Department for
Business, Energy
& Industrial Strategy

SMART METER ROLL-OUT COST-BENEFIT ANALYSIS

Part I

August 2016

Note on structure

This is the first part of a two part publication. Part I provides a summary of the changes to evidence and methodology since the 2014 Impact Assessment (IA), and the effect these changes have on the costs and benefits of the smart meter roll-out. Part II provides more detail in a technical annex of the evidence base on which the assessment is now based for both the domestic and non-domestic sector. It also includes information on monitoring and evaluation, and specific impact tests.

Title: Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB)	Updated cost-benefit analysis (CBA)[1]
	Stage: Final (updated)
Lead department or agency: BEIS	**Source of intervention:** Domestic
	Type of measure: Secondary legislation
Other departments or agencies:	**Contact for enquiries:** smartmetering@beis.gov.uk

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year**	**In scope of One-In, One-Out?**	**Measure qualifies as**
£5,746m	£724m	As per 2014 IA[2]	Yes	In

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

Lack of accurate, timely information on energy use: a) may prevent customers from reducing consumption and therefore bills and CO_2 emissions and; b) increases suppliers' accounts management and switching costs. Better information on patterns of use across networks will aid network planning and development, including future smart energy systems. In Great Britain (GB), the provision of energy meters to consumers is the responsibility of energy retail suppliers, who would be unlikely to deploy smart meters in a way that delivered early benefits or increased competition in the absence of government intervention.

What are the policy objectives and the intended effects?

To roll-out smart metering to GB residential and small and medium sized non-domestic gas and electricity customers in a cost-effective way, optimising the benefits to consumers, energy suppliers, network operators and other energy market participants and delivering environmental and other policy goals.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

This policy focuses on the mandated replacement of approximately 53 million residential and non-domestic gas and electricity meters in GB through a supplier-led roll-out with a centralised data and communications company providing interoperability. The March 2011 IA set out Government's overall approach and timeline for achieving this objective. Subsequent updates in 2013 and 2014 reflected the most recent evidence base following the introduction of the first tranches of smart metering regulations. This update reflects developments in the delivery of the roll-out since 2014 and new evidence that has come to light, including data from early smart meter deployment.

Will the policy be reviewed? It will be reviewed **If applicable, set review date:** After completion of the roll-out

Does implementation go beyond minimum EU requirements?			**Yes**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** Yes	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** -10.02	**Non-traded:** -19.65	

I have read the updated cost-benefit analysis and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

[1] Although this cost-benefit analysis is not an IA, it has been presented in the IA template to enable comparison with previous assessments published by DECC on the smart meter roll-out.
[2] This assessment reflects an update of the smart meter evidence base rather than a change to existing policy. As such metrics relevant for the OIOO accounting system as reflected in the 2014 IA remain unchanged.

Summary: Analysis & Evidence

Policy Option 1

Description: This assessment reflects a supplier led roll-out of smart meters with a centralised Data and Communications Company (DCC).

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2016	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: 1,260	High: 10,589	**Best Estimate: 5,746**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	NA		NA	**NA**
High	NA		NA	**NA**
Best Estimate	717		721	**10,981**

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

Meters, their installation and operation, and the In-Home Displays (IHDs) amount to £5.44bn. DCC related costs, including communications hubs provision, amount to £3.13bn. Energy suppliers' and other industry's IT systems costs amount to £1.00bn. Industry governance, organisational and administration costs, energy, pavement reading inefficiency and other costs amount to £1.42bn.

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

NA

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	0		898	**12,218**
High	0		1,589	**21,593**
Best Estimate	0		1,230	**16,726**

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

Total consumer benefits amount to £5.30bn and include savings from reduced energy consumption (£5.24bn), and avoided costs of microgeneration metering (£57m). Total supplier benefits amount to £8.25bn, composed of avoided site visits (£2.99bn), and reduced inquiries and customer overheads (£1.21bn). Total network-related benefits amount to £839m and generation benefits to £943m. Carbon related benefits amount to £1.29bn. Air quality improvements amount to £98m.

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

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

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

Cost assumptions are adjusted for risk optimism bias where appropriate, and benefits are presented for the central scenario unless stated otherwise. Sensitivity analysis has been applied to the benefits as energy savings depend on consumers' behavioural response to information which could affect the benefits substantially. The numbers presented are based on the modelling assumption that the scope of the DCC will include data aggregation in the long term.

Annual profile of monetised costs and benefits (undiscounted)*

£m	2013	2014	2015	2016	2017	2018
Total annual costs	121	110	267	444	594	881
Total annual benefits	55	67	97	163	342	723

£m	2019	2020	2021	2022	2023	2024
Total annual costs	1,120	1,153	1,022	987	983	950
Total annual benefits	1,162	1,430	1,539	1,675	1,699	1,769

£m	2025	2026	2027	2028	2029	2030
Total annual costs	950	950	951	757	721	740
Total annual benefits	1,839	1,886	1,899	1,897	1,931	1,971

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

Emission savings by carbon budget period ($MtCO_2e$)

Sector		Emission Changes* ($MtCO_2e$) - By Budget Period		
		CB II; 2013-2017	CB III; 2018-2022	CB IV; 2023-2027
Power sector	Traded	0	0	0
	Non-traded	0	0	0
Transport	Traded	0	0	0
	Non-traded	0	0	0
Workplaces & Industry	Traded	0.31	0.85	0.72
	Non-traded	0.82	2.62	2.89
Homes	Traded	0.29	3.04	3.13
	Non-traded	0.41	3.74	4.65
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	0.61	3.89	3.85
	Non-traded	1.22	6.36	7.54
Cost effectiveness	% of lifetime emissions below traded cost comparator	100%		
	% of lifetime emissions below non-traded cost comparator	100%		

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Glossary of Terms

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

Section A: Introduction and New Analysis

1 Introduction

1.1 Background and Strategic Overview

The Government is committed to ensuring that every home and small business in the country is offered a smart meter by 2020, delivered as cost effectively as possible[3] and this is a key priority for the Department for Business, Energy & Industrial Strategy (BEIS)..

- Smart meters will contribute to the UK having a secure and resilient energy system, by being a catalyst for system flexibility on the demand side. This can play an important role in improving energy security in the future and in integrating renewable energy sources into the system.
- By providing near real-time information on cost and usage, smart metering will encourage consumers to reduce their demand, directly contributing to lower energy bills, energy system resilience, and carbon emission reductions. Smart metering will result in more engaged and active energy consumers and enable faster switching. This will in turn lead to a more dynamic and competitive retail energy market. Smart meters will also enable more efficient operations for both energy suppliers and network operators, unlocking savings that will translate into lower bills for households and businesses.
- Smart metering lays the foundation for a range of innovative energy services, which will further enhance consumer choice and control.

This assessment considers the deployment of smart electricity and gas meters in domestic premises and in smaller and medium-sized non-domestic premises in Great Britain. In the wider non-domestic market, energy suppliers are already required to ensure that energy supplied to larger electricity sites (defined as those within profile classes 5-8[4]) and larger gas sites (defined as those with consumption above 732MWh per annum) is measured by an advanced meter. The analysis presented in this document focuses on the remaining, smaller sites – those in electricity profile classes 3 and 4, and those with gas consumption below 732MWh per annum.

Key features of the roll-out include the following:

- Energy suppliers are responsible for the provision and installation of smart meters and are required under conditions in their licences to take all reasonable steps to complete the roll-out by 31 December 2020.
- In-Home Displays must be offered to domestic consumers.
- Metering equipment must comply with Smart Meter Equipment Technical Specifications (SMETS) extant at the time to ensure common minimum functionality and support interoperability.

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[3] Conservative Party, *'Strong leadership, a clear economic plan, a brighter, more secure future'*, 2015.

[4] For settlement purposes Elexon groups electricity consumers into profile classes, according to their total demand and consumption profile.

- A Data and Communications Company (DCC) provides the shared communications platform for the secure transmission of smart meter data and messages. The DCC is a licenced body regulated by Ofgem. A licence was awarded to Capita Ltd in September 2013 to run the DCC. It subsequently signed four contracts to establish and operate the data and communications services provided by the DCC.

The Government's policy design and implementation work has progressed through various stages. The initial policy design stage concluded in March 2011 with the publication of the Government's Response to the Smart Meter Prospectus confirming the approach chosen for the delivery of smart meters[5]. This marked the beginning of the next stage of the Smart Metering Implementation Programme (SMIP) – the Foundation Stage.

The objective of the Foundation Stage was to ensure consumer and industry readiness for the main installation stage, including the establishment of the necessary regulatory and commercial frameworks. This stage included work to establish the DCC and to put in place the new industry Smart Energy Code (SEC) that established a contractual framework, backed up by regulations, between the DCC and its users. In September 2013 the Secretary of State of Energy and Climate Change designated the initial provisions of the SEC.

In May 2013 DECC published a revised timetable under which suppliers are required to take all reasonable steps to complete their roll-outs by the end of 2020. These developments were reflected in the Impact Assessment published in January 2014[6].

Since the 2014 IA, the Programme has moved from design to delivery. This means that it is now possible to further refine cost and benefit assumptions, and in some cases to replace assumptions with actual data. With over 3 million smart and advanced meters operating under the Programme as of March 2016 and the national communication and data infrastructure shortly to begin operating, it is an opportune time to update the cost-benefit analysis, which captures the business case for the Programme.

In line with Her Majesty's Treasury (HMT) Green Book guidance[7], we are taking a prudent approach to cost and benefit quantification. As a result, we have not reflected all potential cost efficiencies nor quantified all likely benefits we could expect to arise across the smart metering system over time. Inevitably, the analysis presents a snapshot of suppliers' operational experience at this point in time, and does not reflect likely market innovation. However, the revised assumptions and move to actual data in some cases means that the CBA estimates now carry a higher degree of certainty than in the 2014 IA.

1.2 Rationale for Government intervention

Traditional metering allows for a simple record of energy consumption to be collected, mainly by manually reading the meter (i.e. by a meter operative visiting the site or consumers sending in meter readings). Whilst this allows for energy bills to be issued, there is limited opportunity for consumers or suppliers to use this information to manage energy consumption proactively. Often suppliers only know how much energy a household has actually consumed after a quarterly (or even less frequent) meter read and consumers are

[5] DECC, *Smart Metering Implementation: Response to Prospectus: Overview Document*, 2011.
[6] DECC, *Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB): Impact Assessment, 2014, available at*: https://www.gov.uk/government/publications/smart-meter-roll-out-for-the-domestic-and-small-and-medium-non-domestic-sectors-gb-impact-assessment
[7] HM Treasury, *The Green Book - Appraisal and Evaluation in Central Government*, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf.

generally only aware of consumption on a quarterly, historic basis unless they take proactive steps to monitor the readings on their meters. Consumers and suppliers in Great Britain's small and medium non-domestic energy market face a similar paucity of accurate consumption data.

In addition, without frequent meter reads bills will be based on estimates made by the supplier. Inaccurate data and billing create significant costs for suppliers and consumers, causing disputes over bills (complaints) and problems with the change of supplier process, thereby potentially hindering competition and hampering the overall customer experience.

As part of the roll-out, domestic customers will be offered an In-Home Display (IHD) enabling them to see, in near real-time, what energy they are using and how much it is costing – in pounds and pence. This will put them in control, avoiding wasting energy and money, and support a broader change in behaviour in the use of energy. A reduction in energy consumption will also result in a reduction in carbon emissions, leading to lower costs to society from greenhouse gas emissions.

Smart meters will enable more efficient collection of billing information and identification of meter faults by communicating directly to energy suppliers and others via the DCC. Information from the meter, subject to appropriate data, privacy and access control arrangements, will also enable more sophisticated tariff structures and energy demand management approaches. Smart metering is an enabling technology that will help to address a number of challenges in the move towards smart energy systems and a smart grid.

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

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

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

Given the information asymmetry, existence of externalities, dispersed investment incentives and interoperability issues that would result from not having a mandated roll-out, Government intervention is required to deliver a universal roll-out of smart meters that unlocks the full societal benefits.

1.3 Policy objectives

The objectives of the smart metering Programme set out in the business case are:

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

1.4 The Economic Case for Smart Metering

The cost-benefit analysis of a mandated roll-out of smart meters has been carried out and further developed since 2008. The analysis and evidence base have been re-assessed and updated before each key Programme decision point. Costs and benefits have been quantified by collecting information from key stakeholders including industry, consumer groups and academia. The assumptions have been consulted on and have been benchmarked against international evidence as well as scrutinised by energy industry specialists.

The analytical work has been supported by cost-benefit modelling and analysis from a range of sources, including Mott Macdonald, Baringa Partners, Redpoint Consulting and PA Consulting Group, and has been presented in a series of publications since 2008.

This 2016 cost-benefit analysis reflects the latest available evidence, including further revisions to the smart meter delivery timetable.

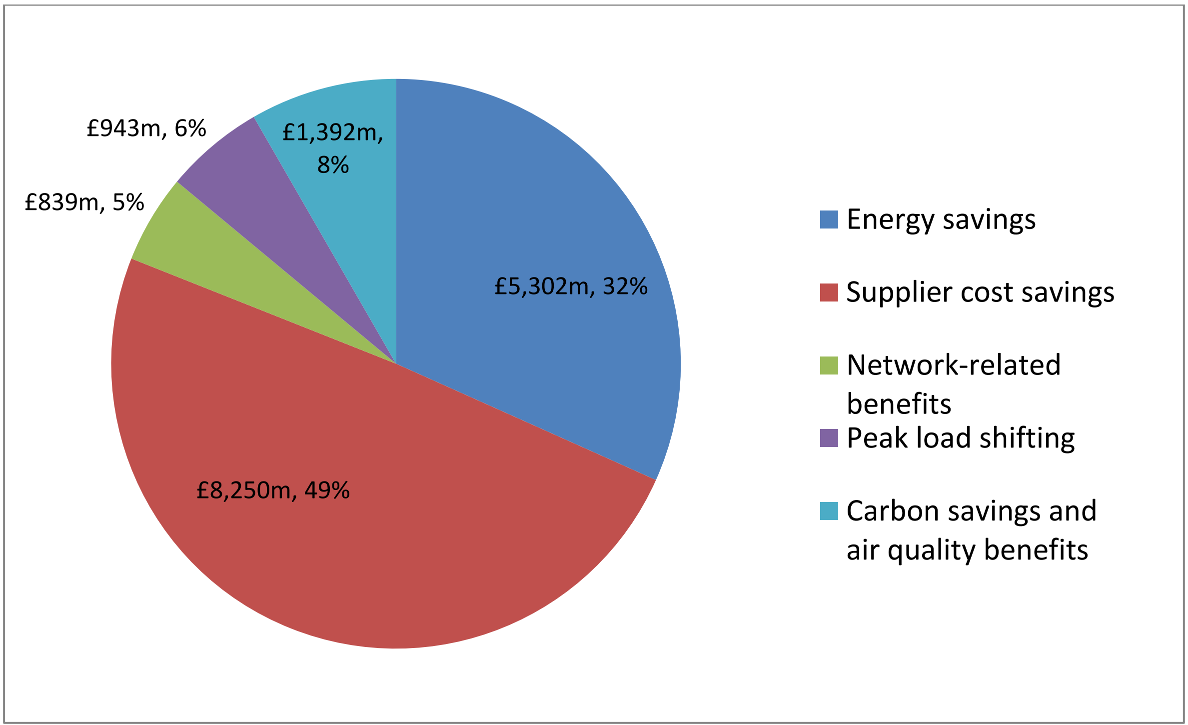
1.4.1 Benefits

With near real-time information on energy use and costs, consumers are expected to make energy savings through enhanced energy efficiency behaviour. This reduction in energy use also brings with it a reduction of carbon emissions.

In parallel, smart meters will allow suppliers to make a range of operational cost savings. They remove the need for site visits to complete meter reads and are expected to reduce suppliers' call centre traffic, with fewer queries about estimated bills. In addition, smart meters are expected to make the consumer switching process cheaper and simpler, thanks to accurate billing and more streamlined interaction between involved parties through on-demand meter readings at the point of switching and consolidated data bases. Suppliers should see improved theft detection and debt management; and consumers will also be able to avoid proactively the accumulation of debt, through access to and consideration of accurate, near real-time energy information.

Network operators will be able to improve electricity outage management and resolve any network failures more efficiently once a critical mass of smart meters has been rolled out; and they will be able to realise further savings from more targeted and informed investment decisions. By enabling time of use (TOU) tariffs which tend to shift a proportion of electricity generation to cheaper off-peak times, smart meters are also expected to generate savings both in terms of distribution as well as generation capacity investment. The analysis continues to only quantify benefits from load shifting as a result of static TOU tariffs, but there is significant additional potential from dynamic TOU tariffs and other more sophisticated demand side response (DSR) measures, for which the presence of smart meters is an important enabler.

Figure 1-1: High level overview of PV benefits[8]

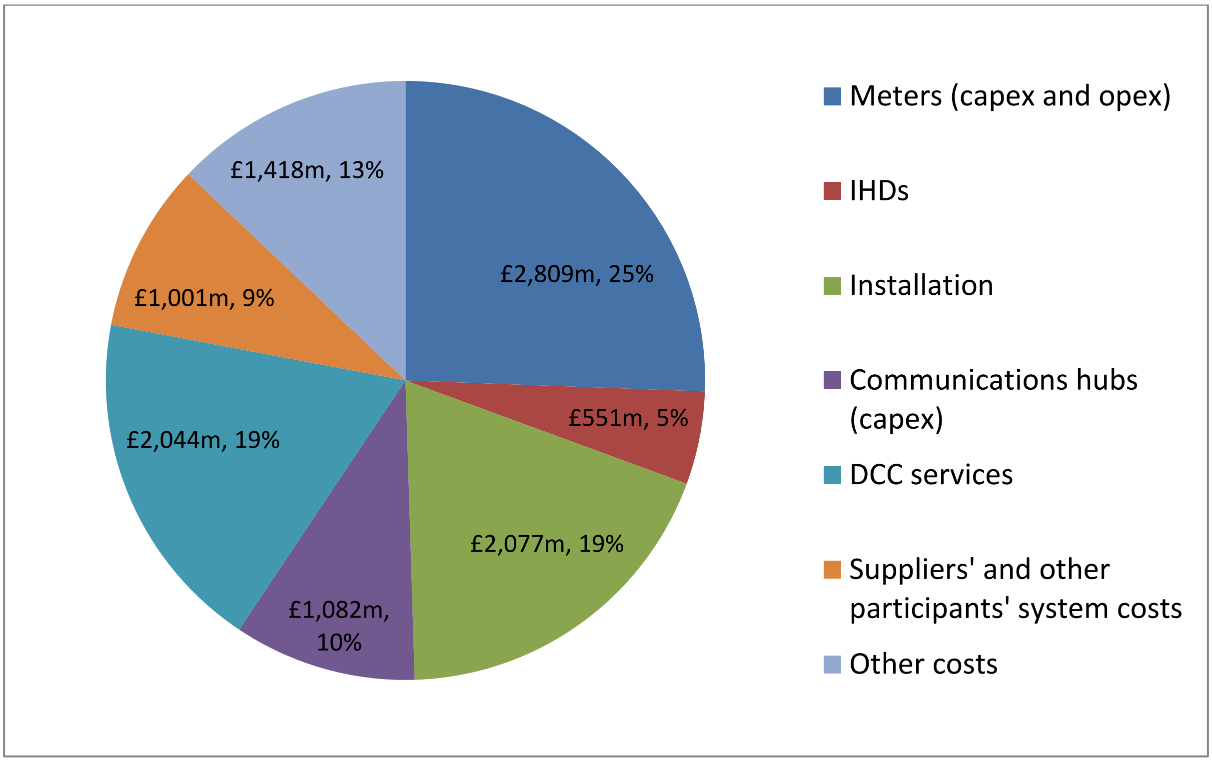


1.4.2 Costs

Energy suppliers will be required to fund the capital costs of smart meters and IHDs. They will also pay for the installation, operation and maintenance of this equipment plus the communications hub (which links the smart meters to the supplier via the DCC). The roll-out of smart meters also requires upfront investment by energy suppliers in supporting IT systems and the DCC, as well as their ongoing operation. Other industry participants such as distribution network operators (DNOs) will also need to upgrade their systems in order to integrate into the smart meter network. Further costs include the accelerated disposal of basic meters being replaced, the energy consumed by the smart meter equipment itself and the launch and support of a consumer engagement strategy. The analysis also considers the increasingly inefficient reading of dumb meters due to lower densities as the roll-out progresses which is referred to in this document as 'pavement reading inefficiency'.

[8] For consistency with previous IAs we maintain the categorisation previously used. It is important to note that within the network-related benefits category some benefits do not accrue to network operators.

Figure 1-2: High level overview of PV costs



1.4.3 Economic impact

With total expected present value (PV) costs of £10.6bn and total PV benefits of £14.3bn up to 2030, the net present value (NPV) for the domestic roll-out of smart meters in GB is now estimated to be £3.8bn. Non-domestic gross benefits amount to approximately £2.4bn, with gross costs of about £0.4bn and a resulting net present value of approximately £2.0bn. Across both domestic and non-domestic sectors the expected net benefit is £5.7bn. As a result of consumers using energy more efficiently and suppliers passing through net cost savings, the roll-out is expected to reduce the combined electricity and gas bill for the average household by £11 in 2020 and by £47 in 2030. The average dual-fuel non-domestic premise is expected to realise bill savings of approximately £128 in 2020 and £147 in 2030 (both undiscounted and in 2012 prices).

1.5 Scope and structure of this assessment

The substantive costs and benefits of the Government's policy on smart meters have been appraised ex ante in IAs published and updated since 2008. This updated CBA is expected to be the last ex ante appraisal, reflecting that the programme is now in its implementation phase, and recognising that this CBA already straddles ex ante policy appraisal and ex post policy evaluation, as some real world evidence based on early smart meter installations has been incorporated into the assessment. Monitoring the number of smart meter installations and evaluating the results and experience of an operational smart meter system will improve the evidence base going forward and will feed into BEIS's evaluation activities.

This assessment reflects an estimate of the overall economic impact from the roll-out of smart meters, based on the latest evidence available. This includes up to date information on equipment and organisational costs, implementation timelines, exogenous assumptions, benefits to distribution network operators and general developments of the retail energy market since the 2014 IA.

2 New analysis

2.1 Context

BEIS is committed to updating the evidence base for the smart meter roll-out to reflect the Programme's progress. This assessment reflects the latest available information with regards to the expected impacts from the smart meter roll-out, ahead of the Data and Communications Company (DCC) commencing its service operation and in light of real-world evidence from a number of suppliers' Foundation Stage smart meter roll-out activity to date and commercial commitments for the main installation stage.

2.2 Overall change in net present value

The updated overall Net Present Value (NPV) of the smart meter roll-out across GB's domestic and smaller and medium-sized non-domestic sectors is expected to be £5.75bn, with underlying gross present value costs of £10.98bn and gross present value benefits of £16.72bn. The appraisal period covers the years 2013 to 2030, prices are expressed in 2011 price base year terms and present values are discounted to 2016 as the base year.

Table 2-1 below compares the high level figures from this assessment with the numbers from the 2014 IA.

Table 2-1: Comparison of overall costs and benefits in the 2016 CBA and 2014 IA

	NPV	Cost	Benefit
2014 IA	£6.21bn	£10.93bn	£17.14bn
2016 CBA	£5.75bn	£10.98bn	£16.72bn

Gross costs have increased by around £54m over the appraisal period, while gross benefits have reduced by around £415m. In net terms this results in an NPV that is £469m below the estimate in the 2014 IA.

It is worth noting that updates to a number of exogenous assumptions (for example significantly reduced fossil fuel and energy price projections) have had a significant impact on the overall figures.
Table 2-2 below shows the impact on gross costs and benefits and the NPV of the various changes that have been applied to the cost-benefit analysis feeding into this assessment. The changes are discussed in more detail in the remainder of this chapter.

Table 2-2: Overview of changes to analysis since 2014 IA

Section	**NPV (£m)**	NPV change (£m)	PV Cost change (£m)	PV Benefit change (£m)
Starting point (2014 IA)	**6,214**	**n/a**	**n/a**	**n/a**
Methodological updates	**6,810**	595	1,151	1,746
Changes to exogenous assumptions	**6,291**	-519	-100	-619
Cost update for the DCC, its service providers, and other mandated organisations (excluding Smart Energy GB)	**5,913**	-378	378	0
Cost update for Smart Energy GB	**5,818**	-95	95	0
Updated roll-out profiles and timing assumptions	**4,805**	-1,013	-534	-1,548
Updated installation and equipment cost assumptions	**5,846**	1,041	-1,019	22
DCC adaptor service costs for smaller suppliers	**5,708**	-138	138	0
Updated assumptions about Home Area Network solutions and costs	**5,523**	-185	186	1
Update of advanced meter volume and cost assumptions	**5,483**	-40	64	25
Revision of network-related benefits	**5,338**	-145	0	-145
Updated assumptions about IHD costs	**5,646**	308	-308	0
Time-of-use assumption changes	**5,749**	103	0	103
SMIP Programme spend update	**5,746**	-4	4	0
2016 CBA vs 2014 IA:		-469	54	-415

2.3 Methodological updates

2.3.1 *Present value base year*

In line with HMT Green Book guidance, cost and benefits over the appraisal period have been discounted at a rate of 3.5% per year to calculate the present value (PV) of costs and benefits. This rate reflects social time preference - the extent to which society values costs and benefits that occur closer to the present than to those that arise further in the future.

The January 2014 IA used 2013 as the PV base year. For this assessment, the base year has been updated to 2016[9]. This is in line with appraisal guidance that is published by the Better Regulation Executive[10], which states that the PV base year should reflect the year in which cost and benefit estimates have been made. With this change in base year, the net benefits from the smart meter roll-out in the future (which peak once the roll-out is completed) are now less distant in time than was the case in 2014, therefore the net benefits are less discounted for the social time preference. The change in the PV base year results in an increase in the NPV of £595m.

[9] Costs incurred and benefits realised between 2013 and 2016 are still taken into account.
[10] Better Regulation Executive, *Better Regulation Framework Manual*, March 2015, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/468831/bis-13-1038-Better-regulation-framework-manual.pdf.

2.4 Changes to exogenous assumptions

In keeping to standard practice on using HMT Green Book guidance, the assessment incorporates the latest available projections on household growth, energy consumption and updated guidance on energy prices, carbon values and emission factors.

Since the publication of the 2014 IA, a number of updates to these projections have been published. In November 2015, DECC published its latest Energy and Emissions Projections, which included updated figures on household growth and energy consumption[11]. In December 2015, the latest version of the supplementary Green Book guidance on energy use and emissions was published, which included updated energy prices, carbon values and emissions factors[12]. These revised projections have been incorporated into this assessment.

Specific impacts of the changes to these projections on costs or benefits of smart meters can be grouped as follows:

- Updated values for carbon emission factors, carbon prices and long-term variable costs result in a fall in the NPV of £759m by reducing the expected value of carbon emission reductions and energy savings respectively.
- An increase in the number of electricity and gas meters based on the latest data available from sub-national electricity and gas consumption statistics results in a £138m increase in the NPV. However, this is counteracted by a reduction in the latest projections of household energy consumption, which reduce the NPV by £206m. In combination, this results in a reduction of the NPV by £69m.
- In recent years inflation has been lower than expected which results in an increase in NPV of £120m by reducing the amount that the value of energy savings is deflated by when converting it into 2011 prices.
- Changes in the projected cost of traded carbon, amount of carbon produced per kWh of energy consumption, and air quality factors have increased NPV by £29m.
- Finally, in light of the fact that smaller non-domestic sites are likely to have energy costs which more closely resemble residential customers rather than large commercial customers, it is considered more appropriate to value smaller site non-domestic energy savings using long-term variable cost projections for the residential sector. This increases NPV by £160m.

The aggregate impact from these changes across both domestic and non-domestic sectors is a decrease in the NPV of approximately £519m.

[11] DECC, *Updated energy and emissions projections: 2015*, available at: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2015.

[12] DECC, *Valuation of Energy Use and Greenhouse Gas (GHG) Emissions*, December 2015, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483278/Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal.pdf

2.5 Cost update for the DCC, its service providers and other mandated organisations

Table 2-3: Overview of cost updates

Area of change	Impact on NPV
DCC and core service providers	-£355m
Other service providers	-£23m
Smart Energy GB	-£95m

2.5.1 *DCC and core service provider cost update*

The DCC's latest forward cost projections as of March 2016 have been integrated into the smart meter cost-benefit model. These projections have led to increased costs and a reduction in NPV of around £355m.

The main drivers behind these costs are:

- Changes to the planned design and build of the DCC system following further development of the GB Companion Specification (GBCS) which describes the detailed requirements for communications between Smart Metering Devices in consumers' premises, and between Smart Metering Devices and the Data and Communications Company (DCC).
- Changes implemented by the DCC resulting from detailed design to ensure optimised system operations;
- Completion of procurement and firm pricing on some elements of the service which were only estimated at the point of licence award (as reflected in the 2014 IA);
- A staged approach to delivering the full functionality of DCC services which has required additional test environments and staffing.

2.5.2 *Other service provider cost updates*

In the 2014 and previous IAs, some costs of organisations that provide services directly to the DCC were captured under a heading of "organisational costs" (for example the costs for the provision of security keys). These have now been moved into a new sub-category within the DCC-related cost category to reflect that these are costs that will be procured or invoiced through the DCC.

Costs for organisations which provide services to the DCC have also been updated to reflect the latest available evidence. This has integrated updated cost information for the Smart Metering Key Infrastructure (SMKI) service provider, the Smart Energy Code Company (SECCO) and the provider of the Parse & Correlate service.

The impact of updating these costs is overall broadly neutral and results in a reduction in NPV of £8m.

In addition, the following assumptions have been updated in light of new evidence from the SEC Administrator & Secretariat (SECAS) and the DCC. These changes result in a reduction in NPV of around £15m.

- Governance costs – Assumptions revised using information in the SEC Panel budget for costs borne by businesses for SEC-related activities (e.g. opportunity costs of SEC parties for attending panel meetings);
- DCC user privacy & security assessments – Costs for the security audits that DCC users will have to undergo have been updated based on estimates provided by SECAS. These estimates are subject to uncertainty and may differ from actual costs, which will ultimately be driven by the size and complexity of the user system and also the level of preparation by the user themselves;
- SMKI Policy Management Authority (PMA) – Assumptions updated using information from the SEC Panel budget for costs;
- SMKI assurance – Revised costs based on actual costs incurred to date and projected costs using information provided by the DCC.

2.5.3 *Cost update for Smart Energy GB*

Previous Impact Assessments included an estimate for the costs of the Central Delivery Body[13], drawing on the costs of the Digital UK campaign as a proxy, in advance of detailed work by the body (established as Smart Energy GB in 2013) to set a budget and publish a consumer engagement plan.

This budgeting work has now been done – overseen by Smart Energy GB's independent Board, including representatives from the energy industry and consumer groups, and with input from experts in consumer engagement and behaviour change.

During the process of establishing this projection, several factors confirmed that the comparator of Digital UK whilst useful had limitations when applied to the consumer engagement task required to support the smart meter roll-out. In particular, for the Digital UK campaign the BBC provided several hundreds of millions of pounds worth of free airtime, which will not be available for the smart metering campaign.

The allowance for marketing costs has been increased by £95m, from previously £97m to £192m (present value).

2.6 Updated roll-out profiles and timing assumptions

The latest available data with regards to smart meters already installed as well as suppliers' plans for future smart meter installations have been integrated into the cost-benefit analysis. For the period to 2015, this assessment now reflects the published actual numbers of smart and advanced meters installed[14], rather than the previous projected roll-out curve as per historical supplier expectations.

In terms of forward projections from 2016, the nine largest suppliers had to provide to Ofgem in early 2016 their roll-out projections for each year up to 2020, in line with their plans to meet the obligation to take all reasonable steps to complete the roll-out by the end of 2020.

[13] Government has put in place licence conditions requiring suppliers to set up and fund the Central Delivery Body in order to deliver a national awareness campaign and effective consumer engagement.
[14] See https://www.gov.uk/government/collections/smart-meters-statistics.

Their projections to 2020 are based on expectations informed by installations to date during the Foundation Stage of the roll-out.

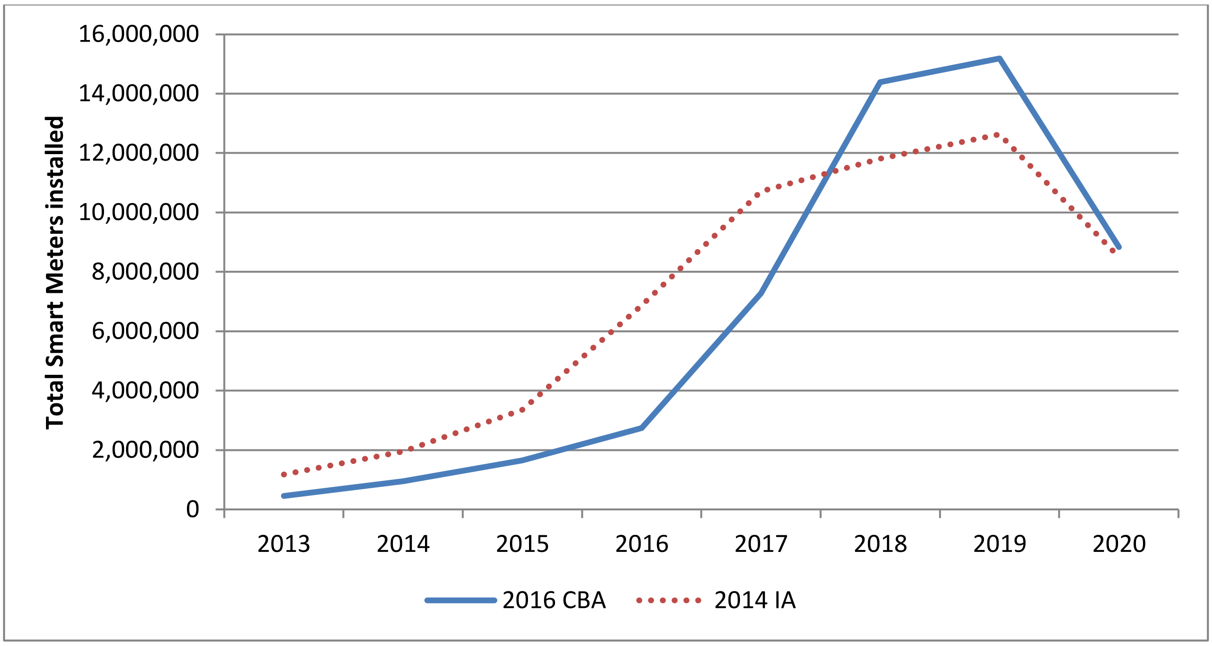
To reflect a continued policy expectation on suppliers to integrate changes in technology and consumer attitude into their roll-out efforts beyond the main installation stage of the Programme, the analysis assumes that smart meter deployment continues to grow after 2020 until a steady state is reached in 2022. From then, additional smart meter installations are limited to new buildings and end of lifetime replacements.

These modelling assumptions recognise that a significant amount of uncertainty remains, (i) while suppliers gather more operational evidence as the full scale roll-out progresses; (ii) while consumer attitudes change in light of Smart Energy GB's engagement activity and (iii) while Ofgem determines – now and in the future - whether suppliers' projections are duly justified and meet the requirement of them taking all reasonable steps towards completion.

While the number of actual SMETS1 installations to date is less than previously modelled, the new timing for the DCC's live service operations and a longer period during which the installation of both SMETS1 and SMETS2 meters will be permissible has resulted in an increase in the volume of SMETS1 meters and a relative decrease in the volume of SMETS2 meters (available once the DCC commences its live service operations). The overall number of domestic SMETS1 meters, based on forecasts given to the Programme by all suppliers, is now 8.0m, compared to 5.4m in the 2014 IA.

The updated timing and roll-out expectations in comparison to the expectations reflected in the 2014 IA are presented in Figure 3 below.

Figure 3: IA 2014 roll-out profile vs current roll-out profile to 2020



The general effect of the updated assumptions is a decrease in NPV of £1,013m.
The main underlying drivers for the NPV impact are:

- A greater number of meters being rolled out later than modelled in the 2014 IA results in greater discounting of both costs and benefits. This, in turn, reduces the NPV because the discounting effect reduces overall benefits to a greater extent than overall costs, independent of the change in PV base year. (Also because the timing of some upfront investment costs is not affected by the updated roll-out profiles).

- The cost model continues to apply the same treatment for SMETS1 equipment as was applied in the 2014 IA, so greater SMETS1 volumes translate into a cost increase to allow for interoperability risks from SMETS1 meters deployed (e.g. risk of asset stranding). Section 1.3.10 in Part II of this assessment provides further detail on the treatment of specific costs related to SMETS1 meters.
- A cost, known as pavement reading inefficiency, covers the increased cost of manually reading remaining traditional meters, when these meters make up a relatively small proportion of the population and economies of scale for reading them manually are lost. This is captured in the modelling by an increase in the costs per manual meter read as the roll-out progresses and the overall volume of traditional meters declines. The updated roll-out projections increase the costs from pavement reading inefficiencies both during and after the main installation stage.
- We expect a greater proportion of expiring traditional meters than previously modelled to be replaced by non-smart meters in the early years of the roll-out (around 5% of the total credit meter population needs replacing every year, on the basis of a 20 year lifetime, and around 10% of the PPM population, on the basis of a 10 year lifetime). However, this will be partly compensated by a new industry approach to collective re-certification of certain types of traditional meters, so that they can remain in place for longer and be replaced by a smart meter, saving approximately £12m costs. Despite this initiative, the net effect is still an increase in costs.
- The latest deployment plans from energy suppliers show a greater compression of installations in the final years of the main installation stage. As in previous impact assessments, we apply uplifts to installation and asset costs where installation rates exceed a threshold of 17% per year, to reflect potential pressures on the supply chain and workforce availability. The absolute number of installations in years in which the threshold has been breached has increased in the latest profiles, and therefore more installations are subject to the cost uplifts than in previous IAs.
- The assumption of when centralisation of the registration system will occur, as well as when any data aggregation responsibilities relating to settlement may fall into the DCC scope[15] have also been updated for this assessment, in light of revised timelines Ofgem's settlement reform work. This results in later delivery of the higher levels of switching benefits that stem from further streamlining of industry processes for changing supplier.

Updating the cost-benefit modelling to take account of all this new evidence reduces the NPV by around £1,013m. This is made up of a £534m reduction in costs (as installation-related costs are incurred further into the future, they are discounted more heavily) and a £1,548m reduction in benefits, across the domestic and non-domestic analysis.

[15] As part of Ofgem's work considering half-hourly settlement of domestic and smaller non-domestic consumers, in 2014 the settlement expert group explored where responsibility for data collection and data aggregation should lie in future. This concluded that more work was required to identify viable options for how these functions could be delivered (in terms of where responsibility should lie) and assess the relative merits of these options. For further details see: www.ofgem.gov.uk/sites/default/files/docs/2015/01/settlement_final_doc.pdf.

2.7 Updated installation and equipment cost assumptions

2.7.1 *Installation costs*

In 2015 and 2016 the Programme collected information on current and projected smart meter installation costs from a number of energy suppliers and Meter Operators. The information collected showed a significant spread in both current and expected future costs. This reflected a number of uncertainties, including the level of customer acceptance and technical difficulties suppliers expect. These, as well as other factors including suppliers' own processes, impact on the number of successful installations a meter installer can conduct in a working day, and therefore the estimated unit cost of an installation.

The latest installation cost estimates provided by industry stakeholders are higher than the estimates previously provided and included in the 2014 IA. This is primarily because suppliers have applied a broader definition of the activities captured by an installation. The latest evidence includes, for example, the costs of training installers, providing tools, managing installers in the field, appointment setting, and other back office support costs.

This assessment reflects this and more closely aligns to how suppliers define installation costs internally and to the figures that they are expected to report to the Programme during the ongoing monitoring of the roll-out.

The specific installation cost assumptions applied in this assessment have been informed by the following considerations:

- Where the dual fuel smart meter installation costs provided by individual suppliers vary over time, they have been weighted by the projected smart meter roll-out profile to estimate a single cost per supplier. The average of these figures has then been taken to derive a single cost estimate.
- A comparison between the dual fuel and single fuel installation costs, where provided by suppliers, identified a dual fuel saving of £27, and this has been applied to suppliers' dual fuel installation cost information to derive the average single fuel installation costs. The dual fuel saving reflects the time saved from not having to travel to the property twice, make two appointments, provide IHD explanations and energy efficiency advice twice, and other efficiencies that would be realised with a dual fuel installation process.
- Updated information provided by industry stakeholders no longer indicates a cost differential between gas and electricity meter installations. A possible reason for this might be that single fuel electricity installations to date would almost all have included the need to install and commission the communications hub. Future electricity only installations, once gas first installations are possible and where consequently the gas meter and communications hub will already be in place, might be quicker to conduct and therefore incur lower costs.
- Given the improvement in the evidence base on installation costs, with the latest figures being based on significant experience of actual installations and some contractual arrangements, the decision has been taken to reduce the optimism bias on installation costs from 20% to 5%.

Information on traditional meter installation costs was collected from suppliers in early 2016, to ensure consistency with the broader definition of installation costs now adopted by suppliers for smart and traditional installations. These costs were generally lower than smart meter installation costs, reflecting the additional time spent commissioning smart equipment by establishing a connection with the communications and data service providers, providing IHD and energy efficiency advice to the consumer for a smart meter installation, and the lower costs of appointment-setting outside of a time-bound meter replacement programme. Nonetheless, the installation costs for traditional meters reported in 2016, and included in this assessment, were significantly higher than assumed in the 2014 IA.

Table 2-4 below includes a summary of the smart and traditional meter installation costs applied in this assessment. The installation cost for traditional meter PPM customers is assumed to be higher than for credit customers as a result of the additional time spent pairing keys and configuring the meter. The relative difference between smart and traditional meter installation costs remain broadly the same as in the 2014 IA.

Table 2-4: Smart and traditional meter installation costs

Installation type	**Cost per installation**
Smart meter	
Electricity only	£67
Gas only	£67
Dual fuel	£107
Dual fuel saving	£27
Traditional meter	
Electricity (credit meter)	£52
Electricity (PPM meter)	£57
Gas (credit meter)	£52
Gas (PPM meter)	£57

2.7.2 *Meter asset costs*

Through the Annual Supplier Returns and other communication channels with delivery partners, the Programme has collected information on the equipment costs of smart meters. While there is a range in the estimates provided, the evidence indicates that equipment costs for suppliers that have deployed or entered into contracts for smart meters are at or below those previously reported in the 2014 IA. This market information significantly improves the certainty in the IA assumptions and to account for this the optimism bias allowance on meter assets has been reduced from 15% to 5%.

2.7.3 *Financing costs for smart meter assets and installation costs*

The installation and asset cost of smart meter equipment is commonly financed over the lifetime of the asset. In previous IAs, the finance rate was assumed to be 10% (real), based on a conservative estimate of the weighted average cost of capital for an energy supplier.

A number of stakeholders have suggested that the assumption in previous IAs was high and that they would aim to utilise cheaper sources of finance. In particular, suppliers are generally financing the installation and meter asset costs through Meter Asset Providers (MAPs). The business model of MAPs is perceived as relatively low risk by financiers in the capital markets and MAPs are therefore able to access capital at more favourable rates than would generally be the case for energy supply businesses.

To reflect this, the Programme has reduced the finance rate applied to meter asset and installation costs to 6% (real). This is between the middle and upper end of the range of the estimated weighted average cost of capital of MAPs provided to us, and therefore remains a prudent assumption.

2.7.4 *Overall impact of changes to installation and asset cost assumptions*

In aggregate, the changes related to installation and asset costs result in a £1,041m increase in the NPV.

2.8 DCC adaptor service costs for smaller suppliers

Energy suppliers will have to invest to upgrade their IT systems so that they are able to take advantage of smart metering. This will include investment in software that allows energy suppliers to connect their IT systems to the DCC, known as a DCC adaptor service, and the costs to suppliers of updating their current systems to make them compatible with the adaptor service software. For independent suppliers, procuring a DCC adaptor service will provide them with the core IT system capability that is required to support and communicate with the smart meters they will install and gain during the roll-out and beyond.

The structure of the energy market has changed significantly since the Programme issued its original request for information on suppliers' IT costs. The entry and expansion of a number of smaller, independent suppliers, means there is a significantly larger number of suppliers than previously assumed that will need to invest in their IT systems. To reflect this change, the Programme has updated its estimates of IT costs to include the cost of a DCC adaptor service for these independent suppliers. The cost assumed for the larger suppliers remains unchanged.

The Programme collected estimates from adaptor service providers on the upfront build cost, annual licence charges and per meter charges to energy suppliers, and the expected costs to suppliers of integrating the adaptor service software into their systems. This market intelligence was used to inform an estimate of the costs for different sized energy suppliers, as different cost models are expected to be adopted by different sized suppliers. This has been combined with the latest information on the number and size of independent suppliers in the market to calculate the overall IT costs for independent suppliers. In total, this increases the IT costs, and reduces the NPV, by £138m.

2.9 Updated assumptions about Home Area Network solutions and costs

2.9.1 *868MHz equipment*

A standard smart metering installation will in most cases include smart gas and electricity meters, an IHD in domestic premises and a communications hub. These devices will communicate with each other via a Home Area Network (HAN). The standard 2.4GHz HAN solution specified in the SMETS2 and Communications Hub Technical Specifications (CHTS) is expected to be suitable for approximately 70% of premises. In the remaining properties the distance between devices, the location of meters or building fabric and design may prevent the propagation of the 2.4GHz signal.

In 2013 the Government concluded that an additional wireless solution at 868MHz should be specified for use in premises where 2.4GHz does not work. In 2015 the Government consulted on the implementation of the 868MHz HAN solution, seeking views on whether and how the 868MHz solution should be supported on each device. In the response to the consultation the Government published a number of conclusions[16], supported by economic analysis. The Government conclusions set out a range of requirements and exclusions concerning the usage of 868MHz HAN equipment.

To account for these changes, the Programme has updated the modelling assumptions to include the higher cost of 868MHz devices and dual band (2.4GHz and 868MHz) communications hubs compared to 2.4GHz devices. The cost increases for different components are captured in the table below and are based on a midpoint of the range of costs provided by manufacturers as part of the consultation in 2015 on the 868MHz HAN solution. The PV cost of 868MHz equipment will depend on the number of 868MHz devices installed and the incremental cost of an 868MHz device. We have adopted a prudent assumption that once 868MHz equipment becomes available it will be installed in around a half of all domestic premises. However, the Programme continues to be of the view that a well-structured installation process can result in the most cost-effective equipment solution being deployed on a case-by-case basis, keeping the need for 868MHz equipment to a minimum and below the level assumed.

Table 2-5: Incremental cost of 868MHz devices relative to 2.4GHz devices

Component	**Additional cost per device**
Communications hub (dual band)	£1.60
Gas meter	£2.00
In-Home Display	£0.20

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

The Programme has updated the modelling assumption that is applied for the expected availability of 868MHz equipment to reflect delays in the delivery of the 868MHz solution by external providers. The availability of communication hubs using a bandwidth of 868MHz has been adjusted from 2016 to 2018 as a holding assumption. In recognition of the operational advantages of having a HAN solution that unlocks a further significant part of the overall population, the Programme continues to push for the availability of 868MHz equipment as early as practicable.

2.9.3 *Costs for the development of the alternative HAN solution*

The 2.4GHz and 868MHz HAN standards are expected to be suitable for the communications links between all smart metering equipment in approximately 96.5% of GB premises. In the remaining 3.5% of premises it is unlikely that the 2.4GHz or 868MHz solutions alone without range-extending equipment will be able to establish a HAN, therefore an Alternative HAN (or ‘Alt HAN’) solution will be needed.

In 2015 the Government consulted on proposals for the detailed design of the Alternative HAN arrangements and the regulatory provisions that will be needed to underpin them. In

[16] DECC, *Government Response to the Consultation on the Home Area Network (HAN) Solutions: Implementation of 868MHz and Alternative HAN solutions*, December 2015, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486052/Government_Response_on_Home_Area_Network_Solutions__Implementation_of_86___.pdf.

the response to the consultation[17] the Government concluded that collective action was needed to secure efficient Alternative HAN solutions and that energy suppliers should be able to collaborate to develop and establish contractual arrangements for the provision of Alternative HAN equipment.

The Government has introduced regulatory provisions to reflect this, including the creation of governance arrangements to enable suppliers to collectively procure Alt HAN solutions. We have included an allowance for the costs associated with these governance arrangements and early procurement activity in our modelling assumptions. We recognise that further incremental costs or efficiencies for the deployment of the Alt HAN solution might arise, but at this point in time there is no evidence available as to the potential quantum of such costs.

2.9.4 Aggregate impact of changes to HAN solution assumptions

The changes related to the HAN solution result in a decrease of the NPV of around £185m.

2.10 Update of advanced meter volume and cost assumptions

The changes described in this section only impact the non-domestic cost-benefit analysis (as set out in section 4 of Part II of this assessment). The present analysis incorporates the impact of decisions taken since the 2014 IA.

In March 2016, the Government amended non-domestic suppliers' licence conditions to extend the period in which advanced meters can be installed to:

- April 2017, for large suppliers;
- August 2017, for small suppliers.

It was also confirmed that suppliers may continue to install advanced meters after the end-dates noted above, but only if a contractual agreement is in place prior to 6 April 2016.

The exemptions reflect the state of development within the non-domestic market, with advanced metering being deployed and attendant early energy and carbon savings being achieved. However, once advanced meters installed under the above mentioned exemptions reach the end of their lifetime, they will (with some exceptions, see section 4.3 of Part II of this assessment for further detail) need to be replaced with smart meters that comply with the technical specification extant at the time.

Drawing on the number of advanced meters that have already been rolled out to relevant properties, and on energy suppliers' forecasts of the number of advanced meters they expect to install until the new exemption end date, the Programme has developed updated assumptions about the steady-state split between smart and advanced meters in the non-domestic sector.

It is now assumed that by 2020 the split between smart and advanced meters in the smaller non-domestic sector will be 65% smart and 35% advanced for electricity meters; and 77% smart and 23% retrofit advanced for gas meters.

[17] DECC, *Government Response to the Consultation on the delivery model and regulatory requirements for Alternative HAN*, April 2016, available at https://www.gov.uk/government/consultations/consultation-on-alternative-home-area-network-han-solutions.

Since the 2014 IA, the analysis has also updated the assumptions on asset costs of advanced meters, in response to more recent information. The assumed costs have reduced from £247 to £120 for advanced gas and electricity meters (see section 4.5.1 of Part II of this assessment). Asset costs for advanced retrofit meters (traditional meters with a communications device fitted to them) are unchanged.

The overall effect of the changes to advanced meters costs and advanced meters prevalence is to reduce NPV by £40m.

2.11 Revision of network-related benefits

Since the publication of the 2014 IA, there have been a number of substantial developments in the evidence base on network distribution benefits, particularly with the conclusion of the RIIO-ED1 price control process undertaken by Ofgem[18].

In light of this, in 2015 the Programme commissioned PA Consulting to re-assess and update the assessment of network benefits in the 2014 IA. This has resulted in a significant improvement in the evidence base and reflects the expected benefits to both DNOs and customers from the use of smart meter data.

PA Consulting undertook a literature review of the evidence published by DECC, the Energy Networks Association (ENA), individual Distribution Network Operators (DNOs) and Ofgem, as well as reports on operational network benefits from the implementation of smart metering in other countries. This was used to identify a range of network benefits that could be realised through the use of smart metering data (including alerts). While there are a number of ongoing discussions about the full delivery of the functional requirements for DNOs, the work by PA Consulting assumes that the smart metering solution will provide the functionalities required for the delivery of benefits to networks and BEIS is committed to provide support to DNOs to achieve this.

Data from Ofgem and DNO business plans was used to quantify these benefits for the RIIO-ED1 period (2015 to 2023). For the RIIO-ED2 period (2023 to 2031) the identified annual benefit for each category of benefit has been increased by 25% to reflect the generally accepted view that benefits in ED2 will be higher (for example in light of an expected increase in the deployment of low carbon technologies). However, uncertainty in this area remains, and the actual benefits realised could be significantly higher than this. BEIS is committed to continue working with DNOs and the energy industry more widely to ensure that the network-related benefits from smart metering can be maximised.

Table 2-6 below summarises the results included in this assessment, based on the analysis provided by PA Consulting. The total benefits are differentiated between customer benefits and DNO benefits, to reflect that some smart meter impacts result in service improvements that do not translate into a direct monetary benefit for DNOs. This is also because some of the cost savings by DNOs have to be passed back to consumers under the RIIO information quality incentive sharing mechanism (IQI), which determines the amount in every Pound saved that the DNO must pass on to customers. These figures reflect an increase in benefits over the RIIO-ED1 period as the penetration of SMETS2 smart meters increases and DNOs scale up their capabilities to realise benefits as critical mass of SMETS2 meters is achieved.

[18] RIIO-ED1 is the first electricity distribution price control to reflect the new RIIO (Revenue = Incentives + Innovation + Outputs) model for network regulation.

In total, the changes to the analysis of network benefits drawing on the results of the PA Consulting work result in a reduction in the PV of benefits of £145m relative to the 2014 IA[19]. A detailed description of these benefits can be found in the evidence base section of Part II of this assessment.

Table 2-6: Summary of network-related benefits
Totals may not sum due to rounding

Benefit category	**Direct benefit to DNOs**	**Direct benefit to customers**	**Total**
Outage management benefits			
Faster restoration of supply	£16m	£11m	**£26m**
Earlier fault notification	-	£37m	**£37m**
Reduction in operational costs to fix faults	£29m	-	**£29m**
Reduction in calls to emergency and fault lines	£21m	-	**£21m**
Better informed investment decisions			
Reduction in reinforcement in existing network	£151m	-	**£151m**
Reduction in investment to serve new connections	£38m	£7m	**£46m**
Other benefits			
Avoided cost of investigating voltage complaints	£24m	-	**£24m**
Total	**£279m**	**£55m**	**£334m**

We continue to include the benefits from avoided losses (PV gross benefits of £460m) on the distribution network as a network-related benefit. The assumptions on losses remain unchanged from the 2014 IA. BEIS recognises that benefits from reduced losses, similar to the benefits to customers included in this section, do not constitute a direct monetary saving to Network Operators. However, our classification of benefits is based on where in the energy supply chain the benefits arise. In practice, the benefits from avoided losses would fall to energy suppliers and would be expected to be passed on to customers given suppliers operate in a competitive energy market.

2.11.1 *Non-quantified benefits to DNOs*

The assessment of non-quantified benefits has also been updated and a number of additional operational benefits have been identified. These are explained in Section 1.4.3.5 of Part II of this assessment.

[19] This comparison excludes any change in the value of benefit from reduced distribution losses. This has now been categorised as a supplier benefit. Further detail on this change can be found in Section 3.

2.12 Updated assumptions about IHD costs

2.12.1 *Payment profile of IHD costs*

In the 2014 and previous IAs the cost of IHDs were assumed to be financed over the 7 year lifetime of the devices. Once the IHD reached the end of its lifetime, it was assumed it would be replaced and the costs of the replacement would be financed over the next 7 year period. This financing approach is the one common for metering assets.

Energy suppliers have however indicated that they are not planning to roll the cost of IHDs into the arrangements with Meter Asset Providers and instead plan to treat the cost of IHDs as an operational expense. To reflect this, the full cost of an IHD in this assessment is modelled to be paid in the year of installation and is no longer financed over the lifetime of the asset.

Since March 2016, suppliers have been able to apply for a derogation from the IHD mandate in order to conduct trials of alternative engagement tools. There is currently a lack of robust, independent and GB-based evidence on the efficacy of innovative alternatives, including whether they can deliver comparable consumer energy savings to IHDs. Evidence from these trials, expected during 2017, will be used to inform considerations on whether the IHD mandate remains the best way to ensure consumers can engage with their energy consumption data. However, any such trials will take time and their outcome is uncertain. The assumption that all consumers are offered an IHD when their smart meter is installed remains in place at this point.

By the time the generation of IHDs provided at installation come to the end of their life, we would expect technical developments and innovation (such as the emergence of Consumer Access Devices) to enable access to data on other devices in a cost-effective way and without loss of benefits to customers. Some customers may opt for other feedback tools once their original IHD comes to the end of its life, reducing the need for suppliers to provide a second physical IHD. To account for this, the cost of future IHD replacements has been scaled down. The modelling assumes that the proportion of consumers that currently have a smart phone (around two-thirds) would, when IHDs come to the end of their life, opt for an energy consumption feedback tool on another device. We have not assumed any increase in the penetration of smart phones in the future, and assume that the entire third of the population currently without a smartphone would receive a replacement IHD once the initial device reaches the end of its life. This prudent assumption potentially overestimates the cost of future physical IHDs, but is expected to cover the costs incurred in developing and maintaining alternative engagement tools, which have not been included in this assessment in light of the absence of evidence at this point in time.

2.12.2 *Optimism bias applied to IHDs*

Information collected by the Programme through its annual supplier return process indicates that the cost of an IHD as purchased or contracted for by suppliers at scale is at or below the cost previously reported in the 2014 IA. Therefore, in line with the changes made to smart meter costs, the optimism bias for IHDs has been reduced from 15% to 5%.

2.12.3 *Aggregate impact of changes to IHD assumptions*

The change to the profile of IHD costs and reduction in optimism bias results in an increase in the NPV of £308m.

2.13 Time-of-use assumption changes

For some time there has been a broad consensus that more active system balancing efforts on the demand side will be a critical tool in addressing the challenges that the UK's energy system will be facing in the future. With more decentralised and intermittent generation from renewable sources connected to the electricity grid and expected increases in the electrification of transport and heating, it will be crucial that opportunities for flexibility on the demand side are exploited, in order to avoid costly increases in generation capacity, as well as transmission and distribution infrastructure.

A number of policy developments have occurred since the 2014 IA which strengthen assumptions about the speed and reach of this transition:

- Ofgem has set out its ambition to enable cost-effective elective half-hourly settlement for domestic and smaller non-domestic customers in early 2017 and is expected to make further announcements with regards to mandatory half-hourly settlement in the longer run during 2016[20]. Settlement reform will be an important enabler of time-of-use (TOU) tariffs, which in turn are a crucial first step towards demand side flexibility and in the long run increased home automation and real-time price signals.
- A dedicated policy team has been set up within BEIS to develop an overarching strategy on smart energy as well as concrete policy proposals to achieve greater flexibility in the energy system, to ensure cost-effective long-term security delivered through innovation and system reform.
- There are already encouraging market developments, with some suppliers offering differentiated services around TOU and encouraging energy consumption at times when there is no system congestion.
- The Competition and Markets Authority (CMA) recognised the important role smart metering can play as an enabling technology in their recent final report on the energy market investigation[21], in which they identify settlement reform and utilising actual half-hourly consumption as the basis for settlement as one of three categories of remedy that it believes will help to improve the framework for effective and efficient competition in the energy market.

In light of the above, the Programme has revised its modelling assumptions with regards to the deployment of TOU tariffs. In light of the timelines for enabling half-hourly settlement, the assumption about when static TOU will be available in the market and taken up by consumers has been shifted from 2016 previously to 2018 in this assessment. In addition, the analysis now assumes a more widespread take up profile of static TOU tariffs during the 2020s, increasing from 20% in 2020 by 1% per year to 30% in 2030. The modelling remains prudent in other assumptions about discretionary load and opportunities taken by households to shift load. Once these are combined with the take-up assumption the

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[20] See https://www.ofgem.gov.uk/publications-and-updates/half-hourly-settlement-way-forward.
[21] CMA, *Energy market investigation final report*, June 2016, available at https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf.

modelling still only assumes around 2% of peak consumption to be shifted to off-peak times in 2020, rising to around 4% in 2030. The modelling also does not assume any additional load shifting as a result from more advanced dynamic TOU tariffs at this point in time. BEIS will monitor the deployment and prevalence of TOU tariffs over time.

The overall effect of the above modelling changes results in an increase of NPV of £103m.

2.14 SMIP Programme expenditure update

The projected forecast for the SMIP Programme's expenditure has been updated following the outcome of the Spending Review and latest round of Business Planning. The impact on NPV is a small reduction of around £4m.