Title: **Smart meter rollout for the domestic sector (GB)**	Impact Assessment (IA)
Lead department or agency: DECC	**IA No:** DECC0009
Other departments or agencies: Ofgem	Date: 30/03/2011
	Stage: Final
	Source intervention: Domestic
	Contact for enquiries: Pau Castells/Ferry Lienert (0300 068 6541/6325)

Summary: Intervention and Options

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

Lack of sufficiently accurate, timely information on energy use may prevent customers from taking informed decisions to reduce consumption and thereby bills and CO_2 emissions. The lack of accurate, timely information increases suppliers' accounts management and switching costs. Better information on patterns of use across networks will aid in network planning and development, including future smart grids.
Smart metering is a key enabling technology for managing energy systems more efficiently in the future, and providing new information and services to consumers which reduce costs and carbon emissions. In Great Britain, the provision of energy meters to consumers is the responsibility of energy retail suppliers, and is subject to competition. Although some suppliers are rolling out smart meters to a selection of their customers it is expected that, in the absence of intervention by Government, suppliers would roll out only limited numbers of smart meters. Government intervention is needed to ensure commercial interoperability and full market coverage. This will facilitate the capture of wider benefits to consumers, the environment, network operators and new businesses.
The policy for smart meters therefore addresses the market failures in the energy markets described above (information asymmetries, lack of coordination and negative externalities from energy consumption).

What are the policy objectives and the intended effects?

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

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

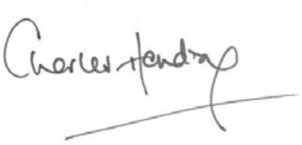
This policy focuses on the mandated replacement of 50 million residential gas and electricity meters in GB. The IA presents the preferred option for implementing a supplier-led rollout in the domestic sector with a centralised data and communications company. This option is underpinned by sub-options on:
- the establishment of the Data and Communications Company (DCC) and its initial scope
- the functionality of the smart meter
- the period preceding the establishment of the DCC, which is key to achieve consumer, business and market readiness.
- the rollout strategy

Sub-options are discussed in the main body of the Impact Assessment but are not presented in the summary sheets, as formulation of a preferred implementation option is only possible with the simultaneous consideration of all sub-options.

When will the policy be reviewed to establish the actual cost and benefits and the achievements of the policy objectives?	An early review of requirements for the rollout to ensure delivery of benefits is expected to be carried out before 2014. Further evaluation of the policy will also be conducted (provisionally by 2017). (See Annex 4 – Post Implementation Review Plan)
Are there arrangements in place that will allow a systematic collection of monitoring information for future policy review?	The requirements for the collection of monitoring information that will contribute to the benefits realisation will be developed in the next phase of the programme.

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

Signed by the responsible Minister. Date: 30/03/2011



URN:11D/683

Summary: Analysis and Evidence Policy Option 1

Description: Preferred implementation option

Price Base Year 2009	**PV Base Year** 2011	**Time Period Years** 20	**Net Benefit (Present Value (PV)) (£m)**		
			Low: 715	High: 9,856	**Best Estimate: 5,071**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	NA		NA	NA
High	NA		NA	NA
Best Estimate	1,626		621	**10,757**

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

Capital costs, installation, and opex costs amount to £6.29bn. Comms costs amount to £2.11bn. IT costs amount to £1.03bn. Legal, marketing, setup, disposal, energy, pavement reading inefficiency and integration of early meter into DCC costs amount to £1.33bn.

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		781	11,472
High	0		1,402	20,613
Best Estimate	0		1,077	**15,827**

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

Total consumer benefits amount to £4.64bn and include savings from reduced energy consumption (£4.60bn), and microgeneration (£36m). Total supplier benefits amount to £8.57bn and include avoided site visits (£3.18bn), and reduced inquiries and customer overheads (£1.24bn). Total network benefits amount to £780m and generation benefits to £774m. UK-wide benefits from carbon savings amount to £1.1bn.

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

Non-monetised benefits include the potential benefits from the development of a smart grid. Smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative products, lower prices and increased choice.

Key assumptions/sensitivities/risks

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

The numbers presented are based on the modelling assumption that the scope of the DCC will include in the long term data aggregation.

Direct impact on business (Equivalent Annual) £m)[1]**:**			**In scope of OIOO?**	**Measure qualifies as**
Costs: 778	**Benefits:** 845	**Net:** 68	Yes	£0 IN

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

Enforcement, Implementation and Wider Impacts

What is the geographic coverage of the policy/option?			GB		
From what date will the policy be implemented?			The start date will be confirmed in accordance with the rollout plans for the preferred Option.		
Which organisation(s) will enforce the policy?			DECC/Ofgem		
What is the total annual cost (£m) of enforcement for these			N/A		
Does enforcement comply with Hampton principles?			N/A		
Does implementation go beyond minimum EU requirements?			Yes		
What is the CO_2 equivalent change in greenhouse gas emissions (for preferred option)?			**Traded:** 17.4MtCO2	**Non-traded:** 15.6MtCO2	
Does the proposal have an impact on competition?			Yes		
Annual cost (£m) per organisation (excl. Transition) (Constant Price)	**Micro** N/A	**< 20** N/A	**Small** N/A	**Medium** N/A	**Large** N/A
Are any of these organisations exempt?	N/A	N/A	N/A	N/A	N/A

Evidence Base (for summary sheets) – Notes

References

No.	Legislation or publication
1	Consultation Response: Towards a smarter future: Government response to the consultation on electricity and gas smart metering – December 2009.
2	Domestic IA for smart meter rollout – December 2009.
3	Electricity Networks Strategy Group (ENSG) (2009) 'A Smart Grid Vision' http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/network/smart_grid/smart_grid.aspx
4	ENA and Imperial College London (2010) ' Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks
5	Sustainability First (2010) 'Smart Pre-Payment in Great Britain'
6	Gemserv (2010) 'Analysis on disablement/ enablement functionality for smart gas meters
7	Baringa Partners, Smart Meter Roll-out: Energy Network Business Market Model Definition and Evaluation Project, 2009
8	Baringa Partners, Smart Meter Roll Out: Risk and Optimism Bias Project, 2009
9	Erhardt-Martinez, Donnelly, Laitner (2010) 'Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities'
10	Darby (2006) 'The effectiveness of feedback on energy consumption'
11	Fischer (2009) 'Feedback on household energy consumption: a tool for saving energy?'
12	Ofgem (2010) "EDRP fifth progress report"
13	Sustainability First (2010) 'Smart tariffs and household demand response for Great Britain'

Options considered

The preferred policy option is presented in the summary sheet of the Impact Assessment. This is consistent with Better Regulation Executive advice on the presentation of policy options in final impact assessments[2]. This option is created by the analysis of sub-options on:

- -Options on the scope of DCC
- -Options on the establishment of the DCC
- -Options on functionality
- -Scenarios on rollout

These options and underlying analysis are presented and discussed in the body of the Impact Assessment. The following table summarises the options analysis considered in each of the areas and the leading option which is modelled in the summary sheet:

Area	Options	Policy position	Modelled option
Options on the scope of DCC	Minimum scope	X	
	Minimum scope + Registration (+ Data aggregation subject to further analysis)	✓	✓
Options on the establishment of DCC	Parallel procurement	✓	✓
	Sequential procurement	X	
Options on functionality	Functionality catalogue proposed in Prospectus	✓	✓
	Functionality catalogue proposed in Prospectus, without "last gasp" and 13 months data storage	X	
Options on rollout (Foundation stage)	Mandate new and replacement	X	
	Voluntary rollout	✓	✓

We have also considered a range of possible outcomes of the supplier led rollout, For modelling purposes we have assumed different installation rates for up to three possible scenarios in regards to the rollout. These rates and scenarios should not be interpreted as policy options on the installation targets that could be set on suppliers but rather as modelling assumptions to allow producing a profile for the quantification of the costs and benefits of the rollout.

[2] http://www.bis.gov.uk/assets/BISCore/better-regulation/docs/10-901-impact-assessment-toolkit.pdf

Evidence Base

Annual profile of monetised costs and benefits* - (£) constant prices

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,088	78,397,782	165,132,212	184,334,432	212,759,310
Annual recurring cost	0	0	25,185,382	48,288,317	153,264,814	345,218,650	539,804,913
Total annual costs	0	0	68,416,471	126,686,099	318,397,026	529,553,082	752,564,223
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	15,827	15,827	15,827	15,827	15,827
Total annual benefits	0	0	15,827	15,827	15,827	15,827	15,827

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,416	166,735,566	129,012,604	111,824,773	96,124,218	93,903,549	92,049,521
Annual recurring cost	735,175,077	871,256,068	922,453,596	932,093,426	918,698,094	911,705,619	905,374,645
Total annual costs	925,360,493	1,037,991,634	1,051,466,201	1,043,918,198	1,014,822,312	1,005,609,168	997,424,166
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	15,827	15,827	15,827	15,827	15,827	15,827	15,827
Total annual benefits	15,827	15,827	15,827	15,827	15,827	15,827	15,827

	2024	2025	2026	2027	2028	2029	2030
Transition costs	90,251,709	89,141,396	88,031,084	89,170,424	87,992,531	90,894,399	93,796,267
Annual recurring cost	899,718,481	906,945,419	910,160,358	902,873,756	895,029,616	883,344,732	867,921,153
Total annual costs	989,970,190	996,086,815	998,191,442	992,044,180	983,022,146	974,239,131	961,717,420
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	15,827	15,827	15,827	15,827	15,827	15,827	15,827
Total annual benefits	15,827	15,827	15,827	15,827	15,827	15,827	15,827

* 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	0.05	2.34	5.84
	Non-traded	0.05	2.09	4.96
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	0.05	2.34	5.84
	Non-traded	0.05	2.09	4.96

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

Contents

Evidence Base

A. Glossary of Terms

CAPEX – Capital Expenditure
DCC – Data Communications Company
DNO – Distribution Network Operators
ESCO – Energy Service Company
GHG – Greenhouse Gas
GPRS – General Packetised Radio Service
GSM – Global System for Mobile Communication
HAN – Home Area Network
IHD– In-Home Display
IT – Information Technology
LAN – Local Area Network
NPV – Net Present Value
O & M – Operation & Maintenance
OPEX – Operational Expenditure
PPM – Prepayment Meter
PV – Present Value
RTD – Real Time Display
SPC – Shadow Price of Carbon
ToU – Time of Use (tariff)
WAN – Wide Area Network

B. Introduction and Strategic Overview

Introduction

The Government set out its commitment to the roll out of smart meters within its coalition programme[3].

The coalition programme sets out the strategic context for the rollout of smart metering alongside the establishment of a smart grid. The smart meter policy sits in the broader Government programme for an increase in the EU carbon emission reduction target by 2020, through encouraging investment in renewable energy both locally and for large scale offshore wind developments, feed in tariffs and home energy efficiency via the Green Deal.

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

As part of the Third Package of Energy Liberalisation Measures adopted on 13 July 2009, EU Member States are obliged to "ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas and electricity markets" - in other words, to roll out some form of smart metering subject to the results of an economic assessment.

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

This Impact Assessment (IA) builds upon the work DECC has undertaken in the last 3 years in establishing and defining the case for rolling out smart meters and its impact. This has been supported by cost benefit modelling and analysis by Mott Macdonald[4], Baringa Partners, Redpoint Consulting and PA Consulting Group. DECC has worked with Ofgem E-Serve as delivery partner during Phase 1 of the programme, which concluded in March 2011.

The smart meter programme has assessed the requirements, costs, benefits and options for the smart meter solution in the areas of:

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

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

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

The changes made to the analysis against the July 2010 IA are noted within the text of this IA in section F. For ease of reference an overview of the changes to input values is also provided in Annex 2.

The IA assesses costs and benefits for options on the implementation strategy for the rollout. The IA considers separately in an analytical annex the impact on costs and benefits of options on whether the minimum mandated functionality for electricity smart meters should include the technical capability to alert networks when power supply is lost, so called “last gasp”(Annex 1).

This IA accompanies the Prospectus Response Document and its accompanying annexes, which set out the detail and discussion of the policy options considered by the Smart Meters Programme.

C. The issue

Existing metering allows for a simple record of energy consumption to be collected, mainly by physically 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. On average suppliers only know how much energy a household consumes after a quarterly (or less frequent) meter read and consumers are generally only aware of consumption on a quarterly, historic basis unless they take active steps to monitor the readings on their meters. In addition many of those quarterly reads may be estimates made by the supplier.

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

Smart meters and the provision of real-time information help address these issues, enabling consumers to access more information about energy use and cost. Combined with appropriate advice and support, consumers will then be able to take positive action to manage energy consumption and costs. Smart meters provide for remote communication with the meter, facilitating, amongst other things, more efficient collection of billing information and identification of meter faults. Information from the meter, subject to appropriate data, privacy and access control, will assist in the development of more sophisticated tariff structures and demand management approaches that could be used to further incentivise energy efficient behaviour by consumers and suppliers alike.

The benefits from a roll out of smart meters together with a free standing display fall to a number of actors – to consumers (in terms of accurate bills, accurate and real-time information to enable them to manage energy consumption and potentially receive new services), to suppliers (in terms of more frequent 100% accurate information, reduced costs to serve) and to society (in terms of reduced carbon emissions).

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

In the absence of Government intervention, it is difficult to judge whether a substantial rollout of smart meters would take place. However, without a Government sponsored inter-operability agreement, meter owners face a large risk of losing most of the value of the meter when customers switch energy suppliers, and switching by customers is relatively likely to occur. The provision of central communications provides greater efficiency for managing the connection and change of supplier processes for smart meters. A decision by Government not to intervene would therefore probably result in a limited roll out. Either a lack of interoperability or a limited rollout would impede the development of a smart grid and the speed with which new renewable generation could be accommodated.
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D. Objectives

The objectives of Government intervention in the rollout of smart metering through the Smart Metering Programme are:

1. To promote cost-effective energy savings, enabling all consumers to better manage their energy consumption and expenditure and deliver carbon savings;
2. 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;
3. To promote effective competition in all relevant markets (energy supply, metering provision and energy services and home automation);
4. To deliver improved customer service by energy suppliers, including easier switching and price transparency, accurate bills and new tariff and payment options;
5. 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;
6. 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;
7. To enable simplification of industry processes and resulting cost savings and service improvements;
8. 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;
9. 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;
10. 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
11. 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.

These objectives form the basis of the benefits management work which has been undertaken in this phase and will be developed in greater detail as part of the next phase of the Programme.

E. Option identification

As set out in the introduction this IA builds on the analysis set out in the July 2010 Prospectus consultation IA[5]. Core to that IA was the concept of a staged implementation and the establishment of the central communications provider. This company will manage central communications and data and is referred to as Data and Communications Company (DCC) throughout this IA.

The focus of this domestic roll out of smart metering IA is on options for implementation of the full rollout with DCC. Cost and benefit estimates of timescales of the rollout, communications, meter functionality and interoperability, in-home displays and speed of roll out are all covered and have been developed to inform the options for the economic assessment set out in Section F.

The IA presents updated costs and benefits for the preferred option as scoped in previous DECC smart meters IAs: a centralised data and communications market model.

The IA also considers separately in an analytical Annex (Annex 1) the impact on costs and benefits of options on whether the minimum mandated functionality should include the capability to remotely alert networks when electricity supply is lost. Such functionality will allow networks to identify outages quicker and deploy power restoration teams more efficiently ("last gasp" functionality). On the basis of the analysis, the Programme concluded that "last gasp" should be part of the minimum functionality for electricity meters.

The cost benefit analysis presented in the summary sheet of the IA includes revised estimates of cost and benefits and assessment of the impact on costs and benefits of preferred policy positions on implementation of the rollout. These revised costs and benefits have arisen as a result of the work carried out by DECC and Ofgem over the period July 2010-March 2011.

The figures presented in this IA are estimates and should be treated with a degree of caution. They are shown to allow comparison between options and components of costs and benefits rather than implying a high degree of accuracy.

The delivery of smart metering to GB domestic consumers is a major infrastructure project. Work since July 2010 has focused on developing the Prospectus Response Document and planning subsequent phases of the Programme. The preferred implementation model is based on a supplier led delivery of smart meters combined with a centralised coordination for communication provision (earlier options assessed, consulted upon and discarded included: a fully competitive model, a fully centralised model, a DNO deployment model, an energy networks coordination model and a regulated asset ownership model[6]). The Prospectus consultation set out a preferred policy option to implement this model, based on a staged implementation approach to the rollout, allowing for the benefits of smart metering to be realised for a proportion of consumers in advance of the full solution. The Impact Assessment presents the preferred policy option for the implementation of the rollout of smart meters, following consultation with stakeholders and further detailed analysis carried out over the period July 2010-March 2011. Relevant areas of analysis for the decision on implementation include the functionality of the smart meter, the rollout

[5] http://www.decc.gov.uk/en/content/cms/consultations/smart_metering/smart_metering.aspx

[6] DECC, Impact Assessment of a GB-wide roll-out of smart meters (December 2009)

strategy, the establishment and scope of the DCC, and the strategy for consumer engagement. These are discussed in the body of the Impact Assessment.

This section therefore scopes the key decision areas for the smart meters Programme where implementation options may have a substantive impact on overall costs and benefits.

1. Metering system functionality

This section sets out the high-level functional requirements for the smart metering system. This "minimum" functionality will ensure that smart metering delivers the wide range of anticipated benefits. It should be noted that there is no assumption about how the functionality is delivered i.e. whether within a "meter", modularly, or through some other technical solution (other than for the Wide Area Network - WAN communications on the consumer premises, which needs to be separate from the meter).

Table 1 below summarises the high level functionality that we consider should comprise the electricity and gas smart metering systems and the underpinning capabilities these are expected to provide. The Prospectus Response supporting Design document and updated smart meter catalogue published alongside this Impact Assessment provide specific details on the minimum functional specifications of the meter.

Table 1: Functionality of metering system

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

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

The Prospectus and Statement of Design Requirements supporting document[7] described in further detail the functional requirements and associated services for the smart metering system. These have been further refined through the period of the Prospectus consultation to form the basis for the meter design supporting document. In developing the functional requirements consideration has been given to the associated costs and benefits, especially where requirements go beyond the original A-H list above. In particular further analysis has been undertaken to assess proposals for:

- -Including the capability in the meter to alert suppliers and networks when electricity supply is lost (so called "last gasp");
- -Including other smart grid requirements; and
- -Storing consumption data at the meter.

A separate Annex has been produced to assess the minimum functionality for electricity smart meters. The Annex presents an assessment of better outage management by networks arising from the rollout of smart meters. The Annex also sets out the advantages and cost implications from having "last gasp" functionality as part of the technical specifications. Last gasp functionality could be delivered through different technologies either within the meter or the communications solution and at this stage of policy development no decision has been taken in regards to the preferred technology. Such decision will be taken at delivery of the technical specification later in 2011. For modelling purposes we assume "last gasp" will be delivered by adding functionality to the meter for which cost estimates are currently available.

On the basis of the analysis, the Programme concluded that "last gasp" should be part of the minimum functionality for electricity meters.

Displays and provision of information: consumer engagement and action to save energy is central to the benefits case for smart metering. Access to the consumption data in real time provided by smart meters combined with appropriate advice and support will provide consumers with the information they need to take informed action to save energy and carbon. The Government believes that free-standing in home displays (IHDs) which provide real-time, near-instant feedback on consumption (in terms of energy, money or CO2) can help to raise consumers' awareness of the energy they use and how savings can be made. The Government Response and supporting documents set out the specification and regulatory arrangements for providing IHDs to consumers which provide information on both gas and electricity use.

Interoperability: competition in the supply of gas and electricity requires that customers can easily switch to their chosen supplier. If not all smart meters are interoperable it may not be possible for an energy supplier to read the data from a meter installed by another supplier. It is important to note that interoperability is not an issue with non-smart meters as any meter can be manually read by any supplier. In addition to ensuring benefits are gained, the framework of functional requirements will provide a first step towards ensuring interoperability in metering systems. If the metering systems used by different suppliers are interoperable, smart meters will also make an important contribution to ensuring that the switching process can be

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7 http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx

quicker and more reliable, and all suppliers will be able to comply with their licence obligations and can retrieve data from all meters without having to visit premises or change a meter or other equipment. In addition to a specification of the minimum functionality of the metering system, the achievement of interoperability will require adherence to open data and communications protocols and is likely to be underpinned by a range of more detailed industry standards, preferably developed at an EU-wide level. In the period preceding availability of DCC services, interim interoperability arrangements will allow customer switching suppliers without the need to visit the premise or replace smart metering assets or communications. Such arrangements are discussed in more detail in the Prospectus Response supporting DCC document.

2. Communications infrastructure and the Data and Communications Company (DCC)

Smart metering requires a suitable communications platform over which data can be securely transmitted. In addition ad hoc remote configuration and diagnostics, software and firmware changes should be able to be made remotely.

The rollout of smart meters presents an opportunity for fundamental streamlining and efficiency improvements to existing gas and electricity industry processes and systems. In preparing the Prospectus Response Document, the Programme has analysed options for both the establishment of the DCC and for its initial scope.

There are a range of functions that might be included within the scope of the DCC. Three broad options have been considered as part of Phase 1 of the Programme:

- a “minimum DCC” option which would include secure communications and access control[8], translation[9] and scheduled data retrieval functions[10].

- Additionally to the “Minimum scope”, registration could be added to the remit of DCC, which would mean that DCC should assume responsibility for managing the supplier registration database that records the registered supplier for every meter point. Such function would facilitate the development of a streamlined dual-fuel change of supplier process.

- Also adding data processing and aggregation functions (for electricity) to the remit of the DCC. These services are currently performed by industry agents and involve the preparation of a meter point data for settlement. Central data storage could also be included in this option.

The analysis indicates that a positive economic case exists for the inclusion of registration within the scope of DCC. Information available also indicates that a positive business case may exist for the inclusion of data processing and aggregation. However a decision on the latter would need to be subject to further technical, economic and competition impacts analysis.

Decisions on the establishment and scope of DCC have an impact on the timing and scale of IT costs (see page 23), as well as the cost savings that are achievable by

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

streamlining current industry processes, particularly systems related to the switch of supplier process (see page 32). Compared to a baseline with a "minimum scope", the inclusion of registration functions as part of the remit of DCC increases the net present value by £190m. Adding also data aggregation to the remit (assumed to happen for modelling purposes in 2019) may add an extra £376m in NPV.

Increasing the scope of the DCC further than a "minimum scope" may also increase the complexity of the establishment process, as a larger remit could delay the establishment of the first generation of services. An early establishment of DCC is key for ensuring that the rollout progresses adequately and that the benefits are realised.

The preferred policy option is one which strikes a balance between maximising the long term benefits and ensuring a rapid establishment of the DCC. The preferred establishment option is a parallel procurement option which leads to the establishment of an operational DCC from the end of Q1 2014 with a "minimum scope" (see Prospectus Response Document), with registration being added to the scope some time after. A decision on the inclusion of data processing and aggregation would need to be considered in the future.

3. Rollout stages and strategy

The Programme has considered the options for progressing and accelerating the rollout in detail. In the Prospectus consultation we requested detailed information from stakeholders (energy suppliers, meter manufacturers and installers, consumer groups and other interested parties). This information was complemented by further detailed information obtained through a rollout open letter[11]; bilateral meetings with key stakeholders; and further information requests to larger energy suppliers.

This process has allowed the Programme to develop a more detailed understanding of the key drivers of rollout volumes during the different stages of the rollout.

In the July 2010 Prospectus, the period previous to the establishment of DCC was referred to as 'staged implementation' and it was proposed that energy suppliers had a mandate to install smart meters in this stage. Analysis of consultation responses, open letter submissions and bilateral meetings indicates that a large scale rollout before the establishment of the DCC could suppose a significant risk, as it is vital that sufficient time is spent upfront to prepare end-to-end systems and processes for a large volume rollout and ensure the customer experience is a successful one. The Evidence Base section sets out our assessment of the additional costs that could be incurred for those smart meter installations preceding the establishment of DCC.

The Programme has therefore decided to focus obligations during this period on measures to ensure market readiness which is likely to result in more limited volumes of smart meters being installed in this stage. Some suppliers are keen to progress with the installation of meters during this period and the regime will allow suppliers to do this with increasing degrees of certainty, while suppliers who face longer system change times will have flexibility to defer when they commence smart installations. This period is referred to as 'foundation stage' in this Impact Assessment.

There are two key parameters that will determine how the mass rollout progresses:

1. Commencement of the mass rollout; and

[11] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=55&refer=e-serve/sm/Documentation

2. Speed of mass rollout once this has started;

Together these allow the formation of a rollout profile.

a) Commencement of mass rollout (Foundation Stage)

Three factors are likely to influence when suppliers will commence rolling out smart meters at volume and therefore when an estimation of these costs and benefits should be modelled. These are:

- availability of a functional DCC (end Q1 2014);
- availability of the technical specification (meter and IHD functionality and certainty on communications standards) (Q2 2012, Q1 2013);
- the scope for an effective interim interoperability solution between these two dates

In order to establish the volumes of meters that can be rolled out previously to the mass rollout, the programme has carried out significant analysis on this phase fully involving a broad range of stakeholders.

The introduction of obligations and protections in relation to smart meter deployments before the DCC services are operational (see Prospectus Response Document) will allow and to some extent encourage installations to occur before the establishment of the first generation of DCC services. We have therefore modelled a range of different conceivable rollout volumes in this phase of the deployment (see page 41).

Before these obligations and commercial protections are introduced, some suppliers are already installing smart meters, at their own risk. One supplier has indicated that they will have installed substantial numbers of meters by the end of 2012. Other suppliers are proceeding with their own trials. We note that such activities remain at the suppliers' own risk but that as the Programme develops its work on functionality and communications the likelihood of suppliers' smart meter installations being compliant with the final requirements will increase. The installation of meters will also mean that costs and benefits are being incurred. It seems sensible then to apply a small percentage to our profile for smart meters being installed in advance of the mandated rollout and count both the costs and benefits in the profile. In the absence of certainty over the number of pre-mandated rollout installations that would remain compliant we have applied an assumption, for modelling purposes, that 50% of meters installed would be compliant to allow us to develop a profile.

b) Speed of Rollout (Mass rollout)

Previous modelling had assumed a maximum rollout averaging around 17% of meters in any one year, which is over three times the current annual installation rate. DECC and Ofgem have further considered the speed of rollout to understand the implications of applying a more aggressive profile to the rollout model. Evidence provided by energy suppliers and meter manufacturers, complemented by analysis of the workforce needs carried out by the National Skills Academy of Power on the course of this process suggests that moderately higher peak installation rates than previously assumed are possible with a negligible impact on costs and risks. There is a risk that a more substantial increase in the peak installation rate may cause a more material impact on the net present value and increase the risks incurred during the rollout.

These risks include overall installation targets not being achieved; a reduction in installation quality; heightened risk of operational incidents; and social costs from a steep ramp down, as large numbers of similarly qualified workers could lose their jobs over a short period of time. Importantly, it could also result in a reduction in the time being spent on customer engagement which is an important driver of the benefits case.

These inherent uncertainties constrain the efforts to capture the relative degrees of risks and impact on net present value between the high and low case. For modelling purposes our central scenario assumes only somewhat higher peak installation rates than in the July 2010 Impact Assessment, to the extent that the available evidence indicates this would not have a significant impact on the costs and risks of the rollout.

We have also looked at the international experience in order to draw lessons for the GB rollout. However a direct comparison is difficult, as the GB rollout is more ambitious in terms of covering both fuels, and by requiring important consumer engagement at the point of installation. International experience shows in general that large-scale pilots typically run for a period of 2-3 years in advance of mass deployment, followed by five-year timescales for the mass rollout of tens of millions of single fuel smart, with peak deployment levels at comparable levels to the proposals for GB in most countries.

The Evidence Base section sets out in more detail the assumptions made, the different scenarios considered, and the factors that would impact on costs and benefits with faster installation rates. We have been able to quantify some of the risks from faster installation rates as we move from the lower bound to the higher bound scenario, however we have not been able to quantify many of the risks outlined above. Our analysis indicates that higher per unit costs of installations and asset costs could have a negative impact on Net Present Value (NPV) of approximately £200m when moving from the lower bound to the higher bound, but only an impact of £60m when moving from lower to central scenario.

c) Rollout strategy and consumer engagement

In the early stages of the rollout energy suppliers will manage and be responsible for the deployment of smart meters to their customers. A review process in the early stages of the rollout will consider whether this approach is maximising the overall benefits and supporting broader policy objectives.

The programme has worked with stakeholders to identify potential mechanisms to promote consumer engagement. This has identified the likely need for some consumer engagement activities to be carried out on a coordinated basis. Such an approach could be important both to promote general consumer awareness and confidence and to enable all consumers to access the potential benefits of smart metering. Further work will be carried out in the next phase to develop an overarching consumer engagement strategy. This will include analysis to determine the appropriate objectives, scope, governance and funding arrangements for any coordinated activities. It will also include further investigation of initiatives to promote engagement, such as activities to build consumer knowledge and awareness, and how the programme could assist particular consumer groups such as the vulnerable.

4. Options analysed

The preferred policy option is presented in the summary sheet of the Impact Assessment. This policy option is created by the analysis of sub-options on:

-Options on functionality
-Options for the establishment and scope of the DCC
-Options for the foundation stage and the rollout

These options and underlying analysis are presented and discussed in the body of the Impact Assessment.

F. Evidence Base

In this section we describe the main assumptions underpinning the analysis and the reasons for them with references to the evidence where appropriate. Further work has been undertaken since the July 2010 IA, particularly in the areas of rollout, functionality and communications. This further analysis has been undertaken by DECC and Ofgem and has been informed by the outputs of Expert Industry Groups following a process of continuous engagement with industry and externally sourced work by Programme contractors. In addition we have received feedback from stakeholders on many aspects of the analysis during this period.

We have refined our assumptions and methodology on the basis of a critical examination of the evidence we have received and changes have also undergone a process of cross-Government peer review. Key estimates that have been refined since July 2010 include the rollout profile, IT costs, meter costs, benefits from better outage management, other network benefits, theft estimates, avoided site visits, benefits from customer switching, and the methodological approach to assessing the impact of ToU tariffs.

Differences between the assumptions used in this IA and the one published in July 2010 are noted and explained within the text. For reference purposes Annex 2 provides an overview of the changes made. The assumptions are generally shared between the options under consideration, but where there are differences these are noted.

Overall the case for a rollout of smart meters to domestic consumers remains strongly positive in central scenarios (see results page 46); The domestic rollout has a positive Net Present Value (NPV) of over £5bn. Table 2 compares costs and benefits of the March 2011 IA against the preferred implementation option in the July 2010 IA. The values for the July 2010 have been adjusted since publication in order to correct an error in the discounting calculation. This increases the value of the NPV published in the July 2010 IA from £4,989m to £5,164m.

Table 2. Costs, Benefits and PV (March 2011 vs July 2010)

	March 2011 (PV 2011)	July 2010 corrected (PV 2010)	July 2010 (PV 2009)
Total Costs	£10,757m	£10,403m	£10,051m
Total Benefits	£15,827m	£15,567m	£15,040m
Net Present Value	£5,071m	£5,164m	£4,989m

The programme has also carried out an exercise to determine the net effect of smart meters on businesses across both the domestic and the non-domestic parts of the policy, establishing that the overall impact on businesses is positive, i.e. benefits outweigh the costs. The overall rollout of smart meters results in a net benefit to businesses of £1bn over a 20 year period. This approach has been agreed with the Better Regulation Executive.

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

1. Counterfactual/benchmarking
2. Costs
3. Benefits
4. Rollout profile
5. Foundation stage

These assumptions are then combined and modelled to provide cost benefit outputs (see section 6. Results)

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

1.Counterfactual/benchmarking

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

- the costs of the continued installation of basic meters,
- benefits from better billing,
- 5% of the predicted consumer electricity savings from smart metering are assumed to occur in the counterfactual world as a result of CERT[13] and other delivery of clip-on RTDs. The assumption that real-time displays installed under CERT will deliver the same savings than those arising from the rollout of smart meters is likely to underestimate the savings attributable to the smart meters rollout (see Evidence Base section, page 28).

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

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

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

the Government mandate[14]. We note however that such activities remain at the suppliers' own risk.

It is worth noting that the situation is different in the case of non-domestic customers (subject of a separate IA). The provision of smarter metering is already established at larger sites, and such metering, whether self-standing or retrofitted to existing meters, is increasingly being installed at smaller sites, particularly of multi-site customers. This reflects, among other things, the proportionately larger potential savings and lower stranding or redundancy risks from smart and advanced metering for larger consumers and the lower relative cost of the meters, as well as incentivisation of installation of smarter metering under the Carbon Reduction Commitment.

However, recognising that some level of smart meters may be rolled out, for illustrative purposes we have also considered a situation where smart meters are rolled out to a significant part of the residential population. A counterfactual scenario has therefore also been examined which reduces NPV by £2.5 billion.

This alternative scenario is very conservative and assumes that a rollout of smart meters in the counterfactual world would mean that energy suppliers rollout first to those consumers which benefit more from it and hence a 20% rollout of smart meters, in a competitive metering counterfactual world, results in a reduction in gross benefits of 30% and a reduction in costs of 20%. Even in this conservative scenario, the NPV is positive.

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

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

2.Costs

Our underlying assumption for cost benefit modelling purposes is that the metering technology deployed will provide the functionality already set out. For the purposes of this analysis delivery of real time information is assumed to be through a standalone display which is connected to the metering system via a Home Area Network (HAN)[15]. It is assumed that a Wide Area Network (WAN)[16] is also required to provide the communications link to the DCC. In the cost benefit modelling we calculate the communications devices as separate to the meter specification.

IHDs (In-Home Displays) will have dual fuel functionality so any second supplier providing gas or electricity in a non-dual fuel home can use the IHD provided by the

[14] We estimate that approximately 250,000 smart meters may have been installed to date, approximately 0.5% of the domestic metering population.
[15] 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.
[16] A WAN is a communications network that in this case spans from the smart meter to the DCC.

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.

Meter, IHD and communications capital costs

The tables below show the capital costs of meter and communications assets used for the current analysis.

Table 3: Capital Costs of Assets (£ per device)

	Electricity	Gas
Display	£15	£15
Meter	£44	£56

Table 4: Communications infrastructure (£ per device)

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

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

The cost per electricity meter has been updated since the July 2010 IA and now reflects an incremental cost of £1 per meter for the inclusion of capability to alert suppliers and networks when electricity supply is lost. This capability is known as "last gasp". The cost estimate is based on the analysis of cost information received from meter manufacturers already producing smart meters with such capability and anecdotal evidence from some communications providers.

We have also considered whether the inclusion of a minimum requirement for smart meters to store 13 months of energy consumption data may result in increased asset costs. Our current assessment is that at this stage no additional evidence has come to light that justifies a review of the current cost estimates.

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

Installation costs

We have retained the assumptions from the July 2010 IA for installation costs; this includes a £10 per installation efficiency resulting from the dual fuel installation.

Table 5: Installation costs

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

Operating and maintenance costs

Smart meter maintenance costs are uncertain, because an integrated solution including common communication provision has not been tried in the British market, even though some suppliers are already installing smart meters. The assumption used in the July 2010 IA was based on Ofgem[17] work which assumed an annual operation and maintenance cost for smart meters of 2.5% of the meter purchase cost. No further substantive evidence has been brought forward on this point and we have therefore retained this assumption for the present IA.

For the ongoing services charges for the communication technology that provides connectivity to the premises we assume – in line with the available evidence – these to be £5.30 per household per year (annuitised) for the WAN connection. This cost estimate includes an allowance for network security that enables secure communications. Further work carried out by Ofgem and the Data and Communications Expert Group have verified this against a mix of different technology solutions and established this to be an appropriate assumption. This is assumed to gradually decrease over the period of the roll out. The costs of operating and maintaining the HAN are assumed to fall within those of the meter as above.

IT costs

In the July 2010 IA we estimated capex costs of £100m for the additional IT spend needed by industry players (suppliers, DCC and others) over and above their business as usual IT costs. Operating IT costs of £15.5m p.a. for DCC and £1m p.a. for suppliers' were also assumed. These costs have been refined during the course of Phase 1 based on the programme's analysis of input data from industry in response to an Information Request.

- Supplier/Other Participant IT capex

The programme received a very broad range of figures for large supplier IT capex. There were two significant outliers. The upper outlier was excluded on the basis that it represented counterfactual development associated with a new suite of systems. The lower outlier has been included, since this was a factor of the existing system suite, but has been increased to bring it closer to the other estimates. The overall figures have been moderated to an average of £30m per large supplier. Figures for small suppliers and other participants have been included as provided.

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

The programme has not included specific smart metering IT refresh costs as smart metering changes are typically being applied to large scale Customer Relationship Management (CRM) and billing systems and market interface systems. The former are predominantly strategic investments by the large 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.

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

- DCC capex

The programme received several estimates for the capex required to establish DCC. These were typically close to the programme's original estimates and we have held to these figures for DCC inception. DCC capex however has been adjusted where appropriate to reflect the inclusion of registration and data aggregation.

- Supplier/Other Participant IT opex

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

- DCC IT opex

As above, an industry standard figure of 15% is used. This is reduced to 7.5% over the period. Evidence from Elexon and Electralink indicated that IT costs were reduced by 50% over a ten year period. Both these organisations were established to support major market change. Electralink was introduced to support data transfer for the liberalised market in 1998. Elexon was introduced to support the new energy trading arrangements in 2001. Their experience is hence highly comparable to that anticipated for DCC. Further, as above, these systems will be subject to further change to assist in streamlining the market based on discrete business cases.

Cost of capital

The costs of assets and installation are assumed to be subject to a private cost of capital, i.e. resources committed to assets and installation have an opportunity cost. That cost is fixed at 10% p.a. in the IA. 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.

Energy cost

The smart metering assets will consume energy, and after discussions with meter specialists 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.

Meter reading costs

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 four times the existing meter reading cost. These reads are treated as an additional cost per meter and the costs are spread across the roll out. The assumptions underlying these costs have not been changed between the July 2010 and this IA.

Disposal costs

The July 2010 Impact Assessment considered costs from having to dispose of dumb meters as part of the roll out, estimated at around £1 per meter. Included among these are the costs of disposing of mercury from gas meters.

These costs would have been encountered under business as usual meter replacement programmes, but would be accelerated by a mandated rollout. While the underlying cost assumption of £1 per meter has not changed, the cost-benefit model now reflects that meters would have had to be disposed off regardless of the implementation of the smart meters programme and now only takes into account the acceleration and bringing forward of the disposal over and above the counterfactual. The calculation now also applies the £1 disposal cost to smart meters, with resulting costs for the first generation meters to be replaced from 2027. The overall impact of these changes is a reduction in PV costs from £41m to £20m. This is reflective of a reduction from £41m to £4m by taking into account the counterfactual disposal and an increase in costs by £16m for disposing smart meters from 2027.

Legal, marketing and organisational costs

The July 2010 IA included a cost category covering legal, IT, setup and organisational costs, adding up to a total amount of £370m. IT costs, which represented £100m of the cost are now subject of a separate treatment. Cost estimates for marketing and consumer support, legal costs and other setup and organisational costs remain unchanged from the July 2010 Impact Assessment. However an additional item of £30m has been added for the costs of the interim solution until the DCC is established. This reflects that before the establishment of DCC suppliers will have to adapt their back office systems to ensure commercial interoperability for smart meters installed prior to the mass rollout.

The below table summarises our latest estimates:

Table 6. Legal, setup and organisational costs

	£m
Marketing and consumer support costs	100
Legal costs	30
Others (interim solution, data protection, ongoing regulation, assurance, accreditation, tendering, programme delivery, trials, testing)	170

Our assumptions for marketing costs also remain unchanged. These estimates are based on a NAO report on the Digital switchover marketing which still provides at this point in time the best available evidence to benchmark the potential costs on consumer engagement arising from the smart meters rollout (Table 7).

Table 7. Digital switchover consumer engagement spend

Activity	Budget
TV, radio & press advertising	£57m
Other customer outreach & support	£29m
Call centre & website	£20m
Planning & production	£18m
Regional mailings	£14m
Trade support	£12m
Research & tracking	£8m
Regional management	£8m
Total	£166m

As set out in the Government Response document the Government believes that there is a strong case for some elements of consumer engagement to be carried out on a coordinated basis, and work in the next Phase of the Programme will develop an overarching consumer engagement strategy, including the appropriate objectives, scope, governance and funding arrangements for any centrally-coordinated activities. The £100m cost estimate will be reviewed in the light of this work.

3.Benefits of smart metering

We classify benefits in three broad categories: consumers, businesses (energy suppliers, networks and generation businesses) and UK-wide. 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.

Consumer benefits

There are expected to be a range of consumer benefits, including those around improved customer satisfaction and financial management benefits, which have not so far 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' expected consumption behaviour. Two potential sources of change in average consumption behaviour may arise:

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

Energy demand reduction

There is a growing evidence base but also continuing uncertainty about the likely level of response of consumers to the full roll out of smart meters. A number of large-scale international review studies exist, the most recent a review of 57 feedback studies in nine different countries by the American Council for an Energy-

Efficient Economy (ACEEE) [18] which finds that on average feedback reduces energy consumption between 4-12%, with higher (9%) savings associated with real-time feedback. Sarah Darby[19] and Corinna Fischer[20] also show that feedback can result in dramatic behavioural changes (average reductions in energy consumption of over 10%). However given the differences of situation and approach between different countries, it is difficult to transfer such evidence on levels of savings directly to the GB context.

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.

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)[21] is another recent 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.

The Energy Demand Research Project[22] has been funded by the Government to provide information on consumers' responses to a range of forms of feedback in Great Britain, including smart meter-based interventions. However the trials are complex, with significant differences in the types of intervention, experimental design and approach to recruitment used by the four suppliers' sets of trials. As a result it has proved difficult to draw generalisable conclusions. Ofgem commissioned AECOM in September to conduct the final analysis and report on the project. The final analysis is examining the primary data to any robust trends across all the trials.

The fifth progress report[23] by Ofgem, published in December 2010, does not draw firm conclusions from the analysis to date. However it states as "emerging lessons" that "the presence of a smart meter in combination with other interventions was often associated with a reduction in consumption, but interventions without smart meters were not. This suggests that smart meters can be a vehicle for effective action to

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[18] Erhardt-Martinez, Donnelly, Laitner, *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010

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

[20] Corina Fischer, *Feedback on household energy consumption: a tool for saving energy?*, Energy Efficiency (2008) 1:79-104

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

[22] The Energy Demand Research Project (EDRP) started in July 2007. Four suppliers are leading the project trials which are examining how energy consumers respond to better information about their energy consumption. The project is funded by £10m from the Government, matched by equivalent funding from the companies. Several interventions are being tested: smart meters, real-time display devices; additional billing information; monthly billing; energy efficiency information; and community engagement. There are a combination of interventions in around 42,000 different households and some 18,000 smart meters. See: http://www.ofgem.gov.uk/Markets/RetMkts/Metrng/Smart/Pages/SmartMeter.aspx

[23] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?file=EDRP%20Progress%20Report%205%20FINAL.pdf&refer=Sustainability/EDRP

reduce domestic energy demand". The report also states that the trials have not found a consistent energy saving impact across all the many interventions involving different forms of real-time feedback. It suggests from this that a focus on technology alone is unlikely to have a major effect on consumption, and that other action to engage and motivate consumers will be required. The final report from the project which is expected to be available in Spring 2011 will provide more information, as well as the monitoring plans outlined in the Post Implementation Review (annex 4).

From the evidence available to date, it appears that the levels and distribution of energy savings will be dependent on a number of factors, including: the effectiveness of consumer engagement approaches carried out by energy suppliers, energy services companies (ESCOs) and potentially other parties; the quality of design solutions (e.g. the quality and usefulness of in-home displays and minimum information requirements, developments in home automation) and enabling the development of energy tariffs and services which encourage or facilitate behaviour change. Different elements of the programme (e.g. the consumer engagement strategy, the IHD minimum requirements which allow scope for innovation, flexible provision for access to data within the home and via the DCC) will address these specific issues.

In addition, retail competition and further steps to promote the programme's objective of effective competition in all relevant markets (energy supply, metering provision and energy services and home automation) are likely to drive market developments which will support energy savings.

Overall, the international evidence shows large savings achievable. However, as outlined above, as a result of the existing uncertainty there is no compelling case at this stage to revise the conservative assumptions made on energy savings. Most commentators have so far adopted relatively conservative assumptions. For example Ofgem's past cost-benefit analysis[24] for domestic metering innovation assumed a 1% energy saving from smart meters, which is at the lower end of the savings of 1-3% reported in the Owen and Ward[25, 26]studies (2006, 2007). Other studies have been more optimistic with Energywatch[27] giving a range of energy saving of 3.5-7%.

We 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.

[24] Ofgem, *Domestic Metering Innovation Consultation*, February 2006
[25] Owen and Ward, *Smart Meters in Great Britain: the Next Steps*, July 2007
[26] Owen and Ward, *Smart Meters: Commercial, Policy and Regulatory Drivers*, March 2006
[27] Energywatch, *Smart Meters – Costs and Consumer Benefits*, 2007

We also apply sensitivity analysis to these benefits as follows:

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

Energy is valued consistently with guidance produced by DECC[28]. The energy baseline from which energy savings are calculated is consistent with the energy baseline used in the July 2010 Impact Assessment[29].

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 various agents in the energy market, and hence it is discussed under the "business benefits" heading.

Microgeneration

We have attempted to estimate the savings from using smart meters to deliver export information from microgeneration devices. We have done that by estimating the number of microgeneration devices that will be in use by 2020. 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 in assuming a separate meter and its installation cost are not needed.

Business benefits

Most benefits (or cost savings) in this section are attributed to energy suppliers. When benefits are related to generation, network or transmission businesses this is noted as appropriate.

Avoided site visits

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

Additional evidence has emerged and has resulted in a revision of our approach to avoided site visits in comparison to the July 2010 IA. Because all aspects discussed in the following are closely interlinked and reflect changes to the operations of visiting customers' premises as a result of the rollout of smart meters, they are grouped here in a section on 'avoided site visits'. The overall impact of the items captured can be seen in the overview table at the end of this section.

[28] DECC Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, June 2010

[29] The business as usual energy consumption accounts already for the reduced energy consumption levels as a result of the impact of the following policies: EEC1, EEC2, CERT, Product Regulations, Building Regulations and Warm Front and fuel poverty policies.

•Regular visits

-Regular meter read visits

Smart meters will allow meter reading savings for all the suppliers once the rollout is complete. 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 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.

-Regular safety inspection visits

This updated IA now also takes account of additional costs for regular safety inspections of smart meters. These had previously not been considered, but consultation responses have led the programme to review previous assumptions. The impact of these additional visits is a cost of £0.6 p.a. for 90% of meters and of £8.75 p.a. for 10% of meters.

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

The programme expects that the rollout 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 need to be subject of a policy decision by The Health and Safety Executive (HSE), but initial discussions with HSE have already indicated that it is willing to consider reform, subject to any changes being risk and evidence based and not resulting in any reduction in existing levels of safety. This adheres to the principles of better regulation and would directly reduce the regulatory burden placed on businesses.

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

- Low risk group:

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

- High risk group:

- 10% of meters
- Require a safety inspection every 2 years (or 5% of meters every year)
- Approach of scheduled appointments with £17.5 cost per successful visit[30]

[30] 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.

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

- Special visits

We have also refined our assumptions with regards to "avoided special visits". Previously we assumed that without smart meters one additional visit per meter at a cost of £3 is required every four years, for purposes of either reading a meter or carrying out a safety inspection, resulting in a benefit of £0.75 per meter p.a.
After a revision of the underlying assumptions we now reflect 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 8: Cost and benefit impacts from avoided site visits (per meter)[31]

Visit type	Current world cost	Smart world cost	Effect
Regular meter read	£6 per credit meter pa, £0 per PPM meter pa	None	saving
Regular safety inspection	No incremental cost	£0.6 per low risk meter pa, £0.875 per high risk meter pa	cost
Special meter read requested by customer	£0.5 per credit meter pa, £0 per PPM meter pa	None	saving
Special safety inspection	£0.875 per meter pa	No longer required as captured under the risk based approach	saving
Total cost:	**£6.73**	**£ 0.63**	**cost saving of £6.10**

Customer service overheads
Call centre cost savings are a result of a reduction in billing enquiries and complaints. Smart meters will mean the end of estimated bills and this is expected to result in lower demand on call centres for billing enquiries. This assumption is unchanged since July 2010 and we assume this cost saving to be £2.20 per meter per year in the central scenario (£1.88 for reduced inbound enquiries and £0.32 for reduced customer service overheads). No new information was gathered and our assumption is based on previous supplier estimates that inbound call volumes could fall by around 30% producing a 20% saving in call centre overheads. Other consultation responses used similar cost assumptions for call centre cost savings.

Remote switching and disconnection
The meter functionality we assume will enable the remote enablement or disablement of the electricity and/or gas supply. The direct benefits associated with these capabilities are the avoided site visits and equipment upgrade costs. These are captured in the debt management and in the pre payment cost to serve savings. We also continue to include a further benefit of £0.5 per credit meter per year for the benefits of being able to remotely disconnect those consumers. Ofgem is consulting on a Spring Package of regulatory measures to strengthen protections for consumers.

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

[31] 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.

Consumers on pre-pay could benefit if these savings were passed on as lower prices. In practice, pre-pay customers have already made those savings because suppliers have artificially lowered prepay tariffs to 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 (although, in practice, suppliers have already chosen to remove the differentials between the tariffs paid by prepay and standard credit customers).

Debt management

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

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.

In addition to responses to the Prospectus, the Programme has collected further evidence through an Information Request[32] on the costs and benefits associated with the establishment and operation of DCC in the gas and electricity industries. This Information Request was completed by members of the Data and Communications Expert Group, which included industry parties (energy suppliers, network operators and market operators) whose existing systems will be impacted by the introduction of smart metering and the establishment of DCC. Participants were asked to provide feedback under a prescribed set of options for the scope of DCC's activities. These included a minimum scope, inclusion of DCC registration and inclusion of data processing, aggregation and storage.

The main category of benefits examined through this Information Request relates to customer switching. The Information Request asked for views of the potential scale of this benefit and the extent to which the benefits are contingent on DCC providing a centralised supplier registration system covering both electricity and gas.

Suppliers were asked to estimate the value of benefits that could be realised under each option 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. Where an option resulted in the transfer of functions from suppliers' agents to DCC (e.g. data processing and 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).

[32] issued on 14th October 2010

In previous impact assessments we had assumed savings of £100m per year, or £2 per meter per year[33]. Following analysis of responses to the request for information, we now consider customer switching benefits of £3.11 per smart meter per year where the scope of the DCC includes data collection, registration, data processing, data aggregation and data storage functions. Where the scope of the DCC includes registration, benefits of £2.22 per smart meter per year are considered and where the scope of the DCC covers only the minimum scope, benefits of £1.58 per smart meter per year are considered. Before the establishment of DCC customer benefits are assumed to be of £0.8 per meter per annum.

The preferred establishment option leads to the establishment of an operational DCC from the end of Q1 2014 with a "minimum scope" (see Prospectus Response Document), with registration being added to the scope some time after. A decision on the inclusion of data processing and aggregation will be considered in the future. For modelling purposes, it is assumed that registration will be added to the remit of DCC in 2016, with data processing and aggregation added in 2019.

Theft

The implementation of smart metering could reveal existing theft and allow suppliers to combat it better. Estimating theft is problematic as by its nature theft levels are difficult to quantify. Detailed analysis carried out by industry over the course of Phase 1 suggests that current levels of theft are higher than previously estimated in the July 2010 Impact Assessment, which assumed that theft for electricity and gas had a retail value of £100m p.a. (Ofgem, 2005)[34]. The revised estimates suggest that levels of gas and electricity theft by domestic customers may have a retail value of over £250m p.a.

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

In our central scenario we continue to assume that the roll out of smart meters will reduce theft by 10%, which is conservative given estimates that smart meters could reduce theft by 20-33% in previous consultation responses, equivalent to per meter per year. We continue to assume that the amount of theft is likely to decrease as suppliers will have access to more accurate and frequent data and will detect theft more quickly; however we also recognise that new methods of theft will arise. Following standard Government practice, we value theft reductions for domestic customers at the resource rather than the retail value of energy, resulting in benefits in 2010 of £0.29 per meter per annum for electricity and £0.36 per meter per annum for gas.

Losses

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[35].

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

[34] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=3&refer=Markets/RetMkts/Compl/Theft

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

Network benefits

DECC and Ofgem have carried out a reassessment of benefits to electricity networks from smart metering following a review of international evidence and analysis provided by the Energy Networks Association (ENA).

- Outage management

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. The analysis has also informed the decision to include last gasp functionality as part of the minimum functionality requirements. Annex 1 outlines the analysis in more detail.

- Other electricity network benefits

In addition to the benefits outlined in the previous paragraph, networks will also benefit from the implementation of smart meters and enhanced availability of data through savings from better informed enforcement investment decisions as well as avoided costs of investigation of customer complaints about voltage quality of supply:

1. Better informed investment decisions for electricity network enforcement

From having more detailed information on locational peak demand, bottlenecks in the network can be identified and enforcement investment better directed. Information received through the ENA cost benefit analysis[36] indicates that the required network enforcement investments might be reduced by 5% through the availability of better information from smart meters. For our base scenario we have adopted this assumption. However, our analysis uses the expected annual investment requirement figure from the distribution price control review 5 (DPCR5) as baseline to reflect the latest information on expected costs from network investment[37].

This results in an estimated £14m benefit in reduced investment expenditure per year.

2. Avoided cost of investigation of customer complaints about voltage quality of supply[38]

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 Annex 1). The estimate is based on the costs of resolving a fault to network operators, which is

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

[37] 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.

[38] While the benefit of better informed investment decisions is subject to the same assumption of critical mass that is outlined in Annex 1, 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 rollout profile.

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 £0.33 per electricity meter per year.

<u>Energy demand shift</u>
A time of use tariff (ToU) uses 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. Smart meters make this type of tariff possible by recording the time when electricity is used, and potentially informing consumers of changes in prices. Load shifting benefits are treated as distinct from demand reduction, even though some studies have found that TOU tariffs can lead to demand reduction in addition to shifting (King and Delurey, 2005[39]).

There are two main types of TOU tariffs:

- -Static TOU tariffs: these 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 would 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.[40]

Additionally, TOU 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. Load shifting arising from automation is therefore only considered as part of our sensitivity analysis in order to illustrate the longer term potential enabled by smart metering.

Our underlying assumptions on Time of Use (ToU) pricing have been revised from the July 2010 IA. We have reassessed the potential for load-shifting, based on a bottom-up calculation, and have considered how this will evolve going forward under different scenarios. Our assessment is that in the short run, 20% of current residential peak load is discretionary

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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[41]). 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. We therefore

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

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). 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 calculation.

We expect take up of ToU tariffs by consumers to be of 20% (in addition to the existing group using Economy 7)[42], and that in the short run those customers on variable tariffs will only shift discretionary load at peak one out of every three times they actually could.

As time goes by, we expect the number of times that load is actually shifted to increase to ½ of the available 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, which would reduce the need for active action by the householder.

The introduction of heat pumps with storage capacity and more widespread charging of electric vehicles is likely to increase the total amount of load that can be shifted in the future. Because these developments are likely to involve development of further policy, in our central scenario we only assume a slight increase in take up and discretionary load (up to 24% by 2030 from 20% originally) in order to accommodate the business as usual (i.e. non-policy related) growth in number of electric cars (DfT, 2008[43]).

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[44] 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 also been reassessed since the July 2010 Impact Assessment. We now valuate benefits from load shifting in three different areas:

Short run marginal cost savings
Load shifting can create benefits for utilities as on average energy can be generated at a lower cost, supposing a resource cost saving to the economy as a whole. A number of studies (Ofgem, 2010; Faruqui & Sergici, 2009) 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 the same amount of energy can be generated at a lower generation cost,

[42] In line with international experience
[43] DfT/ BERR (2008) 'Electric Vehicles'
[44] 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).

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

Capacity investment savings
Lower peak demand also means that long term capacity investment in generation and 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. For generation, this would mean a lower required generating plant demand margin (the difference between output usable and forecast demand, i.e. spare capacity) – this could be reduced in line with reductions in peak demand reductions. Distribution and transmission capacity savings can also be estimated[45].

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.

Carbon savings
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 0.34 and 0.18 kg CO2/ kWh

UK-wide benefits

<u>Valuing avoided costs of carbon from energy savings</u>
We have valued the avoided costs of carbon from energy savings in order to show whether the UK is introducing cost-effective policies to reduce carbon emissions, which is discussed with some more detail in the Carbon Test (see annexes).

For electricity, reductions in energy use will mean the UK purchasing fewer EU ETS allowances and this saving is assimilated as a benefit. In our analysis it accounts for Present Value (PV) of approximately £371m.

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 approximately PV £654m.

<u>Reduction in carbon emissions</u>
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-

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[45] 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.

traded sectors[46]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

Table 9: reductions in CO_2 emissions and energy savings

EU ETS permits savings (Millions of tonnes of CO_2 saved equivalent) – traded sector	Millions of tonnes of CO_2 saved – non-traded	Energy Savings – electricity (£bn, PV)	Energy Savings – gas (£bn, PV)
17.4	15.6	3.1	1.5

Non-quantified benefits

It has been possible to make a quantitative assessment of the benefits described above within the updated modelling for the March 2011 IA. However there remains an important and substantive subset of benefits where the existence of smart metering will facilitate the uptake or management of new services or enable new, smart approaches to energy supply and grid management– especially in the medium to longer term. These remain not quantified[47] but are key elements of benefit from the rollout.

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[48].

This involves the use of communication technology to deliver more dynamic real time flows of network information and more interaction between suppliers and consumers, helping to deliver electricity more efficiently and reliably from a more complex network of generators than today. This would include the ability to manage fluctuations in supply from intermittent renewables generation.

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 energy generation. The smart meter functionality minimum requirements have been developed to accommodate these future smart grid considerations.

[46] 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.

[47] This is with the exception of the reduction in network losses enabled by smart meters, which we have quantified, As smart meters will enhance fraud detection and loss management capability we expect it to be in network operators' interests to minimise costs arising from losses directly as a result of the smart meters roll-out.

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

Although potential benefits to GB from a smarter grid are likely to be significant in the long term, it is difficult at this stage to estimate these with confidence, and we have not attempted to attribute any smart grid related benefits in the smart meters cost benefit analysis.

There have been a number of attempts to quantify potential benefits arising from a smarter grid.[49] Accenture has carried out cost benefit analysis of smart grid investments on behalf of DECC and the ENSG (Electricity Networks Strategy Group), and found a positive business case for smart grid investments[50]. Although there is no single smart grid 'solution', the analysis considers one possible 'path', adopting a two phase approach to take into account the considerable uncertainty post 2020. Phase 1 considers the period 2010-2020 and is found to have an NPV of £1.5bn. This involves investments in smart meters on distribution transformers, direct control equipment, smart appliances and IT; benefits arise due to demand response and system optimisation, reduced need for network reinforcements, lower predictive maintenance, distributed generation, and reduced technical losses and customer minutes lost. Phase 2 (2020-2050) is estimated to have an NPV of £2.6bn. This would include investments in substation automation and enhanced communications; benefits are expected from greater use of demand side management (due to higher assumed levels of heat pumps and electric vehicles) as well as from more cost-effective management of distributed energy resources.

The Energy Networks Association (ENA) and Imperial College have estimated the potential network benefits from Smart Meters due to demand side management at between £0.5 - £10bn NPV from 2020 - 2030.[51] 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: under a 10% penetration of Electric Vehicles and Heat Pumps scenario, the NPV value of smart-meter enabled active control is estimated at £0.5 - £1.6bn, from 2020 - 2030. Other scenarios involving greater levels of heat pumps and electric vehicles could yield benefits of up to £10bn.

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. In addition the improved availability of information should create opportunities for energy services companies to enter the domestic and smaller business markets; and for other services to be developed, for example new tariff packages and energy services. Overall smart meters should enhance the operation of the competitive market by improving performance and the

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

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

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

consumer experience, encouraging suppliers' (and others) innovation and consumer participation.

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

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

Enabled benefits to wider society

Energy consumers might benefit from the increase in consumption information available through smart meters by being able to have access to detailed appliance diagnostics. By identifying individual energy use such diagnostics could help to identify those appliances where investment in more efficient models would be economical. Other areas of potential benefits include more refined automation of heating and hot water controls and the analysis of heating patterns through the availability of detailed energy consumption data.

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.Rollout profile

An accelerated rollout means that the benefits come on line more quickly, greater benefits of scope and scale can be achieved and there is a reduction in the necessity to support multiple processes in back office systems.

However, costs would also be brought forward. Where timelines are shorter, higher capital costs might be expected as it would be necessary to acquire the equipment, competent labour and meters within a compressed period. And there would be additional stranding costs. There is potential for greater risk to consumers in terms of cost.

The key message obtained in consultation from stakeholders was that significantly accelerating the rollout will bring forward benefits, but that there could also be a countervailing increase in costs and risks.

The latest Programme timeline – discussed in more detail in the rollout supporting document - indicates that the full DCC will be offering services from the end of Q1 2014.

For modelling purposes we have assumed different installation rates for up to three possible scenarios in regards to the rollout. These rates and scenarios should not be interpreted as policy options on the installation targets that could be set on suppliers but rather as modelling assumptions to allow producing a profile for the quantification of the costs and benefits of the rollout.

In order to allow modelling of costs and benefits, we have stylised the rollout period in four distinct stages. In each stage, assumptions have been made in regards to the rollout strategy of individual energy suppliers. This has been informed by extensive information and data gathering, and individual interviews with energy suppliers over the course of the consultation period and beyond (see Rollout supporting document).

1) Early movers (present to Q3 2012)

In this period some suppliers will be rolling out volumes and most will be carrying out trials. The consumer may be offered a smart meter, but if the consumer subsequently switches supplier, there is a high risk that smart functionality is lost as the incoming supplier may be unable to support the technical configuration.

A modelling assumption is made that 50% of meters installed in this period will not be compliant.

2) Commercial and technical interoperability (Q4 2012 – Q2 2014)

Suppliers will have access to compliant meters as bulk supply of compliant equipment is available. This may happen as early as Q2 2012 for some energy suppliers. We also assume that from this point in time there are no constraints on availability of trained field staff and safe harbour on communications is offered. Rollout volumes in this period are driven by energy suppliers commercial strategies.

3) DCC establishment (from Q2 2014)

Maximum deployment rates are achieved 6 months after the establishment of the DCC and there are no constraints on the volumes of communications services that the DCC can offer. Such peak volumes are extended until the last 10% of the customer base is reached.

4) Ramp down

This is reached when individual suppliers reach the final 10% of installations as a proportion of customer base is assumed to be hard-to-reach due to a range of customer and technical elements: long term vacant premises, repeated customer no access, lack of standard communication coverage and site specific safety issues.

A great deal of uncertainty remains as to the nature and extent of the rollout tail. Information provided by energy suppliers indicates that it could take three years to complete smart meters installations to their hard-to-reach customer base. For modelling purposes, we assume that the yearly distribution of installations in the tail within these last three years is of 6%, 3% and 1% respectively. This reflects increasing complexity in resolving the most difficult customer and technical elements of the rollout.

Establishing a single rollout profile is complex given the variety of strategies that energy suppliers could follow in each stage of the rollout. Based on data and information gathered by the programme, and given the uncertainties around the rates at which the rollout is completed at each stage, we have created a range of potential outcomes from the rollout. The following assumptions have been made:

<u>Higher bound definition</u>

- In the foundation phase energy suppliers rollout smart meters to new build properties and when dumb meters need to be replaced as they reach the end of their functional life. This is driven by the commercial push of those energy suppliers with the most aggressive commercial strategies.
- In the mass rollout stage, peak installation rates of 23% per year are reached.

<u>Lower bound definition</u>

- In the foundation phase energy suppliers do not rollout at substantial rates, causing existing early movers to reconsider their current strategies until DCC is established
- In the mass rollout stage, peak installation rates of 17% per year are reached.

An intermediate point is used as a <u>central case</u> for modelling purposes. In this central case some suppliers start reaching rates comparable to new and replacement before the establishment of DCC, whereas others have a more conservative strategy and do not rollout at substantial volumes until the DCC is established, aside from conducting large scale trials to allow readiness for ramp up once DCC is established. Once DCC is established an peak installation rate of 19% is assumed.

Figure 1. Range of cumulative rollout volumes

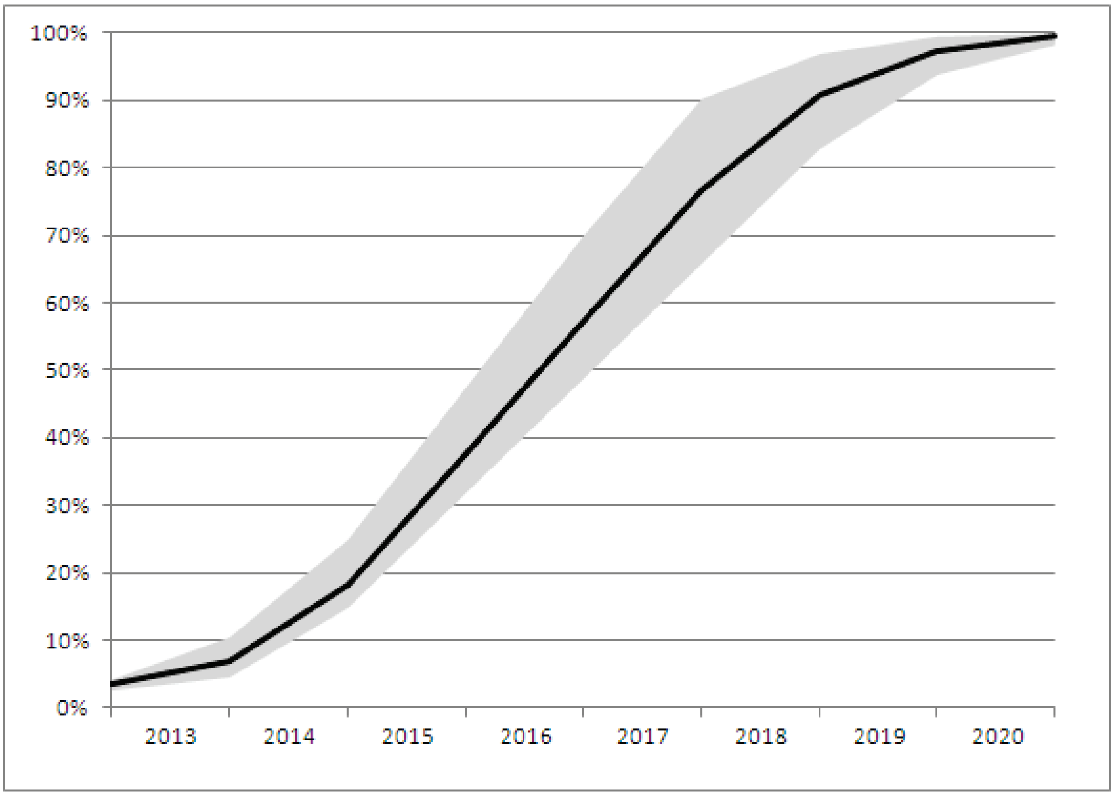

Table 10. Number of meters installed at establishment of DCC (Q2 2014)

Total meters installed at start of DCC	Lower bound	Central case	Higher bound
DCC Apr-14	5%	8%	13%
Number of meters	(2.7m)	(4m)	(6.5m)

Table 11. Completion dates

% Meters Installed	Lower bound	Central case	Higher bound
Dec-16	49%	57%	70%
Dec-17	66%	77%	90%
Dec-18	83%	91%	97%
Dec-19	94%	97%	100%
Dec-20	98%	100%	100%

Factors that impact costs and benefits during the rollout include:

- benefits (and costs) come on stream sooner the faster the rollout;
- with a longer rollout the need for suppliers to run to support parallel processes in "back-office" systems, one to support the old meter stock and one for smart meters, is extended and therefore costs are likely to be higher. Other non-supplier central systems, processes and bodies may also need to be maintained in parallel during this period e.g. the Data Transfer Network, Master Registration Agreement Data Flows Catalogue;

- any rollout of smart meters will require equipment, a skilled labour force and availability of suitable meters to fulfil the roll out. In an accelerated roll out pressures on capital costs and availability may be increased as these will be required in a shorter space of time;
- stranded assets – setting an accelerated deadline for a smart meter roll out will cause a certain proportion of electricity and gas meters to be removed before the end of their normal economic life. Whilst we do not account for stranding costs in the NPV, this will create costs for either the owner of the asset or suppliers depending on the contractual arrangements in place.

There are risks and additional costs associated with higher peak installation rates, and these are likely to increase as more aggressive scenarios are assumed. These include: overall installation targets not being achieved; a reduction in installation quality; heightened risk of operational incidents; and social costs from a steep ramp down, as large numbers of similarly qualified workers could lose their jobs over a short period of time. Importantly, it could also result in a reduction in the time being spent on customer engagement which is a fundamental driver of the benefits case.

We have been able to quantify some of these risks. As we move from the central to the high case scenario, our analysis indicates:

-higher labour costs due to shorter duration of contracts and higher training and redundancy costs; we assume an increase in installation costs of just over 1% when roll out rates are above 17%.
-increase in meter and IHD costs (of 1% and 0.25% respectively) due to constraints in the supply chain and the assumption that the cost of components will reduce over time as supply chain matures and economies of scale are captured; and
-increase in stranding costs to energy suppliers as more dumb meters need to be replaced before the end of their natural life.

These assumptions update the assumption in the July 2010 IA of 1% higher cost for every percentage point higher the installation rates are above 17%. Sensitivity analysis indicates that moving from the lower to the higher bound could have a negative impact on the Net Present Value (NPV) of the rollout of £200m. However we have not been able to quantify many of the risks outlined above.

5. Foundation Stage

The mass rollout of smart meters will begin when the DCC services become available from the end of Q1 2014. However energy suppliers will have access to compliant meters as bulk supply of compliant equipment is available. This will happen at different times for different suppliers during the period Q2 2012-Q4 2012. From this point in time there are no constraints on availability of trained field staff and safe harbour on communications is offered. Depending on the commercial strategies of different energy suppliers the number of smart meters rolled-out during this period will range between 2.5 and 6.5 million meters (see rollout section).

For these meters, and until the establishment of DCC at the end of Q1 2014, some benefits will only be realised partially and there are likely to be one-off integration costs to DCC once this is put in place. Other costs have also been considered such as increased risk of sub-optimal communications solutions due to lack of coordination and increased operation and maintenance costs for communications as the DCC would need to support multiple communications solutions. There is however uncertainty around the extent and the degree to which these risks would be realised and hence the estimates presented should be treated with caution. The modelling assumptions for this period are:

- A reduction in supplier switching benefits for those smart meters installed prior to DCC being in place (benefits assumed to be £0.8 per meter per annum).
- £30m one-off cost to amend interim arrangements and supplier systems to support technical interoperability.
- £10 per meter one-off costs to novate the interim solution into DCC. This could include upgrading the communications or replacing the WAN component of the meter.
- Capex and opex communications cost optimism bias adjustments were assumed to be 30% of the total cost - rather than 10% - for the foundation stage in the July 2010 IA. The optimism bias for communications OPEX has been reduced to 10% following evidence submitted to the Programme indicating that some suppliers are already achieving costs comparable to the Impact Assessment estimates. Furthermore, interoperability arrangements for the interim are likely to encourage novation and re-use of communications agreements which will have a similar effect. These larger scale providers are also likely to be able to negotiate the best deals in the market. . As this market takes shape, the expectation is that competition will drive the price to this level. After this point both opex and capex are assumed to return to the levels in the DCC solution as we are assuming that the one off integration provides a full DCC solution. There is a risk that the DCC solution may not be the same as the solution that suppliers use pre DCC. In this case, DCC would need to support multiple communications solutions which would have a cost impact. An increased optimism bias of 5% is included to account for this risk.

6. Results

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 2011-2030. The cost numbers are risk-adjusted, i.e. they have been adjusted for optimism bias (see section G on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios. Table 16 shows the impact of smart meters on energy bills of domestic customers[52]. This builds on existing DECC modelling on energy prices to estimate the impact on domestic energy bills in cash terms of the deployment of smart meters.

The period of the analysis has been adjusted to reflect the fact that we are in 2011. The price values are nevertheless still based on a 2009 basis (for example, energy prices are based on 2009 to reflect the latest available price data from the Interdepartmental Analysts Group guidance[53]).

[52] Updated values of the average annual impact per meter are available for the central case in Annex 2
[53] http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx

Table 12: Total costs and benefits[54]

	Total Costs £bn	Total Benefits £bn	Net Present Value £bn
March 2011 IA	10.76	15.83	5.07
July 2010 IA (2010 PV)	10.40	15.57	5.16

Table 13: consumer and supplier benefits[55]

	Consumer Benefits £bn	Business Benefits £bn	UK-wide Benefits £bn	Total Benefits £bn
March 2011 IA	4.63	10.12	1.07	15.83
July 2010 IA (2010 PV)	4.66	9.88	1.03	15.57

Table 14: low, central, and high estimates[56]

	Total Costs £bn	Total Benefits £bn			Net Present Value £bn		
		Low	**Central**	High	Low	**Central**	High
March 2011 IA	10.76	11.47	15.83	20.61	0.83	5.17	9.93
July 2010 IA (2010 PV)	10.40	10.65	15.57	20.37	0.27	5.16	9.94

Table 15: benefits[57]

	Consumer Benefits £bn			Business Benefits £bn			UK-wide Benefits £bn		
	L	**C**	H	L	**C**	H	L	**C**	H
March 2011 IA	2.19	4.63	6.97	8.79	10.12	11.96	0.48	1.07	1.68
July 2010 IA (2010 PV)	2.21	4.66	7.01	7.99	9.88	11.76	0.46	1.03	1.59

Modelling results show that our central estimates for both costs and benefits of the rollout have increased since July 2010. Main areas of increase on the benefits side include costs savings from streamlining customer switching and other industry processes, better management of outages and other network benefits and higher estimates from theft reductions. This increase in total benefits is almost entirely offset by an increase in the cost estimates of IT systems and costs of smart electricity meters, leading to a marginal decrease in NPV of £90m.

Additionally, discounting has also an impact on the overall size of cost and benefit estimates in this IA when compared to the July 2010 IA. Firstly, updating the Present Value year to 2011 leads to less discounting of the costs and benefits incurred in the bulk of the rollout, increasing both present value costs and benefits. Secondly, the opposite effect occurs though the updated central scenario for the rollout profile, which is less front-loaded than the one presented in the July 2010 IA. The latter has

[54] July 2010 estimates have been adjusted to correct a mistake in the discounting formula as discussed in page 20.
[55] idem. The categorisation of benefits has been revised since the July 2010 IA. In order to allow comparability, estimates from the July 2010 IA have been adjusted to the new categorisation.
[56] idem
[57] idem

the opposite effect to the former adjustment, as costs and benefits occur on average later and therefore are subject to greater discounting when presented in present value terms. The updated rollout profile also reduces pavement reading inefficiencies and one-off costs to novate the interim solution to DCC.

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, remains constant at 1.5 in central scenarios, with a value of 1.9 in the high scenario and of 1.1 in the low case scenario.

Finally, it is also important to note the revised impact of the rollout in distributional terms for both consumers through energy bills impacts and suppliers through stranding costs. These are discussed in section 7 below.

7.Distributional impacts

i.Consumer impacts of smart meters

We expect any costs to energy suppliers to be recovered through higher energy prices, although any benefits to suppliers and networks will also be passed on to consumers[58]. The results below show the average impact on GB household energy bills. It is expected there will be variation between households depending on the level of energy they save and on how suppliers decide to pass through the costs.

The results show long term reductions in energy bills for dual fuel customers. By 2020, once the rollout is complete, we expect savings on energy bills for the average dual fuel costumer of £23 per annum.

In the short term, transitional and stranding costs from the rollout will be passed down to consumers, and energy savings will only be realised by those consumers who have already received a smart meter. We estimate that this will result in an average bill increase of £6 by 2015. From 2017 onwards, as most consumers start realising the benefits, and transition and stranding costs decrease, the net impact of smart meters on the average electricity and gas customer will be a reduction in bills. By 2030 we estimate average bill savings will be as large as £42 per household (table 16).

Table 16: Impact on average domestic energy bills for a dual fuel customer

	Residential dual fuel bill impact, £

[58] 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.

2010	**0**
2015	**6**
2020	**-23**
2025	**-33**
2030	**-42**

The price impacts of smart meters in the domestic sector are detailed in Table 17 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 rollout period. Once the mass rollout is complete, cost savings to businesses arising from the rollout are expected to outweigh total costs, resulting in the price impact becoming negative from 2021.

Table 17. Price impacts on domestic energy bills

	Electricity	**Gas**
Year	**price impact (£/MWh) (Inc VAT)**	**price impact (£/MWh) (Inc VAT)**
2010	**0.00**	**0.00**
2011	0.00	0.00
2012	0.01	0.00
2013	0.12	0.03
2014	1.09	0.30
2015	**1.83**	**0.49**
2016	1.95	0.50
2017	1.96	0.50
2018	1.44	0.36
2019	0.56	0.14
2020	**0.21**	**0.05**
2021	-0.16	-0.04
2022	-0.27	-0.06
2023	-0.45	-0.11
2024	-0.54	-0.14
2025	**-0.67**	**-0.17**
2026	-0.80	-0.20
2027	-0.90	-0.24
2028	-1.02	-0.28
2029	-1.16	-0.32
2030	**-1.30**	**-0.37**

The present bill impacts update the estimates presented in the July 2010 IA. The impact on energy bills of the preferred option in such IA was estimated to be of +£9 in 2015 and -£14 in 2020, compared to +£6 and -£23 respectively in the current assessment.

The observed increase in bill savings from the July 2010 IA is partly due the refinement of the assumption on which cost savings are effectively passed down to consumers. The July 2010 IA assumed that only energy supplier cost savings were passed down to consumers. We now also consider that cost (and costs savings) to other agents in the energy market are fully passed down to consumers. This includes networks (losses, better outage management, theft), generation and transmission (load shifting) and other industry parties (customer switching rationalisation). Overall, this refinement results in an increase of the estimated bill savings.

The updated bill impacts also reflect lower net costs being passed down to consumers. This arise as a result of revisions in our estimates for costs and benefits as discussed throughout this IA (see Evidence Base section). A rollout profile less front-loaded than in the July 2010 IA results in lower stranding costs and as a result also leads to lower costs being passed down to consumers.

It is important to note that there may be further impacts on consumer bills for those customers who take advantage of peak/off-peak price differentials offered by smart tariffs and take up time of use tariffs. These distributional impacts have not been included in the calculation above. Analysis by the Brattle Group[59] 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.

ii. Remote switching

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

iii. Stranding costs

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

- meter asset value is based on the replacement cost of a basic meter;

[59] Sustainability First (2010)

- 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.

All the options considered in the IA would involve significant stranding costs. Stranding costs are not reflected in other parts of the analysis because they are considered to be a form of sunk costs i.e. costs already incurred but for the purposes of the analysis it is assumed that the costs of stranding will be passed on to consumers and the cost is therefore reflected in price and bill impacts as in tables 16 and 17 in the above section.

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

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

iv.Costs to businesses and better regulation

As businesses generally consume higher levels of energy than domestic premises, they stand to benefit proportionately more from the implementation of smart meters. The programme has carried out an aggregation exercise to determine the net effect of smart meters on businesses across both the domestic and the non-domestic parts of the policy, establishing that the overall impact on businesses is positive, i.e. benefits outweigh the costs. This approach has been agreed with the Better Regulation Executive. While costs to business total £11.4bn in present value terms, business benefits of £12.4bn result in a net present benefit to businesses of £1bn.

As established in the July 2010 version of this IA, there are no 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 rollout. This methodological approach has previously been agreed with the Better Regulation Executive (BRE).

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.

G. Risks

Costs: Risk Mitigation and Optimism Bias

The rollout 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 needed regarding the treatment of risk to the costs of a GB-wide smart meter rollout. Baringa Partners[60] 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 rollout,
- Assessment of the treatment of risk in the April 08 IA, and
- Make recommendations, in light of the above.

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA. Table 18 reflects the optimism bias factors applied to this IA:

Table 18. Optimism bias factors

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

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[61].

60 Baringa Partners, *Smart Meter Roll Out: Risk and Optimism Bias Project*, 2009
61 http://www.hm-treasury.gov.uk/economic_data_and_tools/greenbook/data_greenbook_supguidance.cfm#optimism

Benefits: sensitivity analysis

Sensitivity analysis has been applied to the main elements of the benefits. We ran the following sensitivities on the benefits:

Table 19: Sensitivity analysis for benefits

	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	2%	3%	4%
Energy savings gas	1%	2%	3%
Energy savings gas PPM	0%	1%	1%
Business benefits			
Supplier benefits			
Avoided site visit	underlying visit cost + 8%	underlying visit cost	underlying visit cost - 8%
Call centre savings	£1.9	£2.2	£2.5
Avoided PPM COS premium	30%	40%	50%
Reduced theft	5%	10%	15%
Network benefits			
Avoided investment from ToU (distribution/transmission)	10%	20%	40%
Reduction in customer minutes lost	2%	5%	10%
Operational savings from fault fixing	3%	5%	10%
Better informed enforcement investment decis	3%	5%	10%
Avoided investigation of voltage complaints	£500	£1,000	£1,493
Reduced outage notification calls	5%	10%	20%
Generation benefits			
Short run marginal cost savings from ToU	10%	20%	40%
Avoided investment from ToU (generation)	10%	20%	40%

Please note that as the avoided site visit category captures various elements with varying underlying costs, the sensitivity is presented as a percentage change from the central scenario.

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 20 presents the results of applying the sensitivity ranges presented in Table 19 to each specific benefit assumption.

Table 20: PV of individual benefit items after sensitivity analysis

£m	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	£1,538	£3,140	£4,618
Energy savings gas	£617	£1,458	£2,319
Business benefits			
Supplier benefits			
Avoided site visit	£2,914	£3,179	£3,443
Call centre savings	£1,087	£1,236	£1,391
Avoided PPM COS premium	£743	£991	£1,239
Reduced theft	£118	£237	£355
Network benefits			
Avoided investment from ToU (distribution/transmission)	£15	£29	£58
Reduction in customer minutes lost	£19	£46	£93
Operational savings from fault fixing	£43	£86	£173
Better informed enforcement investment decis	£58	£115	£230
Avoided investigation of voltage complaints	£22	£43	£64
Reduced outage notification calls	£11	£21	£42
Generation benefits			
Short run marginal cost savings from ToU	£64	£121	£236
Avoided investment from ToU (generation)	£341	£653	£1,277

H.Enforcement

All of the options outlined in this IA would be implemented via licence obligations. New licence requirements would be enforced in the same manner as existing licence obligations – by Ofgem as the gas and electricity markets regulator. Ofgem has power to investigate any company which is found to be breaching the terms of their licence (including any consumer protection provisions) or is found to be acting anti-competitively. The Office of Fair Trading also has a range of other enforcement powers in respect of consumer protection (see the Consumer Protection annex to the Prospectus).

I.Recommendation – Next Steps

Next steps are described in the Government Response document which this IA accompanies.

J.Implementation

The Implementation approach is described in the Government Response document which this IA accompanies.

K.Monitoring and Evaluation

The plan for managing and measuring benefits realisation will be developed alongside the detailed design for the smart meter solution. The objectives set out in section D will form the basis for the benefits realisation work.

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

Results from piloting schemes are also expected to feed into a better monitoring and evaluation of the rollout. This includes both previous pilots such as the EDRP, and piloting carried out during the Foundation stage.

Annexes

Annex 1. Network benefits from improved outage management

Background

This Annex provides detail on analysis of the outage management benefits that have been added to this revision of the smart meter cost benefit analysis. A key aspect of the work was also to determine to what extent any newly identified benefits could be improved through the last gasp functionality.

Whilst the analysis is conclusive with regards to the identification and quantification of additional benefits, it is less conclusive in determining to what extent last gasp can increase the identified benefits.

General assumptions:
We have assumed that in order for the below benefits to be realised, a critical mass of smart meters is required so that sufficient regional coverage is provided to identify location and scope of an outage. The benefits therefore are only considered to be realised from 2018 onwards, at which point over 80% of smart meters will be installed in our central scenario. This will also give network operators sufficient time to adjust their outage management systems to take full advantage of the additional available data.

In addition we assume that for the benefits realisable without last gasp a notification of an outage is provided to network operators to initially raise awareness of an issue. This notification would typically be provided by a customer calling the network operator to notify them of an outage.

Additional benefits identified

The additional benefits for improving network operators' outage management are listed below. These benefits are in general realisable without last gasp:

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.

2. Reduction in operational costs to fix faults:

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

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 also 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.

Overview over outage management benefits and level realisable without last gasp functionality:

Benefit PV, £m, 2010 - 2030	Low scenario value and assumptions	Base scenario value and assumptions	High scenario value and assumptions
Reduced CML	**£23** assumes a reduction in CML of 2.5%	**£46** assumes a reduction in CML of 5%	**£93** assumes a reduction in CML of 10%
Reduction in operational costs of fixing faults	**£43** assumes a reduction in costs of 2.5%	**£86** assumes a reduction in costs of 5%	**£173** assumes a reduction in costs of 10%
Reduction in calls to faults and emergencies lines	**£11** assumes a reduction in calls of 5%	**£21** assumes a reduction in calls of 10%	**£42** assumes a reduction in calls of 20%
TOTAL	**£77**	**£154**	**£308**

Additional benefits and reduced costs realisable from having more advanced outage detection functionality

The objective of the analysis was to inform the decision on whether last gasp should be included in the smart meter technical specification catalogue. This section outlines the considerations that have resulted in the decision to make last gasp a mandatory functionality.

The three benefits constituting the improved outage management will generally be driven by the ability to 'ping'[62] individual meters, thereby gaining additional information about location, scope and nature of an outage once initial notification of an issue has been received. This in turn provides networks with the information and ability to take appropriate steps to resolve the issue and also to provide an automated message informing customers that the network is already aware of problems in certain areas as well as indicating the estimated restoration time.

In the most basic case the 'pinging' is triggered by a customer calling in to report an outage. The electricity network operator would then 'ping' the affected meter as well as other meters in the vicinity to determine the scope of the outage. The customer call reflects the current situation of outage detection and would not result in any incremental costs, except that the 'pinging' itself would cause costs to networks when investigating an issue. However, continuing to rely on customer calls to be made aware of an issue would appear anachronistic in the move to a smart grid and is not in line with the general policy objective of achieving a smart energy network with automation abilities.

[62] Remotely sending a signal to the meter in order to check it is off power.

A more sophisticated approach would be a regular communication with meters to verify their energisation status. This could take one of two shapes:

a) DCC feed: a frequent feed from all meters to the DCC is established, with the DCC flagging all meters off communication to network operators for further investigation (networks could then ‘ping’ those for further analysis)

b) Poll: network operators regularly ‘pinging’ all or a selection of strategic meters to check their energisation status, in order to take further steps if issues are discovered

Depending on the frequency of either option, the detection of outages sooner than under the basic case would be enabled. This in turn would lead to a further decrease of outage durations, with the according increase in the associated benefits as outlined in the overview section of this annex. However, since these two options employ the communications network there would be costs associated with them, either from all meters communicating with the DCC under option a or from networks having to address all or at least a large number of meters under option b. The dependency on a customer calling in to report an outage would fall away though.

Through the provision of the additional technical functionality of last gasp, networks do not have to ‘ping’ meters any longer (as last gasp would provide all the information required for the initial analysis) and also have the ability to detect outages without the need of a customer calling in. Outages will be detected instantaneously, so last gasp is likely to deliver a further increase in benefits when compared to the previous option, although it is not possible to quantify this increase at this stage.

The three possibilities are summarised and compared in the table below:

	Costs	Base scenario benefits	Pros	Cons
Triggered ‘ping’	£0 (there would be a small cost associated with the ‘pinging’ of affected meters, but this is negligible)	£154m	- no incremental costs - least committal, additional functionality could be added at later stage	- no advancement from smart meter technology with regards to outage detection – no smart solution and continued reliance on customer call - discrepancy between desired behaviour change and continued dependency on notification - outages at night times or when customers are not at home will go undetected
Regular communication	£1.2 per meter per year based on a communication frequency of every 30 mins; this translates into a total present value	£154m+	- no additional equipment costs - main costs will be borne by network operators who are main beneficiaries - regular communication might be used for other applications in the future	- most expensive - slower detection of outage than last gasp - further delay because two consecutive error feeds would be required to identify a fault - need for frequent utilisation of

	cost of approximately £320m from 2010 – 2030		- not reliant on customer notification	communications system for message between meters and DCC / networks - need for action from network operators in the form of having to ping meters that are off communication - lack of certainty of outage because continuous monitoring is not supported - local comms issues will be flagged as outage (e.g. faulty SIM card) - comms failure will disable functionality
Last Gasp	£1 per meter one off or approximately £30m PV for first generation of smart meters (there would also be a small cost associated with sending the outage notification by affected meters, but this is negligible)	£154m++	- additional benefits over and beyond base scenario from instantaneous detection of outages - first gasp allows for accurate identification of restoration status - certainty of continuous loss - most sophisticated option of integrating smart meters into outage management systems	- more expensive - reluctance by industry to implement - comms failure will disable functionality

The decision on the preferred technical solution has been taken by weighing up the difference in costs with the advantages and disadvantages of either approach and also taking into consideration the additional benefits realisable with the more sophisticated technical solutions. On balance there is a clear case for inclusion of last gasp functionality as a mandatory technical specification.

With regards to the cost information presented, data received from meter manufacturers indicates that the incremental cost of the last gasp functionality to the price of smart meters could be around £1 per unit, resulting in a present value of costs of about £30m based on the number of electricity smart meters installed by 2020. It is important to note that even though cost information on other technological solutions is not available at this stage, anecdotal evidence indicates that communications based solutions could deliver the same functionality at potentially a lower cost. The decision on the particular technology delivering last gasp functionality will be taken in Phase 2 of the Programme.

For the DCC feed the cost estimate has been based on one communication every 30 minutes, with a data volume of 200 byte per message. This would result in about 3.5Mbyte per meter per year at a present value cost of about £320m up to 2030 based on existing information on communication costs.

Methodology and assumptions

1. Reduction in CML

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 distribution network 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.

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 5% reduction of CML in our base scenario which results in an annual benefit of £0.18per 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) and also takes into account the conservative estimate by ENA (who worked on the assumption of a reduction of 2% based on sample data by one DNO). There are several methodologies available to estimate the value to consumer of quality of supply improvements, however as we are trying to establish the benefits to network operators, this figure seems the most appropriate in this case.

2. Reduction in operational costs to fix faults

DECC has also received information from Ofgem detailing the total costs of resolving low voltage faults to network operators in 2008 / 2009, translating into an approximate cost of £2400 per fault restoration. For this analysis we have assumed that these costs could be lowered by 5% in line with the reduction in CML, based on the rationale that quicker restoration of outages will also result in more efficient utilisation of technical crew. We therefore assume that wages and staff time are the main driver of the costs to fix faults – this approach ignores costs reductions in equipment and material. The benefit to network operators accrues to £0.33 per electricity meter per annum.

3. Reduction in calls

International evidence suggests that the number of calls that have to be answered by networks in regards to 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 and without them calling in to provide notification, enabling very thin network operator call centre operations.

Through Ofgem's telephony incentive DECC has been able to access information on the total annual number and cost of calls to network operators in the UK. For the base scenario we have made a very conservative assumption of a reduction of 10%, which results in annual benefits of £0.08 per electricity meter.

Non-quantified benefits

There are also benefits which are not possible to quantify at this stage, but which will result in operational savings to network operators and a reduction in outage times.

Unquantifiable benefits arise from the ability to check the energisation status of any meter, providing the ability to networks to determine with certainty whether supply to a premise has been restored. Currently not being able to check this might result in the need for repeated visits to an area and additional costs. For example, nested outages may require repeat call outs where a crew resolves an issue at a higher level in the network and returns back to the depot, only to be called out again when a nested outage is identified / reported.

Another area of operational savings to network operators from the ability to check the energisation status arises from the easy identification of complaints about a loss of supply that turn out not be a loss of supply. In many incidents customers might report an outage when in fact there is an issue within their premises rather than with the network (e.g. a blown fuse). By being able to check the energisation level remotely, network operators can avoid unnecessary callouts where customer issues are unrelated to the network.

Annex 2 - Base assumptions and changes made

The table below sets out changes that have been made to the base assumptions on costs and benefits since the July 2010 IA. The basis for the change is also identified.

Costs

Item	Assumptions	Rationale for changes
Supplier IT capex	Supplier IT capex was previously estimated at £45m. This has been revised to £173m.	Outcome of industry wide consultation process and analysis of expected IT costs
DCC IT capex	DCC IT capex was previously estimated at £55m. This has been revised to £190m.	Outcome of industry wide consultation process and analysis of expected IT costs
Industry IT capex	Industry IT capex was previously not specifically identified (grouped in broader IT costs category). This has been estimated at £32m.	Outcome of industry wide consultation process and analysis of expected IT costs
Supplier / Industry IT opex	We assume an industry standard figure of 15% of capex for initial opex for smart metering IT. This is reduced year on year to 5% over the 20 year period.	In line with best practice IT application and infrastructure management where ongoing performance improvement is a key feature of contracts.
DCC opex	We assume an industry standard figure of 15% of capex for initial opex for smart metering IT. This is reduced year on year to 7.5%	In line with best practice IT application and infrastructure management, complemented by analysis of evidence from Electralink and Elexon.
Cost of Meters	Electricity meter costs have increased by £1 per meter	Costs have been increased in order to reflect the added cost of providing “last gasp” functionality.
Legacy Meter Disposal	CBA now only takes into account the acceleration of the disposal over and above the counterfactual.	Meters would have had to be disposed off regardless of the implementation of the smart meters programme.
Pre-DCC optimism bias for comms	Has been reduced from 30% to 10% for the period preceding the establishment of DCC.	Evidence submitted to the Programme indicating that some suppliers are already achieving costs comparable to the Impact Assessment estimates.

Benefits

Item	Assumptions	Rationale for changes
Reduced Theft	The annual value of energy theft, valued at the resource cost of energy, has been increased from the July 2010 IA value.	Detailed analysis carried out by industry over the course of Phase 1 indicates that current levels of theft are higher than previously estimated
Avoided site visits	Benefits per meter per annum have been revised to £6.1, from £6.75 previously. These now also reflect safety inspection visits once smart meters are in place. In addition revised previous assumptions on benefits from avoided special visits for which cost savings are higher than previously assumed.	Based on analysis of consultation responses and industry information.
Customer Switching Benefits	Customer switching benefits have been updated from the July IA from £2 per meter to £1.6, £2.2 or £3.1 depending on the remit assumed for DCC.	Based on evidence from an Information Request.
Load Shifting - Short Run Marginal Cost Savings	Modelling of short run marginal cost savings from load shifting results in a present value of £121m.	Benefits from load shifting have been reassessed and re-categorised since the July 2010 Impact Assessment and are now valued in 3 different areas.
Load Shifting – Capacity Investment Savings	Modelling of future avoided investment in generation, distribution and transmission, which results in a present value of £682m.	Benefits from load shifting have been reassessed and re-categorised since the July 2010 Impact Assessment and are now valued in 3 different areas.
Load Shifting - Carbon Savings	Modelling of lower off-peak carbon intensity, which results in a present value of £47m.	Benefits from load shifting have been reassessed and re-categorised since the July 2010 Impact Assessment and are now valued in 3 different areas.
Better Outage Management - Reduction in Customer Minutes Lost	This is a new benefit for the IA. This benefit has added an additional £46m to the IA	Benefit of 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.
Better Outage Management - Operational savings fault fixing	This is a new benefit for the IA. This benefit has added an additional £86m to the IA	With shorter restoration times technical crew can be utilised more efficiently and with better knowledge of a likely cause of an issue teams can be deployed in a more targeted manner.

Better Outage Management - Reduced calls	This is a new benefit for the IA. This benefit has added an additional £21m to the IA	Customers will be confident that networks are aware of outages due to smart meter information.
Other network benefits - Better investment	This is a new benefit for the IA. This benefit has added an additional £115m to the IA	More detailed information on locational peak demand, bottlenecks in the network can be identified and enforcement investment better directed.
Other network benefits - Voltage complaints	This is a new benefit for the IA. This benefit has added an additional £43m to the IA	Network operators will be able to monitor voltage remotely, removing the need to visit premises to investigate voltage complaints.

Annex 3 – Detailed results

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

Total costs		**10,757**	**Total Benefits**			**15,827**
	Capital	4,005	**Consumer benefits**			4,635
	Installation	1,596			Energy saving	4,598
	O&M	692			Microgeneration	36
	Comms upfront	792	**Business benefits**	Supplier benefits		8,567
	Comms O&M	1,314			Avoided site visits	3,178
	Energy	731			Inbound enquiries	1,053
	Disposal	15			Customer service overheads	183
	Pavement reading inefficiency	238			Debt handling	1,075
	Supplier IT	510			Avoided PPM COS premium	991
	Central IT	362			Remote (dis)connection	244
	Industry IT	154			Reduced theft	237
	Industry Set Up	198			Customer sw itching	1,606
	Marketing	85		Netw ork benefits		780
	Integrate early meters into DCC	65			Reduced losses	438
					Avoided investment from ToU (distribution/transmission)	29
					Reduction in customer minutes lost	46
					Operational savings from fault fixing	86
					Better informed enforcement investment decisions	115
					Avoided investigation of voltage complaints	43
					Reduced outage notification calls	21
NPV		***5,071***		Generation benefits		774
					Short run marginal cost savings from ToU	121
					Avoided investment from ToU (generation)	653
			UK-wide benefits			1,072
					Global CO2 reduction	654
	(Stranding costs	739)			EU ETS from energy reduction	371
					EU ETS from ToU	47

Annex 4: Post Implementation Review (PIR) Plan

Basis of the review: The Department of Energy and Climate Change will ensure that the smart meters 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 rollout – provisionally by 2018. The Secretary of State has powers that are likely to be extended until the end of 2018 for introducing regulatory requirements on suppliers regarding the rollout of smart meters

This process will meet a number of obligations, including Programme Management requirements (as set out in OGC guidance e.g. Managing Successful Programmes), policy commitments set out in the Government Response document, and to ensure evidence is available to help DECC maximise the benefits of the Programme and report on outcomes including Carbon reductions required under the Government's Carbon Plan.

There are planned to be two separate review processes:

1. A review of the rollout strategy to establish whether additional requirements should be placed on suppliers with regard to local coordination (the review of early rollout)

2. A Post Implementation Review (provisionally by 2018)

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

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

Review approach and rationale: The review of early rollout will consider the impacts of installations of smart meters on consumers, in particular in respect of the quality of the customer experience and changes to energy consumption, and the effectiveness of different approaches to rollout (for example the quality of communications and approaches to local coordination and community involvement). Consideration will be given to the impacts on different types of consumer, including the vulnerable.

The PIR will include evaluation of the impacts of smart metering on customer service benefits (e.g. ease of switching, availability and uptake of smart-enabled products and services), on industry costs and process simplification, on competition in relevant markets, including energy management products and services, and of the way that smart metering is enabling and supporting other policies e.g. Smart Grids and the Green Deal, as well as the evaluation of the impacts on energy consumption behaviour and customer experience of the rollout. The PIR has yet to be designed but is likely to draw on evidence from the

Benefits Management Strategy (BMS) work, further research commissioned by DECC, stakeholder interviews and international comparisons.

Baseline: The comparison to be made is with the position prior to rollout. Baseline data will be collected as part of the evaluation plan and BMS work.

Success criteria: Quantitative targets will be set for all relevant benefits, including those described in this IA, as part of the BMS work as a basis for deciding whether the Programme objectives had been achieved.

Monitoring information arrangements:

In the first stage of evaluation planning in 2011, priority needs for information on energy consumption and customer experience impacts to inform the review of early rollout and PIR will be specified against a model of behaviour change which will be developed as part of work on the consumer engagement strategy, and informed by discussions with energy suppliers about information they collect as part of the rollout which have been initiated in phase 1.

This first phase of evaluation planning will focus on selected impacts (outcome and intermediate benefits), in particular energy saving, improved customer service, smoother electricity demand, and customer support for smart metering. This work will also seek to measure synergies with the Green Deal.

Work to develop the requirements for this first stage of evaluation planning is currently in progress and will identify detailed requirements and options for the early rollout review. Measurement of other benefits and costs (e.g. network cost savings and support for smart grids, reduced supplier costs), will be carried out under the Programme Benefits Management Strategy (BMS) which is under development and will track benefits delivery. Benefits metrics for these will be developed as part of the BMS. Given the broad objectives of the Programme, a wide range of information will be required.

Where practicable, information would be collected from suppliers on a voluntary basis. Legislative powers are being taken under the Energy Bill currently before Parliament so that the Department will be able if necessary to require energy suppliers to provide information on matters relating to the rollout of smart meters for this purpose.

Consideration will be given to the potential interfaces between the Smart Meters monitoring and evaluation process and DECC's National Energy Efficiency Data framework.

Specific Impact Tests

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

Specific Impact Tests

1.Competition assessment

Consumers
From a consumer point of view the introduction of smart meters will have an effect on the competitive pressure within energy supply markets – in particular because accurate and reliable data flows facilitate faster switching, encouraging consumers to seek out better deals, thereby driving prices down.

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

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

Great Britain is the geographical market affected by the rollout of smart meters. The products and services affected will be:

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

In competition terms the rollout would therefore affect:

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

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

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

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

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

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

Suppliers would be obliged to use the DCC services, which would mean there would be limited opportunity for suppliers to differentiate through delivery of communications systems.

Centralised communications could lead to improved supplier competition as a result of making switching between suppliers easier. This is because many of the complexities involved in switching involving numerous stages could be stripped away, making the process simpler, shorter and more robust, resulting in a faster and more reliable consumer experience and thereby encouraging more consumers to switch.

Speed of Rollout

One possibility is that smaller energy suppliers might be disadvantaged in a rollout 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 rollout. Similarly, if resources are scarce for all under a rollout (i.e. equipment and installers), small suppliers might feel a greater cost impact than larger suppliers due to the relative size of the increased costs in proportion to the size of the business. However, some of this may be mitigated by the more flexible approach for rollout to be applied to small suppliers.

2.Small Firms

Impacts on small business consumers are considered in the IAs for non-domestic rollouts.

There may be small firms affected by the domestic rollout in the areas of:

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

The competition test (above) notes that smaller energy suppliers might be disadvantaged in a rollout 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 rollout. Similarly, if resources are scarce for all under a rollout (i.e. equipment and installers), small suppliers might feel a greater cost impact than larger suppliers due to the relative size of the increased costs in proportion to the size of the business. However, some of this may be mitigated by the more flexible approach for rollout to be applied to small suppliers.

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

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

3.Legal Aid

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

4.Sustainable Development

An objective of the rollout is to reduce energy usage and consequently achieve carbon emissions.

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

The rollout can also contribute to the enhanced management and exploitation of renewable energy resources, for example by helping to facilitate the introduction of smart demand-side management approaches such as time-of-use (TOU) and dynamic tariffs which enable the more effective exploitation of renewable energy. The proposals would particularly contribute to the need to live within environmental limits, but would also help ensure a strong, healthy and just society (see health IA) and would put sound science in metering and communications technology to practical and responsible use. The proposals would promote sustainable economic development, both in terms of enhancing the strength, and improving the products, of meter and display device manufacturers, and by increasing employment and raising skills levels in the installation and maintenance of meters and communications technologies.

5.Carbon assessment

Following DECC guidance[63], we have carried out cost effectiveness analysis of the options in addressing climate change. The existence of traded (electricity) and non-traded (gas) sources of emissions means that the impact of a tonne of CO_2 abated in the traded sector has a different impact to a tonne of CO_2 abated in the non-traded sector. Reductions in emissions in the traded sector deliver a benefit but do not reduce GHG, whereas reductions in the non-traded sector do actually reduce GHG emissions.

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

We calculate the cost-effectiveness of traded and non-traded CO_2 separately:

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

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

The table below presents the present value of costs and non- CO_2 benefits as well as the tonnes of CO_2 saved in the traded and non-traded sectors, the corresponding cost effectiveness figures and the traded and non-traded cost comparators (TPC and NTPC). The Cost Comparators are the weighted average of the discounted traded and non-traded cost of carbon values in the relevant time period. If the cost per tonne of CO_2 saving of the policy (cost-effectiveness) is higher than the TPC/NTPC the policy is non-cost effective.

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

Table 21: 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
10,757	14,755	17.4	15.6	21.89	-255	41.8	-297

Table 21 shows how the rollout will save over 17 million of tonnes of CO_2 equivalent in the traded sector and 15.5 million tonnes of CO_2 in the non-traded sector over a 20-year period. All options are cost-effective: in both the traded and non-traded sector, the cost per tonne of CO_2 of abating emissions (cost-effectiveness) is lower than the cost comparator for both the traded and non-traded sector.

6.Other Environment

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

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

7.Health

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

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

A small number of responses to the consultation expressed concerns about electromagnetic sensitivity relating to smart meter communications technologies, particularly to wireless technologies. At this stage communications technology solutions have not been selected for the smart metering system. Both wired and wireless technologies exist that could be used and, for practical and technical reasons, both will need to be utilised by installers during the roll-out. However where wireless technologies are used they will have to comply with relevant regulations, best practice and international standards as set out by the International Commission on Non-Ionizing Radiation Protection. Compliance with these standards will be a functional requirement of the smart metering equipment and using smart metering equipment that meets the functional requirements will be a licence obligation.

The programme will continue to engage with the Department of Health and our full range of stakeholders on all relevant practical issues as work progresses on communications for smart metering.

8.Human Rights

The smart meter rollout 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. DECC's view is that any interference would be in the general interest and proportionate to the benefits that this policy would accrue.

Article 8 will be engaged because smart technology is capable of recording greater information about a consumer's energy use in his property than existing dumb meters.

In addition, to roll out smart meters, installers will have to enter consumers' property. As the preparatory work under the smart meter Implementation Programme progresses the Government will need to continue to be satisfied that any interference with privacy is justified, proportionate and necessary, in accordance with Article 8.

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

9.Equality IA (EIA)

Introduction

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

- Disability Equality Duty: designed to eliminate unlawful discrimination and victimisation; eliminate harassment of disabled persons that is related to their disabilities; ensure that public sector organisations promote equality of opportunity between disabled persons and other persons; promote positive attitudes towards disabled persons; encourage participation by disabled persons in public life; and take steps to take account of disabled persons' disabilities, even where that involves treating disabled persons more favourably than other persons;

• Race Equality Duty: designed to eliminate unlawful discrimination and victimisation and to promote equality of opportunity and good relations between persons of different racial groups;

• Gender Equality Duty: designed to eliminate unlawful discrimination, harassment and victimisation and to promote equality of opportunity between women and men.

This EIA:

• describes the background to smart metering policy;

• sets out evidence gathered to date and the potential equality issues identified; and

• describes the mechanisms under which these issues will be dealt with, and/or the measures to deal with them.

Assessing the impact of the policy

The 2008 IA recognised that a domestic rollout 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 duties.

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 by Ofgem to provide input to the Smart Meter Programme, and Ofgem's standing Disability Advisory Group.

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

- physical design and location of the smart meter/visual display and its usability for certain consumers, particularly those with limited mobility, visual impairment and learning disabilities;
- provision of clear information to consumers;
- potential impact on certain vulnerable consumers of smart meter installations, which will require entry to all homes, and the consequent need for appropriate protections;
- potential for the functionality of the metering system to be used in such a way that would be considered unfair or discriminatory (e.g. potential abuse of remote disconnection facilities); and
- potential for consumer confusion or resistance to change from some vulnerable groups and individuals as a result of the greater range of energy tariffs and energy-related information that will be available as a result of smart metering.

In respect of the duties, and of those they are designed to protect and assist, the evidence collected to date indicates that the policy would principally engage the

Disability Equality Duty. The policy's greatest potential impact would be upon the visually impaired, those with movement or dexterity issues, the elderly, those suffering from learning disabilities or from mental health conditions. 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; and
- consumers are well-informed both before and after installation.

The policy's potential impacts will arise once meters complying with a finalised technical specification begin to be rolled out. We expect this to be from late-2012 onwards, initially in relatively small numbers. The impacts in terms of risks in relation to installation and information around the installation will be the subject of further consideration, work and regulation in Phase 2 of the Programme, which begins in April 2011. Initiatives and measures, including specific regulatory requirements, proposed during Phase 2 would be subject both to prior discussion with interested parties, including consumer representatives, and, where appropriate, formal consultation.

Some suppliers are already providing smart meters at their own commercial risk before finalisation of a technical specification and the introduction of a Government mandate. Under its existing powers, rather than the legal powers enabling the Government to put in place a smart metering programme, Ofgem has proposed a "Spring Package"[64] of measures to deal with any problems for customers that could arise from the activities of these "early movers". In particular, it has proposed additional safeguards in cases where supply might remotely be disconnected and where a customer might be remotely switched from credit to prepayment, and rules to ensure that customers with early smart meters can still switch supplier. Ofgem will also continue to monitor the market in the area of the tariff confusion that could arise from the introduction of new and more complex tariffs, including time-of-use tariffs. The proposals in the "Spring Package" are designed, as far as possible, to be applicable once a mandated rollout begins, but they do not preclude the introduction of further protections by the Smart Meter Programme.

Legal and regulatory responsibilities

Suppliers will be responsible for purchasing and installing both the smart meter and the in-home display (see below). Overarching responsibility for dealing with domestic consumer meter issues already rests with suppliers, and various legislation and regulation touches on them in areas covered by the duties. The Disability Discrimination Act (DDA) requires them to provide an 'equivalent service' for those covered by the Act. Electricity and gas Supply Licence Conditions 26.2 and 26.3 further require the supplier to provide free information that enables visually impaired and hearing-impaired customers to ask or complain about any bill or statement of account or any other service provided to that consumer by the licensee.

Analysis

The remainder of this assessment examines the three broad areas identified above as potentially impinging on those covered by the duties.

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

A. Providing information from a smart meter

Providing clear and simple information to a range of consumers is key to 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 will customarily be delivered through a free-standing, in-home display (IHD) linked to the smart meter. The IHD must, therefore, be usable by everyone (unless the customer actively chooses to receive information by other means). The evidence suggests that 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 rollout 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.

Responses to the consultation showed no strong support for introducing a licence obligation to provide appropriately designed IHDs. Suppliers and manufacturers considered that Standard Licence Condition 26 and the Equality Act 2010 were sufficient to ensure that IHDs were accessible to all. However, other respondents felt that the market could be slow to meet the needs of vulnerable and disabled consumers if there were no mandate, and 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 Programme also made two Requests for Information (RFIs) in respect of areas covered by the duties. Both the Accessibility and Welsh language RFIs elicited a small number of responses on costs and benefits.   In light of these responses and other information, the Programme has concluded that best practice guidelines should be developed for accessibility, and that suppliers should have due regard to inclusivity by design principles. In respect of Welsh, the Programme has not received evidence to suggest that mandating Welsh language for IHDs would add significant cost. Indeed, some responses suggested that it was to be easy and inexpensive to provide for other languages, including Welsh, using solutions such as icons or software. The Programme is also aware that legislation extending the coverage of Welsh language obligations to suppliers is currently before the Welsh Assembly.

In summary, in areas touching on the duties, the Programme has concluded that:

- there will be no functional requirement for IHD portability, but a requirement to support mains power operation will remain;
- the requirement for the display of some form of non-numerical feedback will remain as a minimum functionality requirement and will be reflected in the detailed technical specification to be finalised at the beginning of Phase 2;
- suppliers must have due regard to "inclusivity by design" principles, and the Programme will oversee their approach to this;
- suppliers must provide Welsh language IHD messages where requested. This will be covered by general licence obligations on suppliers.

Information associated with a smart meter will not only be provided via the IHD, and will not simply consist of price or usage information. It is likely that, subject to appropriate privacy rules, suppliers and third parties will wish to offer services based on analysis of information collected by the meter, and to provide that analysis to consumers to help them manage energy use or to sell the goods and services. Some of this may be done via the IHD, but may also utilise other means (e-mail, traditional mail etc). Again, existing legislation and regulation will continue to apply, but, as part of the forthcoming work on customer engagement, consideration will be required as to whether updated or revised rules are required as a result of the rollout of smart meters.

B. Smart meter installation: protecting customers

The smart meter rollout will require a visit to every home in Great Britain to install the meter and any supporting infrastructure. This process raises a variety of issues for all consumers. 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 rollout.

Protections are already in place. 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. In reality 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, and in relation to providing appropriate IHDs, 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 or other on the back of the rollout.

C. Smart metering rollout: informing and supporting customers

A key element of the development and implementation work preceding the mandated rollout of smart meters will be to ensure that consumers' experience of the rollout and of smart metering in the long-term is positive. One aspect of that work will be to ensure appropriate protections are in place to safeguard consumers especially the vulnerable. The interests of all consumers, including the vulnerable, will be protected by an Installation Code of Practice, including rules on sales and marketing activities around the installation visit. Accession to this Code, which is currently being developed by suppliers in consultation with interested parties, including consumer groups, will be a licence requirement, and the Code itself, and any subsequent changes to it, will have to be approved by Ofgem. Phase 2 of the Programme will allow any further changes to the existing regulatory and consumer protection regimes to be considered and put in place.

The other key element will be active work by the Programme to promote customer awareness of smart metering and engagement with the technology. The Programme is committed, as part of Phase 2, to developing a customer engagement strategy. This might involve such activities as developing national and local awareness-raising activities and investigating the scope for, and design of, support schemes for vulnerable customers (such as assistance for those who have difficulty in understanding and using the meter and display and including the disabled and the elderly) around the smart meter installation. In this respect, the Programme has already taken advice from those involved with the most recent large-scale rollout programme, the Digital Switchover.

The Equality Impact Assessment has been reviewed and agreed by DECC's Disability Advisory Group.

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, 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 will vary according to the mode of operation (i.e. prepayment 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. Where suppliers offer innovative tariffs, such as those based on time of use, they will need 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, prepayment or smart meter.

The Programme has taken a rigorous and systematic approach to assessing and managing the important issue of data privacy. It is intended to build on safeguards already in place, notably in the DPA, to develop a privacy policy framework for smart metering data.

The Programme has listened to the views of a broad range of stakeholders on this key issue. In the Prospectus we committed to ‘privacy by design’, so that privacy issues are considered before and while the smart metering system is designed, rather than afterwards.

We also proposed the principle that consumers should have a choice as to how their data is used and by whom ,except where it required to fulfil regulated duties. This reflects the important principle that data control rests with the consumer, while recognising that there are a range of instances when there will be a legitimate need to access that data, for example by energy suppliers for billing purposes.

We have undertaken a series of workshops to establish the different data requirements of industry participants and whether data collected needs to be personal or aggregated, and the level of detail that is required. Our views on the scope of regulated duties and on data for purposes that are not regulated are set out in the ‘Data Privacy and Security’ Annex to the main Prospectus Response Document

To protect the privacy of data, it is imperative that the smart metering system is secure. Building on best practice we have looked at the privacy and security issues across the end-to-end smart metering system, undertaking an initial risk assessment which will be further developed as the Programme progresses. A set of security requirements for how these risks should be addressed will be produced which will inform development of the technical specifications that the industry will be required to adopt.

To support our work in this area, we have held discussions with stakeholders and have established a Privacy Advisory Group (PAG), which includes the Information Commissioner's Office (ICO) and more recently has been expanded to include representatives of consumer groups and suppliers, to provide expert advice to the Programme. We will continue to expand and deepen our engagement with stakeholders on these issues.

The Programme will undertake more work in the next phase to inform the development of a privacy policy framework. The Programme will continue to work with the expanded PAG and other stakeholders to help us reach a final decision on these issues.

Data privacy and security issues are also discussed more fully in the 'Data Privacy and Security' Annex to the main Prospectus Response Document.

11.Rural proofing

Smart meters will address the problems attached to "difficult to read" meters, which may at present lead to those in rural areas receiving fewer actual meter readings and estimated bills. The scope for introducing different payment methods for smart prepayment meters would assist those in rural areas who find key-charging or token purchase difficult. The opportunity, through smart meters, to provide more targeted and tailored energy efficiency advice would also assist those in rural areas, including those in "hard to reach" dwellings.