Title: Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB)	**Impact Assessment (IA)**
	Date: 30/1/2014
IA No: DECC0009	**Stage:** Final
	Source of intervention: Domestic
Lead department or agency: DECC	**Type of measure:** Secondary legislation
Other departments or agencies:	**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**
£6,214m	£862m	£36m[1]	Yes	In

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 and; 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 approximately 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 Government's overall approach and timeline for achieving this objective. In 2012, the IA was further updated with the most recent evidence base and supported the introduction of the first tranches of smart metering regulations. This IA further updates the overall economic case to support the remaining tranches of regulation which are planned to be introduced.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 2019					
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: 11.3**	**Non-traded: 21.4**	

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.

[1] The net cost to business figure presented is based on OIOO methodology and does not include non-domestic energy savings. Energy savings to non-domestic customers, as well as the costs involved in realising these energy savings are accounted for in the rest of the impact assessment.

Summary: Analysis & Evidence   Policy Option 1

Description: This IA reflects a roll-out completion date in December 2020 of a supplier led roll-out of smart meters with a centralised Data and Communications Company (DCC).

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 1,338	High: 11,372	**Best Estimate: 6,214**

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	517		816	**10,927**

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

In-Home Displays (IHDs), meter and its installation and operation amount to £6.36bn. DCC related costs, including communications hubs provision, amount to £2.47bn. Energy suppliers' and other industry's IT systems costs amount to £0.79bn. Industry governance, organisational and administration costs, energy, pavement reading inefficiency and other costs amount to £1.30bn.

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		982	**12,248**
High	0		1,794	**22,316**
Best Estimate	0		1,376	**17,141**

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

Total consumer benefits amount to £5.73bn and include savings from reduced energy consumption (£5.69bn), and microgeneration (£36m). Total supplier benefits amount to £8.26bn and include amongst others avoided site visits (£2.97bn), and reduced inquiries and customer overheads (£1.19bn). Total network benefits amount to £0.99bn and generation benefits to £851m. Carbon related benefits amount to £1.21bn. Air quality improvements amount to £95m.

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%

Cost assumptions are adjusted for risk optimism bias where appropriate, 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	113,500,043	141,553,925	297,299,350	435,304,690	664,107,808	881,761,480
Total annual benefits	48,940,917	98,124,907	181,556,237	381,322,443	680,221,282	1,060,022,818

£	2019	2020	2021	2022	2023	2024
Total annual costs	1,134,311,960	1,201,900,732	1,167,385,073	1,133,776,588	1,120,773,566	1,100,764,577
Total annual benefits	1,456,560,792	1,748,128,200	1,767,899,495	1,790,088,069	1,824,210,359	1,863,012,556

£	2025	2026	2027	2028	2029	2030
Total annual costs	1,076,429,997	1,063,165,665	1,064,182,537	870,460,611	862,933,145	868,657,603
Total annual benefits	1,918,645,412	1,958,536,154	1,963,718,714	1,982,300,738	2,007,134,272	2,043,317,674

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

Emission savings by carbon budget period (MtCO2e)

Sector		Emission Savings (MtCO2e) - By Budget Period		
		CB I; 2008-2012	CB II; 2013-2017	CB III; 2018-2022
Power sector	Traded	0	0	0
	Non-traded	0	0	0
Transport	Traded	0	0	0
	Non-traded	0	0	0
Workplaces & Industry	Traded	0.01	0.32	0.99
	Non-traded	0.03	0.77	2.81
Homes	Traded	0.01	0.80	3.68
	Non-traded	0.01	0.86	4.32
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	1.12	4.67
	Non-traded	0.04	1.63	7.13
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 and 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
SEC - 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, subject to economic assessment, 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 to domestic premises 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 for whom roll-out is assessed positively should be equipped with intelligent metering systems by 2020. For gas, where the economic assessment is positively Member States are required to prepare a timetable for the implementation of intelligent metering systems.

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 be on track to meeting its target to reduce primary energy consumption by 20% by 2020.

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.

This Impact Assessment considers the deployment of smart electricity and gas meters in domestic premises and in smaller non-domestic premises in Great Britain. Key features of the roll out include the following:

[2] HMG, *'The Coalition: Our programme for government'*, 2010.

- Energy suppliers will be responsible for the provision and installation of smart meters and are required under conditions in their licences to take all reasonable steps to complete the roll-out;
- In-Home Displays (IHDs) must be offered to domestic consumers;
- Metering equipment must comply with Smart Meter Equipment Technical Specifications (SMETS) to ensure common minimum functionality and support interoperability;
- A central Data and Communications Company (DCC) will provide the communications platform for the secure transmission of smart meter data and messages;
- The DCC will be a licenced body regulated by Ofgem.

The Government's policy design and implementation work has progressed through various stages. The initial policy design phase concluded in March 2011 with the publication of the Government's Response to the Smart Meter Prospectus confirming the approach chosen for the delivery of smart meters[3]. This marked the beginning of the next Phase of the Smart Metering Implementation Programme (SMIP) – the Foundation Stage. The objective of the Foundation Stage is to ensure readiness for the mass roll-out, including industry readiness and the establishment of the necessary regulatory and commercial framework. This Phase includes work to establish the DCC and to put in place a new industry Smart Energy Code that establishes a contractual framework, backed up by regulations, between the DCC and its users.

In September 2013 the Secretary of State granted licences to a company to perform the DCC role, and that company signed four contracts to establish and operate the data and communications services provided by the DCC. Also in September 2013 the Secretary of State designated the initial provisions of the SEC. In May 2013 DECC published a revised timetable under which suppliers will be required to complete their roll-outs by the end of 2020. This Impact Assessment reflects the updated timetable, suppliers current forecast roll-out profiles and new cost information arising from the competitions for the DCC licence and service providers contracts. It accompanies further regulations to complete the regulatory framework. These provisions will be introduced in stages and will coincide in time with key milestones in the delivery of the Programme.

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 there are similar information difficulties for both consumers and suppliers.

Consumers do not have dynamic and useful information to enable them easily to manage their energy consumption. In addition problems with accuracy of data and

[3] DECC, *Smart Metering Implementation : Response to Prospectus: Overview Document*, 2011.

billing create costs for suppliers and consumers, causing disputes over bills (complaints) and problems with the change of supplier process, thereby potentially 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 detailed information about energy use and cost. Combined with appropriate advice and support, consumers will be better 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 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.

Given 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 since 2008. 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.

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

In 2009, Impact Assessments informed the appraisal of alternative options for the preferred market model for the roll-out. Options previously considered and discarded include a fully competitive model, a fully centralised model, and a DNO-led deployment. In 2010 and 2011 Government considered options for the implementation of the preferred market model: a supplier-led roll-out with centralised provision of communications and data services. Detailed policy design options were considered and assessed. These included the completion date, the establishment and scope of DCC, the functionality of the smart meter, the roll-out strategy, and the strategy for consumer engagement. In March 2011 Government published its conclusions and published an IA (hereafter March 2011 IA) which presented analysis of:

- Functionality of the smart meters solution, including meters, communications equipment and IHDs;
- Length of the roll-out period;
- Scope and establishment of the central 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.

Subsequent work has included developing detailed Smart Meter Equipment Technical Specifications (SMETS), leading to the publication of two further Impact Assessments in August 2011 and April 2012. During 2012 we made legislation to enable the regulation by licence of the DCC and to allow for the competitive award of those licences. We also made modifications to the licence conditions of electricity and gas suppliers obliging them to: roll out smart meters by the end of 2019; offer in-home displays; and to enter into a consumer protection code governing installation. In 2013 we also made the second and third tranches of energy licence modifications, covering such things as consumer engagement, data access and privacy proposal, information requirements for monitoring and evaluation, Foundation security requirements, requirements to be parties to the Smart Energy Code, and conditions ensuring the provision of smart meter functions to consumers. In February 2013 DECC notified part of the second version of SMETS to the European Commission (EC) which was subsequently approved and was also accompanied by an updated IA.

The present Impact Assessment accompanies further regulations required to complete the regulatory framework.

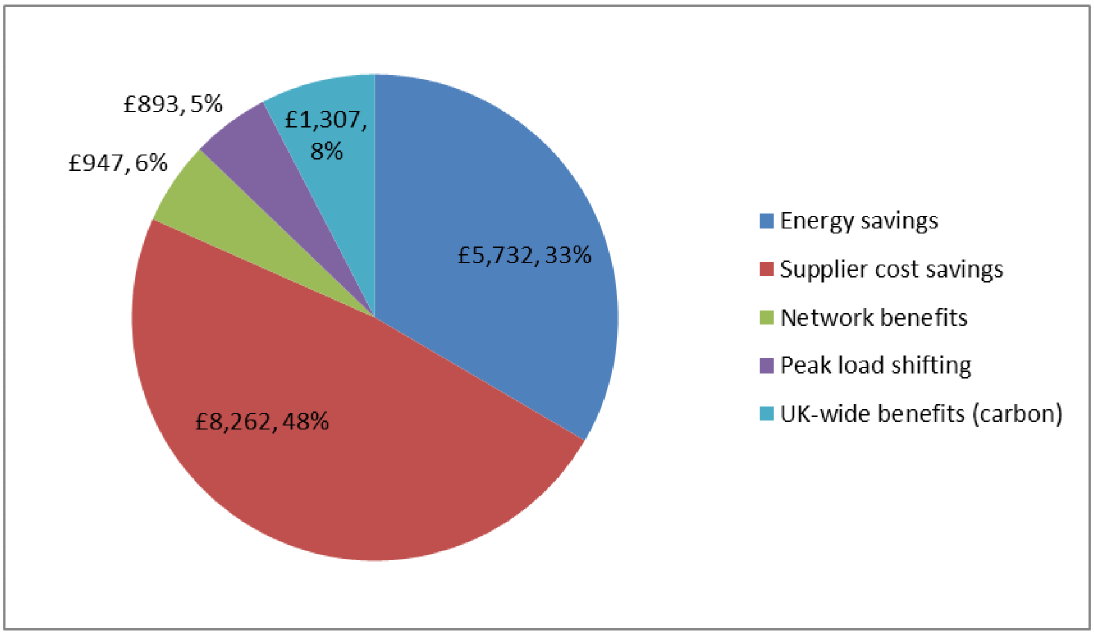
1.4.1 Benefits

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

[4] BERR, *Impact Assessment of Smart Metering Roll Out for Domestic Consumers and Small Businesses*, April 2008, and DECC, *Impact Assessment of Smart Meter rollout for the domestic sector*, April 2012.

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.

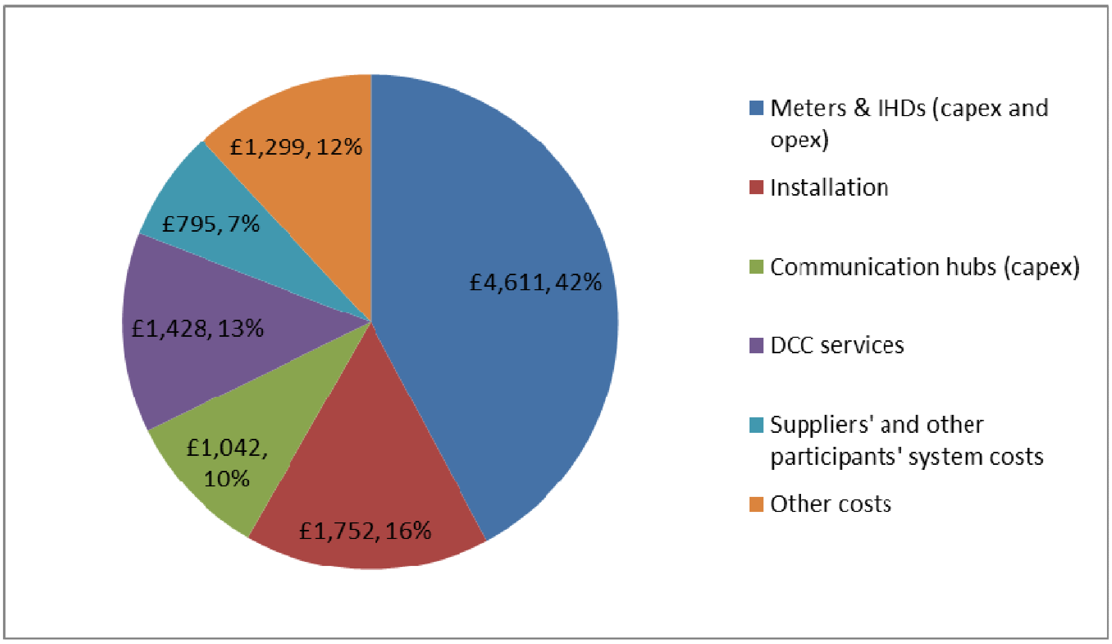
Figure 1-1: High level overview of benefits (£m)



1.4.2 Costs

Costs of the roll-out can be categorised in the following way. Energy suppliers will be required to fund the capital costs of smart meters and IHDs. They will also 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 DCC). The DCC is a new licensed entity responsible for managing the procurement and contract management of data and communications services that will underpin the smart metering system. Communications hubs will be provided by the DCC. The roll-out of smart meters also requires upfront investment in supporting IT systems and the DCC, as well as their ongoing operation. 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)



1.4.3 Economic impact

With total expected present value (PV) costs of £10.5bn and total PV benefits of £14.8bn up to 2030, the net present value (NPV) for the domestic roll-out of smart meters in GB is estimated to be £4.3bn. Non-domestic gross benefits amount to approximately £2.3bn, with gross costs of about £0.5bn and a resulting net present value of approximately £1.9bn. Across both sectors the expected net benefit is £6.2bn. 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 £26 in 2020 and by £43 in 2030. The average dual-fuel non-domestic premise is expected to realise bill savings of approximately £200 in 2020 and £174 in 2030.

1.5 Scope of this impact assessment

The substantive costs and benefits of the Government's policy on smart meters have been covered in full impact assessments published and updated since 2008. The roll out of smart meters will suppose a whole range of commercial, technical and operational arrangements to be set out in an industry code – the Smart Energy Code (SEC). The SEC is the detailed contractual framework, backed by regulation, that underpins the smart meter roll-out – as such all the substantive impacts previously identified in the Smart Meter Programme IA arise from the SEC.

This IA reflects the overall economic impact from the roll-out, based on that latest evidence available. This includes up to date cost information following the conclusion of the procurement of the DCC licensee as well as service providers for data and communication services in September 2013, and also covers updated costs that arise from implementing the new code.

In comparison to the IA published in January 2013, combined NPV across the domestic and non-domestic sectors has reduced from £6,659m to £6,214m. This is separated into a reduced NPV for the domestic sector from £4,397m to £4,337 and for the non-domestic sector from £2,262m to £1,876.

2 New Analysis

2.1 Overview

New analysis has been conducted to integrate the most recent evidence and up to date smart metering end to end design position. The key areas of change in costs and benefits in this Impact Assessment are:

- Following best practice, the economic cost-benefit model used for the production of this Impact Assessment has been subject over the years to regular external review ahead of key decision points. This has ensured that the model remains fit for purpose and makes a robust representation of the expected cost and benefit impacts of smart metering. As a result of an external audit of the model in 2013 a number of improvements have been applied to the model.

- The planning assumptions underlying the cost benefit modelling have been updated to bring them in line with the revised roll-out timetable and available evidence. This has included updating the analysis to account of suppliers' latest roll-out plans and the revised Smart Meter Implementation Programme (SMIP) delivery timeline.

- In July 2013 the SMIP published part (b) of the response to a consultation on the Second Smart Metering Equipment Technical Specifications (SMETS 2)[5]. The IA has been updated to reflect updated evidence in the areas of keypads, communication hub configurations and the Home Area Network (HAN).

- In September 2013 DECC concluded the licence award process for the DCC and the procurement of data and communications services on behalf of the energy industry. Relevant evidence obtained through these processes (e.g. on infrastructure and equipment costs) has been integrated into the cost benefit model and is reflected in this IA update.

- In July 2013 the Programme issued a final response to a consultation regarding the regulatory approach to smart meters installed during the early stages of the roll-out, the Foundation stage. New evidence received through the consultation and revised modelling to reflect final policy positions have been integrated into this IA.

- Existing cost allowances for organisational costs have been revised and updated in light of more detailed development of the regulatory arrangements under the SEC. Cost estimates regarding the governance of the smart meter industry under the DCC as well as data protection and security assurance processes have been developed and integrated into the analysis.

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[5] DECC, *Smart Metering Implementation Programme: Government Response to the Consultation on the second version of the Smart Metering Equipment Technical Specifications, Part 2*, 2012.

- Finally, the analysis has been updated to account for the latest assumptions and projections on fossil fuel prices, carbon prices, carbon emission factors, energy consumption and number of meters in both domestic and non-domestic sectors.

The below table summarises the impact of these changes on cost and benefits.

Table 2-1: Overview of changes (£million)

	Net Present Value (NPV)	Present Value Costs	Present Value Benefits	Change in NPV
January 2013 IA	**£6,659**	**£12,115**	**£18,774**	
Methodological changes	£6,657	£12,200	£18,857	-£2
Planning assumptions and timetable	£6,090	£11,416	£17,507	-£567
Technical specifications	£6,188	£11,320	£17,509	+£98
Procurement	£6,563	£10,793	£17,355	+£375
Foundation	£6,532	£10,823	£17,355	-£31
Governance and administration	£6,414	£10,941	£17,355	-£118
Exogenous assumptions	£6,214	£10,927	£17,141	-£200
October 2013 IA vs. January 2013 IA	**£6,214**	**£10,927**	**£17,141**	**-£445**

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

2.2 Methodological changes and updates to the model

A detailed external audit was undertaken between January and March 2013 by Baringa Partners to quality assure the baseline against which economic analysis is conducted. The audit identified a number of areas for improvement, which have been implemented.

In addition, Baringa Partners carried out a number of enhancements to the model, primarily to integrate information from the DCC and DCC service provider procurement processes into the cost benefit model.

The aggregate effect of these changes to the model version was neutral on the NPV[6].

2.3 Changes to planning assumptions and timetable

In May 2013 DECC announced changes to the plan and timetable for the roll-out after testing with industry the time needed for the design, build and test phases of smart metering systems. Under this revised plan and timetable the roll-out profile in the Impact Assessment (see Figure 2-3) now assumes that suppliers will start their

[6] Underlying this overall effect are impacts on NPV in either direction. The most significant changes are an increase in NPV stemming from an increase of the per meter consumption assumption in all appraisal years (increasing NPV by around £150m) and the addition of optimism bias to the costs of smart metering equipment operation and maintenance (reducing NPV by around £100m).

full scale roll-out deployments in autumn 2015 and complete the roll-out by the end of 2020[7].

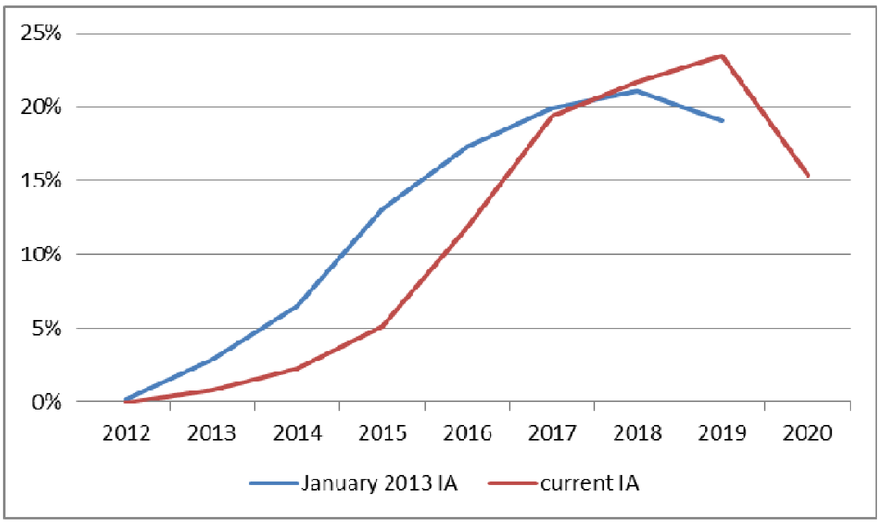
In August 2013, as part of a regular quarterly report, we received information from energy suppliers reflecting their best views of projected annual installation volumes over time, and have subsequently integrated this information into the cost benefit model.

Updating the cost benefit modelling to take account of this new evidence reduces the NPV by around £570m, through a reduction of costs of around £780m and a reduction in benefits of around £1.35bn.

Three main effects drive this overall impact:

- Later estimated deployments result in greater discounting of both costs and benefits. This results in an NPV reduction because benefits outweigh costs and therefore the discounting effect reduces overall benefits to a greater extent than overall costs. This is the main driver of the change in NPV described above;
- Where meters reach the end of their lifetime and the number of rolled-out smart meters are not sufficient to cover end of lifetime replacements, additional costs for the installation of traditional metering equipment in the early years of the roll-out are reflected;
- The latest deployment plans from energy suppliers show a greater compression of installations in the final years of the mass roll-out period. In line with the analysis in previous Impact Assessments, we apply uplifts to installation and asset costs where installation rates exceed a threshold of 17%, to reflect potential pressures on the supply chain and workforce availability. While the number of years where this threshold is exceeded has remained the same, the absolute number of installations in those years has increased in the latest profiles and therefore more installations are subject to the cost uplifts than in previous Assessments.

Figure 2-1: Updated roll-out profile



[7] DECC, *Smart Meters Implementation Programme: Delivery Plan*, May 2013.

2.4 Further development of the technical specifications

The smart meter roll-out needs to be underpinned by detailed technical specifications, to ensure the interoperability of equipment deployed by different suppliers, facilitating supplier switching and in turn customer choice and competition. The first version of the SMETS was published in 2012. Government published its response to the consultation on the second version of the specifications, SMETS 2, in two stages. The first response was published in January 2013, at which time an initial version of SMETS 2 was published and notified to the European Commission. The remaining elements of the response were published in July 2013. A number of decisions reflected in the response document have cost or benefit implications and are accounted for in the economic modelling underlying this IA.

2.4.1 Removal of the provisional requirement for a keypad in every meter

The January 2013 IA introduced a cost allowance of £1.75 per meter to reflect a provisional requirement to include a keypad on smart meters. Following further analysis (including an information request and stakeholder discussions) the Programme has concluded that the decision to mandate a keypad on all meters is not justified by the available evidence and under consideration of relevant costs and risks. The cost allowance created in January 2013 has therefore been removed from the cost benefit analysis.

2.4.2 Communication hub configuration

Communication hubs link the meter(s) in a property to the energy supplier via the DCC. They can be connected to the electricity meter either in a standalone configuration (i.e. in a separate casing and with its own connection to the power supply) or in an intimate fashion (i.e. directly connected to the electricity meter to receive power and to form a secure perimeter). Additional evidence has been received with regard to costs of different design options and the breakdown of the overall population with regard to utilising the different available options.

In response to the consultation industry expressed a strong preference for a universal and standardised requirement for interfaces in electricity meters and communications hubs that support an intimate connection in a simple plug and socket fashion of the two components. This was expected to meet the component requirements for the vast majority of installations and is perceived to reduce supply chain complexity and drive installation efficiencies in light of the reduced equipment variability. Therefore the Communications Hub Technical Specifications (CHTS) and SMETS 2 include requirements for the interfaces between the communications hub and the metering equipment or an alternative connector (the ‘hot shoe’) for the provision of power. While the component costs of a dedicated standalone communication hub are likely to be lower than for the combination of an intimate hub with a hot shoe, there are unquantified benefits which are associated with supply chain simplification and field force operation efficiencies.

In light of evidence provided by suppliers, we now assume that 85% of communications hubs will be deployed in the intimate deployment architecture. Taking into account evidence provided by equipment manufacturers, for the remaining 15% of premises where a standalone set up is deployed we have added a cost allowance of £2.7 to reflect the need for additional interconnector hardware. For modelling purposes the average electricity meter cost has been increased by around £0.4 to account for this additional interconnector equipment cost. This cost would be incurred in the form of additional equipment required for a small proportion of all installations.

2.4.3 Point in time when the 868MHz HAN solution is assumed to be available

The HAN should link all the equipment deployed in premises (meters, communication hub and IHD) and enables communication between those elements. The currently available 2.4GHz HAN solution is not expected to propagate fully (i.e. between all elements) in up to 30% of premises.

An alternative HAN solution using a bandwidth of 868MHz, which will provide greater levels of propagation, is under development. The cost modelling reflects unsuccessful installation visits and continued installation of traditional metering equipment where no HAN propagation is possible before the 868MHz solution is available.

The Programme has updated the modelling assumption that is applied for the expected availability of an alternative wireless HAN solution, which facilitates the local communication between the equipment items deployed in premises. The availability of communication hubs using a bandwidth of 868MHz has been adjusted from 2015 to 2016, in line with current industry expectations.

2.4.4 Multiple communication hubs in split fuel premises prior to availability of an 868MHz HAN solution

In a very small number of premises, where electricity and gas are provided by different suppliers, and ahead of the availability of an 868MHz HAN solution, a smart electricity meter may be installed using a 2.4GHz HAN solution. This installation might result in some scenarios in additional equipment costs when a smart gas meter is fitted in, and these are now reflected in the assessment.

2.4.5 Aggregate impact of changes driven by the technical specifications

In aggregate the changes related to the technical specifications resulted in an increase of the NPV of around £100m. This change is driven by an increase in the NPV of around £150m arising from the removal of the provisional requirement to include a keypad, with the other changes on 2.4 having small negative impacts on the NPV.

2.5 Updated evidence from DCC licence and data and communication service providers procurement processes

The Smart Metering Implementation Programme has, over the last two years and on behalf of the energy industry, led procurement processes for the DCC licensee, the data service provider (DSP) and the communications service providers (CSPs) in three regions. This process concluded in September 2013 when four companies signed contracts to establish and operate the shared infrastructure provided by the DCC. Financial information from these contracts has been integrated into the IA. This section discusses the impact on the cost benefit analysis of updating modelling assumptions with information based on tender returns from the successful DCC applicant and data and communications providers.

Updating the cost benefit model with firm evidence obtained through the licence award and service procurement exercises impacts costs and benefits in three areas:

- Firstly, costs are updated to reflect the prices for the provision of services or equipment as committed to by the service providers / licensee. These prices replace the previous modelling assumptions;
- Secondly, both costs and benefits are updated to reflect the new information about the level of Wide Area Network (WAN) coverage; this is below the 100% level previously assumed and reduces both benefits and costs (all other things being equal);
- Thirdly, the modelling assumption about the reliability of communication hubs has been updated based on the levels committed to by the successful CSP bidders. As a result, a cost allowance for site visits by suppliers to replace faulty communication hubs has been introduced.

2.5.1 Impacts from updated cost information

Three areas of costs are directly impacted by pricing information provided in the bids. Costs expected to be incurred by the DCC licensee, the DSP and the CSPs, the latter also including the provision of communication hubs.

The most significant difference compared to previous estimates is a reduction in the estimated costs for the provision of the communications service by the CSP. The updated modelling shows a reduction of around £350m, reducing the expected communication costs from around £1.40bn to around £1.05bn.

Communication hubs will form part of the equipment deployed in premises which the CSP has been contracted to provide. The costs for the communication hubs have been agreed in contract at a lower average cost than was previously modelled. Previous estimates expected present value costs of around £1.25bn. The contracted solution is estimated to involve present value costs of £1.00bn. This results in a cost decrease of around £250m when compared to the January 2013 IA.

Costs for the Data Service Provider (DSP) have been broadly confirmed at the level that was previously expected. In the updated model DSP costs amount to £183m extrapolated over the IA period, while the January IA had assumed £184m.

Costs that the DCC licensee is expected to incur are also very close to the original estimates. In the updated cost benefit analysis DCC costs amount to £194m, while the last IA had assumed £204m.

HM Treasury guidelines establish that the application of adjustments for optimism bias and risk allowances should be reviewed as certainty increases and substantiating evidence is identified. One of such key points in time in the case of smart metering is the award of the contracts and the DCC licence. We have therefore reviewed the treatment of risk and the application of optimism bias factors in areas where the award of the contracts increases significantly the certainty on the costs (and benefits) of the solution. Since price information derived from the procurement processes is firm and contractually committed to, any optimism bias factors which had previously been applied to the capital costs of the communications and data service providers, including the communications hub, have been removed. Actual costs could however differ from the ones estimated here as contracts are subject to a change control process and some of the costs are dependent on energy suppliers' rate of roll-out and the data volumes requested by users.

Information on the financing rates underlying the elements of capital investment for the DCC and its service providers have also been collected through the procurement process. The finance rates reflected in final contracts are throughout lower than the 10% rate assumption previously used. Both the update of financing rates for capital investment by the DCC and its service providers, as well as the removal of optimism bias uplifts, have had cost reducing effects. These are covered within the cost estimates for the DCC licensee and the service providers presented above.

2.5.2 Impacts from updated information about the level of enduring coverage

The updated coverage information obtained through the communications service procurement process results in a slight reduction of NPV by around £125m. Final communication service contracts commit to a quick but gradual coverage expansion during the roll-out and also an enduring level of coverage of over 99%. This compares to the assumption in previous Impact Assessments which had assumed 100% coverage to be achievable. Evidence provided during the competitive dialogue process indicated that higher levels of coverage would only be possible at uneconomical and disproportionate cost.

2.5.3 Impacts from updated evidence about communication hub failures

A new cost allowance has been added to the cost benefit analysis to reflect site visits by energy suppliers required to deal with potential failures of the communication hub. A cost of £50 per communications hub replacement has been modelled, taking account of existing assumptions about installation costs, failure rates, and indicative information about expected costs of communications hub replacements obtained through a request for information to energy suppliers. The new cost allowance for site visits to address communication hub failures amounts to around £90m.

2.5.4 Aggregate impact of changes driven by the procurement process

Compared against the January 2013 IA the integration of information from the DCC licence award process and the data and communications service provider procurements has increased NPV by around £375m.

2.6 Updated assumptions of the costs of meters installed during the Foundation stage

The period ahead of DCC services being operational and full scale roll-out commencing is referred to as Foundation. This stage is expected to play an important role in generating early learning and providing an opportunity for the early realisation of smart metering benefits. Installations in this period generate benefits such as avoiding multiple site visits where traditional meters reach the end of their asset life, helping energy suppliers smooth their roll-out profiles over a longer period of time, and bringing the benefits from smart meters to consumers and cost savings to energy suppliers forward. There are also some risks involved in the deployment of smart meters in this stage, and under some scenarios these risks could materialise in cost increases. Previous Impact Assessments had reflected that risk through the addition of cost allowances to meters installed in the Foundation stage.

The modelling in the IA has been updated to take account of an improved understanding of the effect on overall costs from installations in Foundation. The impacts presented in this section discuss the impact of updating existing cost estimates rather than presenting an overall economic assessment of the Foundation stage. Two primary effects have been identified.

2.6.1 Additionality of Foundation communication contract costs

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 full scale roll-out in late 2015. Communication costs for a smart meter installed in the Foundation stage are in part incremental to the DCC costs, because the fixed costs for the DCC communication solution do not reduce as a result of Foundation meters using third party communications and data solutions. This is now reflected in the updated IA. In parallel, the Programme has also received information from industry stakeholders about the communication service costs that they are currently facing for their Foundation smart meters. The information received indicates lower costs than were previously assumed. The combined impact of considering Foundation communications service costs as incremental and adjusting the underlying cost assumption in light of new evidence from supply companies is a reduction in NPV of around £150m.

2.6.2 Review of the risk uplifts applied to Foundation installations

The second area where our assumptions for Foundation meters have changed are the risk uplifts that are applied to such installations. The March 2012 IA[8] introduced a number of cost uplifts that are applied to smart meters installed during Foundation, to account for risks such as asset stranding arising from a lack of interoperability, and considered potential additional costs upon integration of a Foundation meter into the DCC system.

In May and July 2013 DECC published its response to the consultation on the Foundation Smart Market[9], confirming the decision to introduce three new licence conditions, which will help to improve industry practices and commercial arrangements associated with change of supplier in the Foundation period. The licence conditions will apply from April 2014 and once in place we expect the risk of asset stranding to be significantly reduced. The licence conditions are summarised below:

- <u>Licence Condition 1</u>: following a change of supplier the losing supplier of a consumer with a SMETS-compliant smart metering system will be required to

[8] DECC, *Impact Assessment: Smart Meter roll out for domestic sector (GB*), April 2012.
[9] DECC, *Smart Metering Implementation Programme - Foundation Smart Market: Government response to the consultation on the Foundation Smart Market and further consultation (original response), May 2012* and *Government response to further consultation (10 May 2013),* July 2013.

provide the gaining supplier with the details of the Meter Asset Provider (MAP) for the relevant smart metering equipment and provide the MAP with the identity of the gaining supplier. Under the competitive metering market arrangements, MAPs fund meters and seek to recoup the asset value of each meter from whichever energy supplier is currently using it to supply energy at premises at which it is installed[10].

- Licence Condition 2: where a gaining supplier acquires a SMETS-compliant smart metering system on change of supplier, it will be required to agree rental terms with the relevant MAP, within one or six months (depending on whether it has existing commercial arrangements with the MAP), or return the smart metering equipment to the MAP by no later than the end of one further month.
- Licence Condition 3: the gaining supplier will be required to take all reasonable steps to install a SMETS-compliant smart metering system when it replaces a SMETS-compliant smart metering system following change of supplier. This will ensure that compliant smart metering equipment will not be replaced with non-compliant equipment (e.g. a dumb meter)[11].

These Licence Conditions reduce but do not completely eliminate the potential residual risks of Foundation activity. The risk uplift for Foundation installations has therefore not been removed completely, but has been reduced from 15% in the January 2013 IA to 5% in the current IA. This uplift is applied to the costs of the metering equipment, the communications equipment in the home, the IHD and the installation costs for both domestic and non-domestic installations during Foundation. The reduction in the risk uplift increases NPV by £120m in comparison to the January 2013 IA.

2.6.3 Wider costs for setting up and integrating Foundation communications and data infrastructure

In addition to the cost uplifts that are applied to various elements of Foundation installations, previous Impact Assessments also included a broader allowance of £30m covering the costs involved in an interim data solution ahead of availability of the DCC's data and communication services.

Further engagement with stakeholders has confirmed that this cost allowance adequately covers both the costs involved in building head-end systems in Foundation as well as potential additional investment that the DCC might have to incur in order to facilitate the integration of Foundation smart meter systems within the overall DCC service.

As noted above, Licence Conditions 1 and 2 will allow the gaining supplier and MAP to initiate a commercial discussion regarding rentals for the smart metering equipment and help MAPs keep track of their assets on churn, which is expected to lower stranding risks.

[10] It is common for supply companies, rather than owning the metering equipment themselves, to effectively lease the asset from a Mater Asset Provider, who would purchase the meter and provide it to the supplier in exchange for a recurring charge. The provision of the asset is also sometimes combined with a maintenance and operation service, in which case the Meter Asset Provider also acts as the meter Operator.

[11] This Licence Condition would not require the gaining supplier to operate the smart metering system in smart mode, nor would it require that the replacement equipment had any functionality over and above the relevant SMETS specification (even if the equipment being replaced did).

There are likely to be some associated implementation costs for Licence Condition 1. Based on data provided to the Government by stakeholders, one-off costs are estimated to be no more than £325k for central systems, plus £50k to £100k per energy supplier. Annual operating costs of around £75k in total are also expected to be incurred for a number of years until systems are further rationalised when the DCC takes on the registration function. This represents total costs of about £1.8 million in present value terms. The government's assessment is that these costs will be significantly outweighed by the benefits of reducing risk and delay which the Licence Conditions address.

It has also been determined that these cost implications from licence condition 1 are sufficiently covered by the £30m cost allowance. In summary, while the understanding of the constituent parts of this cost allowance has significantly improved, the cost allowance itself remains unchanged.

2.6.4 Aggregate impact of changes

The aggregate impact of the changes resulting from an improved understanding of the costs implied by smart meter installation occurring during Foundation is a small reduction in NPV of around £30m in comparison to the January 2013 IA.

2.7 Updated estimates for governance and administration costs

The SEC and other smart metering related legislation will be introduced in stages. Further tranches of SEC and other smart meter regulations are already planned[12] and therefore the cost and benefit implications from those have already been covered in this IA.

A cost allowance for such organisational costs was made in previous Impact Assessments. This allowance has therefore been updated in the production of this IA to reflect further work on the detail of the arrangements.

2.7.1 Governance

The Smart Energy Code (SEC) is a new energy industry code that plays a central role in the smart metering arrangements. It establishes the contractual framework between the DCC and its users. It is a regulated code, backed up by licence conditions, and is the mechanism that gives regulatory force to many of the technical and operational requirements. The detailed implementation work carried out since the last published IA in January 2013 has enabled us to generate more accurate and up to date cost estimates. Some of these areas include:

- The SEC establishes requirements for a number of bodies, each with a specific role to play in the governance of the code e.g. SEC panel, change board, working groups or more specific sub-committees. Cost estimates for these bodies have been generated by considering their membership, the likely frequency of meetings and the opportunity cost of attendants. Cost

[12] During 2014 the Programme expects to notify another iteration of the Smart Meter Equipment Technical Specification as well as the Communications Hub Technical Specification to the European Commission. In addition the Programme for example still expects to lay enduring security obligations, consequential changes to energy licences and enduring roll-out obligations.

allowances have also been made for potential appeals to code changes, where additional resources would be required.
- A procurement exercise for the Smart Energy Code Administrator and Secretariat was concluded in September 2013 and cost information from the final contract has been integrated into the analysis.

2.7.2 Data protection and security assurance

Certification and assurance requirements as part of the end to end security arrangements have been costed for the purpose of this IA update. Three main elements have been considered and integrated into the analysis:
- Security and privacy audits for the DCC and its users;
- The security accreditation scheme for smart metering equipment (i.e. smart electricity and gas meters, communication hubs and prepayment interface devices);
- The smart metering key infrastructure (SMKI) service which will be responsible for the overall provision of cryptographic keys which manages security keys in circulation to SEC Parties on behalf of the DCC.

Cost information obtained from industry stakeholders and security experts within the Programme has been applied to assumptions about the number of future DCC users, expected metering equipment variants and projected number of security keys to be issued over the appraisal period in order to generate an aggregate view of the cost implications.

2.7.3 Aggregate impact of governance and assurance related changes

The previous cost allowance of £140m in the IA has been updated in light of the improved understanding set out above. This has led to an overall increase of around £110m in organisational costs from £140m to around £250m[13].

2.8 Changes in exogenous assumptions

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 September 2013[14].

Specific impacts on costs or benefits can be grouped as follows:
- Updated values for carbon emission factors, carbon prices and variable energy prices have a slightly negative impact on NPV for both the domestic and non-domestic sectors by reducing the estimated value of carbon and energy savings respectively.

[13] An additional cost allowance of £30m for legal activities was also presented under organisational costs in this and previous IAs. This has not been amended.
[14] https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-and-emissions-projections

- In the domestic sector, the number of electricity and gas meters has been increased to reflect the latest data available from DECC sub-national statistics[15]. Projected household energy consumption from DECC's latest projections is overall slightly higher than previously estimated. Both updates increase the estimated NPV of the policy by increasing the energy baseline from which energy and carbon savings are calculated.
- In the non-domestic sector, the number of gas meters and their energy consumption has been revised in order to account for better, more up to date information. This results in a reduction in the overall NPV. Section 6.2.2 discusses these changes further.

The aggregate impact from these changes across both domestic and non-domestic sectors is a decrease in the NPV of approximately £200m.

[15] https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/sub-national-energy-consumption

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

Summary: Analysis & Evidence — Policy Option 1

Description: This IA reflects a roll-out completion date in December 2020 of a supplier led roll-out of smart meters with a centralised Data and Communications Company (DCC).

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 154	High: 8,809	**Best Estimate: 4,338**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	NA		NA	**NA**
High	NA		NA	**NA**
Best Estimate	526		781	**10,470**

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

IHD, meters and its installation and operation amount to £6.03bn. DCC related costs, including asset costs for the provision of communications hubs, amount to £2.34bn. Energy suppliers and other industry IT systems costs amount to £0.79bn. Industry governance, organisational and administration costs, energy, pavement reading inefficiency and other costs amount to £1.27bn.

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		853	**10,607**
High	0		1,555	**19,296**
Best Estimate	0		1,192	**14,808**

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

Total consumer benefits amount to £4.30bn and include savings from reduced energy consumption (£4.27bn), and microgeneration (£30m). Total supplier benefits amount to £7.97bn and include amongst others avoided site visits (£2.85bn), and reduced inquiries and customer overheads (£1.15bn). Total network benefits amount to £877m and generation benefits to £803m. Carbon related benefits amount to £797m. Air quality improvements amount to £70m.

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%

Cost assumptions are adjusted where appropriate 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	110,800,150	135,529,393	287,614,139	415,664,779	629,708,182	833,860,371
Total annual benefits	34,647,089	72,068,837	141,042,889	310,101,701	564,612,025	896,533,495

£	2019	2020	2021	2022	2023	2024
Total annual costs	1,074,233,038	1,138,640,346	1,108,755,055	1,079,368,333	1,070,455,142	1,054,349,684
Total annual benefits	1,242,164,158	1,503,257,137	1,523,032,899	1,546,206,088	1,579,877,872	1,617,529,047

£	2025	2026	2027	2028	2029	2030
Total annual costs	1,033,886,146	1,024,193,754	1,024,386,688	853,911,163	849,921,278	858,981,432
Total annual benefits	1,670,596,338	1,711,614,311	1,721,210,820	1,743,443,236	1,771,359,461	1,810,466,795

* 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	0.80	3.68
	Non-traded	0.01	0.86	4.32
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	0.80	3.68
	Non-traded	0.01	0.86	4.32
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 in relation to the domestic sector 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 unless there is evidence available for specific finance rates as discussed in section 2 (e.g. finance rates specified in contracts for some of the procured services or products). 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[16]. It includes:

- The costs of the continued installation of basic meters;
- Benefits from better billing; and
- 5% of the predicted consumer electricity savings from smart metering are assumed to occur in the counterfactual world as a result of CERT[17] 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

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

information) and in addition be supported by a consumer engagement strategy to ensure that energy consumption behaviour changes are facilitated.

It is difficult to judge whether any significant numbers of smart meters would have been rolled out in the absence of Government facilitation. In deregulated and competitive supply markets such as Great Britain, 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[18].

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[19].

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 counterfactual 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 domestic NPV of £2 billion.

[18] 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.
[19] We estimate that in total approximately 850,000 smart and smart-type meters may have been installed to date, approximately 2% of the domestic metering population.

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 roll-out being realised. Suppliers would 'cherry-pick' those consumers that realise above average benefits from receiving a smart meter. While the overall NPV remains positive, such an illustrative scenario would yield a significantly lower societal net benefit than a universal roll-out.

The cost of the continued basic meter installation is deducted from the costs for the smart meter deployment. As outlined in the January 2013 IA[20], the modelling reflects continued basic meter installations until 2015. 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 discussed above are subtracted from the overall benefits for smart meters as they are assumed to occur in the business as usual case. 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, the IHD, which is connected to the metering system via a HAN[21]. It is assumed that a 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 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
IHD	£15
Electricity meter	£43.6
Gas meter	£57.2
Communications equipment	£31

[20] DECC, *Impact Assessment: Smart Meter roll-out for small and medium non-domestic (GB)*, January 2013.
[21] The HAN is the 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] The WAN is the 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	**£214.8**

IHDs
IHDs will have dual fuel functionality so any second supplier providing gas or electricity in a split fuel home (i.e. where gas is supplied separately from electricity) 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[24].

Smart meters
As described in section 2.4, the allowance of £1.75 for the inclusion of a keypad in all smart meters that was introduced in the January 2013 IA has been removed. For modelling purposes a cost allowance for additional connector equipment between the communications hub and the electricity meter (the 'hotshoe') has been added to the electricity meter cost estimate to reflect a limited number of installations that are expected to deploy this architecture (extra cost of £2.7 in 15% of installations). Average cost estimates for gas and electricity meters have decreased by around £1.75 and £1.35 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 £3,707m.

Operating and maintenance (O&M) 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. As O&M costs are likely to be incurred in the form of having to replace faulty equipment the same optimism bias uplift of 15% which is applied to metering equipment being added to the O&M allowance.

Operating and maintenance costs accrue to £676m in present value terms.

Communications equipment
Cost estimates for the provision of communication hubs have been updated to take account of the firm pricing provided through CSP contracts with the DCC. The volume weighted average cost of a communications hub across the three CSP regions is now around £31. It should be noted that while unit costs for communication hubs are higher than estimated in the January 2013 IA, the overall cost from communications hubs in the domestic sector over the appraisal period has reduced from around £1.15bn in the January 2013 IA to present value costs of around £1.00bn in this latest assessment. This is largely driven by the financing rate which is set out in contractual agreements being on average significantly lower than the previously assumed financing rate of 10%. Furthermore, the cost uplifts previously applied to reflect the risk of optimism bias in the appraisal have now been removed for this item as the costs are now contractually committed to.
The gross present value cost of communications equipment in the domestic assessment is approximately £984m.

[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.
[24] Two exceptions to this are a) the split fuel premises described in section 2.4.4, where the cost modelling assumes a worst case outcome of all such premises receiving two communications hubs and two IHDs and; b) 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.

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 3-2: 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 £1,645m 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.

3.3.2 DCC related costs

The three broad categories into which DCC related costs are now broken down are:

- The costs that the DCC licensee is expected to face
- The costs that the Data Service Provider (DSP) will incur
- The costs that the Communications Service Provider (CSP) is expected to incur for the provision of the communications services (i.e. excluding the costs for the provision of communications hubs, which are covered separately in section 3.3.1)

DCC licensee costs
As outlined in section 2.5.1, the costs that the DCC licensee contract contains are very close to the assumptions that were applied in previous IAs. A total cost of

£194m over the appraisal period is now reflected, containing elements for the initial set-up of services, on-going service provision as well as potential costs incurred in the re-procurement of the DCC.

DSP costs
Costs that are expected for the provision of the data services have also been broadly confirmed at the level of previous IA assumptions. Cost information about set-up costs as well as on-going service provision from the final contracts result in total costs of £183m over the appraisal period.

CSP costs
Costs for the provision of the communication services across the three regions (North, Central and South) have reduced following the integration of cost information from the procurement process and now amount to a total of around £1bn. This cost contains elements for the set-up of a communications infrastructure as well as on-going elements for the provision of the service.

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

Capital expenditure
In 2010 the Programme issued a request for information (RFI) in 2010 to relevant industry stakeholders to obtain information for a range of IT system related costs. Through this RFI 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 was included, since this was a factor of the existing system suite, but was 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.

We model the vast majority of IT investment to be carried out upfront, aligning with the timings for the DCC starting to offer its services from go-live. A small incremental investment is assumed to be incurred in 2017 as cost required for the additional function of registration being added as a DCC service. A cost allowance of around £4m for establishing an interim registration system before this function is added to the DCC's services has also been included following new evidence provided by industry stakeholders. For modelling purposes we also reflect further incremental investment in 2019 supporting the provision of data aggregation services by the DCC.

The supplier IT capex cost estimate also includes the broader allowance of £30m covering the costs involved in an interim data solution ahead of availability of the DCC's data and communication services, first discussed in section 2.6.

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

The total present value for supplier IT capex is £369m, while the costs estimate for other industry participants' IT capex is £69m.

<u>Operational expenditure</u>
For modelling suppliers' IT operational expenditure, previous Impact Assessments have used an industry standard figure of 15% of total IT capex for initial opex for smart metering IT unless where more specific evidence has been available. This initial figure is reduced gradually to 5% by 2030. This is in line with best practice IT application and infrastructure management where on-going performance improvement is a key feature of contracts and has been observed in IT systems of comparable scale and complexity.

Cost estimates are based on the 2010 RFI referred to above, and these were further updated in in the January 2013 IA to reflect operational expenditure arising from changes to IT systems as a result of a refined technical architecture.

Similarly, 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 £275m and £81m 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. For some cost items the procurement of the DCC and its service providers has provided new information about the relevant financing rates, which have been transferred into the cost benefit modelling as described in section 2.5. For the remaining cost items, and 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 for those cost items where no specific cost of capital information has been obtained through the procurement processes by just 1% increases the NPV by over £300m, while an assumed capital cost of 5% (i.e. a reduction of the current assumption by 5%) increases the NPV by approximately £1.5bn. As with other modelling assumptions, this conservative approach results in a potential underestimation of the net benefit of the policy.

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 £681m.

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 £210m.

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. Present value costs amount to £10m.

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.
As discussed in section 2.7 the allowance for such activities has been increased as a result of further work carried out on the detailed arrangements. Previously identified

costs for internal risk audits and externally commissioned security audits during the Foundation period have been adjusted to reflect the revised timetable and continue to be reflected in the cost estimate here. The same applies to a cost allowance of £1m for monitoring and evaluating data submission, which was first established in an Impact Assessment in 2012.

Total present value costs over the appraisal period are approximately £286m.

3.3.9 Costs associated with consumer engagement activities

The March 2011 Government response document to the prospectus consultation[25] 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.

In December 2012 the Government published its smart metering Consumer Engagement Strategy, designed to direct work to raise levels of consumer awareness of, and support for, smart metering, as well as to enable energy-saving behaviour change. The strategy was developed in close consultation with stakeholders and was informed by a range of GB and international evidence. Its strategic aims are:

- Building consumer support for the roll-out by building confidence in benefits and by providing reassurance on areas of consumer concern;
- Delivering cost-effective energy savings by helping all consumers to use smart metering to better manage their energy consumption and expenditure; and
- Ensuring that vulnerable and low-income consumers can benefit from the roll-out.

Energy suppliers will have the primary consumer engagement role as the main interface with their customers before, during and after installation. However, the Government concluded that supplier engagement should be supported by a programme of centralised activities undertaken by a new Central Delivery Body (CDB), funded by larger suppliers, with smaller suppliers contributing to the CDB's fixed energy costs.

Subsequently, the CDB was launched in June 2013. Its objectives are broadly in line with the aims of the Consumer Engagement Strategy. It has an independent Chair, and consumer groups are represented on the Board of Directors.

Trusted third parties, such as charities, consumer groups, community organisations, local authorities and housing associations will also have an important role to play in delivering effective consumer engagement. Many of these groups will not have the resources to work with each individual supplier. It is therefore expected that the CDB will facilitate and coordinate their involvement by producing materials for them to use when engaging consumers or potentially by working with them to undertake localised engagement campaigns.

By the end of 2013, the CDB is required to have set its budget for the following year, and to have developed its first annual engagement plan. The Government has not

[25] https://www.gov.uk/government/consultations/delivering-smart-meters-to-homes-and-businesses

set a budget for the CDB. There are, however, mechanisms to ensure that the costs of the CDB remain at a reasonable level. Larger suppliers are required by Licence Conditions to ensure that the CDB undertakes its consumer engagement activities in a manner which is cost effective and represents value for money, and the CDB's annual report will need to include details of the CDB's efforts to achieve value for money.

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[26].

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 the evidence available at this point in time it is not feasible to generate firm quantified estimates of the likely benefits of centralised engagement. The evidence on the benefits of different types of consumer engagement to support energy saving is being assessed further through our early learning project, as described in 3.4.1.1 below.

Ahead of the completion of CDB's work on setting its budget and publishing its engagement plan, it is not possible to provide improved estimates of the costs of centralised engagement, or quantify the benefits. In present value terms, the overall estimate of the present value costs associated with this Programme remains at £87m[27] 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.

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 full scale roll-out in late 2015. On the basis of information received from suppliers, the

[26] DECC, *Smart Metering Implementation Programme: Government Response to the consumer engagement strategy*, December 2012.
[27] Note that in early IAs, these costs were presented in real terms. These are now presented in NPV terms.

Government expects a significant number of smart meters to be installed during the Foundation Stage.

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);
- Allows development of further evidence regarding a HAN standard without delaying overall progress;
- Takes some pressure off peak installation rates; and
- Supports ambitious roll-out completion target.

Some risks from installations during Foundation have also been identified and these risks might result under some scenarios in cost increases which we reflect through the addition of cost allowances to early meter deployments. These allowances have been determined through a consideration of potential outcomes materialising and the likelihood of the event happening. Three areas of potential risks are identified for smart meters installed during Foundation:

- 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 and different energy suppliers using different WAN standards for their smart metering solutions. 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.
- 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 provided from smart meters installed during Foundation as the functionality will be provided through the CSP communication hubs which won't be available during Foundation. 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.

For the interoperability and DCC categories the cost modelling considers how the risks could materialise in costs, and estimates what a worst-case scenario cost impact per meter would be. Under consideration of mitigating factors (both policy dependent and driven by commercial incentives) 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).

The introduction of licence condition 3 (‘no backward step’) supports the incentives for an incoming supplier to use smart equipment that has been installed by the previous supplier. Under this condition, a gaining supplier will be required to take all reasonable steps to install a SMETS-compliant smart metering system when it replaces a SMETS-compliant smart metering system on change of supplier. To take account of potential residual risks (including a smart meter installed by the previous supplier being run in ‘dumb’ mode and resulting in a loss of supplier benefits) the uplift has not been removed completely, but has been reduced from previously 15% to now 5%. This uplift is applied to the costs of the metering equipment, the communications equipment in the home, the IHD and the installation costs for both domestic and non-domestic installations during Foundation.

For the functionality differences – the lack of outage notification from Foundation meters – the impact is not translated into a cost increase factor but directly applied to the roll-out modelling. Smart installations ahead of availability of CSP communication hubs 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 installations.

The table below sets out the uplift factors that are applied to Foundation installations. It should be noted that the roll-out of smart meters during Foundation is not mandatory for suppliers. Rather, Government policy allows sufficient flexibility so that energy suppliers which see a case to start deploying volumes earlier can do so.

Table 3-3: 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)	**5% 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[28]	**No longer reflected as a cost uplift but captured through assuming that Foundation communication**

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

		contract costs are partly incremental to DCC communication costs.

3.4 Benefits of smart metering

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

3.4.1 Consumer benefits

A range of consumer benefits is expected, including those around improved customer satisfaction and financial management benefits, which have so far not been quantified. They are being examined as part of our current research and evaluation programme, and will be addressed through 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)[29] 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[30] 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[31] and Corinna Fischer[32] also show that feedback can result in dramatic behavioural changes with average reductions in energy consumption of over 10%.

[29] Erhardt-Martinez, Donnelly, Laitner, *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010.
[30] http://www.aceee.org/research-report/b122
[31] Sarah Darby, *The Effectiveness of Feedback on Energy Consumption*, April 2006.
[32] Corina Fischer, *Feedback on household energy consumption: a tool for saving energy?*, 2008.

The European Smart Metering Industry Group (ESMIG) report[33], 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.
Trials in European countries resulted in energy savings within the same range[34]. International studies also provide some evidence on the likely persistence of savings. The ACEEE study quoted above found that feedback-related savings are often persistent, including from the longer-term studies (12 – 36 months) considered. However given the differences of situation and approach between different countries, it is difficult to transfer evidence on levels and persistence of savings directly to the GB context.

The Energy Demand Research Project (EDRP) was a major UK project co-funded by the Government to provide information on consumers' responses to a range of forms of feedback, including smart meter-based interventions. The final report[35] 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)[36] 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

[33] ESMIG, *The potential of smart meter enabled programs to increase energy and systems efficiency*, October 2011.
[34] CER, *Electricity Smart metering Customer Behaviour Trials (CBT) Findings Report, Information paper, CER11080a,* May 2011. In Germany, a recent smart meter trial suggests savings of around 5% due to a combination of indirect feedback and energy efficiency advice: Schleich, J.; Klobasa, M.; Brunner, M.; Gölz, S.; Götz, K.; Sunderer, G., *Smart metering in Germany and Austria - results of providing feedback information in a field trial*, 2011.
[35] Ofgem, *Energy Demand Research Project, final analysis*, June 2011.
[36] Darby, Sarah, *Smart metering: what potential for household engagement?*, 2010

the development of energy tariffs and services which encourage or facilitate behaviour change.

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

As noted above, the effectiveness of consumer engagement approaches is likely to influence the level and distribution of consumer energy savings. Plans are being developed for a central engagement programme as described in section 3.3.9, to supplement the engagement activities of individual suppliers. We are conducting an early learning project, due to report in 2014, which will provide an initial analysis of progress that has been achieved to date in delivering consumer benefits especially in relation to energy saving, and where further steps are likely to be effective in increasing such benefits. We expect this analysis to include assessment of the importance of centralised engagement.

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[37] assumes 6.4% electricity savings with direct feedback through an IHD (3.2% with indirect feedback), and 5.1% (3.7%) for gas[38]. 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[39] 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[40]. The energy baseline from which energy savings are calculated is consistent with the most

[37] KEMA, 2010
[38] 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.
[39] Caveats include the degree of representativeness of the samples, trials effects and scale effects for instance.
[40] 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

recently published DECC energy projections accounting for a number of energy efficiency policies in place before smart metering[41].

Incorporating direct rebound effects is 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 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 empirical trial results, i.e. observed impacts. These observed values are net of any potential comfort taking and direct rebound effects. Therefore, no further adjustment is necessary 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 £4,265m 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 £30m in present value terms over the appraisal 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. Discussions with energy suppliers in workshops and bilateral meetings have validated at an aggregate level across the industry that the supplier benefit assumptions, are valid and achievable. Individual suppliers may however have different commercial positions.

[41] Hence avoiding double-counting energy savings and accounting for policies’ overlap. Policies accounted for in the baseline are Warm Front, Building Regulations 2002 and 2005, EEC1,2 and CERT (excluding CERT +20%), and product policy tranche 1.

3.4.2.1 Avoided site visits

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

- Regular visits

    - Regular meter read visits

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

    - Regular safety inspection visits

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

Currently safety inspections are carried out as part of the regular meter reading visits and therefore carry little if any additional cost. 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[42].

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:

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

- Higher risk group:
    - 10% of meters

[42] Ofgem, *Letter to British Gas*, 14 December 2012.

- Require a safety inspection every 2 years (or 5% of meters every year)
- Approach of scheduled appointments with £17.5 cost per successful visit[43]

There is uncertainty around what proportion of meters might be considered higher 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[44] 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 3-4: Cost and benefit impacts from avoided site visits (per meter per year)[45]

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	cost

[43] 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.

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

[45] 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.

		per high risk meter pa	
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 £2,846m 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[46], 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 £1,146m 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[47], and these could 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.

[46] Mott MacDonald, *Appraisal of costs and benefits of smart meter roll out options*, April 2008.
[47] Ofgem, *Domestic Suppliers' Social Obligations: Annual Report*, October 2011.

Consumers on pre-pay could benefit if these operational cost savings were passed on as lower prices. In practice, pre-pay customers have already made some of those savings because suppliers have artificially lowered prepay tariffs towards standard credit levels. In so far as that process has involved cross-subsidy, part of the benefit of reduced prepay costs might fall back to the whole customer base. A single credit/pre-pay meter means that cost-differentials between standard credit and prepay tariffs will be substantially reduced without any need for cross-subsidisation. We assume that the additional cost to serve consumers with PPMs is 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[48]. 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 £1,048m.

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 some 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

[48] Ofgem, *Energy Supply Probe-Initial Findings report* , October 2008

payment types. With easier payment arrangements for PPM more customers may opt for PPM if they are having difficulty managing their payment. We do however not model an increase in PPM customers over time.

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

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 £968m.

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, but also includes cost savings from the centralisation of registration and data aggregation functions. 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 DCC offers registration and data aggregation services (assumed to be for modelling purposes from 2020. Where the DCC offers registration services (assumed to be from 2018 for modelling purposes) benefits of £2.22 per smart meter per year are considered. From the go-live date of DCC services in late 2015 benefits of £1.58 per smart meter per year are considered. Before the establishment of DCC benefits are assumed to be of £0.8 per meter per annum.

In total present value terms, switching savings generate £1,498m 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[49] and in Ofgem's strategy consultation for the RIIO-ED1 electricity distribution price control[50], 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 £241m.

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 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 £220m over the appraisal period.

[49] Ofgem, *Tackling gas theft: Final impact assessment*, March 2012
[50] Ofgem, *Strategy consultation for the RIIO-EDI electricity distribution price controls outputs, incentives and innovation*, September 2012

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 of changes enabled or generated by smart metering, among other developments in the energy markets.

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.

3.4.3.1 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 are £410m.

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. Taking into account the updated information about the critical mass of meters required as introduced in the January 2013 IA, the benefits are considered to be realised from 2014 onwards, at which point over one third of smart meters with outage detection functionality[51] will be installed. We also assume that the smart metering technology will only lead to outage related benefits in the low voltage network system. This is because other voltage systems within the electricity networks already have sophisticated monitoring and diagnostic systems in place.

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

[51] 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.

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 benefits from a reduction in customer minutes lost are £94m.

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 benefit from the reduction in fault fixing costs is £166m.

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 are £31m.

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[52] 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[53]. This baseline investment figure reflects general reinforcement costs, attributable to normal increases in electricity demand from housing54. 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 £101m over the appraisal period.

3.4.3.4 Avoided cost of investigation of customer complaints about voltage quality of supply[55]

With smart meters electricity Network Operators will be able to monitor voltage remotely, removing the need to visit premises to investigate voltage complaints.

[52] http://www.energynetworks.org/electricity/futures/smart-meters.html

[53] 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.

[54] These figures do 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.

[55] 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.

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 £36m.

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) will 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[56], 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[57] or a critical

[56] We here refer equally to DSR and load shifting.
[57] Sustainability First, *Smart Pre-payment in Great Britain,* March 2010 and *Smart tariffs and households demand response for Great Britain*, March 2010.

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.

The approach and underlying assumptions on load shifting remain unchanged from previous assessments. 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 (Jamasb and Pollitt, 2011[58]). We treat benefits from load shifting as distinct from demand reduction, even though some studies and trials have found that time-varying tariffs can lead to demand reduction in addition to shifting (King and Delurey, 2005[59]; Customer-Led Network Revolution Trials, 2013[60]).

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), starting from 2016. Previous Impact Assessments had considered the take-up of STOU tariffs to start occurring as early as some smart meters had been installed i.e. 2013. We have revised this assumption in order to present a more conservative view as to when energy suppliers are likely to start offering time of use tariffs to their customers.

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[61]). Additionally, those customers with higher than average discretionary consumption at peak time will also be presented with above average incentives for taking up ToU tariffs. It must be noted that some of the existing electric heating storage capacity, which provides discretionary load, is already utilised under Economy 7 tariffs, and therefore we do not account for electric heating storage as part of our bottom up calculation. We therefore estimate the current amount of discretionary load at present to be 20% of total consumption at peak (17% from wet appliances + 3% from above average incentives for those taking up ToU tariffs).

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

[58] Jamasb and Pollitt, *Future of Electricity Demand,* Cambridge University Press, 2011.
[59] King, C and Delurey, D, *Twins, siblings or cousins? Analyzing the conservation effects of demand response programs. Public Utilities Fortnightly*, March 2005.
[60] http://www.networkrevolution.co.uk/default.aspx
[61] DECC, *Energy Consumption in the UK*, 2009.

business as usual (i.e. non-policy related) growth in number of electric cars (DfT, 2008[62]) 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.

These assumptions are in line with recent trials' results. In Great Britain, initial results from the Customer-Led Network Revolution Trials indicate that time of use customers in the trials reduced their overall electricity demand by 3%, with 10% reduction during the evening peak[63]. The EDRP final report also 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%.[64] The recent CER report on Irish smart meters trials[65] 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 suggests peak shifting of around 5% from TOU, and up to 16% with more sophisticated tariffs[66].

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[67] 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

[62] DfT/ BERR, *Investigation into the scope for the Transport Sector to switch to Electric vehicles and plug-in Hybrid Vehicles*, October 2008.
[63] http://www.networkrevolution.co.uk/industryzone/projectlibrary
[64] Neither of the TOU tariff trials involved any automation of energy-consuming appliances to facilitate load shifting.
[65] CER, *Electricity Smart Metering Customer Behaviour Trials (CBT) Findings Report,* May 2011 and *Electricity Smart Metering Customer Behaviour Trials (CBT) , Information paper*, May 2011.
[66] E.g. 12% with Real-time pricing and Critical Peak Rebate and 16% with Critical Peak Pricing.
[67] 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).

generation cost, minimising production-related costs within the wholesale market by balancing generation and demand in a more cost effective way.

The present value gross benefit of short run marginal cost savings is £113m.

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 £690m.

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[68]. For distribution, we use the expected annual investment requirement figure from the DPCR5 as the baseline[69]. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing[70]. 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 £40m.

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

[68] 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).

[69] 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.

[70] This figure 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.

emissions factor differentials between peak and off-peak assumed to be those for coal and gas respectively, at 0.29 and 0.18 kg CO2/ kWh.

The expected present value benefit is £26m.

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 £154m.

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 £617m.

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

Table 3-5: 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 (£m, PV)	Avoided cost of carbon – gas (£m, PV)
9.03	13.45	154	617

3.4.6 Air quality benefits

In line with guidance from the Department for Environment, Food and Rural Affairs' (Defra) Inter-departmental Group on Cost and Benefits of Air Quality[72] a benefit reflecting air quality improvements from reduced emission of pollutants as a result of

[71] 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.

[72] Defra, *Air quality appraisal-damage cost methodology*, February 2011.

energy savings is estimated. Air quality improvements are estimated to deliver benefits of £70m 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 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[73].

Building smarter grids is an incremental process of applying communications technology to deliver more dynamic real time flows of network information and of 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 medium term, it is difficult to quantify these with confidence at this stage. The Government's intention is to better understand opportunities to build smarter grids and to reduce the barrier to deployment. 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[74]. There have been a number of attempts to quantify potential benefits arising from a smarter grid[75]. 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[76]. 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;

[73] Electricity Networks Strategy Group (ENSG), *A Smart Grid Vision*, November 2009.
[74] 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.
[75] DECC does not necessarily endorse these, and emphasises the uncertainty surrounding a future smart grid.
[76] Electricity Networks Strategy Group (ENSG), *A Smart Grid Vision*, November 2009.

benefits are expected from greater use of demand side management (due to higher assumed levels of heat pumps and electric vehicles) as well as from more cost-effective management of distributed energy resources.

The Energy Networks Association (ENA) and Imperial College have estimated the potential network benefits from Smart Meters due to demand side management at between £0.5 - £10bn NPV from 2020 - 2030[77]. 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[78], and has benefited from the input of key stakeholders. Arising from this work, the model "Transform" has been used to estimate the costs and benefits of smart deployment for the electricity distribution system. The outputs of this work have been recently been published on the Smart Grid Forum website[79]. The analysis suggests that smart grid technologies (including functions such as demand side management which can be supported by smart meters) can deliver significant savings over the period to 2050 in the order of 25-30% of total investment costs.

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..

Finally, DECC has commissioned Redpoint and Element Energy to carry out benefits analysis of different DSR schemes (static and dynamic tariffs), through smart meters[80]. 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; and
- 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.

[77] ENA and Imperial College London, *Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks*, April 2010.
[78] It is available on the Smart Grid Forum website: http://www.ofgem.gov.uk/Networks/SGF/Pages/SGF.aspx
[79] https://www.ofgem.gov.uk/publications-and-updates/analysis-least-regrets-investments-riio-ed1-wrapper
[80] Redpoint & Element Energy, *Electricity system analysis-future system benefits from selected DSR* scenarios, August 2012.

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.

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 where appropriate (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 2011 real prices.

Table 4-1: Total costs and benefits

Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
10.47	14.81	4.34

Table 4-2: Consumer and supplier benefits

Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
4.29	9.65	0.87	14.81

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

Total Costs £bn	**Total Benefits £bn**			**Net Present Value £bn**		
	Low	**Central**	High	Low	**Central**	High
10.47(+/-0.018)[81]	10.61	14.81	19.30	0.15	4.34	8.81

[81] 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
2.03	4.29	6.47	8.20	9.65	11.46	0.38	0.87	1.37

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 Impacts of smart meters on household 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[82]. The results below show the average impact on household energy (electricity and gas) 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 roll-out is expected to result in a relatively small transitional bill increase in the short term, followed by larger savings for consumers in the medium and long term. The short term increase on the household energy bill is expected to peak in 2015 at an average of around £6 per household (or 0.4% of an average bill). From 2017 the predicted impact on central scenarios is a bill reduction. By 2020, once the roll-out is complete, we expect savings on household energy bills to average around £26 per annum per household.

From 2020 onwards bill savings generated from smart metering continue to increase as a result of higher energy prices (which make energy savings from smart meters more valuable) and a reduction of costs when compared to the counterfactual (where dumb meters are assumed to continue to be replaced and therefore incur new costs). By 2030 we estimate average bill savings will be approximately £43 per household (Table 4-5).

Table 4-5: Average impact on household energy bill (£, real 2012)

	Household energy bill impact, £
2015	6
2020	-26
2025	-33
2030	-43

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

The price impacts of smart meters in the domestic sector are detailed in Table 4-6 below. The price impact per unit of energy is expected to be positive during the mass roll-out period (although energy savings help offset the impacts on bills). 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: Impacts on household energy prices (£, real 2012)

	Electricity	Gas
Year	price impact (£/MWh) (Inc VAT)	price impact (£/MWh) (Inc VAT)
2015	1.06	0.30
2020	0.52	0.14
2025	-0.27	-0.08
2030	-1.46	-0.45

In previous Impact Assessments, for the calculation of price and bill impacts from smart metering, a conservative scenario had been considered where stranding costs were assumed to be passed through to consumer bills as if they were additional costs to the total costs assumed elsewhere in the analysis. This assumption has been revised for this update to the bill impacts analysis in this Impact Assessment.

The stranded value of a traditional meter is the proportion of the cost initially incurred when the meter is installed that is still 'left' in the asset when the meter is taken out of service before the end of its expected economic life. Stranding costs do not however affect the net economic impact presented in this Impact Assessment, since costs for traditional meters are sunk and also incurred in the counterfactual (i.e. regardless of the smart meter roll-out).

As the Government mandate will not have an impact on the costs of traditional meters which have already been installed, the costs for such traditional meters are therefore assumed to be the same under both counterfactual and roll-out cases. As a result, there are no additional costs to account for over and above those costs already covered in the calculation for net costs and benefits elsewhere in this assessment. The sunk cost of traditional meters is already contained in the energy retail prices that underlie the bill impact calculations, so the addition of stranding costs to the net costs of the roll-out would double-count these costs. It is therefore reasonable to assume that no additional costs would be passed through to consumer bills, over and above the costs incurred for the installation of traditional metering, which are already covered in the baseline.

This change to the assumptions moderates the small increase in bills in the initial years of the roll-out, and increases the magnitude of the bill saving in the medium term. The change has no impact on price and bills projections beyond 2020.

Our analysis estimates the impact of the smart meter roll-out on a baseline which includes only policies firmly set before the smart meter roll-out mandate was announced. The bill impacts presented in this IA therefore differ from those presented in the March 2013 DECC publication ‘Estimated impacts of energy and climate change policies on energy prices and bills’[83], which considers the cumulative impact of all historic, current and firmly planned climate change and energy policies that impact on energy prices and bills. 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 in this IA may be understating the benefits seen by consumers.

We assume all costs and cost savings are 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 in terms of the percentage energy savings they can realise.

It should be noted that there may be further impacts on consumer bills for those customers who take advantage of peak/off-peak price differentials offered by smart tariffs and take up time of use tariffs. These distributional impacts have not been included in the calculation above. Analysis by the Brattle Group[84] 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

As described in the previous section, if a traditional meter is replaced by a smart meter before the end of its economic lifetime, a proportion of the traditional meter asset value is lost in the form of the meter no longer performing its intended function. While this means that costs for an investment that has been made in the past continue to be incurred without delivering any benefits, it does not mean that there are any additional costs that result from the roll-out of smart metering. The costs are borne in both the counterfactual and policy scenarios.

The unrealised value of traditional metering assets that are replaced by smart meters before the end of their economic lifetime is therefore not considered in any of the cost and benefit considerations presented in this document. However, in order to provide an indication of the scale of the unrealised value, some modelling assumptions have been made to derive a monetised figure.
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

[83] https://www.gov.uk/policy-impacts-on-prices-and-bills
[84] http://www.brattle.com/_documents/UploadLibrary/Upload936.pdf

- Meter recertification continues during the deployment period.

Further, for the economic evaluation we assume that there is no attempt to minimise the unrealised asset value 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 £890m in present value. Costs have increased by approximately £280m when compared with previous estimates. There are two main drivers that explain this change. The main driver for this change is the increase in the number of installations of traditional meters in the earlier years of the roll-out. This results in a reduction in the average age of assets being replaced, and therefore an increase in the stranded value. Separately, the calculation of the average replacement age of traditional meters has been amended to correct an erroneous step in the calculation which resulted in stranded values being underestimated.

4.2.3 Better regulation and the net impact to businesses (EANCB – Equivalent Annual Net Cost to Business)

One-In, One-out

A single OIOO figure has been calculated for the smart meters roll-out to reflect that domestic and non-domestic smart meter deployment will be taken forward through a single programme of work and implemented through a single set of legislative tools.

For the calculation of the EANCB figure the energy savings that are realised by non-domestic customers are not considered as direct benefits. The costs of providing the technical means to realise energy savings (i.e. smart meters and IHDs) are included in the OIOO cost considerations.

Based on this approach, and across both domestic and non-domestic sectors, there is a £36m equivalent annual net cost to business (EANCB). The value of stranding costs are not included in this calculation as these refer to costs incurred both in the counterfactual and policy scenarios, and therefore do not arise as a result of smart metering regulations.

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.

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.

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

- Assessment of the international and domestic evidence available;

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

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

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA.

As per HM Treasury guidelines the application of adjustments for optimism bias and risk allowances should be reviewed as certainty increases and substantiating evidence is identified. One of such key points in time in the case of smart metering was the award of the contracts and the DCC licence in September 2013. We have therefore undertaken to review the treatment of risk and the application of optimism bias factors in areas where the award of the contracts increases significantly the certainty on the costs (and benefits) of the solution. Since price information derived from the procurement processes is firm and contractually committed to, any optimism bias factors which had previously been applied to the capital costs of the communications and data service providers, including the communications hub, have been removed.

The below table reflects the updated optimism bias factors applied in this IA:

Table 4-7: Optimism bias factors

	Optimism bias factor
IHD	15%
Smart meter	15%
Installation & commercial risk	20%
Energy industry IT CAPEX	10%
Energy industry IT OPEX[86]	10%

Cost uplift factors are also 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[87].

Overall, the total cost that is added to the appraisal as a result of the application of optimism bias and other cost uplifts is still high in this Impact Assessment (approx. £1.5bn). The main areas where optimism bias and uplift factors remain include installation, metering equipment, treatment of costs in Foundation and additional roll-out costs with high peak installation rates.

[86] Optimism bias factors are applied to energy industry IT capex and opex, which covers suppliers, other industry participants and also provision of the smart meter key infrastructure.
[87] HMT, *The Green Book*, updated 2011.

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.

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

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	£1,442	£2,944	£4,329
Energy savings gas	£556	£1,321	£2,107
Business benefits			
Supplier benefits			
Avoided site visit	£2,608	£2,846	£3,083

Call centre savings	£1,009	£1,146	£1,290
Avoided PPM COS premium	£771	£1,048	£1,325
Reduced theft	£121	£241	£362
Network benefits			
Avoided investment from ToU (distribution/transmission)	£25	£40	£69
Reduction in customer minutes lost	£19	£94	£141
Operational savings from fault fixing	£42	£166	£249
Better informed enforcement investment decisions	£50	£101	£201
Avoided investigation of voltage complaints	£18	£36	£54
Reduced outage notification calls	£10	£31	£41
Generation benefits			
Short run marginal cost savings from ToU	£60	£113	£219
Avoided investment from ToU (generation)	£368	£690	£1,333

5 Domestic sector detailed results

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

Total Costs	**10,470**	**Total Benefits**		**14,808**
In premise costs	7,011	**Consumer benefits**		4,295
Meters & IHDs	3,707		Energy saving	4,265
Installation of meters	1,645		Microgeneration	30
Operation and maintanance of meters	676	**Business benefits**	Supplier benefits	7,967
Communications equipment in premise	984		Avoided site visits	2,846
DCC related costs	1,390		Inbound enquiries	977
DCC licence	194		Customer service overheads	169
Data services	183		Debt handling	968
Communications services	1,013		Avoided PPM COS premium	1,048
Suppliers' and other participants' system costs	795		Remote (dis)connection	220
Supplier capex	369		Reduced theft	241
Supplier opex	275		Customer switching	1,498
Industry capex	69		Network benefits	877
Industry opex	81		Reduced losses	410
Other costs	1,275		Avoided investment from ToU (distribution/transmission)	40
Energy	681		Reduction in customer minutes lost	94
Disposal	10		Operational savings from fault fixing	166
Pavement reading inefficiency	210		Better informed enforcement investment decisions	101
Legal and organisational	286		Avoided investigation of voltage complaints	36
Marketing	87		Reduced outage notification calls	31
NPV	***4,338***		Generation benefits	803
			Short run marginal cost savings from ToU	113
			Avoided investment from ToU (generation)	690
		UK-wide benefits		867
			Global CO_2 reduction	617
			EU ETS from energy reduction	154
			EU ETS from ToU	26
			Air Quality	70

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

Summary: Analysis & Evidence — Policy Option 1

Description: This IA reflects a roll-out completion date in December 2020 of a supplier led roll-out of smart meters with a centralised Data and Communications Company (DCC).

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2013	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 1,184	**High:** 2,563	**Best Estimate: 1,877**

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	-10		35	**457**

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

IHD, meter and communications equipment costs and its installation and operation amount to £433m. Disposal, energy, pavement reading inefficiency and other 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		129	**1,641**
High	0		239	**3,019**
Best Estimate	0		184	**2,333**

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

Total consumer benefits amount to £1.44bn and include savings from reduced energy consumption (£1.43bn), and microgeneration (£6m). Total supplier benefits amount to £295m and include amongst others avoided site visits (£128m), and reduced inquiries and customer overheads (£49m). Total network benefits amount to £112 m and generation benefits to £49m. Carbon-related benefits amount to £415m. Air quality improvements amount to £26m.

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%

Cost assumptions are adjusted where appropriate 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	2,699,893	6,024,532	9,685,212	19,639,911	34,399,626	47,901,110
Total annual benefits	14,293,828	26,056,069	40,513,348	71,220,742	115,609,257	163,489,323

£	2019	2020	2021	2022	2023	2024
Total annual costs	60,078,922	63,260,386	58,630,018	54,408,256	50,318,425	46,414,893
Total annual benefits	214,396,635	244,871,063	244,866,596	243,881,981	244,332,487	245,483,509

£	2025	2026	2027	2028	2029	2030
Total annual costs	42,543,851	38,971,911	39,795,849	16,549,448	13,011,867	9,676,170
Total annual benefits	248,049,075	246,921,843	242,507,893	238,857,502	235,774,811	232,850,879

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

Emission savings by carbon budget period (MtCO2e)

Sector		Emission Savings (MtCO2e) - By Budget Period		
		CB I; 2008-2012	CB II; 2013-2017	CB III; 2018-2022
Power sector	Traded	0	0	0
	Non-traded	0	0	0
Transport	Traded	0	0	0
	Non-traded	0	0	0
Workplaces & Industry	Traded	0.01	0.32	0.99
	Non-traded	0.03	0.77	2.81
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	0.01	0.32	0.99
	Non-traded	0.03	0.77	2.81
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 unless there is evidence available for specific finance rates as discussed in section 2 (e.g. finance rates specified in contracts for some of the procured services or products). 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, 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, governance and administration costs, as well as costs associated with consumer engagement activities, are fully accredited to the domestic sector

- Costs uplifts associated with communications service charges are applied to all smart meters installed until DCC becomes operational, and then the proportion of smart meters modelled to opt out of the DCC – in the non-domestic sector, a voluntary rather than a mandatory approach to using DCC is followed. 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[88].

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 or 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

The non-domestic business sites impacted by the smart metering mandate are those meeting the Supply Licence definitions of non-domestic customers with meters in electricity profile classes 1 to 4 (overwhelmingly 3-4), and with gas meters at sites consuming below 732 MWh per annum.

For electricity, for the purposes of this IA, we assume that the smaller non-domestic market consists of sites in profile classes 3-4. In 2011, 2.1 million meters fell into this category, based on DECC subnational statistics. We continue to assume that these meters have an annual average consumption per meter of 17,400 kWh, which remains consistent with the latest evidence available from Elexon.

As indicated in previous versions of the Impact Assessment, for gas meters there is continued uncertainty about both the number of meters at smaller non-domestic sites and the consumption levels at those sites. Gas meter numbers and their consumption levels are classified and accounted for by consumption brackets. These consumption brackets do not however differentiate between domestic and non-domestic users as is substantially the case with profile classes for electricity meters.

[88] However, benefits accredited in the non-domestic sector are proportional to the non-domestic number of installations.

As in previous IAs, in the non-domestic sector we distinguish between: (a) those gas meters used at sites with consumption of between 73,200 kWh and 732,000 kWh per annum; and (b) those used at sites with consumption of under 73,200 kWh per annum. To avoid double counting, the number of non-domestic meters and their total consumption in category (b) is deducted from the domestic sector (our baseline for domestic gas meter numbers and consumption is accounted for by those with consumption below 73,200 kWh).

We continue to assume that there are 400,000 meters under category (a), consuming an average of 170,000 kWh per annum. We have revised our assumptions for those meters in category (b). Previously, we assumed there were approximately 1.1 million sites in this category. We have updated this assumption based on reporting information on roll-out plans gathered by DECC from the Big 6 energy suppliers. This data was then combined with market share data for all energy suppliers in the non-domestic sector provided by Ofgem, to derive revised estimates of the overall number of meters in this category. A revised number of 520,000 gas meters is now estimated. We have retained our assumption on the average consumption for these meters in category (b) previously made of 47,000 kWh per annum.

While these assumptions significantly improve the accuracy of previous estimates, some uncertainty persists especially for the number of meters and their consumption in category (b). Complementary analysis was undertaken with DECC's NEED database where a sample of premises with electricity profiles 3 and 4 (i.e. non-domestic electricity sites covered by the non-domestic smart meter mandate) were matched with a separate data set with information on gas meters. This provides us with a lower bound estimate (given that the data matching process may result in some gas meters being erroneously not matched). This analysis obtains results in a similar number of gas meters in category (b) as the one obtained in the revised analysis in this IA.

Assumptions about non-domestic sector growth remain unchanged, and we still assume 51,000 new meters per annum. 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 commercial and industrial sectors are available 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.

Table 6-1: Meter numbers and energy consumption

	Electricity	**Gas**
Meters (2011)	2,140,000	920,000
Consumption (kWh)	17,400	110,000
New meters	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. The Government recently announced its intention of amending licence conditions to allow meters without full smart functionality to remain, or to continue to be installed:

- Where advanced metering is installed before April 2016 (previously April 2014) and the customer wishes to retain it;
- Where advanced metering is installed after April 2016 (previously April 2014) under pre-existing contractual arrangements.

In addition to the above exemptions, 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.[89] For these meters, advanced metering will be required instead.

We do not expect the extension (from April 2014 to April 2016) of the period during which advanced meters may be installed (or contracts for their installation before 31 December agreed) to have a significant effect on the number of advanced meters installed overall. The extension is likely to be chiefly used by small suppliers. In light of the large proportion of gas meters that is already assumed to be advanced, we have not revised our modelling assumptions on the assumed split between smart and advanced meters.

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. The exemptions reflect the state of development within the non-domestic market, with advanced metering being deployed and attendant early energy and carbon savings being achieved.

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).

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.

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

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[90]	£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

Some stakeholders have suggested that some advanced meter types can deliver a larger share of benefits than those assumed in the table above. Sensitivity analysis was conducted in scenarios where advanced meters are assumed to deliver a larger share of benefits, and these did not result in significant variations on the overall NPV.

6.2.4 Use of the DCC

In March 2011, the Government decided that a voluntary, rather than a mandatory approach to using the 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 reduced incentive for those suppliers to use the DCC to ensure compatibility with their domestic operations.

[90] 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.

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 the 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. Because all advanced metering systems are also not assumed to use DCC services the overall non-domestic population assumed to be operated outside of the DCC is a pessimistic view and it is likely that in reality more non-domestic metering sites, particularly for gas, will use the DCC. This would increase the NPV that is presented in central scenarios for the non-domestic sector[91].

Benefits from using the DCC

As set out in section 3.4.2.5 of this Impact Assessment, 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. Benefits that are enabled by the DCC are adjusted in the analysis to take account of 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.

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; and
- The costs and benefits from a limited roll-out of smart/advanced meters where a positive business case exists[92].

[91] The proportion of assumed advanced meters is arguably already high as it is likely to cover all non-Big 6 non-domestic metering points plus an allowance for Big 6 non-domestic metering points that might receive an advanced meter. Over and above these metering points there is a limited incentive for opting out of the DCC, so the cost benefit analysis is likely to take a pessimistic view with regard to costs incurred and benefits realised in the non-domestic sector.

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

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 for one or more parties. 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; and
- 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 services offered by the DCC. Since we assume that in the counterfactual there is no DCC, we adjust the benefits in accordance with meters opted out of the 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.

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, the IHD, which is connected to the metering system via a HAN[93]. We recognise that, in the non-domestic market, the offer of an IHD is not mandated, and a variety of means of providing and accessing date is likely to be used – web portals, IHDs or other Consumer Access Devices (CAD). It is assumed that a WAN[94] is also required to provide the communications link to the DCC.

6.4.1 IHD, meter, communications equipment and installation costs

[93] 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.
[94] The WAN is the communications network that in this case spans from the smart meter to the DCC.

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

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

Component	Asset cost	Installation costs[95]
Advanced meter electric	£247	£136
Advanced meter gas	£247	£136
Retrofit option gas	£120	£68
Smart meter electric	£43.6	£29
Smart meter gas	£57.2	£49
IHD	£15	-
Communications equipment	£31	N/A

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
As in the domestic sector analysis, the allowance of £1.75 for the inclusion of a keypad in all smart meters that was introduced in the January 2013 IA has been removed. For modelling purposes a cost allowance for additional connector equipment between the communications hub and the electricity meter (the 'hotshoe') has been added to the electricity meter cost estimate to reflect a limited number of installations that are expected to deploy this architecture (extra cost of £2.7 in 15% of installations). Average cost estimates for gas and electricity meters have decreased by around £1.75 and £1.35 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[96]. 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. Some stakeholders have suggested that some advanced meter types are likely to have lower costs than as presented in Table 6.3 above. We have done some sensitivity analysis which shows that 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[97]. The assumption can therefore be considered as conservative in terms of overall NPV impacts.

Retrofit advanced

[95] 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.
[96] BERR*, Impact Assessment of Smart Metering Roll out for Domestic Consumers and Small Businesses*, April 2008.
[97] 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.

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. This approach is most common for gas. 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.

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 traditional meters installations carried out during Foundation) and IHDs in the non-domestic sector is £196m.

Operating and maintenance (O&M) costs

No further substantive evidence has been brought forward at this point and we have retained previous assumptions for the present IA. The assumption used is an annual operation and maintenance cost for smart meters of 2.5% of the meter purchase cost. As O&M costs are likely to be incurred in the form of having to replace faulty equipment the same optimism bias uplift of 15% which is applied to metering equipment being added to the O&M allowance.

Operating and maintenance costs accrue to £33m in present value terms.

Communications equipment

Cost estimates for the provision of communication hubs have been updated to take account of the firm pricing provided through CSP contracts with the DCC, in line with the adjustments made to the domestic sector analysis. The volume weighted average cost of a communications hub across the three CSP regions is now around £31.

Gross present value communications equipment costs in the non-domestic assessment are £59m.

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 6-4: 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 £107m 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 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

Most of the costs that the DCC licensee is expected to face and that the DSP and the CSP will incur (as described in section 2.5) have been fully apportioned to the domestic sector, as they are either of a nature that doesn't allow a sensible separation into domestic and non-domestic elements (as discussed in section 6.2.1).

The only DCC system related cost item where such a distinction is possible is the variable element of the communications service charge for the operation of the communications equipment by the CSP. This cost element amounts to around £38m for the non-domestic sector in present value terms 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. For some cost items the procurement of the

DCC and its service providers has provided new information about the relevant financing rates, which have been transferred into the cost benefit modelling as described in section 2.5. For the remaining cost items, and 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 £15m while an assumed capital cost of 5% increases the NPV by about £70m. 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 £27m.

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 - £5m, i.e. reflecting avoided costs of £5m (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 £2m.

6.4.8 Legal and organisational costs

These costs are fully accredited to the domestic sector.

6.4.9 Costs associated with consumer engagement activities

A legal power exists to enable the Secretary of State of Energy and Climate Change to require the Consumer Delivery Body (CDB) to extend its focus beyond micro-business to other small and medium-sized businesses if evidence justifies this at a later date.

6.4.10 Cost 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 full scale roll-out in late 2015. On the basis of information received from suppliers, the Government expects a significant number of smart meters to be installed during the Foundation Stage.

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);
- Allows development of further evidence regarding a HAN standard without delaying overall progress;
- Takes some pressure off peak installation rates; and
- Supports ambitious roll-out completion target.

Some risks from installations during Foundation have also been identified and these risks might result under some scenarios in cost increases which we reflect through the addition of cost allowances to early meter deployments. These allowances have been determined through a consideration of potential outcomes materialising and the likelihood of the event happening. Three areas of potential risks are identified for smart meters installed during Foundation:

- 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 and different energy suppliers using different WAN standards for their smart metering solutions. 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.
  For the non-domestic analysis we had modelled in previous IAs 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 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 provided from smart meters installed during Foundation as the functionality will be provided through the CSP communication hubs which won't be available during Foundation. 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.
  In addition to being applied to meters installed early during the Foundation Stage, for the non-domestic analysis this risk is also applied to all smart and advanced meters in the counterfactual as well as to the proportion of meters that is modelled to opt out of the DCC[98].

For the interoperability and DCC categories the cost modelling considers how the risks could materialise in costs, and estimates what a worst-case scenario cost impact per meter would be. Under consideration of mitigating factors (both policy dependent and driven by commercial incentives) a probability is derived, with which

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

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).

The introduction of licence condition 3 ('no backward step') creates a strong incentive for an incoming supplier to use smart equipment that has been installed by the previous supplier. Under this condition, a gaining supplier will be required to take all reasonable steps to install a SMETS-compliant smart metering system when it replaces a SMETS-compliant smart metering system on change of supplier. To take account of potential residual risks (including a smart meter installed by the previous supplier being run in 'dumb' mode and resulting in a loss of supplier benefits) the uplift has not been removed completely, but has been reduced from previously 15% to now 5%. This uplift is applied to the costs of the metering equipment, the communications equipment in the home, the IHD and the installation costs for both domestic and non-domestic installations during Foundation.

For the functionality differences – the lack of outage notification from Foundation meters – the impact is not translated into a cost increase factor but directly applied to the roll-out modelling. Smart installations ahead of availability of CSP communication hubs 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 installations.

The table below sets out the uplift factors that are applied to Foundation installations. It is important to note that the Government decision is not to mandate the roll-out of smart meters during Foundation, 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 6-5: 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)	**5% uplift applied to:** **- Communications hub** **- Meter[99]** **- 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[100]	**No longer reflected as a cost uplift but captured by assuming that Foundation communication contract costs are partly incremental to DCC communication costs.**

[99] Note that this uplift is applied to both smart and advanced meters in the non-domestic case.
[100] 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.

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 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; and
- In the lower benefits scenario: 4% for electricity, 3.5% for gas.

Energy is valued consistently with guidance produced by the DECC[101]. Expected energy savings are applied to the tailored non-domestic energy baseline as described in section 6.2.2 above.

[101] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Incorporating direct rebound effects is 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 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 empirical trial results, i.e. observed impacts. These observed values are net of any potential comfort taking and direct rebound effects. Therefore, no further adjustment is necessary 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 £1,431m.

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 £6m.

6.5.2 Supplier benefits

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

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 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[102].

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:

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

- Higher 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[103]

There is uncertainty around what proportion of meters might be considered higher risk under a new safety inspection regime, but for modelling purposes it seems

[102] Ofgem, *Letter to British Gas*, 14 December 2012.
[103] 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.

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[104] 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 6-6: Cost and benefit impacts from avoided site visits (per meter per year)[105]

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

[104] Ofgem, *Domestic Suppliers' social obligations: 2011 Annual report*, October 2012
[105] 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 £128m 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[106], 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 £49m 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 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

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

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[107] 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 per meter savings from better debt management to be £2.2 per year, resulting in a present value benefit of £44m.

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.
The main category of benefits examined through this Information Request relates to customer switching, but also includes cost savings from the centralisation of registration and data aggregation functions. The Information Request asked for views of the potential scale of this benefit and the extent to which the benefits are contingent on the 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

[107] Consumer Focus, *Small business, big price - Depth interviews with disconnected micro-business energy customers*, May 2011.

switches suppliers. If a potential DCC activity resulted in the transfer of functions from suppliers' agents to the 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 DCC offers registration and data aggregation services (assumed to be for modelling purposes from 2020. Where the DCC offers registration services (assumed to be from 2018 for modelling purposes) benefits of £2.22 per smart meter per year are considered. From the go-live date of DCC services in late 2015 benefits of £1.58 per smart meter per year are considered. Before the establishment of the DCC benefits are assumed to be of £0.8 per meter per annum.

In total present value terms, switching savings generate £68m 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 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 are £87m.

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. Taking into account the updated information about the critical mass of meters required as introduced in the January 2013 IA, the benefits are considered to be realised from 2014 onwards, at which point over one third of smart meters with outage detection functionality[108] will be installed. We also assume that the smart metering technology will only lead to outage related benefits in the low voltage network system. This is because other voltage systems within the electricity networks already have sophisticated monitoring and diagnostic systems in place.

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

[108] 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.

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 £13m.

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 benefit 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[109]

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

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

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

[109] 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.

premise, network operators can therefore avoid unnecessary callouts where customer issues are unrelated to the network.

The Smart Metering Implementation Programme and the ENA will 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[110], 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[111] 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.

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 (in addition to the existing group using Economy 7), starting from 2016. Previous Impact Assessments had considered the take-up of STOU tariffs to start occurring as early as some smart meters had been installed i.e. 2013. We have

[110] We here refer equally to DSR and load shifting.
[111] Sustainability First, *Smart Pre-payment in Great Britain & Smart Tariffs and households demand response for Great Britain,* 2010.

revised this assumption in order to present a more conservative view as to when energy suppliers are likely to start offering time of use tariffs to their customers.

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). 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[112] estimates bottom up SME discretionary load to be around 21%, based on heating and cooling demands. Ofgem (2012)[113] also estimates a significant potential for load shifting in the non-domestic sector.

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[114]) and heat pumps.

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

Sensitivities are made on the take up at 10% and 40%, and also on the potential discretionary load available to accommodate for higher levels of penetration of electric vehicles, growth in heat pumps with storage capacity and the introduction of smart appliances. These are not considered in our central case in order to avoid claiming benefits from developments which are likely to involve an extra cost over and above the business as usual case. For illustrative purposes we have considered two such scenarios[115] which consider such increases in discretionary load, leading to increases on benefits from load shifting by £17m and £68m respectively over and above the figures presented in the summary sheets of the IA.

[112] In 2009 EA Technology produced a report within the context of task 19 of the International Energy Agency Energy Demand Side Management Programme and made the findings of this report available to DECC.
[113] https://www.ofgem.gov.uk/ofgem-publications/57014/demand-side-response-non-domestic-sector.pdf
[114] BERR & DfT, *Investigation into the Scope for the Transport Sector to switch to Electric Vehicles and Plug-in Hybrid Vehicles*, *2008*.
[115] 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).

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 benefits of short run marginal cost savings are £26m.

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 £23m.

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.[116]

For distribution, we use the expected annual investment requirement figure from the DPCR5[117] as the baseline. This baseline investment figure reflects general reinforcement costs attributable to normal increases in electricity demand from housing[118]. Consequently, we do not account for potential additional benefits driven

[116] 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 exponential; hence such approach could underestimate benefits (Ofgem, 2010).
[117] This figure 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.
[118] 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.

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 £1m.

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 0.29 and 0.18 kg CO2/ kWh.

The expected present value benefit is £10m.

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 £34m.

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 £371m.

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

Table 6-7: Reductions in CO_2 emissions and energy savings

EU ETS permits	Millions of	Avoided cost of	Avoided cost of

[119] 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.

savings (Millions of tonnes of CO_2 saved equivalent) – traded sector	tonnes of CO_2 saved – non-traded	carbon – electricity (£bn, PV)	carbon – gas (£bn, PV)
2.30	7.98	0.03	0.37

6.5.6 Air quality benefits

In line with guidance from the Department for Environment, Food and Rural Affairs' (Defra) Inter-departmental Group on Cost and Benefits of Air Quality[120] a benefit reflecting air quality improvements from reduced emission of pollutants as a result of energy savings is estimated. Air quality improvements are estimated to deliver benefits of £26m 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.

[120] Defra, *Air quality appraisal-damage cost methodology,* February 2011.

7 Non-Domestic 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 where appropriate (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 is however reflected in 2011 real prices.

Table 7-1: Total costs and benefits

Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
0.46	2.33	1.88

Table 7-2: Consumer and supplier benefits

Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
1.44	0.46	0.44	2.33

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

Total Costs £bn	**Total Benefits £bn**			**Net Present Value £bn**		
	Low	**Central**	High	Low	**Central**	High
0.46 (+/- 0.0004)[121]	1.64	2.33	3.02	1.18	1.88	2.56

Table 7-4: Benefits

Consumer Benefits £bn			**Business Benefits £bn**			**UK-wide Benefits £bn**		
L	**C**	H	L	**C**	H	L	**C**	H
0.92	1.44	1.93	0.40	0.46	0.53	0.32	0.44	0.56

[121] 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.

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, has a value of 5.1 in the central scenario, with a value of 6.6 in the high scenario and of 3.6 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[122]. 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 £200 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 an average bill decrease of approximately £43 by 2015; £200 by 2020 and £174 by 2030. Table 7-5 shows the incremental bill impact generated from smart and advanced meters that would not have been installed without a mandate.

From 2020 onwards bill impacts are estimated to reduce as in the counterfactual the deployment of smart and advanced meters is assumed to increase gradually in the period to 2030. The bill savings from that counterfactual deployment would have been realised anyway and are therefore deducted from the bill reductions presented here.

Table 7-5: Impact on average non-domestic energy bills for a dual fuel customer (£, real 2012)

	Non-domestic dual fuel bill impact, £
2015	-43
2020	-200
2025	-184
2030	-174

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

[122] 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.

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 2024 and negative from 2025.

Table 7-6: Price impacts on non-domestic energy bills – all smart and advanced meters (£, real 2012)

	Electricity	**Gas**
Year	**price impact (£/MWh) (Inc VAT)**	**price impact (£/MWh) (Inc VAT)**
2015	0.04	0.01
2020	0.17	0.06
2025	-0.06	-0.02
2030	-0.39	-0.15

As for the calculation of bill impact projections in the domestic sector, we have excluded stranding costs from this calculation, as the Government mandate will not have an impact on the costs of traditional meters which have already been installed.

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

As described in section 4.2, if a traditional meter is replaced by a smart meter before the end of its economic lifetime, a proportion of the traditional meter asset value is lost in the form of the meter no longer performing its intended function. While this means that costs for an investment that has been made in the past continue to be incurred without delivering any benefits, it does not mean that there are any additional costs that result from the roll-out of smart metering. The costs are sunk and are borne in both the counterfactual and policy scenarios.

The unrealised value of traditional metering assets that are replaced by smart meters before the end of their economic lifetime is therefore not considered in any of the cost and benefit considerations presented in this document. However, in order to provide an indication of the scale of the unrealised value, some modelling assumptions have been made to derive a monetised figure.

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.

Further, for the economic evaluation we assume that there is no attempt to minimise the unrealised asset value 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 £55m in present value.

7.2.3 Better regulation and the net impact to businesses (EANCB – Equivalent Annual Net Cost to Business)

One-In, One-out

For the calculation of the EANCB figure the energy savings that are realised by non-domestic customers are not considered as direct benefits. The costs of providing the technical means to realise energy savings (i.e. smart meters and IHDs) are included in the OIOO cost considerations.

Based on this approach, and across both domestic and non-domestic sectors, there is a £36m equivalent annual net cost to business (EANCB). The value of stranding costs are not included in this calculation as these refer to costs incurred both in the counterfactual and policy scenarios, and therefore do not arise as a result of smart metering regulations.

Administrative burden

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. 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.

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[123] 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;

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

- 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.

As per HM Treasury guidelines the application of adjustments for optimism bias and risk allowances should be reviewed as certainty increases and substantiating evidence is identified. One of such key points in time in the case of smart metering was the award of the contracts and the DCC licence in September 2013. We have therefore undertaken to review the treatment of risk and the application of optimism bias factors in areas where the award of the contracts increases significantly the certainty on the costs (and benefits) of the solution. Since price information derived from the procurement processes is firm and contractually committed to, any optimism bias factors which had previously been applied to the capital costs of the communications and data service providers, including the communications hub, have been removed.

Table 7-7 reflects the updated optimism bias factors applied in this IA:

Table 7-7: Optimism bias factors

	Optimism bias factor
IHD	15%
Smart meter	15%
Installation & commercial risk	20%
Energy industry IT CAPEX	10%
Energy industry IT OPEX	10%

Cost uplift factors are also 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[124].

Overall, the total cost that is added to the domestic and non-domestic appraisal as a result of the application of optimism bias and other cost uplifts is still high in this Impact Assessment (approx. £1.5bn). The main areas where optimism bias and uplift factors remain include installation, metering equipment, treatment of costs in Foundation and additional roll-out costs with high peak installation rates.

7.3.2 Benefits: sensitivity analysis

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

[124] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

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	£320	£653	£960
Energy savings gas	£596	£779	£962
Business benefits			
Supplier benefits			
Avoided site visit	£117	£128	£138
Call centre savings	£43	£49	£55
Avoided PPM COS premium	£0	£0	£0

Reduced theft	£0	£0	£0
Network benefits			
Avoided investment from ToU (distribution/transmission)	£1	£1	£2
Reduction in customer minutes lost	£1	£7	£11
Operational savings from fault fixing	£3	£13	£19
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	£14	£26	£51
Avoided investment from ToU (generation)	£12	£23	£44

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			**457**
In premise costs			395
	Meters & IHDs		196
	Installation of meters		107
	Operation and maintanance of meters		33
	Communications equipment in premise		59
DCC related costs			38
	DCC licence		-
	Data services		-
	Communications service opex		38
Suppliers' and other participants' system costs			-
	Supplier capex		-
	Supplier opex		-
	Industry capex		-
	Industry opex		-
Other costs			24
	Energy		27
	Disposal		2
	Pavement reading inefficiency	-	5
	Legal and organisational		-
	Marketing		-
NPV			***1,877***

Total Benefits		**2,333**
Consumer benefits		1,437
	Energy saving	1,431
	Microgeneration	6
Business benefits	Supplier benefits	295
	Avoided site visits	128
	Inbound enquiries	42
	Customer service overheads	7
	Debt handling	44
	Avoided PPM COS premium	-
	Remote (dis)connection	7
	Reduced theft	-
	Customer switching	68
	Network benefits	112
	Reduced losses	87
	Avoided investment from ToU (distribution/transmission)	1
	Reduction in customer minutes lost	7
	Operational savings from fault fixing	13
	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	26
	Avoided investment from ToU (generation)	23
UK-wide benefits		440
	Global CO2 reduction	371
	EU ETS from energy reduction	34
	EU ETS from ToU	10
	Air Quality	26

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.

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[125].

12 Monitoring and Evaluation

The Government published its Smart Meters Programme Strategy and Consultation on Information Requirements for Monitoring and Evaluation 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[126]. See also section 13 on plans for a Post Implementation Review (PIR).

[125] https://www.gov.uk/government/consultations/delivering-smart-meters-to-homes-and-businesses
[126] https://www.gov.uk/government/consultations/information-requirements-for-monitoring-and-evaluation-of-smart-meters

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

- Ensure that sufficient evidence about consumer impacts and the effectiveness of different approaches to consumer engagement is available, to inform the on-going development of the approach to consumer engagement;
- Monitor the capability and readiness of industry participants to meet their roll-out obligations;
- Track progress towards completion;
- Report on the full range of costs and benefits attributable to smart metering and inform actions to optimise benefits realisation.

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 learning project which will provide an initial analysis of progress that has been achieved to date in delivering consumer benefits especially in relation to energy saving, and where further steps are likely to be effective in increasing such benefits. This project is underway and will report in 2014.

The first Annual Report has been published in December 2012[127].

[127] DECC, *Smart Metering Implementation Programme: First Annual Progress report on the roll out of Smart Meters*, December 2012.

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. 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.

A Post Implementation Review (provisionally by 2019) will be carried out by the Government and will take a broad perspective on the results of Government intervention and the results of the approaches taken to policy and benefits realisation, in order to feed back into the policy making process.

Review approach and rationale:

The PIR will include evaluation of the impacts of smart metering on consumers, in particular on the consumer experience and energy consumption, as well as the effectiveness of different approaches in delivering consumer benefits(e.g. ease of switching, availability and uptake of smart-enabled products and services). It will evaluate the impacts on industry costs and process simplification, on the availability and uptake of energy management products and services,. 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 and early learning project as described in section 12.

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; and

- Communications services.

In terms of competition 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; and
- Communications and data businesses.

14.1.1 The competition impact of the DCC

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

The 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.

The 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.

14.1.2 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 and Micro Business Assessment

The small and micro business assessment is a new requirement for all regulation coming into effect from April 2014 and is intended to ensure that all new regulatory proposals are designed and implemented so as to mitigate disproportionate burdens on such businesses.

It aims to either exempt all companies with fewer than 50 employees from new regulatory measures, or to mitigate as far as possible the burden on micro and small businesses while delivering the intended benefits[128].

In 2012 a regulatory mandate was introduced obliging energy suppliers to take all reasonable steps to roll-out smart meters to their customers and to offer IHDs allowing consumers to monitor their energy consumption. In 2013 the SEC was designated. The DCC, energy suppliers and network operators are required by conditions of their licences to become a party to the SEC and comply with its provisions. Other bodies who wish to use the DCC's services, such as energy efficiency and energy service companies, must also accede to the Code to do so.

We have undertaken an assessment of the likely size of companies that will be affected by smart metering regulations. As part of this we have researched the number of employees of the organisations which have acceded to the SEC at the point of this assessment, in order to gauge whether any of those organisations are likely to fall into the category of small or micro businesses. The list of SEC parties covers:

- 17 energy suppliers;
- 9 electricity distribution network operators (DNO); and
- 9 gas distribution networks (GDN).

We have determined the size profile of SEC parties by reviewing publically available information (company websites and documentation obtained through the Companies House database). Based on this assessment, out of the 35 companies which were SEC parties at the time of this assessment we identified 3 small businesses with fewer than 50 employees. None of the SEC parties at the time of the assessment were micro businesses, i.e. with no more than 10 employees[129].

Of course this list is only a snapshot of the current point in time and in the future other types of companies might also become subject to the code.

Most of the energy supply companies are large companies and in some instances part of multi-national corporations. Establishing electricity or gas supply services involves a minimum size of operations. These are complex businesses, requiring significant back office system investment and customer support operations (e.g. to establish a billing system), and even companies that are considered smaller in the context of supplying energy are generally speaking at least medium sized enterprises. Some smaller supply companies might however decide to outsource parts of the operation, thereby potentially falling below the threshold for small businesses.

With regard to distribution network operators, at national level Great Britain is divided into 8 gas and 14 electricity distribution areas, which are serviced by just four distinct companies in the case of gas and six companies for electricity[130]. Each of these companies is responsible for millions of metering points and is a large operation, often part of a corporation also involved in a supply business. There are also independent gas distribution networks and independent electricity distribution network operators, which can build, own or operate distribution assets in sometimes

[128] Micro businesses are defined as those businesses with fewer than 10 employees, and small businesses as those with fewer than 50 employees.
[129] Some companies reported no direct employees and / or that all operational activity was carried out by employees of the immediate parent company. In such cases the number of employees of the parent company has been taken into consideration for this assessment.
[130] See Ofgem: https://www.ofgem.gov.uk/gas/distribution-networks/gb-gas-distribution-network and https://www.ofgem.gov.uk/electricity/distribution-networks/gb-electricity-distribution-network

more limited geographic areas (e.g. housing developments or industrial parks). However, because of the capital intensive nature of the energy distribution business they are commonly integrated into larger corporations.

In designing the smart meter regulations Government has engaged in extensive consultation with all affected parties, including smaller businesses, to ensure that a broad range of stakeholders' views was taken into account in the policy making and to help ensure proportionality between regulatory burden and benefits. Small suppliers inevitably have fewer resources available to devote to responding to consultations. Nevertheless, small suppliers have contributed views on a wide range of points and these have been taken into account in the regulatory design.

The Government has put in place a range of measures to minimise or mitigate the potential burden on smaller companies. For example, the smart metering roll-out regulations allow for:

- Greater flexibility in rolling out smart metering in the non-domestic sector, where smaller suppliers have a greater market share than in the domestic sector; for example, the use of DCC services is not mandatory in the non-domestic sector and there is also the possibility to install advanced meters (i.e. not compliant with the SMETS), furthering choice and reducing the regulatory burden;
- Reduced requirements with regard to the provision of monitoring and reporting information by non-Big 6 suppliers; only the Big 6 have to provide information on an annual basis to allow Ofgem to track the progress towards the completion of the roll-out; and
- A cost sharing arrangement for the Central Delivery Body that significantly reduces the cost burden on smaller suppliers; they will only have to make very limited contributions[131], while benefitting in full from the consumer awareness campaign to help minimise the roll-out costs for all supply companies.

In addition to the roll-out obligation, the SEC was designated as a new energy industry code in September 2013. Further stages of the Code will be introduced in a phased approach in advance of the DCC starting to offer its services in late 2015. The SEC requirements have also been designed with a view to ensuring that the regulatory burden is proportionate to the benefits that can be realised and to minimise the burden on smaller companies. For example, the audits required to provide assurance that DCC users have met security requirements allow for a more streamlined assessment of smaller companies, thereby reducing compliance costs. Further, the code constitutes a contract between DCC users, and all code signatories - including small businesses - can propose changes to existing arrangements. Modifications to the Code must be approved by Ofgem and assessed against its general regulatory objectives which include the supervision and development of markets and competition. Supporting this, the SEC governance arrangements make provision for small suppliers and unlicensed businesses to elect members to the main decision making bodies.

14.3 Legal Aid

[131] Small suppliers will only have to contribute to the running costs of the Central Delivery Body in accordance with their market share, while the activity costs will be fully borne by the Big 6 suppliers.

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[132], 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

[132] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

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
10,470	14,011	9.03	13.45	16.15	-412	42.85	-309

The above table shows how the domestic roll-out could save over 9 million of tonnes of CO_2 equivalent in the traded sector and over 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.

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
457	1,919	2.30	7.98	14.13	-655	43.43	-230

The above table shows how the non-domestic roll-out could save over 2 million of tonnes of CO_2 equivalent in the traded sector and approximately 8 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[133]. 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

[133] Further information on the Public Health England's advice can be found at: http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/UnderstandingRadiationTopics/ElectromagneticFields/RadioWaves/SmartMeters/

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 in the new DCC licence which allow for transfers of particular types of property between successive holders of a licence of that type. This could amount to a control of the use of or 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.

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;
- Ddisability;
- 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; and
- 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; and
- 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, 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 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 that 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 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. A report on the research[134], published in March 2013, includes a number of steps that suppliers and others can take to ensure that this group of consumers is not disadvantaged. 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. The Code was subsequently approved by Ofgem, and came into force on 1 June 2013.

[134] DECC & SQW, *Study on Access to Smart Meter Benefits for Blind and Partially Sighted Consumers*, March 2013.

Among the key requirements of the Code of Practice are that suppliers:

- Explain to customers how the smart metering system and IHD work, and how consumers can use them to help to improve their energy efficiency;
- Inform consumers about additional, impartial sources of information on energy efficiency;
- 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;
- Have to identify and meet the needs of vulnerable customers; and
- Not charge their domestic customers any upfront or separate costs for standard smart metering equipment, including the IHD.

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 the availability of clear information and support to enable all consumers to understand and act on the information provided by the smart meter. Suppliers, following 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 put in place licence conditions that require suppliers to set up and fund a Central Delivery Body (CDB) 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. The CDB's objectives will include ensuring that vulnerable[135], 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. The Central Delivery Body was established on 30 June 2013.

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 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.

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

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 made provision for 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[136]. The data privacy framework has been put into energy licences and also the smart energy code.

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 will apply equally to customers in rural areas as to others. A key criterion for selection of the DCC and the CSPs has been the ability to meet the aspiration of

[136] DECC, *Smart Metering Implementation Programme: Data Access and Privacy,* December 2012.

delivering communications to smart meters at all domestic gas and electricity consumer premises regardless of location.

The DCC is incentivised to maximise communications coverage, and the CSPs' contracts include a binding commitment to deliver a minimum of 99.25% connectivity across their territories by the completion date. However, the contracts recognise that there are areas of Great Britain where WAN coverage may not be achieved at reasonable cost by the completion date. This would give difficulties in delivering a fully smart service, which requires two-way communications between the DCC and the meter and a fully operative HAN that enables the customer to access up-to-date information about energy costs.

The areas where WAN coverage is projected to be more difficult to achieve are primarily rural areas, and principally remote and/or mountainous. The Government is considering approaches to these areas with interested parties, recognising that, given the length of time before the completion date; technological approaches and solutions to the properties in question may well be developed, and should not be constrained or discouraged by early regulation.

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