Title: **Smart meter roll-out for the non-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/Laura Platchkov (0300 068 6325/5900)

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 GB non-domestic 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.

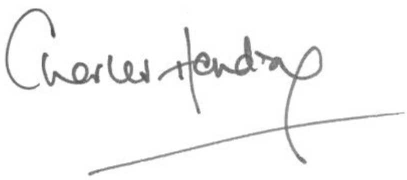
What policy options have been considered? Please justify preferred option (further details in Evidence Base)

This policy focuses on the mandated replacement of 3.6 m non residential gas and electricity meters in GB through a supplier-led roll-out in the non-domestic sector. The March 2011 Impact Assessment set out the overall approach and timeline for achieving this objective. The August 2011 Impact Assessment considered a range of options to define the smart metering technical equipment in the premise. This Impact Assessment 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 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/057

Summary: Analysis and Evidence

Price Base Year 2011	PV Base Year 2012	Time Period Years 19	Net Benefit (Present Value (PV) (£m)		
			Low: 1,494	High: 3,177	**Best Estimate: 2,338**

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	7		45	**608**

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

Metering equipment costs and its installation and operation amounts to £394m. Communications equipment costs amount to £190m. Disposal, energy and pavement reading inefficiency costs amount to £24m.

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		153	2,104
High	0		276	3,784
Best Estimate	0		215	**2,946**

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

Total consumer benefits amount to £1.76bn and include savings from reduced energy consumption (£1.75bn), and microgeneration (£7m). Total supplier benefits amount to £452m and include avoided site visits (£251m), and reduced inquiries and customer overheads (£61m). Total network benefits amount to £110m and generation benefits to £47m. Carbon-related benefits amount to £582m.

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 further development of the energy services market, with innovative energy management tools such as premise 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 energy products, lower prices and increased choice.
In addition there are 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:** 3.83MtCO2	**Non-traded:** 10.07MtCO2	
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	- 1,283,149	- 3,527,458	- 379,490	20,824,955	44,778,479
Total annual benefits	0	0	4,064,513	7,551,011	23,917,925	86,847,513	154,685,086

£	2017	2018	2019	2020	2021	2022	2023
Total annual costs	67,544,047	82,504,455	81,865,607	77,820,178	72,394,078	66,523,067	60,677,566
Total annual benefits	216,859,104	263,043,746	284,617,039	290,706,039	294,607,178	293,692,312	292,713,699

£	2024	2025	2026	2027	2028	2029	2030
Total annual costs	55,102,483	49,539,508	44,013,152	38,508,569	32,965,047	28,400,204	24,290,883
Total annual benefits	295,376,244	299,244,847	296,160,885	295,502,412	293,142,463	291,141,396	289,975,772

* 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	0.01	0.61	1.54
	Non-traded	0.02	1.44	3.64
Homes	Traded	0	0	0
	Non-traded	0	0	0
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	0.00	0.49	1.46
	Non-traded	0.01	1.22	3.62

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
BRE – Better Regulation Executive
CAPEX - Capital Expenditure
CERT - Carbon Emission Reduction Target
CES – Consumer Engagement Strategy
CML - Customer Minutes Lost
CPP – Critical Peak Pricing
CRC Energy Efficiency
CRM - Customer Relationship Management
DCC - Data Communications Company
DNOs - Distribution Network Operators
DPCR5- Distribution Price Control Review 5
DSR – Demand-Side Response
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
EU ETS – European Union Emissions Trading Scheme
EV - Electric Vehicle
GHG - Greenhouse Gas
GPRS - General Packetised Radio Service
GSM - Global System for Mobile Communication
HAN - Home Area Network
HSE – Health & Safety Executive
IA – Impact Assessment
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
PIR – Post Implementation Review
PPM - Pre-payment Meter
PV - Present Value
RFI - Request for Information
RTD - Real Time Display
SECG - Smart Energy Code
SME – Small-Medium Enterprise
SMETS - Smart Meter Technical Equipment Specification
SMDG – Smart Metering Design
SPC - Shadow Price of Carbon
STOU – Static Time of Use (tariff)
TSD – Technical Standard Directive

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 European Union (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.

In the non-domestic market, energy suppliers are already required to ensure that, by April 2014, energy supplied to larger electricity sites (defined as those within profile classes 5-8) and larger gas sites (defined as those with consumption above 732MWh per annum) is measured by an advanced meter. Since April 2009, such metering has also had to be provided where a meter is newly installed or replaced. This Impact Assessment (IA) presents the analysis that focuses on remaining, smaller sites – those in electricity profile classes 3 and 4, and those with gas consumption below 732 MWh per annum.

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 stage, Foundation. The objective of the Foundation Stage 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. The Foundation Stage 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. The Foundation Stage is anticipated to run until Q3 2014 upon which mass roll-out will commence.

The analytical work over the three years of policy design and the first year of The Foundation Stage 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].

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[2] HMG, *'The Coalition: Our programme for government'*, 2010.
[3] DECC, *'Smart Metering Implementation Programme, Response to Prospectus Consultation'*, 2011, available at http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1475-smart-metering-imp-response-overview.pdf
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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 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

Within Great Britain's small and medium non-domestic energy market (which we define as electricity sites within profile classes 3 & 4 and gas sites with consumption below 732MWh/year)[9], there are information difficulties for both consumers and suppliers. Suppliers often only know exactly how much energy a non-residential customer consumes after a quarterly meter read. Similarly, consumers will generally only be aware of consumption on a quarterly, historic basis unless they take active steps to monitor the readings on their meters. Consumers would benefit from having

[5] DECC, *'Smart Metering Implementation: Response to Prospectus Consultation – Functional Requirements Catalogue'*, 2011, http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1480-design-requirement-annex.pdf.

[6] *'Industry's Draft Technical Specifications'*, 2011. Available at http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/2393-smart-metering-industrys-draft-tech.pdfDECC,

[7] DECC, *'Smart Metering Implementation Programme: A consultation on draft licence conditions and technical specifications for the roll-out of gas and electricity smart metering equipment'*, 2011, http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2546-smip-consultation-rollout-180811.pdf .

[8] DECC, *'Impact Assessment: Smart meter roll-out for the small and medium non-domestic sector (GB)'*, 2011, http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2550-smip-rollout-small-and-med-non-dom.pdf.

[9] Where the term "SME" is used, it should be taken to include all sites within these groupings, including the smaller sites of larger private and public sector organisations, as well as those of small and medium enterprises and micro-businesses.

more dynamic and useful information to enable them to easily manage their energy consumption.

Smart meters with an IHD or other means of providing information, or advanced meters providing information that can be accessed via computer or other remote devices, provide the means of addressing these issues.

Besides, as smart meters provide remote communication between the meter and the supplier, they facilitate, amongst other things, more efficient collection of billing information, the development of more sophisticated tariff structures and demand management approaches that could be used further to incentivise energy-efficient behaviour by consumers and suppliers alike.

The benefits from a roll-out of smart meters together with an 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.

Companies are already installing integrated smart/advanced meters or retrofitting advanced elements to "dumb" meters in the non-domestic market. However, in the absence of Government intervention, feedback from market participants suggests that a roll-out of smart/advanced meters could, over time, only involve around 50% of meters and would thus only realise a proportion of the possible benefits. Experience from other countries shows that suppliers and others interested in meter provision, such as meter-owners (at least in competitive markets), rarely fully embrace smart/advanced metering as the benefits fall to a variety of actors and the market does not effectively maximise and share these benefits without some form of Government intervention.

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.

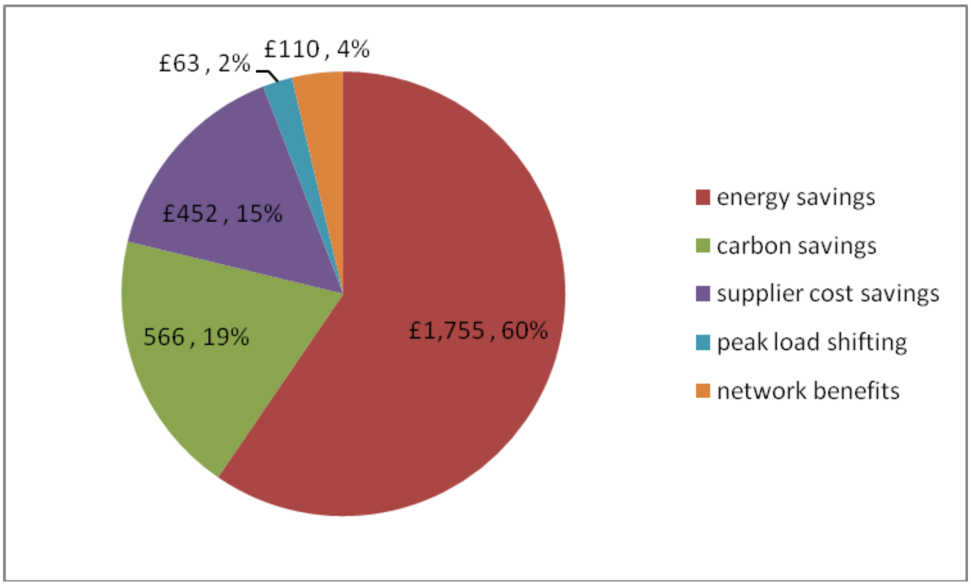
Benefits

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[10] 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

[10] In the non-domestic sector however, we do not account for benefits from theft detection (see section 3.2 for further details).

from more targeted and informed investment decisions[11]. 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

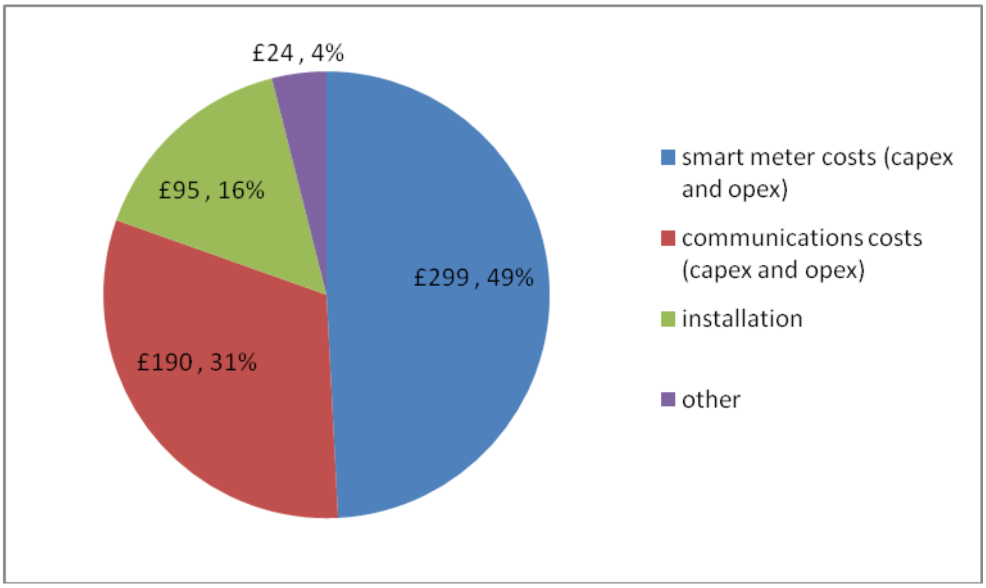


<u>Costs</u>

Costs of the roll-out can be categorised as follows. Energy suppliers will be required to fund the capital costs of smart meters, IHDs and potentially the communications hub that links the meter(s) in a property to the supplier via the 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 DCC, as well as their ongoing maintenance. These are however fully allocated to the domestic sector (for further details, see section 3.2.1 on the differences between the domestic and non-domestic sector). 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 (CES). The CES will focus on the domestic sector, but could also have a role in relation to micro-businesses. The analysis also considers the increasingly inefficient reading of dumb meters as the roll-out progresses otherwise known as 'pavement reading inefficiency'[12].

[11] Benefits from the later are fully allocated to the domestic sector (see section 3.2 for further details).
[12] In the non-domestic sector, these result in avoided costs (see section 3.4.6 for further details).

Figure 1-2: High level overview of costs (£, m)



Economic impact

With total expected present value (PV) costs of £0.6bn and total PV benefits of £2.9bn up to 2030, the net present value (NPV) for the non-domestic roll-out of smart meters in GB is estimated to be £2.3bn. 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 non-domestic electricity and gas bill by £191 in 2020, and by £227 in 2030.

1.5 Scope of this impact assessment

The present IA focuses on Great Britain's small and medium non-domestic energy market (which we define as electricity sites within profile classes 3 & 4 and gas sites with consumption below 732MWh/year). The appraisal period is 2012-2030.

It 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 the Foundation Stage 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	**Non-domestic IA**		
	NPV	total cost	total benefits
August 2011	**2,154**	**604**	**2,759**
April 2012	**2,338**	**608**	**2,946**
Difference	**+184**	**+4**	**+187**

NPV has increased by £184m in comparison to the IA published in August 2011. Both total costs and benefit estimates have increased. This is mainly a result of exogenous changes in carbon and energy prices, as well as the move of present value base year[13]. The move of PV base year result in both increase in costs and benefits, but with the benefit increase having a stronger impact. Updated planning and roll-out profiles as well as cost uplift to early meters slightly counteract this effect. Updated planning and roll-out profiles results in fewer meters 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.

[13] The impact is relatively larger than in the domestic sector, due to the higher gas savings assumptions in the non-domestic case.

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 the DECC's latest updated energy projections (UEP) in October 2011[14] relevant modelling assumptions have been revised. Fossil fuel prices, carbon prices as well as carbon emission factors have been updated to account for the latest forecasts. Minor refinements have also been undertaken to the approach of modelling cost developments over time. Finally, 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 installations in the Foundation Stage. Table 2-1 summarises the impact of these changes on cost and benefits.

Table 2-1: Summary of impacts

Non-domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	2,154	604	2,759	
exogenous and modelling changes	2,409	615	3,023	+ 255
updated planning and roll-out profiles	2,358	588	2,946	-51
cost uplift to early meters	2,338	608	2,946	-20
Total difference	+184	+4	+187	

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 the consumer engagement strategy) these are reflected in the evidence base section (section 3).

2.1.2 Changes in exogenous input parameters and updates to modelling

The 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,

[14] DECC, *'Analytical Projections'*, 2011.

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 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 and emission factors in the non-domestic sector. The most significant changes have been the updated projections for energy and carbon prices, both resulting in an increase in the benefits of the non-domestic smart meter roll-out. In the non-domestic sector, the impact is relatively stronger in the non-domestic sector compared to the domestic sector. This is due to differences in baseline energy consumption levels and energy savings assumptions.

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 outweighing the increase in costs.

Table 2-2: Impact of exogenous and modelling changes

Non-domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	2,154	604	2,759	
Exogenous and modelling changes	2,409	615	3,023	+ 255

The aggregate effect of the above changes has been an increase in NPV of £255m.

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 (IAs) 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 some suppliers will be rolling out at volume, but most are modelled to only conduct trials and move to a new and replacement approach towards the end of the period. The Foundation Stage 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 non-domestic roll-out modelling is consistent with the assumptions for the domestic modelling.

The revised planning assumptions envisage the central 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.

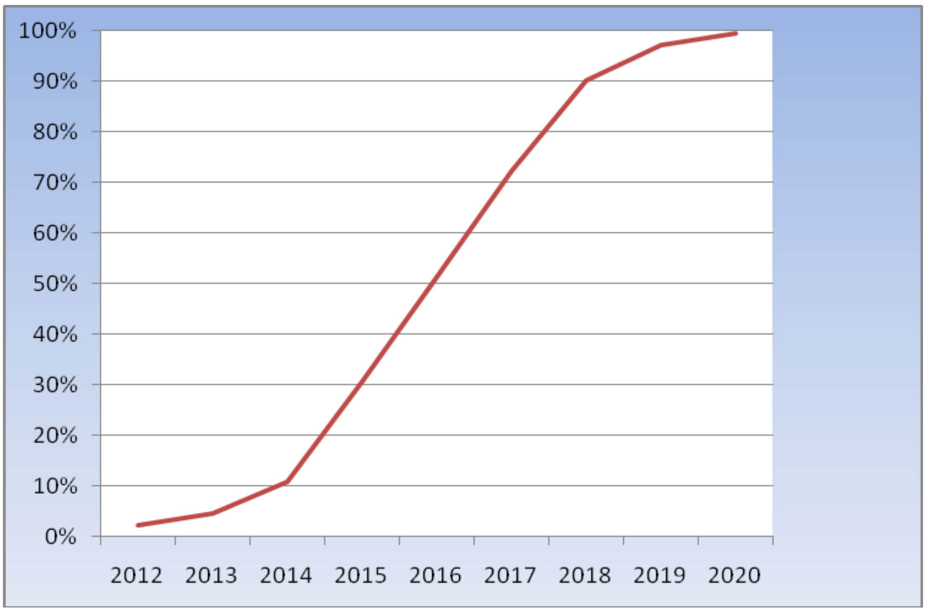
The change in the planning assumption is mainly driven by the decision to procure DCC communications services in three distinct geographical areas rather than as one national contract as had been previously anticipated. The increase in complexity of the procurement exercise has driven additional activity 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. This 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 0.4 million non-domestic meters. 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 meters 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 £51m. The peak installation rate required to reach the December 2019 completion date is 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

Non-domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	2,154	604	2,759	N/A
exogenous and modelling changes	2,409	615	3,023	+ 255
updated planning and roll-out profiles	2,358	588	2,946	-51

2.1.4 Staged approach to the Foundation Stage

The August 2011consultation[15] sought views on the preferred delivery mechanism to implement the final policy decisions taken in March 2011[16]. 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 Foundation Stage objective, the 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)[17] 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 premise. 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.

[15] DECC, *'Smart Metering Implementation Programme: A consultation on draft licence conditions and technical specifications for the roll-out of gas and electricity smart metering equipment'*, 2011, http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/2546-smip-consultation-rollout-180811.pdf .
[16] DECC, *'Smart Metering Implementation Programme'*, 2011 http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx.
[17] DECC, *'Industry Draft Technical Specifications'*, 2011, http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/2393-smart-metering-industrys-draft-tech.pdf

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 enduring 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.

2.1.4.1 Treatment of uncertainty during early Foundation Stage

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
- 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 risks 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 of the risks materialising and the likelihood of the event happening. A number of adjustments in the modelling of these risks have been applied in the non-domestic sector, by contrast to the domestic sector. 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 the Foundation Stage is likely to be limited.
  For the non-domestic analysis we have always modelled that two IHDs and sets of communications equipment would be installed for non-domestic customers who receive electricity and gas from different suppliers, so the latter aspect of this risk does not apply to the SME analysis.

- Functionality differences
  Differences in functionality between the initial and the enduring 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 3.5.3.2 for further detail), an absence of this functionality from early meters could result in a delay in the realisation of outage management benefits. Under current modelling assumptions the assumed critical mass of 80% of meters is still 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. In addition to being applied to meters installed early during the Foundation Stage, for the non-domestic analysis this risk is also applied to all smart and advanced meters in the counterfactual as well as to the proportion of meters that is modelled to opt out of the DCC.[18]

Only the last of these issues was identified in the approach to the Foundation Stage 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[19].

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

[18] Utilisation of the DCC is voluntary in the non-domestic sector since there are already some established communications service providers.
[19] 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.

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 £20 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 £20m 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 in the non-domestic sector

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 applied to:** **- Communications capex** **- Meter capex[20]** **- IHD capex** **- Installation cost**
DCC risk	Risk of communication opex cost increase for those early meters and/or those that elect to operate outside of DCC[21]	**30% uplift to:** **- Communications opex for installations outside of DCC[22] as well as early installations**

Table 2-5: Persistence of early risks through time

	initial SMETS	second SMETS pre-DCC go live	second SMETS post DCC go live

[20] Note that this uplift is applied to both smart and advanced meters in the non-domestic case.
[21] 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.
[22] As explained in the Annex 1, in the non-domestic sector, the uplift is also applied in the counterfactual , as we expect smart meters installed in the counterfactual would incur higher communications costs.

Considered period	2012 – Q3 2013	Q4 2013 – Q3 2014	Q4 2014 onwards
Estimated number of meters	0.2m	0.2m	remainder of meter population
Interoperability risk 1	yes	no	no
DCC risk	yes	yes	no

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

Non-domestic, all in £m	NPV	Total costs	Total benefits	NPV difference
August 2011 IA	2,154	604	2,759	N/A
exogenous and modelling changes	2,409	615	3,023	+ 255
updated planning and roll-out profiles	2,358	588	2,946	-51
cost uplift to early meters	2,338	608	2,946	-20
Total difference		**+4**	**+187**	**+184**

2.2 Further decisions taken in light of consultation responses

2.2.1 Communications architecture in the premise

A central analytical question in the August 2011 IA concerned the configuration of the communications equipment in the premise. 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*

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.

The 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 not 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 non-domestic consumers remains strongly positive in central scenarios (see results section 4); the non-domestic roll-out has a positive NPV of over £2.3bn. Table 3-1 compares costs and benefits of this IA against the preferred option in the August 2011 IA. This increases the value of the NPV published in the August 2011 IA from £2,154m to £2,338m, by £184m.

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

£m	**Non-domestic IA**		
	NPV	total cost	total benefits
August 2011	**2,154**	**604**	**2,759**
April 2012	**2,338**	**608**	**2,946**
Difference	**+184**	**+4**	**+187**

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 primarily driven by the updated exogenous input parameters and modelling changes, most notably increases in projected carbon and energy prices and moving the present value base year into 2012. Updated planning assumptions and roll-out profiles also impacted the benefits to a lesser extent.

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

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 Differences between the domestic and non-domestic analysis

Most of the assumptions used in this IA are shared with the assumptions used in the analysis for the domestic sector. Where this is not the case it is noted and explained within the text.

3.2.1 Overview of differences in treatment of costs and benefits in the non-domestic sector

For some of the costs and benefits analysed it is not possible to determine the proportion that falls to the domestic or non-domestic sector. Therefore, for modelling purposes, we have accredited some of the costs and benefits fully to the domestic analysis[23], in light of the much greater number of meters in that sector. In other instances, we have made different assumptions. Key differences between the non-domestic and domestic sector are:

Costs:

- Costs associated with setting up and operating the DCC are fully allocated to the domestic sector
- Legal, organisational costs as well as costs associated with consumer engagement activities are fully accredited to the domestic sector
- Costs uplifts associated with communications service charges are applied to all smart meters installed until DCC becomes operational, and then the proportion of smart meters modelled to opt out of the DCC, In the counterfactual, the uplifts are also applied to all smart meters over the entire appraisal period.

Benefits:

- Benefits from better informed investment decisions in electricity networks are fully accredited to the domestic analysis.
- We do not assume any savings from theft in the non-domestic sector, as we assume that no theft occurs in these premises (see section 3.5.2.6 for further details).
- We assume limited benefits for those smart/advanced meters that elect to operate outside of the DCC (see section 3.3.2 for further details).
- The critical mass required for outage detection benefits to start incurring takes into account both domestic and non-domestic installations[24].

In light of some cost being fully accredited to the domestic sector, and because costs outweigh benefits, the result is a potential understatement of net benefits of the domestic policy and a potential overstatement of net benefits of the non-domestic policy. It is important to note however, that the overall impact on the net present value of the smart meter domestic and non-domestic roll-outs is neutral and that in aggregate neither costs nor benefits are underestimated or overestimated.

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[23] Published in parallel to this document, see: DECC website, http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx.
[24] However, benefits accredited in the non-domestic sector are proportional to the non-domestic number of installations.

It is also important to note that for the non-domestic sector a different counterfactual is applied than for the domestic analysis. The counterfactual is explained in section 3.3 below.

3.2.2 Meter numbers and non-domestic energy consumption baseline

No new evidence regarding the number of non-domestic gas meters has emerged since the August 2011 IA. We assume 2.14 million electricity meters, and 1.5 million gas meters. Assumptions about non-domestic sector growth also remain unchanged, and we still assume 51,000 new meters per annum.

We also continue to assume annual average baseline electricity consumption per meter of 17,400 kWh, and an annual average baseline gas consumption of 79,800 kWh. The energy consumption baseline is kept constant over time. We use this baseline to derive the energy savings benefits from smart meters by applying energy savings assumptions.

Even though energy projections for the SME sector are available[25] it is not possible to derive from these an accurate representation of the diverse business groupings represented in the non-domestic sector as defined in this IA, the drivers of its energy consumption, and its projected levels of energy consumption going forward.

In light of this, we continue to take a conservative approach and assume stable levels of energy consumption per meter going forward. However, energy consumption business as usual expectations and trends up to 2030 are more likely to be upwards. Therefore the assumed flat baseline is likely to underestimate the energy and carbon savings of the policy.

Table 3-2: Meter numbers and energy consumption

	Electricity	**Gas**
Meters (2009)	2,140,000	1,500,000
Consumption (kWh)	17,400	79,800
New meters	1.5% - 51,000 per annum	

3.2.3 Advanced meters vs. smart meters

The present analysis builds on decisions previously taken with regard to some flexibility for installation of smart and advanced meters. Meters without full smart functionality can remain, or can continue to be installed:

- Where advanced metering is installed before April 2014 and the customer wishes to retain it;
- Where advanced metering is installed after April 2014 under pre-existing contractual arrangements.

In addition to the above exemptions, following further discussion with stakeholders there is a consensus that there is little likelihood, now or in the medium-term, of an

[25] See DECC website, http://www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx.

economically viable smart solution for a number of larger ("U16") gas meters.[26] Therefore, for these meters, advanced metering will be required instead. In light of the large proportion of gas meter that is already assumed to be advanced, we have not revised our modelling assumptions. However, once these meters (installed under above mentioned non-domestic exemptions) reach the end of their lifetime, they will need to be replaced with smart meters that comply with the technical specification extant at the time. This exemption reflects the state of development within the non-domestic market, with advanced metering being deployed and attendant early energy and carbon savings being achieved. The Government does not, therefore, wish to limit this beneficial early activity by creating uncertainty around advanced metering investment.

A variety of advanced metering solutions are available, and used, within the non-domestic market, especially by larger or multi-site customers. Many of the existing advanced meters have been installed by advanced metering service providers rather than suppliers. Non-domestic customers, like domestic customers, may install their own meters or appoint an accredited party, other than their supplier, to install the meter and collect readings from it. These providers have grown in number over recent years and offer a service tailored to consumers requirements, providing feedback on consumption patterns via the internet or over a local network. This feedback allows consumers to monitor their consumption and to target energy and carbon savings. Service providers contract with communications companies to permit the meter to be accessed and data downloaded. These advanced metering solutions not only carry a different cost to smart meters as defined by the Programme, but are also assumed to deliver different levels of benefits (see section 3.3.1 for further details).

It is assumed that by 2020 the split between smart and advanced meters would be:

- Electricity: 77% smart and 23% advanced
- Gas: 60% smart and 40% retrofit advanced

The proportion of benefits realisable for advanced meters is shown in the table below.

Table 3-3: Proportion of smart meter benefits realisable for advanced meters

	Advanced meters	
	Electricity	Gas
Consumer benefits		
Energy demand reduction	90%	80%
Microgeneration	0%	N/A
Supplier benefits		
Avoided site visits	100%	100%
Inbound enquiries	80%	80%
Customer service overheads	80%	80%
Debt management	20%	20%
Switching savings[27]	£0.8	£0.8
Theft	N/A	N/A
Remote switching and disconnection	0%	0%

[26] This affects around 25,000 current transformer meters and 400,000 larger gas meters .
[27] We assume that advanced meters would realise a flat supplier switching benefit of £0.8 per meter, which is in line with the switching benefits realised by smart meters before the DCC is established and for smart meters that choose not to use the DCC.

Network benefits		
Avoided losses to network operators	0%	0%
Better investment decisions	0%	0%
Avoided cost of investigation of customer complaints about voltage quality of supply	0%	0%
Customer minutes lost	0%	0%
Fault fixing savings	0%	0%
Reduced calls	0%	0%
Benefits from load shifting		
Generation short run marginal cost savings from electricity demand shift	0%	0%
Avoided network capacity as a results of load shifting	30%	N/A

3.2.4 Use of DCC

In March 2011, the Government decided that a voluntary, rather than a mandatory approach to using DCC for smart and advanced meters should be applied for the non-domestic sector since it would only change the number of electricity meters that actually use the DCC to a limited extent. This reflects the fact that suppliers with large, domestic portfolios are likely to wish to install a common, smart meter where they can, and to wish to use a common communications platform, even where they are offered a choice. In the non-domestic electricity sector, supply is dominated by suppliers with large, domestic portfolios.

The incentive to opt out of using the DCC might be more pronounced for non-domestic suppliers of gas. Because there are a number of gas suppliers with a significant share of the non-domestic market, but no domestic business, there is a reduced incentive for those suppliers to use the DCC to ensure compatibility with their domestic operations.

For modelling purposes we have assumed that under this voluntary approach 75% of all non-domestic electricity meters and 45% of all non-domestic gas meters would choose to use DCC. These percentages are in line with the market share of suppliers with large domestic portfolios which are likely to wish to install a common, smart meter where they can, and to wish to use a common communications platform, even where they are offered a choice.

<u>Benefits from using the DCC</u>

Smart metering requires a suitable communications platform over which data can be securely transmitted.

Three broad scope options exist for the functions that the DCC can carry out:

- a "Minimum DCC" option which would include secure communications and access control[28], translation[29] and scheduled data retrieval functions[30].
- Additionally to the "Minimum scope", registration could be added to the remit of DCC, which would mean that DCC should assume responsibility for

[28] Secure two way communications with smart meters, enabling remote meter reading, meter diagnostics and other data communications.
[29] The conversion of different technical protocols to support inter-operability.
[30] Scheduling of the collection of meter readings and managing that process on behalf of suppliers and network operators.

managing the supplier registration database that records the registered supplier for every meter point. Such function would facilitate the development of a streamlined dual-fuel change of supplier process.
- Also adding data aggregation functions (for electricity) to the remit of the DCC. These services are currently performed by industry agents and involve the preparation of a meter point data for settlement.

For modelling purposes we assume an establishment of an operational DCC from the end of Q3 2014 with a “minimum scope”, with registration being added to the scope some time after. Information available also indicates that a positive business case may exist for the inclusion of data aggregation. However, decisions on the latter would need to be subject to further technical, economic and competition impacts analysis.

Since some of the benefits identified as arising from the roll-out of smart meters are fully or to an extent dependent on the use of the DCC then benefits that are enabled by DCC are adjusted for the proportion of meters that we assume would opt out of the DCC:

- We assume that by opting out of the DCC, smart meters would only realise those switching benefits that the analysis has identified to be realisable in the pre-DCC situation - £0.8 per smart meter per year
- No benefits from reduced losses are realised for SME smart meters not using the DCC
- Amongst the benefits to networks, we assume that only the savings from reduced investigations of voltage complaints could be realised for non-DCC meters. We assume that network operators would be able to access the voltage information monitored by the smart meter even if no connection to the DCC was established.

Consistent with the domestic analysis, for those meters that would use DCC the benefits are adjusted before 2014, at which point the DCC is implemented in its initial ‘minimum’ scope.

3.3 Non-domestic counterfactual

A counterfactual case has been constructed. This assumes no Government intervention in profile classes 3 and 4 electricity meters and gas meters with consumption under below 732MWh/year. The counterfactual establishes the business as usual world against which the smart meter roll-out is assessed.

By determining the roll-out that would have occurred had there been no policy intervention the analysis can ensure that only incremental costs and benefits are considered.

The non-domestic counterfactual includes:

- the costs of the continued installation of basic meters,
- the costs and benefits from a limited roll-out of smart/advanced meters where a positive business case exists[31]

[31] This include limited energy savings in those non-domestic premises where an advanced/smart meter is installed.

3.3.1 Advanced meters vs. smart meters

The counterfactual case assumes as in previous versions of the IA that without Government intervention market participants will only install smart/advanced meters where a positive business case exists. We assume that this would be 50% of the market by 2030.

We assume that meter competition and choice will exist – in the model we assume that the meter take-up will be:

- advanced meters: 40% (or 20% of total non-domestic meters) by 2030
- smart meters: 40% (or 20% of total non-domestic meters) by 2030
- retrofit advanced : 20% (or 10% of total non-domestic meters) by 2030

3.3.2 Benefits from using the DCC

As outlined in the assumptions section above some benefits are dependent on the existence and scope of the DCC. Since we assume that in the counterfactual there is no DCC, we adjust the benefits accordingly:

- Smart meters will only realise £0.8 switching benefits per meter p.a.
- Smart meters will not realise benefits from reduced losses
- For network benefits we assume that only savings from avoided investigations of voltage complaints are realised in the counterfactual scenario, as the critical mass of smart meters required for the realisation of the remaining network benefits would not be realised in the absence of a mandated roll-out.

3.3.3 Energy consumption in the counterfactual

For the non-domestic counterfactual the analysis uses the energy consumption baseline described above in section 3.2.2, hence assuming stable levels of energy consumption per non-domestic meter going forward.

3.4 Costs

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

As in the domestic IA, 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 HAN[32]. It is assumed that a Wide Area Network (WAN)[33] 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.

3.4.1 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 3-4: Costs of equipment / installation in the premise (per device)

Component	Asset cost	Installation costs[34]	Ongoing/ maintenance costs (annual, £2011)
Advanced meter electric	£247	£136	£6.1
Advanced meter gas	£247	£136	£6.1
Retrofit option gas	£120	£68	£3
Smart meter electric	£43	£29	£1.1
Smart meter gas	£56	£49	£1.4
IHD	£15	-	-
Communications equipment	£25.6	N/A	£5.3
Total cost per dual fuel premise[35]	**£207.6**		

Note: As for the domestic sector, we continue to assume a dual fuel installation efficiency saving of £10. This reflects cost savings from installing two meters in a single visit to a customer's premise.

<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.

<u>Advanced meter</u>

For the non-domestic smart meter IA we base our assumption of advanced meter costs on the work done by the Carbon Trust and the work done by the Government for the IA for larger non-domestic sites[36]. The costs used were the mid-point between the high and low costs for advanced meters used in the Carbon Trust trials. This also applied to installation. It is assumed that the up-front communications costs are part of the asset price but running costs are separate.

A variety of advanced metering solutions is available, and used, within the non-domestic market. These carry a variety of costs. If the costs of advanced metering

[32] 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.
[33] A WAN is a communications network that in this case spans from the smart meter to the DCC.
[34] Where a SME receives both gas and electricity from the same supplier and the gas and electricity meters are installed at the same time we expect an efficiency saving of £10 in comparison to the aggregate costs of individual gas and electricity meter installations.
[35] Total cost for a dual fuel premise that has electricity and gas smart meters installed.
[36] BERR, 'Impact Assessment of Smart Metering roll-out for Domestic Consumers and for Small Businesses', *2011*: www.berr.gov.uk/files/file45794.pdf .

are lower than those we have modelled, the effect would be to increase the overall net present value of the policy[37].

Retrofit advanced

This option means that the dumb meter is not replaced, but is read remotely by a retrofit device attached to the meter, resulting in lower installation costs and avoiding stranding any assets. It is assumed that the upfront communications costs are part of the asset cost and that maintenance is 2.5% of the asset cost.

In-Home Displays (IHDs)

We continue to assume that delivery of real time information is achieved through a standalone IHD which is connected to the metering system via a HAN. In this sector, information would be provided in a variety of ways, not necessarily through a display device, especially via the internet. However, we anticipate that a significant number of customers, particularly smaller customers, would use a display device. Our cost assumptions regarding the IHD remain unchanged since August 2011.

For the non-domestic cost modelling, we assume only one IHD per dual fuel consumers having the same supplier for both fuels as well as electricity only customer. For dual fuel consumers that have different suppliers for electricity and gas, we assume two IHDs.

The combined present value cost for metering equipment (both smart and advanced) and IHDs in the non-domestic sector is £261m.

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

Operating and maintenance costs

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

Operating and maintenance costs accrue to £38m 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 other 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

[37] It is also worth noting that as smart meters decrease in price through economies of scale realised through the roll-out, they will become an attractive alternative to costly advanced meters, potentially resulting in a shift towards a greater proportion of smart meters assumed in this analysis. This would not only have the impact of lowering asset costs, but would also lead to the realisation of greater benefits than for advanced meters as some of the reduction of benefits would fall away.

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 3-5: 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[38]
Total cost of communication equipment	**£25.6**

Gross present value communications equipment costs are £93m.

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 3-6: Breakdown of installation costs

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

In present value terms installation costs equate to £95m 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 premise 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.

[38] 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.

3.4.2 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

<u>Data services and internal capital expenditure (capex)</u>

Costs related to data services and internal capital expenditure (capex) are fully allocated to the domestic sector, even though we expect 75% of the non-domestic electricity meters and 45% of the gas meters to opt in for the DCC.

<u>Data services and internal operational expenditure (opex)</u>

Costs related to data services and internal operational expenditure (opex) are fully allocated to the domestic sector, even though we expect 75% of the non-domestic electricity meters and 45% of the gas meters to opt in for the DCC.

<u>Communications service charges</u>

As in the domestic sector, 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 premise 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 £80m over the appraisal period.

3.4.3 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. Besides suppliers, network operators and energy industry agents are also expected to upgrade their IT systems.

These costs are fully allocated to the domestic sector.

3.4.4 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, reducing capital cost by just 1% increases the NPV by £22m while an assumed capital cost of 5% increases the NPV by more than £100m. 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.

3.4.5 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 £31m.

3.4.6 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. The assumptions underlying these costs have not been changed between the August 2011 and this IA. However, in the non-domestic sector, these are now presented under the benefit section, as avoided costs of manually reading remaining basic meters.

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.

By contrast to the domestic sector, the impact of the smart meters roll-out in the non-domestic roll-out results in *avoided* costs of manually reading remaining basic meters. This is because in the non-domestic counterfactual, we assume a limited roll-out of smart/advanced meters, Therefore, in the counterfactual, these cost increases would be incurred until 2030. The smart meter roll-out mandate in fact results in benefits in terms of avoided costs of manually reading remaining basic meters, as this cost would disappear once the roll-out is complete.

The present value costs of these avoided costs pavement reading inefficiencies amounts to - £10m, i.e. reflecting *avoided* costs of £10m (compared to the counterfactual).

3.4.7 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 £3m. The approach has not changed since the August 2011 IA.

3.4.8 Legal and organisational costs

These costs are fully accredited to the domestic sector.

3.4.9 Costs associated with consumer engagement activities

Work under the CES since August 2011 highlighted the possibility of some engagement activities targeting some segment of the non-domestic sector, such as micro-businesses. One possibility put forward is the development of a common package of information for the smallest business customers (micro-businesses) and that a central delivery body would take responsibility for this. This is among others the subject of a separate consultation document published alongside this IA[39]. More evidence will be collected during the Foundation Stage and we will continue to keep the needs of this sector under review. Therefore, as before, the entire costs associated with the CES are accredited to the domestic sector.

3.5 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

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

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.

For the non-domestic IA it is important to note that the consumer category in this case also captures businesses as customers of the energy industry.

3.5.1 Consumer benefits

In the context of the non-domestic analysis we refer to consumers as non-domestic entities that purchase energy from energy suppliers. 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.

3.5.1.1 Energy demand reduction

We assume that smart/advanced meters, together with provision of data, will reduce energy consumption by between 2.8% (electricity) and 4.5% (gas) per meter in the central case. This is in line with the changes seen in trials carried out by the Carbon Trust. This controlled trial, published in 2007, involved the installation of advanced metering in 538 SME sites. As a result of the advanced meter installation, consumption data revealed that sites identified on average 12% electricity savings (7% for gas) and implemented 5% electricity savings (4% for gas) during the trial period. To increase further the non-domestic evidence base, further work to test the magnitude and persistence of energy savings from smart metering in SMEs is planned in 2012.
We also apply sensitivity analysis to these benefits as follows:

- In the higher benefits scenario: 1.5% for electricity, 5.5% for gas.
- In the lower benefits scenario: 4% for electricity, 3.5% for gas.

Energy is valued consistently with guidance produced by the DECC[40]. Expected energy savings are applied to the tailored non-domestic energy baseline as described in section 3.2.2 above.

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

[40] DECC, 'Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal and Evaluation', 2011: http://www.decc.gov.uk/assets/decc/statistics/analysis_group/122-valuationenergyuseggemissions.pdf

in the IA to the extent that they suppose a resource benefit to the UK economy. This benefit falls as a first order benefit on generation companies and networks and hence it is discussed further below in this section.

3.5.1.2 Microgeneration

We have attempted to 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 in the non-domestic sector. Our estimate of the number of units (under 300,000 by 2020) results in savings per SME electricity meter per annum (£0.43) that result from assuming a separate export meter and its installation cost are not needed.

3.5.2 Supplier benefits

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

3.5.2.1 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[41]

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

[41] 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.

- 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 3-7: Cost and benefit impacts from avoided site visits (per meter per year)[42]

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 inspection	£0.875 per meter pa	No longer required as captured under the risk based approach	saving
Total cost:	**£6.73**	**£0.63**	**cost saving of £6.10**

The Present Value of these benefits amounts to £251m.

3.5.2.2 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 £61m in present value terms are expected from reduced call volumes.

3.5.2.3 Pre-payment cost to serve

These benefits are not of relevance for the SME analysis, as we assume that no prepayment meters are used in the sector.

3.5.2.4 Debt management

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

[42] 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.

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.

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 a operational cost saving that suppliers can realise and consequently pass on to consumers.

We estimate the per meter saving from better debt management to be £2.2 per year, resulting in a present value benefit of £51m.

3.5.2.5 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 3.4.2, 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[43]), 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 £82m in gross benefits.

3.5.2.6 Theft

The approach to benefits from reduced theft differs between the domestic and the SME IA. No benefits from a reduction in theft are accredited to the roll-out in the SME smart meter IA, as we assume that no theft occurs in the non-domestic sector. This is a conservative view and any theft that in reality occurs and that could be reduced through the roll-out of smart meters would increase the non-domestic benefit case.

3.5.2.7 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[44] - but are potentially costly as they might involve multiple personnel. 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 £7m over the appraisal period.

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[43] DECC, *'Smart Metering Implementation Programme: Response to Prospectus Consultation', 2011,* http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1475-smart-metering-imp-response-overview.pdf.

[44] Ofgem, *'Domestic Suppliers' Social Obligations: 2010 Annual Report'*, 2011 http://www.ofgem.gov.uk/Sustainability/SocAction/Monitoring/SoObMonitor/Documents1/Supplier%20Social%20Obligations%20annual%20report%202010.pdf

3.5.3 Network and generation benefits

3.5.3.1 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[45].

The total present value gross benefits from avoided losses is £98m.

3.5.3.2 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 will be installed in our central scenario. The 80% threshold is relative to both domestic and non-domestic installations. 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 DNO 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):

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

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 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 performance exceeds 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 £3m.

2. Reduction in operational costs to fix faults:

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 £5m.

3. Reduction in calls to faults and emergencies lines:

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. The Government 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 £1m.

3.5.3.3 Better informed investment decisions for electricity network enforcement

One area of difference between the domestic and the non-domestic analysis are benefits from better informed investment decisions. As these are realised across the whole electricity network infrastructure, the decision has been taken to accredit them to the domestic side of the analysis only, to reflect that the full picture of investment requirement can only be established under consideration of both domestic and non-domestic demand and to avoid double-counting.

3.5.3.4 Avoided cost of investigation of customer complaints about voltage quality of supply[46]

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 £1m.

3.5.3.5 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.

[46] 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.

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 Smart Metering Implementation Programme and the ENA continue to work to establish whether such benefits can be quantified in the future.

3.5.4 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/allowing two-way communications. Such tariffs can incentivise demand-side response (DSR) or load shifting[47], 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[48] 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[49]).

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

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

we recognise that over time some consumer 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 is actually shifted.

Based on the international evidence, we expect a 20% take up of STOU tariffs by consumers, gradually increasing up to 24% by 2030.

EA Technology[50] estimate bottom up SME discretionary load to be around 21%, based on heating and cooling demands. 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 estimate the current amount of discretionary load at present in the non-domestic sector is 20% of total consumption at peak. 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. Because these developments are likely to involve development of further policy, in our central scenario we only assume a slight increase in take up and discretionary load (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[51]) 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 automation and smart appliances, which would reduce the need for active intervention by the non-domestic consumer.

Sensitivities are made on the 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 considered two such scenarios[52] which consider such increases in discretionary load, leading to increases on benefits from load shifting by £15m and £59m 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 valuate benefits from load shifting in four different areas:

[50] EA Technology, p38.

[51] BERR &DfT, *'Investigation into the Scope for the Transport Sector to switch to* Electric Vehicles and Plug-in Hybrid Vehicles', *2008*.

[52] In the mid scenario the penetration of electric vehicles is based on central projections by BERR & 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 (BERR & DfT, 2008).

3.5.4.1 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, generating a resource cost saving to the economy as a whole. A number of studies (Ofgem, 2010; Faruqui & Sergici, 2009; 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 £28m.

3.5.4.2 Generation capacity investment savings from electricity demand shift

For generation, load shifting 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.

For generation, we use annual investment on capacity costs based on a recent Mott MacDonald report (2010) to DECC.

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 suppose 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 £19m.

3.5.4.3 Network capacity investment savings from electricity demand shift

Lower peak demand due to the expected uptake of STOU 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.[53]

For distribution, we use the expected annual investment requirement figure from the DPCR5[54] as the baseline. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing[55]. Consequently, we do not account for potential additional benefits driven by

[53] Distribution investment figures come 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 exponentional, hence such approach could underestimate benefits (Ofgem, 2010).

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

[55] 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.

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 are £2m.

3.5.4.4 Carbon savings from 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 £16m.

3.5.5 Carbon related benefits

3.5.5.1 Valuing 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 in 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. In our analysis it accounts for Present Value (PV) of approximately £103m.

For gas, the value of carbon savings from a reduction in gas consumption uses the non-traded carbon prices under the Government’s carbon valuation methodology. This corresponds to a net reduction in global carbon emissions and corresponds to approximately PV £463m.

3.5.5.2 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[56]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

[56] 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.

Table 3-8: 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)
3.83	10.07	0.7	1.0

3.5.6 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.

3.5.6.1 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.[57]

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 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[58]. 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[59]. Accenture has carried out cost benefit analysis of smart grid

[57] Electricity Networks Strategy Group (ENSG) , *'A Smart Grid Vision'*, 2009
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/network/smart_grid/smart_grid.aspx
[58] 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.
[59] DECC does not necessarily endorse these, and emphasises the uncertainty surrounding a future smart grid.

investments on behalf of DECC and the Electricity Networks Strategy Group (ENSG) and found a positive business case for smart grid investments[60]. 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[61]. 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 April 2012[62], and has benefited from the input of key stakeholders. The Programme and the 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 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 Demand-Side Response (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.

3.5.6.2 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

[60] Electricity Networks Strategy Group (ENSG) , *'A Smart Grid Vision'*, 2009, http://webarchive.nationalarchives.gov.uk/20100919181607/http:/www.ensg.gov.uk/assets/ensg_smart_grid_wg_smart_grid_vision_final_issue_1.pdf

[61] ENA and Imperial College London , *'Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks'* , 2010.

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

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).

3.5.6.3 Future energy services

We also expect that the existing 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). Table 4-5 shows the impact of smart meters on energy bills of non-domestic customers. This builds on existing DECC modelling on energy prices to estimate the impact on non-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 the 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	0.608	2.946	2.338
August 2011 IA	0.604	2,759	2,154

Table 4-2: Consumer and supplier benefits

	Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
April 2012 IA	1.755	0.452	0.582	2.946
August 2011 IA	1.629	0.446	0.535	2.759

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	0.608	2.104	2.946	3.784	1.494	2.338	3.177
August 2011 IA	0.604	1.980	2.759	3.535	1.375	2.154	2.932

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	1.140	1.755	2.340	0.424	0.452	0.480	0.413	0.582	0.754
August 2011 IA	1.062	1.629	2.169	0.536	0.595	0.674	0.382	0.535	0.692

Modelling results show that our central estimates for both costs and benefits have increased marginally since the last IA in August 2011. Factors contributing to the small increase in total costs include the update of exogenous and modelling changes, as well as the cost uplift applied to meters electing to be out of DCC. Total benefits have increased, principally due to exogenous input and modelling changes. As a result of changes to the total costs and benefits, we project a small increase in NPV (£184m) relative to the August IA figure.

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, slightly increases from 4.6 in the latest August 2011 IA to 4.8 in the central scenario, with a value of 6.2 in the high scenario and of 3.5 in the low case scenario.

4.2 Distributional impacts

4.2.1 Impacts of smart/advanced meters on non-domestic energy bills

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[63]. The results below show the average impact on GB non-domestic average energy bills. It is expected there will be variation between non-domestic premises 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 non-domestic dual fuel costumer of £191 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 an average bill decrease of £54 by 2015; £191 by 2020 and £227 by 2030 (Table 4-5).

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

[63] 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.

	Non-domestic dual fuel bill impact, £
2015	-54
2020	-191
2025	-214
2030	-227

The price impacts of smart meters in the non-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 non-domestic energy bills – all smart and advanced meters

	Electricity	**Gas**
Year	**price impact (£/MWh) (Inc VAT)**	**price impact (£/MWh) (Inc VAT)**
2012	-0.03	-0.01
2013	-0.08	-0.02
2014	-0.05	-0.02
2015	**0.31**	**0.10**
2016	0.45	0.14
2017	0.57	0.18
2018	0.57	0.18
2019	0.35	0.11
2020	**0.24**	**0.07**
2021	0.14	0.04
2022	0.07	0.02
2023	-0.01	-0.00
2024	-0.08	-0.02
2025	**-0.13**	**-0.04**
2026	-0.19	-0.06
2027	-0.25	-0.08
2028	-0.31	-0.10
2029	-0.37	-0.11
2030	**-0.42**	**-0.13**

The present bill impacts update the estimates presented in the August 2011 IA. The annual savings on the average non-domestic energy bill are estimated to be higher than presented in the preferred option of that IA. The average, dual fuel saving has increased from £38 to £54 in 2015, from £142 to £191 in 2020 and from £211 to £227 in 2030. These increases in savings are principally driven by significantly higher price and bill baselines for non-domestic customers, which increase the value of energy savings. Further factors affecting these impact projections include our updated roll-out profiles and revisions to our modelling of costs, presented in this IA.

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 services 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).

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.

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;
- 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 does mean though that suppliers could not deploy a strategy where they simply replace all meters in one particular area with smart meters, but would have to target premises with meters that will incur stranding first, and 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). The Government 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 IA 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[64] were commissioned to consider these issues, in particular to provide:

- Assessment of the international and domestic evidence available,

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

- 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%

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[65].

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	2%	3%	4%
Energy savings gas	4%	4.5%	5.5%

[65] HMT, *'Green Book'*, 2011,http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_supguidance.cfm#optimism.

Energy savings gas PPM	0%	1%	1%
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	3%	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.

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

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	£363	£741	£1,089
Energy savings gas	£770	£1,007	£1,244
Business benefits			
Supplier benefits			
Avoided site visit	£230	£251	£272
Call centre savings	£53	£61	£68
Avoided PPM COS premium	£0	£0	£0
Reduced theft	£0	£0	£0
Network benefits			
Avoided investment from TOU (distribution/transmission)	£1	£2	£2
Reduction in customer minutes lost	£1	£3	£4
Operational savings from fault fixing	£1	£5	£8
Better informed enforcement investment decisions	£0	£0	£0

Avoided investigation of voltage complaints	£0	£1	£1
Reduced outage notification calls	£0	£1	£1
Generation benefits			
Short run marginal cost savings from TOU	£15	£28	£55
Avoided investment from TOU (generation)	£10	£19	£39

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 enforcement 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[66].

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 the Foundation Stage 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;

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

- To provide stakeholders with timely information and meet commitments with regard to progress and cost and benefit reporting;
- 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 Programme 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 Energy Demand Research Project (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 12 for 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	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.	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**

	potentially higher opex.		interoperability framework by Ofgem)		
Interoperability risk 2[67]	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: - mandate of HAN based on open standard Market structure: Only around 40% of households receive their gas and electricity from different suppliers	It is likely that the early focus will be on dual fuel. Commercial incentives make it unlikely that early single fuel installations will reach or exceed current rates. Commercial drivers reduce the likelihood of this risk materialising, which is therefore assumed to be **low / medium**.	0% probability 100% cost impact **0% uplift to:** **- IHD capex** **- Communications capex**
DCC risk[68]	Early meters result in cost increase once DCC is in place[69]	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 for meters	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	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**

[67] 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 comms hub.
[68] For the application of this risk in the non-domestic sector, additional cost allowances are applied to all meters installed before DCC being operational as well as to the proportion of meters that opt out of the DCC. Meters outside of the DCC face uncertainty regarding their communications contracts and the future costs of them. Communications service providers are likely to be reluctant to offer very long term contracts, to retain flexibility for future use of their infrastructure. For example a GPRS bandwidth previously used for smart metering communications outside of DCC might increase in value due to a new commercial application, resulting in the communications provider requesting higher prices. Further arguments for higher prices for communications services outside of the DCC are lower economies of scale and less purchasing power by the individual supplier when compared to DCC as a whole.
[69] 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.

		both integrating into DCC or continuing to be run outside of DCC. 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[70].	Policy based: - fully integrated meters are disallowed - WAN based on open standard to enable easy integration into DCC - adoption criteria and DCC charging regime		
TOTAL	Cost uplifts - communications capex: 15% (increasing the current cost assumption by £3.70 from £24.6 to £28.3) - 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: 15% (increasing the current cost assumption by £2.25 from £15 to £17.25) - installation cost: 15% (increasing the current cost assumption by £10.2 from £68 to £78.2)				

[70] In reality an increase in comms 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.

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).
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.

11 Annex 3 – Detailed results

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

Table 11-1: Detailed results

Total Costs			**608**
In premise costs			487
	Meters & IHDs		261
	Installation of meters		95
	Operation and maintanance of meters		38
	Communications equipment in premise		93
DCC related costs			97
	Data services and internal capex		-
	Data services and internal opex		-
	Communications service charge		97
Suppliers' and other participants' system costs			-
	Supplier capex		-
	Supplier opex		-
	Industry capex		-
	Industry opex		-
Other costs			24
	Energy		31
	Disposal		3
	Pavement reading inefficiency	-	10
	Industry Set Up		-
	Marketing		-
NPV			***2,338***
	(Stranding costs		088)

Total Benefits		**2,946**
Consumer benefits		1,755
	Energy saving	1,748
	Microgeneration	7
Business benefits	Supplier benefits	452
	Avoided site visits	251
	Inbound enquiries	52
	Customer service overheads	9
	Debt handling	51
	Avoided PPM COS premium	-
	Remote (dis)connection	7
	Reduced theft	-
	Customer switching	82
	Network benefits	110
	Reduced losses	98
	Avoided investment from ToU (distribution/transmission)	2
	Reduction in customer minutes lost	3
	Operational savings from fault fixing	5
	Better informed enforcement investment decisions	-
	Avoided investigation of voltage complaints	1
	Reduced outage notification calls	1
	Generation benefits	47
	Short run marginal cost savings from ToU	28
	Avoided investment from ToU (generation)	19
UK-wide benefits		582
	Global CO2 reduction	463
	EU ETS from energy reduction	103
	EU ETS from ToU	16

12 Annex 4 – Post Implementation Review (PIR) Plan

Basis of the review: The Government 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 are 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 the Government 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 the Government 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 <u>Small Firms</u>

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 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 CES 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 Government guidance[71], 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
608	2,405	3.83	10.07	26.73	-505	44.45	-224

Table 13-1 shows how the roll-out will save over 3.83 million of tonnes of CO_2 equivalent in the traded sector and 10.07 million tonnes of CO_2 in the non-traded sector over a 19-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.

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

13.6 Other Environment

The Smart Metering Implementation 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 IHD).

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 licenses, and current meter owners' and providers' possessions. The Government'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. Government'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). The Goverment'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 Smart Meter 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"[72] 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.

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

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

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 prepayment meters would assist those in rural areas who find access to key-charging or 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.