Title: Electricity Market Reform – ensuring electricity security of supply and promoting investment in low-carbon generation [Delivery Plan update: December 2013]	Impact Assessment (IA)
IA No: DECC0143	**Date:** 18 December 2013
Lead department or agency: DECC	**Stage:** Final
	Source of intervention: Domestic
	Type of measure: Primary legislation
	Contact for enquiries: Robert Dixon Robert.Dixon@decc.gsi.gov.uk
Summary: Intervention and Options	**RPC:**N/A

Cost of Preferred (or more likely) Option

Total Net Present Value	Business Net Present Value	Net cost to business per year (EANCB in 2009 prices)	In scope of One-In, One-Out?	Measure qualifies as
£10.7bn	-	-	No	Tax and Spend[1]

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

This Impact Assessment considers the impacts of measures to reduce the risks to future security of electricity supply and promote investment in low-carbon generation, while minimising costs to consumers. Current electricity market arrangements are not likely to deliver the required scale or pace of investment in low-carbon generation. Reasons include cost characteristics of low-carbon capacity (high capital cost and low operating cost) which means that it faces greater exposure to wholesale price risk than conventional fossil fuel capacity, which has a natural hedge given its price-setting role. Our analysis also suggests that there are a number of market imperfections that are likely to pose risks to future levels of electricity security of supply. These effects are likely to be exacerbated when there are significant amounts of intermittent low-carbon generation.

What are the policy objectives and the intended effects?

The three primary policy objectives are to reform the electricity market arrangements to: ensure security of supply; drive the decarbonisation of our electricity generation; and minimise costs to the consumer. These reforms should support delivery of one of DECC's other key objectives of meeting the 2020 renewables target. The intended effects are that sufficient generation and demand-side resources will be available to ensure that supply and demand balance continues to be met and there will be sufficient investment in low-carbon generation to meet decarbonisation objectives.

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

As set out in previous impact assessments, the lead policy option to deliver low-carbon investment was identified as a feed-in tariff Contracts for Difference (FiT CfD) and the lead option to mitigate risks to electricity security of supply was an Administrative Capacity Market.

This IA has been updated to present Cost Benefit Analysis (CBA) and electricity price and bill impacts based on the final choices for CfD strike prices and the reliability standard, as set out in the EMR Delivery Plan. This analysis uses DECC's in-house Dynamic Dispatch Model (DDM)[2] and reflects updated input assumptions (e.g. technology costs, LCF cost profile, electricity demand).

Finally, to reflect the decision to take a power in the Energy Act 2013 to set a decarbonisation target range and show the wider range of costs and benefits of EMR, this Impact Assessment – in addition to analysis based on a carbon emissions intensity of 100gCO_2/kWh for the power sector in 2030, consistent with previous EMR impact assessments – includes analysis based on an average emission level of both 50gCO_2/kWh and 200gCO_2/kWh in 2030. This shows that the design of EMR and specifically the FiT CfD will lower the cost of financing the large investments needed in electricity infrastructure, irrespective of the level of decarbonisation in the sector to 2030.

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

Does implementation go beyond minimum EU requirements?			**N/A**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro No**	**< 20 No**	**Small No**	**Medium No**	**Large No**

[1] The EMR package includes a low-carbon instrument (the CfD) and a Capacity Market, combined with an Emissions Performance Standard (EPS). The impact of the Emissions Performance Standard is considered in the EPS IA, which accompanied the Energy Bill.
[2] https://www.gov.uk/government/publications/dynamic-dispatch-model-ddm

What is the CO2 equivalent change in greenhouse gas emissions? (Million tonnes CO2 equivalent)	**Traded:** **-**	**Non-traded:**

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

Signed by the responsible Minister: ______________________ Date: 20 December 2013

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

Description: EMR: Feed-in Tariff Contracts for Difference (FiT CfD), based on final strike prices, combined with an administrative Capacity Market, using the final reliability standard.[3]

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2012	Time Period Years 18	Net Benefit (Present Value (PV)) (£m)		
			Low: £	**High: £**	**Best Estimate: £10,700**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. transition, constant prices)	**Total Cost** (Present Value)
Low	N/A	-	N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£2,300**

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

Under EMR, carbon costs up to 2030 are higher than the 100g basecase, which achieves a similar decarbonisation profile using existing policy instruments (RO and carbon pricing). This reflects EMR's slightly slower decarbonisation profile; in NPV terms, carbon costs up to 2030 are **£1.7bn higher under EMR**.[4]

The institutional costs of EMR consist of both National Grid delivering their EMR functions and those associated with setting up the single counterparty body. In addition, there will be associated administrative costs to energy sector businesses (the costs of which cover the whole of the UK). In total, these costs (in discounted NPV terms, over the period 2012 -2030) are estimated to range between £500m to £800m (in 2012 prices) – a mid-point estimate of **£0.6bn up to 2030** is used.[5]

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

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition, constant prices)	**Total Benefit** (Present Value)
Low	N/A	-	N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£13,000**

[3] The results presented in this summary are based on a carbon emissions intensity of $100gCO_2/kWh$ for the power sector in 2030, which is consistent with previous EMR impact assessments. However, this IA also includes analysis based on average emissions levels of both $50gCO_2/kWh$ and $200gCO_2/kWh$ in 2030. Figures in this table are rounded to two significant figures and therefore totals may not sum.

[4] This is a modelling result as a consequence of using carbon pricing to incentivise new nuclear under the basecases. It should be interpreted as a hypothetical modelling outcome from using carbon prices to decarbonise.

[5] The costs largely reflect staff, IT, building costs and any external expertise which may be required – both for the institutional body and the energy businesses bidding into the Capacity Market, as well as an estimate of the administrative costs of CfDs on energy sector businesses.

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

The key benefits of decarbonising using EMR are reducing financing costs for investors and minimising generator rents under high wholesale prices. The greater price certainty from CfDs allows financing at a lower cost. The technology-specific hurdle rates used in this analysis are based on data and evidence drawn from various sources.[6] For the central assumption about 2030 carbon emission intensity (100gCO_2/kWh), these benefits are estimated to amount to **£3.8bn up to 2030** in NPV terms (including administrative costs).[7]

As in the modelling for the draft Delivery Plan in July, for this latest analysis the benefits of reductions in unserved energy are calculated using a model using data from DDM outputs. Using this model, relative to the 100g basecase, EMR reduces unserved energy costs by **around £1.7bn up to 2030** (in NPV terms).

The analysis also considers the impact of EMR on system costs, defined as the sum of the costs of building and operating the electricity system (TNUoS, BSUoS and inertia costs). These costs are calculated by National Grid models, based on DDM output. Under EMR, system costs are estimated to be **around £160m lower** than the 100g basecase, in NPV terms up to 2030.

Finally, the capacity and generation mix realised under EMR, and the 100g basecase we assess it against, are crucial in the assessment of the overall NPV of EMR. Different technologies have different operating and capital costs, therefore the CBA results will be influenced by any differences in the technology mixes realised under EMR and the 100g basecase scenarios. In this latest modelling, the differences in technology mix attributable to CfDs under the EMR scenario and 100g basecase is estimated to lead to capital costs benefits of **£8.2bn up to 2030** (including the financing benefits discussed above), in NPV terms. There is also a **£1.6bn** benefit from lower generation costs.

There is a further benefit associated with interconnectors, which results from higher wholesale prices in the 100g basecase relative to the EMR scenario as a result of the policy instrument used to decarbonise in the 100g basecase; this leads to benefits of **£1.4bn up to 2030**, in NPV terms (explained further in the Annex).

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

For domestic consumers, EMR is estimated to reduce average annual household electricity bills by 6% (£41) over the period 2014-2030, relative to a 100g basecase which achieves a similar decarbonisation level using existing policy instruments. The percentage impact on average bills for businesses and energy-intensive industries is estimated to be similar (7-8%), but slightly larger since these users typically face lower energy prices.

Due to the reduction in consumer bills, it is likely that fuel poverty will fall. However, we have not yet calculated updated projections for fuel poverty levels under EMR, based on the Government's revised definition. These will be incorporated in an update to the IA, to be published in early 2014.

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

Estimates of EMR institutional costs must be regarded as tentative as the component costs have not yet been fully determined, as they depend on the final agreed activities to be undertaken by the organisations.[8]

This IA presents modelling assessing the impact of reaching different carbon emission intensities for the power sector in 2030 (100gCO_2/kWh (as reported above), 50gCO_2/kWh and 200gCO_2/kWh).

Dispatch modelling is sensitive to a number of assumptions (e.g. inputs, methodology), which influence the capacity and generation mix under different scenarios. This outcome therefore represents a specific state of the world and is not intended to be a prediction or forecast about what the future is expected to be.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m: [9]			In scope of OIOO?	Measure qualifies
Costs: 5,800	**Benefits: 7,300**	**Net: 1,500**	No	N/A

[6] For more information about how these have been derived, please see DECC's Electricity Generation Costs 2013 report: https://www.gov.uk/government/collections/energy-generation-cost-projections

[7] Depending on the assumed level of decarbonisation in 2030, these benefits would amount to an NPV of between £2.5bn and £6.0bn up to 2030 (including administrative costs).

[8] These costs do not consider what costs might have been in the absence of EMR. For example, they do not consider what the additional administrative costs of greater reliance on carbon pricing or the RO might be in the 100g basecase.

[9] Direct costs to business are calculated using the same methodology presented in the EMR White Paper. See Annex F for further details. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48133/2180-emr-impact-assessment.pdf

Contents

Section 1 Overview

1. This Impact Assessment (IA) is a further update to the series of IAs published in support of Electricity Market Reform (EMR), the latest of which was published in July 2013[10]. This is a shortened version, which focuses on updated analysis (including electricity price & bill impacts) of the key results. It covers a range of potential decarbonisation scenarios in 2030 and also a 'no-decarbonisation ambition' basecase. A more comprehensive update to the full IA is to be published early next year.

2. The analysis contained in this IA has now been updated to reflect the modelling undertaken for the EMR Delivery Plan[11]. This is based on the final Contract for Difference (CfD) strike prices for renewable technologies (the full list of which were published earlier in December 2013[12]) and the final reliability standard (set at an annual level of 3 hours expected lost load[13]).

3. The analysis shows that the design of EMR (through FiT CFDs) will lower the financing costs of the large investments needed in electricity infrastructure, regardless of the level of decarbonisation targeted in 2030 – 50gCO_2/kWh, 100gCO_2/kWh and 200gCO_2/kWh.

4. EMR and Capacity Mechanism IAs of December 2010[14], July 2011[15], May 2012[16], November 2012[17] and May 2013[18] have analysed the policy options that would best deliver our decarbonisation, security of supply and affordability objectives. The key conclusions from these previous impact assessments are:

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10 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225981/emr_delivery_plan_ia.pdf

11 https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan

12 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263937/Final_Document_-_Investing_in_renewable_technologies_-_CfD_contract_terms_and_strike_prices_UPDATED_6_DEC.pdf

13 For further details on the methodology for how the reliability standard has been set, please see Annex C of the Delivery Plan (https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan).

14 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42637/1042-ia-electricity-market-reform.pdf

15 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48133/2180-emr-impact-assessment.pdf

16 http://webarchive.nationalarchives.gov.uk/20121025080026/http://decc.gov.uk/assets/decc/11/policy-legislation/Energy%20Bill%202012/5342-summary-of-the-impact-assessment.pdf

17 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66038/7105-contracts-for-difference-impacts-assessment-emr.pdf

18 https://www.gov.uk/government/publications/energy-bill-impact-assessments

- The FiT CfD is the preferred instrument to deliver investment in low-carbon technology compared to alternatives, including a premium feed-in tariff.[19]

- A Capacity Market is the preferred instrument to mitigate security of supply risks compared to alternatives, including a strategic reserve and the 'do nothing' case.[20]

- An Administrative Capacity Market is the preferred form of the capacity market compared with a reliability option.[21]

5. Section 2 of this IA presents updated Cost-Benefit Analysis (CBA) for the EMR lead policy package, a FiT CfD and an Administrative Capacity Market, based on the final strike prices for renewable technologies and reliability standard set out in the EMR Delivery Plan[22]. Section 3 presents updated analysis of the electricity price and bill impacts associated with this latest modelling.

Modelling changes since July 2013

6. Since the publication of the draft Delivery plan in July 2013, there have been some changes to the underlying assumptions on which EMR modelling has been based. These are set out in more detail in Annex H, which was published alongside the final EMR Delivery Plan.[23] As for the analysis undertaken for the draft Delivery Plan, the modelling is also consistent with the upper limits on spending for electricity policies agreed under the Levy Control Framework.[24]

7. In undertaking the cost-benefit analysis for EMR (based on CfDs with the final strike prices, and a Capacity Market which uses the final reliability standard), the policy package is compared to a basecase counterfactual, without the EMR package. The counterfactual includes existing policies such as the Renewables Obligation (RO) and the EU ETS and Carbon Price Floor (CPF).

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[19] This decision was assessed in the IA accompanying the White Paper in 2011 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48133/2180-emr-impact-assessment.pdf), and was represented in the IA accompanying the draft Energy Bill in May 2012.

[20] This decision was first presented in the December 2011 Technical Update to EMR (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42797/3883-capacity-mechanism-consultation-impact-assessment.pdf).

[21] An Administrative Capacity Market is one in which capacity providers receive a payment for offering capacity which is available when needed, but are able to keep their energy market revenues. Under a Reliability Market, capacity providers receive a payment for offering capacity which is available when needed, but are required to pay back any scarcity rents earned in the energy market.

[22] The conclusions on the relative attractiveness of the different options set out in previous IAs for EMR are considered robust. Therefore, there is no need to update the full analysis on all the potential policy packages previously assessed. Instead this analysis updates and presents the impact of the lead package only.

[23] https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan

[24] This sets the budget for the levels of consumer levy spend up to 2020/21, including spend under the FIT CfD, Renewables Obligation and existing small-scale FITs mechanisms. For further details, please see Annex D of the draft EMR Delivery Plan: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223654/emr_consultation_annex_d.pdf

8. Risks to the security of supply objective are not mitigated against in the counterfactual, as we do not believe it would be possible to meet the same objective without a capacity mechanism.

9. As for previous EMR IAs, this analysis assumes an illustrative carbon emissions intensity of 100gCO_2/kWh in 2030 and uses DECC's in-house Dynamic Dispatch Model (DDM).[25] It also incorporates analysis based on emission intensities of 50gCO_2/kWh and 200gCO_2/kWh, and is based on a standardised set of assumptions, including technology costs and electricity demand at the time the analysis was undertaken.

10. Whilst a range in NPV estimates is not presented, as has been the case in some previous EMR Impact Assessments, the uncertainty over how Government might decarbonise without EMR remains, hence there is still significant uncertainty around the precise welfare impact of EMR.

Summary of results

11. The value of the changes in the NPV estimates between July 2013 and this update are shown in the table below. Overall, the estimated Net Present Value for EMR (assessed up to 2030) has **increased from £9.5bn in July 2013 to £10.7bn in the latest analysis**. Within this, the net welfare benefits associated with CfDs has increased from £9.4bn to £10.2bn, while the net welfare benefit associated with the Capacity Market has also slightly increased – from a net benefit of £0.1bn to a net benefit of £0.6bn (both assessed up to 2030) [26].

Table 1: Change in Net Welfare (NPV) – combined EMR impact (2012-2030), comparison of July 2013 and December 2013 figures (emissions intensity in 2030 = 100gCO_2/kWh)

	NPV, £bn (2012-2030, real 2012 prices)		
	July 2013	Dec 2013	Difference*
EMR: Total NPV	**+9.5**	**+10.7**	**+1.2**
Contracts for Difference	**+9.4**	**+10.2**	**+0.8**
- *Financing impact*	*+4.8*	*+3.8*	*-1.0*
- *Technology mix impact*	*+4.6*	*+6.4*	*+1.8*
Capacity market	**+0.1**	**+0.6**	**+0.5**

Source: DECC modelling - Figures may not sum due to rounding
Inclusive of administrative costs of approximately £0.6bn up to 2030

[25] A description of DECC's Dynamic Dispatch Model is available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65709/5425-decc-dynamic-dispatch-model-ddm.pdf. A description of the quality assurance work that has been undertaken on the DDM is set out in Annex G to the Delivery Plan: https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan

[26] Consistent with the analysis conducted for the draft EMR Delivery Plan, the NPV estimates also include an estimate of the net impact of CfDs on Northern Ireland.

12. Looking at each of the key components of the NPV figures above, there are several drivers of the changes in the overall NPV for EMR.

CfDs – financing impact

13. In this latest analysis, the financing benefits associated with CfDs have **decreased by around £1bn** in NPV terms up to 2030, to £3.8bn.[27]

- Following the Hinkley Point C announcement, the commissioning date of the first new nuclear plant takes place later than assumed in the draft Delivery Plan. This results in lower nuclear financing cost benefits accruing in the period up to 2030. As a result the value of the hurdle rate reductions is lower (**-£0.4bn**).
- Hurdle rate reductions for some renewable technologies have changed from the values assumed in the draft Delivery Plan. This has resulted in some increased hurdle rate reductions relative to July (e.g. onshore wind, solar) and some decreased hurdle rate reductions (e.g. offshore wind), reflecting the analysis conducted by NERA, and published alongside the Delivery Plan[28]. Alongside changes in deployment levels, the impact of these changes is a further reduction in the financing benefit (**-£0.5bn**).

CfDs – technology mix impact

14. There are differences between EMR and the 100g basecase, which arise due to imperfections in matching the decarbonisation profile and generation mix under EMR and the 100g basecase. If these differences were eliminated (i.e. the decarbonisation profile and generation mix were exactly the same), then this element would decrease to zero and the only source of benefits would be the pure financing benefits outlined above. The technology mix impact reflects the portion of capital cost savings not due to financing benefits (discussed above), as well as the net impact of all the remaining categories considered as part of the Cost Benefit Analysis. These include: carbon savings, generation cost savings, system cost savings, unserved energy savings and cost of interconnector energy saved[29]. As such, the technology mix impact is an attempt to aggregate the impacts resulting from differences in the generation and technology mixes in the EMR and basecase scenarios, in contrast to the financing cost benefits which are independent of the modelling's ability to match generation mixes. The individual components of the technology mix variable are presented as part of the CBA tables below.

15. The overall technology mix component remains significant in this latest analysis, having **increased by around £1.8bn** up to 2030 in NPV terms relative to the previous IA. There are a number of explanatory factors:

[27] Component parts may not sum to total due to rounding
[28] https://www.gov.uk/government/collections/energy-generation-cost-projections
[29] For further detail about the definition of these categories, please see the Annex

- The portion of capital cost savings due to technology mix differences has **increased by £0.6bn** relative to the previous analysis. This reflects several offsetting effects: a £1.5bn increase from inclusion of the CCS demonstration projects in the no EMR scenario, a £1.1bn net decrease as a result of closer levels of renewable deployment in the basecase relative to the EMR scenario and a £200m increase as a result of larger differences between the basecase and EMR scenario for CCGT and OCGT technologies.[30]

- A **£1.2bn increase** in the net impact of the other CBA categories relative to the previous analysis, predominantly reflecting the net impact of larger generation cost savings and lower unserved energy benefits.

Capacity Market

16. The latest analysis shows an overall net welfare benefit of £0.6bn in NPV terms, up to 2030[31] – an **increase of £0.5bn** on the previous EMR IA in July 2013. There are two key explanations for these changes:

- Unserved energy benefits are **£1.3bn lower** than in the July analysis, reflecting changes to the assumed economic behaviour of existing plants under EMR and in scenarios without a Capacity Market.

- A **£1.8bn improvement** in the NPV from the net impact of lower system cost impacts and capital cost benefits as a result of the Capacity Market[32].

17. Despite improvements in modelling capability since the draft Delivery Plan analysis in July, there are still imperfections in how we are able to represent the Capacity Market within the DDM (these are covered in more detail in Section 2). We are seeking to

[30] The inclusion of costs for the CCS demonstration projects represents a change from previous EMR IAs, where CCS demonstration costs were not included in the main counterfactual scenarios for the presentation of the main NPV results. Nevertheless, the NPV of EMR including these demonstration project costs was reflected in a footnote. Given the degree of progress in these demonstration projects and the independence of their delivery relative to EMR, we believe it is more analytically consistent to include these costs in the counterfactual, as well as the EMR case. If they were not included in the counterfactual, the NPV of EMR would be £8.9bn up to 2030.

[31] The result that a Capacity Market has a net benefit in the modelling is driven by the assumption of missing money – i.e. that the energy-only market would fail to bring forward sufficient investment in capacity (as prices would not be able to rise to the value of lost load) and investors would fail to invest on the basis of uncertain and infrequent scarcity rents.

[32] System cost savings partly reflect changes to the underlying modelling to incorporate a fixed cost element, based on evidence from the RIIO price control process. It should be noted that the reduction of the CM's system cost impact means that EMR as a package (i.e. including the combined impact of CfDs and CM) is now estimated to have net system cost saving (see Tables below).

improve the capability of the DDM further and hope to reflect this more accurately in the future[33].

Overall impact of EMR

18. In summary, for a scenario where power sector emissions are 100gCO_2/kWh in 2030, the Cost Benefit Analysis (CBA) suggests that EMR is a cost-effective way of decarbonising the electricity sector in comparison with using existing policy levers, up to 2030 and beyond. EMR could lead to an improvement in welfare of around **£10.7bn up to 2030**, with larger benefits up to 2050. Due to the modelling changes detailed above, this NPV is slightly higher compared to the figure published in July 2013 (£9.5bn).

Table 2: Net Present Value (NPV) – Impact of EMR policy package relative to basecase, assumed emissions intensity of 100gCO_2/kWh in 2030

Total NPV, £bn (2012 prices)		2012-2030	2012-2040	2012-2049
		+£10.7	**+£24**	**+£31**
Contracts for Difference		**+£10.2**		
	- Financing Impact	*+£3.8*		
	- Technology Mix impact	*+£6.4*		
Capacity Market		**+£0.6**		

Source: DECC modelling- Figures may not sum due to rounding
Inclusive of administrative costs of approximately £0.6bn up to 2030

Additional scenarios

19. This IA also includes appraisals of EMR targeting a range of carbon emission intensities in 2030 (50gCO_2/kWh, 100gCO_2/kWh and 200gCO_2/kWh). The impact of these various scenarios on the overall NPV for EMR is detailed below. However, there is a more comprehensive analysis of different scenarios in the Delivery Plan (including technology costs and electricity demand).[34]

Decarbonisation ambition in 2030 – 50g, 100g & 200g

20. As shown in the table below, this updated analysis indicates that EMR is a cost-effective tool for decarbonising the power sector across a range of decarbonisation levels in 2030. This is shown by the overall NPV for EMR being positive across all emission intensities,

[33] Analysis of the cost of the Capacity Market is sensitive to a number of assumptions made including projections of demand in capacity auctions, bidding behaviour of existing plants, and the financing and capital costs of new build. These assumptions affect the likely clearing prices to come out of the capacity auctions, as well as what parameters should be set for capacity auctions. DECC is currently consulting on the auction parameters for the first auction in 2014 - including the Cost of New Entry, price taker threshold, and auction price cap - and we will undertake further sensitivity analysis of likely clearing prices before finalising these parameters.

[34] Particularly Annex D of final EMR Delivery Plan (National Grid EMR Analytical Report): https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan

up to 2030 – **£18.1bn for 50g**, **£10.7bn for 100g** and **£8.6bn for 200g**. As for 100g, the figures for the 50g and 200g scenarios are different to those published in July 2013 (£15.0bn and £4.8bn respectively), with the current figures both being higher.

Table 3: Change in Net Welfare (NPV) – combined EMR impact (2012-2030), emission intensities of 50g, 100g and 200gCO_2/kWh

NPV, £bn (2012-2030, real 2012 prices)	Decarbonisation target in 2030 (gCO_2/kWh)		
	50	100	200
EMR: Total NPV	**+18.1**	**+10.7**	**+8.6**
Contracts for Difference	**+15.3**	**+10.2**	**+9.0**
- Financing impact	*+6.0*	*+3.8*	*+2.5*
- Technology mix impact	*+9.3*	*+6.4*	*+6.5*
Capacity market	**+2.9**	**+0.6**	**-0.4**

Source: DECC modelling- Figures may not sum due to rounding
Inclusive of administrative costs of approximately £0.6bn up to 2030

21. The key policy benefit of decarbonising using EMR are reducing financing costs for investors – the greater price certainty offered by CfDs allows investors to access financing at a lower cost. As might be expected, the financing benefits associated with CfDs increase as the 2030 decarbonisation level becomes more ambitious (hence requiring more low-carbon generation to be built): £2.5bn for the 200g scenario, £3.8bn for the 100g scenario and £6.0bn for the 50g scenario up to 2030. The larger technology mix impacts reflect a combination of the wider impacts on the power sector of using relatively inflexible existing policy tools in the basecase to decarbonise, as well as modelling limitations in the ability to match generation mixes precisely.

No-decarbonisation ambition scenario

22. The impact of EMR is also assessed against a basecase without any explicit decarbonisation ambition or tools to mitigate against security of supply risks (the 'no-decarbonisation ambition' basecase). Under this basecase the Renewables Obligation and carbon pricing continue based on existing commitments.[35] This basecase is provided purely as a point of comparison to earlier modelling results (i.e. pre-November 2012), as these were not based on achieving any particular decarbonisation ambition.

23. EMR produces a net negative welfare impact of **-£9.2bn up to 2030** (compared to -£12bn in July 2013). However, the benefits associated with decarbonisation and from

[35] Under this basecase the emissions intensity falls to 2020 as a result of meeting the 2020 renewables target and the impact of the Carbon Price Floor. Post 2020 the RO is assumed to realise a broadly similar proportion of renewable generation, up to 2030, as realised in 2020. Beyond 2036 the carbon price is the only policy impacting the basecase.

the EMR programme are seen over the longer term. In comparison to a counterfactual with no decarbonisation ambition ('no-decarbonisation ambition' basecase), the NPV for EMR is positive in the period up to 2049 (£2.7bn). In this counterfactual there is lower electricity decarbonisation, implying greater ambition needed in other sectors to meet long-term decarbonisation ambitions (discussed further in Section 2), and there is no mitigation against security of supply risks.

Table 4: Change in Net Welfare (NPV) – combined EMR impact (2012-2030), comparison to 'no-decarbonisation ambition' basecase

	NPV, £bn (2012-2030, real 2012 prices)		
	July 2013	Dec 2013	Difference
EMR: Total NPV	**-£12**	**-£9.2**	**+£2.8**

Source: DECC modelling
Inclusive of administrative costs of approximately £0.6bn up to 2030

Delivery plan scenarios – reflecting uncertainty

24. There is still considerable uncertainty over how the electricity sector will develop to 2030 and beyond. Dispatch modelling is sensitive to a number of such assumptions (e.g. around inputs, methodology), which influence the capacity and generation mix realised under different scenarios.

25. National Grid carried out analysis for DECC to explore the implications of a number of strike price scenarios for delivery of Government policy[36]. These illustrate alternative 'views of the world', which can be used to inform and guide strike price setting.

Electricity Prices & bills impacts

26. For domestic consumers, EMR has the potential to **reduce average annual household electricity bills by around 6% (£41) over the period 2014-2030[37]** relative to the basecase, which achieves a similar decarbonisation level of 100gCO_2/kWh using existing policy instruments. The percentage impact on average bills for businesses and energy-intensive industries is estimated to be similar to the domestic reduction (7-8%). For further detail, see section 3.

[36] Annex D of the Delivery Plan, available at: https://www.gov.uk/government/publications/electricity-market-reform-delivery-plan
[37] The time period has been amended to align with the start of the strike price period; the comparable figure for the 2016-2030 period is £46.

Table 5: Price and Bill impact – Impact of EMR policy package on average annual domestic electricity bills, relative to 100g basecase (assumed emissions intensity of 100gCO_2/kWh in 2030)

Time Period	Impact of EMR on average annual domestic electricity bills, relative to 100g basecase (real 2012 prices)
2014-2030	-£41 (-6%)

Source: DECC modelling

Section 2 Updated cost-benefit analysis

2.1 Net Present Value of EMR

27. This section assesses the benefits of EMR as a whole (i.e. combined impact of CfDs with the final strike prices, and a Capacity Market based on the final reliability standard) in more detail.[38]

28. The tables below present the NPV results from assessing EMR (across different decarbonisation levels) relative to a basecase which achieves a similar decarbonisation ambition using the Renewables Obligation (RO) and the carbon price, but does not mitigate against security of supply risks.[39]

Analysis based on emissions intensity of 100gCO_2/kWh in 2030

29. Assessed up to 2030, decarbonising the electricity sector to an average emissions intensity of 100gCO_2/kWh in 2030 through EMR compared to the basecase results in welfare improvements of around **£10.7bn**. Assessed up to 2049, EMR results in net welfare improvements of around **£31bn**.[40]

[38] The analysis presented in this IA is based on one set of assumptions, including assumed technology costs. Assumptions about technology costs are uncertain and future costs depend on assumptions including rates of learning and deployment of particular technologies (including global deployment). As such, actual future technology costs may differ from those assumed within the modelling; for example, costs could change more quickly or slowly than assumed. The modelling results will be sensitive to changes in technology cost assumptions, and any differences between the realised costs and the assumed value.

[39] A description of the different CBA categories is provided in the Annex.

[40] Results from energy market modelling in the following tables are rounded to two significant figures. NPV estimates adjusted for estimated administrative costs are not rounded to two significant figures to ensure consistency with disaggregated NPV estimates presented in Section 1. Administrative cost estimates are not estimated beyond 2030; the estimates up to 2030 must be regarded as tentative as the component costs have not yet been fully determined, as they will depend on the final agreed activities to be undertaken by the relevant organisations. For this reason the administrative cost adjusted NPVs are not estimated beyond 2030.

Table 6: Change in Net Welfare (NPV) – combined EMR impact (CfD and Capacity Market) compared to basecase (emissions intensity in 2030 = 100gCO_2/kWh)

		NPV, £m (real 2012)		
		2012 to 2030	**2012 to 2040**	**2012 to 2049**
Net Welfare	Value of carbon savings	-1,700	-4,500	-7,600
	Generation cost savings	1,600	4,100	5,700
	Capital cost savings	8,200	19,000	27,000
	System cost savings	160	690	1,300
	Unserved energy savings	1,700	3,300	3,300
	Cost of Interconnector energy saved	1,400	2,000	1,800
	Change in Net Welfare	**11,000**	**24,000**	**31,000**
	Change in Net Welfare*	**10,700**		

Source: DECC modelling - Figures rounded to two significant figures, totals may not sum due to rounding
**Inclusive of administrative costs of approximately £0.6bn up to 2030*

Analysis based on emissions intensity of 50gCO_2/kWh in 2030

30. Assessed up to 2030, decarbonising the electricity sector to an average emissions intensity of 50gCO_2/kWh in 2030 through EMR compared to a basecase, results in a net welfare improvement of **£18.1bn**. Assessed up to 2049, EMR results in a net welfare improvement of around **£49bn**.

Table 7: Change in Net Welfare (NPV) – combined EMR impact (CfD and Capacity Market) compared to basecase (emissions intensity in 2030 = 50gCO_2/kWh)

		NPV, £m (real 2012)		
		2012 to 2030	**2012 to 2040**	**2012 to 2049**
Net Welfare	Value of carbon savings	-1,600	-2,800	-7,900
	Generation cost savings	1,900	3,500	4,400
	Capital cost savings	10,000	18,000	32,000
	System cost savings	750	2,400	3,800
	Unserved energy savings	5,100	11,000	12,000
	Cost of Interconnector energy saved	2,700	4,800	5,000
	Change in Net Welfare	**19,000**	**37,000**	**49,000**
	Change in Net Welfare*	**18,100**		

Source: DECC modelling - Figures rounded to two significant figures, totals may not sum due to rounding
**Inclusive of administrative costs of approximately £0.6bn up to 2030*

Analysis based on emissions intensity of 200gCO_2/kWh in 2030

31. Assessed up to 2030, decarbonising the electricity sector to an average emissions intensity of 200gCO_2/kWh in 2030 through EMR compared to a basecase, results in a net welfare improvement of **£8.6bn**. Assessed up to 2049, EMR results in a net welfare improvement of around **£19bn**.

Table 8: Change in Net Welfare (NPV) – combined EMR impact (CfD and Capacity Market) compared to basecase (emissions intensity in 2030 = 200gCO_2/kWh)

		NPV, £m (real 2012)		
		2012 to 2030	2012 to 2040	2012 to 2049
Net Welfare	Value of carbon savings	-1,900	430	1,400
	Generation cost savings	1,200	4,200	7,400
	Capital cost savings	8,000	5,800	5,100
	System cost savings	270	680	1,200
	Unserved energy savings	370	2,200	2,200
	Cost of Interconnector energy saved	1,200	1,800	1,800
	Change in Net Welfare	**9,200**	**15,000**	**19,000**
	Change in Net Welfare*	**8,600**		

Source: DECC modelling - Figures rounded to two significant figures, totals may not sum due to rounding
**Inclusive of administrative costs of approximately £0.6bn up to 2030*

32. The overall NPV figures for all decarbonisation scenarios are higher than the equivalent estimates previously presented in July 2013 – £9.5bn 100g, £15.0bn for 50g and £4.8bn for 200g – all assessed up to 2030. There are two key explanatory factors:

- Changes in the generation mix profile of the EMR scenarios and the counterfactuals. In particular the inclusion of CCS demo projects in the no EMR scenarios leads to a higher EMR NPV by increasing the capital costs of the no EMR scenarios, as well as impacting relative generation costs. Offsetting this positive impact somewhat, the later deployment of new nuclear in the EMR scenarios generally leads to a closer matching of renewable deployment in the no EMR scenarios, because of greater flexibility in the use of existing policy instruments to match new build profiles.

- The increased technology mix benefits are offset somewhat by reductions in pure financing cost benefits, reflecting changes in hurdle rates and the profile of nuclear deployment.

33. In addition, there have been slight increases in the Capacity Market NPVs across all three decarbonisation scenarios, relative to the July analysis.

- For 200g – where it might be expected that demand for a Capacity Market is lower than for a 100g scenario, given the less pressing need for low-carbon generation up to 2030 – the capacity market has a negative net welfare impact of £0.4bn; (-£0.8bn in the July analysis)

- However, for a 50g target in 2030, the NPV of the Capacity Market is positive (£2.9bn, £2.7bn in the July analysis). For a scenario in which a greater proportion of intermittent and/or inflexible low-carbon generation is required in order to meet a lower decarbonisation level, it might be expected that a Capacity Market would lead to more significant benefits.

34. The result that a Capacity Market has a net benefit in the modelling is driven by the assumption of missing money – i.e. that the energy-only market would fail to bring forward sufficient investment in capacity as prices would not be able to rise to the value of lost load, and investors would fail to invest on the basis of uncertain and infrequent scarcity rents.

35. Despite improvements in modelling capability since the draft Delivery Plan analysis in July, there are still imperfections in how we are able to represent the Capacity Market within the DDM.

36. Analysis conducted by Redpoint has suggested that the modelling of the capacity market is highly dependent on assumptions around how wholesale prices in the energy market respond to scarcity[41]. Redpoint have commented that the DECC DDM results could be viewed as a conservative approach to evaluating a CM and may overstate the costs to consumers, given that the DECC DDM model has wholesale prices which were less responsive to increased scarcity than the Redpoint model. We are seeking to improve the capability of the DDM further and hope to reflect this more accurately in the future.

Analysis based on a 'no-decarbonisation ambition' basecase

37. Table 9 presents the net welfare impact of the EMR package relative to 'no-decarbonisation ambition' basecase, for a carbon emissions intensity in 2030 of 100gCO_2/kWh. The results suggest that the EMR package would lead to a net welfare loss of around **£9.2bn**, up to 2030.

41 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263323/Independent_CM_assessment__Redpoint.pdf

Table 9: Change in Net Welfare (NPV) – Combined EMR impact (CfDs with Capacity Market), compared to 'no-decarbonisation ambition' basecase (EMR emissions intensity in 2030 = 100gCO_2/kWh)

		NPV, £m (Real 2012)		
		2012 to 2030	2012 to 2040	2012 to 2049
Net Welfare	Value of carbon savings	6,400	40,000	68,000
	Generation cost savings	5,300	22,000	37,000
	Capital cost savings	-19,000	-70,000	-99,000
	System cost savings	-1,500	-3,400	-5,000
	Unserved energy savings	220	570	660
	Cost of Interconnector energy saved	52	540	950
	Change in Net Welfare	**-8,600**	**-9,900**	**+2,700**
	Change in Net Welfare*	**-9,200**		

Source: DECC modelling - Figures rounded to two significant figures, totals may not sum due to rounding
**Inclusive of administrative costs of approximately £0.6bn up to 2030*

38. This result is driven by increased capital costs generated under EMR relative to the 'no-decarbonisation ambition' basecase, as a result of the increased investment in capital-intensive low-carbon technologies, such as nuclear and renewables. Up to 2030, these costs outweigh the significant carbon and generation cost savings under EMR.

39. The greatest benefits of EMR are seen in the longer term. Therefore, considering the costs and benefits over a longer period – for example, over the complete lifetime of the low-carbon generation technologies – is likely to result in an increasingly positive NPV. Indeed, assessed up to 2049 EMR results in a positive net welfare impact of around £2.7bn.

40. When assessing up to 2049, the generation and carbon cost savings realised under EMR more than offset the higher capital costs incurred (though this is the period for which uncertainties are greatest).

Changes from previous analysis

41. This latest modelling represents a change in the overall NPV for EMR compared to a 'no-decarbonisation ambition' basecase – the NPV up to 2030 has improved by around £2.8bn. There are several important drivers of this change:[42]

- The difference between capital costs under EMR and the 'no-decarbonisation ambition' basecase is around £3.1bn smaller than in the July analysis, this results in the NPV of EMR increasing by £3.1bn relative to the July analysis. This predominately reflects a positive impact from later nuclear deployment and the inclusion of CCS

[42] Component parts may not sum to totals due combined impact of small changes not detailed here as well as rounding.

demonstration projects in the 'no-decarbonisation ambition' scenario, as well as other small changes (£4.1 bn), offset by a £1.0bn reduction in pure cost of capital benefits.

- Offsetting this improvement in the NPV is a small net reduction as a result of lower carbon cost savings and smaller unserved energy benefits, offset by larger generation cost savings (£700m).

42. Considering the costs and benefits of EMR over a longer period – for example, over the complete lifetime of the low-carbon generation technologies – results in an increasingly positive NPV. The latest modelling suggests that EMR has a positive net welfare impact of £2.7bn up to 2049.

43. However, if there is less decarbonisation in the power sector, carbon targets would need to be met by reductions in other sectors; such costs are not considered in EMR modelling. Therefore, this basecase will underestimate the costs of meeting long-term carbon targets, by failing to consider the costs of decarbonising in more expensive sectors outside the power sector (assuming that emission reductions are met domestically, rather than through trading). In addition, this 'no decarbonisation ambition' scenario does not mitigate against security of supply risks.

2.1.1 Institutional costs

44. The institutional costs of EMR consist of both National Grid delivering their EMR functions and those associated with setting up a new institutional body – the single counterparty body. In addition there will be associated administrative costs to energy sector businesses (the costs of which cover the whole of the UK). The total discounted costs (NPV, 2012 -2030) are estimated to range between around £500m to £800m (2012 prices). The costs largely reflect staff, IT, building costs and any external expertise which may be required – both for the institutional body and the energy businesses bidding into the Capacity Market, as well as an estimate of the administrative costs of CfDs on energy sector businesses.[43] They reflect the expected costs of both the CfD and CM instruments. The estimates must be regarded as tentative as the component costs have not yet been fully determined, as they depend on the final agreed activities to be undertaken by the organisations. The table below presents the NPV for EMR, taking into account administrative costs.[44]

[43] Component costs consistent with those presented in the Impact Assessment for the Supplier Obligation Secondary Legislation available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252273/131022_IA_-_Supplier_Obligation__final_for_publication_21_10_2013_.pdf

[44] A midpoint estimate of around £600m is used. The costs reflect a gross estimate of additional institutional costs from National Grid delivering their EMR functions and those associated with setting up a new institutional body – the single counterparty body under EMR; for example they do not consider what costs

Table 10: NPV with administrative costs (NPV 2012-2030, real 2012, £bn)[45]

	NPV – Energy market only	NPV – Energy market and administrative costs*
NPV (£bn)	11.4	**10.7**
Of which: CfDs	10.6	**10.2**
Of which: CM	0.7	**0.6**

*Source: DECC modelling (*Corresponds with the impacts presented in the summary section)*

2.1.2 Implied investment under EMR

45. We have updated the analysis of the level of implied investment between now and the end of the decade, according to the latest EMR modelling. This is unchanged from the estimate in the draft EMR Delivery Plan in July 2013 – i.e. overall investment of £100bn-110bn, of which £60bn-70bn is attributable to generation capacity and around £40bn to networks.

might have been in the absence of EMR. For example, they do not consider what the additional institutional costs of greater reliance on carbon pricing or the RO might be in the basecase scenarios.

[45] All 2030 results presented above include an administrative cost adjustment. They are presented here to illustrate the relative differences clearly.

Section 3 Updated price & bills analysis

3.1 Updated Price and Bill Impacts[46]

46. This section considers the price and bill impacts of the CfD and Capacity Market (based on the final strike prices and reliability standard set out in the Delivery Plan). This EMR package is assessed against each of the basecases described above (i.e. 50g, 100g, 200g in 2030 and a 'no-decarbonisation ambition' basecase).

47. Final consumer electricity bills are made up of wholesale energy costs, network costs, metering and other supply costs, supplier margins, VAT and the impacts of energy and climate change policies. Wholesale electricity prices, and therefore bills, are also strongly influenced by the prevailing capacity margin in the wholesale electricity market.

48. The EMR policy package affects electricity bills in three main ways:

- **EMR support costs:** CfD low-carbon payments and capacity payments which are assumed to be funded through electricity bills.
- **Lower RO support costs:** less new generation will be covered by the Renewables Obligation.
- **Wholesale price effect:** resulting from changed generation mix and capacity margins

49. Direct EMR support costs add to retail prices, as it is assumed that the support costs are passed on to consumers by suppliers. However, the introduction of CfDs also leads to a reduction in the cost of the Renewables Obligation against the basecase, because relatively fewer plants will receive RO payments.

50. The impact on wholesale prices relative to the basecase varies between years. In general, a decarbonised electricity system should result in a lower average wholesale price, due to a higher proportion of capacity having a relatively low short-run marginal cost. In addition, higher carbon prices under the basecase are assumed to be passed through to consumers through higher wholesale prices, resulting in higher wholesale prices in the basecase, and correspondingly lower prices under EMR.

51. In addition, EMR policies will affect the capacity margin on the system, to deliver larger capacity margins than in the basecase, and therefore contribute to a dampening effect on wholesale prices. It is likely that DECC's DDM underestimates the extent to which wholesale prices would rise in response to tight capacity margins in the absence of a capacity market – thereby underestimating the benefits that a capacity market has in dampening wholesale prices.

[46] The analysis presented in this IA is based on an agreed set of assumptions, including technology costs and electricity demand at the time the analysis was undertaken.

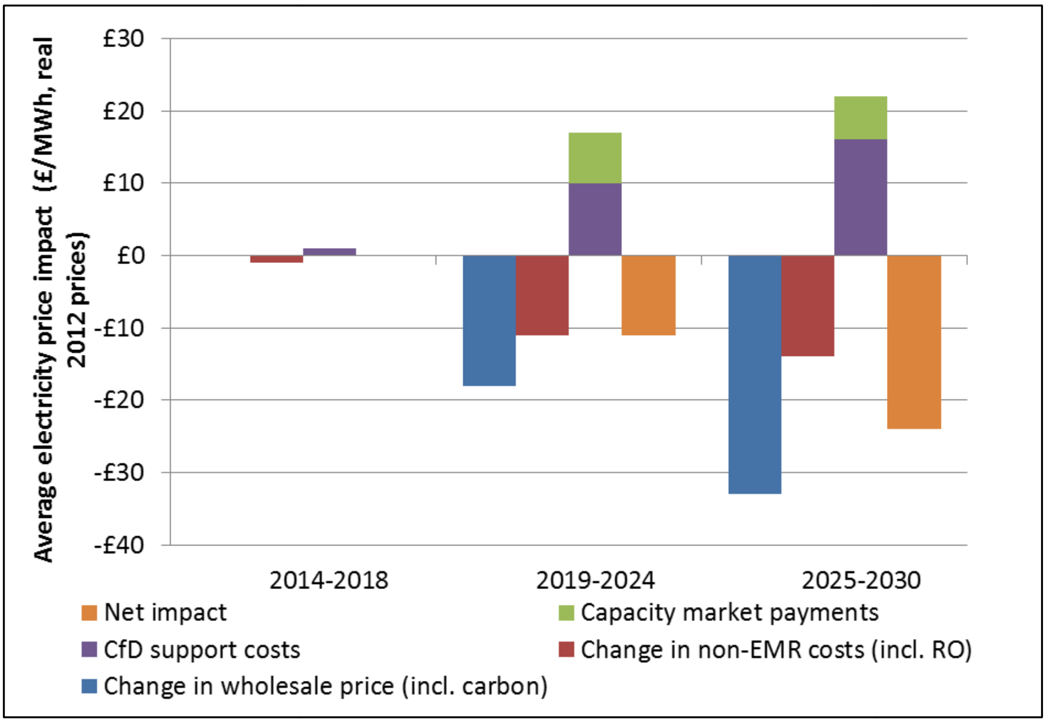
52. The charts below present the average net impact of EMR on domestic retail prices, for three different emission intensities in 2030 (100gCO_2/kWh, 50gCO_2/kWh and 200gCO_2/kWh).

53. To present results consistent with the Delivery Plan and strike price period, as well as presenting the EMR's near term impact the period the modelling covers has been revised relative to previous Impact Assessments. For example, the modelling suggests that the EMR package may influence wholesale prices pre-2016. To present the complete impact of EMR across years we therefore now present price and bill impacts across the periods 2014-2018, 2019-2024 and 2025-2030.

Analysis based on emissions intensity of 100gCO_2/kWh in 2030

54. Relative to the basecase, EMR results in lower average retail electricity prices over the 2014-2030 period. Over the period 2014-2030, domestic electricity prices would be around 6% lower under EMR on average, in comparison to what they would be under the basecase. Despite the increases due to EMR support payments, lower wholesale prices and smaller RO support costs offset this increase in all periods.[47]

Chart 1: Net Impact of EMR on domestic electricity prices, relative to basecase[48] (assumed emissions intensity in 2030 = 100gCO_2/kWh)



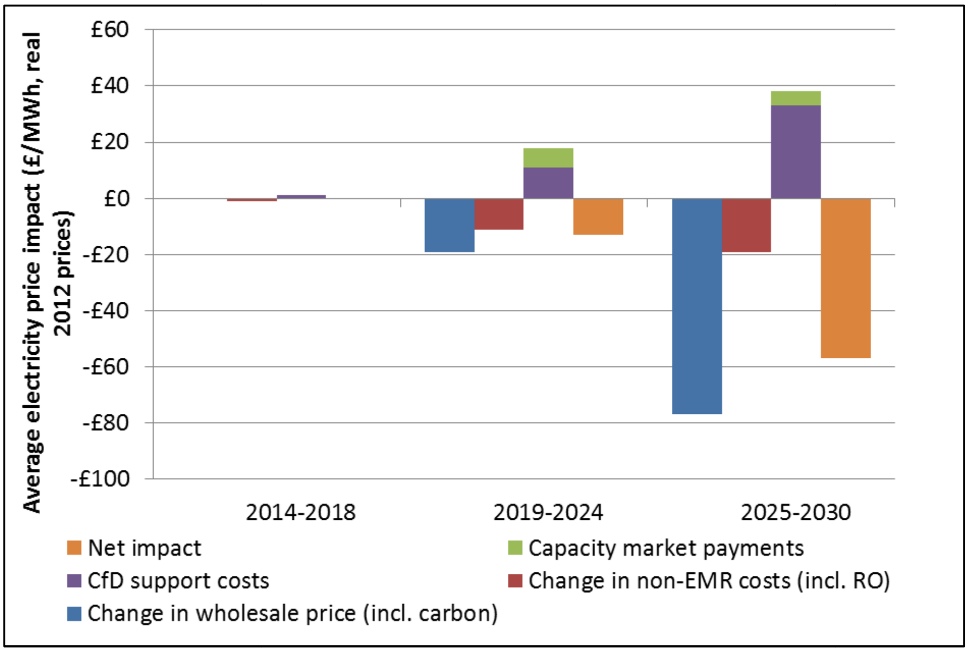
Source: DECC modelling

Analysis based on emissions intensity of 50gCO_2/kWh in 2030

[47] Much of the lower wholesale costs under EMR reflect the lower carbon prices relative to the basecase, as CfDs are used to incentivise nuclear and CCS investment in place of additional carbon pricing.
[48] Non-EMR costs principally refer to lower Renewables Obligation support costs as a result of EMR.

55. Relative to a basecase in which an emissions intensity of 50gCO_2/kWh in 2030 is targeted using existing instruments, EMR still results in lower retail prices over the 2014-2030 time period – it is estimated that domestic (i.e. household) electricity prices would, on average, be around 11% lower under EMR. The cost to consumers of EMR support payments is again outweighed by lower wholesale prices and smaller RO support costs in all periods, resulting in lower prices relative to the basecase, becoming increasingly lower over time. This is particularly the case for the 2025-2030 period, when average domestic prices are 21% (£57/MWh) lower than the basecase.

Chart 2: Net Impact of EMR on Domestic Electricity prices, relative to 50g basecase (assumed emissions intensity in 2030 = 50gCO_2/kWh)

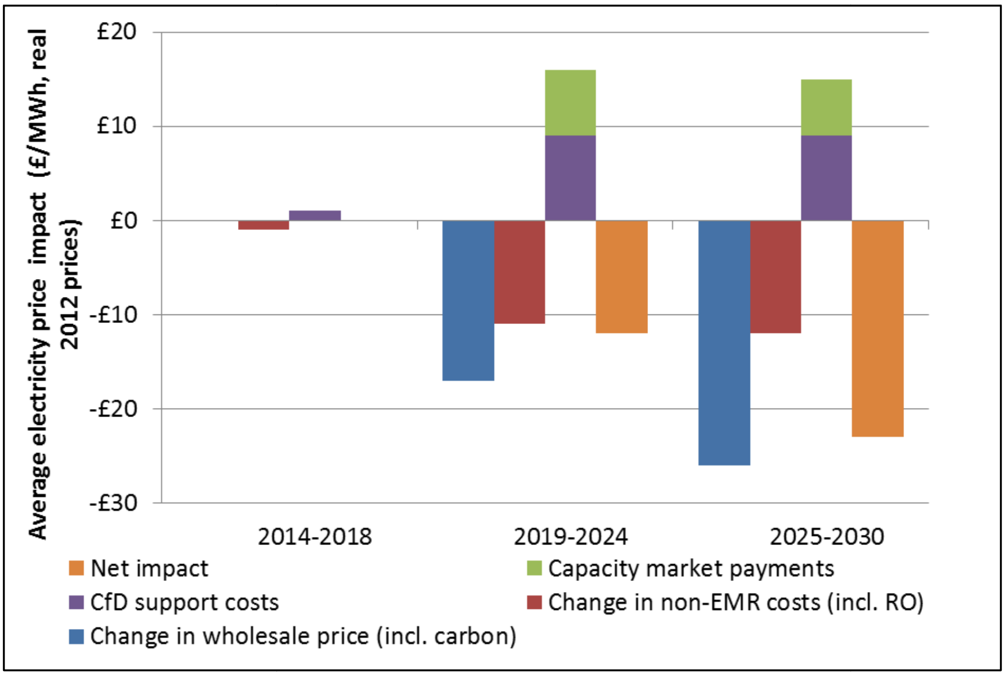


Source: DECC modelling

Analysis based on emissions intensity of 200gCO_2/kWh in 2030

56. Relative to a basecase in which an emissions intensity of 200gCO_2/kWh in 2030 is targeted using existing instruments, EMR still results in lower retail prices over the 2014-2030 time period – it is estimated that domestic electricity prices would, on average, be around 6% lower under EMR. As for other 2030 decarbonisation levels, the cost to consumers of EMR support payments is again outweighed by lower wholesale prices and smaller RO support costs in all periods, resulting in lower prices relative to the basecase.

Chart 3: Net Impact of EMR on Domestic Electricity prices, relative to 200g basecase (assumed emissions intensity in 2030 = 200gCO$_2$/kWh)



Source: DECC modelling

3.1.1 Bill Impacts by consumer type

57. The impacts of the EMR package on bills for different types of consumer, distinguishing between domestic, non-domestic and energy-intensive users, are presented below.

Analysis based on emissions intensity of 100gCO$_2$/kWh in 2030

Domestic customers

58. For domestic consumers, EMR has the potential to reduce average annual household electricity bills by around 6% (£41) over the period 2014-2030, relative to a basecase which achieves the same decarbonisation objective using existing policy instruments.[49] Household bills would be lower under EMR, reflecting the higher carbon prices in the basecase, and therefore the benefit to consumers of incentivising low-carbon investment using CfDs.

Non-domestic customers

59. The table below presents the impact of EMR on non-domestic electricity bills. Annual bills are, on average, around 7% lower under EMR for the period 2014-2030, relative to the basecase. Electricity bills are estimated to be 6% lower on average under EMR over the period 2019-2024 and around 12% lower for the period 2025-2030, in comparison to the basecase.

[49] Based on the previous time period coverage, from 2016-2030, the equivalent figures would be 7% (£46)

Energy-intensive industry

60. The table below presents the modelled bill impacts of EMR on Energy-Intensive Industries (EII). The modelling suggests EMR could reduce annual average EII electricity bills by around 8% relative to the basecase (over the period 2014-2030). The greatest reduction is achieved over the period 2025-2030, when average annual electricity bills are estimated to be around 12% lower under EMR, in comparison to the basecase.[50]

Table 11: EMR Bill Impacts relative to 100g basecase (assumed emissions intensity in 2030 = 100gCO2/kWh)[51]

Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£'000s)		Energy Intensive Industry (£'000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	587	-	1,240	-	9,390	-10 (0%)
2019-2024	659	-35 (-5%)	1,570	-90 (-6%)	12,810	-810 (-6%)
2025-2030	788	-81 (-10%)	1,800	-210 (-12%)	14,910	-1,860 (-12%)
2014-2030	**684**	**-41 (-6%)**	**1,550**	**-110 (-7%)**	**12,540**	**-940 (-8%)**

Source: DECC modelling

Security of supply impacts

61. As discussed above, the impact of EMR on consumer bills will reflect the impact of decarbonising and also mitigating against security of supply risks. EMR bill impacts therefore reflect the combined impact of decarbonising through CfDs, relative to existing instruments, and the cost of mitigating against security of supply risks through the Capacity Market (which the basecase does not).

62. The Capacity Market is estimated to **add around £15 to average annual household bills over the period 2014 to 2030**[52]. However, in practice the costs of a Capacity Market

[50] As announced in the Chancellor's Autumn Statement 2011, the Government is exploring ways to mitigate the impact of electricity costs arising from EMR on the most Energy-Intensive Industries (EIIs), where this significantly impacts their competiveness, and subject to value for money and State Aid considerations. The work to deliver this exemption will be part of the EMR programme, subject to further consultation. Currently, no exemption is assumed in this analysis.

[51] Results for the household sector are based on a representative average annual electricity demand level for households, derived from historical total domestic consumption, and is set at 4.5MWh of electricity per year (before policies). Non-domestic users are based on the consumption of a medium-sized fuel user in industry, with an electricity usage of 11,000 MWh per year (before policies), and includes the effects of the CRC. Bills and impacts will vary with electricity consumption. Similar impacts will occur for non-CRC non-domestic users. For the energy-intensive industry sector, illustrative users consume (before policies) 100,000MWh of electricity. Bills and impact will vary with amount of electricity consumption.

[52] This is assessed on a 'net' basis (i.e. inclusive of impacts on wholesale prices). However, this includes 5 years where the capacity procured through the 2014 auction is not contributing to security of supply, as support costs start to impact on consumer bills in 2019

could be lower, as it should help reduce financing costs for investment in new capacity. DECC's modelling may also underestimate the extent to which wholesale prices would rise in response to very tight capacity margins in the absence of a Capacity Market.

Analysis based on emissions intensity of 50gCO_2/kWh in 2030

63. Relative to the 100g basecase scenario outlined above, the impact on domestic bills from using EMR to target an emissions intensity of 50gCO_2/kWh in 2030 is higher – i.e. EMR achieves a larger reduction in bills, when compared to a basecase of achieving the same emissions intensity using existing instruments. For example, the average reduction over the period 2014-2030 for domestic customers is around £81. Under such a scenario, the Capacity Market is estimated to increase average annual household bills by around £10 over the period 2014 to 2030[53].

Table 12: EMR Bill Impacts relative to 50g basecase (assumed emissions intensity in 2030 = 50gCO2/kWh)

Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£'000s)		Energy Intensive Industry (£'000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	587	-	1,240	-	9,390	-10 (0%)
2019-2024	665	-39 (-6%)	1,580	-110 (-7%)	12,950	-960 (-7%)
2025-2030	909	-190 (-21%)	2,090	-490 (-24%)	17,520	-4,370(-25%)
2014-2030	**728**	**-81 (-11%)**	**1,660**	**-210 (-13%)**	**13,520**	**-1,880 (-14%)**

Source: DECC modelling

Analysis based on emissions intensity of 200gCO_2/kWh in 2030

64. Relative to the 100g scenario outlined above, the impact on domestic bills from using EMR to target an emissions intensity of 200gCO_2/kWh in 2030 is similar. Decarbonisation through EMR still results in a reduction in bills – a 6% reduction in average annual domestic bills over the period 2014 to 2030, relative to a basecase in which decarbonisation is achieved using existing instruments.

65. Under such a scenario, the Capacity Market is estimated to add around £15 to average annual household bills over the period 2014 to 2030[54].

[53] This is assessed on a 'net' basis (i.e. inclusive of impacts on wholesale prices). As for the 100g analysis, this includes 5 years where the capacity procured through the 2014 auction is not contributing to security of supply, as support costs start to impact on consumer bills in 2019

[54] This is assessed on a 'net' basis (i.e. inclusive of impacts on wholesale prices). As for the 100g (and 50g) analysis, this includes 5 years where the capacity procured through the 2014 auction is not contributing to security of supply, as support costs start to impact on consumer bills in 2019

Table 13: EMR Bill Impacts relative to 200g basecase (assumed emissions intensity in 2030 = 200gCO2/kWh)

Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£'000s)		Energy Intensive Industry (£'000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	587	-	1,240	-	9,390	-10 (0%)
2019-2024	659	-36 (-5%)	1,560	-90 (-6%)	12,780	-840 (-7%)
2025-2030	762	-78 (-10%)	1,740	-210 (-12%)	14,390	-1,860 (-13%)
2014-2030	**674**	**-40 (-6%)**	**1,530**	**-110 (-7%)**	**12,350**	**-950 (-8%)**

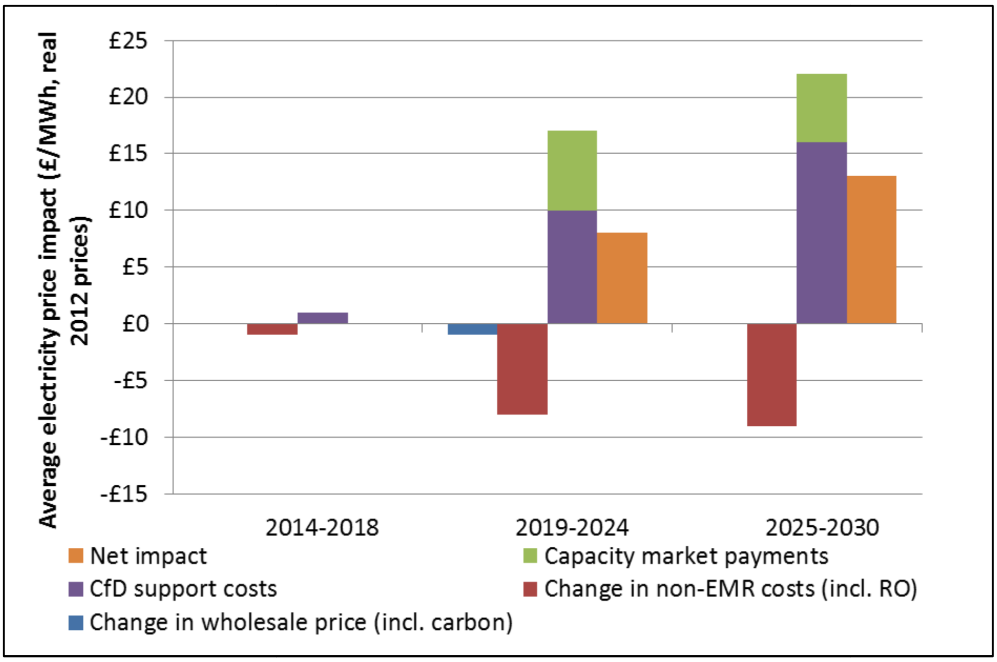
Source: DECC modelling

Analysis based on a 'no-decarbonisation ambition' scenario

66. Assessed over the period 2014-2030, EMR increases prices relative to a basecase where no decarbonisation objective is targeted. Domestic electricity prices to 2030 are on average, around 4% higher under EMR, in comparison to what they would be under the 'no-decarbonisation ambition' basecase (over the period 2014-2030). Despite the impact EMR has in lowering wholesale prices and resulting in lower RO support costs relative to the 'no-decarbonisation ambition' basecase, the size of the EMR support costs outweigh these effects, leading to an overall increase in prices.

67. There are uncertainties when modelling wholesale prices into the future and therefore results are averaged over periods, rather than focusing on individual years. EMR achieves a significantly lower carbon intensity than the 'no-decarbonisation ambition' basecase (as a result of investment in low-carbon generation), as well as mitigating against security of supply risks.

Chart 4: Net Impact of EMR on domestic electricity prices, relative to 'no-decarbonisation ambition' basecase (assumed emissions intensity in 2030 = 100gCO_2/kWh)



Source: DECC modelling

68. The table below presents the impact of EMR on consumer bills relative to the 'no-decarbonisation ambition' basecase. Annual average household electricity bills under EMR are expected to be, on average, around 4% (£25) higher than they would have been under the 'no-decarbonisation ambition' basecase, over the period 2014-2030. Bills for both non-domestic consumers and EIIs are expected to be between 5% and 6% higher.

Table 14: EMR Bill Impacts relative to 'no-decarbonisation ambition' basecase (assumed emissions intensity in 2030 = 100gCO_2/kWh)

Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£'000s)		Energy Intensive Industry (£'000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	588	-	1,240	-	9,390	-10 (0%)
2019-2024	599	+26 (+4%)	1,390	+80 (+6%)	11,220	+780 (+7%)
2025-2030	663	+44 (+7%)	1,470	+120 (+8%)	11,940	+1,100 (+9%)
2014-2030	**618**	**+25 (+4%)**	**1,380**	**+70 (+5%)**	**10,940**	**+660 (+6%)**

Source: DECC modelling

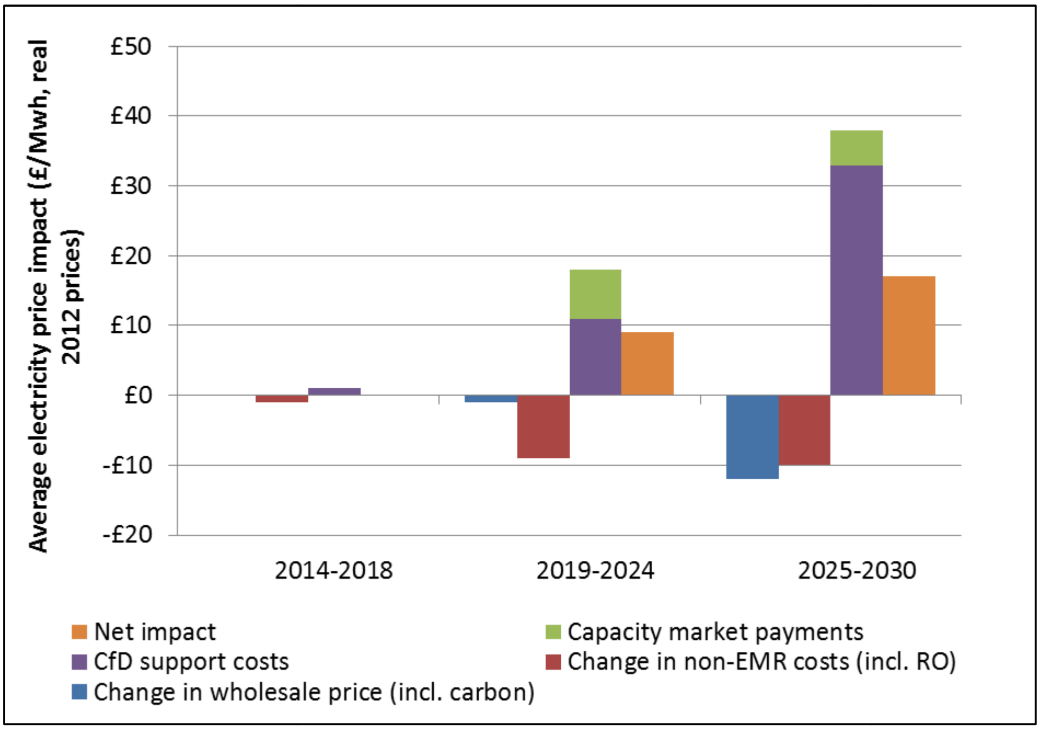
69. Between 2019 and 2024, average annual electricity bills are estimated to be higher under EMR compared to a 'no-decarbonisation ambition' basecase, with annual household electricity bills around £26 (4%) higher. In the late 2020s, the costs of EMR

increase, with average annual domestic electricity bills £44 (7%) higher under EMR in comparison to a 'no-decarbonisation ambition' basecase.

<u>Analysis based on emissions intensity of 50gCO_2/kWh in 2030</u>

70. Under this scenario, EMR again increases prices relative to a 'no-decarbonisation ambition' basecase, with average prices to 2030 estimated to be around 5% higher under EMR, in comparison to what they would be under a 'no-decarbonisation ambition' basecase (over the period 2014-2030). Similarly, despite the downward impact of EMR on bills through lower wholesale prices and lower RO support costs, EMR support costs outweigh these benefits and result in an overall increase in prices. This increase is of slightly greater magnitude than for the 100g scenario above.

Chart 5: Net Impact of EMR on Domestic Electricity prices, relative to 'no-decarbonisation ambition' basecase (assumed emissions intensity in 2030 = 50gCO_2/kWh)



Source: DECC modelling

71. The table below presents the impact of EMR on consumer bills relative to a 'no-decarbonisation ambition' basecase. Annual average household electricity bills under EMR are expected to be, on average, around 5% (£29) higher than they would have been under a 'no-decarbonisation ambition' basecase, over the period 2014-2030. Bills for non-domestic consumers and EIIs are also expected to be between 5% and 6% higher.

Table 15: EMR Bill Impacts relative to 'no-decarbonisation ambition' basecase (assumed emissions intensity in 2030 = 50gCO_2/kWh)

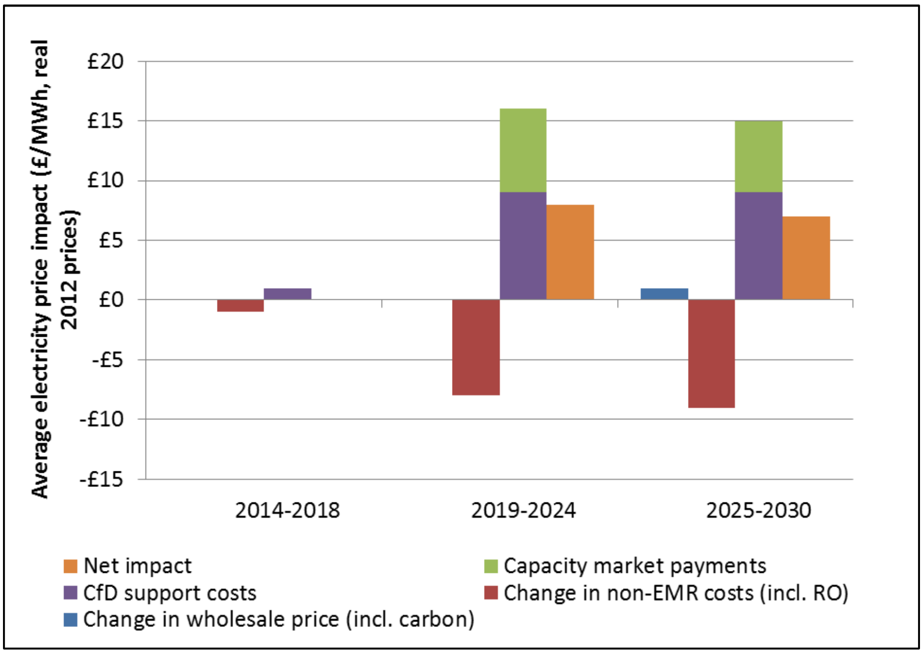
Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£'000s)		Energy Intensive Industry (£'000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	588	-	1,240	-	9,390	-10 (0%)
2019-2024	599	+26 (+4%)	1,390	+80 (+6%)	11,220	+770 (+7%)
2025-2030	663	+57 (+9%)	1,470	+120 (+8%)	11,940	+1,210 (+10%)
2014-2030	**618**	**+29 (+5%)**	**1,380**	**+70 (+5%)**	**10,940**	**+700 (+6%)**

Source: DECC modelling

Analysis based on emissions intensity of 200gCO_2/kWh in 2030

72. Under this scenario, EMR increases prices relative to a 'no-decarbonisation ambition' basecase. On average prices are estimated to be around 3% higher under EMR, in comparison to a 'no-decarbonisation ambition' basecase (over the period 2014-2030). Again, the impact of lower wholesale prices and lower RO support costs under EMR is outweighed by EMR support costs, leading to an overall increase in prices.

Chart 6: Net Impact of EMR on Domestic Electricity prices, relative to 'no-decarbonisation ambition' basecase (assumed emissions intensity in 2030 = 200gCO_2/kWh)



Source: DECC modelling

73. The table below presents the impact of EMR on consumer bills relative to a 'no-decarbonisation ambition' basecase. As might be expected, the increases in annual

average domestic electricity bills under EMR for this scenario are smaller than for either the 50g or 100g scenario, being only 3% (£16) higher than they would have been under a ‘no-decarbonisation ambition’ basecase, over the period 2014-2030. Bills for non-domestic consumers and EIIs are also estimated to be 4% higher over this period.

Table 16: EMR Bill Impacts relative to ‘no-decarbonisation ambition’ basecase (assumed emissions intensity in 2030 = 200gCO_2/kWh)

Real 2012 prices	Domestic (£)		Non-Domestic (with CRC) (£’000s)		Energy Intensive Industry (£’000s)	
	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)	Bill under basecase	Change in bill due to EMR (%)
2014-2018	588	-	1,240	-	9,390	-10 (0%)
2019-2024	599	+24 (+4%)	1,390	+80 (+6%)	11,220	+730 (+6%)
2025-2030	663	+22 (+3%)	1,470	+60 (+4%)	11,940	+590 (+5%)
2014-2030	**618**	**+16 (+3%)**	**1,380**	**+50 (+4%)**	**10,940**	**+460 (+4%)**

Source: DECC modelling

Conclusion

74. Energy prices are volatile, and there are significant uncertainties around estimates, in particular, of wholesale electricity prices for the next 20 years. Therefore these estimates are likely to change further, as projections change over time. However, the latest results suggest that, on average, electricity bills are likely to be lower under EMR, relative to a basecase that achieves the same decarbonisation ambition using existing policy instruments, across a range of potential decarbonisation ambitions (50g, 100g and 200gCO_2/kWh in 2030) – this reinforces the cost-effectiveness of EMR as a tool for decarbonising the power sector.

Annex: CBA Categories

Net welfare

Net welfare is the sum of a number of quantities, defined below.

Carbon costs

The total carbon emissions for a year are multiplied by the appraisal value in that year to determine the total carbon costs for that year. An increase in carbon cost, other things remaining constant, leads to a decrease in net welfare.

Generation costs

Generation costs are the sum of variable and fixed operating costs. The carbon component of the variable operating costs is removed – the EUA price is accounted for in the carbon costs, and the carbon price floor cost is a transfer between producers and the Exchequer so appears in the surplus calculations but not in the net welfare. An increase in generation costs leads to a decrease in net welfare.

Capital costs[55]

All new build is included (plants built by the model, and pipeline plants). Construction costs are annuitised over the economic lifetime of the plant, based on the hurdle rate[56]. An increase in capital costs leads to a decrease in net welfare.

System costs

System costs are the sum of the costs of building and operating the electricity system (TNUoS, BSUoS and inertia costs). These costs are calculated by National Grid models, based on DDM outputs. An increase in system costs leads to a reduction in net welfare.

For network infrastructure costs, the model currently focuses on transmission costs (TNUoS), as this is the main infrastructure needed to connect large-scale generation. As we continue to develop and refine our modelling, we will explore the possibility of including more distribution-related costs (DUoS).

Unserved energy

Expected unserved energy is estimated using an Unserved Energy Module in addition to the DDM. This takes plant outage probabilities, technology mix, demand and historical wind

[55] This is distinct from the cost of capital, which is the overall required return on investment and, as such, it is often used to determine the economic feasibility of a project. When assessing the return on a particular project, the cost of capital is the discount rate used for cash flows and is affected by the relative proportions of debt and equity financing employed.

[56] The hurdle rate reflects the minimum required rate of return which evidence suggests is necessary for a project or investment to proceed

data and uses stochastic modelling to estimate a probability distribution of energy unserved. The mean unserved energy is valued at VOLL (defined by the user, assumed to be £17,000/MWh[57]). An increase in unserved energy leads to a decrease in net welfare.

Interconnectors

This measures the cost of electricity imported via the interconnectors net of the value of exports. If imports are greater or wholesale prices are higher than the cost of imported electricity is increased, scored as a reduction in net welfare.

Consumer surplus

Consumer surplus is the sum of a number of quantities, defined below.

- ***Wholesale price***
  This is the wholesale cost of electricity calculated by taking total demand in each year, subtracting off auto-generation and DSM, and multiplying by the volume-weighted electricity price in that year. An increase in the total cost of electricity consumed leads to a decrease in the consumer surplus.

- ***Low-carbon payments***
  This is the sum of all subsidy payments e.g. ROCs, LECs and CfDs. As these are assumed to be paid (either directly or indirectly) by consumers, an increase in subsidy payments leads to a decrease in the consumer surplus.

  Low carbon payments are a transfer between consumers and producers.

- ***Capacity payments***
  This is the sum of capacity payments. An increase in capacity payments leads to a decrease in the consumer surplus.

  Capacity payments are a transfer between consumers and producers.

- ***Unserved energy***
  This is calculated in the same way as for the net welfare calculation.

Producer surplus

Producer surplus is the sum of a number of quantities, defined below.

- ***Wholesale price***
  This is calculated in a similar way to the same entry in the consumer surplus, except that total demand is defined as total demand minus autogeneration, DSM and net interconnector generation, and the sign is opposite. Interconnectors are excluded

[57] As before, this has been revised upwards from £10,000/MWh on the basis of evidence gathered through an independent externally-commissioned report by London Economics (http://www.londecon.co.uk/publication/estimating-the-value-of-lost-load-voll)

because producers in the UK do not receive any benefit from electricity delivered from the interconnector. An increase in the wholesale price leads to an increase in the producer surplus.

- ***Low carbon support price***

This is calculated in the same way as for consumers but has the opposite sign. An increase in low carbon support leads to an increase in the producer surplus.

- ***Capacity payments***

This is calculated in the same way as for consumers but has the opposite sign. An increase in capacity payments leads to an increase in the producer surplus.

- ***Producer costs***

This is the sum of carbon costs, generation costs, capital costs and the additional carbon cost imposed by the carbon price floor. An increase in producer costs leads to a decrease in the producer surplus.

Environmental tax

This is the amount received by the Exchequer as a result of the carbon price floor. This is effectively the Exchequer surplus. An increase in environmental tax revenue leads to a increase in the Exchequer surplus.

Environmental tax is a transfer between producers and the Exchequer.