Title: Smart meter rollout for the domestic sector (GB)	Impact Assessment (IA)
Lead department or agency: DECC	**IA No:** DECC0009
Other departments or agencies:	Date: 18/08/2011
	Stage: Consultation
	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 to establish minimum technical requirements and a completion date is needed to ensure commercial interoperability and full market coverage. This will facilitate the capture of wider benefits to consumers, the environment, network operators and new businesses.

The policy for smart meters therefore addresses the market failures in the energy markets described above (information asymmetries, lack of coordination and negative externalities from energy consumption).

What are the policy objectives and the intended effects?

To roll out smart metering to 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 through a supplier-led rollout in the domestic sector with a centralised data and communications company. The March 2011 IA set out the overall approach and timeline for achieving this. In this IA options for the configuration of the Communications Hub within the home are considered. Five options are identified and assessed against a number of criteria, both quantitative and qualitative. The preferred option is a separate communications module with a fixed WAN transceiver.

This IA also updates cost and benefit estimates in areas where additional evidence has been received or developed.

The consultation that this IA accompanies seeks views on the impacts of specifying a completion date that is in the earlier part of 2019, but no further evidence regarding the completion date has come to light and the analysis in this IA remains unchanged to March 2011.

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 2018). (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: 18/08/2011

Charles Hendry

URN:11D/841

Summary: Analysis and Evidence Policy Option 1

Description: Fully integrated Communications Hub

Price Base Year 2009	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: 580	High: 9,814	**Best Estimate: 5,059**

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		632	**10,912**

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

Capital costs, installation, and opex costs amount to £6.24bn. Comms costs amount to £2.32bn. 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	11,473
High	0		1,412	20,746
Best Estimate	0		1,087	**15,971**

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 £923m 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. It will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative 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: 789	**Benefits:** 839	**Net:** 50	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

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

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,125	78,397,853	165,132,390	184,334,750	212,759,600
Annual recurring cost	0	0	25,909,639	49,706,326	156,402,800	351,190,036	548,620,418
Total annual costs	0	0	69,140,764	128,104,179	321,535,190	535,524,786	761,380,019
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	0	0	54,101,754	106,664,724	261,697,836
Total annual benefits	0	0	0	0	54,101,754	106,664,724	261,697,836

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,492	166,733,070	129,009,984	111,822,104	96,121,543	93,876,600	92,049,521
Annual recurring cost	746,838,463	885,015,365	937,207,450	947,301,502	934,059,515	927,230,287	920,999,766
Total annual costs	937,023,955	1,051,748,435	1,066,217,435	1,059,123,606	1,030,181,059	1,021,106,888	1,013,049,287
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606
Total annual benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606

	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	915,356,937	922,621,483	925,891,179	918,558,031	910,683,193	899,009,964	883,582,743
Total annual costs	1,005,608,646	1,011,762,879	1,013,922,262	1,007,728,455	998,675,724	989,904,363	977,379,010
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484
Total annual benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484

* 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%		

Summary: Analysis and Evidence Policy Option 2

Description: Integrated Communications Hub with replaceable WAN

Price Base Year 2009	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: 430	High: 9,664	**Best Estimate: 4,909**

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		642	**11,062**

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

Capital costs, installation, and opex costs amount to £6.24bn. Comms costs amount to £2.47bn. 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	11,473
High	0		1,412	20,746
Best Estimate	0		1,087	**15,971**

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 £923m 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. It will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative 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)[2]:			**In scope of OIOO?**	**Measure qualifies as**
Costs: 800	**Benefits:** 849	**Net:** 49	Yes	£0 IN

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

Enforcement, Implementation and Wider Impacts

<table>
<tr><td colspan="3">What is the geographic coverage of the policy/option?</td><td colspan="3">GB</td></tr>
<tr><td colspan="3">From what date will the policy be implemented?</td><td colspan="3">The start date will be confirmed in accordance with the rollout plans for the preferred Option.</td></tr>
<tr><td colspan="3">Which organisation(s) will enforce the policy?</td><td colspan="3">DECC/Ofgem</td></tr>
<tr><td colspan="3">What is the total annual cost (£m) of enforcement for these</td><td colspan="3">N/A</td></tr>
<tr><td colspan="3">Does enforcement comply with Hampton principles?</td><td colspan="3">N/A</td></tr>
<tr><td colspan="3">Does implementation go beyond minimum EU requirements?</td><td colspan="3">Yes</td></tr>
<tr><td colspan="3">What is the CO_2 equivalent change in greenhouse gas emissions (for preferred option)?</td><td>Traded: 17.4MtCO2</td><td colspan="2">Non-traded: 15.6MtCO2</td></tr>
<tr><td colspan="3">Does the proposal have an impact on competition?</td><td colspan="3">Yes</td></tr>
<tr><td>Annual cost (£m) per organisation
(excl. Transition) (Constant Price)</td><td>Micro
N/A</td><td>< 20
N/A</td><td>Small
N/A</td><td>Medium
N/A</td><td>Large
N/A</td></tr>
<tr><td>Are any of these organisations exempt?</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>

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

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,125	78,397,853	165,132,390	184,334,750	212,759,600
Annual recurring cost	0	0	26,594,695	51,049,277	159,425,481	356,953,253	557,096,417
Total annual costs	0	0	69,825,820	129,447,130	324,557,871	541,288,003	769,856,017
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	0	0	54,101,754	106,664,724	261,697,836
Total annual benefits	0	0	0	0	54,101,754	106,664,724	261,697,836

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,492	166,733,070	129,009,984	111,822,104	96,121,543	93,876,600	92,049,521
Annual recurring cost	757,999,314	898,161,950	951,307,293	961,853,819	948,787,353	942,099,860	936,002,374
Total annual costs	948,184,806	1,064,895,020	1,080,317,278	1,073,675,924	1,044,908,897	1,035,976,460	1,028,051,895
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606
Total annual benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606

	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	930,491,206	937,887,414	941,288,775	933,956,675	926,093,394	914,390,775	898,857,784
Total annual costs	1,020,742,915	1,027,028,810	1,029,319,859	1,023,127,099	1,014,085,925	1,005,285,173	992,654,051
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484
Total annual benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484

* 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%		

Summary: Analysis and Evidence Policy Option 3a **(Preferred option)**

Description: Communications Hub with fixed WAN

Price Base Year 2009	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: 426	High: 9,660	**Best Estimate: 4,904**

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		642	**11,067**

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

Capital costs, installation, and opex costs amount to £6.23bn. Comms costs amount to £2.47bn. 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	11,473
High	0		1,412	20,746
Best Estimate	0		1,087	**15,971**

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 £923m 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. It will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative 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)[3]**:**			**In scope of OIOO?**	**Measure qualifies as**
Costs: 800	**Benefits:** 849	**Net:** 49	Yes	£0 IN

[3] 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

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

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,125	78,397,853	165,132,390	184,334,750	212,759,600
Annual recurring cost	0	0	26,614,268	51,087,647	159,511,843	357,117,916	557,338,588
Total annual costs	0	0	69,845,393	129,485,500	324,644,233	541,452,666	770,098,189
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	0	0	54,101,754	106,664,724	261,697,836
Total annual benefits	0	0	0	0	54,101,754	106,664,724	261,697,836

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,492	166,733,070	129,009,984	111,822,104	96,121,543	93,876,600	92,049,521
Annual recurring cost	758,318,195	898,537,567	951,710,146	962,269,600	949,208,149	942,524,705	936,431,019
Total annual costs	948,503,688	1,065,270,637	1,080,720,131	1,074,091,704	1,045,329,692	1,036,401,305	1,028,480,540
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606
Total annual benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606

	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	930,923,614	938,323,584	941,728,706	934,396,636	926,533,686	914,830,226	899,294,214
Total annual costs	1,021,175,322	1,027,464,980	1,029,759,790	1,023,567,060	1,014,526,216	1,005,724,625	993,090,481
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484
Total annual benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484

* 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%		

Summary: Analysis and Evidence Policy Option 3b

Description: Intimate Communications Hub with fixed WAN

Price Base Year 2009	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: 533	High: 9,767	**Best Estimate: 5,012**

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		635	**10,959**

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

Capital costs, installation, and opex costs amount to £6.23bn. Comms costs amount to £2.36bn. 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	11,473
High	0		1,412	20,746
Best Estimate	0		1,087	**15,971**

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 £923m 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. It will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative 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)[4]:			**In scope of OIOO?**	**Measure qualifies as**
Costs: 793	**Benefits: 849**	**Net: 56**	Yes	£0 IN

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

Enforcement, Implementation and Wider Impacts

<table>
<tr><td colspan="3">What is the geographic coverage of the policy/option?</td><td colspan="3">GB</td></tr>
<tr><td colspan="3">From what date will the policy be implemented?</td><td colspan="3">The start date will be confirmed in accordance with the rollout plans for the preferred Option.</td></tr>
<tr><td colspan="3">Which organisation(s) will enforce the policy?</td><td colspan="3">DECC/Ofgem</td></tr>
<tr><td colspan="3">What is the total annual cost (£m) of enforcement for these</td><td colspan="3">N/A</td></tr>
<tr><td colspan="3">Does enforcement comply with Hampton principles?</td><td colspan="3">N/A</td></tr>
<tr><td colspan="3">Does implementation go beyond minimum EU requirements?</td><td colspan="3">Yes</td></tr>
<tr><td colspan="3">What is the CO_2 equivalent change in greenhouse gas emissions (for preferred option)?</td><td>Traded:
17.4MtCO2</td><td colspan="2">Non-traded:
15.6MtCO2</td></tr>
<tr><td colspan="3">Does the proposal have an impact on competition?</td><td colspan="3">Yes</td></tr>
<tr><td>Annual cost (£m) per organisation
(excl. Transition) (Constant Price)</td><td>Micro
N/A</td><td>< 20
N/A</td><td>Small
N/A</td><td>Medium
N/A</td><td>Large
N/A</td></tr>
<tr><td>Are any of these organisations exempt?</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>

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

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,125	78,397,853	165,132,390	184,334,750	212,759,600
Annual recurring cost	0	0	26,124,942	50,128,396	157,352,785	353,001,333	551,284,303
Total annual costs	0	0	69,356,067	128,526,249	322,485,175	537,336,083	764,043,904
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	0	0	54,101,754	106,664,724	261,697,836
Total annual benefits	0	0	0	0	54,101,754	106,664,724	261,697,836

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,492	166,733,070	129,009,984	111,822,104	96,121,543	93,876,600	92,049,521
Annual recurring cost	750,346,159	889,147,149	941,638,829	951,875,087	938,688,264	931,903,582	925,714,871
Total annual costs	940,531,651	1,055,880,219	1,070,648,814	1,063,697,192	1,034,809,808	1,025,780,182	1,017,764,392
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606
Total annual benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606

	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	920,113,422	927,419,347	930,730,423	923,397,605	915,526,399	903,843,933	888,383,470
Total annual costs	1,010,365,130	1,016,560,743	1,018,761,507	1,012,568,029	1,003,518,930	994,738,332	982,179,737
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484
Total annual benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484

* 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%		

Summary: Analysis and Evidence Policy Option 4

Description: Communications Hub with replaceable WAN

Price Base Year 2009	**PV Base Year** 2011	**Time Period Years** 20	**Net Benefit (Present Value (PV)) (£m)**		
			Low: 276	High: 9,510	**Best Estimate: 4,754**

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		653	**11,217**

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

Capital costs, installation, and opex costs amount to £6.23bn. Comms costs amount to £2.62bn. 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	11,473
High	0		1,412	20,746
Best Estimate	0		1,087	**15,971**

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 £923m 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. It will also facilitate the development of the energy services market, with innovative energy management tools such as home automation and smart appliances. More broadly, smart metering is likely to result in stronger competition between energy suppliers due to increased ease for consumers of switching (in particular from the point that DCC is established) and improved information on energy consumption and tariffs. As a result from increased competition, further benefits to consumers could be realised such as more innovative 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)[5]:			**In scope of OIOO?**	**Measure qualifies as**
Costs: 812	**Benefits:** 849	**Net:** 37	Yes	£0 IN

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

Enforcement, Implementation and Wider Impacts

<table>
<tr><td colspan="2">What is the geographic coverage of the policy/option?</td><td colspan="3">GB</td></tr>
<tr><td colspan="2">From what date will the policy be implemented?</td><td colspan="3">The start date will be confirmed in accordance with the rollout plans for the preferred Option.</td></tr>
<tr><td colspan="2">Which organisation(s) will enforce the policy?</td><td colspan="3">DECC/Ofgem</td></tr>
<tr><td colspan="2">What is the total annual cost (£m) of enforcement for these</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Does enforcement comply with Hampton principles?</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Does implementation go beyond minimum EU requirements?</td><td colspan="3">Yes</td></tr>
<tr><td colspan="2">What is the CO_2 equivalent change in greenhouse gas emissions (for preferred option)?</td><td>Traded:
17.4MtCO2</td><td colspan="2">Non-traded:
15.6MtCO2</td></tr>
<tr><td colspan="2">Does the proposal have an impact on competition?</td><td colspan="3">Yes</td></tr>
</table>

Annual cost (£m) per organisation (excl. Transition) (Constant Price)	**Micro** N/A	**< 20** N/A	**Small** N/A	**Medium** N/A	**Large** N/A
Are any of these organisations exempt?	N/A	N/A	N/A	N/A	N/A

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

	2010	2011	2012	2013	2014	2015	2016
Transition costs	0	0	43,231,125	78,397,853	165,132,390	184,334,750	212,759,600
Annual recurring cost	0	0	27,299,325	52,430,597	162,534,525	362,881,133	565,814,587
Total annual costs	0	0	70,530,450	130,828,450	327,666,915	547,215,883	778,574,187
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	0	0	0	0	54,101,754	106,664,724	261,697,836
Total annual benefits	0	0	0	0	54,101,754	106,664,724	261,697,836

	2017	2018	2019	2020	2021	2022	2023
Transition costs	190,185,492	166,733,070	129,009,984	111,822,104	96,121,543	93,876,600	92,049,521
Annual recurring cost	769,479,046	911,684,151	965,809,989	976,821,917	963,935,987	957,394,277	951,433,627
Total annual costs	959,664,539	1,078,417,221	1,094,819,974	1,088,644,022	1,060,057,530	1,051,270,878	1,043,483,148
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606
Total annual benefits	515,064,404	781,634,647	1,034,394,175	1,268,374,102	1,407,797,888	1,450,357,798	1,493,459,606

	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	946,057,882	953,589,516	957,126,302	949,795,280	941,943,887	930,211,037	914,569,254
Total annual costs	1,036,309,591	1,042,730,912	1,045,157,386	1,038,965,704	1,029,936,417	1,021,105,436	1,008,365,521
Transition benefits	0	0	0	0	0	0	0
Annual recurring benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484
Total annual benefits	1,518,250,565	1,567,545,970	1,602,416,653	1,718,691,164	1,797,284,226	1,848,384,646	1,898,984,484

* 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%		

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'
14	Ofgem (2011) "Energy Demand Research Project, final analysis" , http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=21&refer=sustainability/edrp.
15	ENA and Imperial College London (2010) "Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks", available at http://www.cts.cv.ic.ac.uk/documents/publications/iccts01392.pdf
16	CER (2011) "Electricity Smart Metering Customer Behaviour Trials (CBT) Findings Report", cer11080, http://www.cer.ie/en/information-centre-reports-and-publications.aspx?article=5dd4bce4-ebd8-475e-b78d-da24e4ff7339

Contents

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

The Government set out its commitment to the roll out of smart meters within its coalition programme[6].

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 supports 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.

The analytical work over the last three years has been supported by cost benefit modelling and analysis from a range of sources, including Mott Macdonald[7], Baringa Partners, Redpoint Consulting and PA Consulting Group, and has been presented in a series of publications since 2008, among which a number of Impact Assessments (IAs).

In Phase 1 of the programme, DECC has worked with Ofgem E-Serve as delivery partner. This Phase concluded in March 2011 with the publication of Government's Response to the Consultation on the Smart Meter Prospectus which set out conclusions on a range of regulatory, technical and commercial arrangements required to implement smart metering in GB[8]. Alongside the Response the Government also published an IA (hereafter March 2011 IA) which considered and arrived at decisions for:

- functionality of the smart meters solution, including meters, communications and real time displays;
    - length of the rollout period;
    - scope and establishment of the central data and communications provider (DCC);

[6] HMG, *'The Coalition: Our programme for government'*, 2010.
[7] BERR, *Impact Assessment of Smart Metering Roll Out for Domestic Consumers and Small Businesses*, April 2008, http://www.berr.gov.uk/files/file45794.pdf.
[8] The chosen implementation model decided on in the Prospectus response 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.

•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.
Since then and with the start of Phase 2 of the Programme, work has included developing a detailed technical specification for the smart meter equipment, building upon the Functionality Requirements Catalogue (the "Catalogue") that was published alongside the Prospectus Response Document. While the Catalogue provided stakeholders with the functional requirements, these would not, in themselves, ensure interoperability between different pieces of smart metering equipment or back offices .

In January 2011, DECC established eighteen Industry Advisory Groups, under the Smart Metering Design Group (SMDG) to develop functional requirements into technical specifications. The technical specifications are intended to outline how the functionality will be achieved. The output of this process is called "Industry's Draft Technical Specifications"[9] and was published at the beginning of August 2011. Government is seeking views on it via the consultation document published alongside this IA (Smart Metering Implementation Programme: A consultation on draft licence conditions for the roll-out of gas and electricity smart meters).[10]

Further analysis of the industry draft technical specifications will be conducted alongside consideration of the responses of the consultation.

This updated IA presents new analysis carried out since March 2011 in the following areas:
o options for the configuration of the Communications Hub within the home in order to implement the policy of a replaceable WAN transceiver, a requirement identified in the Prospectus Response
o outage management benefit increases in light of the provision of outage detection functionality
o Consumer access to data over the Smart Metering Home Area Network (HAN)
o Enduring Pre-payment (PPM) interface for meters in difficult position

The communications hub analysis has resulted in a number of options being identified to deliver the intended functionalities. Those options are presented in cost terms in the summary sheets of the IA and discussed and assessed in detail in sections E and F. The analysis of the remaining areas (outage management benefits, consumer access to data over the SMHAN and enduring PPM IHD) considered in this IA are discussed in section F.

No new evidence has come to light regarding the analysis of possible rollout completion dates, so this IA sets out the analysis that was undertaken for the March 2011 IA and seeks further views on the question of setting a specific date within 2019 through the consultation.

In other areas new evidence has been developed or received since March 2011. This has been reflected in the revision of the following costs and benefits assumptions:

[9] http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/smart-meters/2393-smart-metering-industrys-draft-tech.pdf.
[10] http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

- changes to our cost assumptions have been made in the areas of electricity meters, communications equipment (to reflect new cost assumptions and also components previously not considered) and outage detection functionality.
- benefits have increased to reflect new assumptions about outage management benefits to networks arising from the provision of outage detection functionality.

All changes to assumptions are referenced in the evidence base in section F, but are also summarised in annex 2.

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 if 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.

The present IA has been updated since March 2011 to accompany a consultation on draft licence obligations and technical specifications to implement the arrangements set out in the Prospectus Response. In particular it sets out and seeks views on the costs and benefits of different options for the configuration of the communications equipment within the home. The identified options serve the purpose of implementing the requirement of an independently replaceable WAN module as identified in the Prospectus Response.

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 refer to the smart metering system as a whole. The objective of the options considered in this IA in particular is the implementation of the requirement for an independently replaceable WAN module as identified in the Response to the Prospectus Consultation in March.

E. Options identification

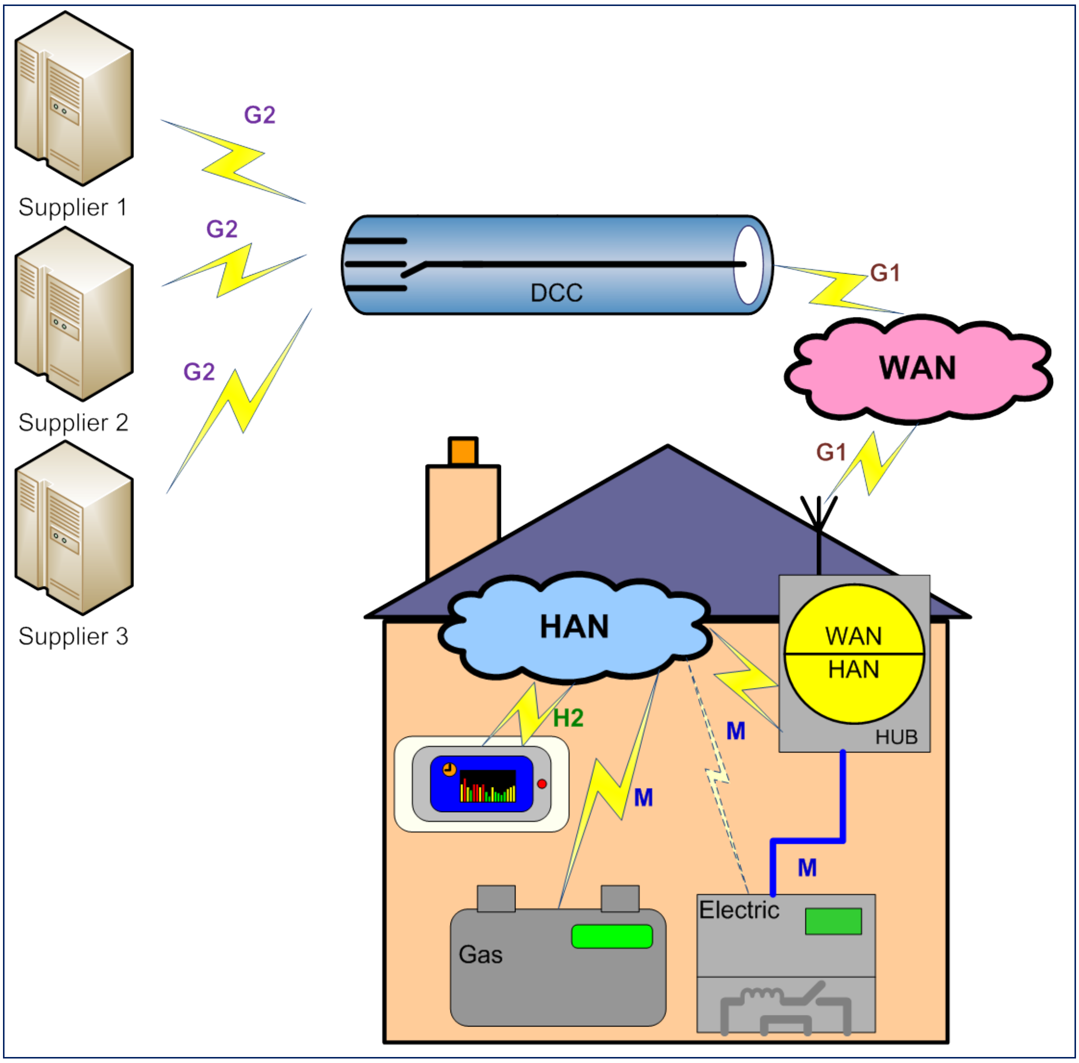
This section presents the different options considered for the configuration of the communications equipment within the home to achieve the WAN modularity identified in the March 2011 Response to the Prospectus consultation IA.[11]

The smart metering system within the home consists of the below components:

- o An electricity smart meter
- oA gas smart meter
- oA real-time display also known as in-home display ("IHD")
- oA wide area network (WAN) to achieve communication between the home and the central data and communications company
- oA home area network (HAN) to achieve communication between the smart meter system components within the home

The last two elements are part of the communications architecture and are subject to further analysis presented in this IA.

The below schematic illustrates the components of the smart metering system and their relation to each other:



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

The Response to the Prospectus Consultation concluded that “the WAN module” should be exchangeable without having to replace metering equipment. Work in this phase has assessed options that are available to implement this requirement.

The identified options for the configuration of the communications equipment within the home to achieve WAN modularity are:

1. Fully Integrated: the wide area communications functionality is built into the electricity meter with no modular components;

2. Integrated Into the electricity meter) with replaceable WAN: the only modular component is a replaceable wide area communications transceiver and minimal supporting components;

3a. *Separate Communications Hub with fixed WAN:* a separate and replaceable Communications Hub with wired or wireless connection to the electricity meter with all wide area communications components contained within the hub;

3b. *Intimate Communications Hub with fixed WAN:* Communications Hub that is adjacent (and possibly attached) to the meter but is replaceable without removing the meter – the Communications Hub has no modular components, and shares a HAN transceiver with the electricity meter;

4. Separate Communications Hub with replaceable WAN: Separate Communications Hub with modular, wired or wireless connection to the electricity meter and a replaceable wide area communications transceiver.

The full appraisal of these options against a number of criteria is set out in section F of this IA. The summary sheets presented at the front of this IA compare the cost implications of the different options. The implications are shown in overall NPV terms. Updates to costs and benefits have been consistently applied to all the options and are included in all the NPV figures presented.

The smart meters programme is seeking views on the identified options through the consultation and this IA should therefore be read in conjunction with the consultation document.

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.

F. New substantive analysis carried out since March

The delivery of smart metering to GB domestic consumers is a major infrastructure project. Work between July 2010 and March 2011 focused on developing the Prospectus Response Document and planning subsequent phases of the Programme. Since March of this year the Programme has worked on developing draft licence obligations regarding implementation and delivery of the rollout. The consultation published alongside this IA sets out these obligations, and invites stakeholders' to comment on them.

The Prospectus Response Document presented 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. This is based on a supplier led delivery of smart meters combined with a centralised data and communications company[12]. Relevant areas of analysis for the decision on implementation included the functionality of the smart meter, the rollout strategy and the establishment and scope of the DCC. To aid the understanding of the smart meters programme as a whole, background information on these areas is provided in annex 1.

This section presents new analysis conducted since March 2011 in the four following areas:

- Configuration of communications equipment in the premise
- Outage detection and benefits from improved outage management
- Consumer interface to the Smart Metering HAN
- Enduring prepayment interface for prepayment customers with meters in inaccessible positions

Configuration of communications equipment in the premise

Work in this phase has brought to light that the requirement of an independently replaceable WAN module is possible to achieve through a number of different approaches and that they all have cost implications. This section of the IA outlines in detail the further analytical work that has been carried out in light of the findings from the industry working groups.

In the following we outline in detail the technical solutions identified in the development work and the approach taken to comparing them and assessing their suitability for the deployment in the smart metering equipment within the home.

The technical options in detail:

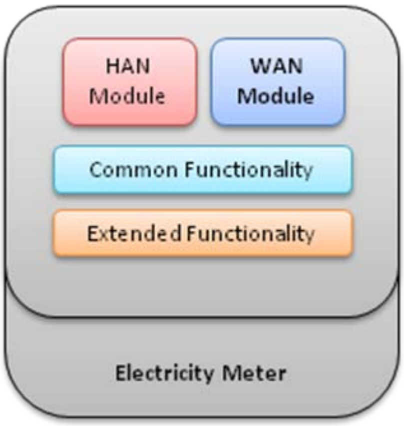
1.Fully integrated (communications equipment within the electricity meter)

This is the most basic architecture design and does not provide the possibility of an independent replacement of the WAN module as identified by the response to the Prospectus Consultation. In light of the potential day 1 cost implications of the

[12] Earlier options assessed, consulted upon and discarded included: a fully competitive model, a fully centralised model, a distribution network operator (DNO) deployment model, an energy networks coordination model and a regulated asset ownership model. See DECC, Impact Assessment of a GB-wide roll-out of smart meters (December 2009).

alternatives this approach is included in the comparison in order to robustly ascertain whether a flexible approach is indeed desirable and should be prescribed by Government. In this design the communications equipment would be integrated into the electricity meter and be powered via the meter's mains electricity connection. The WAN module would not be independently replaceable, so in the case of a WAN exchange the whole electricity meter would be replaced.

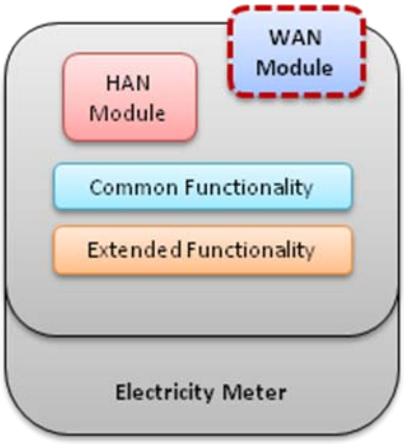
The below schematic illustrates this architecture design:



2.Integrated meter / Communications Hub with replaceable WAN transceiver

This design architecture reflects the approach that was envisaged in the March 2011 consultation response[13]. While the communications equipment would be housed in the same casing as the electricity meter, the WAN module would be easily replaceable – in essence a socket and plug system. This would result in very low equipment costs in case of a WAN technology exchange This option requires a standardised interconnector that would allow for a straightforward replacement of the WAN component, and that would be suitable for all potential communications technologies that might be deployed. It has however emerged that such an interconnector does currently not exist. While the development of a standardised connector is technologically possible it will take time. Until it is developed, alternative options would have to be deployed during the foundation phase.

The below schematic illustrates this architecture design:

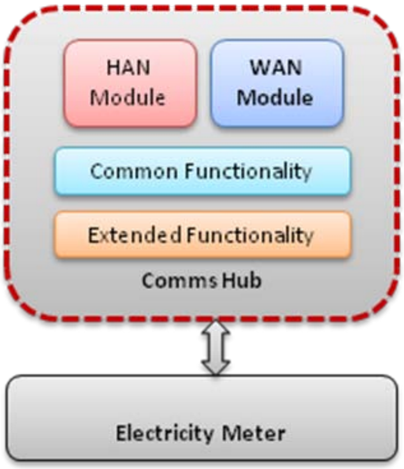


3a. Separate Communications Hub with fixed WAN transceiver

[13] Although the March IA assumed that the replaceable WAN transceiver would be achievable at no incremental cost.

As explained above, a standardised WAN interconnector does not currently exist. A potential alternative solution is to require the architecture design of a modular Communications Hub. This will allow replacement of the WAN module without needing to replace the whole meter is the architecture design of a modular Communications Hub. This is the technical solution that would likely be deployed in the absence of further government intervention. Under this approach, the communications equipment would be housed in a separate casing to the metering equipment and would be connected via a power cable. Data would be transferred via an additional HAN in the electricity meter. In the case of a WAN replacement, the communications unit would be exchanged completely. While this approach would lead to a reduction of the replacement cost in case a new WAN technology was required, it increases the initial equipment costs.

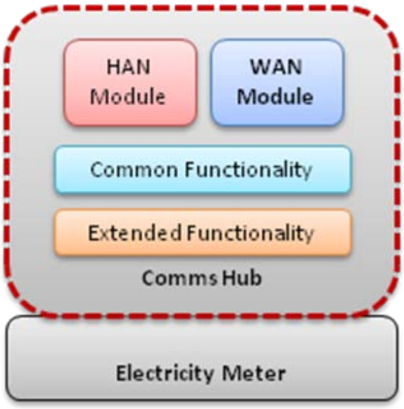
The below schematic illustrates this architecture design:



3b. Intimate Communications Hub with fixed WAN transceiver

This is a hybrid approach where the communications equipment sits within a separate casing that is immediately attached to the electricity meter, i.e. on the outside of the meter casing and not connected to it via a cable. The Communications Hub would share the HAN and power supply with the electricity meter. In the case of a WAN exchange the whole casing containing all the communications infrastructure would be replaced, while the meter would stay in place.

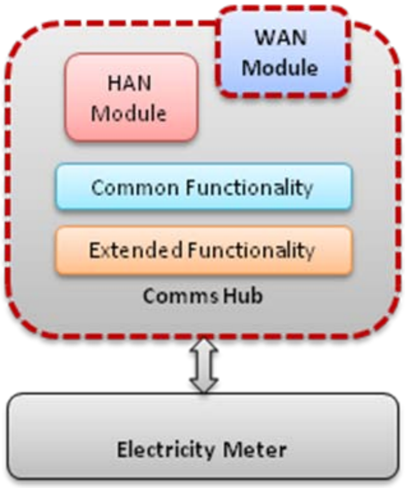
The below schematic illustrates this architecture design:



4. Separate Communications Hub with replaceable WAN transceiver

This architecture design combines the modularity of the Communications Hub with the modularity of the WAN transceiver. Under this approach both a modular Communications Hub and a replaceable WAN transceiver would be deployed.

The below schematic illustrates this architecture design:



Assessment of the identified options

A detailed option appraisal matrix has been developed to assess the available technical solutions against a variety of criteria and to identify Government's preferred option
on which we are seeking further views through the consultation.

Criteria for options appraisal:

- *Cost:* What is the day one installation costs for each of the options?
- *Impact for gas-first installations[14]:* How easily can gas-first installations be supported and what are the cost and other impacts on the programme?
- *Impact for viability of Foundation phase:* What is the impact on the incentives for suppliers to roll-out meters in the foundation phase, and what are the implications for the DCC when it goes live?
- *Impact on procurement:* What is the impact on the procurement of equipment (by suppliers and DCC)? Does it add complexity (and cost)?
- *Future Flexibility:* How easily and cost effectively can equipment be upgraded/replaced?

The outcome of the assessment of the options against these criteria is outlined in the following table and discussed further in the detailed description of each of the options.

[14] Gas-first installations refer to households that receive their electricity from a different supplier than their gas and where the gas smart meter will be installed first.

Table 1: Summary of options appraisal

	1: Fully integrated meter / Communications Hub	2: Integrated meter / Communications Hub with replaceable WAN transceiver	3a: Separate Communications Hub with fixed WAN transceiver	3b: Intimate Com. Hub with fixed WAN transceiver. (Com. Hub shares HAN transceiver and power with electricity meter)	4: Separate Communications Hub with replaceable WAN transceiver
Cost					
Gas-first					
Foundation					
Procurement					
Future Flexibility					
OVERALL					

All cost estimates outlined in the following have been developed in close cooperation with industry experts in the technical working groups.

Detailed appraisal of the identified options:

Option 1: Fully Integrated

For this approach the analysis uses the updated communications infrastructure cost assumptions outlined in the cost section of the evidence base (see section G). Both at the point of initial metering installation (day 1 costs) and at the point of WAN replacement communications component costs of £22 are applied. In addition at the point of WAN replacement a new electricity meter at the cost of £43 is required. This option minimises day 1 installation costs, but has the highest costs of replacement. Gas first installations under this approach are theoretically possible if the gas smart meter installer installs a standalone Communications Hub, however this will result in two Communications Hubs being deployed into the premise. In light of the resulting cost increase (because of the need to have two Communications Hubs) gas first installations are not desirable under this approach.

While this option is readily available in design terms, the high costs of replacement increase the risk for a large scale deployment before the communications technology is decided and the DCC is operational and might discourage suppliers from rolling out smart meters.

With a view to procurement, this option is problematic since it would require suppliers to procure a number of different meter models, so that compatibility with the communications equipment of the meter installed first can be guaranteed.

Future flexibility is limited under this approach since a WAN replacement would require the whole electricity meter to be exchanged.

Option 2: Integrated with replaceable WAN

For the analysis of costs and benefits, an initial cost of the communications equipment at point of smart meter installation of £25.5 has been assumed. This cost uplift of £3.5 in comparison to the non-modular WAN, as well as all other new technical component cost estimates used in this IA, has been developed in close cooperation with industry experts in the architecture working group. At the point of WAN technology exchange, the replacement WAN module would carry a cost £16.75, reflecting that some of the initial cost uplift would be located in the meter (i.e. the socket would stay in place).
As for option 1, gas first installations would not be desirable under this integrated approach.
The fact that this solution will not be available from day 1 of the foundation stage results in this approach being assessed as problematic, since it would delay the availability of compliant equipment.
Procurement of equipment would only be slightly easier than under option 1, seeing that this option is based on a standardisation of the WAN transceiver. The second installer (gas or electricity) would however still need to carry different meter models to ensure compatibility with the HAN of the smart meter already in place.
Future flexibility would be ensured under this approach as WAN replacement costs would be low compared to the alternatives.

Option 3a: Separate Communications Hub with fixed WAN
For the modelling of this approach an initial communications equipment cost figure of £25.6 is used (option 1 i.e. £22 plus £1.1 for a separate casing and seal and one additional HAN at £2.5), with the same cost incurred at the point of WAN exchange.
Under this design gas first installations would be possible at no or little additional cost. Rather than receiving mains power from the electricity meter as under the standard approach, the gas meter installer would establish a separate mains connection to power the standalone communications equipment.
For the foundation stage criterion, there would be no delay since metering equipment to this specification is readily available.
In terms of procurement this approach is the strongest option (together with option 4), since it removes the need for any standardisation of the meters.
This approach scores stronger than the fully integrated approach in terms of future flexibility since a WAN exchange would only require the replacement of the Communications Hub rather than the whole meter.

Option 3b: Intimate Communications Hub with fixed WAN
This design slightly decreases day 1 equipment cost compared to option 3a (since the Communications Hub shares the HAN with the electricity meter) and also reduces the replacement costs in comparison to option 3a. The costs applied are £23.1 day 1 costs and £23.1 at point of replacement. However, some development work would be required to achieve a standard specification (including physical form factor and interfaces), resulting in a delay of compliant equipment.
Gas first installations are more difficult than under the fully standalone approach, because the Communications Hub is by default attached to the electricity meter, which might result in two Communications Hubs being deployed in some premises.
The delay from the requirement to develop a standardised design is also problematic regarding the foundation stage, as compliant metering equipment will not be available from day 1.
The assessment against the procurement criterion is similar to option 2, since it is based on a standardisation of some of the components procurement of equipment is not as difficult as under the fully integrated approach. To ensure compatibility with the HAN equipment, different equipment would still need to be carried by the meter installer.

Given lower WAN replacement costs than under the fully integrated approach but higher costs than under the replaceable WAN transceiver, this approach scores an amber with regards to future flexibility.

Option 4: Separate Communications Hub with replaceable WAN
Since this approach is essentially a hybrid between options 2 and 3a, initial communications equipment costs at point of smart meter installation of £29.1 are assumed (option 3a plus £3.5 for WAN modularity as in option 2), with replacement WAN equipment costing £16.75 (as in option 2). Since this option builds on the availability of a standardised WAN interconnector as under option 2 the same delay to the availability of compliant equipment applies.
Gas first installations are possible under this approach, in line with the rationale outlined for option 3a.
The lack of a standardised WAN interconnector and the resulting delay in compliant equipment negatively impacts the assessment against the foundation criterion.
In terms of procurement this approach is the strongest option (together with option 3a), since it removes the need for any standardisation of the meters.
This option scores slightly higher than option 2 for the assessment of the future flexibility criterion because not only is the WAN replacement possible at lowest cost, but also would it be possible to replace the Communications Hub rather than the whole meter should a non-WAN related communications exchange be required.

For all of the above options, there would be installation costs (in addition to the cost of equipment) at point of WAN replacement of £29. No cost differential is assumed for the different architectural approaches because in all cases the installer would need to be trained to handle mains electricity powered units. The cost estimate of £29 is equal to the installation costs assumed for an electricity smart meter.

The below table summarises the cost assumptions for the available options, both at point of smart meter installation and at point of replacement.

Table 2: Overview of per unit costs for different communication architectures

Communications architecture	Day 1 costs	Cost of replacement equipment	Installation cost at point of replacement
1. Fully Integrated	£22	£65 (day 1 plus electricity meter cost)	£29
2. Integrated with replaceable WAN	£25.5	£16.75	£29
3a. Separate Communications Hub with fixed WAN:	£25.6	£25.6	£29
3b. Intimate Communications Hub with fixed WAN	£23.1	£23.1	£29

4. Separate Communications Hub with replaceable WAN	£29.1	£16.75	£29

The overall cost of each option in NPV terms is presented in table 3.

Conclusions:

Having considered all relevant factors as outlined above and summarised in table 1, the programme is of the view that option 3a should be taken forward as the preferred approach and option 1 should be ruled out as a possible approach. It is important to note that both quantitative and qualitative criteria have been considered in deciding on the preferred options. While the preferred option has relatively high day 1 costs associated with it when compared to the alternatives, there are a number of unquantified risks that are not reflected in the NPV numbers. Options 2, 3b and 4 are all not currently available and will require a standardisation process before they can be deployed, therefore risking a delay in the rollout and the realisation of benefits. Option 1 results in the highest NPV with regards to day 1 costs, but does not satisfy the identified requirement of having an independently replaceable WAN transceiver and can therefore not be considered as a feasible approach.

We are in addition seeking views through the consultation published with this IA on whether suppliers should be free to choose to install other architectural design approaches once the standardisations required to address some of the identified issues with options 2, 3b and 4 are completed.

<u>Consideration of the options under an illustrative WAN replacement scenario</u>

In order to further illustrate potential benefits from opting for an architecture approach that does not minimise day 1 costs, an illustrative WAN replacement has been modelled and the replacement costs of the identified options are compared . For this illustrative purpose a WAN replacement in 2024 has been modelled. This is not part of the central case in the main model, but serves to illustrate potential cost advantages of options with higher day 1 costs at point of replacement.

An illustrative WAN replacement is important to consider in the context of the realisation of smart grid benefits. Given the cost implications of a WAN replacement, such a replacement would only be undertaken in the future if a positive business case existed, i.e. if the expected benefits outweighed the expected costs. Therefore the costs of an illustrative replacement of the WAN should be interpreted as potential costs that might need to be incurred to realise smart grid benefits.

Table 3 outlines the overall NPV reflective of the cost implications of the individual options and shows the replacement costs day 1 cost increase, the illustrative replacement costs and the net smart grid benefits for the five communication architecture approaches.

<u>Table 3: Comparison of costs</u>

Communications Hub configuration	Overall NPV reflecting day 1 cost (in millions)	Replacement costs (in millions)
1. Fully Integrated	£5,059	£1,351
2. Integrated with replaceable WAN	£4,909	£680
3a. Separate Communications Hub with fixed WAN	£4,904	£817
3b. Intimate Communications Hub with fixed WAN	£5,012	£783
4. Separate Communications Hub with replaceable WAN	£4,754	£680

While the fully integrated option 1 is the cheapest in terms of day 1 costs, the above illustrates that in the case of an illustrative WAN exchange the replacement costs of option 1 are significantly higher than the alternatives.

Incremental outage management benefits to Network Operators from outage detection functionality

The March IA had identified a range of outage management benefits that are expected to arise to DNOs once smart meters are deployed. This section illustrates what increase in these benefits can be reasonably expected from the provision of outage detection functionality and considers in addition to what extent different outage management benefits would have to increase in order to make incremental costs of the functionality worthwhile.
The outage management benefits to networks outlined in the evidence base section of this IA have been revised according to this analysis. Improvements considered here only refer to outages in the low voltage parts of electricity distribution networks, since other parts of the system already have some fault detection processes in place.

Summary:

Looking first at a scenario of benefit improvements that can be reasonably expected, a break-even point for incremental costs from outage detection is established. The analysis then further considers customers' willingness to pay for distribution quality of service improvements and establishes implicit expected improvements required to justify costs from a customer perspective. Lastly, by looking at different possible outage management benefit increases, the analysis establishes some illustrative

scenarios under which additional equipment costs from having outage detection functionality would be justified.
All approaches lead to the conclusion that the improvements in outage management benefits that are required to offset increased costs are realistically achievable and that therefore there is a positive business case to include the functionality. Government seeks further views on our cost and benefit assumptions through the consultation but intends to include outage detection in the technical specification.

Expected improvements from outage detection
While we are seeking further views from industry through the current consultation to verify this assessment, it seems not overly optimistic to expect the average low voltage customer interruption to be shortened by around 10 minutes through having outage detection, on top of the 10 minutes reduction introduced in the March IA (this improvement could be delivered through the general smart meter functionality, without the provision of outage detection). This could be achieved by a mixture of earlier detection (e.g. outages at night-time where customers currently only call in the next morning), quicker mobilisation of corrective measures (e.g. no need for further diagnostics by the DNO) and a quicker resolution of the technical issue (e.g. avoidance of undetected nested faults).
In line with this incremental improvement of a further 5% reduction in customer minutes lost (CML) in comparison to the March 2011 IA - reducing the duration of the average LV customer interruption from 192 to 182 CML - we expect operational cost savings from fault fixing to be increased by a further 5% as well as a result of adding outage detection functionality (on top of the 5% improvement from general smart meter functionality that was outlined in March). In addition we make a cautious assumption about incremental benefits from a reduction in the call volume that DNOs will have to handle once outage detection is in place and estimate a further 5% reduction in costs (on top of a 10% reduction introduced in the March 2011 IA).
In sum these improvements would lead to present value benefits of £143m, equating to a break-even point for the outage detection cost per unit of around £3.6 in a scenario where 15% optimism bias is assumed and £1.4 in a scenario with more uncertainty about the eventual costs and an optimism bias uplift of 150%. Therefore, given the current cost estimate of £1 with a 150% optimism bias uplift there is a positive economic case for the inclusion of outage detection functionality.

As outlined above, the improvements are estimates on the basis of reasonable expectations and need to be further tested for robustness with industry and DNOs. However, they illustrate that relatively modest savings are required for there to be a positive business case for outage detection.

In addition to the above scenario of benefits that can be reasonably expected, we explore below a number of illustrative scenarios that would deliver sufficient benefits to offset additional costs at the currently assumed £1 per unit cost point (with an optimism bias uplift of 150%).

Customers' willingness to pay for distribution quality of service improvements
Ofgem uses under the Distribution Price Control Review 5 (DPCR5)[15] a rate of £0.17 to incentivise / penalise DNOs' performance with regards to interruptions and the resulting amount of CML within their networks. This figure was derived from a stated preference survey carried out in 2008 that established the willingness to pay of customers for improvements in the quality of distribution services. More precisely,

[15] 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.

the £0.17 reflect the value customers attribute to each minute less of lost supply in a year.
For the purpose of assessing the desirability of the outage detection functionality, it is helpful to look at potential cost implications from the willingness to pay angle through which the quality of supply incentive rate was initially derived. This implies that for an annual outage management equipment cost of 17 Pence, customers expect a reduction in CML of 1 minute. Consequently, each one off Pound of outage detection costs - equalling over the 15 years lifetime of the meter an annual cost of under 9 Pence – is justified if it delivers on average an annual reduction in CML of around 30 seconds per customer[16].

Available levers to increase outage management benefits

I. Customer minutes lost
-Each 1% reduction in the annual sum of CML results in PV benefits of ~£10m

II. Operational savings from fault fixing
-Each 1% improvement of fault fixing costs results in PV benefits of ~£18m

III. Reduced calls
-Each 1% of avoided customer calls results in PV benefits of ~£2.1m

Delivery target

In PV terms, the additional costs for outage detection results in a PV asset cost increase of £108m. This reflects a unit cost estimate of £1 and the high optimism bias uplift of 150% that is applied to the outage detection component cost.

Break-even scenarios

In order to recover the additional costs that arise from having the outage detection functionality, a number of illustrative benefit scenarios are conceivable.

Scenario 1:
Improvements in all identified outage management benefits areas
If all the identified benefits were to increase simultaneously, fairly modest increases from the individual items would be sufficient to generate £108m in present value benefits required to offset the incremental costs of each £1 for adding outage detection to the smart meter functionality.

As an illustrative example, a further 3.5% reduction in both CMLs and the costs of fault fixing in combination with a further 7% reduction in customer calls (all on top of the outage management benefits identified in the March IA) would generate sufficient incremental benefits to outweigh the additional costs from providing outage detection.

Scenario 2:
No CML and fault fixing benefits over and beyond current estimates, but high reductions in call volumes through outage detection
Moving to the current high benefit scenario of 20% reduction in the volume of calls (i.e. assuming an additional 10% reduction from outage detection), delivers incremental PV benefits of £21m.

[16] This ignores other benefits that might be delivered from having outage detection functionality and only looks at the required benefits to meet customers' expectations in quality improvements for a certain willingness to pay.

The incremental present value outage detection costs of £108m for a unit price increase of £1 and including 150% optimism bias uplift would be recovered if the volume of calls was reduced by about 60% (while the other outage management benefits remained at the level outlined in the March IA). This is an extreme scenario, but international evidence indicates that network call volumes can be reduced over time by up to 60%. This is intuitive as awareness of and reliance on outage detection among customers grows and fewer people call in. A reduction of calls by 26% (and potentially beyond that level) seems therefore both realistic and achievable. The added ability achieved through outage detection could be actively outlined during the installation or in information material that comes alongside the smart meter, in order to make consumers aware of not having to inform networks of outages any longer. Network Operators could also put in place automated messages about areas with known incidents and estimated resolution times, so that fewer calls have to be answered by call centre operatives[17].

<u>Scenario 3:</u>
<u>No improvement in fault fixing and customer call benefits, but a reduction of CML through quicker detection</u>
In order to recoup £108m outage detection costs for a unit price increase of £1 at an optimism bias uplift of 150%, the reduction in CML would have to increase from 5% to roughly 17%.

This equates to a reduction of the sum of annual CML across all customers within the UK by 93m and the average duration of a low voltage system customer interruption to be reduced from 202 to 168 minutes.
Bearing in mind that currently time lags would occur both on the customer side (e.g. because the outage occurs at night time) and on the DNO side (e.g. for pinging other meters in the vicinity once a customer call has been received), a reduction by 34 minutes as a result of outage detection seems within achievable bounds, in particular since further time savings from better diagnostics, e.g. location and extent of fault and re-energisation can be expected (these time savings are further considered in the fourth example). Again it is important to note that this an extreme scenario that is unlikely to occur in reality.

<u>Scenario 4:</u>
<u>No improvement in customer call benefits, but reduced CML in line with increased fault fixing cost savings</u>
Assuming that reduced CML change in line with fault fixing cost savings, a further improvement of just over 4% on top of the March IA levels for both benefits would be sufficient to recoup present value outage detection costs of £108m (reflective of £1 unit cost and 150% optimism bias). There is a solid rationale for such an assumption, as fault fixing cost savings would at least partially be driven by a more efficient utilisation of technical staff resulting in a quicker resolution of incidents.

A 4% improvement in CML benefits equates to a reduction of the length of the average customer incident of only another 8 minutes which seems wholly plausible, e.g. because technical crew can be dispatched sooner or have to spend less time finding a fault once outage detection is in place (anecdotal evidence indicates that

[17] Should battery operated IHDs be implemented, Network Operators might consider to inform customers of issues in their area via a message to the IHD, to further discourage customers from calling and further reducing call centre operations.

engineers currently spend considerable time in some instances driving through the affected area in a attempt to localise the source of the problem).
Even though a detailed breakdown of the components of fault fixing costs is not available, it appears realistic to expect a 4% reduction of costs to stem from time savings, e.g. from being able to pinpoint the root cause of an outage or from avoided repeat call-outs where nested outages have been able to be identified through re-energisation notifications (first gasp).

Consumer access to data over the Smart Metering HAN (SMHAN)

Two key Programme objectives are:

- supporting a market for ESCOs and other Authorised Third Parties; and
- allowing consumers to access consumption data in a variety of ways

One way in which these objectives will be met is by ensuring that consumers and authorised third parties are able to access consumer data over the Smart Metering HAN (SMHAN). Whilst consumers will have access to a minimum set of consumption information on the SMHAN[18] through their IHD, some consumers may wish to use data on consumption and tariffs from the smart metering system to send commands to other smart appliances in the home; or to transmit the data via a different communications network (such as their existing wifi network) which can be picked up by other devices (e.g. smart phone or computer).

While it may be possible to connect directly to the SMHAN, this would require smart devices to meet a higher level of security. Facilitating bridging to a consumer's network will allow consumers to connect devices to their existing network - currently many homes already have a WiFi network - without having to follow the secure connection process in place for connecting devices to the SMHAN.

Additionally the HAN may not use technologies that are prevalent or are sub optimal for use in consumer devices.

To translate data from the SMHAN to a consumer's network a bridging device/translation chip is required. There are various technical ways in which a bridging device can be connected to the SMHAN.

Further work has been carried out in this phase of the smart meters programme to analyse the approach to delivering or facilitating a local consumer interface with the SMHAN.

The short term applications that are enabled by this interface are not critical given the required functionalities of the WAN and IHD[19]. In the medium term, significant benefits could arise from the connection of smart appliances. There is, however, much uncertainty concerning the expected penetration of smart appliances in the short and medium term.

Different technological solutions can be used to facilitate this access. The three approaches assessed by the Programme team are:

[18] Both real-time and historical consumption information will be available over the SMHAN (A full list of data items and detail of access control is set out in the Industry's Draft Technical Specifications).
[19] Access to real time consumption and tariff information will be provided as part of the minimum IHD specifications and access to 13 months historical data can be achieved over the WAN.

•**1):** A consumer owned 'bridging' device (envisaged to be a wireless connection) that will provide a secure connection and converts the signals from the SMHAN into another communication system that can be used by other devices.

•**2):** A physical port within the smart metering equipment where the consumer can 'plug-in' a device (similar to the 'Bluetooth' or '3G' adapters already used to connect laptop computers to a peripheral device such as a mouse, or for mobile internet access) that can communicate with a communications network within the home.

•**3):** Provide the ability to directly connect through an second transmission system (e.g. Wi-Fi or Bluetooth chip etc) that would be embedded into the Smart Metering Equipment. This would allow consumers to communicate with smart metering equipment through their own communications network (in a similar manner to a wireless hard drive, or a wireless printer).

These solutions have been assessed qualitatively against a number of criteria (timing, future flexibility; cost implications and competition impact).

Essentially, the two last solutions build costs into every smart meter (because either a port or a component need to be incorporated in the meter) for a functionality that a large proportion of consumers might not use in the near future, while a wireless bridge does not risk unnecessary expenditure, and leaves consumer's choice to add this functionality if desired, as well as flexibility with regards to technology. It also leaves flexibility to adapt to future HAN technologies. The second alternative could also limit competition if it is only able to support one provider (unless it has multiple ports). In terms of timing, the wireless bridge could be made available by the market in line with the rollout timeline, while the other solutions require further technological development since they would require the development of compliant metering equipment.[20]

The Programme preferred approach is the first solution (wireless bridge), however we welcome comments on that view through the consultation published alongside this IA. Such an approach offers a number of advantages which are described above. This solution is essentially a default option, since it will materialise as consumers create a demand for a wireless interface bridge to the SMHAN which the market consequently would provide. To ensure that consumers are able to easily connect bridging devices, the Programme intends to develop an appropriately secure but consumer-friendly connection process. The Programme will monitor the arrangement during Foundation Stage.

Enduring prepayment interface:

The March response to the Prospectus Consultation requested a view on a new "remote prepayment interface" for prepayment meters where the meter is in a difficult position. It is estimated that a number of premises have meters in an inaccessible position (likely to be up to 10%). This will impose additional costs for the installation of a prepayment meter.

Further work has been conducted in this phase on the costs of a number of options. Given that the decision to install a PPM is not driven by smart metering and would need to be incurred anyway in the business as usual case, the programme has taken the view that these costs should not be treated as an additional programme cost.

[20] The likely delay has been estimated by up to one year.

Already under existing licence obligations, energy suppliers are expected to provide prepayment meters to their customers upon request. By implication, the Government is of the view that the choice of the solution to ensure prepayment options to customers with meters in inaccessible position would be best left to the market as would happen in the business as usual case anyway. The Government however proposes with industry to facilitate the development of a wireless solution.

G. 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 analysis has been undertaken by DECC since the publication of the March IA 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 some of our assumptions on the basis of a critical examination of the available evidence. Key estimates that were refined for the March 2011 IA included 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.

For this version of the Impact Assessment the analytical focus has been to revise, in dialogue with industry, some of the cost estimates for technical components as well as further analysing the cost implications of different approaches to achieving the functional requirements set out in March. This has led to changes in our estimates of the costs of the electricity meter and the communications equipment.

Further work has also been conducted to refine our understanding of the benefits that can be expected from an outage notification function. In order to reflect continued uncertainty about the costs of the outage detection functionality we have revised our optimism bias assumptions for this component.

Differences between the assumptions in this IA and previous IAs are noted and explained within the text. For reference purposes Annex 2 provides an overview of the changes made since March 2011.

Overall the case for a rollout of smart meters to domestic consumers remains strongly positive in central scenarios (see results pages 72-75); the domestic rollout has a positive Net Present Value (NPV) of over £4.9bn. Table 4 compares costs and benefits of the preferred option in this IA (i.e. August 2011 IA against the preferred option in the March 2011 IA). This decreases the value of the NPV published in the March 2011 IA from £5,071m to £4,904m, by £167m.

The changes in costs are driven by new evidence about the components required within the communication equipment. Also, outage detection component costs have been removed from the electricity meters costs and added to the communications equipment costs. The changes in benefits reflect the increase of outage management benefits. Details of the new assumptions are provided in the next subsection.

Table 4: Costs, Benefits and PV (August 2011 vs March 2011)

	March 2011 IA (PV 2011)	August 2011 IA (PV 2011)
Total Costs	£10,757m	£11,067m
Total Benefits	£15,827m	£15,971m

Net Present Value	£5,071m	£4,904

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 £840m 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[21]. 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[22] 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.

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.

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

It is therefore reasonable to assume for modelling purposes a counterfactual world in which there is no smart meters roll out: this is the assumption used in the headline estimates presented in this IA. This is supported by the fact that even though the technology has been available for a number of years, no significant numbers of smart meters have been rolled out prior to the announcement of a Government mandate. Following the Government announcement, some energy suppliers have started rolling out limited numbers 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 the Government mandate[23]. 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.

Recognising that some level of smart meters may be rolled out in the domestic sector, for illustrative purposes we have also considered a situation where smart meters are rolled out to a significant part of the residential population. Such an illustrative scenario is outlined below and would imply a reduction in NPV of £2.6 billion.

This alternative scenario assumes that a rollout of smart meters would mean that energy suppliers rollout first to those consumers which benefit more from it, achieving a 20% rollout of smart meters. In a competitive metering world, this would result in a reduction in gross benefits of 30% and a reduction in costs of 20%. Even in this extreme illustrative scenario, the NPV of the smart meter rollout remains 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

We classify the costs associated with the smart meters rollout in the following categories: meters and IHD capital costs; communications infrastructure; installation

[23] We estimate that approximately 250,000 smart meters may have been installed to date, approximately 0.5% of the domestic metering population.

costs; operating and maintenance costs; IT costs; costs of capital; energy costs; meter reading costs; disposal costs; and legal, marketing and organisational costs.

Changes since March 2011 IA have been made in the first two categories listed, i.e. meters and IHD capital costs, as well as communications infrastructure.

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)[24]. It is assumed that a Wide Area Network (WAN)[25] 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 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 5: Capital Costs of Assets (£ per device)

	Electricity	Gas
Display	£15	£15
Meter	£43	£56

The cost per electricity meter was updated in the March 2011 IA to reflect an incremental cost of £1 per meter for the inclusion of outage detection capability to alert suppliers and networks when the electricity supply is lost. Further work has been carried out regarding the design of the overall smart metering equipment within the home. The conclusion of this work is that the most cost effective solution is that the necessary hardware providing this functionality is located within the Communications Hub using the same power source as the wide area communications technology. The March cost increase (£1) has therefore been removed from the meter cost and added to the costs of the Communications Hub which are outlined in detail below.

The cost estimate for the IHD has been further tested by the Industry working group meetings since March 2011 and the programme continues to be of the view that the required minimum functionality can be delivered at the £15 cost estimate.

Within the modelling it is assumed that due to technological advancement the costs of the meters and communications equipment will fall over time. We currently assume that costs fall by 1% per annum, resulting in a 10% reduction by the end of

[24] 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.
[25] A WAN is a communications network that in this case spans from the smart meter to the DCC.

2020. This reduction is split and is applied at three time points: 2010, 2017 and 2024. The assumptions about cost reductions over time are based on historic cost developments of traditional metering equipment. The programme is of the view that there is a strong rationale for increasing the cost reduction assumptions for a number of reasons:

- as smart meters are being deployed in more countries internationally and production volumes increase, there will be an incentive for new manufacturers to enter the market, leading to increased competition and price pressure
- economies of scale and learning effects from mass volume production will materialise and further reduce production costs of smart metering equipment

Initial views from industry seem to support that the current assumptions about cost erosion over time are low and further work will be undertaken to review them. We invite views on potential costs developments of smart metering equipment through responses to the consultation that this IA accompanies.

Table 6: Communications Hub (£ per device)

WAN (modem)	£15
HAN (within Communications Hub)	£2.5
Gas mirror	£4
Power supply unit	£2
Casing / seal	£1.1
Outage detection	£1

Further work has been carried out since March 2011 to analyse the cost and benefit implications of differing communications infrastructure requirements in the smart meter.

While the WAN modem cost assumption of £15 per unit remains unchanged from the March publication, a number of additional components within the communications equipment have been identified in the industry working groups. These have been added to our estimate of the communications module cost:

- The HAN for the gas meter was previously assumed to be more expensive than the HAN for the electricity meter as it was assumed that higher specified electronics were necessary for this battery operated device. Further work carried out in this phase implies that the same cost for electricity and gas meter HANs should be assumed. The previously assumed costs were £1 and £3 respectively and a cost figure of £2.5 per HAN is now used for all types of HANs. However, further work with industry has concluded that these component costs are already included in the meter cost estimates and have therefore been removed from the communications equipment costs. To reflect the preferred architecture approach of a standalone Communications Hub (as outlined in section F.) the cost for a third HAN within the communications equipment has been added.

- The SMDG working groups have identified that the regular transmission of consumption data from the gas meter would reduce the battery life and require a premature exchange. An additional component is required to enable the storage of the gas consumption information within the communications infrastructure so it can be accessed without depletion of the gas meter battery. This component will act as a “gas mirror” and will allow data to be accessed without the need of accessing the gas meter. Meter manufacturers in the working groups have provided their views that this has a cost of £4 per unit. This technical approach is more economical than having to replace the battery of the gas meter more frequently.

- A power supply unit will have to be built in to power the communications infrastructure. This is necessary because the meter is likely to have different power requirements to the wide area communications components within the Communications Hub. Work in the architecture working group has estimated a cost of £2 per unit.

- Section F details analytical work that has been carried out to determine a preferred approach to the configuration of the communications equipment within the premise. To reflect the current preferred option of a standalone Communications Hub, £1.1 for a separate casing and seal for this are also added to the costs of the communications infrastructure. This cost estimate has been developed in the architecture working group of SMDG.

- The cost increase for the electricity outage detection functionality has been moved from the electricity meter cost into the costs of the communications infrastructure since this is where the necessary hardware will be located within the metering equipment. We continue to apply a £1 cost per unit estimate for this functionality. The cost estimate is based on cost information received from meter manufacturers already producing smart meters with such capability. No compelling evidence has come to light that indicates that this cost figure would not be possible to realise in a GB smart meter rollout context. The consultation published alongside this Impact Assessment is seeking further views on the costs associated with the outage detection functionality as well as on the achievable outage management benefits. Until there is further clarity about the costs of components required to deliver the functionality we will follow a conservative approach to cost estimates and apply an optimism bias factor of 150% to the cost estimate for outage detection functionality. This will be revisited in light of evidence that will be received through the consultation and will be adjusted at the final stage of this Impact Assessment, once the technical specification is complete.

Installation costs

We have retained the assumptions from the March 2011 IA for installation costs; this includes a £10 per installation efficiency resulting from the dual fuel installation.

Table 7: 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[26] 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. The figure has also been further confirmed by responses to the Project Information Memorandum issued by DECC in preparation of the procurement of data and communications services for the DCC. The costs are 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 extensive data received 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.

- DCC capex

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

Ahead of the March 2011 IA 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. No further changes to the DCC capex estimates have been made since March.

- Supplier/Other Participant IT opex

The programme has used an industry standard figure of 15% of total IT 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. Following a conservative approach to the estimation of costs a capital cost of 10% p.a. is applied. 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 March 2011 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. The underlying cost assumption of £1 per meter has not changed since March 2011 and the cost-benefit model continues to reflect that meters would have had to be disposed of regardless of the implementation of the smart meters programme and only takes into account the acceleration and bringing forward of the disposal over and above the counterfactual. The calculation also applies the £1 disposal cost to smart meters, with resulting costs for the first generation meters to be replaced from 2027. PV costs amount to £20m. This is reflective of taking into account the counterfactual disposal and costs of £16m for disposing smart meters from 2027. The approach has not changed since the March 2011 IA.

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:

<u>Table 8. Legal, setup and organisational costs</u>

	£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).

<u>Table 9. Digital switchover consumer engagement spend</u>

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.

<u>Energy demand reduction</u>
There is a growing evidence base but also uncertainty about the precise level of response of consumers to the full roll out of smart meters. A number of large-scale international review studies exist, such as a review of 57 feedback studies in nine different countries by the American Council for an Energy-Efficient Economy (ACEEE) [27] which finds that on average feedback reduces energy consumption between 4-12%, with higher (9%) savings associated with real-time feedback. Sarah Darby[28]

[27] Erhardt-Martinez, Donnelly, Laitner, *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, June 2010.
[28] Sarah Darby, *The Effectiveness of Feedback on Energy Consumption*, April 2006.

and Corinna Fischer[29] 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. Recent trials in European countries resulted in energy savings within the same range.[30].

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)[31] 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 (EDRP) was a major project co-funded by the Government to provide information on consumers' responses to a range of forms of feedback, including smart meter-based interventions. The recently published final report[32] (June 2011) brings substantial new evidence on the behavioural impact of improved energy information in the GB context. 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 proven difficult to draw conclusions which can be generalised. However, the final report collates and builds on suppliers' findings and additional analysis of the data by AECOM. Findings are also discussed in light of the wider literature, to identify the interventions that have proved most effective in reducing consumption, and key messages about how these can best be delivered.

The report comes to the conclusion that trials involving the use of a smart meter were more likely to be successful and associated with larger percentage savings than

---

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

[30] The Commission for Energy Regulation (CER)30 in Ireland recently published the results of smart meter trials there. Electricity savings of around 2.5% overall were found from the combination of different types of demand-side interventions and time of use tariffs. (See CER (2011) Electricity Smart metering Customer Behaviour Trials (CBT) Findings Report, Information paper, CER11080a, May 2011, Available at http://www.cer.ie/en/information-centre-reports-and-publications.aspx?article=5dd4bce4-ebd8-475e-b78d-da24e4ff7339). In Germany, a recent smart meter trial suggests savings of around 5% due to a combination of indirect feedback and energy efficiency advice. (See Schleich, J.' Klobasa, M.; Brunner, M.; Gölz, S.; Götz, K.; Sunderer, G. (2011), Smart metering in Germany - results of providing feedback information in a field trial, *ECEEE 2011 Summer Study*, Energy Efficiency First: The Foundation of a low-carbon society).

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

[32] The 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/Pages/MoreInformation.aspx?docid=21&refer=Sustainability/EDRP.

those without. This supports the assumption that smart meters can be a vehicle for effective action to reduce domestic energy demand. EDRP trials generally found that the combination of a smart meter with an RTD was associated with significant electricity savings. Levels of savings varied according to how they were conducted, however, the trials that are more closely comparable to the GB roll-out showed statistically robust electricity savings of 2% to 4%. For gas, it was the provision of a smart meter rather than the RTD which was most significant in delivering savings, with savings of around 3%. This is in keeping with theoretical considerations that real time feedback is more relevant to electricity.

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 over time.

Overall, the GB evidence, as well as the international evidence, shows that large savings are achievable. Recent cost-benefit analyses have adopted various energy savings assumptions. Kema's recent cost-benefit analysis for the Dutch Ministry of Economic Affairs[33] assumes 6.4% electricity savings with direct feedback through an IHD (3.2% with indirect feedback), and 5.1% (3.7%) for gas.[34] The recent Irish CBA adopts a 3% electricity savings to compute illustrative estimates of the change in consumer welfare resulting from the installation of smart meters.

Even though the March 2011 Impact Assessment assumption on energy savings lie within the lower range of recent trials' results, they have not been revised upwards. This is because of the existing uncertainty on the precise level of energy savings at this stage of the analysis and caveats[35] in generalising trial results to the whole population. Further analysis is currently being conducted in the context of the consumer engagement strategy on the wider literature on behavioural change to develop a framework of behavioural change for smart metering. Lessons will also be learned from the early rollout installations and piloting of smart meters. This will strengthen the evidence base in the GB context. Together with Programme's development of plans for consumer engagement, including any support arrangements for different consumer groups, this work will help identify the potential need to refine our energy savings assumptions.

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

[33] KEMA (2010).
[34] The CBA assumes options for refusing the installation of a smart meter due to recent changes in Dutch political circumstances, and the CBA assumes a 20% voluntary uptake of IHD.
[35] Caveats include the degree of representativeness of the samples, trials effects and scale effects for instance.

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

We also apply sensitivity analysis to these benefits as follows:

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

Energy is valued consistently with guidance produced by DECC[36]. The energy baseline from which energy savings are calculated is consistent with the energy baseline used in the March 2011 Impact Assessment[37].

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.

<u>Microgeneration</u>
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.

<u>Avoided site visits</u>
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.

For the March 2011 IA additional evidence had emerged and had resulted in a revision of our approach to avoided site visits in comparison to the July 2010 IA. The revised assumptions are retained for this 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

---

[36] DECC Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, June 2010.
[37] 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.

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.

• 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[38]

[38] 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

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 10: Cost and benefit impacts from avoided site visits (per meter)[39]

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.

[39] 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.

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**

<u>Customer service overheads</u>
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 March 2011 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.

<u>Remote switching and disconnection</u>
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 will be consulting on a Spring Package of regulatory measures to strengthen protections for consumers.

<u>Pre payment cost to serve</u>
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.

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[40] 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).

[40] issued on 14th October 2010.

In IAs previous to March 2011 we had assumed savings of £100m per year, or £2 per meter per year[41]. 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)[42]. 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[43].

Network benefits

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

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

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

- Outage detection and 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.

We have assumed that a critical mass of smart meters is required for the above benefits to be realised. This is so that sufficient regional coverage is provided to identify the location and the scope of an outage. The benefits are therefore only considered to be realised from 2018 onwards, at which point over 80% of smart meters will be installed in our central scenario. This will also give Network Operators sufficient time to adjust their outage management systems to take full advantage of the additional available data. We also assume that the smart metering technology will only lead to outage related benefits in the low voltage network system. This is because other voltage systems within the electricity networks already have sophisticated monitoring and diagnostic systems in place.

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

This section outlines both the basic benefits considered in the March Impact Assessment, and the additional benefits from adding outage detection functionality to the minimum electricity meter specification. A number of potential scenarios how outage management benefits might increase are also considered.

Below the outage management benefits to Network Operators are outlined in more detail:

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.

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. There are several methodologies available to estimate the value of quality of supply improvements to consumers, however as we are trying to establish the benefits to Network Operators, this figure seems the most appropriate in this case.

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

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 teams can be deployed more efficiently and in a more targeted manner.

DECC has 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 10% 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 teams. We therefore assume that wages and staff time are the main drivers of the costs to fix faults – this approach ignores costs reductions in equipment and material. The benefit to Network Operators amounts to £0.66 per electricity meter per annum.

3. Reduction in calls to faults and emergencies lines:

In the long run customers will be confident that networks are aware of outages due to smart meter information. In the short run we envisage a reduction in the number of calls that need to be answered by the introduction of automated messages that inform callers of the geographic scope and expected restoration time, facilitated by more accurate information from smart meters.

International evidence suggests that the number of calls that have to be answered by networks regarding outages can be reduced by up to 60%. Over time customers will develop trust in the ability of networks to detect outages through the functionality provided by smart meters without them calling in to provide notification. This will enable very thin network operator call centre operations.

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 conservative assumption of a reduction of 15%, which results in annual benefits of £0.12 per electricity meter.

- Other electricity network benefits

In addition to the benefits outlined in the previous paragraph, Networks Operators will also benefit from the implementation of smart meters and enhanced availability of data. Network Operators will make savings resulting from their ability to make better informed enforcement investment decisions. They will also benefit from 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 will allow bottlenecks in the network to be identified more easily. Investment in network reinforcement can then be better directed. Information received through the ENA cost benefit analysis[44] indicates that the required network enforcement investments might be reduced by 5% through the availability of better information from smart meters. We have adopted this assumption for our base scenario. Our analysis uses the expected annual investment requirement figure from the fifth Distribution Price Control Review 5 (DPCR5) as the baseline to reflect the latest information on expected costs from network investment[45].

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[46]

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

The resulting benefit is £0.14 per electricity meter per year.

- Non-quantified benefits

There are also benefits which we are unable to quantify at this stage, but which will result in operational savings to Network Operators and a reduction in outage times. One area of operational savings to Network Operators will arise from the ability to check the energisation status of a meter. This will allow them to check whether a reported loss of supply is due to an issue within the consumer's premise rather than with the network (e.g. a blown fuse). Network Operators can thereby avoid unnecessary callouts where customer issues are unrelated to the network.

---

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

[45] 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.

[46] While the benefit of better informed investment decisions is subject to the same assumption of critical mass, the argument can be made that the avoided costs for investigating voltage complaints is not dependent on a critical mass and will be realised for the proportion of premises where a smart meter has been installed. For modelling purposes we have therefore translated the identified benefits from voltage investigation into per meter benefits and linked them to the rollout profile. This assumes that each household within the system has the same probability of experiencing voltage issues and the same probability of having received a smart meter.

Energy demand shift

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[47]).

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.[48]

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.

The underlying assumptions on Time of Use (ToU) remain unchanged from the March 2011 IA, Our assessment is that in the short run, 20% of current residential peak load is discretionary. Such potential for load-shifting is based on a bottom-up calculation, and examination of how this will evolve going forward under different scenarios.

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[49]). 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 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.

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

We expect take up of ToU tariffs by consumers to be of 20% (in addition to the existing group using Economy 7)[50], 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.

This is in line with some recent trials' results. The EDRP final report for instance presents two trials that tested the impact of TOU tariffs on electricity consumption. Those trials showed effects on load shifting from the peak period, with bigger shifts at weekends than on weekdays. Estimates of the magnitude of shifting effect vary with trial but were up to 10%.[51] The recent CER report on Irish smart meters trials[52] also found peak reductions of 8.8% due to the combination of different types of demand-side interventions and time of use tariffs.

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[53]).

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[54] 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.

---

[50] In line with international experience.
[51] Neither of the TOU tariff trials involved any automation of energy-consuming appliances to facilitate load shifting.
[52] CER (2011).
[53] DfT/ BERR (2008) 'Electric Vehicles'.
[54] 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).

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, 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[55].

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-

[55] 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[56]. The table below presents the CO_2 emissions associated with the energy savings in the central scenario across options.

Table 11: 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 August 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[57] 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[58].

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.

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

[56] Note that the impact of a tonne of CO2 abated in the traded (electricity) sector has a different impact to a tonne of CO2 abated in the non-traded (gas) sector. Traded sector emissions reductions lead to a reduction in UK territorial greenhouse gas emissions, but do not constitute an overall net reduction in global emissions since the emissions will be transferred elsewhere to member countries in the EU-ETS. The UK gains a cost saving from buying fewer emissions allowances, but these allowances will be bought up by other member states – the total size of the EU-wide 'cap' on emissions does not change during each phase of the EU-ETS. Non-traded sector emissions reductions will reduce both UK and global emissions.

[57] 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.

[58] 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

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.[59] 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[60]. Although there is no single smart grid 'solution', the analysis considers one possible 'path', adopting a two phase approach to take into account the considerable uncertainty post 2020. Phase 1 considers the period 2010-2020 and is found to have an NPV of £1.5bn. This involves investments in smart meters on distribution transformers, direct control equipment, smart appliances and IT; benefits arise due to demand response and system optimisation, reduced need for network reinforcements, lower predictive maintenance, distributed generation, and reduced technical losses and customer minutes lost. Phase 2 (2020-2050) is estimated to have an NPV of £2.6bn. This would include investments in substation automation and enhanced communications; benefits are expected from greater use of demand side management (due to higher assumed levels of heat pumps and electric vehicles) as well as from more cost-effective management of distributed energy resources.

The Energy Networks Association (ENA) and Imperial College have estimated the potential network benefits from Smart Meters due to demand side management at between £0.5 - £10bn NPV from 2020 - 2030.[61] Their analysis assumes that meeting the Government's emissions and renewables targets would lead to higher peak loads of up to 92% due to the electrification of transport and heating (electric vehicles and heat pumps) under a business as usual scenario, requiring more investment in network reinforcement infrastructure to accommodate this. By optimising electric vehicle charging and the use of heat pumps and smart appliances (by shifting towards off-peak times), the peak increase would only be 29%. This would bring significant benefits due to reductions in the network reinforcement costs required: 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 consumer experience, encouraging suppliers' (and others) innovation and consumer participation.

---

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

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

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

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

For the modelling of the monetised impacts of the options considered in this IA, we continue to use the central scenario as was applied in the March IA. Through the consultation Government is seeking views on the advantages and potential risks and costs of setting the completion date for the roll-out earlier or later in 2019. We are keen to receive further evidence from stakeholders on this point before confirming a final completion date in suppliers' licences.

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 during the Prospectus consultation 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 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 three possible scenarios in regards to 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.

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:

Higher bound definition

- 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.

Lower bound definition

- 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 central case 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 a peak installation rate of 19% is assumed.

Figure 1. Range of cumulative rollout volumes

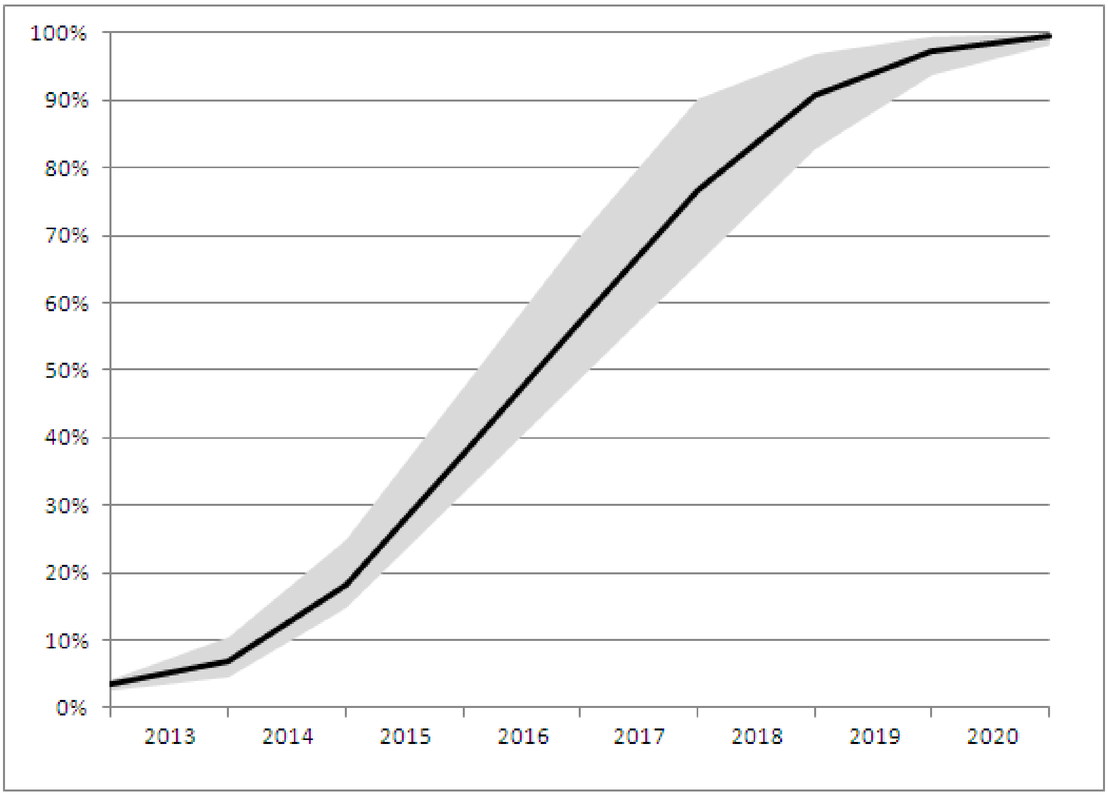


Table 12. Number of meters installed at establishment of DCC (Q2 2014)

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 13. 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 central to the higher bound could have a negative impact on the Net Present Value (NPV) of the rollout of £150m. 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 2.7 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 H on risk). We have applied sensitivity analysis to benefits and we present benefits in terms of low, central and high scenarios. Table 18 shows the impact of smart meters on energy bills of domestic customers[62]. 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 base year of the analysis is 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[63]).

Table 14: Total costs and benefits

	Total Costs £bn	**Total Benefits £bn**	**Net Present Value £bn**
August 2011 IA	11.07	15.97	4.90
March 2011 IA	10.76	15.83	5.07

Table 15: Consumer and supplier benefits

	Consumer Benefits £bn	**Business Benefits £bn**	**UK-wide Benefits £bn**	**Total Benefits £bn**
August 2011 IA	4.63	10.26	1.07	15.97
March 2011 IA	4.63	10.12	1.07	15.83

Table 16: Low, central, and high estimates

	Total Costs £bn	**Total Benefits £bn**			**Net Present Value £bn**		
		Low	**Central**	High	Low	**Central**	High
August 2011 IA	11.07	11.47	15.97	20.74	0.426	4.90	9.66
March 2011 IA	10.76	11.47	15.83	20.61	0.83	5.07	9.93

Table 17: Benefits

	Consumer Benefits £bn			**Business Benefits £bn**			**UK-wide Benefits £bn**		
	L	**C**	H	L	**C**	H	L	**C**	H
August 2011 IA	2.19	4.63	6.97	8.80	10.26	12.10	0.48	1.07	1.68
March 2011 IA	2.19	4.63	6.97	8.79	10.12	11.96	0.48	1.07	1.68

Modelling results show that our central estimates for both costs and benefits of the rollout have increased since March 2011. The only area of increase on the benefits

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

side arises from better management of outages through outage detection functionality. This increase in total benefits is offset by an increase in the cost estimates of components of the Communications Hub of smart electricity meters and an increase in the optimism bias uplift applied to the component cost of the outage detection functionality, leading to a decrease in NPV of £167m.

The benefit-cost ratio, which is a good indicator of the cost-effectiveness of the policy, remains constant at 1.4 in central scenarios, with a value of 1.9 in the high scenario and of 1.04 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[64]. 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 £22 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 18: Impact on average domestic energy bills for a dual fuel customer

	Residential dual fuel bill impact, £

[64] 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	**-22**
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 19. 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	0.15	0.04
2013	0.27	0.08
2014	1.15	0.32
2015	**1.91**	**0.51**
2016	2.07	0.53
2017	2.08	0.53
2018	1.50	0.37
2019	0.63	0.15
2020	**0.29**	**0.07**
2021	-0.09	-0.02
2022	-0.20	-0.05
2023	-0.38	-0.09
2024	-0.48	-0.12
2025	**-0.61**	**-0.15**
2026	-0.73	-0.19
2027	-0.84	-0.22
2028	-0.96	-0.26
2029	-1.10	-0.30
2030	**-1.24**	**-0.35**

The present bill impacts update the estimates presented in the March 2011 IA. The impact on energy bills of the preferred option in that IA was estimated to be very similar to this updated IA, with the only difference being the bill reduction in 2022, which has reduced from £23 to £22 since the March IA. This is reflective of the slight decrease of overall NPV resulting from an increase in costs which will be passed through to consumers.

The approach of considering that cost (and costs savings) to other agents in the energy market are fully passed down to consumers has not changed. This includes networks (losses, better outage management, theft), generation and transmission (load shifting) and other industry parties (customer switching rationalisation).

It is important to note that there may be further impacts on consumer bills for those customers who take advantage of peak/off-peak price differentials offered by smart tariffs and take up time of use tariffs. These distributional impacts have not been included in the calculation above. Analysis by the Brattle Group[65] 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;
- 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.

[65] Sustainability First (2010)

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 18 and 19 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 £11.8bn in present value terms, business benefits of £12.6bn result in a net present benefit to businesses of £840m.

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.

H. 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 was needed regarding the treatment of risk to the costs of a GB-wide smart meter rollout. Baringa Partners[66] 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 2008 IA, and
- Make recommendations, in light of the above.

This resulted in a revised approach to optimism bias which was first reflected in the May 2009 IA. Table 20 reflects the optimism bias factors applied to this IA:

Table 20. Optimism bias factors

	Optimism bias factor
IHD	15%
Smart meter	15%
Outage detection	150%
WAN CAPEX	10%
WAN OPEX	10%
HAN	15%
Installation	10%
Commercial risk	10%
IT CAPEX	10%
IT OPEX	10%

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

More detail on optimism bias and how it is applied can be found on the Treasury website in the Green Book guidance[67].

Benefits: sensitivity analysis

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

Table 21: Sensitivity analysis for benefits

	Low benefits	Central benefits	High benefits
Consumer benefits			
Energy savings electricity	1.5%	2.8%	4.0%
Energy savings gas	1%	2%	3.5%
Energy savings gas PPM	0.3%	0.5%	1.0%
Business benefits			
Supplier benefits			
Avoided site visit	underlying visit cost + 8%	underlying visit cost	underlying visit cost - 8%
Call centre savings	£1.9	£2.2	£2.5
Avoided PPM COS premium	30%	40%	50%
Reduced theft	5%	10%	15%
Network benefits			
Avoided investment from ToU (distribution/transmission)	10%	20%	40%
Reduction in customer minutes lost	2%	10%	15%
Operational savings from fault fixing	2.5%	10%	15%
Better informed enforcement investment decisions	3%	5%	10%
Avoided investigation of voltage complaints	£500	£1,000	£1,493
Reduced outage notification calls	5%	15%	20%
Generation benefits			
Short run marginal cost savings from ToU	10%	20%	40%
Avoided investment from ToU (generation)	10%	20%	40%

It is worth noting that the energy savings affect the total cost for each option due to the energy use by the devices, but the effect is minimal. Table 23 presents the results of applying the sensitivity ranges presented in Table 22 to each specific benefit assumption.

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

Table 22: 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	£93	£139
Operational savings from fault fixing	£43	£173	£259
Better informed enforcement investment decisions	£58	£115	£230
Avoided investigation of voltage complaints	£22	£43	£64
Reduced outage notification calls	£11	£32	£42
Generation benefits			
Short run marginal cost savings from ToU	£64	£121	£236
Avoided investment from ToU (generation)	£341	£653	£1,277

I. 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).

J. Recommendation – Next Steps

The government is seeking views on the rollout strategy and the technical specification via the consultation document that this IA accompanies.

K. Implementation

The Implementation approach is described in the Government Response document which was published in March 2011[68].

L. 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.

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

Annexes

Annex 1: Background

This Annex provides an overview and some background information on the smart metering system that is required to deliver the benefits identified in this IA. Three system components that are crucial to the delivery of the smart meters rollout are described below: section 1 provides an overview of the metering system functionality, section 2 on the Data Communications Company and section 3 on the rollout stages and strategy.

Section 1: The metering system functionality

This section sets out the high-level functional requirements for the smart metering system. This was presented in March and formed the basis for the work by industry to develop the technical specification. This "minimum" functionality will ensure that smart metering delivers the wide range of anticipated benefits. It should be noted that there are certain assumptions made about how the functionality is delivered.

This is restricted to a level that provides certainty on interoperability and that all functional and security requirements can be delivered. This includes: where the functionality resides (i.e. the smart metering equipment architecture); the communications protocols and languages (i.e. application layers); and certain hardware (e.g. switches/valves, displays, equipment form factors).

Table 1 below summarises the high level functionality that we consider should comprise the electricity and gas smart metering equipment and the underpinning capabilities these are expected to provide. The Prospectus Response supporting Design Requirements document and updated Functional Requirements Catalogue published alongside the March 2011 Impact Assessment provided 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 • upload and download data through a link to the wide 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 [69] •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 •support remote switching between credit and prepayment modes	✓	✓[70]
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[71] 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 published in March 2011, on the basis of which working groups reporting to the Smart Metering Design Group (SMDG) have developed the draft technical specifications published on 4 August 2011.

In translating the functional requirements into technical specifications a number of areas have been identified where multiple options to achieving the functionality exist. The programme has formed initial views on the options and it is seeking further views and evidence through the consultation published alongside this IA.

Below are described the relevant areas that need to be considered for the functionality of the smart metering system.

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.

[69] Domestic only.
[70] Domestic only.
[71] http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx.

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 traditional 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 quicker and more reliable. 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.

Section 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[72], translation[73] and scheduled data retrieval functions[74].

- 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

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

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, as well as the cost savings that are achievable by streamlining current industry processes, particularly systems related to the switch of supplier process. 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 policy option chosen in the Prospectus Response strikes a balance between maximising the long term benefits and ensuring a rapid establishment of the DCC. The preferred establishment option of a parallel procurement option leads to the establishment of an operational DCC from the end of Q1 2014 with a “minimum scope”, 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.

Section 3: Rollout stages and strategy

In the Prospectus Response the Government concluded that obligations should be put on suppliers to complete the roll-out of smart meters by a specified date in 2019. The Response set out a central case profile for completing the roll-out at the end of 2019, together with upper and lower bound scenarios for completing roll-out at the end of 2018 and 2020 respectively. It also identified a number of risks and uncertainties associated with accelerating the rollout. Setting the date earlier or later in 2019 may affect the risks and uncertainties, but evidence is not currently available to quantify or scale these risks with sufficient certainty to identify one particular completion date.

Since no new evidence regarding different rollout completion dates has come to light, the analysis remains unchanged to the March 2011 IA. All the options outlined in the summary sheets are based on the central rollout scenario, to reflect that Government continues to see value in an ambitious rollout timetable.

Ahead of the March publication, analysis of consultation responses, open letter submissions and bilateral meetings indicated 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.

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
2. Speed of mass rollout once this has started;

Together these allow the formation of a rollout profile.

a) <u>Commencement of mass rollout (Foundation Stage)</u>

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) <u>Speed of Rollout (Mass rollout)</u>

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 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 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 were able to quantify some of the risks from faster installation rates as we move from the central 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 £150m when moving from the lower bound to the higher bound.

c) <u>Rollout strategy and consumer engagement</u>

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 phase 2 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.

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 March 2011 IA. The basis for the change is also identified.

Costs

Item	Assumptions	Rationale for changes
Cost of Meters	Electricity meter costs have decreased by £1 per meter	Costs have been decreased in order to reflect that the outage detection components have been moved into the communication equipment
Cost of Meters	Electricity meter costs have increased by £1.1 per meter	Costs have been increased in order to reflect the preferred option of ensuring an independently replaceable WAN transceiver
Cost of HANs	For all HANs a cost of £2.5 is assumed	Cost have been updated from previously £3 (gas HAN) and £1 (electricity HAN) in light of additional evidence from industry
Cost of communications infrastructure	Communications Hub costs have increased by £4 to reflect the addition of a gas mirror component	Components previously not considered have been added in light of detailed technical work in this phase
Cost of communications infrastructure	Communications Hub costs have increased by £2 to reflect the addition of a power supply unit	Components previously not considered have been added in light of detailed technical work in this phase
Cost of communications infrastructure	Communications Hub costs have increased by £2.5 to reflect the addition of a third HAN within the Communications Hub	Costs have been increased in order to reflect the preferred option of ensuring an independently replaceable WAN transceiver
Cost of communications infrastructure	Communications Hub costs have decreased by £4 to reflect that the meter HANs previously assumed are already captured by the meter costs	A breakdown of meter component costs has brought to light that the meters already include a HAN for the electricity meter and the gas meter each and that considering them within the communications infrastructure as well would be double counting
Cost of communications infrastructure	Communications Hub costs have been increased by £1 to reflect the location of the outage detection functionality	The outage detection component will be physically located within the communications equipment.
Outage detection optimism bias	The optimism bias for the component cost has been increased from 15% to 150%	In light of the uncertainty about the component costs the optimism bias uplift has been increased

Benefits

Item	Assumptions	Rationale for changes
Better Outage Management - Reduction in Customer Minutes Lost	In light of the outage detection functionality this benefit has been increased from a 5% reduction to a 10% reduction	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	In light of the outage detection functionality this benefit has been increased from a 5% saving to a 10% saving	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	In light of the outage detection functionality this benefit has been increased from a 10% reduction to a 15% reduction	Customers will be confident that networks are aware of outages due to smart meter information.

Annex 3 – Detailed results

Below are the detailed results from the model (in £million) for the central case scenario of the preferred option 3a: Separate communications Hub with fixed WAN transceiver:.

Total costs		**11,067**
	Capital	3,958
	Installation	1,596
	O&M	685
	Comms upfront	1,156
	Comms O&M	1,314
	Energy	731
	Disposal	15
	Pavement reading inefficiency	238
	Supplier IT	510
	Central IT	362
	Industry IT	154
	Industry Set Up	198
	Marketing	85
	Integrate early meters into DCC	65
NPV		***4,904***
	(Stranding costs	739)

Total Benefits		**15,971**
Consumer benefits		4,635
	Energy saving	4,598
	Microgeneration	36
Business benefits	Supplier benefits	8,567
	Avoided site visits	3,179
	Inbound enquiries	1,053
	Customer service overheads	183
	Debt handling	1,075
	Avoided PPM COS premium	991
	Remote (dis)connection	244
	Reduced theft	237
	Customer switching	1,606
	Network benefits	923
	Reduced losses	438
	Avoided investment from ToU (distribution/transmissio	29
	Reduction in customer minutes lost	93
	Operational savings from fault fixing	173
	Better informed enforcement investment decisions	115
	Avoided investigation of voltage complaints	43
	Reduced outage notification calls	32
	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
	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 response) 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. This will be supported by the Consumer Engagement Strategy which is under development.

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[75], 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.

[75] 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
11,067	14,899	17.4	15.6	21.9	-245	41.8	-287

Table 21 shows how the rollout will save over 17.4 million of tonnes of CO_2 equivalent in the traded sector and 15.6 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 are the subject of further consideration, work and regulation in Phase 2 of the Programme, which began in April 2011. These include licence conditions in respect of an Installation Code of Practice, on which the Government is consulting in August 2011. Initiatives and measures, including specific regulatory requirements, proposed during Phase 2 will 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. In February 2011, under its existing powers, rather than the legal powers enabling the Government to put in place a smart metering programme, Ofgem proposed a "Spring Package"[76] of measures to deal with any problems for customers that could arise from the activities of these "early movers". In particular, it proposed additional safeguards in cases where supply might remotely be disconnected and where a customer might be remotely switched from credit to prepayment, and rules to ensure that customers with early smart meters can still switch supplier. Consultations on some measures in the Spring Package have taken place; others are taking place in Summer 2011. 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.

76 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. A consultation on the licence conditions underpinning a Code is being issued in August 2011. 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.

A call for evidence on privacy and data access is being published alongside this impact assessment. This will provide further evidence and views to inform the development of a privacy policy framework and any necessary regulatory obligations. The Programme will continue to work with the expanded PAG and other stakeholders to help us reach a final decision on these issues.

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.