Title: **Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB)** **IA No: DECC0009** **Lead department or agency: DECC** **Other departments or agencies:**	**Impact Assessment (IA)** **Date:** 24/01/2013 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** Ferry Lienert (0300 068 6325)

Summary: Intervention and Options

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB in 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
£6,659m	£510m	N/A[1]	N/A	N/A

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

Lack of accurate, timely information on energy use: a) may prevent customers from reducing consumption and therefore bills and CO_2 emissions; b) 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. In Great Britain, the provision of energy meters to consumers is the responsibility of energy retail suppliers, who are expected to roll out only very limited numbers of smart meters in the absence of Government intervention. To ensure commercial interoperability and full market coverage, intervention to establish minimum technical requirements and a completion date is needed.

What are the policy objectives and the intended effects?

To roll-out smart metering to all GB residential and small and medium sized 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, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

This policy focuses on the mandated replacement of about 53 million residential and non-domestic gas and electricity meters in GB through a supplier-led roll-out with a centralised data and communications company. The March 2011 IA set out the overall approach and timeline for achieving this objective. The August 2011 IA considered a range of options to define the smart metering technical equipment in the premise. This IA also reflects the impacts of requirements in the first and second tranche of smart meter regulations as well as impacts from the second version of the Smart Meter Equipment Technical Specification.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 2018

Does implementation go beyond minimum EU requirements?			**Yes**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro Yes**	**< 20 Yes**	**Small Yes**	**Medium Yes**	**Large Yes**
What is the CO2 equivalent change in greenhouse gas emissions? (Million tonnes CO2 equivalent)			**Traded: 12.1**	**Non-traded: 25.6**	

[1] Since no new legislation is being introduced as a result of the notification of Smart Meter Equipment Technical Specification to the EU, metrics relevant for the OIOO accounting system have not been updated.

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

BARONESS VERMA

Summary: Analysis & Evidence — Policy Option 1

Description: Within the context of a supplier led roll-out of smart meters with a centralised data and communications company , this IA reflects a roll-out completion date in December 2019 and models the implementation route for the remainder of Foundation and mass roll-out with a two staged specification of the smart metering equipment. It reflects cost and benefit implications from the Smart Meter Technical Specifications.

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 1,387	High: 12,197	**Best Estimate: 6,659**

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	1,430		810	**12,114**

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

Metering equipment costs and its installation and operation amount to £6.98bn. Communications equipment costs amount to £2.65bn. IT systems costs amount to £1.24bn. Industry set up, disposal, energy, pavement reading inefficiency and costs associated with the Consumer Engagement Strategy amount to £1.24bn.

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

NA

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	0		1,022	**13,485**
High	0		1,844	**24,328**
Best Estimate	0		1,423	**18,774**

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

Total consumer benefits amount to £6.3bn and include savings from reduced energy consumption (£6.26bn), and microgeneration (£43m). Total supplier benefits amount to £9.07bn and include avoided site visits (£3.37bn), and reduced inquiries and customer overheads (£1.29bn). Total network benefits amount to £1.05bn and generation benefits to £794m. Carbon related benefits amount to £1.46bn. Air quality improvements amount to £104m.

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

These include benefits from further development of the energy services market and the potential benefits from the development of a smart grid. Smart metering is likely to result in stronger competition between energy suppliers due to increased ease of consumer switching and improved information on consumption and tariffs. An end to estimated billing and more convenient switching between credit and pre-payment arrangements will improve the customer experience.

Key assumptions/sensitivities/risks	Discount rate	3.5%

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.

Annual profile of monetised costs and benefits (undiscounted)*

£	2013	2014	2015	2016	2017	2018
Total annual costs	137,933,936	286,061,656	436,111,688	657,442,565	894,710,179	1,103,594,570
Total annual benefits	90,501,101	207,599,690	417,159,927	696,867,745	1,055,155,452	1,381,791,313

£	2019	2020	2021	2022	2023	2024
Total annual costs	1,233,088,254	1,197,300,849	1,170,297,465	1,134,752,368	1,111,694,089	1,093,349,944
Total annual benefits	1,760,022,137	1,765,309,448	1,792,878,313	1,829,230,586	1,854,873,227	1,877,602,075

£	2025	2026	2027	2028	2029	2030
Total annual costs	1,079,188,289	1,063,887,071	1,047,684,653	1,030,194,253	1,008,132,390	988,180,708
Total annual benefits	1,939,652,877	1,955,300,899	1,969,055,308	2,006,609,813	2,017,419,587	2,057,315,160

* 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	0.02	0.45	1.11
	Non-traded	0.04	1.25	3.62
Homes	Traded	0.01	1.34	3.85
	Non-traded	0.02	1.54	5.03
Waste	Traded	0	0	0
	Non-traded	0	0	0
Agriculture	Traded	0	0	0
	Non-traded	0	0	0
Public	Traded	0	0	0
	Non-traded	0	0	0
Total	Traded	0.03	1.79	4.96
	Non-traded	0.06	2.79	8.65
Cost effectiveness	% of lifetime emissions below traded cost comparator	100%		
	% of lifetime emissions below non-traded cost comparator	100%		

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Glossary of Terms

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

Part A: Introduction and New Analysis

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]. The smart meter policy supports the broader Government programme for a more ambitious EU carbon emission reduction target by 2020, through encouraging investment in renewable energy, feed in tariffs and home energy efficiency via the Green Deal.

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

Further, as part of the Third Package of Energy Liberalisation Measures adopted on 13 July 2009, EU Member States are obliged to "ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas and electricity markets" - in other words, to roll out some form of smart metering subject to the results of an economic assessment. For electricity, where the roll-out of smart meters is assessed positively, at least 80% of consumers should be equipped with intelligent metering systems by 2020. For gas, Member States are required to undertake an economic assessment and to prepare a timetable for the implementation of intelligent metering systems.

In March 2009 the European Commission issued a mandate (M/441) to the three European Standardisation Organisations (CENELEC, ETSI and CEN), to develop smart metering technical standards for communications and any additional functionality that goes beyond existing meters core measuring operation. Work commenced in December 2009 and focused on updating existing European technical standards and, where gaps existed, developing new standards. The European Council and European Parliament reached agreement on an EU Energy Efficiency Directive (EED) in June 2012, and it came into legal force in November 2012. Member States need to implement the Directive by 5 June 2014. The Directive is wide ranging and contains new provisions related to demand side and supply side energy efficiency, including smart meters, to enable the EU to get back on track towards meeting its target to reduce primary energy consumption by 20% by 2020. DECC is currently consulting on options to implement the Directive provision on providing easy access to 24 months of daily/weekly/monthly/annual consumption data to consumers with smart meters.

Regardless of the existence of standards or the EED, a GB smart metering specification is necessary as the needs of the GB market are substantially different to other European markets. For example, the GB gas and electricity supply markets and metering provision are subject to competition, which makes necessary a focus on the interoperability of smart metering systems at switch of supplier. The GB market also has other distinctive characteristics, such as a significant number of prepayment customers[3] as compared to the rest of Europe. Requirements to provide for

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[2] HMG, *'The Coalition: Our programme for government'*, 2010.
[3] In 2010 Ofgem registered almost 4m electricity prepayment meters and over 2.5m gas prepayment meters.

interoperability and prepayment have therefore been included in the GB specification. Similarly, other European countries are likely to require tailored specifications to address their energy market particularities (e.g. the Dutch notification to the EC specified requirements that enable exchanging data with the grid manager at least every fifteen minutes, in such a way that the grid manager can read and use the data that is exchanged).

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.

In Great Britain the initial 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[4]. The end of the policy design phase also marked the beginning of the next stage in the Smart Metering Implementation Programme (hereafter the Programme) - the Foundation Stage. The objective of the Foundation Stage is to provide a solid basis for mass roll-out by establishing the appropriate regulatory and commercial framework and ensure readiness across all participants including consumers. The Foundation Stage will also be used to establish a new Data and Communication Company (DCC) which will provide a suitable communications platform over which data can be securely transmitted. Foundation is anticipated to run until Q3 2014 when we expect mass roll-out will commence.

The analytical work over the three years of policy design and the first 18 months 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)[5].

Alongside the March 2011 Response the Government also published an IA (hereafter March 2011 IA) which presented analysis of:

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

Since then, work has included developing detailed Smart Meter Equipment Technical Specifications (SMETS), leading to the publication of two further Impact

[4] http://www.decc.gov.uk/assets/decc/Consultations/smart-meter-imp-prospectus/1475-smart-metering-imp-response-overview.pdf
[5] BERR, *Impact Assessment of Smart Metering Roll Out for Domestic Consumers and Small Businesses*, April 2008, http://www.berr.gov.uk/files/file45794.pdf and DECC, http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx

Assessments in August 2011 and April 2012[6]. During 2012 secondary legislation was laid, for example to enable the creation of the DCC and to create licence conditions for suppliers obliging them to roll out smart meters by the end of 2019. The Programme has also conducted a number of consultation exercises for the development of the second tranche of legislative proposals, including seeking views in April 2012 on consumer engagement and data access and privacy proposals and in May 2012 on information requirements for monitoring and evaluation as well as Foundation security requirements. Government responses were published in December 2012. In August 2012 DECC has also published a consultation on the second version of the SMETS. The present Impact Assessment accompanies the response to this consultation.

1.2 Rationale for Government intervention

Existing metering allows for a simple record of energy consumption to be collected, mainly by manually reading the meter. Whilst this allows for energy bills to be issued, there is limited opportunity for consumers or suppliers to use this information to manage energy consumption. On average suppliers only know how much energy a household consumes after a quarterly (or less frequent) meter read and consumers are generally only aware of consumption on a quarterly, historic basis unless they take active steps to monitor the readings on their meters. In addition many of those quarterly bills may be based on estimates made by the supplier.

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)[7], there are similar information difficulties for both consumers and suppliers.

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

Smart meters and the provision of real-time information help address these issues, enabling consumers to access more information about energy use and cost. Combined with appropriate advice and support, consumers will then be able to take positive action to manage energy consumption and costs. A reduction in energy consumption will also result in a reduction of negative externalities to society from the emission of carbon.

Smart meters provide for remote communication, facilitating, amongst other things, more efficient collection of billing information and identification of meter faults. Information from the meter, subject to appropriate data, privacy and access control arrangements, will assist in the development of more sophisticated tariff structures and demand management approaches that could be used to further incentivise energy efficient behaviour by consumers and suppliers alike. Smart metering is an enabling technology, that will help to address a number of challenges in the move towards more decentralised electricity systems and a smart grid. This can be seen as

[6] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx#equipment
[7] 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.

positive externalities from the provision of smart metering that would not be considered in private investment decisions.

Without a Government intervention which ensures technical and commercial interoperability, meter owners in competitive markets face greater risks of losing the value of the meter when customers switch energy suppliers. Because the receiving supplier might be unable or unwilling to use the smart technology they might also be unwilling to cover the full cost. Because of this potential loss of asset value and the resulting investment uncertainty, the lack of interoperability is a considerable hurdle to the universal roll-out of smart metering in the absence of a Government mandate. There might also be a risk that some suppliers would only deploy a smart metering system that maximises their own cost savings, but might not deliver the full consumer benefits (e.g. by not providing an IHD). Similarly, smart metering equipment provided without a mandate might not enable realisation of wider systemic benefits such as enabling demand side management or smart grid functions, which fall to different agents to the ones responsible for metering.

In the absence of Government intervention, it is therefore difficult to judge whether a substantial roll-out of smart meters would take place. Smart or advanced metering technology has been available for a number of years, without any significant take up by domestic meter operators (energy suppliers) prior to the announcement of a Government mandate. In the non-domestic sector, companies are already installing integrated smart/advanced meters or retrofitting advanced elements to “dumb” meters. However, in the absence of Government intervention, feedback from market participants suggests that only a relatively small population of meters, unlikely to be more than 50%, would be replaced with smart or advanced meters over time, thus only realising a proportion of the possible benefits.

Experience from other countries supports the view that suppliers and other interested parties are very unlikely to fully embrace smart metering unless or until Government either explicitly requires provision of smart meters, or requires the provision of services which cannot be delivered, or are uneconomic to provide, without smart meters.

In light of information asymmetry, existence of externalities, dispersed investment incentives and interoperability issues that would result from not having a mandated roll-out, a universal roll-out of smart meters unlocking the full societal benefits would not occur without Government intervention.

1.3 Policy 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.

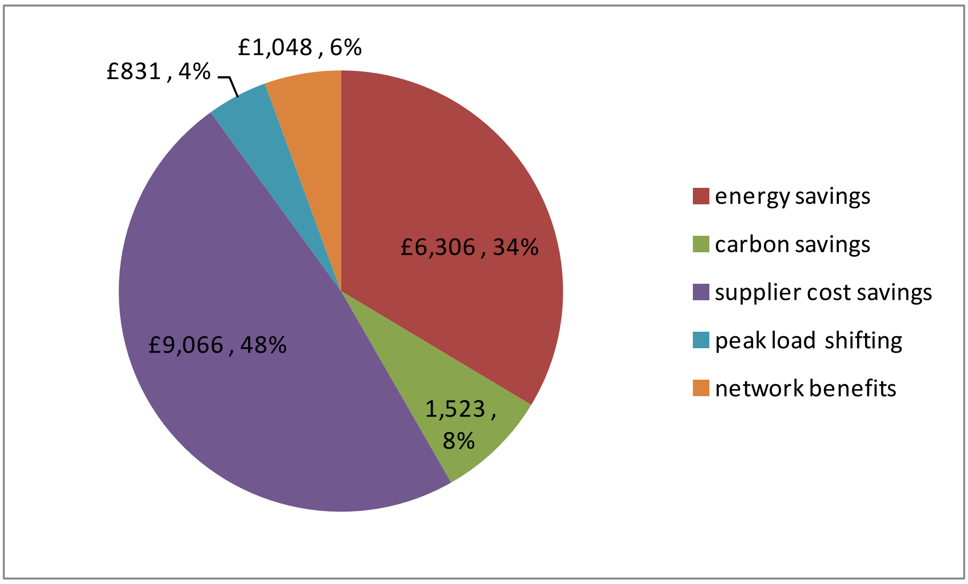
1.4 The Economic Case for Smart Metering

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. Costs and benefits have been quantified by collecting information from key stakeholders including industry, consumer groups and academia. The assumptions have been broadly consulted on and have been benchmarked against international evidence as well as scrutinised by specialists. The costs and benefits considered and the results of the economic assessment are set out at a high level below.

Benefits

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

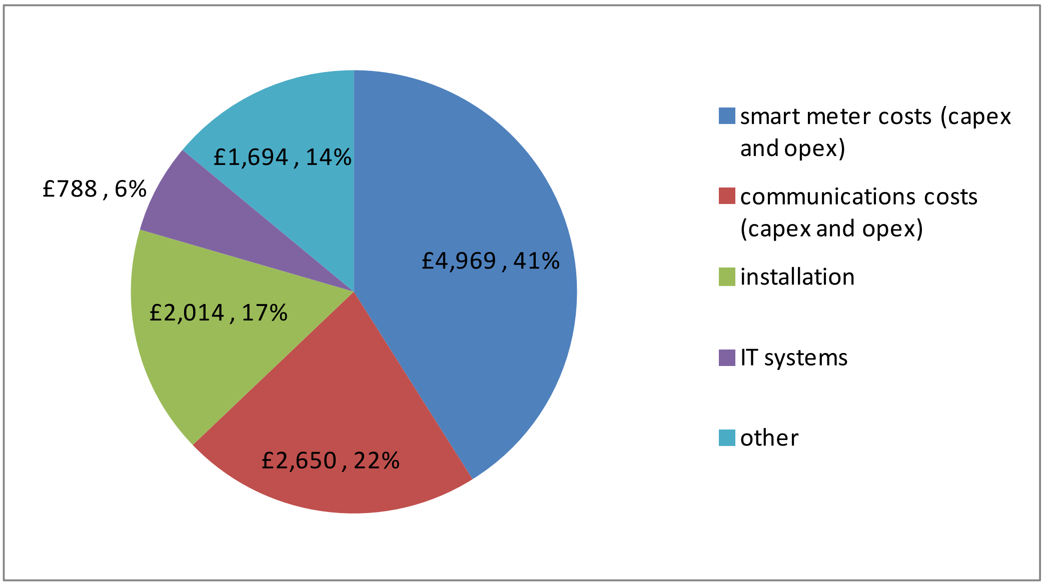
Figure 1-1: High level overview of benefits (£m)



<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 and In-Home Displays (IHDs). They will also have to pay for the installation, operation and maintenance of this equipment plus the communications hub (which links the meter(s) in a property to the supplier via the Data Communications Company (DCC)). Communications hubs will be provided by the DCC. The roll-out of smart meters also implies upfront investment in supporting IT systems and the DCC, as well as their ongoing maintenance. Other industry participants such as distribution network operators (DNOs) will also need to upgrade their systems in order to integrate into the smart meter network. Further costs include the accelerated disposal of basic meters being replaced, the energy consumed by the smart meter equipment itself and the launch and support of a consumer engagement strategy. The analysis also considers the increasingly inefficient reading of dumb meters as the roll-out progresses otherwise known as 'pavement reading inefficiency'.

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



Economic impact

With total expected present value (PV) costs of £11.5bn and total PV benefits of £15.9bn up to 2030, the net present value (NPV) for the domestic roll-out of smart meters in GB is estimated to be £4.4bn. Non-domestic gross benefits amount to £2.9bn, with gross costs of £0.6bn and a resulting net present value of £2.3bn. Across both sectors the expected net benefit is £6.7bn. As a result of consumers using energy more efficiently and suppliers passing through net cost savings, the roll-out is expected to reduce the average household electricity and gas bill by £24 in 2020, and by £39 in 2030. The average dual-fuel non-domestic premise is expected to realise bill savings of £164 in 2020 and £140 in 2030.

1.5 Scope of this impact assessment

The present Impact Assessment (IA) supports the Government's response to the Consultation on the second version of the Smart Meter Equipment Technical Specification[8] as well as the notification of the technical specifications to the European Commission. It reflects developments in policy positions and updated evidence which has been collected over the last few months. In comparison to the IA published in April 2012, combined NPV across the domestic and non-domestic sectors has reduced from £7,178m to £6,659. This is separated into a reduced NPV for the domestic sector from £4,840m to £4,397 and for the non-domestic sector from £2,338m to £2,262.

[8] http://www.decc.gov.uk/en/content/cms/consultations/smets2cons/smets2cons.aspx

2 New Analysis

2.1 Overview

New analysis has been conducted to reflect developments in the design work and more broadly in the evidence base. The analysis has been supported by responses to the August 2012 consultation[9] and further evidence gathered from relevant stakeholders. The key areas of change in costs and benefits in this Impact Assessment include:

- Fossil fuel prices, carbon prices, carbon emission factors, energy consumption and household growth have been updated to account for the latest available forecasts and estimates, following the publication of DECC's updated emissions projections (UEP)[10] and the updated Interdepartmental Analysts Group (IAG)[11] guidance in October 2012. We have also reflected the move into the calendar year 2013, and now use 2013 as the base year for all present value calculations.

- In line with guidance from the Department for Environment, Food and Rural Affairs' (Defra) Inter-departmental Group on Cost and Benefits of Air Quality[12] a new benefit reflecting air quality improvements from reduced emission of pollutants as a result of energy savings has been added to the analysis.

- We have also revised a number of planning assumptions to take into account the latest available evidence. Energy suppliers have made their roll-out plans available for a variety of planning purposes across the Programme and these profiles have been aggregated and adopted for the cost benefit model, alongside the latest assumptions around equipment availability. The economic modelling has also been updated to reflect the installation of some traditional metering equipment by suppliers during Foundation.

- The minimum requirements for smart metering equipment will provide a standardised Home Area Network (HAN) solution which initially operates at a bandwidth of 2.4GHz. Adopting this standard helps to ensure interoperability and inter-connectivity of metering equipment deployed by different suppliers. There is some evidence that the propagation of this solution will not allow full connectivity of the equipment in all premises. The economic modelling has been updated to take into account that for a limited period of time a proportion of visits may result in uncompleted smart meter installations until alternative HAN solutions (wireless or wired) are available for the remainder of premises.

- Detailed technical design work over the last year has resulted in amendments to the security requirements of the end to end solution. The cost benefit

[9] http://www.decc.gov.uk/en/content/cms/consultations/smets2cons/smets2cons.aspx
[10] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx
[11] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx
[12] http://archive.defra.gov.uk/environment/quality/air/airquality/panels/igcb/documents/damage-cost-methodology-110211.pdf

analysis has been updated to reflect cost implications on energy suppliers' IT systems and metering equipment.

- Input from network operators has led to a refinement of the projected benefits from improved outage management, which are now expected to materialise sooner than previously modelled.

- SMETS2 technical specifications include a requirement for a numeric keypad in the gas and electricity meter. Whilst no final decision has been taken yet and the Smart Meters Programme will undertake further work in the coming months to confirm the position, the updated analysis includes a cost allowance to account for the potential cost impacts.

- Government has taken further technical decisions which are not assumed to have impacts on the costs or benefits of the Programme.

Table 2-1 summarises the impact of these changes on cost and benefits.

Table 2-1: Overview of changes

£ Millions	NPV	Costs	Benefits	Change in NPV	Change in domestic NPV	Change in non-Domestic NPV
April 2012 IA	**7,178**	**11,458**	**18,635**	**0**	**0**	**0**
Exogenous changes	7,281	11,824	19,102	103	196	-93
Air quality assessment	7,385	11,828	19,210	104	77	27
Planning	6,927	11,789	18,717	-458	-445	-13
Uncompleted installations	6,893	11,823	18,717	-34	-34	0
Technical architecture – supplier IT systems	6,780	11,933	18,715	-113	-111	-1
Technical architecture – metering equipment	6,730	11,983	18,715	-50	-48	-2
Outage detection	6,790	11,983	18,774	60	47	13
Keypad	6,659	12,114	18,774	-131	-124	-7
Total	**6,659**	**12,114**	**18,774**	**-519**	**-443**	**-76**

The remainder of this section describes in detail the economic assessment of these changes.

2.1.1 Changes in exogenous input parameters

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 prices and emission factors, 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 2012. Specific amendments which have impacted costs or benefits are as follows:

- The most significant changes for the domestic analysis have been the updated projections for household growth and energy prices[13], both resulting in an increase of the benefits from the smart meter roll-out. Having the opposite effect, lower projected prices for carbon and reduced marginal carbon emission factors have reduced the benefits as previously estimated.

- Household growth projections take into account updated data from the Department for Communities and Local Government and the Office for National Statistics. Latest household trends (e.g. decreasing size of households) and an upward revision of ONS's central population forecast reflect higher household numbers over time and a resulting increase in net benefits.

- While in the period up to 2016 domestic energy price projections have decreased in comparison to previous projections, longer term price projections from then onwards are higher than in previous estimates. As the majority of energy savings from smart meters will be generated post 2016, this results in a higher value of the energy savings and therefore increased net benefits. Non-domestic energy price projections are consistently lower than previous projections, resulting in decreased non-domestic net benefits.

- Marginal emission factors are used to determine the carbon intensity of the marginal electricity generation plant, from which generation is assumed to be avoided as a result of energy savings. The most recent Greenhouse gas (GHG) marginal emissions factors for electricity are lower (less emissions-intensive) in both the domestic and non-domestic sector than those previously used, reflecting the increased presence of low carbon generation technologies. As a result, any reductions in electricity consumption achieved by smart metering are now projected to result in a lower reduction in GHG emissions than previously anticipated and are therefore associated with a reduction in monetised net benefits from carbon savings in the traded sector.

- In addition, projected carbon prices are down in comparison to previous IAs, mainly as a result of weak demand for emissions allowances in light of the current economic climate and surplus allowances in the EU ETS. This results in a further reduction of net benefits through a lower implied value of avoided carbon emissions in the traded sector.

- Finally, we have moved the present value base year into 2013. Early costs and benefits assumed to have been incurred in 2012 are removed from the NPV calculations but are considered for the remainder of the analysis where

[13] Energy price here refers to the long-run variable supply cost which is used to value energy savings.

the cost or benefit persists over time e.g. when a cost incurred in 2012 is financed over a longer period of time.

The aggregate impact from these changes across both domestic and non-domestic sectors is an increase in NPV of £103m. This separates into an increase of the domestic NPV of £196m (mainly driven by increased projected household growth and higher projected energy prices after 2016) and a decrease of the non-domestic NPV of £93m (driven by reduced carbon prices, non-domestic energy prices and lower projected emission factors).

2.1.2 Air quality benefits

This is a new benefit item which had not been included in previous Impact Assessments. Air quality benefits are derived from reductions in energy demand, leading to fewer pollutants from combustion of fuels.

In line with guidance from DEFRA's Inter-departmental Group on Cost and Benefits of Air Quality (IGCB)[14], air quality impacts have been estimated by applying air quality damage factors to the amount of energy saved as a result of installed smart meters. Air quality benefits therefore follow the roll-out profile of smart meters and increase over time as the smart meter deployment progresses. A full modelling of regional concentration of air pollutants (via pollution climate mapping) has not been carried out in light of the fact that air quality improvement is an ancillary effect of rolling out smart meters and not a primary policy objective.

Over the appraisal period up to 2030 the benefit from air quality improvements amount to £77m in the domestic sector and £27m in the non-domestic sector, resulting in an overall increase of NPV by £104m.

2.1.3 Changes in planning assumptions

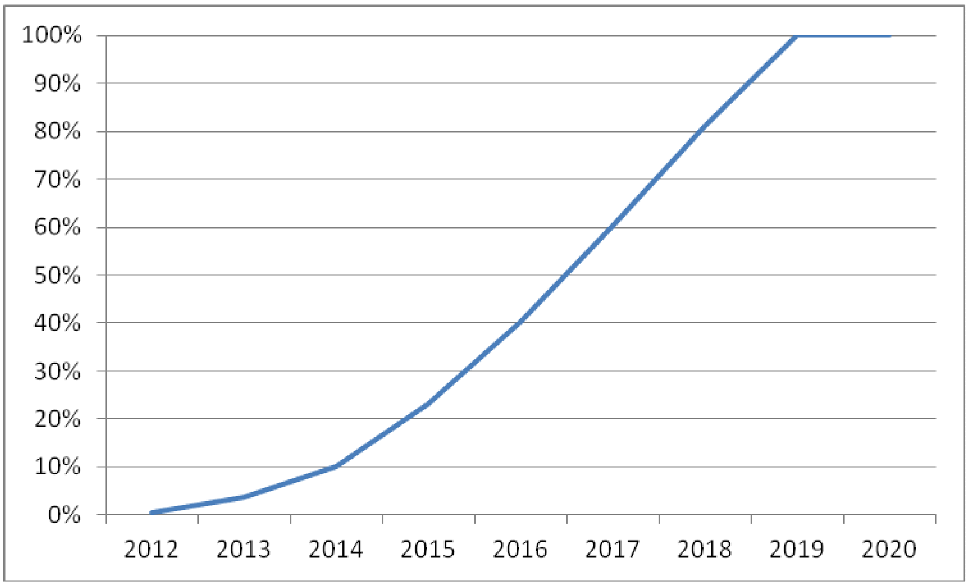
Detailed planning has been undertaken by the Programme and industry over the months since the last IA publication in April 2012[15]. Updated evidence in the areas of roll-out profiles, equipment availability and the ongoing need for installation of traditional metering equipment is presented here.

The Smart Meter Implementation Programme regularly receives information from energy supply companies about their roll-out plans. We have used aggregated information provided to DECC by energy suppliers in December 2012 to determine the modelling of roll-out profiles in this Impact Assessment.

Figure 2-1 presents the updated aggregated roll-out profile in graphic form.

[14] DEFRA's IGCB recommends using the damage costs approach for projects where net benefits from air quality do not exceed £50m
[15] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

Figure 2-1: Updated roll-out profile



Energy supplier roll-out projections indicate that until 2014 the planned volume of smart meter installations in the domestic sector will not cover the required replacement of meters that reach the end of their lifetime. Metering equipment has a limited asset lifetime and energy suppliers are under licence obligation to replace or recertify meters that have reached the end of their lifetime. In any year where the volume of smart meter installations falls short of the volume required to replace the existing metering equipment as this reaches the ends of its asset life, there is a need for the continued installation of traditional metering equipment.

The avoidance of costs associated with the continued installation of traditional equipment during Foundation is considered as a saving resulting from the smart meter roll-out. The modelling has been updated to reflect revised assumptions on the number of traditional meters likely to be installed for operational reasons during the early years of the roll-out. A proportion of these installations were not reflected in previous IAs and are now also introduced in the assessment.

The effect is further enhanced because projected overall volume of installations in the domestic sector until 2013 is over 10% lower than the previous projections. The number of smart meters at the point in time when DCC is expected to be operational has remained relatively stable - around 4m meters. The updated projections indicate that overall around 0.8m traditional meters will be installed in the domestic sector during 2013 as lifetime replacements. We have applied existing cost assumptions for traditional equipment and installations to estimate the cost of traditional meters installations until 2014.

In the non-domestic sector smart meter installation volumes as indicated by suppliers exceed for the length of the roll-out the volumes of end of lifetime replacements. In the analysis we therefore do not project a need for a continued installation of traditional metering equipment for end of lifetime replacements in this sector.

We have also updated the modelling assumptions for equipment availability, to align with the latest Programme expectations. SMETS2 equipment is for modelling purposes assumed to be available during the first half of 2014 for testing, and for deployment at scale from the second half. This extends the period of time for which SMETS1 meters are expected to be deployed. We continue to apply a cost uplift to these meters to reflect some potential risks around lack of interoperability and integration into DCC (see section 3.3.10 for a detailed discussion). While planned smart installation volumes in the early years have reduced, the updated assumptions about availability of SMETS2 still result in an overall increase of expected SMETS1 meters to be deployed, increasing the cost uplift that results from such meters.

Other minor updates to planning assumptions have been introduced. In light of discussions with suppliers the cost benefit modelling no longer assumes that suppliers will specifically target prepayment meters in the early years of the roll-out. We have also used the latest planning assumptions about the likely timing of the centralisation of registration services in the DCC, as detailed below in Table 2-2.

Table 2-2: Centralisation of registration services

	DCC goes operational	**Registration services added**	**Data collection and aggregation services added**
When do costs arise?	2014	2016	2018
When do simplification benefits arise?	Q4 2014	2017	2019

The overall impact of updated planning assumptions has been a reduction in NPV of £445m in the domestic sector and £13m in the non-domestic sector.

2.1.4 Uncompleted smart meter installations in Foundation

The updated modelling reflects that during Foundation some installations visits might not result in a completed installation of smart metering equipment.

Currently the only SMETS compliant HAN solution that is expected to be deployable within SMETS2 timescales is based on a radio frequency of 2.4GHZ. Radio propagation trials commissioned by DECC have shown that a 2.4GHz HAN solution will be effective in a minimum of 70% of premises. Some consultation responses have expressed that propagation of 2.4GHz HAN equipment might be higher than indicated by the radio propagation results. We conservatively assume a proportion of 30% of premises where smart metering installations will not be possible until an alternative HAN solution to 2.4GHz is available.

The timeframes for the development of an alternative compliant HAN solution are subject to ongoing planning and some equipment manufacturers have indicated that a solution might not be available in time for start of mass roll-out (i.e. DCC go live in Q4 2014). We take this view into account but also reflect that there are both industry and commercial pressures in place that should drive the development of an alternative solution. We therefore assume a compliant technical alternative to 2.4GHz to be available from 2015.

The economic analysis reflects a continuation of uncompleted installations once suppliers are rolling out smart meters above the rate of end of lifetime replacement. Discussions with energy suppliers indicate that identification of premises with a risk of HAN coverage issues should – to an extent – be possible in advance. These discussions have however also indicated that the capability to profile premises will never be perfect and that HAN coverage issues are likely to arise with an element of unpredictability.

In the Foundation period, energy suppliers are assumed to target those installations where the existing metering equipment has to be replaced as it reaches the end of its asset life, and to determine on site whether installation of smart equipment is possible or whether traditional equipment has to be deployed. In 2013 the projected number of smart meter installations is below the rate required for lifetime replacements of traditional equipment, even after accounting for those lifetime replacements that could not have been carried out because of physical propagation issues. For this year we therefore do not assume any additional costs from a continued need to install traditional metering equipment over and above those already reflected in section 2.1.3. In 2014, the projected number of smart installations exceeds the number of end of lifetime replacements. There are therefore some end of lifetime replacements of traditional meters with smart meters that are assumed to be uncompleted as a result of HAN propagation issues and these are reflected in the cost benefit analysis.

For modelling purposes we assume that 15% of installations above the rate of end of lifetime replacement will result in uncompleted visits in 2014. We have utilised existing cost assumptions for successful installation visits and adjusted them to reflect that some components that contribute to the overall costs would also arise for an uncompleted visit (e.g. scheduling an appointment, travel time, time on site to determine feasibility of installation), while other components (e.g. installation time on site) would fall away. The resulting cost assumption for an uncompleted installation is £25[16].

For the non-domestic sector we assume that HAN propagation will not result in any change to the expected number of uncompleted visits as the majority of advanced metering systems currently deployed do not make use of a HAN and where it does energy suppliers also have the option to deploy non-SMETS compliant HAN equipment.

The updated modelling results in an overall impact on the net present value of a £34m decrease.

2.1.5 Technical architecture

Detailed work on the technical design over the last year has resulted in amendments to the security requirements of the end to end solution.

The Programme has issued requests for information to collect evidence from industry stakeholders on the cost implications from the refined architecture. Responses

[16] An optimism bias of 20% is applied to this cost assumption. The estimate is lower than the estimate indicated at consultation stage, because the figure here reflects spending a minimum amount of time on site, using range finding equipment to determine HAN coverage. The figure presented in the consultation reflected a range of possible scenarios on site, requiring more time (ranging from determining straight away that HAN coverage was not achievable to installing and then having to remove again smart metering equipment).

indicate cost impacts in two areas: energy suppliers' IT systems and metering equipment.

Implications for suppliers' IT systems

The Programme has collected evidence from energy suppliers to determine the likely cost impact on their back office systems. In light of the fact that some implementation details of the proposals are still under development, views regarding the cost implications varied considerably. For the modelling we assume initial capital expenditure per supplier of around £5m, with annual operational expenditure of around £1m. This reflects the different views expressed by suppliers and also reflects different assumptions regarding what the requirements on suppliers were under previous architecture proposals.

For smaller suppliers a central provision of all additional activities is assumed, without any cost impacts on their systems. Networks are currently not expected to be impacted by the refined requirements.

In line with other IT expenditure, newly identified system costs are fully apportioned to the domestic analysis, because such costs are required to support the smart metering system per se and cannot be sensibly split into components that are driven by the domestic roll-out and others that are driven by the non-domestic roll-out. The overall impact on NPV is a reduction of around £113m.

Implications for metering equipment

Meter manufacturers have also indicated cost implications from the revised technical architecture. The gas meter is likely to require additional processing power, and both the electricity and the gas meter are also expected to require additional memory.

Information provided by a number of metering equipment manufacturers indicate that the cost impact on gas meters is likely to be in the region of £1 to £1.5, with a smaller expected impact on electricity meters.

For modelling purposes we have used an assumed cost increase of £1.25 per gas meter and £0.2 per electricity meter. This cost increase is only applied from the point in time when SMETS2 equipment is assumed to be available.

This results in a decrease of NPV by £48m overall in the domestic sector and £2m in the non-domestic sector.

2.1.6 Outage management benefits

Following engagement with the Energy Networks Association (ENA) updated evidence has also been taken into account to improve the modelling of outage detection benefits. These are modelled as benefits that will be realised once a critical mass of smart electricity meters with outage detection functionality had been installed. This critical mass had previously been assumed to be 80% of the total population.

Improved evidence by the ENA indicates that outages can be separated into two different categories. Firstly, there are outages that only affect a single premise and these constitute around 25% of all outages (open circuit faults on low voltage cables). As soon as a premise is equipped with a smart electricity meter with outage detection functionality, outages affecting only this premise can be detected and appropriate steps taken to resolve the issue. The updated modelling assumes 25% of the benefit from outage management to be realised once the functionality is deployed and for those premises that have had a smart electricity meter installed (i.e. following the roll-out profile).

The remaining 75% of outage management benefits are assumed to only be realised once a critical mass of smart electricity meters has been installed, reflecting that 75% of outages affect multiple premises and therefore require multiple notifications for the Distribution Network Operator (DNO) to adequately be able to determine scope and likely nature of an outage (substation fuse failures).

The new evidence indicates that this proportion of benefits can be realised once one third of the total meter population in place at the point in time has received outage detection functionality. From that point in time the benefit will be realised in full, because it should be possible to detect all substation fuse failures.

However, we also reflect in the updated modelling that outage detection functionality is likely to start being deployed later than previously anticipated. The functionality is expected to be implemented via the communications hub and we model the functionality to be deployed from late 2014.

These changes increase the net present value of the domestic smart meters roll-out by £47m over the appraisal period and the non-domestic NPV by £13m.

2.1.7 Inclusion of keypads in the meter specifications

Once a smart meter is installed, prepayment customers can upload credit remotely over the Wide Area Network (WAN), without the need for physical interaction with the meter. There might be very limited instances where communication over the WAN might be temporarily unavailable and where a prepayment customer may need to upload credit locally. To do this securely the customer will need to input a unique transfer reference number (UTRN) through the customer interface on the meter. To date this interface had been expected to consist of two buttons.

In order to ensure a better experience for the small subset of customers that may have to input data to the meter, the design requirement for the customer interface has been revised from two buttons to a 10 figure keypad.

This is a provisional requirement included in the notification of the technical specification to the European Union and a final position will be taken in the coming months following further analysis. Whilst no final decision has yet been taken the updated analysis includes a cost allowance to account for the potential cost impacts. As an initial modelling assumption we have made a cost allowance of £1.75 per meter for this design change. The Programme will continue to work with industry to revise this cost assumption as necessary.

This change decreases the net present value of the domestic smart meters roll-out by £124m over the appraisal period and the non-domestic NPV by £7m.

2.1.8 Further technical decisions not resulting in changes to this Impact Assessment

Government has taken further technical decisions under SMETS2 which are not reflected in this IA because they are assumed not to have cost or benefit implications.

Meter variants

SMETS2 will provide specifications for metering equipment variants, but consultation responses agreed that these would result in the same cost increments as they do currently for inclusion in traditional meters.

Since the volume of deployment of such meter variants is not assumed to change under the smart meter roll-out, there is no incremental cost.

DNO functionality

Configurable maximum demand registers will be implemented through metering equipment and therefore specified in SMETS2. Equipment manufacturers have indicated that no significant cost implications would arise from adding this functionality. Future benefits to DNOs could arise from this functionality (for example to ensure that new connections do not result in total load exceeding the rating of the service cable), but they have not been quantified at this stage.

Configurable voltage threshold counters will not be implemented through metering equipment and are therefore not specified in SMETS2. Network operators have indicated that the magnitude of potential benefits is uncertain and will in any case also be possible to be realised through carrying out data filtering in the back office. No cost or benefit implications are reflected in this IA.

Part B: Smart meter roll-out for the domestic sector

Summary: Analysis & Evidence **Policy Option 1**

Description: Within the context of a supplier led roll-out of smart meters with a centralised data and communications company , this IA reflects a roll-out completion date in December 2019 and models the implementation route for the remainder of Foundation and mass roll-out with a two staged specification of the smart metering equipment. It reflects cost and benefit implications from the Smart Meter Technical Specifications.

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: -61	High: 9,127	**Best Estimate: 4,397**

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	1,435		761	**11,466**

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

Metering equipment costs and its installation and operation amount to £6.57bn. Communications equipment costs amount to £2.44bn. IT systems costs amount to £1.24m. Industry set up, disposal, energy, pavement reading inefficiency and costs associated with the Consumer Engagement Strategy amount to £1.22bn.

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

NA

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0		863	**11,387**
High	0		1,563	**20,610**
Best Estimate	0		1,203	**15,863**

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

Total consumer benefits amount to £4.59bn and include savings from reduced energy consumption (£4.56bn), and microgeneration (£35m). Total supplier benefits amount to £8.60bn and include avoided site visits (£3.11bn), and reduced inquiries and customer overheads (£1.23bn). Total network benefits amount to £931m and generation benefits to £745m. Carbon related benefits amount to £921m. Air quality improvements amount to £74m.

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

These include benefits from further development of the energy services market and the potential benefits from the development of a smart grid. Smart metering is likely to result in stronger competition between energy suppliers due to increased ease of consumer switching and improved information on consumption and tariffs. An end to estimated billing and more convenient switching between credit and pre-payment arrangements will improve the customer experience.

Key assumptions/sensitivities/risks — **Discount rate** 3.5%

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.

Annual profile of monetised costs and benefits (undiscounted)*

£	2013	2014	2015	2016	2017	2018
Total annual costs	130,589,975	274,849,008	414,450,271	619,247,995	837,604,934	1,028,799,041
Total annual benefits	62,692,978	161,121,748	336,863,742	569,704,276	874,327,811	1,150,070,761

£	2019	2020	2021	2022	2023	2024
Total annual costs	1,147,295,854	1,118,023,689	1,097,090,167	1,067,388,710	1,050,211,726	1,037,608,108
Total annual benefits	1,471,996,415	1,479,393,912	1,507,264,892	1,543,404,571	1,571,203,030	1,594,975,177

£	2025	2026	2027	2028	2029	2030
Total annual costs	1,029,094,131	1,019,434,436	1,007,310,931	994,009,979	975,324,951	957,168,690
Total annual benefits	1,653,356,107	1,672,075,046	1,690,562,767	1,728,881,966	1,744,088,330	1,788,388,750

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

Emission savings by carbon budget period (MtCO2e)

Sector		Emission Savings (MtCO2e) - By Budget Period		
		CB I; 2008-2012	CB II; 2013-2017	CB III; 2018-2022
Power sector	Traded	0	0	0
	Non-traded	0	0	0
Transport	Traded	0	0	0
	Non-traded	0	0	0
Workplaces & Industry	Traded	0	0	0
	Non-traded	0	0	0
Homes	Traded	0.01	1.34	3.85
	Non-traded	0.02	1.54	5.03
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	0.01	1.34	3.85
	Non-traded	0.02	1.54	5.03
Cost effectiveness	% of lifetime emissions below traded cost comparator	100%		
	% of lifetime emissions below non-traded cost comparator	100%		

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.

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

1. Counterfactual/benchmarking
2. Costs
3. Benefits

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

It should be noted that within the economic model all up-front costs are annuitised over the lifetime of the meter or over the roll-out period. The modelling assumes that a loan is required to pay for the asset, which is then repaid over the period. Following Government guidance a cost of capital of 10% real has been assumed. The benefits are not annuitised but annualised, that is they are counted as they occur. The realisation of most benefits will occur as more smart meters are installed in consumers' premises, so they are modelled on a per meter basis and are linked to the roll-out profile.

3.2 Counterfactual

A counterfactual case has been constructed. This assumes no Government intervention on domestic smart metering but includes the implementation of the policies on billing (primarily provision of historic comparative data) and displays set out in the August 2007 consultation on billing and metering[17]. It includes:

- the costs of the continued installation of basic meters,
- benefits from better billing,
- 5% of the predicted consumer electricity savings from smart metering are assumed to occur in the counterfactual world as a result of CERT[18] and other delivery of clip-on displays. The assumption that real-time displays installed under CERT will deliver the same savings as those arising from the roll-out of smart meters is likely to underestimate the savings attributable to the smart meters roll-out. IHDs provided as part of the smart meter roll-out will have access to precise price information, a feature not provided by clip-on displays into which a unit price of energy has to be inputted by the consumer / installer. Clip-on displays typically also cannot help monitor gas consumption, a feature that will be provided by smart meter IHDs. The smart meter roll-out will include the installation of the display (this has to be done by the consumer with clip-on displays, including input of the relevant tariff information) and in addition be supported by a consumer engagement

[17] A *'do nothing'* option is not analysed because policy implementation as described will continue.
[18] Carbon Emissions Reduction Target.

strategy to ensure that energy consumption behaviour changes are facilitated.

It is difficult to judge whether any significant numbers of smart meters would have been rolled out in the absence of Government facilitation. In deregulated and competitive supply markets such as the UK's, suppliers or other meter owners are reluctant to install their own smart meters without a commercial and technical inter-operability agreement. Without such an agreement meter owners would face a large risk of losing a major part of the value of any smart meter installed. This is because there is a significant chance that consumers will switch to a different energy supplier who will not want or be able to use the technology installed earlier and will, therefore, not be willing to pay to cover the full costs – making the smart meter redundant.

Some small suppliers have deployed smart meters in the absence of Government intervention as a way to differentiate their services from the offerings of other energy suppliers. However this activity has been very limited in overall terms (information received from small suppliers indicates less than 50,000 smart electricity and less than 25,000 smart gas meters to have been installed by them as of early 2012, equating to less than 0.15% of the total meter population). Given the dominance of large suppliers in both the domestic electricity and gas markets activity by some small suppliers would not have the potential to result in any significant penetration of smart meters within the overall population[19].

It is therefore reasonable to assume for modelling purposes a counterfactual world in which there is no smart meters roll-out: this is the assumption used in the headline estimates presented in this IA. This is supported by the fact that even though the technology has been available for a number of years, no significant numbers of smart meters have been rolled out to domestic customers prior to the announcement of a Government mandate. Following the Government announcement, some of the larger energy suppliers have also started rolling out limited numbers of smart meters. This reflects individual energy suppliers' commercial strategies towards the mandated roll-out and it can be assumed that even this reduced number of installations might not have occurred without the Government mandate[20].

It is worth noting that the situation is different in the case of non-domestic customers (see further detail in part C of this document). The provision of smarter metering is already established at larger sites, and such metering, whether self-standing or retrofitted to existing meters, is increasingly being installed at smaller sites, particularly those of multi-site customers.

Recognising that some level of smart meters may be rolled out in the domestic sector, for illustrative purposes we have also considered a situation where smart meters are rolled out to a significant part of the residential population. Such an illustrative scenario is outlined below and results in a reduction in NPV of £1.9 billion.

Under this hypothetical scenario, we assume that in the counterfactual smart meters are voluntarily rolled out to a subpopulation of consumers at average costs but resulting in above average benefits. This counterfactual scenario assumes 20% of the population receiving a smart meter, with 30% of the overall benefits from the full

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[19] DECC's UK Energy Sector Indicators publication (2012) shows that in 2010 93.9% of electricity supplied in the industrial, commercial and domestic sector were supplied by the top 9 suppliers. For gas, 82.0% were supplied by the top 9 suppliers: http://www.decc.gov.uk/assets/decc/11/stats/publications/indicators/6801-uk-energy-sector-indicators-2012.pdf . Note further that not all of the small suppliers provide smart meters as part of their offering.
[20] We estimate that in total approximately 600,000 smart meters may have been installed to date, approximately 1% of the domestic metering population.

roll-out being realised. Suppliers would ‘cherry-pick’ those consumers that realise above average benefits from receiving a smart meter. This is modelled as a 20% reduction of costs of the mandated roll-out, in combination with a 30% reduction in benefits of the mandated roll-out. Even in this extreme illustrative scenario, the NPV of the smart meter roll-out remains positive.

The cost of the continued basic meter installation is deducted from the costs for the smart meter deployment. As outlined in section 2.1.3, the updated modelling reflects continued basic meter installations until 2014. The numbers of meters that can be fitted on a coordinated basis is also constrained by the fact that a certain number of meters have to be replaced in any case every year due to either breakdown or because they have reached the end of their operational life.

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

3.3 Costs of smart metering

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

In line with the design of the end-to-end solution and technical specifications, delivery of real time information is assumed to be through a standalone display which is connected to the metering system via a Home Area Network (HAN)[21]. It is assumed that a Wide Area Network (WAN)[22] is also required to provide the communications link to the DCC.

3.3.1 IHD, meter, communications equipment and installation costs

The tables below show the capital costs of meter and communications assets used for the current analysis. These assumptions include changes introduced to the analysis as discussed in section 2 (new analysis).

Table 3-1: Costs of equipment / installation in the home (per device)

Component	Cost
In home display (IHD)	£15
Electricity meter	£44.95
Gas meter	£59
Communications equipment	£25.6

[21] 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.
[22] A WAN is a communications network that in this case spans from the smart meter to the DCC.

Dual fuel installation[23]	£68
Total cost per dual fuel premise	**£212.55**

In-Home Displays (IHDs)

IHDs will have dual fuel functionality so any second supplier providing gas or electricity in a non-dual fuel home can use the IHD provided by the first supplier. It will be at any second suppliers' discretion whether they wish to provide a second display. This will allow for continued competition and customer choice. For modelling purposes only one IHD per household is assumed (except for initial SMETS meters where the risk for duplication of parts of the equipment is reflected in the cost uplifts that are applied – as set out in section 3.3.10).

Smart meters

Following the revision of the technical architecture the need for additional memory in both meters and processing power (for gas meters only) has been identified (see section 2.1.5 for a detailed discussions). This has resulted in cost increases of £1.25 per gas meter and £0.2 per electricity meter. We have also added an allowance of £1.75 for the inclusion of a keypad in all smart meters (see section 2.1.7). Cost estimates for gas meters and electricity meters have therefore been increased by £3 and £1.95 respectively. Equipment costs of any traditional meters installations carried out during Foundation are also reflected here. The total present value gross costs for IHDs and meters are £4,1354m.

Operating and maintenance costs of metering equipment

No further 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 £685m in present value terms.

Communications equipment

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. We present below the component cost scenario of modelling standalone communication hubs in all premises.

Table 3-2: Breakdown of communication equipment component costs

WAN module	£15
Power supply unit	£2
Gas mirror	£4
Casing / seal	£1.1

[23] The cost of a dual fuel installation is comprised of the cost of an electricity meter installation (£29), the cost of a gas meter installation (£49) and a dual fuel efficiency saving of £10.

HAN module	£2.5
Outage notification	£1[24]
Total cost of communication equipment	**£25.6**

The gross present value cost of communications equipment is £1,150m.

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 3-3: 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 £1,746m over the appraisal period. This includes cost estimates for uncompleted installation visits and installation of traditional metering equipment during Foundation.

Installation costs do not include any potential value of the time spent by consumers who stay at home to be present for the installation visit. This is because meter installations would have also taken place in the counterfactual, as traditional metering equipment reaches the end of its lifetime and needs to be replaced. The roll-out of smart meters will result in an acceleration of such instances as the replacement cycle, which would normally be spread over 20 years will be more compressed . This effect, which remains unquantified, only results in bringing forward any such potential time spent by consumers when the meter is replaced rather than in creating a new cost. It is also important to reflect that there are significant convenience gains for consumers relating to potential time gains which are also not quantified in the IA. Such benefits arise for example from not having to be present for a meter read, spend time submitting a read on-line, or from not needing to be present for a meter to be changed between credit and prepay modes.

Development of equipment cost over time

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

[24] 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.

3.3.2 DCC related costs

DCC related costs are broken down into three broad categories:

- Data services and internal capital expenditure
  Investment that is required for both the DCC and its data service providers to offer services
- Data services and internal operational expenditure
  Ongoing costs that both DCC and its 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>

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

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

The gross present value cost of DCC and its Data Service Provider (DSP) capital expenditure is estimated to be £101m.

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

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

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

The gross present value of DCC and its DSP operational expenditure is estimated to be £287m.

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

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

In present value terms these costs amount to £1,291m over the appraisal period.

3.3.3 Suppliers' and other industry participants' system costs

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

These costs are broken down into two categories:

- Capital expenditure
- Operational expenditure

<u>Capital expenditure</u>

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

It is important to note that some of the IT capital expenditure will be dependent on the scope of the DCC in place. We model the vast majority of investment will be carried out with a "minimum scope" of DCC, with a small incremental investment being made in 2016 as the additional function of registration is added. For modelling purposes we also reflect further incremental investment in 2018, when data aggregation is expected to be added to DCC's scope.

The supplier IT capex cost estimate also includes costs of £30m for an interim solution until the DCC is established.

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

For this version of the IA we have added additional supplier IT system costs which arise from the revised technical architecture. As outlined in section 2.1.5, these add £113m to the investment required for suppliers' back office systems.

The resulting present value for supplier IT capex is £392m, while the cost estimate for other industry participants' IT capex is £77m.

Operational expenditure

For modelling of suppliers' IT operational expenditure, the Programme has used an industry standard figure of 15% of total IT capex for initial opex for smart metering IT. This is reduced gradually to 5% by 2030. This is in line with best practice IT application and infrastructure management where ongoing performance improvement is a key feature of contracts and has been observed in IT systems of comparable scale and complexity. Incremental operational expenditure as a result of the refined technical architecture has been added as outlined in section 2.1.5.

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

The resulting present value cost estimates for suppliers' and other industry participants' IT opex are £295m and £88m respectively.

3.3.4 Cost of capital

While not presented as a separate cost item, the costs of assets and installation are assumed to be subject to a private cost of capital, i.e. resources committed to assets and installation have an opportunity cost. Following a conservative approach to the estimation of costs a capital cost of 10% p.a. real is estimated. A number of stakeholders have suggested that their own rates of return are lower than this level. This relatively high rate has been chosen to ensure that the full opportunity cost of the investment is reflected in the IA. If a lower interest rate was applied the net present value of the smart meters roll-out would increase significantly. For example, reducing capital cost by just 1% increases the NPV by over £400m, while an assumed capital cost of 5% increases the NPV by almost £2bn. As with other modelling assumptions, this conservative approach results in a potential underestimation of the net benefit of the policy. In effect such a conservative approach creates a safety margin over and above explicit risk allowances that are applied such as optimism bias uplifts.

3.3.5 Energy cost

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

The total present value of energy costs over the appraisal period is £734m.

3.3.6 Increased costs of manually reading remaining basic meters

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

The present value of these pavement reading inefficiencies is £206m.

3.3.7 Disposal costs

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

These costs would have been encountered under business as usual basic meter replacement programmes, but will be accelerated by a mandated roll-out of smart meters. The underlying cost assumption of £1 per meter has not changed 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. Net present value costs amount to £20m.

3.3.8 Legal and organisational costs

There will be costs for the legal, institutional and organisational set up of the mass roll-out across both the energy industry and Government. The following table reflects the expected costs of these activities:

Table 3-4: Legal and organisational costs

	£m
Legal costs	30

Organisational (data protection, ongoing regulation, assurance, accreditation, tendering, Programme delivery, trials, testing)	140

The smart meter programme consulted during 2012 on proposals around information requirements for monitoring and evaluation purposes[25] as well as on proposals around security risk assessments and audits in the period before the DCC provides services to smart meters[26]. Improved evidence obtained as part of these consultations has enabled us to quantify the cost implications arising from suppliers submitting data for monitoring and evaluation (M&E) purposes as well as the impacts of having to carry out risk assessments and externally commissioned independent security audits during the Foundation phase. Costs of such activities were already allowed for under organisational costs in previous Impact Assessments, but we are now able to apportion some of the overall £140m costs to these specific requirements. The quantification of costs for M&E data submission and Foundation security requirements is outlined below.

3.3.8.1 Foundation security costs

During the Foundation phase suppliers installing SMETS compliant meters (i.e. meters that will count towards their roll-out targets) will be required to carry out internal risk assessments as well as externally commissioned independent, security audits. The Programme sought views on the cost implication of such a requirement through a consultation launched in May 2012 and published a response in December. Few responding stakeholders provided quantifications of the cost implications, but the few estimates received were in line with the indicative cost figures security experts within the Programme had developed.

We assume an annual cost per supplier of £50,000 for risk assessments and external security audits. To reflect uncertainty an optimism bias uplift of 30% is applied to this cost estimate. The resulting cost has been applied across a total of 12 domestic suppliers[27] and for the Foundation years of 2013 and 2014, generating a present value cost of £1.5m. For small suppliers risk assessments and security audits are expected to reduce in costs in proportion to the size of their smart metering systems.

3.3.8.2 Monitoring and evaluation data submission costs

In May 2012 DECC's Smart metering Implementation Programme published its Strategy and consultation on information requirements for monitoring and evaluation, followed by the publication of a response document in December 2012[28]. This set out proposals to collect different data items from suppliers at different frequencies to enable the Programme to track progress and realisation of benefits. The consultation sought stakeholders' views on the cost implications of the proposals but little quantitative evidence was received. There was broad consensus among suppliers that potential burdens from having to collate and submit data should be minimised, but also recognition that the Government had a legitimate interest in collecting this data and that much of the required data was likely to be collected for internal monitoring purposes anyway.

[25] http://www.decc.gov.uk/en/content/cms/consultations/sm_evaluation/sm_evaluation.aspx
[26] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_sec/smart_mtr_sec.aspx
[27] Six small domestic suppliers (Ecotricity, First Utility, Good Energy, Green Energy, Spark Energy, Utilita) have been considered in the analysis in addition to the six large energy supply companies.
[28] http://www.decc.gov.uk/en/content/cms/consultations/sm_evaluation/sm_evaluation.aspx#

DECC is working with Ofgem and suppliers to identify cost effective ways of providing monitoring and evaluation data, for example by aligning requests from DECC and Ofgem.

The requirements for provision of quarterly data only apply to large suppliers, in recognition of the potential disproportionate burden of frequent reporting for smaller suppliers, who will instead be required to report annually. Further, a sunset clause is built into the regulations so that the requirement for data submission ceases after 2020.

The Programme estimates that the overall net present value costs across suppliers and over the next nine years amount to around £1m. This cost estimate reflects recurring activity within the supply companies to collate and sign-off at senior level annual reports; to collect and submit roll-out information at aggregate level (quarterly) and at meter level (annually); as well as an element of one-off changes to back office systems in order to make the required information available in a standardised format.

3.3.9 Costs associated with consumer engagement activities

The March 2011 the Government response document to the prospectus consultation[29] made clear that it saw individual suppliers playing an important role in engaging their customers. However there was also strong support for some activities being carried out centrally or on a co-ordinated basis during mass roll-out to minimise risks around consumer benefits realisation and to enhance the cost-effectiveness of the roll-out.

The Programme has since carried out further work to better understand what underpins effective consumer engagement. This included the development of a behaviour change framework by COI; a series of stakeholder workshops; a Request for Information to suppliers on costs and benefits of central engagement (December 2011); and a consultation on the Consumer Engagement Strategy (April 2012), including a response document published in December[30].

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

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

Given a lack of evidence at this point in time it is not feasible to generate firm quantified estimates of the likely benefits of centralised engagement. We have therefore not made any estimate of this potential benefit. Further evidence on the

[29] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx
[30] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx#consumer

benefits of different types of consumer engagement will be collected in order to enable us to have a more informed assessment towards the end of Foundation. In present value terms, the overall estimate of the costs associated with this Programme amounts to £87m[31] over the appraisal period. In estimating this figure, the Programme has used the communications model used by Digital UK as an approximate comparator whilst recognising some limitations of this. This figure is an estimated figure based on the most relevant available evidence. In December 2011, we issued a Request for Information to suppliers, asking about likely expenditure for a Central Delivery Body (CDB) and setting out some indicative levels of expenditure for different activities, consistent with the overall estimate referred to above. The responses suggested areas where expenditure was likely to be both higher and lower than our estimates. However the detail of the activities, and therefore the costs, will be established in an iterative process by the CDB and will only begin to be fully understood further down the line. At this point in time there is therefore no further evidence on which basis the current assumptions could be updated. Consideration has been given to whether an assessment could be made of the costs of suppliers setting up the CDB on a voluntary basis, but no evidence was received during the CE Strategy consultation process to inform such an assessment. It can be argued that suppliers developing a CDB on a voluntary basis carries greater risk of delay, lack of public credibility and, possibly, the need for regulation at a later date, should the suppliers fail to agree on a CDB that is fully fit for purpose. However, these risks and potential attendant costs are not quantifiable in a robust way.

3.3.10 Costs arising from uncertainty during early Foundation

Smart meters will be installed in two stages: the Foundation Stage and Mass Roll-out Stage. The Foundation Stage started in April 2011 and is due to end with the start of mass roll-out in late 2014. On the basis of information received from suppliers, the Government expects a significant number of smart meters to be installed during the Foundation Stage.

The Government's April 2012 Programme Update (the April Update)[32] confirmed the intention that equipment that complies with the version of the Smart Metering Equipment Technical Specification (SMETS) that is extant at the time of installation will count towards suppliers' roll-out obligations. In addition, meters installed prior to the designation of the first technical specification (SMETS1) that comply with SMETS1 as designated will count towards suppliers' roll-out.

There are a number of benefits from early roll-out activity and counting Foundation meters towards suppliers' roll-out obligations. In particular this:

- 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);

[31] Note that in previous IAs, these costs were presented in real terms. These are now presented in NPV terms.
[32] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

- 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.

For meters installed during the Foundation period Government is currently consulting on proposals around smart change of supplier and enrolment and adoption[33]. Proposals brought forward regarding the smart change of supplier process aim to provide greater clarity for suppliers and meter asset providers (MAPs) in relation to the process for agreeing rental terms. Regarding enrolment and adoption the Government is inviting views whether there is a case for mandating enrolment. These proposals are aimed at mitigating some potential risks arising from initial SMETS meters.

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 materialising and the likelihood of the event happening. Three areas have been identified for initial SMETS meters:

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

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

- DCC adoption and enrolment
  There is some uncertainty as to how meters installed before the DCC is operational will be integrated into the DCC smart metering system. This may result in additional costs if actions are required to bring such early meters into the DCC or if they have to be operated at greater cost outside the DCC. Government is currently consulting on proposals for the adoption criteria and also for the allocation of potential costs.

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

[33] http://www.decc.gov.uk/en/content/cms/consultations/found_smt_mkt/found_smt_mkt.aspx

which the risk prevails. Any optimism bias uplifts already applied to that cost category continue to be considered (and are indeed increased by the risk uplift as well).

For the functionality differences – the lack of outage notification from initial SMETS meters – the impact is not translated into a cost increase factor but directly applied to the roll-out modelling. Meters installed ahead of availability of enduring SMETS meters will not provide outage notification functionality. This is modelled by adjusting the point in time from which network operators will have sufficient coverage of outage management functionality to realise savings. 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. 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.

Table 3-5: Cost uplifts to initial SMETS meters

Risk type	Risk	Cost increase factor
Interoperability risk 1	Costs upon change of supplier (incoming supplier might not be able / willing to support meter and therefore replace meter)	**15% uplift to:** **- Communications hub** **- Meter** **- IHD** **- Installation**
Interoperability risk 2	Double communications hub / IHD for single fuel installations	**15% uplift to:** **- IHD capex** **- Communications hub**
DCC risk	Early meters result in cost increase once DCC is in place[34]	**30% uplift to:** **- Communications Wide Area Network charge**

3.4 Benefits of smart metering

We classify benefits in three broad categories: consumers, businesses (energy suppliers, distribution network operators and generation businesses) and carbon related. Benefits are categorised based on the first order recipient of the benefit. To the extent that businesses operate in a competitive market – in the case of energy suppliers – or under a regulated environment – in the case of networks – a second order effect is expected as benefits or cost savings are passed down to end energy

[34] 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.

users i.e. consumers. For example, avoided meter reads are a direct, first order, cost saving to energy suppliers. As energy suppliers operate in a competitive environment, we expect these to be passed down to consumers.

3.4.1 Consumer benefits

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

Significant benefits from smart meters can be driven by changes in consumers' energy consumption behaviour. Two areas of change in average consumption behaviour may arise:

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

3.4.1.1 Energy demand reduction

There is a growing evidence base demonstrating that smart metering leads to energy demand reductions but also continued uncertainty about the precise level of response of consumers to the full roll-out of smart meters, which will depend on a range of factors. A number of large-scale international review studies exist, such as a review of 57 feedback studies in nine different countries by the American Council for an Energy-Efficient Economy (ACEEE)[35] which finds that on average feedback reduces energy consumption between 4-12%, with higher (9%) savings associated with real-time feedback. A further study by ACEEE[36] reported residential electricity savings from real-time feedback in the nine pilots reviewed ranging from 0 to 19.5%, with average savings across the pilots of 3.8%.

Sarah Darby[37] and Corinna Fischer[38] also show that feedback can result in dramatic behavioural changes with average reductions in energy consumption of over 10%. The recently published European Smart Metering Industry Group (ESMIG) report[39], a review of 100 pilots and 460 samples covering 450,000 consumers suggested savings from around 5-6% from interventions without IHD, to an average of 8.7% with an IHD.
Recent trials in European countries resulted in energy savings within the same range[40]. International studies also provide some evidence on the likely persistence of savings. The ACEEE study quoted above found that feedback-related savings are often persistent, including from the longer-term studies (12 – 36 months) considered.

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

However given the differences of situation and approach between different countries, it is difficult to transfer evidence on levels and persistence of savings directly to the GB context.

The Energy Demand Research Project (EDRP) was a major UK project co-funded by the Government to provide information on consumers' responses to a range of forms of feedback, including smart meter-based interventions. The final report[41] provided substantial new evidence on the behavioural impact of improved energy information in the GB context. EDRP trials generally found that the combination of a smart meter with an IHD was associated with significant electricity savings. Levels of savings varied according to how the trials were conducted, however, trials that are more closely comparable to the GB roll-out showed statistically robust electricity savings of 2% to 4%. For gas, it was the provision of a smart meter rather than the IHD which was most significant in delivering savings, with savings of around 3%. This is in keeping with theoretical considerations that real time feedback is more relevant to electricity.

Also relevant is the evidence base around mechanisms and enablers for behaviour change, and the extent to which they are likely to be supported through the Programme design. Fischer (ibid.) found that higher savings are associated with feedback which is: based on actual consumption; given frequently (ideally, daily or more) and over a longer period; involves interaction and choice for households; includes appliance-specific breakdowns; may involve historical or normative comparisons; and is presented in an understandable and appealing way. Darby (2010)[42] is another review which identifies *inter alia* the need to design customer interfaces for ease of understanding, and for guiding occupants towards appropriate action in order to reduce demand. The ACEEE study also concluded that achieving maximum feedback-related savings will require an approach that combines useful technologies with well-designed programs that successfully inform, engage, empower, and motivate people. ESMIG findings further confirmed the importance of consumer involvement and surrounding variables – over and above the supportive technology used or program structure. It highlighted the fact that the greater the variety and layering of engagement activities, the greater the impacts of roll-out.

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

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

[41] See: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=21&refer=Sustainability/EDRP.
[42] Darby, Sarah (2010) 'Smart metering: what potential for household engagement?', Building Research and Information 38: 5, 442-457.

As noted above, the effectiveness of consumer engagement approaches is likely to influence the level and distribution of consumer energy savings. Plans are being developed for a central engagement programme as described in section 3.3.9, to supplement the engagement activities of individual suppliers. Evidence will be collected from early roll-out installations and piloting of smart meters in order to enable us to have a more informed assessment towards the end of Foundation.

Overall, the GB as well as the international evidence shows that considerable savings are achievable. Cost-benefit analyses in other countries have adopted similar energy savings assumptions. Kema's cost-benefit analysis for the Dutch Ministry of Economic Affairs[43] assumes 6.4% electricity savings with direct feedback through an IHD (3.2% with indirect feedback), and 5.1% (3.7%) for gas[44]. The recent Irish CBA adopts a 3% electricity savings assumption to compute illustrative estimates of the change in consumer welfare resulting from the installation of smart meters.

The Impact Assessment assumption on energy savings lies within the lower range of trials' results because of the existing uncertainty on the precise level of energy savings at this stage of the analysis and caveats[45] in trial results to the whole population.

In light of our current analysis of the available evidence and given the underlying uncertainty, we retain a conservative approach and continue to assume that the gross annual reductions in demand will be as follows:

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

We also apply sensitivity analysis to these benefits as follows:

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

Energy is valued consistently with guidance produced by DECC[46]. The energy baseline from which energy savings are calculated is consistent with the most recently published DECC energy projections accounting for a number of energy efficiency policies in place before smart metering[47].

Rebound effects are necessary to accurately estimate net energy savings. When physics-based or theoretical energy savings potentials are used for the analysis (e.g. the efficiency gain effect of a certain strength of insulation), rebound effects have to be explicitly estimated and subtracted from the theoretical estimate. The real, net energy savings effect in such cases will always depend on the behaviour that the

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[43] KEMA (2010)
[44] The CBA assumes options for refusing the installation of a smart meter due to recent changes in Dutch political circumstances, and the CBA assumes a 20% voluntary uptake of IHD.
[45] Caveats include the degree of representativeness of the samples, trials effects and scale effects for instance.
[46] DECC Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, December 2012: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx
[47] Hence avoiding double-counting energy savings and accounting for policies' overlap. Policies accounted for in the baseline are Warm Front, Building Regulations 2002 and 2005, EEC1,2 and CERT (excluding CERT +20%), and product policy tranche 1.

consumer displays as a result and income gains from increased energy efficiency might well partly be spent by increasing the consumption of the energy service (so called comfort taking).

However, the approach taken for the estimation of smart meter energy savings is fundamentally different and is based on trial results, i.e. observed impacts. These observed values are net of any potential comfort taking and rebound effects are therefore not appropriate to apply to the smart meter energy savings estimates.

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

Overall, reduced energy demand accounts for £4,555m gross benefits in present value terms.

3.4.1.2 Microgeneration

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

Microgeneration benefits amount to £35m in present value terms over the appriaisal period.

3.4.2 Supplier benefits

The following sets out the range of benefits and cost savings the energy supply industry is expected to realise. Energy suppliers have validated in workshops and bilateral meetings that the supplier benefit assumptions, at an aggregate level across the industry, are valid and achievable. Individual suppliers may have different commercial positions but recognise that assumptions made are representative of the industry as a whole.

3.4.2.1 Avoided site visits

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

- Regular visits
    - Regular meter read visits

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

- Regular safety inspection visits

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

Currently safety inspections are carried out as part of the regular meter reading visits and therefore carry little if any additional cost. 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). One supplier has recently been granted from Ofgem a derogation on its obligation to carry out gas safety inspections every two years and instead to move to a risk based approach. Ofgem has also expressed an intention to review the existing meter inspection regime with a view to implementing new arrangements that facilitate the benefits of smart metering[48].

For modelling purposes we have made assumptions on the costs to suppliers of carrying out safety inspections after the roll-out of smart meters. The model assumes a new risk-based regime to apply to all meters 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[49]

There is 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

[48] http://www.ofgem.gov.uk/Markets/sm/metering/tftm/roma/Documents1/Open%20Letter%20-%20British%20Gas%20Two%20year%20metering%20inspection%20derrogation%20application.pdf
[49] 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.

visits (see next section) will continue to require dedicated costs at a greater frequency than the majority of meters (see special visits section). Under the recently granted derogation for gas safety inspections by one supplier, customers on the Priority Service Register (PSR) will continue to require two-year inspection cycles. Information published by Ofgem[50] indicates that around 8% of all gas and electricity customers in 2011 were on the PSR.

- Special visits

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

- Special meter read visits:

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

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

- Special safety inspection visits:

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

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

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

Table 3-6: Cost and benefit impacts from avoided site visits (per meter per year)[51]

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

50 http://www.ofgem.gov.uk/Sustainability/SocAction/Monitoring/SoObMonitor/Documents1/SOR%20annual%20report%202011.pdf

51 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.

Total cost:	**£6.73**	**£0.63**	**cost saving of £6.10**

The above costs and cost savings are applied to smart meters according to the roll-out modelling assumptions. Overall, avoided site visits account for £3,114m gross benefits in present value terms.

3.4.2.2 Reduction in inbound enquiries and customer service overheads

Call centre cost savings are a result of a reduction in billing enquiries and complaints. Smart meters will mean the end of estimated bills and this is expected to result in lower demand on call centres for billing enquiries. This assumption is unchanged and we assume this cost saving to be £2.20 per meter per year in the central scenario (£1.88 for reduced inbound enquiries and £0.32 for reduced customer service overheads). This estimate is in line with the original assumption developed my Mott MacDonald[52], which has been verified by suppliers at aggregate level. No new information was gathered and our assumption is based on previous supplier estimates that inbound call volumes could fall by around 30% producing a 20% saving in call centre overheads.

In total gross benefits of £1,231m in present value terms are expected from reduced call volumes.

3.4.2.3 Pre-payment cost to serve

Smart meters are expected to bring savings in the cost to serve customers with pre-payment meters (PPM). These savings arise primarily from avoided site visits to replace credit with pre-payment meters and vice versa. While the number of pre-payment customers as a proportion of the total population has remained relatively constant over time, there is a considerable churn within this subpopulation of households switching to pre-payment or back to credit. In a simplified way this can be envisioned as a constant pool of pre-payment meters, with a customer only being equipped with a pre-payment meter as a previous pre-payment customer switches to a credit meter. Ofgem reported a total of around 450,000 PPM installations in 2011[53], which can be avoided once smart meters are rolled out and meters can be remotely switched between credit and pre-payment functionality.

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

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

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

[53] http://www.ofgem.gov.uk/Sustainability/SocAction/Monitoring/SoObMonitor/Documents1/SOR%20annual%20report%202011.pdf

We assume that the additional cost to serve consumers with PPMs are currently £30 for electricity and £40 for gas. This is in line with the Energy Supply Probe Initial Findings Report published by Ofgem in December 2008 which shows that combined across gas and electricity, direct and service costs for a PPM customer are £88 higher than for a direct debit customer[54]. The introduction of smart metering would reduce (but not remove all) those additional costs. Our assumption is unchanged from that used previously. The level of savings attributed to smart meters is 40%, representing an annual saving of £12 for each electricity PPM and £16 for each gas PPM.

The present value of this benefit accrues to £1,097m.

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

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

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

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

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

[54] http://www.ofgem.gov.uk/Markets/RetMkts/ensuppro/Documents1/Energy%20Supply%20Probe%20-%20Initial%20Findings%20Report.pdf

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

Based on estimates originally derived by Mott MacDonald and since endorsed by energy suppliers, we estimate the per (credit) meter saving from better debt management to be £2.2 per year, resulting in a present value benefit of £1,054m.

3.4.2.5 Switching Savings

The introduction of smart metering will allow a rationalisation of the arrangements for handling the change of supplier process. Trouble shooting teams employed to resolve exceptions or investigate data issues will no longer be needed. Suppliers will be able to take accurate readings on the day of a change of supplier, resolving the need to follow up any readings that do not match and instances of misbilling will reduce.

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

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

Following analysis of responses to the request for information, we 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[55]), with registration being added to the scope some time after. A decision on the inclusion of data aggregation will be considered in the future. As set out in section

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

2.1.3, we have updated the assumption about when registration will be added to the remit of DCC from 2016 to 2017, with data aggregation added in 2019.

In total present value terms, switching savings generate £1,621m in gross benefits.

3.4.2.6 Theft

The implementation of smart metering could improve the ability for suppliers to detect and manage theft. Estimating theft is problematic by nature and levels of theft are difficult to quantify. Detailed analysis carried out by industry in 2010 suggested that levels of theft for gas and electricity come to 1.6 TWh and 5.5 TWh respectively. Using the DECC domestic retail energy prices, in 2012, this translates to a retail value of about £240 million each. In Ofgem's consultation response to their impact assessment on tackling gas theft[56] and in Ofgem's strategy consultation for the RIIO-ED1 electricity distribution price control[57], the value of gas and electricity theft in 2012 is estimated to be between £220m-£400m and £400m per year respectively.

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

In our central scenario we continue to assume that the roll-out of smart meters will reduce theft by 10%, which is also conservative given estimates that smart meters could reduce theft by 20-33% in previous consultation responses. We continue to assume that the amount of theft is likely to decrease as suppliers will have access to more accurate and frequent data and will detect theft more quickly; however we also recognise that new methods of theft will arise. Following standard Government practice, we value theft reductions for domestic customers at the resource rather than the retail value of energy, resulting in benefits of £0.29 per meter per annum for electricity and £0.36 per meter per annum for gas.

This results in present value gross benefit of £243m.

3.4.2.7 Remote disconnection

The meter functionality that is specified in SMETS will enable the remote enablement or disablement of the electricity and/or gas supply. The direct benefits associated with these capabilities are the avoided site visits in instances where an authorised supplier operator is despatched to a customer's premise to disconnect supply. The number of such instances per year is limited – Ofgem data for 2011 shows that 1,250 disconnections across both electricity and gas occurred - but are potentially costly as they might involve multiple personnel. A disconnection is most likely to occur where an indebted customer cannot be provided with a pre-payment meter. Ofgem have introduced licence changes as part of the Spring Package of regulatory measures to strengthen protections for consumers and there is no expectation that the number of disconnections will increase as a result of smart metering. The reflected benefit

[56] http://www.ofgem.gov.uk/Markets/RetMkts/Compl/Theft/Documents1/Gas%20Theft%20IA(2).pdf
[57] http://www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/riio-ed1/consultations/Documents1/RIIOED1SConOutputsIncentives.pdf

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 £240m over the appraisal period.

3.4.3 Network benefits

Assumptions about network benefits have been developed with the support of information provided by Ofgem. Since some of the benefits to networks impact regulated activities, future price control reviews and incentive schemes may need to take into account developments in the energy markets, including changes enabled or generated by smart metering.

Recent work with the Energy Networks Association (ENA) has also provided further assurance that the identified areas of network benefits are realistic. We will continue to work with the ENA to further test and verify the assumptions.

3.4.3.1Avoided 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.

The total present value gross benefits from avoided losses is £428m.

3.4.3.2 Outage detection and management for electricity DNOs

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

We have assumed that a critical mass of smart meters is required for these benefits to be realised. This is so that sufficient regional coverage is provided to identify the location and the scope of an outage. Reflecting updated information about the critical mass of meters required, the benefits are considered to be realised from 2014 onwards, at which point over one third of smart meters with outage detection functionality[58] will be installed (see section 2.1.6 for more detail). 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

[58] there will be no requirement for outage detection in the initial SMETS and early meters are therefore not counted towards the achievement of the critical mass.

outage to initially raise awareness of an issue. This notification would typically be provided by a customer calling the network operator to make them aware of an outage. However, once a Network Operator was made aware of an issue, then the functionality of the Smart Metering System would allow them to deal with the fault more efficiently. Only these basic outage management benefits were considered in the March 2011 IA. The August 2011 IA and consecutive versions increased the expected benefits to reflect additional cost savings from a "positive" outage notification functionality.

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

1. Reduction in customer minutes lost (CML):

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

In order to calculate benefits we valued the estimated reduction in customer minutes lost (CML) with the average CML price incentive under the Distribution Price Control Review 5 (DPCR5), running from April 2010 to 2015. The CML incentive rate reflects end customers' willingness to pay for quality of supply improvements with regards to a reduction in minutes lost. It also acts as one part of the overall interruptions incentive scheme for network companies to improve the quality of their service (the other part being the number of interruptions experienced). The distribution companies earn additional revenue if they beat their CML target (i.e. their CML for the year in question is lower than their target for that year) and suffer a reduction in revenue if their CML exceed their target. There are several methodologies available to estimate the value of quality of supply improvements to consumers, however as a measure of the benefits to Network Operators, this figure seems the most appropriate to use.

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

The present value gross benefits from a reduction in customer minutes lost is £101m.

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 assume 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 £178m.

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 did also provide data collected for its quality of service incentive regime 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 £33m.

3.4.3.3 Better informed investment decisions for electricity network enforcement

Having more detailed historical information will allow bottlenecks in the network to be identified more easily. Better planning data will result in investment in network reinforcement being better directed. Information received through the ENA cost benefit analysis[59] indicates that the required network enforcement investments might be reduced by 5 % through the availability of better information from smart meters, in particular historical data on power flow and voltage information. We have adopted this assumption for our base scenario. Our analysis uses the expected annual investment requirement figure from the fifth Distribution Price Control Review (DPCR5) as the baseline to reflect the latest information on expected costs from network investment[60]. This baseline investment figure reflects general reinforcement costs, attributable to normal increases in electricity demand from housing[61]. Hence, we do not model any benefits to DNOs from active demand control and real-time network management, and advanced notification to consumers of planned outages.

This results in an estimated £14m benefit in reduced investment expenditure per year, or £112m over the appraisal period.

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59 http://www.energynetworks.org/ena_energyfutures/ENA_HighLevel_SmartMeters_CostBenefitAnalysisV1_100713.pdf

60 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.

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

3.4.3.4 Avoided cost of investigation of customer complaints about voltage quality of supply[62]

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

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

3.4.3.5 Non-quantified DNO benefits

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

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

3.4.4 Benefits from electricity load shifting

Smart meters make time-varying and other sophisticated type of tariffs possible by recording the time when electricity is used, and by allowing two-way communications. Such tariffs can incentivise demand-side response (DSR) or load shifting[63], 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,

[62] 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.

[63] We here refer equally to DSR and load shifting.

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[64] 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[65]).

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

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

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

To assess the potential discretionary load, it is possible to disaggregate the components of domestic demand to provide a 'bottom-up' approach of electricity consumption by use type. Of total household demand, 'wet' goods (i.e. washing machine, dishwasher) are expected to provide in the short term the most probable base for load shifting – these account for 17% of household electricity consumption (DECC, 2009[66]). Additionally, those customers with higher than average discretionary consumption at peak time will also be presented with above average incentives for taking up ToU tariffs. It must be noted that some of the existing electric heating storage capacity, which provides discretionary load, is already utilised under Economy 7 tariffs, and therefore we do not account for electric heating storage as part of our bottom up calculation. We therefore estimate the current amount of discretionary load at present to be 20% of total consumption at peak (17% from wet appliances + 3% from above average incentives for those taking up ToU tariffs).

Over time, the introduction of heat pumps with storage capacity and more widespread charging of electric vehicles is likely to increase the total amount of load

[64] Sustainability First (2010).
[65] King, C and Delurey, D, *Twins, siblings or cousins? Analyzing the conservation effects of demand response programs. Public Utilities Fortnightly*, March 2005.
[66] DECC (2009) 'Energy Consumption in the UK'.

that can be shifted in the future in conjunction the take up of STOU tariffs which increase in attractiveness. Because these developments are likely to involve development of further policy, in our central scenario we only assume a slight increase (up to 24% by 2030 from 20% originally) in order to accommodate the business as usual (i.e. non-policy related) growth in number of electric cars (DfT, 2008[67]) and heat pumps.

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

This is in line with recent trials' results. The EDRP final report for instance presents two trials that tested the impact of TOU tariffs on electricity consumption. Those trials showed effects on load shifting from the peak period, with bigger shifts at weekends than on weekdays. Estimates of the magnitude of shifting effect vary with trial but were up to 10%.[68] The recent CER report on Irish smart meters trials[69] also found peak reductions of 8.8% due to the combination of different types of demand-side interventions and time of use tariffs. The ESMIG study suggest peak shifting of around 5% from TOU, and up to 16% with more sophisticated tariffs[70].

Sensitivities are made on the level of take up at 10% and 40%, and also on the potential discretionary load available to accommodate for higher levels of penetration of electric vehicles, growth in heat pumps with storage capacity and the introduction of smart appliances. These are not considered in our central case in order to avoid claiming benefits from developments which are likely to involve an extra cost over and above the business as usual case. For illustrative purposes we have assessed two scenarios[71] which consider such increases in discretionary load, leading to increases on benefits from load shifting by £135m and £550m respectively over and above the figures presented in the summary sheets of the IA.

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

3.4.4.1 Generation short run marginal cost savings from electricity demand shift

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

[67] DfT/ BERR (2008) 'Electric Vehicles'.
[68] Neither of the TOU tariff trials involved any automation of energy-consuming appliances to facilitate load shifting.
[69] CER (2011).
[70] E.g. 12% with Real-time pricing and Critical Peak Rebate and 16% with Critical Peak Pricing.
[71] In the mid scenario the penetration of electric vehicles is based on central projections by DfT (2008), whereas the high case also considers the introduction of smart appliances and heat pumps, based on central cases of market penetration from Kema (2010), DECC (2009), as well as the high case of penetration of electric vehicles (DfT, 2008).

The present value gross benefit of short run marginal cost savings is £114m.

3.4.4.2 Generation capacity investment savings from electricity demand shift

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

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

The expected present value benefits are £631m.

3.4.4.3 Network capacity investment savings from electricity demand shift

Lower peak demand due to the expected uptake of static TOU tariffs also means that long term capacity investment in networks can be reduced, as peak loads will be lower than at business as usual levels. If consumers shift to off-peak consumption some of the investment in capacity will be unnecessary, therefore realising savings to energy utilities. Network savings from energy demand shift are also estimated[72]. For distribution, we use the expected annual investment requirement figure from the DPCR5 as the baseline[73]. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing.[74] Consequently, we do not account for potential additional benefits driven by more responsive demand solutions to minimise the impact of significant penetrations of EV and HP, for which DNOs would require real time data.

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

3.4.4.4 Carbon savings from electricity demand shift

Some studies (Sustainability First, 2010; Ofgem, 2010), show that peak load shifting could lead under some scenarios to carbon savings, as the generation mix during the peak period is typically more carbon intensive than off-peak. We assume that overall, peak demand is on average more carbon intensive than off-peak demand, and therefore we present modest savings from the reduced cost of purchasing EU ETS permits to the UK economy arising from an on average less carbon intensive generation mix. Carbon reductions are valued following IAG guidance, with marginal emissions factor differentials between peak and off-peak assumed to be those for coal and gas respectively, at 0.30 and 0.18 kg CO_2/ kWh.

The expected present value benefit is £26m.

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

[73] 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.

[74] 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.

3.4.5 Carbon related and UK-wide benefits

3.4.5.1 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 14.5).

For electricity, reductions in energy use will mean the UK purchasing fewer (or selling more) EU ETS allowances and this saving is assimilated as a benefit. In our analysis it accounts for PV benefits of approximately £168m.

For gas, the value of carbon savings from a reduction in gas consumption uses the non-traded carbon prices under DECC's carbon valuation methodology. This corresponds to a net reduction in global carbon emissions and corresponds to benefits of approximately PV £726m.

3.4.5.2 Reduction in carbon emissions

Over the period covered in the IA, we assume that as a result of a reduction in energy consumption, CO_2 emissions reductions will take place in the traded and non-traded sectors[75]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

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

EU ETS permits savings (Millions of tonnes of CO_2 saved equivalent) – traded sector	Millions of tonnes of CO_2 saved – non-traded	Avoided cost of carbon – electricity (£bn, PV)	Avoided cost of carbon – gas (£bn, PV)
9.52	15.42	0.2	0.7

3.4.6 Air quality benefits

As outlined in section 2.1.2, this new benefit item has been added to the analysis. Air quality improvements deliver benefits of £74m in present value terms.

3.4.7 Non-quantified benefits

It has been possible to make a quantitative assessment of the benefits described above. However there remains an important and substantive subset of benefits where the existence of smart metering will facilitate the uptake or management of

[75] 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.

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 benefits from the roll-out.

3.4.7.1 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[76].

Building smarter grids is an incremental process of applying communications technology to deliver more dynamic real time flows of network information and more interaction between suppliers and consumers. This will be important in 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. To that effect, it has undertaken work across a number of teams within DECC, including the Smart Meter team, which has benefitted from inputs from external stakeholders including the Smart Grids Forum[77].

There have been a number of attempts to quantify potential benefits arising from a smarter grid[78]. Accenture carried out in 2009 cost benefit analysis of smart grid investments on behalf of DECC and the ENSG (Electricity Networks Strategy Group) and found a positive business case for smart grid investments[79]. 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 was 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

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

[77] 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.

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

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

between £0.5 - £10bn NPV from 2020 - 2030[80]. Their analysis assumes that meeting the Government's emissions and renewables targets would lead to higher peak loads of up to 92% due to the electrification of transport and heating (electric vehicles and heat pumps) under a business as usual scenario, requiring more investment in network reinforcement infrastructure to accommodate this. By optimising electric vehicle charging and the use of heat pumps and smart appliances (by shifting towards off-peak times), the peak increase would only be 29%. This would bring significant benefits due to reductions in the network reinforcement costs required.

The Smart Grids Forum commissioned in 2011 the development a cost-benefit evaluation framework to explore the value drivers for smart grids against business as usual alternatives. The framework was published in March 2012[81], and has benefited from the input of key stakeholders. The Programme and ENA continue to examine the developments in the evidence base to establish the extent to which the roll-out of smart meters can facilitate or directly deliver smart grid related financial benefits to electricity network operators. The work to quantify these benefits is still underway, so they remain unquantified in this iteration of the Impact Assessment.

Finally, DECC has commissioned Redpoint and Element Energy to carry out benefits analysis of different DSR schemes (static and dynamic tariffs), through smart meters[82]. The project considered potential benefits in three areas:

• Operational cost savings in terms of variable generation costs (fuel, carbon emissions, variable O&M)
• Avoided peak generation investment costs arising from reductions in peak demand
• Avoided DNO reinforcement investment costs arising from reductions in peak demand

The most significant potential savings have been found to be associated with reducing investment in peak plant and DNO reinforcement, as well as reduced operational generation costs. Only network benefits directly driven by the roll-out of smart meters have been considered in this IA, while potential smart grid benefits are not included.

3.4.7.2 Competition

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

[80] ENA and Imperial College London (2010) ' Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks.
[81] It is available on the Smart Grid Forum website: http://www.ofgem.gov.uk/Networks/SGF/Pages/SGF.aspx
[82] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/future-elec-network/5759-electricity-system-analysis--future-system-benefit.pdf

While we judge that greater levels of competition may result in lower prices, it is difficult to quantify these competition-related benefits 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 14.1).

3.4.7.3 Future products

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

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

4 Domestic Results

4.1 Costs, benefits and NPV

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 2013-2030. The cost numbers are risk-adjusted, i.e. they have been adjusted for optimism bias (see section 4.3.1 on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios (see section 4.3.2). Section 4.2.1 shows the impact of smart meters on energy bills of domestic customers. This builds on existing DECC modelling on energy prices to estimate the impact of the deployment of smart meters on domestic energy bills in cash terms.

The base year of the analysis is 2013. Cost and benefit information is however reflected in 2012 real prices.

Table 4-1: Total costs and benefits

Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
11.47	15.86	4.40

Table 4-2: Consumer and supplier benefits

Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
4.60	10.28	1.00	15.86

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

Total Costs £bn	**Total Benefits £bn**			**Net Present Value £bn**		
	Low	**Central**	High	Low	**Central**	High
11.47 (+/- 0.018)[83]	11.39	15.86	20.61	-0.06	4.40	9.13

[83] Total costs change marginally with changes in the benefit scenario. The net present values reported here are those produced by the model and reflect the marginal changes in cost.

Table 4-4: Benefits

Consumer Benefits £bn			Business Benefits £bn			UK-wide Benefits £bn		
L	**C**	H	L	**C**	H	L	**C**	H
2.20	4.60	6.92	8.79	10.28	12.12	0.44	1.00	1.57

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, remains constant at 1.4 in the central scenario, with a value of 1.8 in the high scenario and of 1.0 in the low case scenario.

4.2 Distributional impacts

4.2.1 Consumer impacts of smart meters

We expect any costs to energy suppliers to be recovered through higher energy prices, although any benefits to suppliers and networks will also be passed on to consumers[84]. The results below show the average impact on GB household energy bills. It is expected there will be variation between households depending on the level of energy they save and on how suppliers decide to pass through the costs.

The results show long term reductions in energy bills for customers. By 2020, once the roll-out is complete, we expect savings on energy bills for the average dual fuel costumer of around £24 per annum.

In the short term, transitional costs from the roll-out will be passed down to consumers, and energy savings will only be realised by those consumers who have already received a smart meter. We estimate that this will result in an average bill increase of £7 by 2015, when bill increases are expected to peak. From 2017 onwards, as most consumers start realising the benefits, and transition and stranding costs decrease, the net impact of smart meters on the average electricity and gas customer will be a reduction in bills. By 2030 we estimate average bill savings will be approximately £39 per household (Table 4-5).

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

	Residential dual fuel bill impact, £
2015	7
2020	-24
2025	-33
2030	-39

The price impacts of smart meters in the domestic sector are detailed in Table 4-6 below. The price impact per unit of energy (i.e. the impact before energy savings are

[84] 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.

accounted for) is expected to be positive during the mass roll-out period. After 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 2024.

Table 4-6: Price impacts on domestic energy bills

	Electricity	**Gas**
Year	**price impact (£/MWh) (Inc VAT)**	**price impact (£/MWh) (Inc VAT)**
2015	**1.61**	**0.46**
2020	**0.71**	**0.20**
2025	**-0.23**	**-0.07**
2030	**-0.95**	**-0.29**

For the calculation of bill impacts we have assumed a conservative scenario in which stranding costs (which are further outlined in section 4.2.2) are ultimately borne by consumers. This implies that suppliers would continue to charge a metering element for the traditional equipment in addition to the metering element of the smart equipment through their energy prices. Since stranding costs are sunk costs they are not included in the remaining cost benefit calculations in this IA.

In order to maintain consistency with the price and bills impacts analysis in previous Impact Assessments, our analysis estimates the impact of the smart meter roll-out on a baseline which includes the impact of policies firmly set before the smart meter roll-out mandate was announced. The bill impacts presented in this IA differ from those presented in the November 2011 DECC publication 'Estimated impacts of energy and climate change policies on energy prices and bills'[85], which considers policy impacts on a baseline which includes the impact on consumption and prices of all policies except smart meters. Such an approach gives, all else being equal, greater bill saving projections (and lower bill increases in early roll-out years) from smart meters, due to the higher baseline price, so the figures presented above may be understating the benefits seen by consumers.

We assume all costs and cost savings to be passed down to customers given competitive pressures on suppliers. This includes networks (losses, better outage management), generation and transmission (load shifting) and other industry parties (customer switching rationalisation).

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

It is important to note that there may be further impacts on consumer bills for those customers who take advantage of peak/off-peak price differentials offered by smart tariffs and take up time of use tariffs. These distributional impacts have not been

[85] http://www.decc.gov.uk/en/content/cms/meeting_energy/aes/impacts/impacts.aspx# ; this publication is expected to be updated in early 2013.

included in the calculation above. Analysis by the Brattle Group[86] in the US indicates that low income customers tend to benefit more than average from time-of-use tariffs. No analysis has been done in a UK context, however anecdotal feedback from suppliers is that low income customers on average tend to have flatter usage profiles and hence would benefit from taking up time-of-use tariffs through bill reductions even without changing their consumption patterns.

4.2.2 Stranding costs

Stranding costs are the costs incurred when a meter is taken out of service before the end of its expected economic life. This does not include the costs of removing old meters and installing new meters, but includes the costs from an accelerated depreciation of the asset (i.e. reduced length of the meter's life). This cost is dependent on the speed of the roll-out option; we assume it would be largely avoided in a new and replacement scenario, but costs would occur in a 20-year or shorter roll-out option (the life span of a traditional meter 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 from the replacement of traditional metering equipment before it reaches the end of its life. However, stranding costs do not affect the net economic impact, since existing meter costs have already been incurred in the counterfactual and are sunk. Therefore, they are not reflected in the calculation of net benefits from the roll-out of smart meters. Even though the distributional impact of stranding costs will depend on contractual arrangements, we take a conservative approach assuming that consumers will ultimately bear these costs, and reflect these in the estimation of the energy price impacts (as presented in section 4.2.1).

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

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.

[86] http://www.brattle.com/_documents/UploadLibrary/Upload936.pdf

This potentially overestimates stranding costs since suppliers might have commercial incentives to deploy a more targeted replacement strategy. We estimate stranding costs of £611m in present value. These have decreased by £93m due to a more back-loaded smart meter roll-out profile than previously modelled.

4.2.3 Better regulation

Administrative burden
We have identified 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. Following the submission of detailed evidence from energy suppliers this methodological approach was agreed with the Better Regulation Executive (BRE). The smart meters roll-out will bring forward the replacement of metering equipment and as such notifications to customers of such planned visits. Such potential effect remains unquantified in this Impact Assessment.

A small administrative burden from having to submit data for monitoring and evaluation purposes has been identified. This amounts to £1m between now and 2020 and is further detailed in section 3.3.8.2.

The Government 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. There will be no targets set with regards to the number of meters that suppliers have to install, in the Foundation Stage allowing them to take decisions based on commercial considerations and without having to fulfil a mandate. Similarly the decision has been taken to give suppliers to 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.

Micro-business exemption
The available evidence indicates that no energy supply business (the type of company immediately affected by the obligations) falls into the definition of a micro-business. The Smart Meter Implementation Programme therefore does not propose to include a micro-business exemption in the regulations.

Sun-setting or statutory review clauses
We have considered the case for sun-setting of the regulatory interventions required for smart metering. These interventions are intended to set out an enduring framework for the effective provision and operation of smart metering and, as such, are not candidates for sun-set clauses. In particular interoperability of equipment deployed by different suppliers cannot be expected to become business as usual at any point in the future and therefore sun-setting is not appropriate. DECC will keep all smart meter regulation under review as policy is developed further – as stated in section 13, the Programme is committed to a comprehensive review and evaluation process, both during the initial Foundation Stage as well as towards the end of the main roll-out.

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[87] were commissioned to consider these issues, in particular to provide:

- Assessment of the international and domestic evidence available;
- Development of a risk matrix based on the identification of key risks, their potential impacts and mitigation actions;
- Assessment of the sensitivity of these risks to market model and duration of the roll-out;
- Assessment of the treatment of risk in the April 2008 IA; and
- Make recommendations, in light of the above.

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA. Table 4-7 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 & commercial risk	20%
IT CAPEX	10%
IT OPEX	10%

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

Since then, new cost uplift factors have been introduced and applied to meters deployed early during the Foundation stage. These factors are presented in section 3.3.10.

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[88].

4.3.2 Benefits: sensitivity analysis

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

Table 4-8: Sensitivity analysis for benefits

	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1.5%	2.8%	4.0%
Energy savings gas	1.0%	2.0%	3.0%
Energy savings gas PPM	0.3%	0.5%	1.0%
Business benefits			
Supplier benefits			
Avoided site visit	underlying visit cost + 8%	underlying visit cost	underlying visit cost - 8%
Call centre savings	£1.9	£2.2	£2.5
Avoided PPM COS premium	30%	40%	50%
Reduced theft	5%	10%	15%
Network benefits			
Avoided investment from ToU (distribution/transmission)	10%	20%	40%
Reduction in customer minutes lost	2%	10%	15%
Operational savings from fault fixing	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.

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

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

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1,475	3,012	4,429
Energy savings gas	651	1,543	2,459
Business benefits			
Supplier benefits			
Avoided site visit	2,855	3,114	3,374
Call centre savings	1,083	1,231	1,385
Avoided PPM COS premium	823	1,097	1,371
Reduced theft	122	243	365
Network benefits			
Avoided investment from ToU (distribution/transmission)	28	42	70
Reduction in customer minutes lost	20	101	151
Operational savings from fault fixing	44	178	267
Better informed enforcement investment decisions	56	112	224
Avoided investigation of voltage complaints	19	39	58
Reduced outage notification calls	11	33	44
Generation benefits			
Short run marginal cost savings from ToU	60	114	223
Avoided investment from ToU (generation)	323	631	1,245

5 Domestic sector detailed results

Table 5-1: Domestic sector detailed results from the model (in £million) for the central case scenario:

Total Costs		**11,466**	**Total Benefits**		**15,863**
In premise costs		7,717	**Consumer benefits**		4,590
	Meters & IHDs	4,135		Energy saving	4,555
	Installation of meters	1,746		Microgeneration	35
	Operation and maintanance of meters	685	**Business benefits**	Supplier benefits	8,601
	Communications equipment in premise	1,150		Avoided site visits	3,114
DCC related costs		1,680		Inbound enquiries	1,049
	Data services and internal capex	101		Customer service overheads	182
	Data services and internal opex	287		Debt handling	1,054
	Communications service charge	1,291		Avoided PPM COS premium	1,097
Suppliers' and other participants' system costs		852		Remote (dis)connection	240
	Supplier capex	392		Reduced theft	243
	Supplier opex	295		Customer sw itching	1,621
	Industry capex	77		Netw ork benefits	931
	Industry opex	88		Reduced losses	428
Other costs		1,217		Avoided investment from ToU (distribution/transmission)	42
	Energy	734		Reduction in customer minutes lost	101
	Disposal	20		Operational savings from fault fixing	178
	Pavement reading inefficiency	206		Better informed enforcement investment decisions	112
	Organisational	170		Avoided investigation of voltage complaints	39
	Marketing	87		Reduced outage notification calls	33
NPV		***4,397***		Generation benefits	745
				Short run marginal cost savings from ToU	114
				Avoided investment from ToU (generation)	631
			UK-wide benefits		995
				Global CO2 reduction	726
	(Stranding costs	611)		EU ETS from energy reduction	168
				EU ETS from ToU	26
				Air Quality	74

Part C: Smart meter roll-out for the non-domestic sector

Summary: Analysis & Evidence — Policy Option 1

Description: Within the context of a supplier led roll-out of smart meters with a centralised data and communications company , this IA reflects a roll-out completion date in December 2019 and models the implementation route for the remainder of Foundation and mass roll-out with a two staged specification of the smart metering equipment. It reflects cost and benefit implications from the Smart Meter Technical Specifications.

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 1,448	**High:** 3,070	**Best Estimate: 2,262**

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	-6		50	**649**

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

Metering equipment costs and its installation and operation amounts to £416m. Communications equipment costs amount to £208m. 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		159	**2,097**
High	0		282	**3,719**
Best Estimate	0		221	**2,911**

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

Total consumer benefits amount to £1.72bn and include savings from reduced energy consumption (£1.71bn), and microgeneration (£7m). Total supplier benefits amount to £466m and include avoided site visits (£259m), and reduced inquiries and customer overheads (£63m). Total network benefits amount to £117m and generation benefits to £49m. Carbon-related benefits amount to £534m. Air quality improvements amount to £30m.

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

These include benefits from further development of the energy services market and the potential benefits from the development of a smart grid. Smart metering is likely to result in stronger competition between energy suppliers due to increased ease of consumer switching and improved information on consumption and tariffs. An end to estimated billing and more convenient switching between credit and pre-payment arrangements will improve the customer experience.

Key assumptions/sensitivities/risks — **Discount rate** 3.5%

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.

Annual profile of monetised costs and benefits (undiscounted)*

£	2013	2014	2015	2016	2017	2018
Total annual costs	7,343,961	11,212,648	21,661,417	38,194,570	57,105,245	74,795,529
Total annual benefits	27,808,123	46,477,942	80,296,185	127,163,469	180,827,641	231,720,552

£	2019	2020	2021	2022	2023	2024
Total annual costs	85,792,401	79,277,161	73,207,298	67,363,658	61,482,363	55,741,836
Total annual benefits	288,025,722	285,915,536	285,613,421	285,826,015	283,670,198	282,626,898

£	2025	2026	2027	2028	2029	2030
Total annual costs	50,094,158	44,452,635	40,373,722	36,184,274	32,807,439	31,012,018
Total annual benefits	286,296,770	283,225,854	278,492,540	277,727,846	273,331,257	268,926,410

* 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	0.02	0.45	1.11
	Non-traded	0.04	1.25	3.62
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	0.02	0.45	1.11
	Non-traded	0.04	1.25	3.62
Cost effectiveness	% of lifetime emissions below traded cost comparator	100%		
	% of lifetime emissions below non-traded cost comparator	100%		

6 Evidence Base

6.1 Overview

In this section we describe the main assumptions underpinning the analysis and the reasons for them with references to the evidence where appropriate.

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. The realisation of most benefits will occur as more smart meters are installed in consumers' premises, so they are modelled on a per meter basis and are linked to the roll-out profile.

6.2 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.

6.2.1 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[89], 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:

- IT system costs are fully allocated to the domestic sector
- 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

[89] Published in parallel to this document, see: DECC website, http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx.

- 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, where no DCC is assumed to be in place, equivalent cost uplifts are 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 6.5.2.6 for further details).
- We assume limited benefits for those smart/advanced meters that elect to operate outside of the DCC (see section 6.3.2 for further details).
- The critical mass required for outage detection benefits to start incurring takes into account both domestic and non-domestic installations[90].

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 because of this apportionment.

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 6.3 below.

6.2.2 Meter numbers and non-domestic energy consumption baseline

We continue to 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[91] 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.

[90] However, benefits accredited in the non-domestic sector are proportional to the non-domestic number of installations.
[91] See DECC website, http://www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx.

Table 6-1: 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	

6.2.3 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 consensus that there is little likelihood, now or in the medium-term, of an economically viable smart solution for a number of larger ("U16") gas meters. Current transformer electricity meters can also not be given smart functionality. [92] For these meters, advanced metering will be required instead. In light of the large proportion of gas meters that is already assumed to be advanced, we have not revised our modelling assumptions. Once advanced meters installed under the above mentioned exemptions reach the end of their lifetime, they will (with the exception of U16 and current transformer meters) 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 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 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. This approach is more common in the non-domestic sector, especially amongst customers with a number of sites. These providers have grown in number over recent years and offer a service tailored to customers' 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 6.3.1 for further details).

[92] This affects around 25,000 current transformer meters and 400,000 larger gas meters .

It is assumed that by 2020 the split between smart and advanced meters will 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 6-2: 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[93]	£0.8	£0.8
Theft	N/A	N/A
Remote switching and disconnection	0%	0%
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

6.2.4 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. 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

[93] 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.

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 97.5% of all non-domestic smart electricity meters and 75% of all non-domestic smart 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. Advanced metering systems are not assumed to use DCC services.

<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[94], translation[95] and scheduled data retrieval functions[96].
- Additionally to the "Minimum scope", registration could be added to the remit of DCC, which would mean that DCC should assume responsibility for 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.

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

Consistent with the domestic analysis, for those meters that would use DCC the benefits are adjusted before Q3 2014 at which point the DCC is implemented in its initial 'minimum' scope.

6.3 Counterfactual

A counterfactual case has been constructed. This assumes no Government intervention in profile classes 3 and 4 electricity meters and non-domestic gas meters with consumption 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[97]

6.3.1 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

6.3.2 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 in accordance with meters opted out of DCC.

6.3.3 Energy consumption in the counterfactual

For the non-domestic counterfactual the analysis uses the energy consumption baseline described above in section 6.2.2, hence assuming stable levels of energy consumption per non-domestic meter going forward.

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

6.4 Costs of smart metering

We classify the costs associated with the smart meters roll-out in the following categories: meter and IHD capital costs; communications equipment in the 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.

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[98]. It is assumed that a Wide Area Network (WAN)[99] 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.

6.4.1 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.

Table 6-3: Costs of equipment / installation in the premise (per device)

Component	Asset cost	Installation costs[100]	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	£44.95	£29	£1.1
Smart meter gas	£59	£49	£1.5
IHD	£15	-	-
Communications equipment	£25.6	N/A	£5.3
Total cost per dual fuel premise[101]	**£212.55**		

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.

Smart meters

Following the revision of the technical architecture the need for additional memory and processing power (for gas meters only) has been identified (see section 2 for a

[98] 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.
[99] A WAN is a communications network that in this case spans from the smart meter to the DCC.
[100] 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.
[101] Total cost for a dual fuel premise that has electricity and gas smart meters installed.

detailed discussions). Cost estimates for gas meters and electricity meters have been increased by £3 and £1.95 respectively.

Advanced meter

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[102]. 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 are lower than those we have modelled, the effect would be to increase the overall net present value of the policy[103].

Retrofit advanced

This option means that the dumb meter is not replaced, but is read remotely by a device such as a pulse-reader that is retrofitted 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 meter asset cost and that maintenance is 2.5% of the meter asset cost.

In-Home Displays (IHDs

In this sector, information would be provided in a variety of ways. Customers, particularly smaller customers, may ultimately use a stand-alone consumer access device (performing an equivalent function to an IHD), that is connected to the metering system via a HAN. However, many customers will use internet-based tools to access information, and this approach appears to be the default among current smart installations in this sector.

For the non-domestic cost modelling, we assume only one device per dual fuel customer, as we do for electricity-only customers. For 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 £281m.

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

[102] BERR, 'Impact Assessment of Smart Metering roll-out for Domestic Consumers and for Small Businesses', *2011*: www.berr.gov.uk/files/file45794.pdf .

[103] 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.

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

Operating and maintenance costs accrue to £40m in present value terms.

Communications equipment

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. We present below the component cost scenario of modelling standalone communication hubs in all premises.

Table 6-4: 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[104]
Total cost of communication equipment	**£25.6**

Gross present value communications equipment costs are £102m.

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 property with both fuels. 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 6-5: 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 £96m over the appraisal period.

Installation costs do not include any potential value of the time spent by consumers who need to be present for the installation visit. This is because meter installations would have also taken place in the counterfactual, as traditional metering equipment reaches the end of its lifetime and needs to be replaced. The roll-out of smart meters will result in an acceleration of such instances as the replacement cycle, which would normally be spread over 20 years will be more compressed . This effect, which

[104] 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.

remains unquantified, only results in bringing forward any such potential time spent by consumers when the meter is replaced rather than in creating a new cost. It is also important to reflect that there are significant convenience gains for consumers relating to potential time gains which are also not quantified in the IA. Such benefits arise for example from not having to be present for a meter read, spend time submitting a read on-line, or from not needing to be present for a meter to be changed between credit and prepay modes.

Development of equipment cost over time

We continue to use the cost erosion assumptions used in previous IAs and modelled 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.

6.4.2 DCC related costs

DCC related costs are broken down into three broad categories:

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

Data services and internal capital expenditure (capex)

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.

Data services and internal operational expenditure (opex)

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.

Communications service charges

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 £106m over the appraisal period.

6.4.3 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.

6.4.4 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 £24m 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.

6.4.5 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 £30m.

6.4.6 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 for 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. These reads are treated as an additional cost per meter and the costs are spread across the roll-out. The assumptions underlying these costs have not been changed at this point in time.

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 - £9m, i.e. reflecting *avoided* costs of £9m (compared to the counterfactual).

6.4.7 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 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. Present value costs amount to £3m.

6.4.8 Legal and organisational costs

These costs are fully accredited to the domestic sector.

6.4.8.1 Foundation security costs

These costs are fully accredited to the domestic sector (through the legal and organisational costs).

6.4.8.2 Monitoring and evaluation data submission costs

These costs are fully accredited to the domestic sector (through the legal and organisational costs).

6.4.9 Costs associated with consumer engagement activities

Work on the CES since August 2011 has highlighted the possibility of some engagement activities targeting segments of the non-domestic sector, such as micro-businesses. The CES Government Response document has concluded that the CDB should initially be required to engage micro-business consumers, where steps taken for domestic consumers can be adapted and supplemented. It is envisaged that the CDB's activities will principally involve ensuring that consistent and accurate information on smart meters is readily available. A power has also been included in the associated Licence Conditions that will enable the Secretary of State to require the CDB to extend its focus beyond micro-business to other small and medium-sized businesses if evidence justifies this at a later date. More evidence will be collected during the Foundation stage and we will continue to keep the needs of this sector under review. This policy decision does not impact on the costs associated with the CES outlined in previous versions of the IA and the existing cost assumptions are fully apportioned to the domestic analysis.

6.4.10 Cost arising from uncertainty during early Foundation Stage

Smart meters will be installed in two stages: the Foundation Stage and Mass Roll-out Stage. The Foundation Stage started in April 2011 and is due to end with the start of mass roll-out in late 2014. On the basis of information received from suppliers, the Government expects a significant number of smart meters to be installed during the Foundation Stage.

The Government's April 2012 Programme Update (the April Update)[105] confirmed the intention that equipment that complies with the version of the Smart Metering Equipment Technical Specification (SMETS) that is extant at the time of installation will count towards suppliers' roll-out obligations. In addition, meters installed prior to the designation of the first technical specification (SMETS1) that comply with SMETS 1 as designated will count towards suppliers' roll-out.

There are a number of benefits from early roll-out activity and counting Foundation meters towards suppliers' roll-out obligations. In particular this:

- 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);

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

- 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.

For meters installed during the Foundation period Government is currently consulting on proposals around smart change of supplier and enrolment and adoption[106]. Proposals brought forward regarding the smart change of supplier process aim to provide greater clarity for suppliers and meter asset providers (MAPs) in relation to the process for agreeing rental terms. Regarding enrolment and adoption the Government is inviting views whether there is a case for mandating enrolment. These proposals are aimed at mitigating some potential risks arising from initial SMETS meters.

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 3.4.3.2 for further detail), an absence of this functionality from early meters could result in a delay in the realisation of outage management benefits.

- DCC adoption and enrolment
  There is some uncertainty as to how meters installed before the DCC is operational will be integrated into the smart metering system. This may result in additional costs if actions are required to bring such early meters into the DCC or if they have to be operated at greater cost outside the DCC. Government is currently consulting on proposals for the adoption criteria and also for the allocation of potential costs. In addition to being applied to meters installed early during the Foundation Stage, for the non-domestic analysis this

[106] http://www.decc.gov.uk/en/content/cms/consultations/found_smt_mkt/found_smt_mkt.aspx

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.[107]

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

For the functionality differences – the lack of outage notification from initial SMETS meters – the impact is not translated into a cost increase factor but directly applied to the roll-out modelling. Meters installed ahead of availability of enduring SMETS meters will not provide outage notification functionality. This is modelled by adjusting the point in time from which network operators will have sufficient coverage of outage management functionality to realise savings. 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.. 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.

Table 6-6: 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 hub** **- Meter[108]** **- IHD** **- Installation**
DCC risk	Risk of communication Wide Area Network charge increase for those early meters and/or those that elect to operate outside of DCC[109]	**30% uplift to:** **- Communications Wide Area Network charge for installations outside of DCC[110] as well as early installations**

[107] Utilisation of the DCC is voluntary in the non-domestic sector since there are already some established communications service providers.
[108] Note that this uplift is applied to both smart and advanced meters in the non-domestic case.
[109] 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.
[110] 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.

6.5 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 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.

6.5.1 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 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.

6.5.1.1 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, work to test the magnitude and persistence of energy savings from smart metering in SMEs is planned.
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[111]. Expected energy savings are applied to the tailored non-domestic energy baseline as described in section 6.2.2 above.

Rebound effects are necessary to accurately estimate net energy savings. When physical or theoretical energy savings potentials are used for the analysis (e.g. the efficiency gain effect of a certain strength of insulation), rebound effects have to be explicitly estimated and subtracted from the theoretical estimate. The real, net energy savings effect in such cases will always depend on the behaviour that the consumer displays as a result and income gains from increased energy efficiency might well partly be spent by increasing the consumption of the energy service (so called comfort taking).

However, the approach taken for the estimation of smart meter energy savings is fundamentally different and is based on trial results, i.e. observed impacts. These observed values are net of any potential comfort taking and rebound effects are therefore not appropriate to apply to the smart meter energy savings estimates.

A second source of change in consumption patterns enabled by smart meters is a shift of energy demand from peak to off-peak times. Even though this shift will likely result in bill reductions for those taking up TOU tariffs, bill savings for some customers may be offset by bill increases for other customers, as the existing cross-subsidy across time of use unwinds. Benefits from load shifting are therefore valued in the IA to the extent that they 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.

The total value of this benefit over the appraisal period amounts to £1,708m.

6.5.1.2 Microgeneration

We estimate the savings from using smart meters to deliver export information from microgeneration devices. We have done that by estimating the number of microgeneration devices that will be in use by 2020 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.

The total value of this benefit over the appraisal period amounts to £7m.

6.5.2 Supplier benefits

The following sets out the range of benefits and cost savings the energy supply industry is expected to realise. Energy suppliers have validated in workshops and bilateral meetings that the supplier benefit assumptions, at an aggregate level across the industry, are valid and achievable. Individual suppliers may have different commercial positions but recognise that assumptions made are representative of the industry as a whole.

6.5.2.1 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

[111] DECC, 'Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal and Evaluation', 2012: http://www.decc.gov.uk/en/content/cms/consultations/sm_evaluation/sm_evaluation.aspx#

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. 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. 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). supplier has recently been granted from Ofgem a derogation on its obligation to carry out gas safety inspections every two years and instead to move to a risk based approach. Ofgem has also expressed an intention to review the existing meter inspection regime with a view to implementing new arrangements that facilitate the benefits of smart metering[112].

For modelling purposes we have made assumptions on the costs to suppliers of carrying out safety inspections after the roll-out of smart meters. The model assumes a new risk-based regime to apply to all meters 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)

[112] http://www.ofgem.gov.uk/Markets/sm/metering/tftm/roma/Documents1/Open%20Letter%20-%20British%20Gas%20Two%20year%20metering%20inspection%20derrogation%20application.pdf

- Approach of scheduled appointments with £17.5 cost per successful visit[113]

There is 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). Under the recently granted derogation for gas safety inspections by one supplier, customers on the Priority Service Register (PSR) will continue to require two-year inspection cycles. Information published by Ofgem[114] indicates that around 8% of all gas and electricity customers in 2011 were on the PSR.

- Special visits

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

- Special meter read visits:

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

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

- Special safety inspection visits:

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

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

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

Table 6-7: Cost and benefit impacts from avoided site visits (per meter per year)[115]

Visit type	Current world cost	Smart world cost	Effect
Regular meter read	£6 per credit meter pa, £0 per PPM meter pa	None	saving

[113] 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.

[114] http://www.ofgem.gov.uk/Sustainability/SocAction/Monitoring/SoObMonitor/Documents1/SOR%20annual%20report%202011.pdf

[115] 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.

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 above costs and cost savings are applied to smart meters according to the roll-out modelling assumptions. Overall, avoided site visits account for £259m gross benefits in present value terms.

6.5.2.2 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). This estimate is in line with the original assumption developed my Mott MacDonald[116], which has been verified by suppliers at aggregate level. 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 £62m in present value terms are expected from reduced call volumes.

6.5.2.3 Pre-payment cost to serve

The non-domestic analysis does not assume any prepayment meters in non-domestic premises and therefore does not consider non-domestic benefits from such meters.

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

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

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

For energy suppliers, two core functionalities will drive debt management benefits. On the one hand more frequent and accurate consumption data for billing purposes will enable suppliers to identify customers at risk of building up debt sooner and will enable them to discuss and agree reactive measures. The supplier might for example

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

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

There is evidence indicating that business to business costs such as utilities constitute a large proportion of businesses' cost structure and that volatility of energy costs year-on-year is an issue for businesses. This highlights the importance of energy costs for businesses, as well as factors increasing the risk of debt. While there are no precise figures for energy debt in the non-domestic sector it can nonetheless be deduced from the information available that energy debt is an issue. Data from Consumer Focus[117] indicates that non-domestic disconnections as a result of unpaid debt have been on the rise, which demonstrates that non-domestic energy debt occurs and results in costs for suppliers and inconvenience for non-domestic customers. Consumer Focus has issued a follow-up request to suppliers and we will examine new evidence when it becomes available.

We also expect further evidence on non-domestic debt to become soon available as part of Ofgem's work on the non-domestic sector following the Spring Package consultation. Ofgem has issued a request to suppliers to provide data on an ongoing, quarterly basis covering the total number of disconnections and pre-payment meters installed in the non-domestic sector, which might also provide evidence on debt issues in this sector. The first return is due in the first half of 2012. We will examine this evidence when it becomes available.

Based on estimates originally derived by Mott MacDonald and since endorsed by energy suppliers, we estimate the per meter saving from better debt management to be £2.2 per year, resulting in a present value benefit of £53m.

6.5.2.5 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 3.3.2, the Programme carried out an extensive request for information in 2010 to determine the costs and benefits that the energy industry expects from the establishment of the smart metering system and the DCC.

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[117] Consumer Focus: Small business, big price Depth interviews with disconnected micro-business energy customers, Andrew Hallett (2011)
http://www.consumerfocus.org.uk/files/2011/05/Small-business-big-price.pdf

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 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[118]), with registration being added to the scope some time after. A decision on the inclusion of data aggregation will be considered in the future. As set out in section 2.1.3, we have updated the assumption about when registration will be added to the remit of DCC from 2016 to 2017, with data aggregation added in 2019.

In total present value terms, switching savings generate £84m in gross benefits.

6.5.2.6 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.

6.5.2.7 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 2011 shows that 1,250 disconnections across both electricity and gas occurred - 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

[118] 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.

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.

6.5.3 Network benefits

Assumptions about network benefits have been developed with the support of and under use of information provided by Ofgem. Since some of the benefits to networks impact regulated activities, future price control reviews and incentive schemes will need to take into account developments in the energy markets, including changes enabled or generated by smart metering.

Recent work with the Energy Networks Association (ENA) has also provided further assurance that the identified areas of network benefits are realistic. We will continue to work with the ENA to further test and verify the assumptions.

6.5.3.1 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.

The total present value gross benefits from avoided losses is £93m.

6.5.3.2 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. Reflecting updated information about the critical mass of meters required, the benefits are considered to be realised from 2014 onwards, at which point over one third of smart meters with outage detection functionality[119] will be installed (see section 2.1.6 for more detail). 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

[119] There will be no requirement for outage detection in the initial SMETS and early meters are therefore not counted towards the achievement of the critical mass.

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 2011 IA and consecutive versions increased the expected benefits to reflect additional cost savings from a “positive” outage notification functionality.

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

1. Reduction in customer minutes lost (CML):

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

In order to calculate benefits we valued the estimated reduction in customer minutes lost (CML) with the average CML price incentive under the Distribution Price Control Review 5 (DPCR5), running from April 2010 to 2015. The CML incentive rate reflects end customers’ willingness to pay for quality of supply improvements with regards to a reduction in minutes lost. It also acts as one part of the overall interruptions incentive scheme for network companies to improve the quality of their service (the 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 £7m.

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 assum 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 £12m.

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 did also provide data collected for its quality of service incentive regime 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 £2m.

6.5.3.3 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.

6.5.3.4 Avoided cost of investigation of customer complaints about voltage quality of supply[120]

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.

[120] 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.

The resulting benefit is £0.14 per electricity meter per year, generating a total present value gross benefit of £1m.

6.5.3.5 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. 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.

6.5.4 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[121], 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[122] 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.

[121] We here refer equally to DSR and load shifting.
[122] Sustainability First (2010).

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[123]).

The approach and underlying assumptions on load shifting remain unchanged. We only consider load shifting from STOU tariffs, even though 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.

In the non-domestic sector, electricity demand from lighting, catering and computing are typically not flexible, while electricity demand from hot-water, heating, cooling, ventilation and some other small loads such as refrigeration and cold storage, can provide flexibility. While not fully matching the definition of non-domestic premises for purposes of the smart meter roll-out, DECC statistical data provides the breakdown of energy consumption for the service sector (DUKES, 2011[124]). This data shows that today 25% of total electricity consumption in the service sector comes from heating, cooling and ventilation. Including heating, hot water, and other uses, the share increases to 40%, however, not all of this can be considered as fully flexible. Over time, the introduction of smart appliances, 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. EA Technology[125] estimates bottom up SME discretionary load to be around 21%, based on heating and cooling demands.

Based on this evidence, we estimate that today, the current amount of discretionary load in the non-domestic sector is 20% of total consumption at peak. Because EVs, heat pumps, and smart appliances take up is likely to be driven by future policies, 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[126]) 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

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[123] King, C and Delurey, D, '*Twins, siblings or cousins? Analyzing the conservation effects of demand response programs. Public Utilities Fortnightly'*, 2005.
[124] *DUKES 2011, http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/total/total.aspx*
[125] EA Technology, p38.
[126] BERR & DfT, *'Investigation into the Scope for the Transport Sector to switch to* Electric Vehicles and Plug-in Hybrid Vehicles', *2008*.

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[127] 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. We valuate benefits from load shifting in four different areas:

6.5.4.1 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 £29m.

6.5.4.2 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 £20m.

6.5.4.3 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.[128]

[127] 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).

[128] 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).

For distribution, we use the expected annual investment requirement figure from the DPCR5[129] as the baseline. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing[130]. Consequently, we do not account for potential additional benefits driven by more responsive demand solutions to minimise the impact of significant penetrations of EV and HP, for which DNOs would require real time data.

The expected present value benefits are £2m.

6.5.4.4 Carbon savings from electricity demand shift

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

The expected present value benefit is £29m.

6.5.5 Carbon related and UK-wide benefits

6.5.5.1 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 (section14.5).

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 £41m.

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 £483m.

6.5.5.2 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[131]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

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[129] 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.

[130] 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.

[131] 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

Table 6-8: 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	Avoided cost of carbon – electricity (£bn, PV)	Avoided cost of carbon – gas (£bn, PV)
2.57	10.13	0.05	0.5

6.5.6 Air quality benefits

As outlined in section 2.1.2, this new benefit item has been added to the analysis. Air quality improves deliver benefits of £30m in present value terms.

6.5.7 Non-quantified benefits

See section 3.4.7 in the domestic evidence base for a discussion of the non-quantified benefits. These do not differ for the non-domestic sector.

'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.

7 Results

7.1 Costs, benefits and NPV

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 2013-2030. The cost numbers are risk-adjusted, i.e. they have been adjusted for optimism bias (see section 7.3.1 on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios (see section 7.3.2). Table 7-5 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 2013. Cost and benefit information his however reflected in 2011 real prices.

Table 7-1: Total costs and benefits

Total Costs £bn	Total Benefits £bn	Net Present Value £bn
0.650	2.911	2.262

Table 7-2: Consumer and supplier benefits

Consumer Benefits £bn	Business Benefits £bn	UK-wide Benefits £bn	Total Benefits £bn
1.715	0.632	0.564	2.911

Table 7-3: Low, central, and high estimates

Total Costs £bn	Total Benefits £bn			Net Present Value £bn		
	Low	**Central**	High	Low	**Central**	High
0.650 (+/- 0.007)[132]	2.097	2.911	3.719	1.448	2.262	3.070

132 Total costs change marginally with changes in the benefit scenario. The net present values reported here are those produced by the model and reflect the marginal changes in cost.

Table 7-4: Benefits

Consumer Benefits £bn			Business Benefits £bn			UK-wide Benefits £bn		
L	**C**	H	L	**C**	H	L	**C**	H
1.121	1.715	2.282	0.562	0.632	0.720	0.415	0.564	0.717

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, has fallen slightly from 4.8 in the March 2012 IA to 4.5 in the central scenario, with a value of 5.7 in the high scenario and of 3.2 in the low case scenario.

7.2 Distributional impacts

7.2.1 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[133]. The results below show the average impact on GB non-domestic dual fuel 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 around £164 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 approximately £42 by 2015; £164 by 2020 and £139 by 2030 (Table 7-5).

These bill impacts are smaller than outlined in the 2012 Impact Assessments as a result of methodological refinements to the presentation of non-domestic bill impacts. Previously the presentation of bill impacts included all smart and advanced meters installed in the non-domestic sector, whereas now we present only the bill impact of those smart and advanced meters installed as a result of the Government intervention. This therefore reflects that smart and advanced meters would have been installed in the counterfactual and in the absence of any Government intervention. Table 7-5 accordingly shows the incremental bill impact generated from smart and advanced meters that would not have been installed without a mandate.

Table 7-5: Impact on average non-domestic energy bills for a dual fuel customer

	Non-domestic dual fuel bill impact, £

133 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.

2015	-43
2020	-164
2025	-155
2030	-140

The price impacts of smart meters in the non-domestic sector are detailed in Table 7-6 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 almost neutral in 2023 and negative from 2024.

Table 7-6: 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)**
2015	**0.22**	**0.07**
2020	**0.22**	**0.07**
2025	**-0.14**	**-0.04**
2030	**-0.36**	**-0.11**

For the calculation of bill impacts we have assumed a conservative scenario in which stranding costs (which are further outlined in section 7.2.2) are ultimately borne by consumers. This implies that suppliers would continue to charge a metering element for the traditional equipment in addition to the metering element of the smart equipment through their energy prices. Since stranding costs are sunk costs they are not included in the remaining cost benefit calculations.

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.

7.2.2 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 life span of a traditional meter 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 from the replacement of traditional metering equipment before it reaches the end of its life. However, stranding costs do not affect the net economic impact, since existing meter costs have already been incurred in the counterfactual and are sunk. Therefore, they are not reflected in the calculation of net benefits from the roll-out of smart meters. Even though the distributional impact of stranding costs will depend on contractual arrangements, we take a conservative approach assuming that consumers will ultimately bear these costs, and reflect these in the estimation of the energy price impacts (as presented in section 7.2.1).

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

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. We estimate stranding costs of £89m in present value terms.

7.2.3 Better regulation

<u>Administrative burden</u>
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. Following the submission of detailed evidence from energy suppliers this methodological approach

was agreed with the Better Regulation Executive (BRE). The smart meters roll-out will bring forward the replacement of metering equipment and as such notifications to customers of such planned visits. Such potential effect remains unquantified in this Impact Assessment.

A small administrative burden from having to submit data for monitoring and evaluation purposes has been identified. This amounts to £1m between now and 2020 and is further detailed in section 3.3.8.2. This cost has been fully apportioned to the domestic analysis.

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.

Micro-business exemption

The available evidence indicates that no energy supply business (the type of company immediately affected by the obligations) falls into the definition of a micro-business. The Smart Meter Implementation Programme therefore does not propose to include a micro-business exemption in the regulations.

Sun-setting or statutory review clauses

We have considered the case for sun-setting of the regulatory interventions required for smart metering. These interventions are intended to set out an enduring framework for the effective provision and operation of smart metering and, as such, are not candidates for sun-set clauses. In particular interoperability of equipment deployed by different suppliers cannot be expected to become business as usual at any point in the future and therefore sun-setting is not appropriate. DECC will keep all smart meter regulation under review as policy is developed further – as stated in section13, the Programme is committed to a comprehensive review and evaluation process, both during the initial Foundation Stage as well as towards the end of the main roll-out.

7.3 Risks

7.3.1 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[134] were commissioned to consider these issues, in particular to provide:

- Assessment of the international and domestic evidence available;
- Development of a risk matrix based on the identification of key risks, their potential impacts and mitigation actions;
- Assessment of the sensitivity of these risks to market model and duration of the roll-out;
- Assessment of the treatment of risk in the April 2008 IA; and
- Make recommendations, in light of the above.

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA. Table 7-7 reflects the optimism bias factors applied to this IA:

Table 7-7: Optimism bias factors

	Optimism bias factor
IHD	15%
Smart meter	15%
Outage detection	150%
WAN CAPEX	10%
WAN OPEX	10%
HAN	15%
Installation & commercial risk	20%
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 6.4.10.

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[135].

7.3.2 Benefits: sensitivity analysis

[134] Baringa Partners, *'Smart Meter Roll Out: Risk and Optimism Bias Project'*, 2009.
[135] HMT, *'Green Book'*, 2011,http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_supguidance.cfm#optimism.

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

Table 7-8: Sensitivity analysis for benefits

	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1.5%	2.8%	4.0%
Energy savings gas	3.5%	4.5%	5.5%
Energy savings gas PPM	0.3%	0.5%	1.0%
Business benefits			
Supplier benefits			
Avoided site visit	underlying visit cost + 8%	underlying visit cost	underlying visit cost -8%
Call centre savings	£1.9	£2.2	£2.5
Avoided PPM COS premium	30%	40%	50%
Reduced theft	5%	10%	15%
Network benefits			
Avoided investment from TOU (distribution/transmission)	10%	20%	40%
Reduction in customer minutes lost	2%	10%	15%
Operational savings from fault fixing	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 7-9 presents the results of applying the sensitivity ranges presented in Table 7-8 to each specific benefit assumption.

Table 7-9: PV of individual benefit items after sensitivity analysis

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	£343	£700	£1,029
Energy savings gas	£771	£1,008	£1,246

Business benefits			
Supplier benefits			
Avoided site visit	£238	£259	£281
Call centre savings	£55	£63	£71
Avoided PPM COS premium	£0	£0	£0
Reduced theft	£0	£0	£0
Network benefits			
Avoided investment from TOU (distribution/transmission)	£1	£2	£3
Reduction in customer minutes lost	£1	£7	£10
Operational savings from fault fixing	£3	£12	£18
Better informed enforcement investment decisions	£0	£0	£0
Avoided investigation of voltage complaints	£0	£1	£1
Reduced outage notification calls	£1	£2	£3
Generation benefits			
Short run marginal cost savings from TOU	£15	£29	£56
Avoided investment from TOU (generation)	£10	£20	£40

8 Non-Domestic sector detailed results

Table 8-1: Non-domestic sector detailed results from the model (in £million) for the central case scenario

Total Costs			**649**
In premise costs			518
	Meters & IHDs		281
	Installation of meters		96
	Operation and maintanance of meters		40
	Communications equipment in premise		102
DCC related costs			106
	Data services and internal capex		-
	Data services and internal opex		-
	Communications service charge		106
Suppliers' and other participants' system costs			-
	Supplier capex		-
	Supplier opex		-
	Industry capex		-
	Industry opex		-
Other costs			24
	Energy		30
	Disposal		3
	Pavement reading inefficiency	-	9
	Organisational		-
	Marketing		-
NPV			***2,262***
	(Stranding costs		089)

Total Benefits		**2,911**
Consumer benefits		1,715
	Energy saving	1,708
	Microgeneration	7
Business benefits	Supplier benefits	466
	Avoided site visits	259
	Inbound enquiries	54
	Customer service overheads	9
	Debt handling	53
	Avoided PPM COS premium	-
	Remote (dis)connection	7
	Reduced theft	-
	Customer sw itching	84
	Netw ork benefits	117
	Reduced losses	93
	Avoided investment from ToU (distribution/transmission)	2
	Reduction in customer minutes lost	7
	Operational savings from fault fixing	12
	Better informed enforcement investment decisions	-
	Avoided investigation of voltage complaints	1
	Reduced outage notification calls	2
	Generation benefits	49
	Short run marginal cost savings from ToU	29
	Avoided investment from ToU (generation)	20
UK-w ide benefits		564
	Global CO2 reduction	483
	EU ETS from energy reduction	41
	EU ETS from ToU	10
	Air Quality	30

Part D: General Information

9 Enforcement

The policy outlined in this IA will be implemented via regulation, for example 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 licensed energy company which it has reason to believe may be breaching the terms of their licence (including any consumer protection provisions) or acting anti-competitively, and has powers of enforcement. The Office of Fair Trading also has a range of other enforcement powers in respect of consumer protection).

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 Ofgem for determination. The Government is consulting in further detail on policy issues and legal drafting of the SEC. consulting consultation on Stage one of the Smart Energy Code[136] has recently closed.

10 Recommendation – Next Steps

The Government has laid and intends to continue to lay licence conditions in Parliament, pursuant to Section 89 of the Energy Act 2008.

The Government will also notify SMETS 2 to the European Commission, as required by the Technical Standards and Regulations Directive. After notification to the Commission, a standstill period of a minimum of three months will apply, during which time the draft measures may not be adopted; this period may be extended if the Commission or a Member State believe the specifications represent a serious barrier to trade.

11 Implementation

The Implementation approach is described in the Government Response document which was published in March 2011[137].

12 Monitoring and Evaluation

The Government published its Smart Meters Programme Strategy and Consultation on Information Requirements for Monitoring and Evaluation[138] in May 2012. This set out its plans for monitoring and evaluation both during Foundation and mass roll-out stages, and identified relevant data requirements. Where these data requirements entail placing new obligations on suppliers or network operators, the Government has consulted on draft licence conditions. This section gives a high-level overview of our approach. The Government's response to the consultation as well as final licence conditions were published in December 2012[139]. See also section 13 on plans for a Post Implementation Review (PIR).

[136] http://www.decc.gov.uk/en/content/cms/consultations/stage1_sec/stage1_sec.aspx
[137] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx
[138] https://www.decc.gov.uk/en/content/cms/consultations/sm_evaluation/sm_evaluation.aspx
[139] http://www.decc.gov.uk/en/content/cms/consultations/sm_evaluation/sm_evaluation.aspx

The Programme will collect monitoring and other information in order to:

- Inform the ongoing development of the approach to consumer engagement;
- Monitor the capability and readiness of industry participants for the start of mass roll-out;
- Track progress towards completion;
- Manage the full range of costs and benefits attributable to smart metering.

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

- Data about smart meter installations, collected by suppliers and reported quarterly;
- Annual reports from suppliers 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 have consulted on proposals for collecting data in the first three categories using information-gathering powers in Section 88 of the 2011 Energy Act and the licence conditions to give effect to these have now been published. Results from piloting schemes and trialling are also expected to inform the monitoring and evaluation of the roll-out. This includes both previous pilots such as the EDRP, and piloting and trialling carried out during the Foundation Stage.

Monitoring and evaluation results will be published by Government as follows:

- An annual progress report will draw together data and information gathered from suppliers and other sources, and include an update on progress, plans, costs and benefits. The precise content will build over time .
- Quarterly updates on key metrics.
- Evaluation reports, including the results of an early assessment of emerging impacts, which is currently being developed and which will report in 2013.

The first Annual Report has been published in December 2012[140].

[140] http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/7348-first-ann-prog-rpt-rollout-smart-meters.pdf

13 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 have been extended until the end of 2018 for introducing regulatory requirements on suppliers regarding the roll-out of smart meters, and licence conditions on the process for collecting information from suppliers and network operators for monitoring and evaluation purposes have been laid in Parliament in December 2012. 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 approach to consumer engagement to establish whether any changes are needed in order to achieve Programme objectives (the review of early roll-out)

2. A Post Implementation Review (provisionally by 2018)

<u>Review objective</u>: The review of early roll-out objective is to review progress against the consumer engagement strategy's aims and objectives, in order to establish whether any changes in approach are needed prior to mass roll-out. This will involve establishing the range of benefits to consumers and their distribution across different consumer types and identifying the critical success factors, especially in terms of consumer engagement.

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.

<u>Review approach and rationale</u>: 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 in delivering consumer benefits.

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 including evidence collected under the smart meters Monitoring and Evaluation Strategy as described in section 12.

Monitoring information arrangements:

See section 12 and the Monitoring and Evaluation Strategy for this information.

14 Specific Impact Tests

Type of testing undertaken	***Results in Evidence Base? (Y/N)***	***Results in this section? (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

14.1 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 and potentially 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 and data 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 periodic 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

There is a risk 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 costs in proportion to the size of the business.

14.2 Small Firms

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.

The introduction of smart metering potentially offers small firms the opportunity to compete on the basis of innovative smart meter-based energy supply retail products, including new tariffs. There are already developments of this nature, with a number of small suppliers seeking early mover advantage in the market by offering smart meters.

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. Wherever appropriate regulatory decisions seek to ensure that small firms can compete on a level playing field and are not subjected to unnecessary or disproportionate burdens.

14.3 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.

We have also considered the potential impact on the justice system of the introduction of the Electricity and Gas (Smart Meters Licensable Activity) Order 2012. This instrument came into force 19 September 2012 and increases the range of activities which it is a criminal offence to undertake without a licence. It is considered that this will have a minimal, if any, impact on the justice system.

14.4 Sustainable Development

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

Smart metering will provide consumers with the tools with which to manage their energy consumption, enabling them to access innovative solutions and incentives to support energy efficiency and take greater personal responsibility for the environmental impacts of their own behaviour. This will be supported by the Consumer Engagement Strategy (CES) which has been the subject of consultation and on which additional obligations on energy suppliers have been laid in Parliament in December 2012.

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.

14.5 Carbon assessment

Following Government guidance[141], 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 tables below outline 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) for the domestic and the non-domestic sectors. 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 14-1: Domestic 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
11,466	14,941	9.52	15.42	16.85	-386	43.99	-273

Table 14-1 shows how the domestic roll-out could save over 9.52 million of tonnes of CO_2 equivalent in the traded sector and 15.42 million tonnes of CO_2 in the non-traded sector over an 18-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.

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

Table 14-2: Non-domestic 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
649	2,377	2.57	10.13	15.28	-693	44.50	-218

Table 14.2 shows how the non-domestic roll-out could save over 2.57 million of tonnes of CO_2 equivalent in the traded sector and 10.13 million tonnes of CO_2 in the non-traded sector over an 18-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.

14.6 Other Environment

The Smart Metering Implementation Programme could 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. IT is assumed that the metering equipment will consume 1 W over and above current equipment, a display 0.6 W and the communication equipment 1 W. These assumptions are unchanged from previous Impact Assessments. Gas meters would require batteries for transmitting data and some display devices may also use batteries. The batteries will 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.

14.7 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).

Smart meters are covered by UK and EU product safety legislation, which requires manufacturers to ensure that any product placed on the market is safe. The Government recognises that some consumers remain concerned that their health may be affected by radio waves and draws attention to the work of Health Protection Agency showing that the evidence to date suggests exposures to the radio waves produced by smart meters do not pose a risk to health[142]. The Agency has committed to keeping the evidence under review.

14.8 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 has been developed 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, 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 (including the new smart metering licence conditions). 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.

[142] Further information on the Health Protection Agency's advice can be found at: http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/ElectromagneticFields/SmartMeters/#exposuressmartmeters

14.9 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 take all reasonable steps to ensure smart metering systems are installed and to offer an In-Home Display (see below) to domestic consumers. 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 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.

Working with suppliers, Consumer Focus has drawn up best practice guidelines for suppliers and manufacturers 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.

The current minimum specifications for IHDs do not provide accessibility for blind or partially sighted consumers. The Government has commissioned research to understand the options for ensuring that this group of consumers are able to access the benefits from smart meter roll-out. This will inform any future regulatory decisions and will provide evidence that may assist suppliers in meeting the Equality Act requirements.

B. Smart meter installation: protecting customers

Suppliers have primary responsibility for delivering the roll-out, and ensuring 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 proposed licence conditions requiring suppliers to meet certain standards around the installation visit, and to develop, seek approval for, and comply with an installation Code of Practice. A consultation on these licence conditions underpinning a Code of Practice was published in August 2011. The Government published its response, including revised draft licence conditions, in April 2012. The licence conditions came into force on 30 November 2012. Among the key requirements of the Code of Practice are that suppliers:

- will explain to customers how the smart metering system and IHD work, and how consumers can use them to help to improve their energy efficiency
- will inform consumers about additional, impartial sources of information on energy efficiency
- will not conclude any sale at the domestic installation visit
- will need prior customer consent to carry out any face-to-face marketing at the domestic installation visit
- will have to identify and meet the needs of vulnerable customers; and
- will not charge their domestic customers any upfront or separate costs for standard smart metering equipment, including the IHD.

During 2012, suppliers finalised a draft Code of Practice covering both the domestic and micro-business markets. This Code must be approved by Ofgem, and a draft for approval was submitted in December 2012. The Government expects the Code to be in place in Spring 2013.

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. In response to the consultation on the Consumer Engagement Strategy, the Government has put in place licence conditions that require suppliers to set up and fund a Central Delivery Body to deliver consumer engagement activities which contribute to a cost-effective smart metering roll-out and the realisation of benefits, particularly those related to energy consumption. Its objectives will include ensuring that vulnerable[143], low income and pre-payment consumers are appropriately engaged to help them realise the benefits of smart meters while continuing to maintain an adequate level of warmth and meet their other energy needs.

D. Early roll-out: protecting consumers where remote functionality is used for disconnection and for switching customers from credit to prepayment mode

Some suppliers have been installing early smart-type meters at their own commercial risk. These meters are unlikely to fully meet the minimum technical specification. In October 2011, Ofgem introduced licence modifications and published accompanying guidance as part of its 'Spring Package' of measures to protect consumers in light of these early moves to install meters with smart functionality. The package of measures included guidance that suppliers are required to have regard to when identifying vulnerability prior to taking the decision to disconnect a customer's supply. Suppliers are also now required to have regard to guidance when identifying

[143] Those who face additional barriers to accessing the benefits of smart metering because of personal circumstances or characteristics.

whether it is safe and reasonably practicable for a customer to be switched to prepayment mode.

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

Ofgem issued its latest set of Retail Market Review proposals for consultation on 26 October 2012. They include proposals to limit suppliers to offering four core tariffs each for gas and electricity to individual consumers. They propose that suppliers can set up to four core tariffs per fuel for customers with non-time of use meters and four core tariffs per fuel for each type of time of use meter or smart meter mode, for any particular location at any one time. In addition Ofgem has stated it will consider whether it is appropriate to allow derogations for innovative time of use tariffs to facilitate the benefits of smart meters or for legacy time of use meters such as DTS meters.

The Government has also issued a discussion document on 20 November 2012 to seek views on legislative proposals to help consumers with their energy bills, including the commitment to ensure that consumers get the cheapest tariff offered by their supplier that meets their preferences, announced by the Prime Minister. This document builds on Ofgem's proposals and includes proposals to limit suppliers to four core tariffs per fuel, to require that four core tariffs contain one standard variable rate tariff and one fixed term fixed price tariff that are comparable like with like across the market, to allow suppliers freedom to offer the remaining two tariffs types as they wish and to require that suppliers offer just a single price for each of the four tariff types and prohibit poor value 'dead' tariffs. It sets out the ambition that by summer 2014 all consumers will have been placed on the cheapest price available from their supplier for the tariff type of their choice.

14.10 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 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 is required to fulfil regulated duties. The Government Response to its consultation on data access and privacy and associated licence conditions were published in December 2012[144].

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.

14.11 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 aspiration 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 more 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.

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

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