establishment of DCC customer benefits are assumed to be of £0.8 per meter per annum.

The implementation route leads to the establishment of an operational DCC from the end of Q3 2014 with a "minimum scope" (see Prospectus Response Document[40]), with registration being added to the scope some time after. A decision on the inclusion of data aggregation will be considered in the future. For modelling purposes, it is assumed that registration will be added to the remit of DCC in 2016, with data aggregation added in 2019.

In total present value terms, switching savings generate £1,594m in gross benefits.

3.4.2.6 Theft

The implementation of smart metering could reveal existing theft and allow suppliers to combat it better. Estimating theft is problematic as by its nature theft levels are difficult to quantify. Detailed analysis carried out by industry in 2011 suggested that levels of theft of gas and electricity by domestic customers may have a retail value of over £250m p.a.

[40] http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1475-smart-metering-imp-response-overview.pdf

Such theft estimates are based on independent industry analysis of the measurement error encountered when reconciling gas consumption data, from which the share attributable to theft is derived. Levels of electricity theft are extrapolated from the gas figure by assuming electricity theft at the same levels than gas theft. This is conservative as evidence suggests that levels of electricity may actually be higher than for gas (Ofgem, 2005).

In our central scenario we continue to assume that the roll-out of smart meters will reduce theft by 10%, which is also conservative given estimates that smart meters could reduce theft by 20-33% in previous consultation responses. 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. Following standard Government practice, we value theft reductions for domestic customers at the resource rather than the retail value of energy, resulting in benefits of £0.29 per meter per annum for electricity and £0.36 per meter per annum for gas.

This results in present value gross benefit of £236m.

3.4.2.7 Remote disconnection

The meter functionality that is specified in SMETS 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 in instances where an authorised supplier operator is despatched to a customer's premise to disconnect supply. The number of such instances per year is limited – Ofgem data for 2010 shows that 2,800 disconnections across both electricity and gas occurred[41] - but are potentially costly as they might involve multiple personnel. A disconnection is most likely to occur where an indebted customer cannot be provided with a pre-payment meter. Ofgem have introduced licence changes as part of the Spring Package of regulatory measures to strengthen protections for consumers and there is no expectation that the number of disconnections will increase as a result of smart metering. The reflected benefit merely captures operational cost savings from avoided site visits in an assumed number of instances.

The assumed benefit per meter per year is £0.5, accumulating to a present value benefit of £237m over the appraisal period.

3.4.3 Network benefits

3.4.3.1 Avoided losses to network operators

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[42].

The total present value gross benefits from avoided losses is £405m.

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41 http://www.ofgem.gov.uk/Sustainability/SocAction/Monitoring/SoObMonitor/Documents1/Supplier%20Social%20Obligations%20annual%20report%202010.pdf

42 Mott MacDonald, *Appraisal of costs and benefits of smart meter roll out options*, April 2008.

3.4.3.2 Outage detection and management for electricity DNOs

The availability of detailed information from smart meters will improve electricity outage management and enable more efficient resolution of network failures once a critical mass of meters and the resulting geographical coverage is reached. Benefits identified are a reduction in unserved energy (customer minutes lost), a reduction in operational costs to fix faults and a reduction in calls to fault and emergency lines.

We have assumed that a critical mass of smart meters is required for these benefits to be realised. This is so that sufficient regional coverage is provided to identify the location and the scope of an outage. The benefits are therefore only considered to be realised from 2018 onwards, at which point over 80% of smart meters with outage detection functionality[43] will be installed. We have reflected in the modelling that for early meters there will be no requirement to have outage detection functionality, but in light of the relatively small number of such early meters this does not result in a shift of the year in which the threshold is achieved. We also assume that the smart metering technology will only lead to outage related benefits in the low voltage network system. This is because other voltage systems within the electricity networks already have sophisticated monitoring and diagnostic systems in place.

Some outage management benefits do not rely on the capability of individual meters to actively send a message when there is an outage ("positive" outage notification). These are benefits which arise from the ability of a DNO to use the Smart Metering system to remotely check the energisation status of any meter in the system. If meters are unable to send a message to inform of an outage, then Network Operators would continue to rely on 'traditional' non-automated notification of an outage to initially raise awareness of an issue. This notification would typically be provided by a customer calling the network operator to make them aware of an outage. However, once a Network Operator was made aware of an issue, then the functionality of the Smart Metering System would allow them to deal with the fault more efficiently. Only these basic outage management benefits were considered in the March 2011 IA. The August IA increased the expected benefits to reflect additional cost savings from a "positive" outage notification functionality.

The individual elements of outage management benefits to Network Operators are outlined in more detail below:

1. Reduction in customer minutes lost (CML):

This captures the customer benefit from reduced outages, because better information from smart meters will enable networks to better identify the nature, location and scope of an incident and to take the most appropriate reactive action, leading to quicker restoration times. Consumers have an interest for outage times to be reduced to minimise the inconvenience of not having electricity.

In order to calculate benefits we valued the estimated reduction in customer minutes lost (CML) with the average CML price incentive under the Distribution Price Control Review 5 (DPCR5), running from April 2010 to 2015. The CML incentive rate reflects end customers' willingness to pay for quality of supply improvements with regards to a reduction in minutes lost. It also acts as one part of the overall interruptions incentive scheme for network companies to improve the quality of their service (the

[43] As outlined in section 2.1.4.1, there will be no requirement for outage detection in the initial SMETS and early meters are therefore not counted towards the achievement of the critical mass.

other part being the number of interruptions experienced). The distribution companies earn additional revenue if they beat their CML target (i.e. their CML for the year in question is lower than their target for that year) and suffer a reduction in revenue if their CML exceed their target. There are several methodologies available to estimate the value of quality of supply improvements to consumers, however as a measure of the benefits to Network Operators, this figure seems the most appropriate to use.

International evidence shows a large range of potentially achievable reductions in unserved energy, ranging from 5% to 35%. We have opted for a conservative estimate of 10% reduction of CML in our base scenario which results in an annual benefit of £0.35 per electricity meter. This reflects the uncertainty around potential differences between the UK and the countries where large benefits have been realised (e.g. higher population density and smaller geographical distances between customers might result in lower scope to reduce outage durations).

The present value gross benefits from a reduction in customer minutes lost is £90m.

2. <u>Reduction in operational costs to fix faults:</u>

This captures operational savings to networks from being able to manage outages better, because with earlier notification and better knowledge of a likely cause technical teams can be deployed more efficiently and in a more targeted manner.

Based on information from Ofgem detailing the total costs of resolving low voltage faults to Network Operators in 2008 / 2009, we estimate an approximate cost of £2400 per fault restoration. For this analysis we have assumed that these costs could be lowered by 10% in line with the reduction in CML, as quicker restoration of outages will also result in more efficient deployment of technical teams. We therefore assume that wages and staff time are the main drivers of the costs to fix faults – this approach ignores costs reductions in equipment and material. The benefit to Network Operators amounts to £0.66 per electricity meter per annum.

The total present value gross benefit from the reduction in fault fixing costs is £159m.

3. <u>Reduction in calls to faults and emergencies lines:</u>

In the long run customers will be confident that networks are aware of outages due to smart meter information. In the short run we envisage a reduction in the number of calls that need to be answered by the introduction of automated messages that inform callers of the geographic scope and expected restoration time, facilitated by more accurate information from smart meters.

International evidence suggests that the number of calls that have to be answered by networks regarding outages can be reduced by up to 60%. Over time customers will develop trust in the ability of networks to detect outages through the functionality provided by smart meters without them calling in to provide notification. This will enable very thin network operator call centre operations.

Ofgem has also provided data collected for its telephony incentives, part of its quality of service incentive regime. DECC has been able to use this information on the total annual number and cost of calls to Network Operators in the UK. For the base scenario we have made a conservative assumption of a reduction of 15%, which results in annual benefits of £0.12 per electricity meter.

The present value gross benefits from a reduction in calls is £29m.

3.4.3.3 Better informed investment decisions for electricity network enforcement

Having more detailed historical information will allow bottlenecks in the network to be identified more easily. Better planning data will result in investment in network reinforcement being better directed. Information received through the ENA cost benefit analysis[44] indicates that the required network enforcement investments might be reduced by 5 % through the availability of better information from smart meters, in particular historical data on power flow and voltage information. We have adopted this assumption for our base scenario. Our analysis uses the expected annual investment requirement figure from the fifth Distribution Price Control Review (DPCR5) as the baseline to reflect the latest information on expected costs from network investment[45]. This baseline investment figure reflects general reinforcement costs, attributable to normal increases in electricity demand from housing[46]. Hence, we do not model any benefits to DNOs from active demand control and real-time network management, and advanced notification to consumers of planned outages.

This results in an estimated £14m benefit in reduced investment expenditure per year, or £119m over the appraisal period.

3.4.3.4 Avoided cost of investigation of customer complaints about voltage quality of supply[47]

With smart meters electricity Network Operators will be able to monitor voltage remotely, removing the need to visit premises to investigate voltage complaints. Information collected by Ofgem indicates the total number of notifications that require a visit to the premises. For the base scenario we have used a cost per visit of £1,000, reflecting a significantly reduced figure of the cost per fault (see outage management benefits). The estimate is based on the costs of resolving a fault to Network Operators, which is on average around £2,400 but will involve locating the issue, which is not the case for voltage investigations. A voltage investigation will generally also not require multiple staff to be dispatched, providing additional reason to discount the fault cost. We assume that such visits would be redundant in the future as voltage can be monitored remotely.

The resulting benefit is £0.14 per electricity meter per year, generating a total present value gross benefit of £39m.

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[44] http://www.energynetworks.org/ena_energyfutures/ENA_HighLevel_SmartMeters_CostBenefitAnalysisV1_100713.pdf

[45] Every five years Ofgem sets price controls for the 14 electricity Distribution Network Operators (DNOs). Price controls both set the total revenues that each DNO can collect from customers and incentivises DNOs to improve their efficiency and quality of service. As part of this process the total volume of investment required over the next price control period is also set.

[46] This figures does not reflect any investment to accommodate significant uptake of electric vehicles and heat pumps; upgrade of existing or new exit points, or new generation connections.

[47] While the benefit of better informed investment decisions is subject to the same assumption of critical mass, the argument can be made that the avoided costs for investigating voltage complaints is not dependent on a critical mass and will be realised for the proportion of premises where a smart meter has been installed. For modelling purposes we have therefore translated the identified benefits from voltage investigation into per meter benefits and linked them to the roll-out profile. This assumes that each household within the system has the same probability of experiencing voltage issues and the same probability of having received a smart meter.

3.4.3.5 Non-quantified DNO benefits

There are also benefits which we are unable to quantify at this stage, but which will result in operational savings to Network Operators and a reduction in outage times. One area of operational savings to Network Operators will arise from the ability to check the energisation status of a meter. This will allow them to check whether a reported loss of supply is due to an issue within the consumer's premise rather than with the network (e.g. a blown fuse). Such an issue would not constitute an outage as defined for regulatory purposes by Ofgem, but might still result in investigation costs for the DNO. With the ability to remotely discern whether power is supplied to a premise, network operators can therefore avoid unnecessary callouts where customer issues are unrelated to the network.

The Programme and the Energy Networks Association (ENA) continue to work to establish whether such benefits can be quantified in the future.

3.4.4 Benefits from electricity load shifting

Smart meters make time-varying and other sophisticated type of tariffs possible by recording the time when electricity is used, and by allowing two-way communications. Such tariffs can incentivise demand-side response (DSR) or load shifting[48], which can potentially bring significant benefits to the electricity system.

There are three main types of tariffs that can incentivise DSR/load shifting:

- Static time of use tariffs (STOU):
  STOU use different prices depending on the time of day in order to incentivise consumers to shift their energy consumption from peak to off-peak times, in doing so flattening the load demand curve. STOU have fixed price structures, which do not vary according to real time network conditions. An example of its simplest expression is the Economy 7 tariff in the UK.
- Dynamic TOU tariffs:
  These offer consumers variable prices depending on network conditions – for example, during a period of plentiful wind, consumers may receive an alert that electricity will be cheaper for the next few hours. This could include critical peak pricing (CPP), where alert of a higher price is given usually one day in advance, for a pre-established number of days a year[49] or a critical peak rebate (CPR), where the consumer is offered a rebate to reduce its energy consumption at peak time.
- Other tariffs could also include automation, for example through remote control of appliances by a third party or programmable appliances, and could be driven by price or non-price factors (such as network conditions). Although automated TOU tariffs may have the largest potential for load shifting, consumers' willingness to use such automated tariffs has not yet been fully tested, while communications requirements and protocols are yet to be fully costed.

We treat benefits from load shifting as distinct from demand reduction, even though some studies have found that time-varying tariffs can lead to demand reduction in addition to shifting (King and Delurey, 2005[50]).

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[48] We here refer equally to DSR and load shifting.
[49] Sustainability First (2010).
[50] King, C and Delurey, D, *Twins, siblings or cousins? Analyzing the conservation effects of demand response programs. Public Utilities Fortnightly*, March 2005.

The approach and underlying assumptions on load shifting remain unchanged from the August 2011 IA. We only consider load shifting from STOU tariffs, even though we recognise that over time some consumers might take up more sophisticated tariffs with the potential to realise larger benefits.

To estimate the benefits from load shifting, we derive the potential load shifting, by assessing (1) the level of uptake of STOU tariffs up to 2030, (2) the potential discretionary load, and (3) the number of times load will actually be shifted.

Based on the international evidence, we expect a 20% take up of STOU tariffs by consumers (in addition to the existing group using Economy 7).

To assess the potential discretionary load, it is possible to disaggregate the components of domestic demand to provide a 'bottom-up' approach of electricity consumption by use type. Of total household demand, 'wet' goods (i.e. washing machine, dishwasher) are expected to provide in the short term the most probable base for load shifting – these account for 17% of household electricity consumption (DECC, 2009[51]). Additionally, those customers with higher than average discretionary consumption at peak time will also be presented with above average incentives for taking up ToU tariffs. It must be noted that some of the existing electric heating storage capacity, which provides discretionary load, is already utilised under Economy 7 tariffs, and therefore we do not account for electric heating storage as part of our bottom up calculation. We therefore estimate the current amount of discretionary load at present to be 20% of total consumption at peak (17% from wet appliances + 3% from above average incentives for those taking up ToU tariffs).

Over time, the introduction of heat pumps with storage capacity and more widespread charging of electric vehicles is likely to increase the total amount of load that can be shifted in the future in conjunction the take up of STOU tariffs which increase in attractiveness. Because these developments are likely to involve development of further policy, in our central scenario we only assume a slight increase (up to 24% by 2030 from 20% originally) in order to accommodate the business as usual (i.e. non-policy related) growth in number of electric cars (DfT, 2008[52]) and heat pumps.

Finally, in the short run, we assume that those customers on STOU will only shift one third of the discretionary load at peak that they actually could. As time goes by, we expect the number of times that load is actually shifted to increase to 50% of the available discretionary load, driven by the consolidation of the behavioural change and customer familiarisation with the technology, and the role of other factors such as higher price differentials and the introduction of some home automation and smart appliances, which would reduce the need for active action by the householder.

This is in line with recent trials' results. The EDRP final report for instance presents two trials that tested the impact of TOU tariffs on electricity consumption. Those trials showed effects on load shifting from the peak period, with bigger shifts at weekends than on weekdays. Estimates of the magnitude of shifting effect vary with trial but were up to 10%.[53] The recent CER report on Irish smart meters trials[54] also found peak reductions of 8.8% due to the combination of different types of demand-side

[51] DECC (2009) 'Energy Consumption in the UK'.
[52] DfT/ BERR (2008) 'Electric Vehicles'.
[53] Neither of the TOU tariff trials involved any automation of energy-consuming appliances to facilitate load shifting.
[54] CER (2011).

interventions and time of use tariffs. The ESMIG study suggest peak shifting of around 5% from TOU, and up to 16% with more sophisticated tariffs[55].

Sensitivities are made on the level of take up at 10% and 40%, and also on the potential discretionary load available to accommodate for higher levels of penetration of electric vehicles, growth in heat pumps with storage capacity and the introduction of smart appliances. These are not considered in our central case in order to avoid claiming benefits from developments which are likely to involve an extra cost over and above the business as usual case. For illustrative purposes we have assessed two scenarios[56] which consider such increases in discretionary load, leading to increases on benefits from load shifting by £135m and £550m respectively over and above the figures presented in the summary sheets of the IA.

The methodology employed for the valuation of benefits from load shifting has not been changed since the August 2011 IA. We value benefits from load shifting in four different areas.

3.4.4.1 Generation short run marginal cost savings from electricity demand shift

Load shifting can create benefits for utilities as on average energy can be generated at a lower cost, producing a resource cost saving to the economy as a whole. A number of studies (Faruqui & Sergici, 2009; Ofgem, 2010; ESMIG, 2011) find that economic savings are possible due to the differential between peak and off-peak costs as generation plants are utilised in ascending order of short run marginal cost. If load is shifted from peak to off-peak periods, a short run marginal cost saving will be realised as a given amount of energy can be generated at a lower average generation cost, minimising production-related costs within the wholesale market by balancing generation and demand in a more cost effective way.

The present value gross benefit of short run marginal cost savings is £111m.

3.4.4.2 Generation capacity investment savings from electricity demand shift

For generation, this would mean a lower required generating plant demand margin (the difference between output usable and forecast demand, i.e. spare capacity), which could be reduced in line with reductions in peak demand reductions.

In the long run, once the existing generation plants have been replaced by new plant capacity, inclusion of both capacity investment savings and short run marginal cost savings would mean double-counting of benefits. However, in the short run (i.e. up to 2030), both benefits from utilising the existing capacity more efficiently and reducing the need for investing in future capacity are realised.

The expected present value benefits are £627m.

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[55] E.g. 12% with Real-time pricing and Critical Peak Rebate and 16% with Critical Peak Pricing.

[56] In the mid scenario the penetration of electric vehicles is based on central projections by DfT (2008), whereas the high case also considers the introduction of smart appliances and heat pumps, based on central cases of market penetration from Kema (2010), DECC (2009), as well as the high case of penetration of electric vehicles (DfT, 2008).

3.4.4.3 Network capacity investment savings from electricity demand shift

Lower peak demand due to the expected uptake of static TOU tariffs also means that long term capacity investment in networks can be reduced, as peak loads will be lower than at business as usual levels. If consumers shift to off-peak consumption some of the investment in capacity will be unnecessary, therefore realising savings to energy utilities. Network savings from energy demand shift are also estimated[57]. For distribution, we use the expected annual investment requirement figure from the DPCR5 as the baseline[58]. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing.[59] Consequently, we do not account for potential additional benefits driven by more responsive demand solutions to minimise the impact of significant penetrations of EV and HP, for which DNOs would require real time data.

The expected present value benefits to network are £42m.

3.4.4.4 Carbon savings from electricity demand shift

Some studies (Sustainability First, 2010; Ofgem, 2010), show that peak load shifting could lead under some scenarios to carbon savings, as the generation mix during the peak period is typically more carbon intensive than off-peak. We assume that overall, peak demand is on average more carbon intensive than off-peak demand, and therefore we present modest savings from the reduced cost of purchasing EU ETS permits to the UK economy arising from an on average less carbon intensive generation mix. Carbon reductions are valued following IAG guidance, with marginal emissions factor differentials between peak and off-peak assumed to be those for coal and gas respectively, at 0.30 and 0.18 kg CO2/ kWh.

The expected present value benefit is £40m.

3.4.5 Carbon related benefits

3.4.5.1Valuing avoided costs of carbon from energy savings

We have valued the avoided costs of carbon from energy savings in line with Government guidance. We also test whether the UK is introducing a cost-effective policy to reduce carbon emissions through the roll-out of smart meters, which is discussed with some more detail in the Carbon Test (section 13.5).

For electricity, reductions in energy use will mean the UK purchasing fewer (or selling more) EU ETS allowances and this saving is assimilated as a benefit. In our analysis it accounts for Present Value (PV) of approximately £402m.

For gas, the value of carbon savings from a reduction in gas consumption uses the non-traded carbon prices under DECC's carbon valuation methodology. This

[57] Annual investment on capacity costs based on a recent Mott MacDonald report (2010) to DECC. Distribution investment figures from Ofgem's Price Control Review 5. Our estimation approach assumes a one-to-one relationship between peak load shifting and distribution benefits. However, Ofgem argues the relationship could be exponential, hence such approach could underestimate benefits (Ofgem, 2010).

[58] Every five years Ofgem sets price controls for the 14 electricity Distribution Network Operators (DNOs). Price controls both set the total revenues that each DNO can collect from customers and incentivises DNOs to improve their efficiency and quality of service. As part of this process the total volume of investment required over the next price control period is also set.

[59] This figures does not any investment to accommodate significant uptake of electric vehicles and heat pumps, nor includes upgrade at or new exit points, or new generation connections.

corresponds to a net reduction in global carbon emissions and corresponds to approximately PV £727m.

3.4.5.2 Reduction in carbon emissions

Over the period covered in the IA, we assume that as a result of a reduction in energy consumption, CO_2 emissions reductions will take place in the traded and non-traded sectors[60]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

Table 3-7: Reductions in CO_2 emissions and energy savings

EU ETS permits savings (Millions of tonnes of CO_2 saved equivalent) – traded sector	Millions of tonnes of CO_2 saved – non-traded	Energy Savings – electricity (£bn, PV)	Energy Savings – gas (£bn, PV)
14.5	15.9	0.4	0.7

3.4.6 Non-quantified benefits

It has been possible to make a quantitative assessment of the benefits described above within the updated modelling for the April 2012 IA. However there remains an important and substantive subset of benefits where the existence of smart metering will facilitate the uptake or management of new services or enable new, smart approaches to energy supply and grid management – especially in the medium to longer term. These remain largely unquantified but are key elements of benefit from the roll-out.

3.4.6.1 Enabling a Smarter Grid

A smart grid can be seen as an electricity power system that intelligently integrates the actions of all users connected to it – generators, suppliers, and those that do both – in order to deliver sustainable, economic, and secure electricity supplies and support the transition to a low carbon economy[61].

Building smarter grids is an incremental process of applying communication technology to deliver more dynamic real time flows of network information and more interaction between suppliers and consumers, helping to deliver electricity more efficiently and reliably from a more complex network of generators than today. Smart meters are a key component in the creation of a UK 'smart grid', providing information to improve network management (subject to data, privacy and access

[60] Note that the impact of a tonne of CO2 abated in the traded (electricity) sector has a different impact to a tonne of CO2 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.

[61] Electricity Networks Strategy Group (ENSG) (2009) 'A Smart Grid Vision' http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/network/smart_grid/smart_grid.aspx

controls), facilitating demand shifting, and supporting distributed and renewable energy generation.

Although potential benefits to GB from a smarter grid are likely to be significant in the long term, it is difficult to estimate these with confidence at this stage. The Government's intention is to better understand opportunities to build smarter grids and to develop further its policy. To that effect, it has started joined up work across a number of teams within DECC which also benefit from inputs from external stakeholders through the Smart Grids Forum[62]. The Programme is actively taking part in this work.

There have been a number of attempts to quantify potential benefits arising from a smarter grid[63]. Accenture has carried out cost benefit analysis of smart grid investments on behalf of DECC and the ENSG (Electricity Networks Strategy Group) and found a positive business case for smart grid investments[64]. Although there is no single smart grid 'solution', the analysis considers one possible 'path', adopting a two phase approach to take into account the considerable uncertainty post 2020. Phase 1 considers the period 2010-2020 and is found to have an NPV of £1.5bn. This involves investments in smart meters on distribution transformers, direct control equipment, smart appliances and IT; benefits arise due to demand response and system optimisation, reduced need for network reinforcements, lower predictive maintenance, distributed generation, and reduced technical losses and customer minutes lost. Phase 2 (2020-2050) is estimated to have an NPV of £2.6bn. This would include investments in substation automation and enhanced communications; benefits are expected from greater use of demand side management (due to higher assumed levels of heat pumps and electric vehicles) as well as from more cost-effective management of distributed energy resources.

The Energy Networks Association (ENA) and Imperial College have estimated the potential network benefits from Smart Meters due to demand side management at between £0.5 - £10bn NPV from 2020 - 2030[65]. Their analysis assumes that meeting the Government's emissions and renewables targets would lead to higher peak loads of up to 92% due to the electrification of transport and heating (electric vehicles and heat pumps) under a business as usual scenario, requiring more investment in network reinforcement infrastructure to accommodate this. By optimising electric vehicle charging and the use of heat pumps and smart appliances (by shifting towards off-peak times), the peak increase would only be 29%. This would bring significant benefits due to reductions in the network reinforcement costs required.

The Smart Grids Forum commissioned in 2011 the development a cost-benefit evaluation framework to explore the value drivers for smart grids against business as usual alternatives. The framework was published in March 2012[66], and has benefited from the input of key stakeholders. The Programme and ENA continue to examine the developments in the evidence base to establish the extent to which the roll-out of smart meters can facilitate or directly deliver smart grid related financial benefits to

[62] The Smart Grids Forum, jointly led by DECC and Ofgem, was set up in 2011 to bring together key opinion formers, experts and stakeholders in the development of GB smart grids to provide strategic input to help shape Ofgem and DECCs policy making and leadership in this area. It should also help provide the network companies with a common focus in addressing future networks challenges.

[63] DECC does not necessarily endorse these, and emphasises the uncertainty surrounding a future smart grid.

[64] http://webarchive.nationalarchives.gov.uk/20100919181607/http:/www.ensg.gov.uk/assets/ensg_smart_grid_wg_smart_grid_vision_final_issue_1.pdf

[65] ENA and Imperial College London (2010) ' Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks.

[66] It is available on the Smart Grid Forum website: http://www.ofgem.gov.uk/Networks/SGF/Pages/SGF.aspx

electricity network operators. The work to quantify these benefits is still underway, so they remain unquantified in this iteration of the Impact Assessment.

Finally, DECC has commissioned Redpoint and Element Energy to carry out benefits analysis of different DSR schemes (static and dynamic tariffs), through smart meters. The outputs of this work are being finalised and findings will be reflected in future work as appropriate.

3.4.6.2 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 therefore drive prices down. Already the market has seen an influx of small suppliers that differentiate themselves through the provision of a smart meter to their customers. 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 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.

While we judge that 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 IA. A competition assessment is included in the Specific Impact Tests section at the end of this document (see section 13.1).

3.4.6.3 Future products

We also expect that the existing home energy management sector to experience strong growth as a result of the roll-out of smart meters. The availability of detailed consumption data will create significant new opportunities to these companies in offering services and products on appliance diagnostics, more refined automation of heating and hot water controls and the analysis of heating patterns.

It has also been suggested that smart metering might contribute to addressing some of the challenges facing the UK's ageing society and that the health system could realise savings through the availability of real time smart meter energy consumption information. Patients requiring care might be enabled to remain in the familiar surroundings of their own home for longer by using tele-care systems and granting family members or carers access to their energy consumption information in real time. This way, if unexpected consumption patterns are detected (for example no increase in energy consumption for cooking at meal times; no changes in level of consumption over extended periods of time) appropriate steps can be taken. By enabling to delay the transfer of patients / elderly into full time care, considerable savings to the healthcare system could result.

4 Results

4.1 Cost, benefit and NPV changes since August 2011

The results below are produced by running a cost benefit estimation model using the assumptions outlined above. Within the model, the upfront costs are annuitised over either the lifetime of the asset or over the period 2012-2030. The cost numbers are risk-adjusted, i.e. they have been adjusted for optimism bias (see section 4.3.1 on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios (see section 4.3.2). Section 4.2.1. shows the impact of smart meters on energy bills of domestic customers[67]. 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 base year of the analysis is 2012. The equipment price base year has also been brought forward to 2012 to reflect moving into calendar year 2012. Equipment cost assumptions are reviewed on an ongoing basis, so the estimates should be considered to reflect current views.

Exogenous values (such as energy and carbon prices) have a base year of 2011, in line with DECC's latest IAG guidance.

Table 4-1: Total costs and benefits

	Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
April 2012 IA	10.85	15.69	4.84
August 2011 IA	11.07	15.97	4.90

Table 4-2: Consumer and supplier benefits

	Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
April 2012 IA	4.43	10.09	1.17	15.69
August 2011 IA	4.63	10.26	1.07	15.97

Table 4-3: Low, central, and high estimates

	Total Costs £bn	**Total Benefits £bn**			**Net Present Value £bn**		
		Low	**Central**	High	Low	**Central**	High
April 2012 IA	10.85	11.25	15.69	20.41	0.419	4.84	9.55
August 2011 IA	11.07	11.47	15.97	20.74	0.426	4.90	9.66

[67] Updated values of the average annual impact per meter are available for the central case in section 4.2.1.

Table 4-4: Benefits

	Consumer Benefits £bn			Business Benefits £bn			UK-wide Benefits £bn		
	L	**C**	H	L	**C**	H	L	**C**	H
April 2012 IA	2.08	4.43	6.69	8.65	10.09	11.9	0.53	1.17	1.83
August 2011 IA	2.19	4.63	6.97	8.80	10.26	12.10	0.48	1.07	1.68

Modelling results show that our central estimates for both costs and benefits have decreased marginally since the last impact assessment in August 2011. Factors contributing to the small reduction in total costs include our updated planning and roll-out profiles (which see a decrease in expected meters to be rolled out in early appraisal years) and the removal of last gasp costs from pre-SMETS2 meters. Total benefits have also decreased marginally, principally due to our updated planning and roll-out profiles. As a result of changes to the total costs and benefits, we project a small decrease in NPV (£64m) relative to the August IA figure.

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, remains constant at 1.4 in central scenarios, with a value of 1.9 in the high scenario and of 1.0 in the low case scenario.

4.2 Distributional impacts

4.2.1 Consumer impacts of smart meters

We expect any costs to energy suppliers to be recovered through higher energy prices, although any benefits to suppliers and networks will also be passed on to consumers[68]. The results below show the average impact on GB 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 results show long term reductions in energy bills for customers. By 2020, once the roll-out is complete, we expect savings on energy bills for the average dual fuel costumer of £25 per annum.

In the short term, transitional and stranding costs from the roll-out will be passed down to consumers, and energy savings will only be realised by those consumers who have already received a smart meter. We estimate that this will result in an average bill increase of £7 by 2015. From 2017 onwards, as most consumers start realising the benefits, and transition and stranding costs decrease, the net impact of smart meters on the average electricity and gas customer will be a reduction in bills. By 2030 we estimate average bill savings will be £40 per household (Table 4-5).

[68] For this analysis we have assumed that suppliers and networks pass 100% of the costs (including stranding costs) and benefits on to consumers due to the pressures of the competitive market and the regulatory regime respectively.

Table 4-5: Impact on average domestic energy bills for a dual fuel customer

	Residential dual fuel bill impact, £
2015	7
2020	-25
2025	-33
2030	-40

The price impacts of smart meters in the domestic sector are detailed in Table 4-6 below. The price impact per unit of energy (i.e. the impact before energy savings are accounted for) is expected to be positive during the mass roll-out period. Once the mass roll-out is complete, cost savings to energy companies arising from the roll-out are expected to outweigh total costs, resulting in the price impact becoming negative from 2023.

Table 4-6: Price impacts on domestic energy bills

	Electricity	**Gas**
Year	**price impact (£/MWh) (Inc VAT)**	**price impact (£/MWh) (Inc VAT)**
2012	0.02	0.01
2013	0.15	0.04
2014	0.56	0.16
2015	**1.91**	**0.54**
2016	2.24	0.62
2017	2.48	0.69
2018	2.02	0.57
2019	0.90	0.26
2020	**0.57**	**0.16**
2021	0.18	0.05
2022	0.04	0.01
2023	-0.15	-0.04
2024	-0.29	-0.09
2025	**-0.34**	**-0.10**
2026	-0.43	-0.13
2027	-0.56	-0.17
2028	-0.70	-0.22
2029	-0.89	-0.27
2030	**-1.04**	**-0.32**

The present bill impacts update the estimates presented in the August 2011 IA. The impact on energy bills of the preferred option in that IA was estimated to be very similar to the results presented here. The projected impact in 2015 remains largely unchanged at £7 (from £6), the average saving in 2020 has increased to £25 (from

£22) and the saving in 2030 has fallen marginally to £40 (from £42). These small changes relative to the August 2011 IA reflect updates of a number of factors, including baseline energy prices, roll-out modelling and cost assumptions.

In order to maintain consistency with the price and bills impacts analysis in previous Impact Assessments, our analysis estimates the impact of the smart meter roll-out on a baseline which includes the impact of policies firmly set before the smart meter roll-out mandate was announced. The bill impacts presented in this IA differ from those presented in the Annual Energy Statement[69], which consider policy impacts on a baseline which includes the impact on consumption and prices of all policies except smart meters. Such an approach gives greater bill saving projections (and lower bill increases in early roll-out years) from smart meters, due to the higher baseline price, so the figures presented above may be understating the benefits seen by consumers.

The approach of considering that cost (and costs savings) to other agents in the energy market are fully passed down to consumers has not changed. In light of competitive and regulatory incentives we assume all costs and cost savings to be passed down to customers. This includes networks (losses, better outage management), generation and transmission (load shifting) and other industry parties (customer switching rationalisation).

Bill impacts on different household types and income groups is not considered explicitly in this analysis. However EDRP trials have showed that those households in areas with a higher propensity for fuel poverty can benefit at least as much as other households.

It is important to note that there may be further impacts on consumer bills for those customers who take advantage of peak/off-peak price differentials offered by smart tariffs and take up time of use tariffs. These distributional impacts have not been included in the calculation above. Analysis by the Brattle Group[70] in the US indicates that low income customers tend to benefit more than average from time-of-use tariffs. No analysis has been done in a UK context, however anecdotal feedback from suppliers is that low income customers on average tend to have flatter usage profiles and hence would benefit from taking up time-of-use tariffs through bill reductions even without changing their consumption patterns.

4.2.2 Stranding costs

Stranding costs are the costs incurred when a meter is taken out of service 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 20-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;

[69] www.decc.gov.uk/en/content/cms/meeting_**energy**/aes/aes.aspx
[70] http://www.brattle.com/_documents/UploadLibrary/Upload936.pdf

- 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;
- 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.

The roll-out of smart meters will result in significant stranding costs. 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 price and bill impacts as in Table 4-5 and Table 4-6 in the above section.

Suppliers can take different approaches and strategies to their roll-out and under some strategies reduce the stranding costs they incur.

If meters that will reach the end of their economic lifetime within the period of the smart meter roll-out are allowed to stay in situ until they would have to be replaced anyway, they incur no stranding. However, to follow this strategy requires a considerable amount of planning. Based on a replacement rate of 5% per year and a roll-out period of 8 years, 40% of meters will reach the end of their lifetime during the roll-out. In order to minimise stranding costs these meters cannot be replaced with a smart meter before they would have to be replaced anyway. This would mean that suppliers could not deploy a strategy where they simply replace all meters in one particular area with smart meters, but would have to return to the area at later points in time to replace meters that have reached the end of their lifetime with smart meters. Whether suppliers see benefit in such a strategy (i.e. where they reduce the costs of stranding but potentially increase the costs of rolling out smart meters), is dependent on their commercial decision making.

For the remaining pool of meters (i.e. those that will definitely incur some stranding because they will have to be replaced under the roll-out before they have reached the end of their lifetime) the order in which they are replaced does not matter. Leaving discounting effects aside, the cumulative stranding of useful economic lifetime in this pool of meters is the same, regardless of whether older meters are replaced first or newer meters are replaced first. For this sub-pool of the meter population it does therefore not matter whether the supplier takes a strategic or a random approach to the replacement.

For the economic evaluation we assume that there is no attempt to minimise stranding costs during the roll-out by avoiding the premature replacement of meters that will reach the end of their lifetime during the roll-out. Once meters that have reached the end of their lifetime in any given year have been replaced, we assume that the age of the meters also replaced in that year is the average age of legacy meters remaining (i.e. includes meters that are replaced prematurely before they have reached the end of their lifetime within the roll-out period). 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.

This potentially overestimates stranding costs since suppliers might have commercial incentives to deploy a more targeted replacement strategy.

4.2.3 Costs to businesses and better regulation

As businesses generally consume higher levels of energy than domestic premises, they stand to benefit proportionately more from the implementation of smart meters. The Programme has carried out an aggregation exercise to determine the net effect of smart meters on businesses across both the domestic and the non-domestic parts of the policy, establishing that the overall impact on businesses is positive, i.e. benefits outweigh the costs. This approach has been agreed with the Better Regulation Executive. While costs to business total £11.5bn in present value terms, business benefits of £12.5bn result in a net present benefit to businesses of £1bn.

As established in the July 2010 version of this IA, there are no significant additional administrative burdens to business from the smart meter policy. Notifying customers of planned visits to install or remove a meter is considered good business practice and helps in ensuring access to the premise, so cannot be seen as a burden to business arising from the roll-out. This methodological approach has previously been agreed with the Better Regulation Executive (BRE).

Similarly, it is good business practice for suppliers to understand their trajectory for delivery of the Programme, and to record numbers of smart meters being installed, their location, IHD uptake and numbers of issues (e.g. refusals, technical problems, disconnections). DECC will require suppliers to provide this information to have confidence that roll-out will occur by the completion date, and to understand what activity is taking place on the ground. Information from suppliers will also provide inputs to refining this Impact Assessment and understanding the costs of the Programme, as well as being able to assess the impact on consumer behaviour and energy savings that are being delivered. As noted in section 8 we will be publishing a Monitoring and Evaluation Strategy in Spring 2012 when we will set out the required information. Requests for information will be managed to ensure that any burden on suppliers is minimised.

There are likely to be some one-off costs to suppliers and the Programme, particularly in developing mechanisms for collecting and interrogating data, but they are expected to be very small in comparison with overall cost figures.

The Programme has taken a number of other policy decisions with a specific view to keeping the cost of implementing the smart meters policy low to businesses. Prior to the establishment of the DCC there will be no targets set with regards to the number of meters that suppliers have to install, allowing them to take decisions based on commercial considerations and without having to fulfil a mandate. Similarly the decision has been taken to give SMEs freedom of choice with regards to participating in the DCC rather than mandating this. Again this will lead to businesses being able to minimise their compliance costs by deciding their preferred approach based on commercial considerations.

4.3 Risks

4.3.1 Costs: Risk Mitigation and Optimism Bias

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 IA, it was acknowledged that more work was needed regarding the treatment of risk to the costs of a GB-wide smart meter roll-out. Baringa Partners[71] 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 2008 IA, and
- Make recommendations, in light of the above.

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA. Table 20 reflects the optimism bias factors applied to this IA:

Table 4-7: Optimism bias factors

	Optimism bias factor
IHD	15%
Smart meter	15%
Outage detection	150%
WAN CAPEX	10%
WAN OPEX	10%
HAN	15%
Installation	10%
Commercial risk	10%
IT CAPEX	10%
IT OPEX	10%

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

In addition new cost uplift factors have been introduced and applied to meters deployed early during the Foundation Stage. These factors are presented in section 2.1.4.1 and discussed in more detail in section 9.

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[72].

4.3.2 Benefits: sensitivity analysis

Sensitivity analysis has been applied to the main elements of the benefits. We apply the following sensitivities to the benefit assumptions:

Table 4-8: Sensitivity analysis for benefits

	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1.5%	2.8%	4.0%
Energy savings gas	1%	2%	3.5%
Energy savings gas PPM	0.3%	0.5%	1.0%
Business benefits			
Supplier benefits			
Avoided site visit	underlying visit cost + 8%	underlying visit cost	underlying visit cost - 8%
Call centre savings	£1.9	£2.2	£2.5
Avoided PPM COS premium	30%	40%	50%
Reduced theft	5%	10%	15%
Network benefits			
Avoided investment from ToU (distribution/transmission)	10%	20%	40%
Reduction in customer minutes lost	2%	10%	15%
Operational savings from fault fixing	2.5%	10%	15%
Better informed enforcement investment decisions	3%	5%	10%
Avoided investigation of voltage complaints	£500	£1,000	£1,493
Reduced outage notification calls	5%	15%	20%
Generation benefits			
Short run marginal cost savings from ToU	10%	20%	40%
Avoided investment from ToU (generation)	10%	20%	40%

It is worth noting that the energy savings affect the total cost for each option due to the energy use by the devices, but the effect is minimal. Table 4-9 presents the results of applying the sensitivity ranges presented in Table 4-8 to each specific benefit assumption.

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

Table 4-9: PV of individual benefit items after sensitivity analysis

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1,382	2,822	4,150
Energy savings gas	663	1,570	2,499
Business benefits			
Supplier benefits			
Avoided site visit	2,826	3,083	3,340
Call centre savings	1,070	1,216	1,369
Avoided PPM COS premium	797	1,063	1,328
Reduced theft	118	236	354
Network benefits			
Avoided investment from ToU (distribution/transmission)	28	42	69
Reduction in customer minutes lost	18	90	135
Operational savings from fault fixing	40	159	239
Better informed enforcement investment decisions	60	119	239
Avoided investigation of voltage complaints	19	39	58
Reduced outage notification calls	10	29	39
Generation benefits			
Short run marginal cost savings from ToU	58	111	215
Avoided investment from ToU (generation)	321	627	1,239

5 Enforcement

All of the options outlined in this IA 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 the power to investigate any company which is found to be breaching the terms of their licence (including any consumer protection provisions) or is found to be acting anti-competitively. The Office of Fair Trading also has a range of other enforcement powers in respect of consumer protection (see the Consumer Protection annex to the Prospectus).

In due course, it is anticipated that governance of SMETS will move to the Smart Energy Code (SEC). The SEC will be a multi-lateral contract, and parties to the SEC will have the right to take action against other parties if they do not meet their obligations under it. The SEC will also contain dispute resolution arrangements, for example on which matters Parties can seek arbitration and which matters are referred to the Authority (Ofgem) for determination. The Government is consulting in further detail on policy issues in respect of the SEC this month, prior to a consultation on a legal draft of the SEC later this year.

6 Recommendation – Next Steps

The licence conditions and SMETS will be notified to the European Commission, in line with requirements of the Technical Standards Directive (98/34/EC). Following completion of the notification process Government intends to lay the licence conditions in Parliament.

7 Implementation

The Implementation approach is described in the Government Response document which was published in March 2011[73].

8 Monitoring and Evaluation

The Government will publish a smart meters Monitoring and Evaluation Consultation and Strategy in Spring 2012, setting out its plans for monitoring and evaluation both during Foundation and mass roll-out stages, and identifying data requirements; where these entail placing new obligations on suppliers we will consult on these. The development of the Strategy is still ongoing; this section gives a high-level overview of our approach. See also section 12 on plans for a Post Implementation Review (PIR).

The Programme needs to collect monitoring and other information for a range of purposes:

- To understand whether the Programme is being implemented effectively, whether its objectives are being met and what its economic impacts are;
- To monitor suppliers' progress against their regulatory obligations and thereby ensure DECC and Ofgem can have confidence that roll-out is proceeding as planned and that the completion date will be met;
- To provide stakeholders with timely information and meet commitments with regard to progress and cost and benefit reporting;

[73] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx

- To meet central requirements for performance and benefits management, evaluation and post-implementation review.

It is expected that a range of types of information and data will be required, including:

- Data about smart meter installations, collected by suppliers
- Reports on plans for roll-out and progress to date
- Data relating to costs and benefits attributable to the SMIP collected from suppliers (and potentially in future the DCC)
- Other smart meter-related data collected by DECC, including customer surveys and linking to other Government datasets
- Wider data sources e.g. as collected by Ofgem but used to inform our monitoring and evaluation

We expect to consult on proposals for collecting data in at least the first two categories using information-gathering powers in Section 88 of the 2011 Energy Act. Results from piloting schemes and trialling are also expected to inform the monitoring and evaluation of the roll-out. This includes both previous pilots such as the EDRP, and piloting and trialling carried out during the Foundation Stage.

Monitoring results will be published as follows:

- Annual progress reports, covering the monitoring of installations, plans for roll-out and reporting on costs and benefits
- Any more frequent reporting it is decided is appropriate in the light of consultation e.g. on numbers of installations, access rates, customer experience and benefits etc.
- Evaluation reports, including the results of an early roll-out review in Q3 2013. See section 12for more information on plans for Post-Implementation Review

9 Annex 1 – Treatment of early meters

The below table sets out in detail the considerations that have been used to generate the cost allowances that are applied to early meters as set out in section 2.1.4.

Classification of likelihoods and resulting probabilities:

- Low – less than 10% likelihood (central value of 5% probability)
- Low / Medium – 10-20% likelihood (central value of 15% probability)
- Medium – over 20-30% likelihood (central value of 25% probability)
- Medium / High – 30-40% likelihood (central value of 35% probability)
- High – 40% or higher likelihood (central value of 70% probability)

Table 9-1: Treatment of risk from meters compliant with initial SMETS

Risk type	Risk	Worst case cost impact per meter	Risk mitigation factors	Risk conclusion	Cost increase factor
Interoperability risk 1	Costs upon change of supplier (incoming supplier might not be able / willing to support meter and therefore not willing to pay a higher rent than for a basic meter but prefer to replace meter). Might alternatively materialise in commercial arrangement between suppliers and potentially higher opex.	100% increase in capex cost if the risk materialises. Additional meter installation, involving new capex for smart meter, IHD, communications hub and installation	Commercial incentives: initial SMETS owner has incentives to offer attractive terms to gaining suppliers which avoid stranding of asset. Policy based: - mandate of HAN based on open standard - encourage commercial interoperability and commercial arrangements upon COS (e.g. interoperability framework by Ofgem) Market structure: 60% of electricity and 59% of gas customers have currently never been subject to COS[74].	Mitigating factors are significant. Mitigating policy mechanisms are also in place or under development. A likelihood of **low / medium** is therefore assumed.	15% probability 100% cost impact **15% uplift to:** **- Communications capex** **- Meter capex** **- IHD capex** **- Installation cost**
Interoperability risk 2[75]	Double communications hub / IHD for single fuel installations	100% increase in IHD and communications hub (one additional IHD and communications hub for every non-dual fuel household).	Commercial incentives: Dual fuel installation efficiency (i.e. two meters installed with one visit) Policy based:	It is likely that the early focus will be on dual fuel. Commercial incentives make it unlikely that early single fuel installations will	15% probability 100% cost impact **15% uplift to:** **- IHD capex**

[74] A 2011 Ipsos Mori Omnibus survey indicates that only 41% of gas and 40% of electricity consumers have switched supplier at least once: http://www.ofgem.gov.uk/Markets/RetMkts/rmr/Documents1/IpsosMori_switching_omnibus_2011.pdf .
[75] This risk uplift is not applied to the non-domestic modelling as for the SME sector it is already assumed that all single fuel installations will result in a double IHD and communications hub.

			- mandate of HAN based on open standard Market structure: Only around 40% of households receive their gas and electricity from different suppliers	reach or exceed current rates. Commercial drivers reduce the likelihood of this risk materialising, which is therefore assumed to be **low / medium**.	**- Communications capex**
DCC risk[76]	Early meters result in cost increase once DCC is in place[77]	The worst case cost impact would be created by having to replace the communications hub of an early meter as DCC goes live in 2014; a communications opex increase is however more likely to materialise. The additional capex of a communications hub replacement has been translated into an increase of communications opex. The equivalent cost uplift is about 200% of communications opex[78].	Commercial incentives: - suppliers have incentive to work towards integration into DCC for cost certainty, full functionality and to avoid risk of stranding upon COS - drive for commercial interoperability could result in convergence to single pre-DCC communications provider Policy based: - fully integrated meters are disallowed - WAN based on open standard to enable easy integration into DCC - adoption criteria and DCC charging regime	In light of the fact that early movers have a commercial incentive to try to facilitate DCC integration and that the modelled cost increase is a very extreme outcome a **low / medium** risk is assumed.	15% probability 200% cost impact **30% uplift to:** **- Communications opex**

[76] For the application of this risk in the non-domestic sector it is taken into account that a proportion of meters elect to operate outside of the DCC, i.e. potential cost increases from integration into DCC would not apply to those.
[77] This is not a risk specific to the staged Foundation approach and has been recognised in earlier IAs – pre-DCC meters had a number of cost escalation allowances built in.
[78] In reality an increase in communications opex is more likely to materialise, but the communications hub replacement presents the ceiling in terms of potential cost increases. If the communications opex increase over the rest of the lifetime exceeded the costs of replacing the communications hub, suppliers would have a commercial incentive to replace.

TOTAL	Cost uplifts - communications capex: 30% (increasing the current cost assumption by £7.40 from £24.6 to £32.0) - communications opex: 30% (increasing the current cost assumption by £1.6 from £5.3 to £6.9 per year) - meter capex: 15% (increasing the current cost assumption by £15.5 from £99 to £114.5 between gas and electricity meter) - IHD capex: 30% (increasing the current cost assumption by £4.5 from £15 to £19.5) - installation cost: 15% (increasing the current cost assumption by £10.2 from £68 to £78.2)				

10 Annex 2 – Changes made to base assumptions

The table below sets out changes that have been made to the base assumptions on costs and benefits since the August 2011 IA. The basis for the change is also identified. As mentioned below, the revisions are either exogenous or refinement of the model.

Item	Assumptions	Rationale for changes
Energy prices	Electricity prices projections have been revised downward, while the impact on gas prices is mixed, as per IAG Guidance, which reflects updated fossil fuel price assumptions and some methodological changes.	These exogenous assumptions have been updated following latest IAG Guidance tables (October 2011).
Carbon prices	Carbon price projections have been revised upwards, as per IAG Guidance.	These exogenous assumptions have been updated following latest IAG Guidance tables (October 2011).
Emission factors	Emissions factor projections have been revised downward, as per IAG Guidance reflecting more efficient generation plants assumptions.	These exogenous assumptions have been updated following latest IAG Guidance tables (October 2011).
Energy demand baseline	Domestic energy demand baseline has been revised downward. This reflects downward overall demand projections, as per DECC updated emissions projections (UEP)[79] as well as slower households' growth, as per OBR[80] forecasts.	These exogenous assumptions have been updated as per latest available UEP (October 2011) and OBR latest forecasts.
Change in PV base year to 2012	One year of discounting costs and benefits has been removed.	This reflects moving into calendar year 2012
New Programme planning and updated roll-out assumptions	New assumptions regarding Programme milestones and early installation behaviour.	New evidence
Treatment of early meters	Cost uplifts applied to meters installed during early Foundation stage to reflect uncertainty.	To reflect staged approach to specification of SMETS.

[79] This is due to lower economic growth assumptions, changes in the impact of some policies, as well as some methodological changes
[80] Office for Budget Responsibility.

11 Annex 3 – Detailed results

Below are the detailed results from the model (in £million) for the central case scenario:

Total Costs		**10,850**
In premise costs		7,243
	Meters & IHDs	3,846
	Installation of meters	1,577
	Operation and maintanance of meters	675
	Communications equipment in premise	1,146
DCC related costs		1,686
	Data services and internal capex	97
	Data services and internal opex	278
	Communications service charge	1,312
Suppliers' and other participants' system costs		688
	Supplier capex	300
	Supplier opex	228
	Industry capex	74
	Industry opex	85
Other costs		1,233
	Energy	708
	Disposal	12
	Pavement reading inefficiency	220
	Industry Set Up	205
	Marketing	87
NPV		***4,840***
	(Stranding costs	704)

Total Benefits		**15,689**
Consumer benefits		4,427
	Energy saving	4,391
	Microgeneration	36
Business benefits	Supplier benefits	8,471
	Avoided site visits	3,083
	Inbound enquiries	1,036
	Customer service overheads	180
	Debt handling	1,044
	Avoided PPM COS premium	1,063
	Remote (dis)connection	237
	Reduced theft	236
	Customer switching	1,594
	Network benefits	884
	Reduced losses	405
	Avoided investment from ToU (distribution/transmission)	42
	Reduction in customer minutes lost	90
	Operational savings from fault fixing	159
	Better informed enforcement investment decisions	119
	Avoided investigation of voltage complaints	39
	Reduced outage notification calls	29
	Generation benefits	738
	Short run marginal cost savings from ToU	111
	Avoided investment from ToU (generation)	627
UK-wide benefits		1,169
	Global CO2 reduction	727
	EU ETS from energy reduction	402
	EU ETS from ToU	40

12 Annex 4 – Post Implementation Review (PIR) Plan

Basis of the review: The Department of Energy and Climate Change will ensure that the Smart Metering Implementation Programme is subject to a comprehensive and integrated review and evaluation process, both during the initial Foundation Stage and towards the end of the main roll-out – provisionally by 2018. The Secretary of State has powers that have been extended until the end of 2018 for introducing regulatory requirements on suppliers regarding the roll-out of smart meters. This process will ensure evidence is available to help DECC maximise the benefits of the Programme and report on outcomes.

There are planned to be two key review milestones:

1. A review of the roll-out strategy to establish whether any additional action should be taken, for example, further requirements should be placed on suppliers with regard to local coordination (the review of early roll-out)

2. A Post Implementation Review (provisionally by 2018)

Review objective: The review of early roll-out objective will be to identify whether suppliers' approaches to roll-out are meeting the Government's overall objective to roll out smart meters in a cost-effective way, which optimises the benefits to consumers, suppliers and other parties and delivers environmental and other policy goals.

The PIR which will be carried out by DECC will take a broad perspective on the results of Government intervention and the results of the approaches taken to policy and benefits realisation, in order to feed back into the policy making process.

Review approach and rationale: The review of early roll-out will consider the impacts of installations of smart meters on consumers, in particular in respect of the quality of the customer experience and the effectiveness of different approaches.

The PIR will include evaluation of the impacts of smart metering on customer service benefits (e.g. ease of switching, availability and uptake of smart-enabled products and services), on industry costs and process simplification, on the availability and uptake of energy management products and services, and of the way that smart metering is enabling and supporting other policies e.g. the Green Deal, as well as the evaluation of the impacts on energy consumption and customer experience of the roll-out. The PIR has yet to be designed but is likely to draw on a range of evidence and our precise approach to gathering data and evidence will be set out in our Smart Meters Monitoring and Evaluation Strategy to be published in the Spring.

Monitoring information arrangements:

See section 8 and the forthcoming Monitoring and Evaluation Strategy for this information.

13 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	Yes
6. Other Environment	No	Yes
7. Health	No	Yes
8. Equality IA (race, disability and gender assessments)	No	Yes
9. Human Rights	No	Yes
10. Privacy and data	No	Yes
11. Rural Proofing	No	Yes

13.1 Competition assessment

Consumers

From a consumer point of view 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 facilitate faster switching, encouraging consumers to seek out better deals, thereby driving prices down.

In addition the improved availability (subject to appropriate privacy controls) 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 IA it is important that consideration of the pro-competitive aspects 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 response) and smart homes
- meter ownership, provision and maintenance;
- other meter support services;
- gas and electricity network services;
- communications services.

In competition terms the roll-out would therefore affect:

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

The competition impact of the Data Communications Company (DCC).

There is an impact on competition through the establishment of the DCC.

DCC will be responsible for managing the procurement and contract management of data and communications services that will underpin the smart metering system. All domestic suppliers will be obliged to use the DCC.

DCC will be a new licensed entity, which is granted an exclusive licence, through a competitive tender process for a fixed term. In effect the DCC would secure the communications services for a fixed period of time. Ofgem will be able to exert direct regulatory control over it to ensure that it applies its charging methodology in line with its licence obligations as well as regulating the quality and service levels delivered by the DCC.

Competition will be maximised within the model by re-tendering for services on a frequent basis, but a balance will need to be struck to take account of the length of contract needed to achieve efficiencies.

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.

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 (i.e. equipment and installers), small suppliers might feel a greater cost impact than larger suppliers due to the relative size of the increased costs in proportion to the size of the business. However, some of this may be mitigated by the more flexible approach for roll-out to be applied to small suppliers.

13.2 Small Firms

Impacts on small business consumers are considered in the IAs 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 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 (i.e. equipment and installers), small suppliers might feel a greater cost impact than larger suppliers due to the relative size of the increased costs in proportion to the size of the business. However, some of this may be mitigated by the more flexible approach for roll-out to be applied to small suppliers.

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. Decisions on the role of DCC and data protection and access arrangements will need to promote a level playing field for small firms.

13.3 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.

13.4 Sustainable Development

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

Smart metering will provide consumers with the tools with which to manage their energy consumption, enabling them to access innovative solutions and incentives to support energy efficiency and take greater personal responsibility for the environmental impacts of their own behaviour. This will be supported by the Consumer Engagement Strategy which is being consulted on alongside this document.

The roll-out can also contribute to the enhanced management and exploitation of renewable energy resources, for example by helping to facilitate the introduction of smart demand-side management approaches such as time-of-use (TOU) and dynamic tariffs which enable the more effective exploitation of renewable energy. 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 IA) 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.

13.5 Carbon assessment

Following DECC guidance[81], we have carried out cost effectiveness analysis of the 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 CO_2 abated in the traded sector has a different impact to a tonne of CO_2 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 CO_2 separately:

Cost-effectiveness (traded sector) = (PV costs – PV non- CO_2 benefits – PV traded carbon savings)/tonnes of CO_2 saved in the traded sector

Cost-effectiveness (non-traded sector) = (PV costs – PV non- CO_2 benefits – PV non-traded carbon savings)/tonnes of CO_2 saved in the non-traded sector

The table below presents the present value of costs and non- CO_2 benefits as well as the tonnes of CO_2 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 CO_2 saving of the policy (cost-effectiveness) is higher than the TPC/NTPC the policy is non-cost effective.

Table 13-1: Cost effectiveness

PV costs	PV Non-CO_2benefits (£million)	EU ETS permits savings (Millions of tonnes of CO2 saved equivalent)	Millions of tonnes of CO_2 saved – non-traded sector	Traded sector cost comparator	Cost-effectiveness – traded sector	Non-traded sector cost comparator	Cost-effectiveness – non-traded sector
10,850	14,520	14.5	15.9	27.6	-285	44.1	-276

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

Table 13-1 shows how the roll-out will save 14.4 million of tonnes of CO_2 equivalent in the traded sector and 15.9 million tonnes of CO_2 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 CO_2 of abating emissions (cost-effectiveness) is lower than the cost comparator for both the traded and non-traded sector.

13.6 Other Environment

The 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 will 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, and a display 0.6 W and the communication equipment 1 W. 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.

13.7 Health

There are a number of positive health impacts from the roll-out of smart meters. In particular, smart meters enable suppliers to target energy efficiency measures more effectively and encourage customers to take such measures. These measures in turn confer health benefits to individuals – particularly vulnerable individuals – deriving from greater thermal comfort. Smart meters could also, with appropriate privacy arrangements, provide a basis for using tele-care systems or for giving carers access to real-time consumption information.

Many of the benefits of smart metering are underpinned by the ability to access the meter remotely and to provide customers with real time data on their gas and electricity consumption. In the home or premises the system will comprise various elements including a wide area communication module to provide communications to the DCC and a home area system linking devices within the home or premises to the smart metering system (including the in-home display).

However, we recognise that there will be some customers who will have concerns about receiving a meter. At this stage communications technology solutions have not been selected for the smart metering system. Both wired and wireless technologies exist that could be used and, for practical and technical reasons, both will need to be utilised by installers during the roll-out. Where telecommunications technologies are used in deploying smart meters they will have to comply with relevant regulations and international standards as set out by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Compliance with these standards will be a functional requirement of the smart metering equipment and using smart metering equipment that meets the functional requirements will be a licence obligation.

As the Programme develops, we will be considering further – together with the Department of Health, the Health Protection Agency and the energy companies - how best to respond to individual concerns.

13.8 Human Rights

The smart meter roll-out may engage the following rights under the European Convention on Human 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 licences, and current meter owners' and providers' possessions. DECC's view is that any interference would be in the general interest and proportionate to the benefits that this policy would accrue.

In addition, Article 1, Protocol 1 may be engaged by provisions which may be included in the new type of licence which allow for transfers of particular types of property between successive holders of a licence of that type. This could amount to a deprivation of property. DECC's view is that any interference would be in the general interest and proportionate to the benefits that this policy would accrue.

Article 8 will be engaged because smart technology is capable of recording greater information about a consumer's energy use in his property than existing dumb meters. A framework of rules concerning data privacy and the rights of the consumer is being consulted on and Government will need to continue to be satisfied that any interference with privacy is justified, proportionate and necessary, in accordance with Article 8.

In addition, to roll out smart meters, installers will have to enter consumers' property. In the context of the obligations placed on suppliers to install meters Government is satisfied that any interference is necessary, justified and proportionate.

Ofgem is responsible for enforcing the conditions of gas and electricity supply licences (and the new smart metering licence). 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 new licences under the Electricity and Gas Acts in relation to the smart metering activity. Government is developing a competitive process for the awards of those licences. The Government's view is that the new process will be compliant with Article 6.

13.9 Equality IA (EIA)

Introduction

The Government is subject to the public sector Equality Duty, which is set out in Section 149 of the Equality Act 2010 and came into force across Great Britain on 5

April 2011. The Act brings together all previous equality legislation in England, Scotland and Wales. The Equality Duty replaced the separate duties relating to race, disability and gender equality. It requires public bodies to consider all individuals when carrying out their day to day work – in shaping policy, in delivering services and in relation to their own employees. It requires public bodies to have due regard to the need to eliminate discrimination, advance equality of opportunity, and foster good relations between different people when carrying out their activities.

The protected characteristics covered by the Equality Duty are:

- age
- disability
- gender reassignment
- marriage and civil partnership (but only in respect of eliminating unlawful discrimination)
- pregnancy and maternity
- race – this includes ethnic or national origins, colour or nationality
- religion or belief – this includes lack of belief
- sex
- sexual orientation

This EIA sets out evidence gathered to date and the potential equality issues identified; and explains how issues will be addressed by existing and new measures.

Assessing the impact of the policy

The 2008 IA recognised that a domestic roll-out of smart meters could 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 bodies confirmed that there was a range of potential consumer-related impacts. Some of these could affect customers covered by the Equality Duty.

Before and following publication of the Smart Metering Prospectus in July 2010, the Programme therefore explored these aspects of consumer impacts with interested parties, in particular, the Consumer Advisory Group, established to provide input to the Programme, and Ofgem's standing Disability Advisory Group. Consultation also included a workshop involving a wide range of stakeholders held by DECC in November 2011 to examine the particular needs of vulnerable consumers and how these should be addressed.

This work, together with responses to the Prospectus and earlier consultations, has identified the following as the main areas of concern relevant to the protected characteristics under the Act:

- physical design and location of the smart meter/visual display and its usability for certain consumers, particularly those with limited mobility, impaired dexterity, visual impairment, memory and learning disabilities, and perception and attention impairments;
- provision of information to consumers, including advice and support needed to use and understand the information provided by the IHD;
- potential impact on certain vulnerable consumers of smart meter installations, which will require entry to all homes;

- potential for the functionality of the metering system to be used in such a way that it would have a disproportionate impact on particular consumers (e.g. potential supplier abuse of remote disconnection facilities); and
- potential for consumer confusion as a result of the greater amount energy-related information from smart metering and of the possibility of more complex energy tariffs.

In respect of the Equality Duty, and of those it is designed to protect and assist, the policy's greatest potential impact would be upon those with disabilities relating to sight, mobility, dexterity or mental health as well as the elderly. Discussions with interested parties have led to a compelling case for ensuring that:

- design and meter/display location are suitable for all (whether by inclusive or tailored design)
- risks to vulnerable consumers in relation to installations are minimised;
- consumers are well-informed both before and after installation;
- strong protections are put in place to avoid vulnerable customers being remotely disconnected or switched to pre-payment tariffs when it is not safe and practical to do so;
- long term issues relating to the consumer engagement in the market and complexity of tariffs are addressed.

Legal and regulatory responsibilities of suppliers
Suppliers will be required to taking all reasonable steps to ensure smart metering systems are installed and to offer an In-Home Display (see below) to the consumer. Energy suppliers are subject to Section 29 of the Equality Act 2010. This places a duty on suppliers of services to make reasonable adjustments to ensure that a disabled person is not put at substantial disadvantage in comparison with a non-disabled person. In particular, the Act requires that where a disabled person would be put at a disadvantage by physical equipment, that reasonable steps are taken to avoid that disadvantage, or to provide an auxiliary aid if this would avoid putting someone at a disadvantage. There is also a requirement that information is provided in an accessible format where to not do so would put a disabled person at a disadvantage.

A number of specific regulatory requirements are either in place or being put into place to protect customers with protected characteristics, including those discussed below in relation to the specific issues raised by the smart meter roll-out.

A. Providing consumers with information from smart meters
Provision of clear and simple information to a range of consumers is essential for realising smart metering benefits. It is primarily through availability of better information about energy use and energy efficiency measures and availability of new products and services that customers can optimise energy use.

Information on energy use will be available through a free-standing, In-Home Display (IHD) linked to the smart meter. Information will also be accessible through a consumer access port attached to the meter, which will enable provision of other display options that may be better suited to customers with disabilities. However, it is expected most consumers will access their information through a the standard IHD. The IHD must, therefore, be usable by a wide range of customers (unless the customer chooses to receive information by other means). There are two potential equality issues with the IHD:

- its location will need to take account of particular consumer circumstances. For example, consumers who are wheelchair-users will need the IHD to be located at an appropriate height for them to view it;
- consumers are likely, to a greater or lesser extent, to need to interact with the display, rather than simply view it. The IHD should, therefore, be suitable for use by the visually impaired, those with learning disabilities, the hearing impaired or those with particular dexterity or movement issues.

The Programme therefore recognises that, for the IHD to be effective, it must be physically accessible. The Prospectus indicated that the Programme did not consider it appropriate to mandate detailed requirements in this area. It noted that, if minimum requirements in respect of portability were set within the functional specification, all IHDs would have to be able to receive power from a non-mains source. This would, in turn, lead to the need to provide IHDs with rechargeable or non-rechargeable batteries. The Programme estimated that non-rechargeable batteries would have to be replaced every twelve months, leading to higher consumer and environmental costs. It received further evidence that requiring use of rechargeable batteries would add c£135 million to roll-out costs.

The Programme did not, therefore, consider, in light of this evidence and the lack of countervailing evidence on benefits, that portability should be set as a minimum requirement. However, it sought views on whether there was a case for a licence obligation on suppliers to provide those consumers with special requirements with an appropriately designed IHD and/or best practice to be identified and shared once suppliers started to roll out meters and IHDs.

Suppliers and manufacturers responding to the Government's smart meter prospectus considered that Standard Licence Condition 26 and the Equality Act 2010 were sufficient to ensure that IHDs were accessible to all. However, other respondents argued for the adoption of a principle that all IHDs should meet "inclusive" design standards (clearly marked, large screen and font size, large and tactile buttons, feedback in plain English etc). These respondents suggested that this approach would benefit millions of consumers who might not identify themselves as disabled, or having special needs. The needs of such consumers would therefore not necessarily be met by compliance with the Equality Act or other legislation.

In light of the responses to the consultation, the Programme concluded that obligations should be put in place to ensure accessibility. These should include the requirement that the display be designed to enable the information displayed on it to be easily accessed and easy to understand including by consumers with impaired sight; memory and learning ability; perception and attention; or dexterity.

Consumer Focus, working with suppliers, is developing best practice guidelines for suppliers on how to ensure that IHDs are designed to be inclusive. This will assist suppliers in meeting the requirements of the technical specification.

The Gas Act 1986 and the Electricity Act 1989 prohibit suppliers from charging a disabled customer for altering the position of meter or replacing a meter with one specifically adapted to meet needs of a disabled person. The Programme is currently considering what amendments might be required in the regulatory framework as a consequence of the roll-out of smart meters, which will include an assessment of equivalent access to information.

B. Smart meter installation: protecting customers

Suppliers have primary responsibility for delivering the roll-out and ensuring both that the consumer experience of smart meter installation is positive; and that consumers are given appropriate advice, tailored to their needs. While the installation visit provides an important opportunity to promote energy saving behaviour, consumers must be protected from unwelcome sales and marketing at home. To promote a good standard of service by suppliers and to safeguard consumers' interests the Government is putting in place licence conditions that will require suppliers to develop, seek approval for, and work in line with an installation Code of Practice. This includes rules on sales and marketing activities associated with the installation visit, as well as the provision of advice on the smart metering system and energy efficiency measures. It requires suppliers to identify and meet the needs of vulnerable consumers, including those who are of pensionable age, disabled or chronically sick. Compliance with this Code of Practice, which is currently being developed by suppliers in consultation with interested parties, including consumer groups, will be a licence requirement. The Code of Practice itself, and any subsequent changes to it, will have to be approved by Ofgem. A consultation on the licence conditions underpinning a Code of Practice was issued in August 2011 and the Government is publishing its response, including revised draft licence conditions, alongside this document.

Stakeholders have highlighted the need to ensure that all consumers and particularly those with mobility, learning, mental health and other conditions, in addition to the elderly are protected from criminals seeking to capitalise on the roll-out. Protections are already in place to address this risk. The Electricity Act 1989, Schedule 6 and the Gas Act 1986, Schedule 2B provide the key protections on access to property for maintenance, installation and disconnection. Specifically, for electricity, Schedule 6, paragraph 7 (5) covers a required notice period to be given to the occupier (2 days) prior to entry and paragraph 10 (4) states that a person may only exercise power of entry on production of some duly authenticated document showing his authority. There are similar requirements in paragraphs 24 and 26 of Schedule 2B for gas which require 24 hours notice to be given and the production of authenticated documentation. 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." Supply Licence condition 26.4 further requires suppliers to establish a 'Priority Service Register' that lists all domestic consumers who are of pensionable age, disabled or have chronic health conditions. However although the licence condition requires suppliers to establish a register, customers need to register to be included. It may therefore not cover all vulnerable customers. Once added to the Register, the consumer must be given free of charge advice and information on the services available described in supply licence condition 26. In operating Registers suppliers use a "social model", under which the individual customer (or the customer's representative) is able to set out his/her special needs. The customer may be required to provide evidence of those needs.

It will be important for suppliers to liaise closely with local authorities and police to seek to minimise the risk of distraction burglary on the back of the roll-out.

C. Smart metering roll-out: informing and supporting customers

A key element of the successful roll-out of smart meters will be clear information and support to enable all consumers to understand and act on the information provided by the smart meter. Suppliers, guided by the Installation Code of Practice, will have a key role in ensuring that the needs of vulnerable consumers for clear information and advice are met.

Supplier information and advice to their customers will be need to be supported by centrally managed engagement action to ensure that consistent messages and other interventions are provided to consumers to promote acceptance of smart meters and to meet the needs of vulnerable consumers. The consultation on the smart meters Consumer Engagement Strategy, published alongside this document, sets out in detail the Programme's current understanding of the characteristics that could make some consumers vulnerable to additional barriers to realising the benefits of smart meter installation. The Strategy includes proposals for co-ordinated consumer engagement delivered by a central body on behalf of suppliers. It proposes co-ordination of activities by third parties in disseminating messages and building trust. It notes that the involvement of such organisations is particularly important for vulnerable and low income consumers, who are often "hard to reach" as well as being most likely to be in, or at risk of, fuel poverty.

D. Early roll-out: protecting vulnerable consumers from remote disconnection and switching to pre-payment mode

Some suppliers are already providing smart meters at their own commercial risk before finalisation of a technical specification and the introduction of a Government mandate. In February 2011, Ofgem proposed a "Spring Package"[82] of measures to deal with any problems for customers that could arise from the activities of these "early movers". In particular, it proposed additional safeguards in cases where supply might remotely be disconnected and where a customer might be remotely switched from credit to pre-payment when it is not safe or practicable for the consumer. Licence modifications and accompanying guidance came into effect on 1 October 2011 address this, requiring suppliers to take rigorous action in identifying vulnerability in a household when considering pre-payment or disconnection.

E: Future market changes: consumer engagement and addressing market complexity

In its Retail Market Review, Ofgem consulted on proposals to enhance consumer engagement in the energy market, which included proposals to simplify tariffs. Ofgem recognise the need to examine in the future the interaction between their proposals and the introduction of new innovative ToU tariffs that are expected to become increasingly prevalent with the roll-out of smart meters.

13.10 Data and Privacy

Smart metering will result in a step change in the amount of data available from electricity and gas meters. This will in principle enable energy consumption to be analysed in more detail (e.g. half-hourly) and to be 'read' more frequently (e.g. daily, weekly or monthly) by suppliers. This will allow consumers to view their consumption history and compare usage over different periods (e.g. through the IHD or internet applications). We believe it is essential consumers can readily access the information available from their meters. They should be free to share this information with third parties, should they choose to, for example to seek tailored advice on energy efficiency or to consider which supplier or tariff is best for them.

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82 http://www.ofgem.gov.uk/Sustainability/SocAction/Publications/Documents1/Smart%20Metering%20Spring%20Package%20-%20Addressing%20Consumer%20Protection%20Issues.pdf.

The frequency with which meters are read and the level of detail of data to be extracted is likely to vary according to the mode of operation (i.e. pre-payment or credit) and the type of tariff the customer has chosen. For example, as now, suppliers will need regular meter readings to provide accurate bills. For many credit customers, meter readings every month or so are likely to be sufficient for billing. Where suppliers offer innovative tariffs, such as those based on time of use, they are likely to seek access to more detailed consumption information.

The availability of data to suppliers, particularly at a half-hourly level, raises some potential privacy issues. Energy consumption data may be considered to be personal data where a living individual can be identified from the data itself or from the data and other information in the possession of the person, e.g. address details. In this case energy consumption data will be personal data for the purposes of the Data Protection Act 1998 regardless of whether the data is from a conventional, pre-payment or smart meter.

The Programme is taking a rigorous and systematic approach to assessing and managing the important issue of data privacy. In the Prospectus we committed to 'privacy by design', to ensure that privacy issues are considered and embedded into the design of the system from the start, rather than afterwards.

We have also committed to the principle that consumers should have a choice about how their data is used and by whom ,except where it required to fulfil regulated duties.
The Programme is publishing policy proposals on privacy and data access for consultation alongside this document.

Ensuring there is appropriate security of the smart metering system is key to realising a privacy by design approach. The Programme has developed a set of technical and non-technical security requirements to facilitate this approach.

13.11 Rural proofing

The obligations on energy suppliers to take all reasonable steps to install smart meters for all their domestic and smaller non-domestic customers by the completion date in 2019 will apply equally to customers in rural areas as to others. A key criterion for selection of the Data and Communication Company will be the ability of the bidders to meet the target of delivering communications to smart meters at all domestic gas and electricity consumer premises regardless of location. Many rural customers, though not served by the gas-grid, will receive an electricity smart meter and an IHD.

Smart meters will address the problems attached to "difficult to read" meters, which may at present lead to those in rural areas receiving fewer actual meter readings and estimated bills. The scope for introducing different payment methods for smart pre-payment meters would assist those in rural areas who find access to key-charging outlets 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 reach" dwellings.