Title: RHI Tariff Review, Scheme Extensions and Budget Management	Impact Assessment (IA)
IA No: DECC0153	**Date:** 24/09/2013
	Stage: Final
Lead department or agency: Department of Energy and Climate Change	**Source of intervention:** Domestic
	Type of measure: Secondary legislation
Other departments or agencies: N/A	**Contact for enquiries:** correspondence@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**
-£471m	N/A	N/A	No	N/A

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

The Renewable Heat Incentive (RHI) is an inflation-linked incentive to owners of renewable heat installations. It was introduced in the non-domestic sector in November 2011 and a domestic scheme is planned for Spring 2014. It is intended to help overcome the cost differential between renewable and conventional heating systems in order to incentivise deployment and contribute to meeting the UK's legally binding 2020 Renewable Energy Directive target.

These proposals respond to consultations covering two areas **(1)** to extend the scheme to cover a wider range of technologies and **(2)** to review existing tariffs in response to new evidence and low deployment. Budget management policy is being updated in response to a settlement of £430m in 2015/16.

What are the policy objectives and the intended effects?

To **1)** facilitate the heat sector's contribution to the 2020 renewable energy target; **2)** deliver significant reductions in the carbon emissions from fossil fuels used for heating; **3)** deliver a step-change in the uptake of renewable heat technologies, helping to increase renewable heat from its current level of around 1.5% (now 2%) to 12%; **4)** incentivise uptake across a range of technologies and sectors, minimising the costs to society and avoiding the creation of perverse incentives.

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

- **Policy Option 0**: Do nothing - retain existing non-domestic RHI tariffs, technologies and budget management;
- **Policy Option 1**: Update RHI tariffs using latest evidence available, introduce support for new technologies and update budget management policy to reflect settlement for 2015/16.

The preferred option is Policy Option 1 as it best supports the cited policy objectives. In particular, setting tariffs based on the best available evidence and introducing support for more technologies will mean the RHI is more able to contribute to the 2020 renewables target and allow deployment to drive cost reductions and innovation. Other policy options have been considered as part of developing proposals; however, at this stage we have only 2 options.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 2014

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
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent) (Net savings total to 2015/16)			**Traded:** 0.52	**Non-traded:** 0.03	

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: 3 December 2013

Summary: Analysis & Evidence — Policy Option 1

Description: Support for new technologies is added to the RHI, the increased tariff and changes to tariff structures proposed in the May consultation are adopted and budget management policy that controls spend to £430m in 2015/16 is introduced. The cost and benefit estimates presented in this summary refer to the impacts of the additional deployment up to 2015/16 brought on by these policy changes.

FULL ECONOMIC ASSESSMENT

Price Base Year 2014/15	PV Base Year 2014/15	Time Period Years 27	Net Benefit (Present Value (PV)) (£m)		
			Low: -£776m	**High: £6m**	**Best Estimate: -£471m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate				

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

Cumulative net resource costs associated with the additional 2015/16 deployment brought about by the changes to the RHI over the lifetime of the installations are estimated at around -£722m to -£245m with a central estimate of -£722m. Lifetime monetised health (air quality) costs are estimated at around -£302m to -£115m. Both of these cost estimates represent the changes in costs relative to Policy Option 0 (retaining existing policy) and are included in the NPV calculations.

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

- **Rebound effect**: As the RHI provides a financial incentive to produce heat, in some cases it will lead to heating bill savings which could result in increased heat consumption.
- There are some additional costs arising from Biomass Sustainability standards which are addressed in Annex 1. The quantified costs are administrative and immaterial to the scheme as a whole, however there is a possibility that standards will result in higher biomass prices over the longer term.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	Optional		Optional	**Optional**
High	Optional		Optional	**Optional**
Best Estimate				

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

Monetised benefits of the tariff changes include additional traded and non-traded carbon savings relative to Policy Option 0 (retain existing policy). Much of the renewable heat uptake will be outside the EU ETS and will represent additional UK carbon savings. Carbon savings inside the EU ETS are valued at £18m. Carbon savings outside the EU ETS are valued at £347m.

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

Additional benefits include: avoided infraction fines from failing to meet the renewables target, greater diversification of the fuel mix, improved UK competitiveness in green technologies, innovation benefits and reduced technology costs due to learning from wider deployment. Furthermore, cost reductions in renewable heating system installation driven by the RHI will make future decarbonisation more cost effective. These benefits have not been monetised and are not included in the Present Value calculations.

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

The analysis for this IA has been carried out using scenarios for deployment out to 2015/16 and 2020/21.

- This is very uncertain, due to a lack of evidence, wide variations in the applications for technologies and the relative immaturity of markets for these technologies
- Judgement & market intelligence has been used heavily in policy design and appraisal
- The response of markets to our budget management policy and uncertainty is unknown
- Key sensitivities on appraisal values are included in this IA
- The risks of low carbon savings arising from biomass is mitigated by Biomass Sustainability standards

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**In scope of OIOO?**	**Measure qualifies as**
Costs: N/A	**Benefits: N/A**	**Net: N/A**	No	N/A

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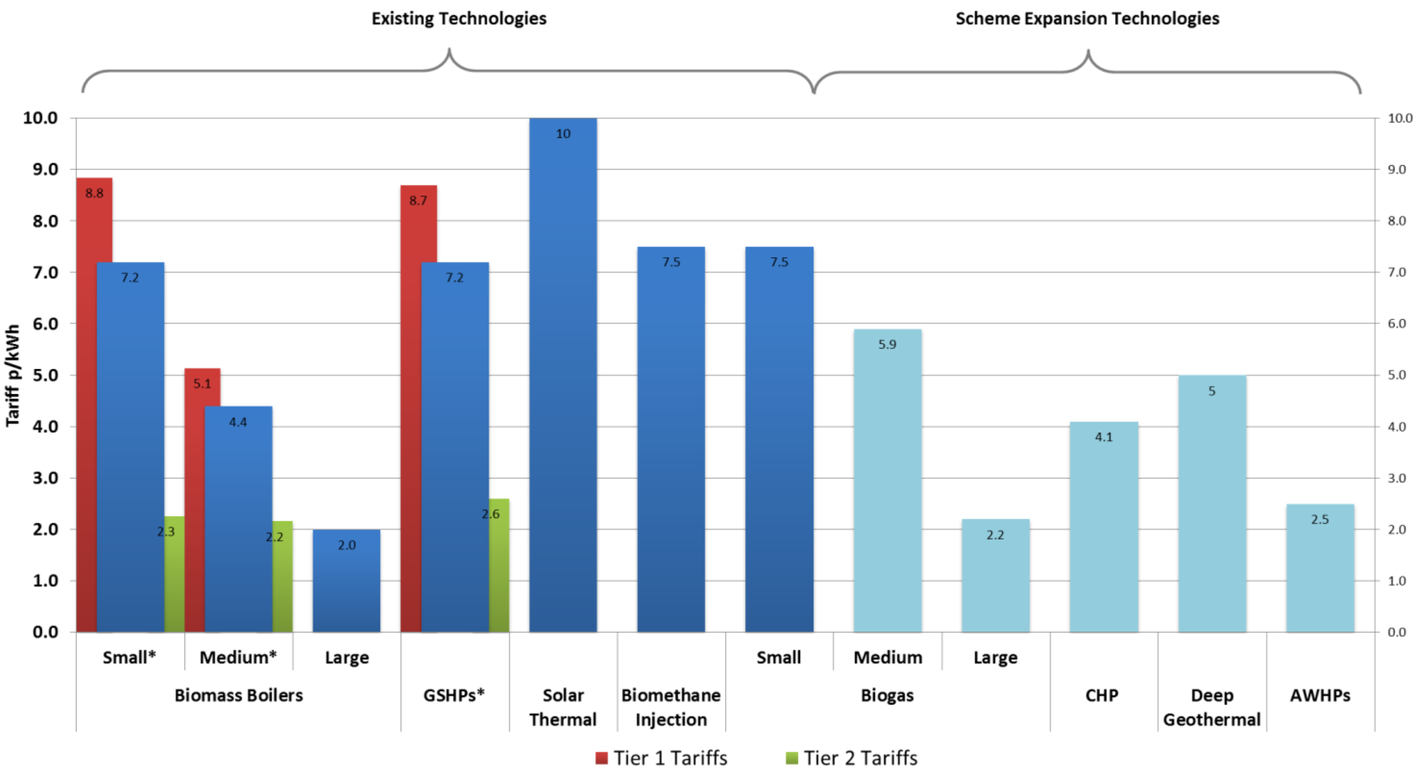
Executive Summary

1. This IA (Impact Assessment) is part of the Government's response to previous consultations on changes to the non-domestic RHI (Renewable Heat Incentive). It aims to appraise the impact of: the expansion of the scheme to support further technologies; increases to tariffs following an early tariff review that was triggered as a result of low scheme deployment and the availability of new evidence on renewable heat technology costs and performance; and an updated approach to budget management. Finally, Annex 1 to this IA provides an assessment of the impacts associated with new biomass sustainability regulations.

2. Figure 1 below illustrates the tariff levels that will be introduced from spring 2014. These tariffs have been set using a combination of MI, modelling using multiple combinations of evidence, stakeholder evidence, and internal judgement and expertise. They are subject to a value for money cap at 10p/kWh of renewable energy, set as the equivalent of the current direct support cost of offshore wind. Finally, GSHP tariffs are tiered to remove the perverse incentive to over-produce heat as a result of the high tariff rate.

Figure 1: Non-domestic RHI tariffs from spring 2014



All tariffs are shown in expected 2014 levels, this means existing tariffs have been inflated using an estimate of RPI for this year, actual RPI may be different.
* The tariffs for these technologies are tiered. The untiered tariff level has been shown in this chart for comparison against other technolgies.

3. In order to quantify the impacts of the policy changes we have estimated the levels of deployment that could result from the policy changes using MI (Market Intelligence) based estimates of deployment potential. These estimates have been produced by drawing on a range of sources including industry estimates of potential, scheme data collected to date, project pipeline data and direct engagement with industry.

4. Our MI estimates suggest that installations supported by the RHI tariffs could result in between 5 and 10TWh of renewable heat in 2015/16 which at the planned tariff levels would cost between £301m and £556m. However, as part of the Spending Review the RHI was allocated a spend limit of £430m for 2015/16 which means that budget management policy will limit renewable heat generated in that year to around 7.4TWh (assuming tariffs are not degressed in 2014/15 and 2015/16).

5. Given the uncertainty surrounding future deployment we have derived a central scenario of 6.4TWh in 2015/16 for use in appraising the impacts of the policy changes. However, budget management policy has been set to allow spending and associated deployment all the way up to £430m in 2015/16. We have appraised the impacts of the policy changes on deployment out to 2015/16 as,

although the RHI is intended to continue to 2020, deployment over that period is so uncertain that it is more informative to focus on the shorter term impacts of the policy change.

6. Even over the relatively short period to 2015/16 and assuming a fixed level of deployment there is considerable uncertainty over the impacts that the deployment will have because of uncertainty around carbon prices, technology efficiencies, air quality impacts, emission factors and resource costs. We have carried out sensitivity analysis with these variables on our central deployment estimate and found that the NPV associated with the policy changes varies from -£776m to £6m around a central estimate of -£471m.

7. As well as the NPV (Net Present Value) we have also estimated the impact of the policy changes on the investment in renewable heating technology that is supported by the RHI and the number of FTE jobs this investment supports. Under our central deployment estimate the RHI could support between £1-2bn of investment in renewable heating technologies during 2015/16, which in turn could support between 7,000 and 16,000 jobs. This is £300m-£600m more investment than would be supported if the policy changes were not implemented and is expected to result in sustainable market growth which can be extended in future years.

8. This IA qualitatively considers the changes in budget management to the non-domestic scheme and introduction of budget management to the domestic scheme. The changes outlined are designed to ensure that the scheme represents best value for money for the taxpayer, deployment remains sustainable, and the scheme will be affordable within the current and 2015/16 spending review periods. There are significant uncertainties over exactly how the budget management system will affect deployment and the costs and benefits associated with individual technologies. We therefore outline the rationale for each change and indicative impacts.

9. Finally the potential impacts of the introduction of biomass sustainability standards are also shown, these standards ensure the lifecycle GHG emissions of biomass are acceptable and prevent adverse land use change. The introduction will help ensure the expected carbon emissions from biomass fuels are realised, which helps safeguard the central RHI NPV estimate presented in this IA.

Part 1 – Background

1A. Introduction

10. This IA (Impact Assessment) is part of the Government's response to previous consultations on changes to tariff levels and the expansion of the scheme. It aims to appraise and quantify the impact of adopting the proposed changes to the RHI (Renewable Heat Incentive) developed through the consultation process. These changes include increases to certain non-domestic tariffs where deployment of technologies has been very low and the introduction of new tariffs for additional technologies. As well as this, changes to the budget management policy and the introduction of biomass sustainability requirements are also described. Part 1 of this IA provides some context to these policy changes whilst Parts 2-4 describe the objectives, analytical approach and an assessment of the impacts.

1B. History

11. The 2009 Renewable Energy Strategy (RES)[1] set out the indicative contributions from heat, transport and electricity that would be required to reach the legally binding EU Renewable Energy Directive target of 15% of UK energy coming from renewable sources by 2020. The RES set out that heat might contribute around a third of this effort through the transition toward 12% of UK heat demand coming from renewable sources by 2020.

12. The RHI was launched for non-domestic consumers in 2011 with IA modelling at the time suggesting that it could achieve total renewable heat deployment of 56.5TWh by 2020[2]. In 2011 we also committed to launch a domestic scheme and to extend the non-domestic scheme to cover a number of technologies which had not been included in the initial launch due to lack of evidence and issues associated with deliverability.

13. Since the launch of the RHI, deployment from most technologies (with the exception of small and medium biomass which have outperformed expectations) has been below the trajectories set out in the modelling for the 2011 IA. These trajectories have been published as far as 2014/15 as the basis for the degression triggers implemented in the 2012 budget management policy.

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[1] http://www.official-documents.gov.uk/document/cm76/7686/7686.pdf
[2] Additional to baseline deployment of around 10TWh – November 2011 IA: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48241/3775-renewable-heat-incentive-impact-assessment-dec-20.pdf

Table 1: 12 month forecast spend based on data up to 30th July 2013 versus anticipated forecast expenditure

Tariff category	Anticipated committed annual expenditure[3] (£m), as at 31.07.2013	Actual committed annual expenditure (£m) at as 31.07.2013
Description	*Anticipated spend triggers*	*Based on actual data provided by Ofgem*
Small commercial biomass	16.7	24.5
Medium commercial biomass	15.5	23.4
Large commercial biomass	27.6	8.8
Small commercial heat pumps	36.3	0.4
Large commercial heat pumps	6.0	0.5
All solar collectors	6.0	0.1
Biogas combustion & biomethane	18.1	1.7
Total	**126.2**	**59.3**

14. The deployment of some technologies key to the objectives of the RHI has been significantly below our original forecasts. Table 1 shows a comparison of actual forecast deployment against the anticipated expenditure set out in the budget management regulations.

15. When the scheme was launched in November 2011, the Government signalled its intention to roll-out a second phase of the RHI, introducing support for additional technologies such as air-source heat pumps and deep geothermal. The policy development required to identify the appropriate support levels and eligibility criteria has now been completed.

16. In addition, in response to the low deployment against anticipated levels and concerns raised to DECC by stakeholders, we undertook a review of the evidence under-pinning the 2011 tariffs and deployment expectations. This review of evidence included a commissioned study on the costs and performance of technologies[4] which along with stakeholder evidence and low deployment has resulted in a convincing case that some of the RHI tariffs under-estimate the cost of deployment and therefore undercompensate.

1C. Consultations

17. As a response to the low deployment and the need to introduce the second phase of technologies, we have carried out three consultations on changes to the non-domestic RHI since September 2012 as well as announcing the Domestic RHI in July 2013.

Expanding the Non-domestic Scheme

18. We launched two consultations detailing proposals to extend the non-domestic RHI on 20 September 2012. The technologies in the consultation fell into four main categories:

    a. Those for which we had previously announced our intention to introduce support through the RHI but we were unable to include in the initial tranche of the RHI in November 2011. The reasons we were unable to introduce support for these technologies varied significantly, from metering challenges to lack of evidence and more fundamental considerations around the suitability of the technology for subsidy;

    b. Technologies which were not included in the original RHI proposals but for which there is now a case for inclusion;

[3] Both anticipated and actual measures need to make assumptions about the operation of installed capacity over a 12 month cycles, so are still estimates. These are based on the forecasting methodology used in budget management policy.

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204275/Research_on_the_costs_and_performance_of_heating_and_cooling_technologies__Sweett_Group_.pdf

c. Technologies which are currently supported under the RHI but the available tariff levels do not reflect their particular costs and performance. For example; CHP installations can currently claim the large biomass tariff. We are proposing separate, higher tariff levels for those technologies to provide genuine incentives; and

d. Technologies for which we do not yet have enough evidence to make proposals on introducing or adjusting support.

19. Table 2 shows the tariffs that were proposed during the consultations on extensions to the scheme. Not all of the technologies consulted on will be introduced as part of these proposals and some of the tariffs have been revised as a result of new evidence and consultation responses. Table 5 & Table 6 show the final proposed technologies and tariffs that will be implemented as part of the policy proposals discussed in this IA.

Table 2: Consultation stage proposals for expanding the Non-Domestic RHI

Technology		Proposed tariff (p/kWh)
Air to air heat pumps		0.97
Air to water heat pumps		1.7
Biomass direct air heating	<1MW	2.1
	>1MW	1
Biogas combustion	200-500kW	5.9
	>500kW	2.2
CHP		4.1
Deep geothermal		5.0
Energy from commercial/Industrial waste		1.0

20. The headline finding from this consultation was that stakeholders were supportive of the proposals for the new technologies and tariffs. The tariffs for some technologies, in particular air to water heat pumps and those linked to the large biomass tariff (biomass direct air >1MW and energy from waste) were identified as low by some respondents.

21. More detail by technology on the consultation outcome and final policy proposals is in Annex 3.

Non-Domestic RHI Early Tariff Review

22. In order to learn more about the main drivers of the tariffs, DECC commissioned a study[5] in August 2012 on the costs and performance of renewable heat technologies. This concluded that for some technologies costs were higher and load factors were lower than was suggested by the data that had been used for tariff setting (more detail can be found in Annex 4).

23. In light of the study's conclusions, scheme performance to date and strong stakeholder feedback we announced a review of existing tariffs in the non-domestic RHI in January 2013. We concluded from this review that higher tariffs would be necessary for some of the technologies already supported in the scheme and in May, consulted on proposed new tariff levels for these technologies. Table 3 shows the current support and the changes that we proposed through the tariff review consultation.

[5] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204275/Research_on_the_costs_and_performance_of_heating_and_cooling_technologies__Sweett_Group_.pdf

Table 3: Existing support and proposed changes through the tariff review consultation

Technology		Current tariffs[6] (p/kWh)	Reviewed tariffs (p/kWh) (proposed for introduction in 2014/15)
Biomass boilers	**Small** (up to 200kW)	Tier 1: 8.6, Tier 2: 2.2	**NO CHANGE**
	Medium (200kW to 1MW)	Tier 1: 5.0, Tier 2: 2.1	
	Large (1MW and above)	1.0	**2.0**
GSHPs	**Small** (up to 100kW)	4.8	**7.2-8.2**[7]
	Large (100kW and above)	3.5	
Solar Thermal (up to 200kW)		9.2	**10-11.3**

24. The tariff review consultation also presented updated proposed tariffs for air to water heat pumps and biomass direct air heaters which were included in the September 2012 consultation on expansions to the non-domestic scheme. These were updated because we had new evidence to inform tariff setting on these technologies, their level relative to other technology tariffs was also important to informing the tariff review. These updated tariffs can be seen below in Table 4.

Table 4: Proposed new tariffs for extension technologies updated in tariff review consultation

Technology		Tariff proposed in September 2012 (p/kWh)	Reviewed tariffs - proposed for 2014/15 (p/kWh)
ASHP (Air to water heat pumps)		1.7	**2.5**
Biomass Direct Air Heating	**Small and medium**	2.1	**2.5**
	Large (>1MW)	1.0	**2.0**

25. The Government Response to the Consultation discusses the consultation responses to these proposed tariffs, which were broadly supportive.

1D. Budget

26. The current RHI scheme and budget management mechanism were set based on 2011 IA modelling of deployment to 2020. The Comprehensive Spending Review settlement which included a nominal spending limit of £424m in 2014/15

27. The relative levels of the budget in 2014/15 and 2015/16 as well as updates to our understanding of potential for near term deployment means that existing 2014/15 triggers for most technologies will be revised at the same time that we set triggers for 2015/16. DECC's 2015/16 Spending Review (SR) agreement is that RHI expenditure will be up to £430m. The adjustments to the budget management policy outlined here (specifically the degression triggers) are intended to ensure that RHI budgets can be controlled to £430m in 2015/16, with the non-domestic scheme expenditure being controlled to £351m.

[6] For comparison purposes please note that these tariffs will be uprated in 2014/15 for any RPI increase from the previous year. https://www.gov.uk/government/consultations/non-domestic-rhi-early-tariff-review
[7] Equivalent to 10.0 - 11.3p/kWh of renewable heat – the range represents the different levels of the VfM cap presented during the tariff review.

1E. Biomass sustainability

28. The RHI subsidises biomass and biofuels in a number of forms, including biomass boilers, biogas and biomass used in district heat networks. At the launch of the RHI in November 2011, there were no mandatory sustainability criteria for solid biomass used for heat generation. Whilst the EU provided recommendations for potential criteria, it left the introduction of sustainability criteria for solid biomass to the discretion of each member state. However without any mandatory sustainability criteria, ensuring the lifecycle GHG emissions of biomass are below a defined level is not possible. The RHI could be subsidising unsustainable biomass that delivers little or no carbon savings, which may lead to even higher emissions relative to heat from fossil fuels. The impacts of changes to the biomass sustainability regulations are also described in Annex 1 to this IA.

29. Non-domestic participants will be able to demonstrate compliance with the criteria in one of two ways: either reporting quarterly to Ofgem on the performance against the GHG criteria of their biomass feedstock, or to purchase RHI compliant biomass from an approved biomass fuel supplier, registered on the Biomass Suppliers List. The Biomass Suppliers List will be managed on behalf of DECC by a contracted organisation chosen via a competitive tender. We expect the list to be up and running by spring 2014, with the introduction of requirements in the autumn.

Part 2 – Rationale, objectives and proposed policy options

2A. Problem under consideration

30. The RHI is the key policy mechanism that DECC has put in place to help the heat sector contribute to the 2020 renewables target and wider low carbon goals. Low deployment from the scheme to date will have an impact on the levels of possible long term deployment. The policy proposals discussed in this IA are a response to this low deployment and the availability of new evidence. This new evidence has indicated that tariffs for some technologies are too low and that there is a case for supporting some of the technologies that were previously consulted on. In addition to this, we have agreed a budget for 2015/16 of £430m. This informs decisions around budget management policy in which we seek to allocate budget efficiently in order to get maximum deployment at good value for money.

2B. Policy objectives

Overall RHI objectives

31. The Government previously decided to take a phased approach to implementing the RHI due to the wide range of technologies and fuel uses that could potentially be included within the scheme. The first phase was launched in November 2011, with stated objectives of[8]:

    a. facilitating the heat sector's contribution to the 2020 renewable energy target;
    b. delivering significant reductions in the carbon emissions from fossil fuels used for heating;
    c. delivering a step-change in the uptake of renewable heat technologies, helping to increase renewable heat from its current level of around 1.5% (now around 2%) towards 12%;
    d. incentivising uptake across a range of technologies and sectors, minimising the costs to society and avoiding the creation of perverse incentives.

32. In addition, the RHI aims to encourage cost reductions in renewable heat technologies through innovation and development of the supply chain in order to better enable the long-term decarbonisation of the UK.

Objectives and rationale for extensions and tariff changes

33. When the RHI was first introduced, the availability of support for certain technologies was delayed due to concerns about performance and measurement. Other technologies were not offered a technology specific tariff as there was insufficient evidence available to determine appropriate tariff levels. Since then, more evidence on the costs and performance of commercial installations has become available which permits new technologies to be included and some of the deliverability issues have been overcome.

34. The objective of the tariff review has been to ensure that tariffs are set on the best available evidence and at a level that allows the technologies to make as full a contribution as possible towards the 2020 renewables target, whilst remaining within value for money limits. The extensions are intended to provide additional potential renewable heat whilst remaining within budget and VfM limits.

35. Without the implementation of increased tariffs and additional technologies in March 2014, it is unlikely that DECC would be in a position to bring any new tariffs into force until after the planned 2014 review of the scheme which would mean that the scheme would continue to significantly underperform for longer, and make it harder to meet our renewables target. Continued low deployment would also leave the market less capable to take advantage of any policy changes made as a result of the 2014 review of the scheme.

Budget management objectives

36. The objectives of the budget management mechanism support the overall scheme objectives. Specifically the mechanism:

    a. puts in place a transparent system that is capable of managing the RHI budget, should demand exceed forecasts;
    b. safe-guards the value for money of renewable heat deployment;

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[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48042/1381-renewable-heat-incentive-ia.pdf

c. avoids suspensions of the scheme;
d. reduces uncertainty in the market; and
e. is relatively straightforward to administer and implement.

37. The changes to the budget management scheme detailed in the accompanying policy document are designed to ensure that these objectives continue to be met by the development of the RHI through the tariff review, extensions and updated forecasts of deployment.

2C. Policy options

38. This section provides an overview of the policy options being assessed in this IA. More detail on analytical or policy considerations is provided in the relevant annexes which are cross-referenced where appropriate.

Option 0: Do-nothing / Counterfactual

39. This IA is intended to provide an estimate of the impacts of the proposed changes to the RHI. As such, the impacts on deployment, carbon savings and air quality associated with the changes are compared to the impacts that would take place if we implemented none of the changes and kept existing tariffs, technologies and budget management policy in place.

40. Under this scenario certain technologies currently supported by the RHI would continue to deploy well. Small and medium biomass boilers have deployed beyond original expectations to date. One reduction to the medium biomass tariff has already been implemented because the anticipated spend on the technology has exceeded the trigger levels set as part of budget management policy. We would expect both small and medium biomass boiler deployment to continue along the path set by their existing degression triggers to the end of 2014/15.

41. Beyond this point budget management policy has not been set but for the purposes of the counterfactual scenario we assume that through 2015/16 small and medium biomass boiler deployment is able to continue along the trajectory suggested by the same modelling that was used to set degression triggers for the 2012 budget management policy[9].

42. Based on our updated estimates of near-term deployment, biomethane to grid has a healthy project pipeline so we would expect strong deployment out to 2015/16. We assume that biomethane deploys along its central MI scenario (see section 3C), which is still slightly below the level of its current triggers for 2014/15 and the 2015/16 level from the 2012 budget management modelling. Under the do-nothing option we assume that all the other technologies that are currently supported through the RHI continue to only deploy at low levels in-line with historical trends and that none of the extension technologies are brought into the scheme.

Option 1: Introduce revised tariffs, support for new technologies and updated budget management policy

43. All of the proposed changes to RHI tariffs and technologies being assessed in this document relate to the non-domestic RHI, changes to the budget management policy apply to the entire scheme (non-domestic and domestic). The proposed policy option is to adopt all of the policy proposals outlined below as one package. Under this option, the non-domestic scheme would be updated to include new technologies and new tariff levels with some changes to tariff structures. Budget management policy for the entire scheme will be updated. The deployment scenarios we present in the Impact Evaluation section assume that all of the policy options below are adopted and the domestic scheme is launched. All of the proposed changes to the non-domestic scheme are to be introduced in spring 2014.

Option 1a: New technologies

44. Table 5 shows the technologies and associated tariff levels that will be introduced from spring 2014. The methodology used for tariff setting is also provided. Annex 3 provides more detail on the tariff setting approach and considerations made for each of the technologies we are proposing to introduce support for. In the September 2012 consultation on extensions to the scheme we also consulted on the introduction of Air-to-Air ASHPs and Biomass Direct Air. However, we have decided that we will not proceed with their introduction at this stage. This is because providing payments for

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[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/120669/2013-02-26_Final_Impact_Assessment_RHI_Cost_Control_Budget_Management_2013.pdf

heat delivered by these technologies would require a method for either metering or deeming their heat output which we would not be able to implement by spring 2014. For more detail on the reasons for technologies not being introduced, refer to the Government Response to Consultation, which outlines the proposals, responses and Government consideration for each technology.

45. The expansion technologies have only had very limited deployment to date so the cost and performance data needed to calculate tariffs from the cost curve methodology is not available. In addition, deployment of CHP and Biogas Combustion for renewable heat will be heavily influenced by the tariffs available for renewable electricity using these technologies. In order to set tariffs for these technologies we have considered a range of sources. See Annex 3 and 4.

Table 5: Technologies to be introduced to the RHI from spring 2014 and associated tariff levels

Technology		Proposed tariff (p/kWh)
Air to water heat pumps		2.5
Biogas Combustion	200-600kW	5.9
	>600kW	2.2
CHP		4.1
Deep Geothermal		5.0
Energy from Commercial/Industrial waste		2.0

Option 1b: Updated tariffs

46. Table 6 shows the current tariffs available to RHI technologies and the updated tariffs we are proposing following the consultation.

Table 6: Updated tariff proposals following tariff review consultation

Technology		Current tariffs[10] (p/kWh)	Reviewed tariffs proposed for 2014/15 (p/kWh)
Biomass Boilers	**Small** (up to 200kW)	Tier 1: 8.6, Tier 2: 2.2	**NO CHANGE**
	Medium (200kW to 1MW)	Tier 1: 5.0, Tier 2: 2.1	
	Large (1MW and above)	1.0	**2.0**
GSHPs	**Small** (up to 100kW)	4.8	**7.2[11]**
	Large (100kW and above)	3.5	
Solar Thermal (up to 200kW)		9.2	**10.0**

47. These increases were a response to low deployment of these technologies under the current tariffs and new evidence on costs and performance collected through commissioned research and engagement with stakeholders. The proposed tariffs were derived from an updated methodology that placed more emphasis on the wider evidence base (stakeholder evidence and scheme data) in conjunction with the model-based methodology that was used at the time of the scheme's launch. A summary of the tariff setting methodology is provided in Box 1 and further detail is provided in Annex 4.

48. We are taking forward the lower end of the proposed range for the value for money cap. 10.0p/kWh represents the direct support cost of offshore wind in 2014/15 through ROCs and LECs. The 11.3p/kWh would have included the value of the indirect support of the EU ETS and Carbon Price

[10] For comparison purposes please note that these tariffs will be uprated in 2014/15 for any RPI increase from the previous year. https://www.gov.uk/government/consultations/non-domestic-rhi-early-tariff-review

[11] Equivalent to 10.0p/kWh of renewable heat

Support received by offshore wind through the wholesale electricity price. This has not been taken forward as the indirect policy landscape facing offshore wind and renewable heat is very complicated and it is not possible to put financial values on all indirect support which could increase or decrease the cap (e.g. downstream impacts of EU ETS and tax rates all impact various decision makers). Therefore, in order to ensure good value for money versus other RED contributing options, we will use a tariff cap of 10.0p/kWh of renewable heat.

Box 1: Changes to the tariff setting approach introduced as part of the 2013 tariff review

Approach to setting tariffs in 2011

RHI tariffs aim to compensate, through a 12% internal rate of return on the net[1] costs, the 50th percentile of the annual heat potential for each technology. Existing RHI tariffs were developed using an economic model and AEA data using the following steps:

a. Estimate the additional levelised cost of installing and running a renewable heating system. This is used to calculate the cost per unit of heat produced for renewable technologies less the cost of the conventional technology alternative. Added to this cost are the additional barrier costs. Calculations are made using costs, use and performance data for each technology in each category of building (broken down by commercial, industrial, counterfactual fuel and location).
b. Estimate the heat demand of each building category, the number of such buildings and the proportion of them suitable for each renewable technology.
c. From these figures, a "supply curve" is produced for each technology which estimates the amount of renewable heat potential at each tariff level.
d. From these curves we identify the tariff required to offer a 12% internal rate of return to the 50% point on the supply curve (unless the tariff is capped for value for money reasons).

Approach Taken to RHI Tariff Setting in 2013 Tariff Review

When the RHI was introduced, tariffs were based on the best available data at the time – the AEA reports from 2009[1] and 2010[1]. DECC now has four key data sources that have been used to inform tariff setting in the recent tariff review consultation. These include: the original AEA data, new data set from Sweett commissioned in August 2012, actual scheme deployment data and the data collected from stakeholder engagement.

DECC has decided to use this broader range of evidence to set tariff levels, rather than having to rely solely on the outputs of the RHI model. The aim of the tariffs set in the scheme remains the same as before, that is, to incentivise up to the 50th percentile of the heat potential for each technology, whilst providing a rate of return of 12% to the reference installation.

To make judgements about the appropriate tariffs levels, the following considerations have been taken into account:

a. The level of deployment seen to date achieved by current tariffs.
b. The range of modelling outputs resulting from different combinations of evidence. [Table 27 in Annex 4].
c. The tariffs presented by the renewable heat industry in response to consultations and as part of our on-going engagements with them, the range of which is set out in [Table 26 in Annex 4].
d. The recommendations of DECC engineering and market specialists.
e. The nature of each technology in question and specific risks around over- or under-compensation of that technology i.e. some technologies could ramp-up deployment very quickly if over-subsidised and so pose an affordability risk.
f. The levels of tariffs relative to one another, where there are clear parallels between the technologies and their applications, e.g. biomass boilers and biomass direct air heating.

Option 1c: Changes to tariff structures

49. In addition to the increases in the tariff levels shown in Table 6 we proposed to combine the separate tariffs for small and large GSHPs into a single tariff for all installation sizes and to "tier" the GSHP tariff in a similar way to the Small and Medium Biomass tariffs. The single tariff was a response to evidence that there were limited returns to scale for GSHPs.
50. Tiering is proposed because the increase in the GSHP tariff would take RHI payments well above the marginal cost of producing a unit of heat from a GSHP - Box 2 provides more detail on the incentive to over-produce heat in the RHI. Tiering splits the tariff into a higher initial tariff for the first 15% of possible run-hours in a year and a lower tariff for the remaining heat produced that year. A tiered tariff is intended to remove the incentive to game the RHI by over-producing heat but does introduce incentives for other "gaming" behaviour (see Box 2).
51. Table 7 sets out the levels of the tier 1 and tier 2 tariffs for GSHPs. The second tier has been set by using the short-run marginal cost of producing a unit of heat from a GSHP i.e. the cost of the electricity input. The most recent projections of electricity prices from DECC's UEP have been used[12]

Table 7: Proposed levels of tiers for GSHPs

Proposed GSHP tariff (p/kWh for all heat output)	Tier 1 (p/kWh - first 15% of potential annual heat output)	Tier 2 (p/kWh - remaining heat output)
7.2	8.7	2.6

52. Setting the level of the tier 2 tariff involves a trade-off over the scale of two incentives that work in opposite directions. The lower the level of tier 2 the higher tier 1 needs to be to provide the same level of overall compensation to an installation. This increases the difference between tier 1 and tier 2 which increases the incentive to over-size the kit being installed (see box 2). The higher the level of the tier 2 tariff, the lower the net cost of producing extra unit of heat. This could lead to higher levels of comfort taking where GSHP users increase their overall heat production compared to what they would have produced if using a conventional heat source.
53. In order to balance these two effects we have opted to set tier 2 payments at 85% of what we estimate to be the cost of the electricity input[13] for a unit of heat. This minimises the difference between the tier 1&2 tariffs so minimises the incentive to over-size but does not set the marginal cost of heat to zero (or even make it negative). We would not set the tariff at exactly the marginal cost for 2 main reasons; one because of the risk of comfort taking and two because future electricity prices are uncertain and if prices are low the incentive to comfort-take is more likely to transform into an incentive to over-produce. This represents an inherent trade-off between two undesirable incentives.
54. Setting the tier 2 level close to the marginal cost does increase the risk that comfort-taking or over-production will take place however, as we set out in the 2011 IA[14], because individual installations are unlikely to have sufficient information over their SPF, they are unlikely to be able to reliably exploit the benefits of a low marginal cost of heat.

Option 1d: Revised budget management

55. The budget of £430m allocated to the RHI as part of the Spending Review for 2015/16, alongside the extensions to the scheme and increases to tariff levels, has lead us to review our existing budget management policies and introduce some changes to the levels of degression triggers and how they are set. Part 5 of this IA provides more detail on changes to budget management policy.

[12] https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-and-emissions-projections
[13] Assuming an SPF of 360% and the average projected commercial electricity price between 9.8 and 12.6p/kWh.
[14] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48241/3775-renewable-heat-incentive-impact-assessment-dec-20.pdf

Box 2: The incentive to over-produce heat in the RHI and the impacts of tiered tariffs

Because of the way RHI tariffs are designed to compensate users for **both** the extra capex and opex involved in installing a renewable heating system, tariffs will often be higher than the short run marginal cost of generating an extra unit of heat (i.e. the fuel or electricity cost). This can lead to an incentive to over-produce heat in order to maximise revenue from RHI payments. This excess heat would not be useful and would not be displacing heat produced from conventional sources.

To address this, a tiered tariff was introduced at launch for small and medium biomass installations as these are the installations where the incentive to over-produce is clearest (because the marginal cost of generating heat from a small or medium biomass boiler is lower than the un-tiered tariff). The tiered tariff is split into a tier 1 tariff which is available for the eligible heat generated in the first 1,314* hours of full capacity operation each year (this tier aims to mainly cover the capital cost repayment) and a tier 2 payment that covers the net fuel costs of the installation (which in 2014 would be set at around 2.3p/kWh for small and medium biomass boilers). This second tier tariff applies once the maximum of the tier 1 tariff has been reached. The tier 2 tariff is set at a level that should remove the incentive to over-produce and vent heat whilst still compensating for the net cost of the renewable fuel.

Whilst tiered tariffs are designed to avoid the incentive to over-produce heat they can also introduce a secondary incentive to oversize the kit being installed. This is because the amount of heat under tier 1 or tier 2 can be determined by the capacity of kit (see note below *). So if it is relatively cheap for installers to increase the size of kit they will be able to earn larger revenues through the RHI by claiming for a larger proportion of their heat needs at the tier 1 tariff.

The deployment data for biomass boilers that we have received to date does show a bias towards the larger sizes within size bands. However, it is difficult to identify how much of this is due to oversizing to take advantage of the higher tier 1 tariffs and how much is due to other factors.

The availability of a higher tariff for smaller installations creates an incentive to install kit that falls into the smaller band, even where it may have been more efficient to use larger kit. This incentive would also lead to larger numbers of installations at the top end of banding thresholds as has been seen in the scheme deployment data. Given the uncertainty in identifying the key drivers of behaviour DECC will continue to monitor this issue and most likely revisit it as part of the wider 2014 review of the scheme.

*This is the number of hours associated with a 15% load factor which is an estimate of the lower-end of the range of possible load factors. The amount of heat an installation will receive at the tier 1 tariff is a product of its capacity and 1,314 hours. E.g. a 100kW system would be eligible for the tier 1 tariff on up 131,400kWh of heat

Part 3 – Evidence Base, Uncertainty & Analytical Approach

3A. Sources and impact of uncertainty

56. RHI policy design and appraisal is severely limited by weak evidence and uncertainty across the board. This is due to a number of factors but predominantly:

    a. **Lack of evidence –** Low levels of deployment to date mean data, evidence and understanding of technologies is weak. It also means market sizes and consumer awareness can change rapidly. In addition, the evidence that we do have often has large ranges for the same sorts of applications and varies significantly from source to source.

    b. **Heterogeneity –** Both non-domestic heat demand and individual renewable heat installations are extremely heterogeneous and poorly understood. For example, the cost of heat generation per unit of heat varies considerably for a single technology, dependent on factors such as location, heat load, size and user behaviour.

    c. **Feedback between policy design and uptake –** The costs, performance and deployment of technologies are all heavily influenced by behaviours such as design, use and specification which are influenced by individual and market wide reactions to the way policy is designed.

57. These significant uncertainties create risks in both the setting of new tariffs and the forecasting of the impacts of tariffs for the Tariff Review and RHI Extensions. There are two main areas this affects:

    a. **Tariffs –** The government response that this IA accompanies proposes changes to tariffs and new tariffs. There is significant uncertainty about the appropriate level of tariff to offer due to factors described above. For example the data we have can be combined in a number of ways which leads to a wide range of tariffs. The tariff review proposals are based on DECC judgement drawing on four distinct data sources, AEA data, Sweett data, scheme deployment data and stakeholder feedback. Annex 4 provides more detail on the evidence base that was drawn on when updating tariffs.

    b. **Forecasting deployment –** A detailed breakdown of the non-domestic building sector and robust information about firm's decision making is not currently available. Coupled with the uncertainty about the cost and performance of technologies, this means that technical potential and likely deployment are very uncertain.

58. In both areas market intelligence (MI) and stakeholder views have been used significantly to offer a more complete picture than our modelling and data offer. The following sections outline the approach taken to appraisal for this IA given the challenges set about above.

3B. Analytical approach

59. In order to appraise the affordability, costs, benefits and wider impacts of these proposals we need to develop forecasts of deployment. Previous RHI policy development, appraisal and forecasts have been produced using the RHI model[15]. Given the difficulties, evidence gaps and uncertainties described above, we have improved our approach by drawing on the wider evidence now available to us. We have developed a MI approach to forecasting over the short to medium term. This approach has involved:

    a. **Collecting MI –** We have compiled Low, Medium and High estimates of deployment through to the end of 2015/16 for all technologies using a combination of MI including: Industry reports; Trade Association data; pipeline data; trend extrapolation; stakeholder interview and internal expert judgement. The results are described in the next section and our approach in developing the MI has been described in more detail in Annex 2.

    b. **Building a calculator –** We have built an impacts calculator which estimates the costs and benefits associated with the forecasts of deployment. This involved building in factors such as tariff tiering, seasonality of heat demand and deployment profiling. More detail on the calculator's approach can be found in Annex 6.

    c. **Populating calculator with assumptions –** We have developed a set of assumptions around parameters such as carbon intensity, installation size, capital costs and employment

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[15] Built by Nera and populated with data from AEA and Sweett Group

per £ revenue in order to estimate the wider impacts of certain levels of deployment. More detail on these assumptions can be found in Annex 7.

d. **Scenario based approach to long term (to 20/21) –** A view of potential deployment is important for tracking progress towards 2020 targets and to inform our understanding of potential market size. We present very wide ranges for the longer term impacts in Annex 10. This is appropriate given the enormous uncertainty faced in demand, supply and long-term impact of government policy.

3C. Description of MI – Market potential out to 2015/16

60. We have generated the following estimates of potential deployment under the RHI by 2015/16. This draws on a range of sources including industry and project pipeline data, more detail is provided in Annex 2. The three scenarios shown in

61. Table 8 represent the range of deployment that the MI suggests would be possible at the tariff levels set out in Table 5 and Table 6.

62. An estimate of the current and future market size for each of the main renewable heat technologies has been made using MI. These estimates have been based on a variety of sources:

    a. Publicly available market data from organisations like BSRIA and Delta-EE
    b. Reports produced for DECC by AEA, NNFCC and others
    c. Data from trade bodies like the AD and Biogas Association and REA
    d. Data from other third parties with an interest in particular markets
    e. Discussions with installers, manufacturers and other stakeholders
    f. Internal DECC work on project pipelines
    g. Application data from Ofgem

63. Many of the markets for renewable heat technologies are in their infancy so high quality data on existing markets and market projections is not readily available. The MI represents our "best guess" of what might happen over the next few years but is necessarily subject to a high degree of uncertainty in many cases.

64. In order to account for some of this uncertainty, low, high and central estimates of potential deployment were derived for each technology. Because of the range of sources that have been drawn on to prepare the estimates for different technologies, there is not a consistent set of assumptions underlying the low and high scenarios as they will reflect different factors for different technologies. Annex 2 provides more detail on the assumptions and sources used on a technology by technology basis.

65. These scenarios do not take account of the budget limit for 2015/16 or any impact from uncertainty over tariff levels or budget availability that is introduced by budget management policy. In addition, the subsidy spend estimates shown in Table 8 assume that the tariffs are not reduced by degression over the period to end 2015/16.

Table 8: Potential deployment and spend in 2015/16 across the three MI scenarios

	2015/16 scenarios[16]								
	Renewable heat GWh			Nominal spend £m			Number of Installations		
	Low MI	Central MI	High MI	Low MI	Central MI	High MI	Low MI	Central MI	High MI
Small and Medium Biomass	2,799	3,167	3,536	143	165	188	1,957	2,933	3,910
Large Biomass	818	1,228	1,638	10	19	27	30	96	161
GSHPs	138	194	271	14	21	29	380	550	883
ATWHPs	312	427	673	17	23	36	1,541	1,698	2,695
Biomethane & Biogas	708	1,073	1,490	54	82	114	43	78	108
CHP	186	879	1,572	8	37	66	0	4	8
Other (Deep Geo, ST)	28	34	40	2	3	3	777	930	1,083
Domestic[17]	178	370	481	52	76	93	21,350	44,930	58,409
Total	5,167	7,373	9,701	301	426	556[18]	26,078	51,219	67,258

66. The spend estimates in Table 8 above illustrate that under the central scenario spend would be within the £430m budget for 2015/16. However, deployment above this level towards the High MI scenario would not be possible without either overspend in 2015/16 or reductions in the tariff levels. Therefore the high scenario is not used in our evaluation of impacts.

67. The budget management policy described in Part 4 of this IA is designed to control spending to £430m, however this doesn't mean that 2015/16 deployment is limited to around the 7 TWh suggested by our central MI scenario. This is because degression triggers are set in a way to allow some flexibility over the exact mix of technologies that deploy. For example, the deployment of technologies with lower tariffs could be higher whilst more expensive technologies is lower, this would lead to slightly higher overall deployment whilst remaining within the £430m limit. In addition, deployment of some technologies may be high enough to trigger a tariff reduction through degression which would mean more heat could be deployed for the same level of spend.

68. However, we cannot currently model the impact of degression on deployment so cannot reliably estimate the levels of spend or deployment that might ultimately arise if deployment is high enough to lead to tariff reductions.

3D. Limitations of analysis

69. As per the uncertainty and approach outlined above, there are very important limitations to the analysis presented in this IA. The estimates should be seen as a set of plausible scenarios of costs and benefits of the additional deployment brought on by the policy changes to 2015/16.

70. Estimates beyond 2015/16 should be treated merely as an illustration of what deployment might be achieved under different scenarios. They are simply based on the trends shown in previous modelling and therefore do not take into account constraints on demand or supply that may occur before those levels of deployment are achieved. They also do not build in the possibility of cost reductions or improved performance over that time frame.

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[16] The figures in this table represent the potential deployment, spend and installation numbers associated with our MI scenarios. The numbers do not represent projections of deployment at the individual technology level. There is a great deal of uncertainty over what the actual deployment will be for any one technology.

[17] The number of installations for domestic RHI is very uncertain as it is very dependent on the heat demand of households who take up the RHI. For this estimate we have used average heat demand as recorded in RHPP. In the July 2013 IA we used a lower figure based on modelled heat demand. Taken together they give a plausible range of deployment in the coming years, in both estimates we expect the renewable heat supported to be similar.

[18] This level of spend and deployment would not be possible within budget limits.

71. Finally, the lack of current evidence means that where metrics are estimated on the basis of assumptions and applied to these deployment scenarios (for example jobs estimates, capital expenditure or NPV) these should be used extremely cautiously.

3E. Evidence base improvement plans

72. We have set out a number of ways in which we are constrained by the limitations of our evidence base. As a result of these limitations we have prepared plans for how we will improve our evidence base in order to understand impacts better.

73. There are a number of specific plans in place to improve the evidence base, data sets and understanding of the technologies. These plans, which depend on scope, include:

    a. Collecting cost and performance data for standard technologies. This involves an 18 month project with a final report early 2015, to inform a June 2015 new Government initial Spending Review

    b. Collecting cost and performance data for new non-domestic technologies. This will include an examination of evidence on non-domestic technologies not already in the RHI to inform the 2014 RHI Review

    c. Collecting data on Heat Networks costs and characteristics to inform the 2014 RHI Review

    d. Producing a report on the technical potential of recoverable heat from industrial process to inform the 2014 RHI Review

74. In the longer term a modelling strategy will provide more flexible and appropriate tools for the next generation of policy questions. In particular the new National Household Model will be ready for use in 2014.

75. An evaluation of the RHI is being commissioned. The commissioned evaluation will run until March 2015 and will cover the domestic and non-domestic schemes and, together with the impact evaluation and value for money analysis which we are planning to carry out in house, will comprise the evaluation activity to inform policy delivery and provide accountability.

76. One of the priorities will be to revisit and refine the research questions in line with any developments in the policy. The scenarios developed from our MI work are an important input to this as they provide a clear overview of the anticipated outcomes of the policy changes.

77. We will also continue to make use of data generated by installations that apply for or receive RHI support.

Part 4 – Impact appraisal

79. The estimates of deployment we have used to assess the potential impacts of the policy changes are all based on the MI scenarios that were presented in the previous section. Because of the further uncertainty over the level and technology mix of deployment between 2015/16 and 2020/21 we have chosen to focus on quantifying the impacts of the extra deployment brought by the proposed policy changes up to 2015/16. The renewable heating systems installed between now and 2015/16 have an assumed lifetime of 20 years. This means that additional deployment in 2015/16 will continue to have an impact all the way to 2035/36: overall impacts have therefore been quantified up to this point in time.

4A. Range of potential deployment to 2015/16

Translating the MI estimates to projected deployment

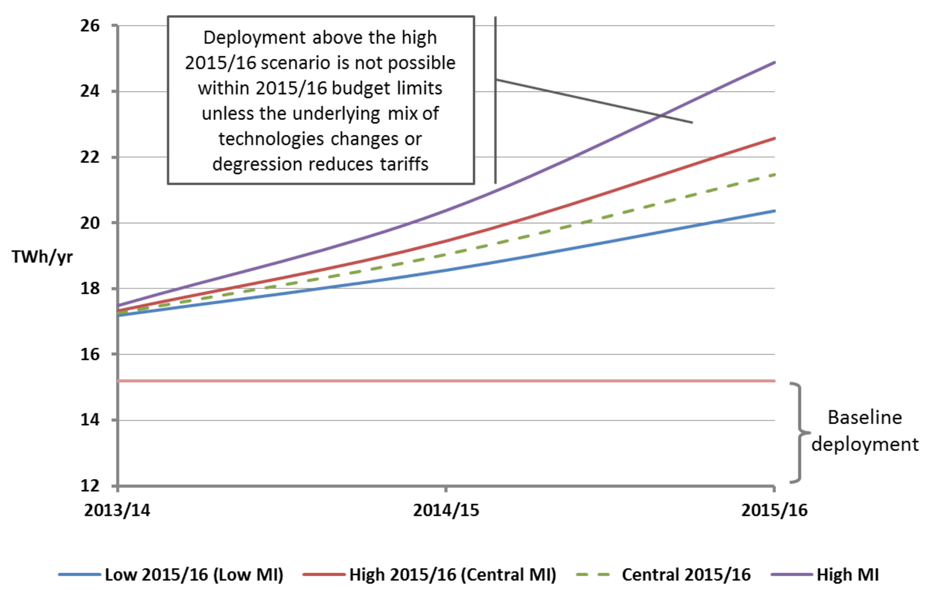
80. The deployment potential identified through our MI work forms the basis of the deployment scenarios that we have used in appraising the impact of the policy changes. We have produced deployment projections for the period to 2015/16 which take account of the impact of the budget limit for 2015/16 and the budget management policy.

81. As shown in Table 8 our MI work suggests that deployment through the RHI could cost between £301m and £556m in 2015/16 once new tariffs and technologies are implemented. Budget management policy will be set to control expenditure to the agreed £430m 2015/16 limit. This means deployment at the upper-end of the range identified by our MI would not be possible without considerable reductions in tariffs. The expenditure limit coupled with the assumption that tariffs will not reduce in the period to 2015/16 means that our projected deployment scenarios fall within the range suggested by the low and central MI scenarios[19].

Projected deployment to 2015/16

82. We project that 2015/16 deployment of renewable heat supported by the RHI will be somewhere between 5.2 and 7.4TWh/year, which is the range covered by the low and central MI scenarios. Deployment could still be above this level but this would trigger tariff reductions meaning that deployment much above the central MI scenario is unlikely. Equally, lower deployment than the low MI scenario is also possible but this would require a considerable slowdown in the deployment growth of small and medium biomass and for there to be very limited deployment in response to the tariff changes and extensions to the scheme.

Figure 2: Range of scenarios for deployment to 2015/16



[19] Higher deployment and lower tariffs is still possible but this sort of scenario lies outside of our high and low range.

83. Figure 2 illustrates the different scenarios we have for deployment out to 2015/16 and how they relate. Our central estimate for deployment to 2015/16 is the mid-point between the low and central MI scenarios which implies 6.4TWh of renewable heat being supported by the RHI and a 2015/16 spend of £351m. This means that our central estimate of 2015/16 deployment is below the central MI scenario. This central estimate reflects the potential for optimism bias in MI and the fact that with the High MI scenario ruled out by budget management, deployment should now be expected to fall between the Low MI and Central MI scenarios. Nonetheless, deployment all the way to our central MI scenario is possible given the budget and would be a very positive outcome for the scheme.

84. In addition to the scenarios for deployment supported by the RHI, Figure 2 also shows the baseline level of deployment of 15.2TWh. This is the amount of RED eligible renewable heat produced by installations that were put in place prior to the RHI or by installations that are not eligible for RHI support[20]. In reality this may grow or shrink over time due to factors external to the RHI. We do not look at this in detail in this IA as it is out of scope of RHI. This is also discussed in our counterfactuals discussion in the next section and Annex 10.

Extending projections to 2020/21

85. The range of possible deployment to 2020/21 is inherently wider than the range to 2015/16. In order to capture this uncertainty we have taken our 2015/16 deployment scenarios and extended them to 2020/21. We have also appraised the costs and benefits of these in terms of an NPV estimate. Due to the uncertainty around the longer term scenarios, and as they are only illustrative, we include them in Annex 10.

Counterfactual scenario

86. In addition to the scenarios described above we have also produced a counterfactual scenario which is used to project deployment under the “do nothing” policy option of keeping the scheme as it is. Under this scenario deployment of small and medium biomass continues to 2015/16 on the path suggested by existing degression triggers. Similarly, Biomethane-to-grid deployment follows its central MI scenario as this is affordable at current trigger levels. All other technologies would only deploy at relatively low levels suggested by historical data or not at all. This scenario would result in 4.6TWh of renewable heat in addition to the baseline being deployed in 2015/16.

4B. Monetised costs and benefits

87. Table 9 below shows the air quality impacts and the value of the carbon savings associated with the three 2015/16 deployment scenarios and an estimate for those values under the counterfactual “do-nothing” scenario[21]. The values have been derived using Defra guidance on air quality impacts and IAG guidance carbon valuation[22]. The table shows the additional impact in 2015/16 and the lifetime impact of those installations that are in place by the end of 2015/16.

88. The figures in Table 9 do not account for the impact of any installations that are put into place after 2015/16. Again, we have opted to only cost the impacts of the proposed policy changes on deployment out to 2015/16.

[20] 2011 estimate of renewable heat produced

[21] Counterfactual deployment is expected to be only slightly below the Low MI scenario and is only applicable to the central scenario so is not shown on the chart for clarity

[22] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243936/2013_Appraisal_Guidance_-_Toolkit_-_FINAL.xls

Table 9: Values of Air Quality impacts and CO_2 savings associated with different deployment levels

	AQ Cost £m		CO_2 savings £m	
	15/16	lifetime	15/16	lifetime
"do nothing"	14	396[23]	47	1,554
High (Central MI)	24	698	75	2,613
Central 2015/16	21	511	64	1,920
Low (Low MI)	17	323	53	1,227

Resource costs

89. A core part of the NPV calculation is the resource cost associated with any policy changes. In this case this is the additional cost to society associated with increased deployment of renewable heating systems rather than conventional fossil-fuel based systems. The RHI payments that renewable heat installations can receive through the RHI are intended to compensate for these additional costs. However, because the additional costs faced by heat producers vary depending on the type of kit being installed and the use of the heat, there will be some degree of over-compensation at any given tariff level. i.e. those heat producers for whom it is relatively cheap to install a renewable heat technology will achieve a better rate of return than those for whom the RHI only just makes renewable heat financially viable.

90. Without detailed information on the costs faced by the full range of potential installations we are unable to determine exactly what proportion of RHI payments are made up of resource costs as opposed to over-compensation. However, we do have estimates of the subsidy spend associated with our deployment scenarios which we can use to derive approximate resource costs.

91. In order to estimate resource costs for this IA we are using a range based on the supply curves and modelling used for the 2011 IA. This allows us to illustrate the order of magnitude for resource costs and NPV under the central 2015/16 deployment scenario. The low and high estimates encompass a range of underlying changes in assumptions about costs (e.g. fossil fuel, carbon and biomass prices) and resulting changes to the deployment mix and show that the resource costs for the non-domestic RHI could vary between 19% and 56% of the subsidy cost.

92. Table 10 shows the range of 2015/16 resource costs associated with the additional non-domestic deployment brought on by the policy changes described under option 1 and how this feeds through to our estimate of the NPV of the policy proposals. We have used 56%, our central estimate of the ratio of resource cost to subsidy spend, as this is the ratio derived from the central NPV estimate in the 2011 IA. We consider this offers a sensible, illustrative relationship between resource and subsidy costs given the transfers involved and the average slopes of supply curves used in tariff setting. As above the resource cost proportion could be as low as 19%, the impact of this lower resource cost on the NPV is also shown below. Whilst it is possible that resource costs will be higher (and therefore make-up a larger proportion of total subsidy costs) the outputs of the 2011 modelling suggest that they would not exceed 56% of the subsidy costs. We have therefore not quantified the impact of even higher resource costs on the NPV. Annex 7 provides the assumptions underlying the quantifications of the costs and benefits shown in Table 10 and Table 11.

[23] The "do nothing" counterfactual should only be used for comparison against the central scenario

Table 10: NPV of planned changes to the RHI based on central deployment scenario with impact of resource costs range

£m real discounted	NPV estimate	
	Under high resource costs	Under low resource costs
Resource costs	722	245
NPV of increased 15/16 deployment	**-471**	**6**

NPV estimate

93. Table 10 provides a breakdown of the NPV associated with the additional deployment that the policy changes will bring on up to the end of 2015/16. This NPV and the ranges derived from the sensitivity analysis in section 4D are all based on the deployment under our central 2015/16 scenario. Different deployment levels will generate different NPVs which could further extend the range shown by the sensitivities, higher deployment will generally lead to a more negative NPV and vice versa. However, NPV estimates we have produced for the low 2015/16 scenario (low MI) and the high 2015/16 scenario (central MI) using our central assumptions are very close to or within the range derived by applying sensitivities to our central 2015/16 scenario. Therefore the range of NPVs shown in this IA is probably sufficient to illustrate the uncertainty around the monetised impacts of the policy.

Table 11: Breakdown of NPV associated with the central 2015/16 deployment scenario

£m real discounted	Impact on central NPV estimate
Resource costs	-722
Air quality impacts	-115
Carbon Benefits in traded sector	18
Carbon Benefits in non-traded sector	347
NPV of increased 15/16 deployment	**-471**

4C. Cost effectiveness of RHI – renewable energy & CO_2 savings

94. The deployment under the central scenario has been used to produce the estimates in Table 12 of resource cost and subsidy cost effectiveness for the non-domestic scheme with proposed tariffs applied to the currently supported technologies. The average (undiscounted, real) cost to Government per unit of renewable energy under these proposals is expected to be 4.7p/kWh (£47/MWh), though this will depend on the exact proportion of technologies and their use.

Table 12: Subsidy cost and resource cost per MWh of renewable heat produced and tonne of CO_2 abated (discounted average lifetime)

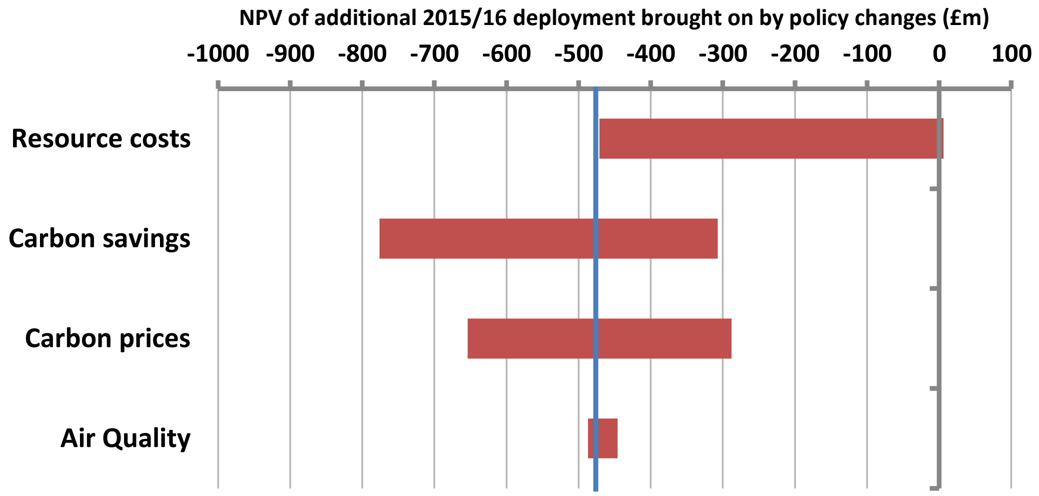
	Resource Cost per MWh *£/MWh*	Carbon Cost Effectiveness - subsidy *£/tCO₂*	Carbon Cost Effectiveness - resource *£/tCO₂*	Non traded comparator *£/tCO₂*
Central	34	331	176	78

4D. Sensitivities

95. The NPV of the chosen policy option is very uncertain because of the range of possible deployment outcomes. However, there is also considerable uncertainty around the assumptions that we have used to quantify the impacts in order to calculate the NPV. Sensitivity analysis has been carried out to illustrate the range of possible NPVs under different scenarios. We have carried out sensitivities on each of the core components of the NPV calculation; carbon savings from the deployment of renewable heat, the value of the carbon savings and air quality impacts.

96. Figure 3 below illustrates the range of NPVs that result from the sensitivities we have carried out on our central 2015/16 deployment estimate. The full range of NPVs goes from -£776m to £6m around our central estimate of -£471m.

Figure 3: Range of NPVs suggested by sensitivities on central scenario[24]



Carbon savings

97. The main benefit monetised in this assessment is the carbon savings achieved by the scheme. There is significant uncertainty around the carbon (emissions) intensity of technologies supported by the RHI and therefore the emission savings achieved; this not only depends on the input fuel[25], but also the efficiency of the technology. To test the sensitivity of the NPV to changes in the carbon savings associated with renewable heat deployment we have changed the following factors:
    a. Efficiency of the renewable heating technology;
    b. The CO_2 emission factors associated with different renewable input fuels;
    c. The carbon intensity of the counterfactual heat source.

98. High and low efficiency and CO_2 emission factors have been applied to the central 2015/16 deployment projection. Annex 7 outlines the assumptions used in calculating the NPV and these sensitivities in more detail.

Table 13: NPV of planned changes to the RHI based on central deployment scenario with impact of uncertain carbon emission factors

£m real discounted	NPV estimate		
	Low	Central	High
Carbon Benefits in traded sector	3	18	26
Carbon Benefits in non-traded sector	58	347	503
NPV of increased 15/16 deployment	**-776**	**-471**	**-307**

[24] Chart is centred on the central NPV of -£471m to show the sensitivity of this result.
[25] Both the input fuel of the counterfactual (the heating system being replaced) and the feedstock used for renewable fuel will have a large impact on the carbon savings.

99. Table 13 shows that in a world where emission factors for technologies supported by the RHI are high and their efficiencies low, the policy proposals lead to a more negative NPV. The reverse holds in a world where emission factors are low and efficiencies are high. The NPV could be 65% lower or 25% higher once carbon savings uncertainty is taken account of.

100. In addition to this sensitivity for carbon emissions, a specific sensitivity for biomass emissions has been conducted in Annex 1 to demonstrate the potential impact that introducing sustainability standards for biomass may have. The biomass sustainability standards should reduce the risk of the low carbon savings scenario illustrated here. This is because the standards ensure biomass is sustainably and appropriately sourced.

Carbon prices

101. There is not only uncertainty around the total carbon savings which can be achieved by the scheme, but also the carbon price that is used to monetise these benefits shown in Table 14. This sensitivity has been carried out using the high and low carbon valuation series from the IAG toolkit[26].

Table 14: NPV of planned changes to the RHI based on central deployment scenario with impact of uncertain carbon price

£m real discounted	NPV estimate		
	Low	Central	High
Carbon Benefits in traded sector	9	18	27
Carbon Benefits in non-traded sector	174	347	521
NPV of increased 15/16 deployment	**-654**	**-471**	**-288**

Air auality impacts

Table 15: NPV of planned changes to the RHI based on central deployment scenario with impact of uncertain AQ impacts

£m real discounted	NPV estimate		
	Low	Central	High
Air quality impacts	130	115	90
NPV	**-487**	**-471**	**-446**

102. Table 15 shows that, in a world where the damage costs associated with biomass are high, the chosen policy leads to a worsening of the NPV relative to the central scenario assumptions.

4E.Non-monetised costs and benefits

Avoided infraction costs

103. We estimate that the proposed policy changes will lead to up to 2TWh of additional deployment by 2015/16 and will potentially allow markets to grow even further by 2020. If this renewable heat was not deployed through RHI, the renewable heat forgone would have to be produced through another renewable source, or the UK would face an infraction penalty for not meeting the 2020 target. This benefit has not been quantified because of inadequate information on the costs of delivering additional renewable energy from other sectors and how much the infraction penalty would be.

26 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243936/2013_Appraisal_Guidance_-_Toolkit_-_FINAL.xls

Innovation & cost reductions

104. By supporting renewable heat deployment DECC expects that costs will reduce and performance may increase over time. Additionally the barriers that customers currently face when thinking about renewable heating such as the risk around unproven technologies and hassle costs will reduce if deployed successfully. These benefits have not been quantified.

Rebound effect

105. For some installations the RHI will lead to an overall lowering of fuel bills. This could lead to an overall increase in energy consumption.

4F. Wider impacts

Impacts of RHI tariffs on renewable electricity deployment

106. For CHP and Biogas installations there will be an interaction between tariffs offered on renewable electricity and those proposed for renewable heat. Because of the way our deployment scenarios have been developed from MI we are limited in our ability to quantify the impact that RHI support may have on the deployment of CHP. This IA is focussed on impacts from deployment to 2015/16 and we believe the additional costs to renewable electricity funding from our policy changes will be limited over this period. As CHP deployment to 2015/16 is likely to be predominantly made up of projects that are already under development it is likely that they would claim support for their electricity generation even without the presence of RHI support. RHI support is therefore considered to unlock more heat generation without materially increasing electricity generation over the period to 2015/16.

107. When preparing RHI deployment scenarios for CHP we have assumed that where plants are likely to come online before the RO uplift for CHP ceases to be available at the end of 2014/15, they will choose RO support over RHI support if this leads to a better return. This means only those plants that will be better off under the RHI are incorporated into our deployment scenarios. In the longer term the presence of RHI support is likely to lead to additional spend on renewable electricity (either through RO or CfDs) compared to a scenario where the RO uplift is withdrawn at the end of 2014/15 and no alternative support is introduced.

108. The introduction of support for larger scale Biogas combustion will also potentially impact on deployment of AD (Anaerobic Digesters) through RO and CfDs as developers will now have the choice over which scheme to enter. Our MI suggests that most sites where AD production is possible will still choose to produce electricity rather than generate heat as generating heat requires the presence of a heat customer. As such we expect the impact on demand for renewable electricity tariffs to be limited.

Investment and jobs

109. As well as the NPV estimates presented in sections 4B & 4D we have produced estimates of the level of investment and the number of jobs supported by the RHI. In order to do this we derived estimates of ‘typical’ capex, heat load and capacity characteristics for each technology; a table showing these assumptions can be found in Annex 7.

110. The capacity and heat load characteristics were obtained from a mixture of installation data from scheme data, MI and industry engagement. Where it was available we used the average of the Sweett data range[27] for capex figures. Where no Sweett data was available we obtained figures from other stakeholders and consultants.

111. The ‘typical’ characteristics were then used to estimate how much renewable heat a typical installation might produce in one year. This figure then allows us to estimate how many installations or capacity of a particular technology would be associated with a given level of renewable heat deployment. Once we have an estimate of how much extra capacity is needed each year to drive our projected levels of deployment we can estimate how much this capacity would cost to install and therefore have an estimate of the investment or capital spend supported by the RHI.

[27] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204275/Research_on_the_costs_and_performance_of_heating_and_cooling_technologies__Sweett_Group_.pdf

112. We have carried out sensitivity tests on this estimate using the high and low capex figures from the range of Sweett data or using our central estimate plus or minus 20% where Sweett data or a range was not available.

113. The estimate for jobs supported has been calculated using industry turnover and employment figures from a report published by the REA[28]. From these figures we estimated the numbers of jobs supported per million pounds of capital spend for each renewable technology. As the turnover figures from the REA report will have been generated predominantly by sales of renewable technologies we have assumed that turnover can be used as a proxy for capital spend on those technologies. Using these estimates of jobs per million pounds of capital spend in conjunction with our investment estimates allows us to estimate the number of jobs that are supported by the RHI. Because the number of jobs supported through investment will vary with the level of investment we have also provided the estimates of the number of jobs supported under the high/low investment sensitivities.

114. Table 16 and Table 17 below show the estimated investment and jobs supported by the RHI under the central 2015/16 deployment scenario and also the counterfactual "do nothing" levels. The counterfactual measures the level of investment and the number of jobs that we estimate would be supported without the implementation of changes to the RHI. The difference between these two values therefore describes the increase in investment and jobs attributable to the changes being made to the RHI.

Table 16: Investment in renewable heat technologies supported by the RHI in 2015/16

Investment Supported			
2015/16	**Low**	**Central**	**High**
Central Deployment	£931m	£1,357m	£1,927m
"Do Nothing"	£589m	£912m	£1,346m
Difference	£342m	£444m	£581m

Table 17: Jobs supported by investment shown in Table 16 during 2015/16

Jobs Supported (FTE)			
2015/16	**Low**	**Central**	**High**
Central Deployment	7,378	10,838	15,591
"Do Nothing"	4,851	7,547	11,231
Difference	2,527	3,291	4,360

Carbon budgets

115. The switch from fossil fuel based heating to renewables will generally result in carbon savings over the lifetime of the kit installed.

116. Table 18 provides estimates of the carbon savings from RHI deployment over the next three carbon budgets periods. These savings are based on our central spend scenario with RHI growth of 30% between 2015/16 and 2020/21. The carbon savings estimates use our central estimates for carbon savings for each technology. These are very uncertain and sensitivity analysis suggests that carbon benefits could be 40% lower or higher depending on the assumptions made about technology efficiencies and emission intensities of fuels.

[28] http://www.r-e-a.net/resources/rea-publications

Table 18: Carbon savings from RHI supported deployment of renewable heat over the next 3 carbon budget periods associated with the central range of deployment

Carbon Budget Period	Net carbon savings ($MtCO_2$)					
	Lower Deployment			Higher Deployment		
	traded	non-traded	total	traded	non-traded	total
2013 - 2017	0.1	2	2.1	0.2	3	3.2
2018 - 2022	0.6	10.5	11	0.7	14.2	14.9
2023 - 2027	1	18.3	19.2	1.3	24.7	26

Small firms

117. The RHI is a voluntary scheme so a full Small Firms Impact Test (SFIT) has not been carried out. However, the RHI is available to all firms and the tariff structure takes into account the size of particular installations. Therefore, small firms are able to benefit from the RHI.

Competition assessment

118. As set out in Box 1, tariffs have been estimated with the intention of incentivising 50% of the technical potential of different technologies taking into account the additional cost of renewable heat and the higher risks and uncertainties associated with its use. Therefore, subsidies from the RHI are intended to allow competition between technologies, even if they compete with firms who use conventional fossil fuel heating. Continuing to ensure tariffs are based on the best available evidence will help ensure value for money and maintain levels of competition within individual technology markets.

Rural proofing

119. A more detailed rural proofing analysis on the introduction of the non-domestic RHI scheme was set out in the IA accompanying its launch. This section sets out whether there are any additional issues over and above those considered when the scheme was launched that need to be considered as a result of the potential changes to the scheme.

120. The key difficulty in assessing spatial impacts is in predicting uptake patterns of renewable heat in terms of geographical locations given the limited historical evidence in this area. However renewable heat technologies are likely to be particularly attractive to fossil fuel consumers outside the gas network where the operating costs of heating are relatively high. Wider constraints to installing certain renewable heat installations, such as the requirement of storage for biomass feedstock used in biomass boilers, the need for planning permission (especially in areas of protected landscape) or the space requirements for the installation of GSHPs, may allow rural areas to benefit more from the RHI.

121. The key policy options, including supporting Air to Water heat pumps, larger biogas installations and bioCHP, could benefit rural areas given the potentially lower constraints. However, as section 5.2 in the 2012 non-domestic extension IA[29] set out, urban areas are potentially better able to benefit from deep geothermal technology. These policy options would also affect both urban and rural communities living in the vicinity of the new developments.

Sustainable development

122. As set out in the 2011 IA, we recognise the important contribution bio-energy can make to the generation of renewable heat. However, it is important that encouraging the uptake of bio-energy does not result in untoward environmental and social impacts and this has been a guiding principle in devising our policy approach. The changes to the biomass sustainability regulations described in this IA will help to ensure the RHI doesn't subsidise unsustainable biomass that delivers little or no carbon savings. A more detailed description of the impacts of the changes can be found in Annex 1.

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[29] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66161/RHI_-_impact_assessment_on_changes_to_the_non-domestic_scheme.pdf

Part 5 – Budget Management

5A. Rationale for change

123. In the May 2013 Early Tariff Review consultation we set out that we would need to review and update triggers in light of forthcoming changes to the scheme and the 2015/16 Spending Review settlement to ensure that it remains affordable as a whole.

124. In addition, we have revised our estimates for the potential deployment over this spending review period. For some technologies expected deployment is significantly higher; while for others it is lower than in previous estimates. This is due to a combination of deployment to date and an improved understanding of market size. The updated triggers will also therefore reflect the market behaviours that have been observed in the scheme to date, as well as anticipated future deployment under new tariffs. At the same time we need to introduce a budget management system for the domestic scheme.

5B. Current budget management mechanism

125. The RHI non-domestic degression mechanism estimates scheme costs on a cumulative basis and brings forward tariff reductions if spend exceeds certain levels set out in regulations. It operates with a total spend trigger, to ensure that the scheme remains within budget, as well as with individual tariff triggers to ensure that value for money is maintained across the scheme.

126. The cost of the scheme is assessed quarterly, with a one month notice period before any reduction takes effect.

127. The non-domestic tariff and total triggers are set up to allow flexibility for deployment to differ from the triggers set out in legislation. This is intended to allow deployment scenarios to emerge which may differ from our forecasts but which do not threaten the budget.

a. **The total scheme trigger** ensures that the scheme remains within budget. If it is hit then a 5% reduction is applied to all tariffs where deployment levels are higher than expected. This means that if the whole scheme is growing successfully all tariffs deploying above their expected levels of deployment will see a 5% reduction.

b. **Tariff triggers are currently scaled** to 150% of expected tariff deployment. This means that if only some technologies are deploying successfully they will be allowed to grow to 150% of expected levels. This allows for some flexibility should technology deployment rates be different from those expected, while still maintaining a link to value for money and preventing one tariff dominating the RHI budget. If a tariff trigger is hit, initially there will be a 5% tariff reduction, with the possibility of further subsequent degressions of up to 20% if deployment continues to grow too quickly.

c. **If total deployment is less than half of the scheme trigger** then there can be no tariff reductions. This is to prevent there being tariff reductions in one part of the scheme where overall deployment is very low.

d. **Low deploying technologies:** where our uptake forecasts are low, or zero, the tariff triggers have been set at 5% of the value of the total trigger to ensure that there is plenty of scope for deployment of these technologies, whilst maintaining assurance over the RHI budget.

128. For more details on the overall approach see the Degression Fact Sheet[30].

129. The domestic budget management mechanism will be introduced at the same time as the domestic scheme is launched. Details can be found in section 5C.

[30] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209671/Degression_Factsheet.pdf

5C. Proposed revised budget management mechanism

Non-domestic mechanism

130. Several aspects of the policy have been revised to reflect the changes to the policy environment:

a. **Basis of triggers –** will be reset using the market intelligence (MI) used to develop the central MI scenario as a basis. A detailed explanation of the methodology for the calculation of triggers and considerations made can be found in Annex 8.

b. **Scaling –** will be reduced to 120% for small and medium biomass and biomethane triggers, because of the more established nature of these technologies and the greater certainty regarding their deployment potential in this spending review, 150% scaling will be retained for new technologies and tariffs because we have less certainty over the reaction of these markets to new tariffs and therefore need to allow more flexibility in potential deployment. This allows the flexibility needed for what will effectively be new markets to reach their full deployment potential.

c. **Low deploying technologies –** currently have triggers set at 5% of total estimated spend. This approach will continue, but will be reduced to 2.5% given that our new deployment estimates show that this will be sufficient to allow for more growth than the market is expected to deliver. Table 19 demonstrates the expected deployment in January 2015 and January 2016 in each year and what the trigger level will be. It shows the growth in spending which the triggers allow, compared to the forecasts of deployment:

Table 19: Triggers and expected deployment of Solar Thermal, Deep Geothermal and Biogas

Technology	Spending (Oct-13)	Jan-2015		Jan-2016	
		Forecast	Trigger	Forecast	Trigger
Solar Thermal	£0.1m	£1.2m	£5.5m	£2.1m	£9.8m
Biogas (all sizes)	-	£0.8m	£5.5m	£1.2m	£9.8m
Deep Geothermal	-	£0.7m	£5.5m	£0.8m	£9.8m

131. These changes ensure that the RHI as a whole offers value for money and appropriately controls expenditure throughout the spending review period.

132. A full explanation of all changes and the rationale for them can be found in the Government Response.

Domestic mechanism

133. In the policy document, "The first step to transforming the way we heat our homes," and the associated Government Response, "A Government Response to 'Proposals for a Domestic Scheme' September Consultation" published in July 2013[31], we confirmed that the main method of controlling the budget for the domestic RHI would be degression (lowering) of the tariffs paid to new applicants as spend on the domestic scheme reaches "triggers" set out in the RHI Regulations. The broad outline can be found below, more details can be found in the accompanying policy document:

a. **Timing and frequency of degression** - tests of whether spend on each tariff has reached its degression trigger will take place on a quarterly basis, with announcements of whether a degression has been triggered being made by 1st June, 1st September, 1st December and 1st March. The announcement will provide one month's notice of any tariff reduction taking place.

b. **Triggers** - degression triggers will be set for each tariff in the scheme until the end of 2015-16. Degression will only occur if spend on that tariff has reached a degression point; tariff triggers will not be affected by non-domestic deployment, other domestic technologies or applications from those who installed before the launch of the scheme. Degression will occur if a technology is deploying above its trigger, even if total scheme deployment is low.

   Every quarter we will forecast expenditure based on both applications and accreditations to the scheme to check whether a degression trigger has been hit. We will forecast expenditure based on the deemed heat usage of the property, except for second homes where we will reduce the deemed heat based on how often the property is occupied and bivalent properties which are metered.

   Following a degression, the reduced tariffs would apply to new RHI applications only. Installations that had already been accredited would continue to receive the tariff in place at the time they were accredited.

c. **Size of degressions -** as a general rule hitting a trigger will result in a 10% reduction in the tariff however if spend goes above a second higher "super trigger", a 20% reduction will take place. We do not expect this to happen however it will guard against sudden and unexpected over-deployment of any technology.

d. **Subsequent degressions -** when a degression has taken place in the previous quarter, rather than test whether spend is above the trigger we will test whether spend has grown faster than the trigger has grown in that quarterly period. If growth in forecast spend was above the growth in the trigger a further degression would take place, if not, no degression would take place. This will apply to both 10% and 20% degressions.

134. The rationale for these decisions compared to the non-domestic scheme are summarised in Annex 9.

5D. Impact evaluation of budget management changes

135. The budget management proposals detailed in the Government Response are difficult to evaluate given the uncertainties surrounding market reaction to them and the significant uncertainties about deployment scenarios which may lead to a degression being triggered. There are two types of effects which can be evaluated – the overall scheme effects and the technology specific effects.

Overall scheme effects

[31] https://www.gov.uk/government/consultations/renewable-heat-incentive-proposals-for-a-domestic-scheme

136. While the budget management system allows most individual non-domestic scheme technologies to deploy up to 150% of their central MI estimate (120% for established technologies), the non-domestic and domestic schemes as a whole will experience degressions if total spend on either is on a trajectory to be above their share of £430m. This means that budget management should act to reduce tariff payments if scheme deployment as a whole is following the high MI projection.

137. The presence of the budget management system as set out in section 5C will control spending to no more than £430m. The range projected through the MI (Table 8) is £301m to £556m, without any budget management. Budget management seeks to reduce this range to £301m to £430m.

Technology specific effects for non-domestic technologies

138. The technology specific effects of degression are significantly harder to quantify due to the importance of the context in which they are triggered. For example, how strong deployment of other technologies is, or the trajectory of that specific technology.

139. It is however possible to qualitatively assess the impact that the changes proposed might have on technology deployment and this is shown in Table 20 below.

Table 20: Qualitative impact of the budget management changes

Change	Technologies affected	Impact
Revised triggers	All	Triggers set based on the latest deployment estimates are more likely to allow the market to grow sustainably to its full potential.
Scaling to 120% for established technologies	Small Biomass, Medium Biomass and Biomethane	This should ensure that these technologies are able to achieve their most likely deployment trajectories, ensuring that any unsustainable growth is checked early by the degression mechanism, avoiding a potential boom and bust scenario and maintaining technology diversity in the scheme.
Low deployment trigger calculation	Solar thermal, Deep Geothermal and Biogas	This will allow for more growth than the market data suggests will be realistically achieved for these technologies. This means that effectively there will not likely be degressions for these tariffs. This ensures that these markets, which are either constrained by supply or demand side limitations or by capped tariffs, have the space to exceed our central estimates by a reasonable amount, which will not threaten the overall budget.
Forecasting methodology	All non-domestic	The forecasting methodology used to estimate committed spend will be updated to take account of the latest information and to increase accuracy.

Technology specific effects for domestic technologies

140. In the domestic RHI policy document and Government Response published in July 2013[32] it was confirmed that the budget for the domestic RHI would be managed through degression (lowering) of tariffs as pre-set levels of spend are reached. With the confirmation of the exact mechanism it is possible to qualitatively assess the impact that this budget management system may have on tariffs. As the system is an integral part of the policy it is not possible to separately identify the effects of budget management compared to other parts of the policy.

141. The implications for domestic tariffs are summarised below in several scenarios. These cover the majority of scenarios which could occur in the opening two years of the domestic scheme. It includes the implications of particular deployment scenarios and the rationale for combinations of degression. This does not include the "super trigger” to simplify the analysis of the implications. If deployment is above the “super trigger” then a 20% degression is applied to that technology, to control costs and ensure value for money.

[32] https://www.gov.uk/government/consultations/renewable-heat-incentive-proposals-for-a-domestic-scheme

Table 21: Deployment scenarios for domestic RHI

Technology one	Other technologies	Degression	Rationale
Below trigger	**Below triggers**	No degressions for any technology	No technology deploying at level anticipated and budgeted for. Therefore no need for degressions to control costs.
Above trigger, below super trigger	**Below triggers**	10% degression for technology above trigger, no degressions for any other technology	One technology is above anticipated deployment. This suggests that tariff is above level necessary to incentivise budgeted demand level and should be reduced to maintain scheme diversity and ensure value for money. Other technologies are deploying below level anticipated and budgeted for. Therefore there is no need for degressions for these technologies.
Above trigger, below super trigger	**Above triggers, below super triggers**	10% degression for each technology above trigger	All technologies are above anticipated deployment. This suggests that tariffs are above level necessary to incentivise budgeted demand level and should be reduced to maintain value for money and budget control.

Annexes

Annex 1: Biomass sustainability

The problem under consideration and rationale for intervention

1. The RHI supports biomass and biofuels in a number of forms, including biomass boilers, biogas and biomass used in district heat networks. At the launch of the RHI in November 2011, there were no mandatory sustainability criteria for solid biomass used for heat generation. Whilst the EU provided recommendations for potential criteria[33], it left the introduction of sustainability criteria for solid biomass to the discretion of each member state.

2. Without mandatory sustainability criteria ensuring the lifecycle GHG emissions of biomass are below a defined level, the RHI could:
    a. Be supporting unsustainable biomass that delivers little or no carbon savings on a life-cycle basis
    b. Sometimes lead to even higher emissions relative to heat from fossil fuels

3. The primary objective of the RHI is to help to facilitate the heat sector's contribution towards the Government's legally binding target of supplying 15% of total energy consumption from renewable sources by 2020. In addition, the RHI is aimed to deliver significant reductions in carbon emissions, helping to mitigate the damaging effects of global warming. Therefore introducing sustainability criteria will help ensure the RHI is meeting its objectives and is good value for money as a Government policy.

4. The introduction of sustainability standards also aims to ensure the lifecycle GHG emissions of biomass are acceptable and to prevent adverse land use change, such as deforestation and destruction of other carbon sinks, therefore ensuring biodiversity and other environmental impacts are protected.

5. To minimise reporting and administrative burdens, the RHI biomass sustainability standards are designed to ensure consistency with the approach under the Renewables Obligation (RO) where possible.

6. The UK also aims to ensure that indirect adverse impacts are minimised, for example on global food supplies and indirect land use change.

Policy options

Counterfactual

7. Not introducing sustainability standards for solid biomass risks heat users using feedstocks from unsustainable sources that deliver little or no GHG savings on a life-cycle basis and could sometimes lead to higher emissions. A lack of standards for sustainable biomass also has the potential to lead to destructive impacts on land use through deforestation or destruction of other carbon sinks.

8. The potential contribution to emissions reductions and the significant role biomass is expected to play in meeting the 2020 Renewable Energy Strategy (RES) target, means that doing nothing is not considered a reasonable option but served only as a counterfactual in previous analysis.

Chosen policy option

9. The current RO sustainability reporting requires generators of greater than 1MWe to submit an annual report on their biomass feedstocks, assessing their lifecycle greenhouse gas emissions relative to fossil fuels taking into account the energy conversion efficiency of their plant, and country

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[33] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010DC0011:EN:HTML:NOT

of origin and any land use change since November 2005. The RO has required generators to report against a target of a 60% reduction on greenhouse gas emissions compared to the fossil fuel based average since April 2011. In addition, generators are required to report to the regulator on whether any materials other than wastes are not sourced from raw materials obtained from land which is important on carbon or biodiversity grounds. The RO will be making meeting the greenhouse gas target and other sustainability criteria as set out in August 2013[34] mandatory from April 2015. Introducing mandatory solid biomass and biogas sustainability criteria would provide consistency across the UK's renewable energy policy.

10. The RHI currently encourages biomass installations with a capacity of 1MWth and above to provide monthly sustainability reports for their biomass feedstock on a voluntary basis. The chosen policy option is to go further than this, adopting a mandatory minimum GHG saving criteria similar to that in the RO.

11. Non-domestic participants will be able to demonstrate compliance with the criteria in one of two ways: either reporting quarterly to Ofgem, alongside the sustainability information, on the performance against the GHG criteria of their biomass feedstock, or to purchase their biomass from an approved biomass fuel supplier, registered on the Biomass Suppliers List.

12. We anticipate that biomass installations with a capacity of 1MWth, who are already encouraged to provide sustainability information, will prefer to report independently, whereas smaller installations, for whom the administrative burden of independent reporting is too high, will prefer to use the List. Proof of purchase of fuel marked as RHI compliant from a supplier registered on the Biomass Suppliers List will also be considered evidence of compliance with RHI regulations for participants in the Domestic RHI scheme. The Biomass Suppliers List will be managed on behalf of DECC by a contracted organisation chosen via a competitive tender. We expect the List to be up and running by Spring 2014, with the introduction of requirements in the Autumn.

13. Government is committed to funding the BSL for three years. DECC will work with the biomass industry to consider appropriate options for the sustainability of the Biomass Suppliers List.

Impact evaluation

Costs

14. There are three types of costs associated with the introduction of sustainability standards for biomass. Firstly the cost on business of complying with the sustainability criteria and secondly the cost faced by DECC of initially setting up the Biomass Suppliers List for domestic biomass installations and those non-domestic installations who find it more cost effective to use it. Finally, as well as the burden of showing compliance, there is a possibility of this affecting the price of biomass more generally through limiting supply.

15. The cost for setting up the biomass sustainability list for the first 3 years has been estimated to be around £600,000. This includes staff, IT, running and audit costs. However when including additional costs DECC will face i.e. Ofgem and contingency costs this increases to around £750,000 in nominal terms. These cost estimates will be finalised once a successful contractor has been appointed.

16. Government hopes that the list will be handed over to industry after 3 years. If this happens, it will be necessary to introduce a small registration fee and annual subscriptions for suppliers, although these are not anticipated to be very burdensome.

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34 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/231102/RO_Biomass_Sustainability_consultation_-_Government_Response_22_August_2013.pdf

17. Non-monetised costs include the additional cost to applicants to ensure their biomass supplier does comply with biomass sustainability standards. The impact of this should be minimal. The Biomass Suppliers List will be free of charge to join for the first three years of running. Nevertheless, suppliers may experience a small increase in administrative costs as a result of demonstrating compliance with the standards. There is uncertainty on whether this cost burden will be passed on to consumers in price rises.

18. We do not have an estimate of the impact of introducing biomass sustainability standards on biomass prices, given the significant uncertainty about agricultural markets in the long term and how the general support of biomass through the RHI may impact prices.

19. Tightening sustainability standards could lead to indirect land use changes (and associated GHG emissions) which are not known. There could be indirect costs on the economy of increased prices and bills, however these are highly uncertain and will depend on the counterfactual technology.

20. For more details on the policy, including the intention to introduce land criteria on the sustainable sourcing of biomass feedstocks, please see the Government Response to the Government Consultation on ‘Providing certainty, improving performance[35] and the accompanying Government Response to this IA.

Benefits

21. The benefits of introducing biomass sustainability criteria are the reduction in carbon emissions associated with biomass. There is however significant uncertainty about what the carbon emission factor (kg CO_2/kWh) would be if no sustainability standard was introduced.

22. Table 22 displays the net present value of the planned changes to RHI, if carbon emissions are higher than expected. It shows the impact of a higher biomass emission factor (133kg/kWh vs. 50kg/kWh) and a higher biogas emission factor (136 kg/kWh vs. 50 kg/kWh) on the NPV to the end of 2015/16. The valuation of emissions uses the UK appraisal values. In reality we do not know the ratio of emissions inside and outside the UK and to what extent they would already be captured by other direct or indirect carbon prices. This will depend on to what extent an import market develops for biomass. While this does not fully capture the benefits of the sustainability standards, it provides a proxy to show the impacts which could occur if emission factors were significantly higher. This sensitivity is designed to demonstrate the potential impact of a change in emissions factor on the total value of the RHI.

Table 22: NPV of planned changes to the RHI based on central deployment scenario with impact of high biomass emission factors

Policy lifetime	Central	If biomass emissions factors were higher than DECC central estimate
NPV	-471	-644

23. When valuing the emission savings realised, we have valued the majority of the savings at the NTS (Non-Traded Sector) prices as we anticipate most renewable heat deployment will take place in the

35 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/128679/Gov_response_to_non_domestic_July_2012_consultation_-_26_02_2013.pdf

NTS. This applies to both the emissions from the counterfactual being displaced and any biofuel used for renewable heat generation. As we use lifecycle emissions for biofuel emission factors valuing biomass emissions in this way requires two underlying assumptions 1) that the biofuel is sourced from the UK and 2) that the lifecycle emissions take place in the NTS. Both of these assumptions are reasonable for the period to 2015/16 as we expect most of the biofuel that is used for heating will be sourced from within the UK in the short term.

24. In addition, this approach is likely to lead to a conservative estimate of the value of carbon savings from switching to biofuels as if biofuel emissions are assumed to take place outside the UK or the NTS they would be valued at the ETS (Emission Trading Scheme) price[36]. This value is lower and would result in higher benefits values from switching from conventional fuels to biofuels.

Indirect impacts

25. Sustainability criteria on biomass in the UK or across the EU could lead to indirect impacts which are hard to quantify. These include benefits to bio-diversity, protection of areas of high carbon stock and/or nature reserves which, as well as safeguarding carbon sinks could have positive recreational or conservation benefits.

26. There could also be a range of indirect effects not captured above. It is possible that demand for sustainable biomass could displace agricultural production onto uncultivated areas with impacts on food prices, biodiversity and land use change impacts. There could also be an impact on the price of biomass (see previous IA on introducing sustainability standards into the RHI[37]).

27. Such indirect impacts are very difficult to model due to the complex nature of agricultural markets, the uncertainties involved in assessing the cause and effect interactions and pathways, and the difficulties in projecting to the future.

Specific impact tests

28. Specific impact tests on small firms, competition, carbon assessment etc. have been carried out. Please see the previous IA on introducing sustainability standards into the RHI[38].

29. It is DECC's policy intent for any administrative burden to be sensitive to the size of the organisation registering on the List, meaning that SMEs will be subject to a simplified audit requirement and hence lower administrative cost. There is however uncertainty around the impact on fuel prices in the long run.

Summary of chosen policy

30. The chosen policy is to introduce a minimum GHG threshold of 60% relative to the EU-wide fossil fuel comparator, and to apply the criteria to all biomass heat receiving RHI subsidies. This will help ensure that significant carbon savings are achieved as biomass heat grows as an alternative option to fossil fuels. Our decision on the target of 60% relative to the EU comparator guarantees that

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[36] This was the approach taken for the biomass sustainability IA https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43167/5885-ia-biomass-rhi-cons.pdf

[37] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/93848/RHI_Biomass_Sustainability_IA_250612__2_.pdf

[38] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/93848/RHI_Biomass_Sustainability_IA_250612__2_.pdf

biomass heat will achieve GHG savings relative to each fossil fuel used to produce heat, while minimising the burden on consumers and the impact on the market for biomass.

Annex 2: Market intelligence

31. As discussed in Section 3C, deployment estimates, and therefore degression triggers have been developed using a Market Intelligent approach. Below we list some of the sources alongside the headline considerations taken in developing deployment scenarios for each technology.

32. A lot of the conversations and interactions that took place in developing these estimates are commercially sensitive and so are not disclosed.

33. The exact methodology used to determine these estimates has varied from technology to technology as the evidence on each is different in nature and availability. Therefore the Market Intelligence is the input to a judgement based estimate taken in-house by DECC. This judgement element is important as we need to weigh up evidence in different forms, both quantitative and qualitative, and we also need to take account of potential optimism bias. We believe this range of judgement based scenarios is an as accurate as possible reflection of the overall evidence and sentiment presented to DECC for each technology.

34. Further, DECC needs to update projections over time and is likely to continue to use a Market Intelligence method for doing so in the medium term. Therefore it is important that DECC maintains discretion on how it uses evidence to avoid the potentially high risk of iterative gaming as market participants respond to the way that DECC uses their evidence.

35. In future iterations of projections we will be looking to broaden our Market Intelligence where possible, using different sources and ensuring we look for views from direct, indirect and competing stakeholders for each technology.

36. A broad summary of the considerations and sources used in developing deployment scenarios follows.

Existing technologies

Small & medium biomass

- Draws heavily on the BSRIA[39] report on UK commercial boiler market 2012, stakeholder interviews and RHI application data
- Range driven by consideration as to whether the current market growth slows as saturation is reached or whether growth continues as per current trend

Large biomass

- Draws on the BSRIA report on UK commercial boiler market 2012, stakeholder interviews and RHI application data
- Range driven by consideration that the market for large projects proves to be uneconomic with additional barriers or that a new tariff brings forward large numbers of installations
- Large range represents high uncertainty. Key drivers of uncertainty are a lack of deployment data and that the interplay with CHP is not clear

GSHPs

- Draws on the BSRIA report on UK Heat Pump Market 2013, the Delta EE[40] market reports on UK Microgeneration market 2012 and 2013, GSHPA and other stakeholder interviews
- Range driven by the assumed starting point (displaying uncertainty about current market capacity due to declines) and view of growth in new-build markets

[39] https://www.bsria.co.uk/market-intelligence/market-reports/renewable-technology-/
[40] http://www.delta-ee.com/knowledge-areas/microgeneration/research

- All estimates reflect that the market is very slow at present with relatively few participants and that the construction downturn has impacted severely on new build projects

Biomethane
- Draws on discussions with CNG Services on UK biomethane-to-grid activity and pipeline
- Range driven by different assumptions about the speed at which pipeline is able to come forward and different assumptions about the likelihood of projects coming forward at all
- Supply side constraints may play a role if demand is high, as may budget management

Biogas combustion
- Draws on information from AD and biogas Association, NNFCC report for ORED on UK AD and biogas sector 2013
- Range driven by a simple range due to a lack of detailed information. Potential for AD plants with heat uses is quite small with the total number of AD plants about 350 by 2015/16. Most expected to be under RO/FIT's with biomethane as an attractive option

Solar thermal
- Draws on Solar Trade Association quarterly solar thermal statistics updates and the BSRIA[41] report on UK Solar Thermal Market 2012
- Range driven by different considerations on market growth from current levels, views on construction growth and whether the market for process heat materialises
- Even at a high scenario, heat contribution is relatively low as competition for roof space with PV continues in commercial space

Extension technologies

Deep geothermal
- Draws on Atkins report for DECC on deep geothermal potential 2013 and EGC Country update
- Range driven by consideration of whether any plant can be delivered within the SR, only a handful of potential projects are considered possible so the range is driven by none, some or all coming on board
- Very few deep geothermal projects are in development with only one having actually broken ground yet so chances of big contributions in this time frame are slim

ASHPs
- Draws on the BSRIA[42] report on UK Heat Pump Market 2013, the Delta EE market report on UK Microgeneration market 2012 and 2013 and stakeholder interview
- Range driven by different stakeholder views on growth potential
- Similar considerations to GSHPs around high levels of uncertainty and the inter-dependence on the new-build sector

Biomass CHP
- Draws on the AEA Technical potential report for DECC 2013 and the internal CHP pipeline/CHPQA
- Range driven by assumptions around how many projects are financially feasible under RHI in this timescale without tariff guarantees, and how many would prefer the RO uplift
- All scenarios expect a low number of projects but with potentially high heat loads, making this technology one of the most uncertain, especially in combination with long project lead-times

[41] https://www.bsria.co.uk/market-intelligence/market-reports/renewable-technology-/
[42] https://www.bsria.co.uk/market-intelligence/market-reports/renewable-technology-/

Annex 3: Detail on policy and analytical considerations for extension technologies

Air to water ASHPs

37. Heat pumps have an important role to play in helping to achieve the longer-term carbon budgets as the grid decarbonises. Air to water heat pumps (AWHPs) are cheaper and easier to install than ground source heat pumps (GSHPs) and can be a viable option when GSHPs are not.

38. We always intended to support air to water heat pumps from the outset of the RHI, but a lack of data meant we were previously unable to set a tariff. This issue has now been addressed and we were able to consult on a proposed tariff of 1.7p/kWh, updated to 2.5p/kWh in the tariff review following responses from the consultation that suggested 1.7p was slightly lower than what was required to adequately incentivise 50% of the supply curve for this technology. This is a low tariff relative to other technologies and represents good value for money considering its strategic importance.

Biogas combustion >200kW

39. Biogas is highlighted as important for industrial heat in the bioenergy strategy and the heat strategy. Although it is only expected to make a small but good value contribution to our deployment, biogas also offers a sustainable solution to waste management.

40. Biogas combustion is currently only supported up to a thermal capacity of 200kW due to a lack of data to set a tariff for larger installations. This restriction means that the majority of potential biogas heat installations are excluded from the scheme.

41. We are therefore introducing support for biogas over 200kW.

42. Biogas tariffs are not modelled using the standard methodology as set out in Annex 4. This is because we do not have the data available to develop a supply curve based on the levelised costs of the technology. The existing biogas <200kW tariff is instead based on the tariff for biomethane injection which involves a further process of purifying the biogas and injecting into the gas grid. This tariff was only able to be applied to the small biogas because the costs of a small biogas plant are equivalent to a large scale biomethane plant. Due to economies of scale, the same cannot be said of large biogas plants.

43. Biogas over 200kW is supported for electricity generation under the Feed-in-Tariff (FiTs). The current FiTs levels of support mean it would be commercially more attractive to produce electricity than heat, which can lead to inefficient outcomes where there is a large heat load. Creating a tariff structure consistent with FiTs would reduce the distortion towards electricity and mean an installation would be more likely to produce heat when it would be more efficient to do so.

44. We consulted on heat tariffs for the RHI based on the support available under FiTs and the size bands used in that scheme, and adjusted for the differences in opportunity costs between generating electricity and heat. The tariffs consulted on therefore represent the subsidy value placed on a unit of biogas produced renewably under FiTs at the time of consultation. This ensures that the limited resource is used efficiently between producing electricity and heat and does not introduce an incentive to inefficiently alter the ratio between heat and electricity generation.

45. We are therefore introducing the tariffs as consulted on of 5.9p/kWh for medium sized installations (200-600kW) and 2.2p/kWh for large installations (>600kW). We have tested these with industry stakeholders and found them to be reasonable with respect to project costs presented.

46. As no separate study was done on biogas CHP costs, these tariffs would also be applicable to biogas CHP plants provided they were commissioned as CHP after the eligibility date, in line with existing policy on CHP.

47. The existing policy for eligibility of CHP systems states that previously electricity generating systems can be eligible for the RHI if they are commissioned as CHP after the eligibility date. Through applying this policy, we will rule out support for existing biogas plants recovering heat for the production process who intend to simply transport waste heat to a nearby heat demand. This alleviates the risk of overcompensation for plants for which only a small adjustment is required and also reduces the risk of claiming the RHI where there is no genuine heat demand.

Combined Heat and Power (Biomass)

48. Combined Heat and Power (CHP) offers the most energy efficient use of fuel where there is a demand for both heat and electricity and is identified in the bioenergy strategy as a low risk pathway for biomass use to 2030.

49. Biomass CHP currently receives the standard biomass tariff, which given the costs involved, is too low to incentivise this technology. While support is available under the Renewables Obligation in the form of an uplift to support on electrical output, this is due to be removed from April 2015 and owing to the long lead in times on this technology, certainty is required now on the support available to bring forward CHP. Additionally the RHI provides better targeted support for heat in CHP systems than the RO. The tariff was based on the standard RHI tariff setting methodology and received widespread stakeholder support.

Deep geothermal

50. Deep geothermal heat is already supported by the RHI for the same tariff as ground source heat pumps. However these installations, which drill to depths of 500m, are a distinct technology from GSHPs with a unique cost basis of highly front loaded investment.

51. Having deep geothermal and GSHPs on the same tariff also decreases certainty for both sectors since deployment of GSHPs could result in a degressed tariff for deep geothermal and vice versa. This would have the potential perverse outcome of reducing demand for one of the technologies even if it is under-deploying.

52. We consulted on a tariff of 5.0p/kWh which was based on all available evidence and it is unlikely that we will receive any further data on geothermal at this stage. The tariff proposed received support from respondents.

Commercial/Industrial waste

53. The combustion of residual waste offers a better option than sending directly to landfill in terms of environmental impact and greenhouse gas emissions. Support in the RHI is currently restricted to the combustion of municipal solid waste (MSW), in contrast to the RO which also supports commercial and industrial (C&I) waste.

54. The Government review of waste policy in England’s commitment to increasing renewable energy from waste includes C&I waste in addition to MSW. The exclusion of these waste streams from the RHI has presented a significant barrier for energy from waste plants since waste contracts mean it is rarely viable to run a plant purely on MSW.

55. The biodegradable content of commercial and industrial waste provides another renewable fuel source not currently supported in the RHI. MSW currently receives a proportion of the large biomass tariff in the RHI, currently 1p/kWh but to be raised to 2p/kWh. Stakeholder feedback to the proposals was very positive, with many pointing out that taking a consistent approach to the RO was of particular importance. Some respondents felt the existing tariff of 1p/kWh was too low.

56. We are therefore extending eligible feedstocks for waste combustion in the RHI to include C&I waste and are continuing to pay the biomass tariff on the biogenic proportion of the waste, which is being raised from 1p/kWh to 2p/kWh in line with the proposed increase for large biomass.

57. The four key data sources available to DECC for tariff setting are:

   a. AEA data

   b. Sweett data

   c. Stakeholder evidence

   d. Scheme data

58. Of these, only the first two are in a format that can easily be incorporated into DECC's RHI model. However, in order to ensure that the tariffs incentivise sufficient deployment whilst avoiding over-compensation and also offering value for money and being affordable, all available evidence sources have been used to inform tariff levels.

Scheme deployment to date

59. Table 23 below sets out how the forecast spend over the next year for each technology compares to the anticipated deployment. The table shows that current deployment for the whole scheme is roughly half of what DECC had expected at launch with deployment rates for large biomass and GSHPs particularly low. The low deployment suggests the current tariffs offered through the RHI need to be changed if greater deployment is to be incentivised in the future. When this is combined with other evidence from the Sweett Group and stakeholder evidence, the argument that some tariffs should be revised becomes stronger.

Table 23: 12 month forecast spend based on data up to 31st July 2013

Tariff	Forecast expenditure as % of anticipated
Small Biomass	147%
Medium Biomass	151%
Large Biomass	32%
Small GSHP	1%
Large GSHP	8%
Solar thermal	2%
*Biomethane and biogas (**not in scope of review**)*	9%

60. As well as data on the number of applications and installed capacity, the scheme data collected so far provides an insight into heat usage patterns. The limited outturn data from the non-domestic RHI suggests that the estimated AEA heat loads (the proportion of time heating equipment is run) are relatively high. Outturn data suggests load factors of between 6% and 29% as opposed to the 35% suggested by AEA. This range of load factors from the scheme data is also close to the range proposed by the Sweett Group (see Table 25). The load factor is a key assumption in tariff setting, assuming too high a load factor would lead to a lower tariff (all else held constant) and therefore lower deployment.

Overview of DECC cost and heat use data

61. DECC now has access to two commissioned datasets that provide an overview of renewable heat costs and heat use in the non-domestic sector. For each dataset, costs and performance have been derived using a different approach. For example in calculating heat demand associated with different building types:

   a. The older AEA data used expert opinion and stakeholder engagement to disaggregate total non-domestic heat demand to build a picture of how heat demand varies across different sectors, e.g. factories, commercial buildings etc. From this they estimated the typical heat demand in different building categories and how this could be met with different technologies, thereby inferring sizes and load factors of renewable heat installations.

b. In contrast, the Sweett Group used a case study approach, i.e. a set of example buildings (school, office etc.), to build up a picture of non-domestic heat demand. That is, they extrapolated from a number of real life examples to infer appropriate sizes and load factors of renewable heat technologies for different building categories. However, this was based on a relatively small number of examples.

62. The two datasets give different pictures of capital costs associated with different size installations, reflecting the different approaches that have been used:

a. AEA used industry interviews and expert opinion to create a set of cost data that they considered appropriate and calibrated this to the categories of heat demand they identified.

b. The Sweett Group used primary data, i.e. receipts, collected from industry, to calculate the expected cost of different size installations. Although sample sizes for some technologies and larger installations are very limited.

Box 3: Description of key findings from Sweett Group report

A key input to this consultation and the accompanying analysis has been the research carried out by the Sweett Group on heat costs and performance. Sweett Group was commissioned in August 2012 to look at costs of renewable heating technologies including an examination of evidence from Renewable Heat Premium Payments (RHPP). This research has concluded and was subject to independent peer review in January 2013.

A key finding from the Sweett Group research is that, in general, the costs of renewable heating systems are higher than the previous estimates made by AEA. However, the coverage of the Sweett data is not as wide as the AEA data and for some technologies – such as Air to Air Heat Pumps and large capacity installations – there are too few observations in the Sweett data to draw significant conclusions.

On load factors and heat outputs, there is a lack of representative measured data available in the non-domestic sector. This is because the capacity of a system and the load factor are influenced by a range of factors that are highly variable and not directly linked to a generic building type. They are more influenced by the type of heat use so will therefore vary greatly between sectors and whether heat is for process or space use. In addition, non-domestic properties may also have multiple heat sources, meaning that the size and load factor of any one of them is down to the discretion of the owner and can be altered in response to incentives. For example, a non-domestic entity may have one technology for its base load heating and another to meet peak loads.

The non-domestic heat outputs and load factors were provided by Burro Happold (part of the consortium with Sweett Group who undertook this research). In many cases, these heat outputs (and load factors) represent a significant reduction compared to AEA data. The impact of incorporating these assumptions would be to increase tariffs significantly in the non-domestic sector, particularly for GSHPs.

However, it should also be noted that the non-domestic load factor estimates from Sweett Group and Burro Happold are highly uncertain. In particular, given the time available, it was difficult for them to source a wide range of data on heat use in industrial applications so the heat use data in these cases is drawn from a relatively narrow example and is not sufficiently representative of the UK industrial sector as a whole. Therefore it was not used to inform the tariff review.

63. A detailed picture of heat demand in the UK non-domestic sector is not currently available, which makes determining tariffs using cost and performance assumptions alone highly uncertain, given the sensitivity of tariff levels to changes in key assumptions. For example load factors vary hugely across different building types and heat uses. It is therefore difficult to make generalisations which are representative of the non-domestic sector as a whole.

64. The Sweett Group report, IA and previously published AEA data are intended to demonstrate as fully as possible the data that DECC currently holds and how it has been used to help derive at the tariffs in this IA. Table 24 and Table 25 below illustrate the high level differences between capex and load factor estimates from AEA and Sweett. The ranges indicate highest and lowest figures used in DECC's modelling.

Table 24: Comparison of AEA and Sweett capex estimate ranges (£/kW)

Technology (£/kWh)	Commercial		Industrial	
	AEA	Sweett	AEA	Sweett
ATW ASHPS	588-827	725-1,070	-	-
Biomass boilers	350-723	520-754	304-467	520-1,076
Biomass District Heating	701-1,380	631-725	701-1,380	643-737
GSHPs	950-1,579	1,292-1,868	950-1,579	1,593-2,136
Solar Thermal	1,439	1,250-1,269	1,439	1,269

Table 25: Comparison of AEA and Sweett load factor estimate ranges (% of time spent operating in a year)

Technology	Commercial		Industrial	
	AEA	Sweett	AEA	Sweett
ATW ASHPS	35%	10-26%	-	-
Biomass boilers	20-45%	13-29%	20-82%	8-50%
Biomass District Heating	20-45%	20-45%	20%	20%
GSHPs	35%	10-26%	35%	8-23%
Solar Thermal	6%	4-7%	6%	4%

Stakeholder evidence

65. The industry views and MI we have used come from a variety of sources including the tariffs presented by trade associations, individual companies, or investors in response to consultations and as part of our on-going engagements with them. Table 26 shows a summary of the views on appropriate tariff levels which we have collected.

Table 26: Range of industry and market views on required RHI tariffs by technology

Tariff (p/kWh)		Current tariffs (2013 Prices) or September 2012 consultation tariffs	Range of industry and market views	
			Min	Max
Biomass	Small	Tier 1: 8.6	N/A	N/A
	Medium	Tier 1: 5.0	3.5	6.5
	Large	1.0	1.6	2.7
GSHPs	Small	4.8	8	10.7
	Large	3.5	3	8
Air to Water Heat Pumps (AWHP) (consulted on)		1.7	1	3.2
Solar Thermal		9.2	N/A	N/A
Biomass Direct Air Heating (BDAH) (consulted tariffs)	Small and medium	2.1	N/A	3
	Large	1	1.5	2.7

Modelled tariffs

66. As discussed above, there is considerable uncertainty over which cost, head demand and load factor assumptions are most appropriate to use in tariff setting. Limitations in both the AEA and Sweet data have been highlighted. As part of this tariff review DECC has used the RHI model with different combinations of data to produce a range of possible tariffs. This range does not capture all uncertainty, but does capture the major variations that exist between evidence gathered by Sweett and AEA.

67. There is a very large range of possible data combinations where either costs or load factors for each technology are taken from either or both data sets. In order to provide an illustrative range of tariffs three core combinations of data have been put together and are shown in Table 27 below:

    a. **All AEA –** This provides an illustration of how changes to the model (as opposed to its input assumptions) since 2011 have impacted on the tariff setting.

    b. **Sweett costs with AEA heat loads –** Where Sweett have been able to provide updated cost assessments based on large enough samples it is sensible to use them in tariff calculations. Sweett heat load data is less certain and was heavily caveated; this combination of data shows the impact of keeping the AEA load factor assumptions for tariff calculations.

    c. **Sweett costs and commercial load factors but AEA industrial loads –** A key finding of the evidence base review is that the load factor assumptions used by AEA are generally too high. This combination of data illustrates the effect on tariff levels of the lower load factors in the commercial Sweett data but retains the industrial load factors from AEA as the Sweett data for this sector was particularly limited.

Table 27: Range of model outputs for different input assumptions

Tariff (p/kWh)		Current tariff (2013 Prices) or September 2012 consultation tariff	Data combinations		
			1: All AEA	2: Sweett costs and AEA heat loads	3: Sweett costs, but AEA heat loads for industrial
Biomass	Small*	Tier 1: 8.6	Tier 1: 6.2	Tier 1: 7.7	Tier 1: 10.6
	Medium*	Tier 1: 5.0	Tier 1: 3.9	Tier 1: 4.0	Tier 1: 8.3
	Large	1.0	1.1	2.2	0.0
GSHPs	Medium	4.8	5.2	6.2	11.7
	Large	3.5	3.2	7.2	10.8
AWHPs (consulted on)		1.7	3.8	3.8	6.6
Solar Thermal		9.2[43]	26.5	27.8	24.2
Biomass direct air (consulted on)		2.1	3.2	6.3**	6.4**

*Tier 2 is set at 2.2p/kWh

**Cost data based on a relatively small sample size

[43] Current Solar Thermal tariff is capped at 9.2p/kWh, modelled tariffs are shown uncapped for info.

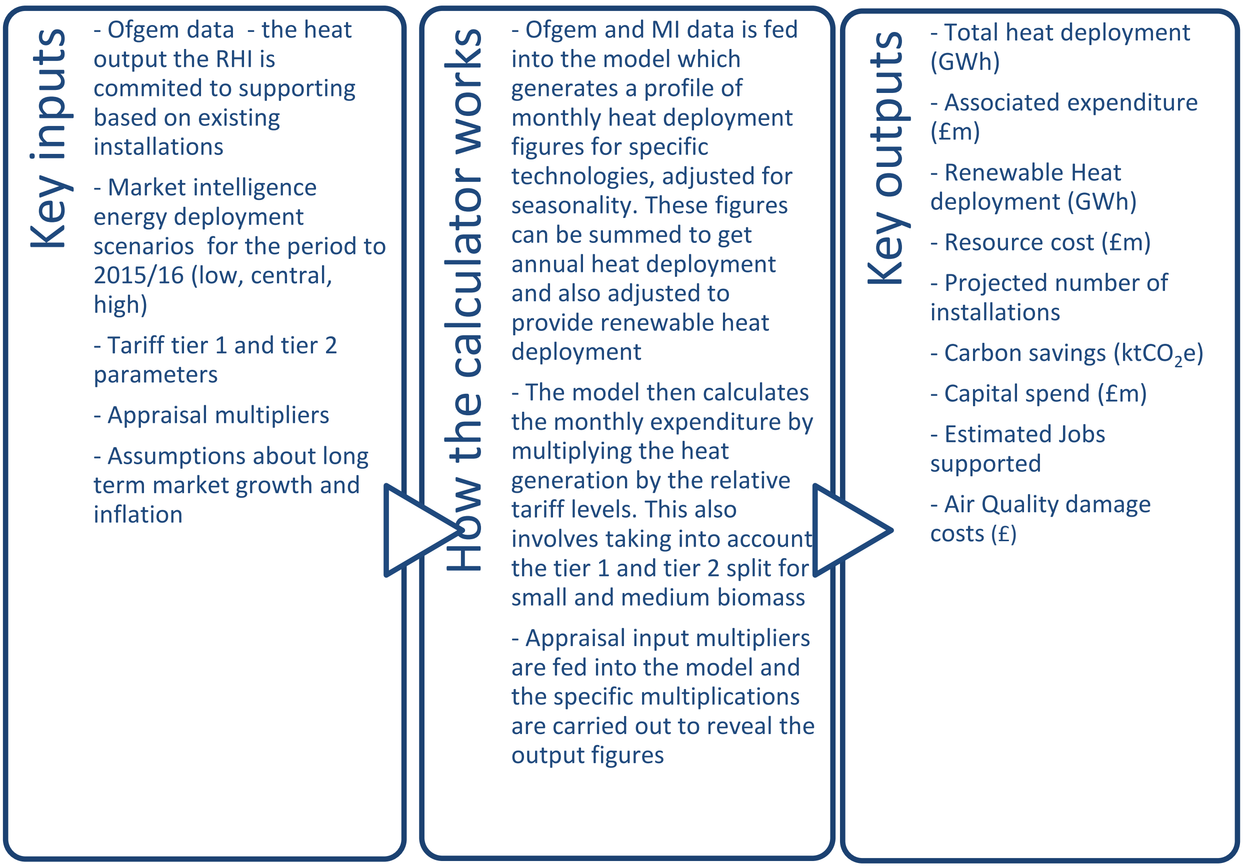
Annex 6: Calculator structure

68. The analysis presented in this IA has been produced using an economic and technical calculator built by analysts at DECC.

69. The calculator was developed in order to conduct a high-level appraisal of the outcomes of a range of deployment scenarios. The calculator allows different RHI technology uptake scenarios to be explored and costed in order to see what is feasible within the agreed Budget. As well as deriving spend and deployment estimates from the MI we have collected, the calculator produces various other outputs that are used to generate NPVs and quantify some of the wider impacts associated with the renewable heat deployment through the RHI.

70. **Error! Reference source not found.** below outlines, at a very high-level, how the calculator works and what the key inputs and outputs are.

Figure 4: High Level Diagram outlining the structure of the Calculator



71. As shown in the diagram above a number of economic, technical, and behavioural assumptions underpin the operations of the calculator and therefore affect the projections. The key assumptions include:

Assumptions:

72. Deployment and Spend Assumptions:

   a. **Energy Committed:** The calculator assumes low, central and high scenarios for energy committed (GWh) based on MI data.

   b. **Post 2015/16 Growth rate:** The calculator assumes 30% growth every year up until the scheme ends in 2020.

   c. **Renewable proportions:** Because heat pumps will generally use grid electricity as an input not all of their heat output can be considered renewable. The proportion of total heat output that is renewable is calculated using assumptions about the SPFs that heat pumps supported by the RHI will have.

   d. **Seasonality:** In order to take account of the potential impact from seasonality in heat demand on the financial year costs of the RHI, it is necessary to make an assumption on seasonal changes in heat demand. We can calculate seasonality factors using UK quarterly gas consumption data from energy trends. Gas consumption can be used as a proxy for heat demand as it is primarily used for heating (space, hot water or process). We only use the seasonality factors on the non-domestic technologies as non-domestic payments are based on actual heat use and are therefore affected by seasonality whereas domestic payments are based on estimated heat use and are therefore not affected by seasonality.

e. **Inflation:** An RPI inflator is used to calculate nominal spend figures – this is because Ofgem will use RPI to update tariffs each year.

f. **Tiering:** In order to calculate the total spend, the calculator assumes a certain proportion of heat produced by small/medium biomass and GSHPs is paid at a tier 1 tariff and any heat produced beyond that proportion is paid at a tier 2 tariff. For the small and medium biomass boilers this proportion is based on the Ofgem data that the scheme has collected to date. For GSHPs we assume that given a typical load factor of 20%, 75% of the heat produced is paid at tier 1 and the remaining 15% is paid at tier 2.

g. **Discounting:** A discount rate of 3.5% is assumed when calculating discounted spend figures for appraisal purposes.

h. **Tariffs:** For our spend estimates we assume that there is no degression between now and 2015/16 so tariffs remain at the levels proposed in this IA and the accompanying government response.

i. Technology efficiency: The calculator includes efficiency assumptions specific to each RHI technology and counterfactual technologies. These assumptions are based on NERA analysis and the range is estimated by DECC Engineers. Table 30 shows these estimates.

Annex 7: Appraisal assumptions

Appraisal outputs:

73. In addition to generating estimates of deployment and spend figures, the calculator also generates a number of appraisal outputs. These outputs can be split up into those which feed into the NPV calculation and wider impacts.

74. The appraisal outputs which are components of the NPV are resource costs, air quality impacts and carbon savings. The inputs into the calculator to generate these are:

    a. Resource cost multiplier (£ per kWh of heat)

    b. Damage cost air quality multiplier (£ per kWh of heat generation) – varies from technology to technology

    c. Carbon savings multiplier (kg CO_2 per kWh of heat generation)

75. The wider impacts are capital spend, number of installations and supported job estimates. In order to produce these appraisal outputs, the calculator requires the following inputs:

    a. Capex multiplier (£ per kWh of new generation)

    b. Installations multiplier (number of installations per kWh of new generation)

    c. Supported Jobs multiplier (number of jobs per £m capital spend)

Appraisal output assumptions

Air Quality Impacts

76. In order to take account of the net costs on air quality, the calculator includes assumptions on how high the air quality costs incurred by one unit of heat are for each technology. These assumptions are based on:

    a. Emission factors from NAEI[44]: These are emission factors for NOx and PM10 that have been sourced directly from NAEI's database and converted, into the relevant units. These emission factors are used for all the non-domestic technologies.

    b. Damage cost values from Defra (see Table 28): Non-domestic values use the 'NOx' and 'PM Industry' damage costs which are consistent with Defra's previous work on AQ damage cost calculations. These damage costs are estimates of the costs to society of the likely impacts of changes in emissions. They assume an average impact on an average population affected by changes in air quality. The damage costs we have used come from the IGCB Air Quality subgroup and include values for the impacts of exposure to air pollution on health, morbidity effects, damage to buildings and impacts on materials.

    c. Air Quality Impact calculations produced by Defra/AEA: Monetised air quality impacts for domestic technologies use the air quality impact calculations that were produced for the July 2013 Domestic IA[45]. There is no split by technology available, therefore all technologies are assumed to have the same £m/TWh air quality impact. Legacy installations are not included and are taken account of in the baseline.

77. The damage costs have been inflated to 2014 prices using the OBR RPI inflator in line with the calculator. Health values implied in the damage costs have been inflated from 2010 to 2014 using a health value inflation rate of 2% per annum. This value follows Green Book supplementary guidance.

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[44] http://naei.defra.gov.uk/data/ef-all

[45] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211978/Domestic_RHI_Impact_Assessment.pdf

Table 28: Defra IGCB Air Quality Damage costs per tonne in 2010 prices

	Air Quality Damage costs in £ per tonne (2010 prices)		
	Low Central Range	Central Estimate	High Central Range
Nitrous Oxides NO_X	744	955	1,085
Particulate Matter (industry)	19,753	25,229	28,669

78. The sensitivities are based on the central emission factors from NAEI[46] and high/low damage cost values from Defra. These values are shown in Table 28 above. Variation between the Damage Cost values reflects uncertainty about the time lag between the exposure to air pollution and the associated negative health impact. There are no sensitivity tests for domestic RHI technologies.

Carbon savings

79. In order to provide estimates for the carbon savings, it has been necessary to make a number of assumptions within the calculator. These include assumptions about the efficiencies of the technologies, CO_2 factors, counterfactual mix and carbon prices.

80. The technology emissions are calculated using efficiency and CO_2 factors. The central efficiency value is based on NERA analysis and the range is estimated in discussion with the DECC engineering team. The CO_2 factors are obtained from the Office of Renewable Energy Deployment within DECC. The range follows the EU LCA methodology and includes land use change at the highest end. For heat pumps and deep geothermal technologies the CO_2 factors are obtained from the DECC's calculations toolkit. This approach is confirmed by the RHI engineers.

[46] http://naei.defra.gov.uk/data/ef-all

81. Table 29 shows the CO_2 emissions and Table 30 shows the efficiency factors. Both these tables also include sensitivities which have been calculated with the central estimates and have been agreed with by DECC engineers.

82. The carbon savings calculations also include an assumption about the mix of deployment against the counterfactual. The counterfactual can make a big difference in terms of the carbon savings. There is a great deal of uncertainty regarding the counterfactual mix and in order to demonstrate this we have assumed a mix of 50% gas and 50% oil. We have carried out sensitivities with 100% oil and 100% with the results showing that a higher mix of oil provides most carbon savings and a higher mix of gas provides fewer carbon savings.

83. The calculator assumes carbon prices and sensitivities from the IAG Toolkit[47]. This data also provides the split between traded and non-traded carbon prices.

47 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243936/2013_Appraisal_Guidance_-_Toolkit_-_FINAL.xls

Table 29: CO_2 emissions associated with Biomass and Biogas Boilers under the RHI

Technology	CO_2 emissions (CO_2e/MWh)		
	Low	Central	High
Biogas boilers	25	50	136
Biomass boilers	23	50	133

Table 30: The range of efficiency factors for supported Biogas and Biomass boilers under the RHI

	Technology	Efficiency Range (%)		
		Low	Central	High
Non-Domestic	Biomass Boilers	75	81	85
Non-Domestic	GSHPs	320	360	400
Non-Domestic	Solar Thermal	100	100	100
Non-Domestic	Small Biogas	80	85	90
Non-Domestic	Biomethane	100	100	100
Non-Domestic	Medium and Large Biogas	80	85	90
Non-Domestic	CHP	70	85	80
Non-Domestic	Deep Geothermal	500	1,000	2,000
Non-Domestic	ATWHPs	250	320	350
Domestic	ASHP	250	280	300
Domestic	Biomass	75	85	90
Domestic	GSHP	280	340	340
Domestic	Solar Thermal	100	100	100

Capital spend

84. Due to the range of data available, there are a number of sources of capex values depending on the technology. Where possible an average of Sweett data[48] was used but we also sourced data from MI and other consultants.

85. As CHP installations have heat and power outputs we have had to include a heat:power ratio assumption of 2.6:1 from Ricardo-AEA[49]. This ratio has been applied to the capex estimates to isolate the heat component.

86. To calculate high/low sensitivities for the capital investment figures, the calculator uses the range of figures from the Sweett data. Where Sweett data isn't available for certain technologies, the calculator uses the central estimates plus 20% for the high sensitivity or minus 20% for the low sensitivity. The exact capex estimates and their sources can be found below in Table 31.

Table 31: Low, central and high capex estimates and their sources

	CAPEX £ per kW			
	Low	Central	High	Source of data
Small Biomass	208	577	945	Sweett Data
Medium Biomass	440	550	660	Market Intelligence
Large Biomass	286	357	428	Technology Assumptions used in the November 2011 IA[50]
GSHPs	1,172	1,295	1,417	Sweett Data
Solar Thermal	555	1,308	2,060	Sweett Data
Small Biogas	1,600	2,000	2,400	SKM Enviros Report[51]
Biomethane	2,640	3,300	3,960	SKM Enviros Report
Medium Biogas	1,600	2,000	2,400	SKM Enviros Report
Large Biogas	2,186	2,733	3,280	SKM Enviros Report
CHP	2,115	2,644	3,173	Ricardo-AEA Report[52]
Deep Geothermal	1,000	2,000	3,500	Central: Market Intelligence, Sensitivities: Sweett Data
ATWHPs	513	877	1,240	Sweett Data

Number of installations

87. In order to calculate the estimated number of installations it has been necessary to make some assumptions about 'typical installation' characteristics for each technology. These characteristics include capacity, load factor and heat loads. For most technologies we have sourced capacity and load factor data from MI. We have then calculated heat loads using capacity x load factor x 365 x 24.

88. Due to a lack of MI data on Solar Thermal technologies we have used Ofgem installation data in order to come up with a 'typical' capacity of 14 kW. We have then used the Solar Thermal Association's 'Rules of Thumb' in order to convert the capacity into a heat output of 10,000kWh:

Solar Trade Association 'Rules of Thumb':
a. 0.7kW per m^2
b. 4-600Kwh per year per m^2

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[48] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204275/Research_on_the_costs_and_performance_of_heating_and_cooling_technologies__Sweett_Group_.pdf
[49] http://www.ricardo-aea.com/cms/assets/Documents/ProjectionsofCHPcapacityuseto2030.pdf
[50] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48042/1381-renewable-heat-incentive-ia.pdf
[51] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48166/2711-SKM-enviros-report-rhi.pdf
[52] http://www.ricardo-aea.com/cms/assets/Documents/ProjectionsofCHPcapacityuseto2030.pdf

89. As with the capex estimates above we have had to apply a heat:power ratio of 2.6:1 from Ricardo-AEA[53] to the CHP characteristics. This ratio has been converted to a heat proportion figure of 0.72 which is included in the heat load calculation.

90. The sensitivities for the numbers of installations alter depending on the technology type. For most technologies we have carried out sensitivities on 'typical' capacities and load factors:

Non-domestic

91. For all sizes of biomass boilers, GSHPs and Air to Water heat pumps the calculator uses assumptions on low and high capacity from MI. For Solar Thermal the calculator assumes capacity sensitivities of our central estimate plus 25% for the high figure and minus 25% for the low figure. For all sizes of biogas the high capacity sensitivity is equal to the central estimate as that it the top of the size band. The lower sensitivity is a suitable estimate within the band based on market data. Given the uncertainty surrounding Biomethane, CHP and Deep Geothermal we have used the central estimate plus/minus 50% for the capacity sensitivities.

92. For Solar Thermal and Biomethane we have not carried out sensitivities on load factors as there seems to be little variation according to previous Sweett data reports and MI. We have carried out sensitivity tests on the load factors of all other technologies using the central estimate plus/minus 20%. The 'high' sensitivity for load factors is the central estimate minus 20% and the 'low' sensitivity is the central estimate plus 20%. This is because as the capacities increase, load factors tend to fall therefore when it comes to calculating heat outputs and subsequently the number of installations we need to multiply the two numbers accordingly.

Domestic

93. The calculator uses MI inputs for the high sensitivities and the central estimate minus 20% for the low sensitivities.

94. Table 32 shows the 'typical' installation characteristics we have used.

95. The load factors below represent what we expect to, or are seeing in the scheme rather than the design load factors outside the scheme.

Table 32: 'Typical' installation characteristics

	Capacity kW			Load Factor		
	Low	Central	High	High	Central	Low
Small Biomass	100	160	200	0.18	0.15	0.12
Medium Biomass	500	800	1000	0.19	0.16	0.13
Large Biomass	2,000	2,300	5,000	0.28	0.23	0.18
GSHPs	100	200	1,000	0.21	0.19	0.16
Solar Thermal	11	14	18	0.08	0.08	0.08
Small Biogas	100	200	200	0.82	0.68	0.54
Biomethane	500	1,000	1,500	0.93	0.93	0.93
Medium Biogas	300	500	500	0.55	0.46	0.37
Large Biogas	700	1,500	1,500	0.55	0.46	0.37
CHP	17,500	35,000	52,500	0.89	0.74	0.59
Deep Geothermal	2,500	5,000	7,500	0.66	0.55	0.44
ATWHPs	40	90	200	0.25	0.21	0.17

Supported jobs

96. In order to estimate the number of jobs supported by the RHI, the calculator uses 2012 employment and turnover data from the REA[54] to produce an assumption for the number of jobs

[53] http://www.ricardo-aea.com/cms/assets/Documents/ProjectionsofCHPcapacityuseto2030.pdf
[54] REA Report: Renewable Energy: Made In Britain http://www.r-e-a.net/resources/rea-publications

per £m capital spend. As part of this, the sector turnover estimates produced by the REA are used as a proxy for overall capital spends. The REA data used for this calculation can be seen in Table 33 below.

97. The sensitivities for supported job estimates feed in from the high/low capex figures and the resulting capital spend estimates.

Table 33: REA employment and sector turnover 2010/11 data

	Jobs across the supply chain (FTE)	Sector Turnover £m
Biomass	4,530	540
Heat Pumps	7,320	935
Solar Thermal	7,550	830
CHP	2,190	331
Biogas & Biomethane	2,650	320
Deep Geothermal	200	10

Annex 8: Calculation of triggers

142. The overall aim of the budget management system is to control spending to a level no greater than the central estimate of deployment, based on our latest MI. While it does not eliminate these risks, it does control them by reducing tariffs for new applicants, and would potentially reduce deployment by making the RHI less financially attractive.

143. The updated central MI deployment forecasts are therefore the basis of developing triggers for both the domestic and non-domestic scheme. Any upwards deviation from this implies a greater chance of overspend.

Technology specific adjustments

144. Technologies with a low deployment estimate (less than 2.5% of the total non-domestic budget) have been given a trigger of 2.5% of the non-domestic budget. This acts as both the 100% and scaled trigger. This applies to solar thermal, deep geothermal and all 3 biogas tariff bands together. Setting triggers based on central estimates for these tariffs could unnecessarily constrain tariffs for embryonic markets, e.g. the solar thermal tariff is already constrained by the value for money cap.

145. Small, medium and large Biogas technology triggers have been aggregated into one, as this avoids excessive levels of granularity in the mechanism.

146. Biomethane is expected to deliver a similar amount of heat by the end of the spending review period as the current triggers imply. MI suggests that the majority of this deployment will occur towards the end of the spending review period. There are however uncertainties surrounding this. The trigger has in 2014/15 not been based directly on MI; instead it has been modified to allow a smoother transition between the old set of triggers and new.

147. For other new tariffs and technologies, to reduce the risk of slight variations from the central scenario resulting in unnecessary tariff reductions soon after new tariffs are implemented, we will set initial triggers slightly higher than central market intelligence in some cases, and bring them back into line with the central market intelligence scenarios by April 2015. This will apply to GSHP, ASHP, large biomass, CHP and biomethane. These are the technologies which are either new or have updated tariffs.

Domestic trigger setting

148. The domestic triggers give equal shares of the budget to ground source heat pumps, air source heat pumps and biomass boilers and allow a smaller budget for solar thermal (in-line with the deployment our central scenario MI predicts for this technology).

149. The evidence base for deployment of domestic technologies in the first few years of the scheme is highly uncertain. There is some MI on potential installations over the SR period. There is however weak evidence about the average heat demand of households who take up the RHI.

150. In the absence of any better evidence, this is a pragmatic option that allows the market to decide between technologies (within the parameters of the tariffs we have set). It also allows growth in deployment for all technologies through to the end of 2015/16.

151. The solar thermal budget is set lower than the budget allocated to other technologies to reflect the fact that solar thermal will usually be used for water heating rather than space and water heating, so heat loads are likely to be lower than those associated with the other technologies.

152. Metering and Monitoring service packages are an important aspect of the domestic scheme to help both installers and householders. The budget given to these installations will be a fixed amount which when reached will close support to MMSP for the rest of the financial year.

153. Installations prior to the launch of the RHI, but after July 2009 (Legacy applications) can still apply for RHI provided they meet the conditions set out in the July policy document. These will not

count towards the calculation of whether triggers for degression have been met because they were deployed before the start of the scheme and are therefore not indicative of the current effect of the scheme and its tariffs on the market. If included they could trigger a degression that would drive tariffs too low to incentivise new deployment.

154. Legacy applications will also have a guaranteed tariff for the first year of the scheme. This is to reduce the risk of a rush of legacy applicants at the beginning of the scheme (which could result in delays and expense in processing applications) and to treat phased applications (phasing is necessary to manage the scheme delivery costs associated with these applications) fairly.

Table 34: Summary of Triggers at the end of 2014/15 and 2015/16

		Spending	100% Triggers							
		Oct-13	Apr-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16
Existing Technologies	Small Biomass	£32m	£42m	£49m	£56m	£63m	£71m	£80m	£90m	£99m
	Medium Biomass	£27m	£38m	£44m	£49m	£54m	£60m	£66m	£72m	£79m
	Large Biomass	£9m	£9m	£11m	£12m	£14m	£16m	£19m	£22m	£25m
	Ground Source Heat Pump	£1m	£6m	£7m	£9m	£10m	£13m	£16m	£20m	£23m
	Small Solar Thermal	£.1m	£3m	£4m	£5m	£6m	£6m	£8m	£9m	£10m
	Biomethane	£2m	£37m	£41m	£46m	£50m	£58m	£70m	£83m	£95m
Non-domestic Extensions	Biogas (Small, Medium and Large)		£3m	£4m	£5m	£6m	£6m	£8m	£9m	£10m
	CHP- Biomass		£17m	£18m	£19m	£20m	£23m	£30m	£38m	£45m
	Deep Geothermal		£3m	£4m	£5m	£6m	£6m	£8m	£9m	£10m
	Air Source Heat Pumps		£10m	£12m	£14m	£16m	£18m	£21m	£23m	£26m
Domestic Technologies	Air Source Heat Pumps			£2.4m	£4.2m	£6.0m	£8.4m	£11.9m	£15.5m	£19.1m
	Biomass Boilers			£2.4m	£4.2m	£6.0m	£8.4m	£11.9m	£15.5m	£19.1m
	Ground Source Heat Pumps			£2.4m	£4.2m	£6.0m	£8.4m	£11.9m	£15.5m	£19.1m
	Solar Thermal			£1.2m	£2.1m	£2.9m	£3.9m	£5.0m	£6.1m	£7.2m

Annex 9: Domestic budget management choices and implications

155. The domestic RHI budget management system has been designed with some differences to the non-domestic system. This is to better reflect the differences in technologies, scheme objectives and potential customer reaction to degression. The system will also be simpler to reflect the different customer base, making it easier for small installers and private householders to assess the potential returns from RHI.

156. Table 35 below highlights the major changes and describes why these alterations have been made:

Table 35: Degression differences between domestic and non-domestic RHI

Current non domestic RHI	Domestic RHI	Rationale
Degression triggers for each tariff and a total trigger based on whole scheme deployment	Degression triggers for each tariff and no total trigger	Tariff triggers ensure a mix of technologies to support long term growth of renewable heat. They reduce the risk of low deployment of technologies that are more expensive but may be more cost effective in the long term, ensuring that one technology does not dominate the whole domestic budget. Domestic triggers will not be scaled, instead they will be set based on splitting the available budget between technologies. There will, therefore, not be a total trigger, which simplifies the degression mechanism compared to non-domestic. This does however make it more likely that degression for any one technology will be triggered as it is entirely based on the deployment of that technology rather than also being at least partially reliant on healthy deployment in other technologies.
Degression does not occur if overall deployment is less than 50%	Degression occurs if tariff triggers are met, even if overall deployment is low	The domestic scheme aims to support a mix of technologies that which supports mass deployment of renewable heat in 2020's / 2030's. Hitting a trigger implies that a technology is over-incentivised and, in a scheme where securing diverse deployment is the primary aim, it is better value for money that tariffs are degressed.
5% initial degressions followed by 10% and 20% degressions	10% degressions if triggers are breached	A 5% degression might not be large enough to have an appreciable effect on deployment; particularly for the cheaper tariffs (the difference between an annual payment of £500 and £475 is unlikely to have very much effect). It also may not be enough of a decrease in the cost of those applications that do come forward to manage the budget. Whereas a 20% reduction may be too great, unless deployment is significantly above where we would expect it to be and we need to significantly reduce the number of installations coming forward and the cost associated with those installations.
Setting a "super trigger"		The "super trigger" would provide additional control, similar to a cap, without risking a stop-start scheme which could damage the market. It would guard against sudden and unexpected over-deployment of any technology which would imply either initial tariffs were too high or there have been major cost reductions e.g. due to cheaper imported technology. Given that domestic project install times tend to be shorter than non-domestic, quarterly degressions of 10% could be insufficient to control deployment in this situation.

Triggers set by MI for most technologies	Budget split equally across space heating technologies	An even budget split between the main space heating technologies is pragmatic and allows the market to decide between technologies. There is a lack of evidence for any particular technology split in the domestic scheme given the change in types of households who may apply for RHI compared to previous support programmes

Annex 10: Extending projections to 2020/21

157. The range of possible deployment to 2020/21 is inherently wider than the range for 2015/16. In order to capture this uncertainty we have taken our 2015/16 deployment scenarios and extended them in the following ways:

Low 2020/21 – This takes our low deployment estimate for 2015/16 and extends it to 2020/21 by assuming that the markets for each technology do not grow i.e. the same amount of capacity is installed in each year from 2015/16 to 2020/21. The scenario would lead to RHI supported deployment of around 14TWh in 2020/21 once baseline deployment of 15.2TWh is included this leads to 2020/21 deployment of around 29TWh.

Central range for 2020/21 – Given the high degree of uncertainty around long-term deployment we have chosen to present a "central range" rather than point estimates for potential deployment to 2020/21. This extends our central 2015/16 deployment scenario and the central MI scenario to 2020/21 by assuming that the markets for individual heat technologies can grow at rate of 30% a year. This growth assumption is in line with the output of previous modelling done at the time the scheme was launched[55]. With the baseline deployment this leads to a range of 41-47TWh by 2020/21. This is our estimate of most likely 2020/21 deployment levels with the implementation of the policy changes.

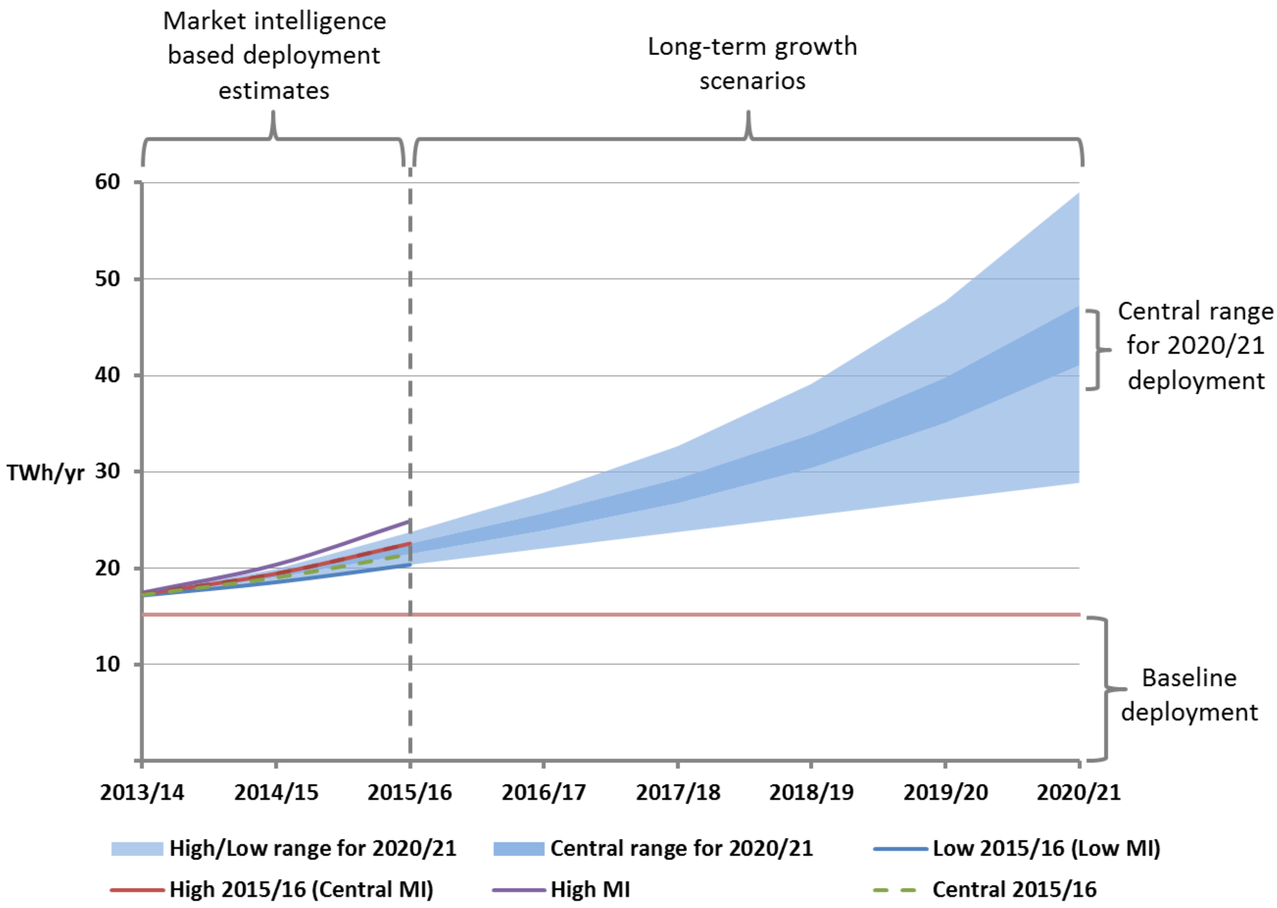
High 2020/21 – This scenario is not directly based on any of the 2015/16 scenarios but illustrates the possibility that post 2015/16 growth in deployment could be higher than our central assumption at 35% a year, or that growth in the near-term could be higher than what is suggested by our central MI, for example if degression is triggered due to high deployment. Once the baseline level of deployment is accounted for this would lead to 2020/21 deployment of up to 59TWh.

158. Figure 5 below illustrates these deployment scenarios alongside the three MI scenarios that cover the period from 2013/14 through to 2015/16. The NPV (Net Present Value) estimates provided in the next section are based on the impacts of the extra deployment brought on up to 2015/16 under our central deployment estimate.

159. It should be noted that the longer-term trajectories are only intended to illustrate a possible range of plausible outcomes, assuming that the RHI continues largely as it is out to 2020/21. A simple constant percentage growth rate has been used to generate the range. In reality growth rates may vary over time, and future policy may evolve in ways that are beyond the scope of this IA.

[55] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48042/1381-renewable-heat-incentive-ia.pdf

Figure 5: RHI supported deployment of renewable heat under different scenarios



Lifetime NPV

160. As well as the NPV we have calculated for the impacts of the additional deployment out to 2015/16 that result from the policy proposals, we have produced an estimate of the NPV of the policy changes for the entire lifetime of the policy. To produce this NPV range we have used the "central range" of potential deployment to 2020/21 described in section 4A. As with all of the estimates presented in this IA there is a great deal of uncertainty around these estimates. These are particularly uncertain because long-term deployment potential is unclear but also because we do not know what the mix of technologies deploying in 2020 will be or the extent to which cost reductions will be able to bring down resource or subsidy costs.

Table 36: Estimate of lifetime NPV associated with central range of deployment to 2020/21

£m real discounted	Impact on NPV estimate of central 2020/21 range scenario	
	Lower deployment	Higher deployment
Resource costs Air quality impacts	-3,606 -506	-6,520 -838
Carbon Benefits in traded sector Carbon Benefits in non-traded sector	91 1,731	158 3,008
NPV of policy changes over lifetime	**-2,290**	**-4,191**

161. These estimates assume that deployment stays within the "central range" identified in section 4A; the NPV range in Table 36 is driven purely by the change in deployment as our central assumptions around carbon prices, emission factors and efficiencies are used for both the higher and lower ends of deployment. The NPV range would be wider if we applied the same sensitivities to this NPV

estimate as were applied to our 2015/16 NPV estimates in section 4D. The sensitivities we have carried out on the 2015/16 deployment impacts suggests that our uncertainty around these assumptions can lead to a variation in the NPV of as much 65%. Assuming this same level of uncertainty applies to our lifetime NPV estimates this would lead to an even wider range of -£0.8bn to -£7bn.

Update to overall RHI NPV – "No RHI counterfactual"

162. As our analytical approach has changed significantly from the one used in previous IAs we have also updated our estimate of the NPV associated with the scheme as a whole. This uses the same central scenario as the NPV estimate calculated in the previous section and compares it with deployment estimates of what would have happened in the absence of the RHI.

163. Determining what would have happened in the absence of policy is difficult, and as such the estimates are uncertain, but we have assumed that without the RHI in place, the market size for renewable heat would have to change significantly between 2011 and 2020/21. This baseline shows a small increase over the period driven by cost effective biomass and heat pump installations but only contributes an additional 0.5TWh by 2020/21 on top of a current deployment level of 15.2TWhs.

Table 37: NPV of central range against a counterfactual of no RHI

£m real discounted	Impact on NPV estimate of central 2020/21 range scenario	
	Lower deployment	Higher deployment
Resource costs	-10,642	-13,555
Air quality impacts	-756	-1,088
Carbon Benefits in traded sector	166	233
Carbon Benefits in non-traded sector	3,159	4,436
NPV of policy changes over lifetime	**-8,073**	**-9,974**

URN: 13D/301