Title: The Renewable Heat Incentive: A reformed and refocused scheme **IA No:** BEIS029(F)-17-RH **RPC Reference No:** N/A **Lead department or agency:** Department for Business, Energy and Industrial Strategy **Other departments or agencies:** N/A	**Impact Assessment (IA)** **Date:** 06/02/2018 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Secondary Legislation **Contact for enquiries:** rhi@beis.gov.uk
Summary: Intervention and Options	**RPC Opinion:** Not Applicable

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANDCB in 2014 prices)	**One-In, Three-Out**	**Business Impact Target Status**
£30m	N/A	N/A	N/A	NQRP

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

The Renewable Heat Incentive (RHI) is an incentive to owners of renewable heat installations. It was introduced in the non-domestic sector in November 2011 and the domestic sector in April 2014. It is intended to help overcome the cost differential between renewable and conventional heating systems to encourage more deployment of renewable systems. This will contribute to meeting the UK's Carbon Budgets and legally binding 2020 Renewable Energy Directive target.

What are the policy objectives and the intended effects?

The aim of the RHI is to incentivise the cost effective generation of renewable heat in order to contribute to meeting Carbon Budgets, generate renewable energy to help meet the UK's 2020 renewable energy target, and develop the renewable heat market and supply chain so that it can support the mass roll out of low carbon heating technologies. The reforms being made to the RHI are designed to ensure it focuses on long term decarbonisation, offers better value for money and protects consumers, and supports supply chain growth while challenging the market to deliver.

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

This IA is an update to the December 2016 IA which accompanied the Government's response to the March 2016 RHI consultation. Similar to the December 2016 IA, this IA presents estimated costs and benefits of a reformed RHI against a counterfactual where the scheme is closed. The impacts of specific reform measures are assessed qualitatively as a quantitative assessment is not possible given the evidence available about future deployment. The considered policy options are:

Option 0: Counterfactual / Close the RHI *(used as the baseline for estimated costs and benefits)*

Option 1: Do nothing/ leave the scheme regulations as they were

Option 2: Reform the RHI (Preferred) - Consisting of two parts, the first part of the reform package was introduced in September 2017 and focused on budget controls and tariff changes to alleviate immediate pressure on the RHI budget. The second part of the reform package, being introduced by affirmative regulation in Spring 2018, implements the re-focusing of the RHI including tariff and eligibility changes, and introducing tariff guarantees and assignment of rights. Additionally, the long term budget management and affordability mechanism are introduced in the second part of the reform package.

Will the policy be reviewed? It will not be reviewed. **If applicable, set review date:**

Does implementation go beyond minimum EU requirements?		N/A		
Are any of these organisations in scope?	**Micro** N/A	**Small** N/A	**Medium** N/A	**Large** N/A
What is the CO_2 equivalent change in greenhouse gas emissions in Carbon Budget 4? (Million tonnes CO_2 equivalent) see Section 4.4		**Traded:** ~1 Mt	**Non-traded:** ~11 Mt	

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: Claire Perry Date: 6 February 2018

Summary: Analysis & Evidence

FULL ECONOMIC ASSESSMENT

Price Base Year 17/18	PV Base Year 17/18	Time Period Years 25	Net Benefit (Present Value (PV)) (£m)		
			Low: -£1,290m	**High:** £1,350m	**Best Estimate:** £30m

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low				£2,120m
High				£3,250m
Best Estimate				£2,830m

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

The main cost of the reformed RHI will be the resource cost of supporting all eligible renewable technologies; the central estimate which is £2,830m. This represents the additional cost of installing low carbon heating systems in place of conventional systems. These estimates are subject to uncertainty, both in terms of the types of technologies which come forward and their additional costs. Air quality impacts are included as net values, meaning any costs are accounted for in reduced benefits.

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

Rebound effect: for some users, installing a low carbon heat technology could lead to lower fuel bills. This could lead to an overall increase in energy consumption, reducing energy saving and carbon benefits, but increasing welfare benefits from households comfort taking and organisations increasing their output, with an uncertain overall impact. Wider impacts: there are some potential costs of collecting food waste from local authorities; and potential impacts on air quality resulting from spreading digestate from anaerobic digestion plants.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low				£1,540m
High				£4,180m
Best Estimate				£2,860m

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

The main monetised benefit of the RHI is the reduction in carbon emissions which mainly occurs in the non-traded sector; central estimate of the value of these savings is £100m traded carbon and £2,540m non-traded carbon. The other important benefit is the air quality impact principally resulting from displacing oil boilers. The air quality impact is highly uncertain, with a best estimate of net impacts of £220m. For some installations there will also be benefits from saving energy.

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

Innovation & cost reductions: by supporting low carbon heat deployment BEIS expects that costs of low carbon heating will fall and performance increase as supply chains grow in capacity and capability, and learning by doing effects reduce the barriers that customers currently face.

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

The RHI is a demand led scheme so it is not possible to know the exact number and mix of technologies that will come forward in the future. Given some installations have lifetime of 20 years, the appraisal period runs to 2041 (20 years from the last month of possible deployment). Estimating cost and benefits over this period introduces significant uncertainty. Fossil fuel prices, system efficiency, fuels displaced, feedstocks used, and the price of carbon are the major sensitivities which affect the NPV of the scheme. A large uncertainty is the availability and alternative uses of feedstocks for anaerobic digestion. This results in an asymmetric risk profile on carbon abatement, with lower abatement more likely than higher. The impact of the use of anaerobic digestion's digestate use on farms is uncertain and could impact the air quality benefits of the scheme.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: N/A	**Benefits:** N/A	**Net:** N/A	N/A

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Section 1) Introduction and Background

1. The RHI is central to the Government's plans for the long-term decarbonisation of heating in the UK. It is also an important contributor to meeting the UK's binding renewable energy target, as set out in the EU Renewable Energy Directive.

2. The Scheme is intended to help overcome the cost differential between renewable and conventional heating systems to encourage more deployment of renewable systems. Tariffs are set and paid to businesses and households in order to compensate them for the additional costs of installing renewable heat technologies compared to conventional heating technologies. In order to protect budgets and ensure that there is diversity of deployment and value for money, a degression mechanism lowers tariffs automatically when deployment reaches certain thresholds.

3. The Non-Domestic RHI scheme was launched in November 2011. This was followed by the Domestic RHI scheme in April 2014. So far the RHI has supported over 60,000 domestic renewable heat installations, and nearly 18,000 non-domestic renewable heat installations in the UK[1]. The majority of deployment to date has been in the bioenergy sector. Non-domestic deployment has seen a lot of small biomass, biomethane, and to a lesser extent, medium biomass and biogas. In the domestic scheme, biomass has also seen the largest amount of heat generated and paid for (54% of the total); however, heat pumps have seen the largest number of installations (65% of the total).[1]

4. In November 2015, the Government renewed its commitment to the transition to low carbon heat by confirming a continued budget for the Renewable Heat Incentive, rising from £430m in 2015/16 to £1.15bn in 2020/21 in nominal terms.

5. This impact assessment (IA) is an update to the December 2016 IA[2] which accompanied the Government's response to the March 2016 RHI reform consultation. It covers RHI reforms introduced through regulations made in September 2017[3] as well as additional changes which will be made through affirmative regulations laid in early 2018.

1.1. Rationale for Intervention

6. The current market for renewable heat is relatively small[4] and these technologies are largely unable to compete on cost with conventional heating options such as gas, oil and direct electric heating. This is partly due to the emerging nature of renewable heating which means that it does not benefit from economies of scale or from mature supply chains to the same degree as the older technologies. Additionally, the full societal costs of fossil fuel combustion are not reflected in their market prices (examples include the impacts on health and climate change).

[1] https://www.gov.uk/government/collections/renewable-heat-incentive-statistics
[2] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme
[3] http://www.legislation.gov.uk/uksi/2017/857/contents/made
[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/643414/DUKES_2017.pdf

7. There are a number of non-financial barriers to the uptake of renewable heat. Important examples include awareness of technologies, availability of local suppliers, and the hassle involved in changing heating systems.

8. The economic rationale for subsidising renewable heating in the domestic and non-domestic sectors has five main aspects:

   a. The negative carbon externality associated with the conventional heating of buildings, which is not currently reflected in the cost of those systems.

   b. Renewable heat is expected to make a significant contribution to UK meeting its target under the EU Renewable Energy Directive (RED). The UK has a legally binding target to generate 15% of its energy demand from renewable sources by 2020..

   c. Preparing the supply chain (installer and manufacturer) for the mass roll-out and deployment of low carbon heating. This is needed to reduce the cost of decarbonising heat use in buildings and industrial processes as well as meeting legally binding carbon targets.

   d. Raising consumer awareness, reducing deployment barriers and increasing innovation through increased deployment. These spill-over benefits to society (of marginal increases in performance or marginal decreases in costs) are not reflected in the price of renewable heating.

   e. Renewable heat adds a further non-monetised benefit through diversifying the UK's energy supply, reducing UK economy's exposure to the volatility of oil and gas prices.

9. The RHI is designed to address these aspects by incentivising cost effective installations, creating cost reductions for installation and operation, and improving performance of renewable heating systems.

1.2. Policy Objectives

10. The overarching aim of the RHI, both Domestic and Non-Domestic schemes, is to incentivise the cost effective installation of renewable heat technologies and generation of renewable heat in order to:

    a. Contribute to decarbonising heating in the UK and to meeting Carbon Budgets.

    b. Contribute to renewable energy in order to help meet the UK's 2020 renewable energy target for sourcing 15% of energy demand from renewable sources.

    c. Develop the renewable heat market and supply chain to support the mass roll out of low carbon heating technology required in the 2020s and onwards to meet the UK's Carbon Budgets.

11. This document sets out the Government's reforms to both Domestic and Non-Domestic RHI schemes, designed to ensure the schemes' objectives are met in a manner which:

    a. **Focuses on long-term decarbonisation:** The reforms promote deployment of the right technologies for the right uses, while ensuring the RHI contributes to short-term decarbonisation targets and retaining a credible plan for the UK's existing targets under EU law, as long as these apply.

b. **Offers value for money, protects taxpayers and consumers and is affordable:** Taken together, the measures significantly improve the scheme's value for money and cost control, delivering carbon savings at a lower cost[5] than the existing scheme.

c. **Supports supply chain growth, and challenges the market to deliver**: The reforms are intended to drive cost reductions and innovation to help build growing markets that provide quality to consumers and are sustainable without future Government support.

1.3. Policy Timeline and Changes Made since the December 2016 IA

12. The scheme has undergone several updates and extensions since the Non-Domestic Scheme launch in 2011. These have included:
    a. Support for new technologies in the Non-Domestic Scheme, launched in 2014.
    b. A tariff review for non-domestic technologies launched in 2014.
    c. Launch of the Domestic Scheme in 2014.
    d. A review of the biomethane tariff in 2014/15.
    e. Introduction of biomass sustainability criteria in 2015.
    f. Introduction of the RHI Budget Cap and minor changes in March 2016.
    g. Tariff changes introduced in September 2017.

13. Annual budget caps for each year were agreed as part of the Spending Review 2015, rising from £640m in 2016/17 to £1,150m in 2020/21.

14. Since the publication of the December 2016 IA, the package of reforms has been altered in the following ways:
    a. The reforms have been split into two phases. In order to control the risk of increased overspend and deliver some of the promised tariff increases, negative regulations were introduced to: i) align non-domestic biomass tariffs across all sizes and introduce a common higher tiering threshold; ii) increase domestic biomass and heat pump tariffs; iii) introduce domestic heat demand limits; and iv) extend degression thresholds out to July 2018. These amendments came into force on 20 September 2017.

    b. The introduction of Assignment of Rights (AoR) in the Domestic RHI will be included with the rest of the reforms. This was originally separated from the legislative package due to policy concerns, but these have since been addressed and AoR will now be included.

    c. Increased deployment – notably in medium biomass – over the course of 2017 led to a reduction in headroom for future years' budgets. As a result, tariff guarantees (TGs) in the Non-Domestic Scheme will now be introduced with a limiting mechanism built in to the legislation. This will prevent Ofgem from

[5] See Section 4.1

granting any more TGs when the committed spend on TGs reaches set limits. The limit will help prevent budget overspend but is likely to lead to fewer TGs being granted.

d. Following consultation,[6] the power efficiency threshold for biomass combined heat and power (CHP) will be increased back up from 10% to 20%.

e. Also following consultation[12], changes will be made to eligible heat uses in the Non-Domestic Scheme. Restrictions will be placed on the drying of woodfuel and waste, as well as the heating of domestic swimming pools. These changes are included to provide better value for money.

f. Additional powers are also being granted to Ofgem to address non-compliance in the scheme and to smooth the operational processes, allowing them to reject applications more easily in certain cases. This will result in fewer dormant or inactive applications being reported to BEIS.

[6] https://www.gov.uk/government/consultations/the-non-domestic-renewable-heat-incentive-further-proposed-amendments

Section 2) Analytical Approach

This section outlines the analytical stages involved in assessing the costs and benefits of the Renewable Heat Incentive Scheme.

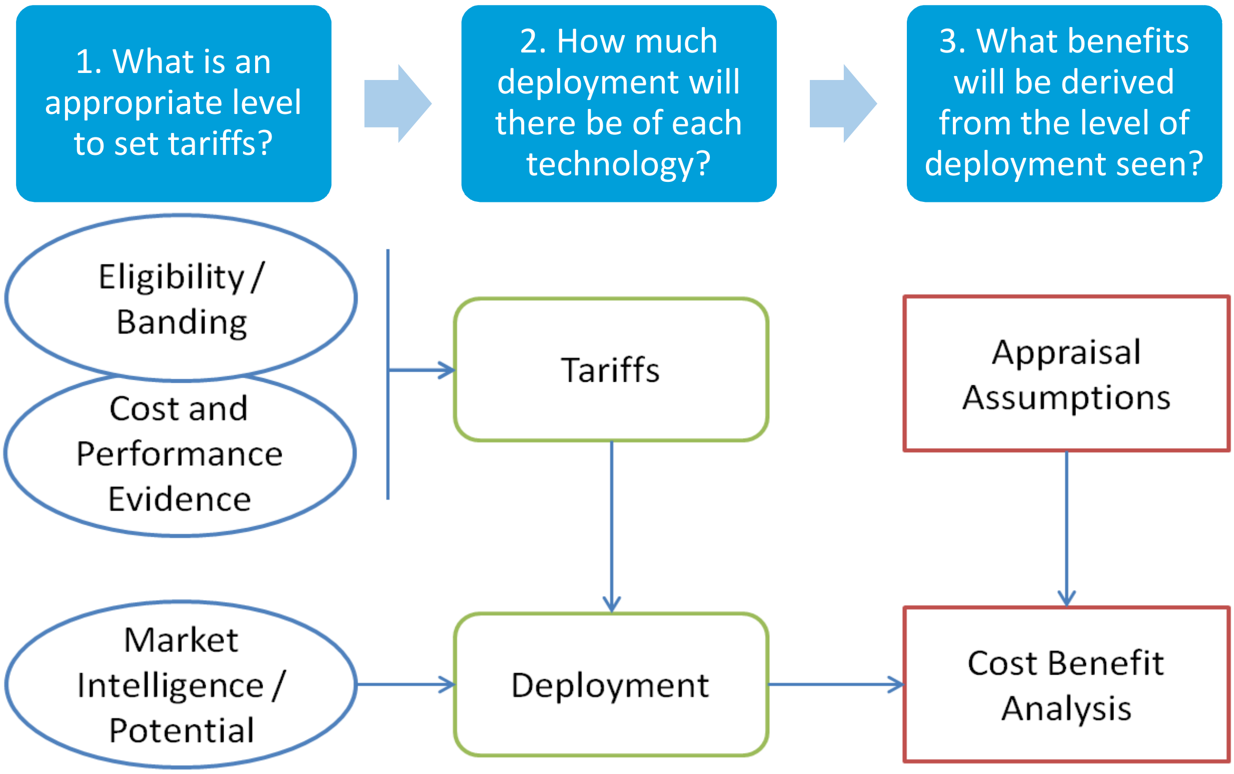
15. Changes to the evidence since the December 2016 Impact Assessment have been applied to both future deployment, appraised in this IA, and committed deployment, which are included in order to present whole scheme impacts. Changes to the evidence are set out in Section 2.1 below.

16. The analytical component of the refocus of the Renewable Heat Incentive seeks to answer three main questions, shown in the boxes below. Our high level approach to addressing these questions is:

    a. Tariffs are set to compensate installations for the additional incurred costs and to provide a rate of return on the additional investment. This takes into account the cost and performance of the renewable heating system and the counterfactual systems which would otherwise have been installed.

    b. Deployment is derived through market intelligence to assess the possible impact of the policy package and draws on a range of sources.

    c. Appraisal of the benefits of the given deployment is based on the appraisal assumptions which make use of the best evidence on the performance of systems, carbon emissions, and other impacts.



2.1. Evidence Base

17. A list of the main sources of evidence and assumptions used in this IA can be found in Annex A.

18. The evidence on the cost and performance of technologies used to inform tariff setting comes from a wide array of sources. These feed into the design of tariffs, as well as the impacts appraisal. There is uncertainty around many of these key assumptions. Key examples include:

    a. There is variation in the cost and performance of low carbon heating technologies from a number of reasons, including variation in the building stock, the types of technology solutions, and how the technology is used.

    b. Many of the technologies are emerging, or are growing from very small deployment levels. This can cause large variations and changes in costs and performance across the market and over time.

    c. Technology specific aspects can vary based on, for example, market segment, types of system, or building type.

    d. There is some uncertainty about the relationships between different variables (for example, where the performance of a system and the cost of a system may be linked).

19. The evidence has been reviewed by experts in BEIS to develop a set of assumptions for parameters such as: capital cost of technologies, performance or efficiency, installation sizes, and the fossil fuels displaced.

20. Since the December 2016 IA, changes to our evidence base include:

    a. **Updated deployment profile:** including actual deployment up to the end of September 2017, and revised estimates of future deployment.

    b. Updated emissions factors:

    - Fossil fuel nitrogen oxides (NOx) and particular matter (PM) factors come from the revised National Atmospheric Emission Inventory (NAEI) which has changed source database.[7]
    - RHI-supported non-domestic biomass NOx and PM emissions, now based on RHI scheme-specific evidence.

    c. **Counterfactual energy:** the mix of systems assumed to be replaced has been updated in the past year, based on additional data from scheme applicants.

    d. **Carbon Price Series:** routine updates to BEIS projections for carbon prices take place as part of the HMT Green Book supplementary guidance.[8]

[7] http://naei.beis.gov.uk/data/
[8] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

e. **Heat pump performance**: the analysis of the Renewable Heat Premium Payment (RHPP) scheme field trial data has developed further.

f. **Electricity grid emissions:** routine updates to BEIS projections for carbon content of electricity, from the HMT Green Book supplementary guidance.

g. **Evidence on the eligibility of heat uses** following a recent public consultation.[9]

2.2. Tariff Setting

21. No changes to tariffs from those outlined in the December 2016 IA are proposed in this IA. The purpose and approach to tariff setting is briefly explained here for information.

22. Tariffs are set to compensate businesses and households for the additional costs of installing renewable heat technologies compared to conventional heating technologies such as oil or gas (for non-domestic) fuelled systems.

23. The tariff calculation methodology takes into account several components of cost which differ between the renewable and conventional heating technology, including:

    a. **Additional capital cost:** the compensation for higher net capital costs is required because renewable heating systems are typically more expensive to install than conventional systems.

    b. **Differences in operating and fuel costs:** changes in the required maintenance, as well as the type and amount of fuel used, can impact the ongoing costs faced by consumers. They can either result in savings or price increases, depending on the case.

    c. **Rate of return:** installing renewable heating systems often involves barriers which decision makers require a financial rate of return to overcome. For example, this can be additional work on the building, a risk premium associated with the new technology. Additional returns are assumed to be required in the Non-Domestic Scheme in order to compensate for the opportunity cost of funding the installation of the measure.

24. The tariffs available to different technologies may have changed over time either due to BEIS adjusting tariffs after receipt of additional evidence during well-defined tariff reviews and formal consultation, or due to degressions (trigger points that lower tariffs automatically when deployment reaches certain levels).

25. Scheme tariffs are not intended to offer a fixed rate of return to all installations for the duration of the scheme. Instead, they act as a guide to the rate of return targeted when tariffs are set. There are many reasons why a householder or business may not achieve the above rate of return. For example, the degree of heterogeneity in the building stock and in the operation of renewable heating installations mean that an applicant may receive a higher or lower return. In addition, the degression mechanism, in place to

[9] https://www.gov.uk/government/consultations/the-non-domestic-renewable-heat-incentive-further-proposed-amendments

protect budgets and ensure that there is diversity of deployment and value for money, means that over time the actual rate of return may change.

26. More detail on the tariff setting methodology and differences between the Domestic and Non-Domestic Scheme tariffs can be found in Annex A.

2.3. Deployment

27. The deployment estimates used in this Impact Assessment are derived by a combination of market intelligence and underlying analytical drivers. Deployment estimates in this IA reflect a balance between several factors, including:
    a. What the policy objectives are.
    b. Changes being made to policy and resulting uncertainty.
    c. Capacity of markets to drive deployment under that policy.

28. It is not possible to model future deployment in a more sophisticated manner at this time. The renewable heat market constitutes a relatively small proportion of the much larger space and process heating market, and so small changes in overall take up could have outsized effects on the market for the technologies supported by the RHI. Additionally, any modelling of take-up would need to be able to accurately predict the decision making of both domestic and non-domestic consumers.

29. The process of deriving deployment estimates combines all the information available to the Government; our understanding of the impacts our proposals will have on markets is necessarily reliant on information provided by industry. Deployment estimates of the current proposals draw on a range of sources including:
    a. Industry reports.
    b. Trade Association data.
    c. Pipeline data.
    d. Scheme learning to date.
    e. Stakeholder interviews.
    f. Feedback from previous publications.
    g. RHI Evaluation.
    h. BEIS judgement.

30. These are used to develop a central assessment of the likely deployment over the new deployment appraisal period (October 2017 – March 2021). The estimated 20 year lifetime of the installations means that the full impacts are appraised up to 2041. Alternative sensitivities, including higher or lower deployment, are explored in more detail in Section 4: *Impacts Appraisal*. Discussion of the uncertainties surrounding deployment and sensitivities in analysis can be found in Section 5: *Uncertainty*.

2.4. Monetised Costs and Benefits

31. In order to understand the impact of the RHI, analysis has been conducted to estimate the costs and benefits associated with the forecast deployment, taking into account factors such as tariff tiering, seasonality of heat demand, and deployment profiling.

32. The components of the monetisation of the costs and benefits contribution to the Net Present Value (NPV) are:

a. **Resource costs**: the net economic cost of installing the renewable heating technologies over and above the counterfactual cost, including capital, fuel, and running costs (this is net of the benefits where there are reduced resources, such as fuel savings from more efficient heating systems).

b. **Carbon savings**: our monetised estimates of the value of the abated carbon, in both the traded and non-traded sectors.

c. **Air quality impacts**: the costs/benefits of the health impacts of higher/lower emissions of nitrogen oxides and particulate matter due to fuel combustion and fuel switching.

33. In addition to the evidence base on technologies used for setting tariffs, additional information regarding appraisal values from various sources has been used, including:

    a. **Emissions factors:** these look at the greenhouse gases, nitrogen oxides (NOx) and particulate matter (PM) emissions for various low carbon options and the technologies they are replacing. These are sourced from BEIS and Defra emissions guidance and projected electricity carbon intensity factors.

    b. **Costs of emissions:** these look at monetising the costs to human health and the costs of carbon emission, again using guidance from BEIS and Defra and carbon prices.

    c. **Other standard analysis:** is used, such as Green Book appraisal guidance, and Office for Budget Responsibility (OBR) projected inflation series.

34. As many of the factors included in the policy appraisal may vary, sensitivity analysis on the main variables is also included, as outlined in Section 5 below.

35. The NPV estimate included in this impact assessment is the main metric used for policy appraisal and comparison, though it is not the only metric for assessing the desirability of undertaking a policy. This NPV does not include a number of non-monetised impacts (see below).

2.5. Non-Monetised Cost and Benefits

36. Although the main impacts of the revised scheme are included in the calculation of the NPV, not all effects of the scheme are captured in the cost benefit analysis, including:

    a. **Renewable heat generation towards RED targets**: there is no agreed value for renewable energy. However, in the absence of the RHI, additional action would be required to meet our RED target, the cost of which is not reflected in the NPV.

    b. **Innovation & cost reductions**: BEIS expects that supporting low carbon heat deployment will reduce costs and possibly increase performance over time, as supply chains develop and barriers that customers currently face are reduced through technologies being deployed successfully.

c. **Rebound effect**: for some users, installing a low carbon heat technology could lead to lower fuel bills. This could lead to increased energy consumption which would reduce energy saving and CO_2 benefits, but increase welfare benefits from households comfort taking and organisations increasing their output, with an uncertain overall impact.

d. **Electricity system impacts**: some technologies supported within the RHI also support the production of low carbon electricity (CHP systems), while others increase electricity demand when switching from fossil fuels (e.g. Heat Pumps). Marginal impacts on production and demand of low carbon electricity have not been modelled.

e. **Air quality impacts from AD**: digestate from anaerobic digestion plants is typically spread on agricultural land as a fertiliser, which results in the release of ammonia that negatively impacts air quality. The direct impact from RHI-supported AD plants is dependent on the counterfactual use of the feedstock and how the digestate is stored and applied to the land. Uncertainties around these factors have prevented quantification of the impact to date. The Government will work to improve the evidence available, to reduce this uncertainty.

37. Additional policy design considerations which are not captured in the impacts assessment include:

a. Reducing the risk of environmental impacts associated with the production of crops used in the energy sector (e.g. impacts on soil and water quality) by limiting support for food crops (see Chapter 4 and Questions 26 and 27 in Annex A of the Government response to the March 2016 consultation[10]).

b. Wider impacts on the waste, agriculture, and forestry sectors have not been captured, and therefore additional costs or benefits impacting these sectors have not been included. These could include costs such as local authorities' food waste collection, and benefits such as increasing UK's forested area.

38. Qualitative assessments of the impacts and net effect of these is included in Section 4: *Impacts Appraisal*, below.

[10] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

Section 3) Policy Options

3.1. Policy Options Assessed

39. The policy options considered in this impact assessment are:
    - Option 0: Counterfactual / Close the RHI
    - Option 1: Do nothing / Leave the scheme regulations as they were
    - Option 2: Reform the RHI (Preferred)

Option 0: Counterfactual / Close the RHI

40. In this IA the quantified costs and benefits of a reformed RHI scheme (Option 2) are estimated against a counterfactual where the scheme is closed to new applicants. In Section 4: *Impacts Appraisal*, the overall impacts of a reformed RHI are presented in terms of Government spend, generation of renewable heat, carbon savings, and an overall net present value (NPV). More detail on the counterfactual can be found below.

Option 1: Do nothing / Leave the scheme regulations as they were

41. Making no changes to the scheme would have left the RHI open with eligibility criteria, tariff levels, and degression triggers as they were prior to the RHI reforms. This could have led to the RHI exceeding its budget for 2017/18 and closure of the scheme to new applicants.
42. Making no changes would also mean leaving degression triggers fixed at their previous levels. Since several technologies were at or above their triggers, any of these technologies which had *any* deployment would see tariffs reduced rapidly. For instance, having a single application in a quarter could result in a degression of up to 25%. This makes it particularly difficult to assess precisely what would have occurred in this scenario.
43. Due to the outcomes described above, the costs and benefits of Option 1 have not been assessed in this IA. Leaving the RHI regulations as they were would have resulted in a highly unpredictable market for renewable heat with sharp adjustments to support levels, high sensitivity to price elasticities and market responses, and a higher probability of scheme closure to new applicants.

Option 2: Reform the Renewable Heat Incentive Scheme – Preferred

44. The option of reforming the RHI is the preferred policy option because it offers the best potential for the scheme to deliver its objectives while providing good value for money, ensuring that the scheme remains affordable and aligns with the Department’s wider objectives.
45. This policy option has two components:

a. The first package of changes was made in September 2017, focusing on budget controls and tariff changes to alleviate pressure on the RHI budget.

b. The second package will implement the more detailed policy changes to the regulations, as set out below, to take effect from 2018/19 onwards, subject to the successful passage of amending regulations through Parliament in early 2018. This includes: tariff and eligibility changes, introduction of tariff guarantees and assignment of rights, and establishing the budget management and degression triggers for the period.

46. Table 1, below, provides more detail on the changes included in Option 2. For additional detail on the marginal impacts of the different changes, please see Section 4.8.

47. For information on the basis for the changes to tariffs, eligibility, and budget management, as well as on how the policy proposal was altered as a result of consultation, please refer to the Government Response published in December 2016[11].

Table 1 - Final policy changes of the Reformed RHI

Change	Brief description
New Structure of Biomass Support	Focusing biomass support to provide the best value for money and better align with the Government's longer-term decarbonisation strategy. Moving from three non-domestic bands based on capacity, to a single band and making the scheme more attractive to larger, more strategic installations by structuring tariffs to promote higher heat load factors (HLFs). • Non-domestic: Tier 1 tariff of 2.96p/kWh, Tier 2 tariff of 2.08p/kWh after threshold of 35% of maximum output. The domestic tariff was 'reset' based on deployment evidence of what level of support would be sufficient to support further deployment and supply chain development at a level which represents value for money • Domestic 6.54p/kWh as of September 2017.
Support for Heat Pumps	Increasing domestic tariffs for Air Source Heat Pumps (ASHPs) to 10.18p/kWh and Ground Source Heat Pumps (GSHPs) to 19.86p/kWh, to better reflect the available evidence base. Extending eligibility for shared ground loops in the Non-Domestic Scheme. Mandating metering for domestic systems to help householders understand the performance of their systems (not for payment).
Tariff Guarantees	Improving the attractiveness to large investors by introducing tariff guarantees. This will provide certainty about tariff levels for investment decisions about large installations with long lead times.

[11] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

Change	Brief description
Targeted Anaerobic Digestion (AD) support	Focusing AD support for biomethane and biogas towards the feedstocks which are most consistent with delivering cost effective carbon abatement potential and optimal environmental outcomes, by: • Limiting payments for crop-based feedstocks to 50% by output volume. • Tightening criteria for eligible heat uses including removing payments for heat used to dry digestate. • 'Resetting' the Biomethane tariff to the level available between 1 April and 1 July 2016, and Biogas tariffs to the level available as of 1 October 2016, to isolate reformed delivery from further degressions caused by accrediting plant during the current transitional period. • Feedstock auditing for 1MWh and over.
Introduction of Domestic Heat Demand Limits	Promoting affordability, scheme robustness, and value for money by introducing heat demand limits to new participants, limiting the level of returns and potential for overcompensation for owners of larger properties. Set at 20,000 kWh/yr for ASHPs, 25,000 kWh/yr for biomass boilers, and 30,000 kWh/yr for GSHPs.
Assignment of Rights	Helping householders overcome the barrier of the initial capital cost of a renewable heating system and improving access to the scheme for consumers less able to pay by allowing householders to assign their right to RHI payments to a third party that has paid for all, or part, of their renewable heating system. The householder will still own the heating system.
CHP Power Efficiency	Ensuring that biomass-CHP plants producing a relatively small amount of power are not overcompensated and that payments represent value for money, by making receipt of the biomass-CHP tariff for all heat produced dependent on the plant having a power efficiency of 20% or above. Plant with a power efficiency of below 20% will receive the biomass-CHP tariff for a portion of their heat, with the remainder eligible for the relevant biomass heat-only tariff.
Eligible Heat Use Restrictions	Several changes to eligible heat to increase scheme value for money and reduce incentives to overconsume are being made, including: • Removing woodfuel drying as an eligible heat use, other than where it is replacing a fossil fuel heat source. There will be a transitional window for invested projects from the point of the government response[12] . • Removing the drying of waste from the scheme. • Tightening requirements in relation to supporting swimming pools. • Tightening requirements, imposing heat demand limits, and requiring metering for single domestic properties eligible for the Non-Domestic RHI.

[12] https://www.gov.uk/government/consultations/the-non-domestic-renewable-heat-incentive-further-proposed-amendments

3.2. Counterfactual Deployment

48. As noted above, the ‘do nothing’ option of leaving the RHI regulations as they were would have resulted in a highly unpredictable market for renewable heat with sharp adjustments to support levels and likely closure of the scheme to new applicants. Given the unpredictable impacts of leaving regulations unchanged, this option has not been used for the counterfactual.

49. Instead, for the consideration of the costs and benefits of deployment supported by a reformed RHI, a counterfactual where the scheme is closed to new applicants is used.

50. If the scheme were to close, it is likely that some low level deployment of low carbon heating technologies would continue as suggested through the RHI evaluation[13,14]. However, it is not possible to accurately assess the level of deployment which would occur without support, in particular because these markets have themselves been supported and expanded through the existence of the RHI.

51. As such, the impacts of the reformed RHI are presented against a counterfactual of no deployment of technologies supported by the RHI after October 2017.

52. Assessing the proposed refocused RHI against a scenario of no deployment also provides greater clarity on what we expect the reformed scheme to deliver. Assessing the proposals against theoretical counterfactual based on potential market response to a lack of reforms would be highly subjective and therefore less transparent. This also makes the preferred counterfactual a more appropriate benchmark against which to assess performance and benefits in the future.

53. From the perspective of individual installations, the counterfactual is the alternative technology which would have been installed instead of RHI-supported technologies. For the purpose of appraising scheme impacts, the mix of counterfactual heat sources and fuels being displaced by the RHI has been estimated.

54. Sensitivity analysis of our assumed counterfactual technologies for the NPV impacts is presented in Section 5, and explained in more detail in Annex C.

55. Note that, whilst a counterfactual of zero deployment is used in order to provide quantified costs and benefits of a reformed RHI, the ‘marginal impacts’ of individual policy changes/ reforms are described qualitatively in Section 4.8.

[13] RHI Domestic Evaluation: https://www.gov.uk/government/news/evaluation-of-renewable-heat-incentive-rhi
[14] RHI Non-Domestic Evaluation: https://www.gov.uk/government/news/evaluation-of-renewable-heat-incentive-rhi

Section 4) Impacts Appraisal

4.1. Main Impacts

56. This section presents the quantified costs and benefits of the RHI, and changes to RHI proposed in the preferred policy option. The costs and benefits include renewable heat generated, air quality impact, carbon savings and resource costs. Description of the costs and benefits assessed can be found in Section 2; uncertainty is discussed in Section 5 and Annex C.

57. Updates to previous analysis include updated evidence since the December 2016 publication as well as the additional policy changes as set out in Section 1.3. Evidence changes have been applied to estimated impacts of both committed and reformed deployment, though only reformed deployment is in scope for the NPV assessment.

58. Table 2 below sets out the key impacts of the RHI by when the deployment occurs:

    a. **Committed Deployment**: estimates of the costs and benefits of installations on the scheme up to the end of September 2017. These are not included in NPV assessment.

    b. **Reformed RHI**: the impacts of the proposed changes from October 2017 onwards, which are assessed in this IA. This is the period of the NPV assessment.

    c. **Total RHI impact:** the RHI impacts for both Committed and Reform RHI deployment, to estimate total scheme delivery. These are not included in the NPV assessment.

Table 2 - Headline impacts of the RHI

	Committed Deployment	Reformed RHI Deployment	Total RHI Impact
Period of Deployment	Nov 2011 - Sept 2017 (71 months)	Oct 2017 - Mar 2021 (42 months)	Nov 2011 - Mar 2021 (113 months)
Nominal Spending in 2020/21 [£m]	£850 m	£260 m	£1,110 m
Renewable Heat in 2020/21 [TWh]	15.8	5.7	21.4
CB4 Carbon Savings[15] [MtCO2e] (of which upstream)	23.5 (9.5)	11.8 (5.8)	35.3 (15.3)
NPV [Lifetime, real, discounted]	Not in scope	£30 m	Not in scope

[15] Total carbon savings, of which 95% is estimated to be in the Non-Traded Sector. See Section 4.6.

59. Reformed RHI deployment is estimated to support around 5.7 TWh of renewable heat in 2020/21, and abate up to around 12 MtCO2e over each of Carbon Budgets (CB) 4 & 5. In total, including existing deployment, the RHI is estimated to support over 21 TWh of renewable heat in 2020/21, and carbon savings up to around 35 MtCO2e over each of CB 4 & 5. The total estimated NPV of the reformed RHI is £30m.

4.2. Changes since the Previous IA

60. Since the December 2016 IA a number of changes have been made, in particular
    a. A different period of time covered by the reformed scheme: the previous IA covered 2017/18 to 2020/21, while it now covers Sept 2017 to end of 2020/21, with several reforms not coming online until the start of 2018/19.
    b. As a result to the changes in timing, there has been a change in the mix of projected deployment .
    c. Changes to actual deployment covering the period of 2016/17, previously 'interim' deployment covered by the Impact Assessment, and the first 5 months of the 2017/18 financial year.
    d. Changes to the evidence base are described in Section 2.1.

61. The overall impact of the updates on the headline figures are:
    a. Downward revision of the renewable heat estimated by around 0.6TWh.
    b. Downward revision of the CB4 carbon abatement potential by around 6Mt.
    c. Downward revision of the NPV of deployment covered from £1,344m to £30m.

62. Table 3 below, sets out the change in our assessment of spend and benefits since the December 2016 IA. Though the NPV has decreased as a result of the deployment mix and evidence changes described in Section 2.1 above, the current and previous IA cover different time periods so a direct comparison cannot be made.

Table 3 - Changes in headline figures since previous Impact Assessment

	December 2016 IA Estimate	Current Estimate
Additional Impact of New RHI Deployment		
Months of Deployment	60 months*	42 months
Nominal Spending in 2020/21 [£m]	£518m	£260 m
Renewable Heat in 2020/21 [TWh]	12.2	5.7
CB4 Carbon Savings [MtCO2e]	12.6 – 26.7	6.0 - 11.8
NPV [Lifetime, real, discounted]	£1,344 m	£30 m
Social Non-Traded Cost of Carbon [£/tCO2e]	£40/t	£58/t
Total RHI Impact		
Nominal Spending in 2020/21 [£m]	£1103 m	£1,110 m
Renewable Heat in 2020/21 [TWh]	22.1	21.4
CB4 Carbon Savings [MtCO2e]	20.4 – 41.6	20.0 - 35.3

* In the December 2016 IA new deployment was split into two periods: 'Interim' covering 2016/17, and 'Reform' covering 2017/18 to 2020/21. Both were part of the assessment of 'new deployment' and NPV.

63. The net impact of the updates is an overall decrease of the estimated NPV of around £1,300m. A large part of the change has been as a result of changing the appraisal period, and thus of total deployment covered. Other changes include updates to assumptions about the level of deployment, the mix of technologies and the fuels they displace, and changes to the air quality evidence base. These changes interact with each other so it not possible to calculate the exact impact of each change on the NPV. Table 3a therefore sets out an approximate estimate of the impact of each change.

Table 3a – Main changes to NPV since previous IA publication

Source of Impact	Approximate impact on NPV
Time Period Covered	A closer though not exact comparator for the time period used in this IA is the 'reform' deployment period of 2017/18 to 2020/21 in the December 2016 IA, for which the NPV was around £1,000m. **Impact of around -£340m**
Mix and Level of Deployment	Changes to the anticipated mix and total deployment owing to updates to the remaining budget headroom and updated estimates of market pipelines. **Impact of around -£380m**

Source of Impact	Approximate impact on NPV
Counterfactual Fuels Displaced	Changes to the mix of heating systems and fuels being displaced based on updated scheme evidence. Broadly corresponding to fewer oil systems and more gas systems being replaced. **Impact of around -£370m**
Changes to Air Quality Evidence	These include the updates to the NAEI database which had a large negative effect (see Annex B), offset by additional evidence on the emissions factors of non-domestic biomass systems supported by the RHI. **Impact of around -£180m**

4.3. Deployment and Spend

64. As described in Section 2 above, there is uncertainty around the level of deployment which will result from the package of policy changes being made. In this impact assessment, deployment projections are based on evidence from a number of sources.

65. The deployment seen under the RHI is critical to quantifying the potential benefits and costs of RHI as well as the changes proposed in the preferred policy proposal. Deployment potential is considered in two parts:
    a. Committed deployment that occurred up to the end of September 2017.
    b. Reformed RHI deployment from October 2017 to 2020/21.

66. As outlined above, it is deployment from October 2017 to 2020/21 which is covered in this Impact Assessment. Previous deployment is included to give an assessment of the overall impact of the RHI.

67. Three deployment sensitivities illustrate the impact of varying the estimate of deployment from October 2017 through 2020/21. This is within the scope of market potential and forms a central range of projected deployment. It does not consider tariff degressions resulting from higher deployment. More information is available in Annex B.
    a. **High:** this sensitivity shows the costs and benefits which would occur if the deployment increased until the full budget was spent over the final years.
    b. **Central:** BEIS central view on the likely deployment to occur over the period.
    c. **Low:** a lower estimate of possible deployment resulting from the changes to the scheme.

68. The scheme is managed against an overall budget cap which covers both domestic and non-domestic deployment, and both deployment already committed and new deployment over the forthcoming period. This means that there is likely to be an asymmetry to potential deployment, with downside impacts more likely to occur.

69. Table 4, below, shows the in-year spend estimates for each of the three sensitivities described above. Note that these only show changes in new deployment, while in

practice there is variation year on year due to changes in how owners use existing systems (which is not reflected here).

Table 4 - Nominal spend estimates under main deployment sensitivities

	2017/18	2018/19	2019/20	2020/21
Budget Cap	£780m	£900m	£1,010m	£1,150m
High	£735 m	£900 m	£1,010 m	£1,150 m
Central	£730 m	£870 m	£990 m	£1,110 m
Low	£725 m	£840 m	£940 m	£1,030 m

70. For deployment during the refocused RHI from April 2018 onwards, the degression triggers will be reset, and no degressions are projected to occur at the levels of deployment modelled in the central projection. However, should deployment occur with a different mix of technologies than estimated, degressions are possible. Within the central range of total deployment it is therefore possible that there are degressions.

71. Detailed discussion of the impacts of budget management and the possibility of scheme closure to new applicants are presented in the Government Response in Chapter 5 and in Questions 2 – 4 in Annex A. The detailed analysis is conducted on the central projections; however, the headline results for the central range of deployment sensitivities are shown in Section 5.2 below.

72. The RHI budget is an overall budget covering both deployment supported by changes proposed in the preferred policy proposal, but also spending on deployment from the scheme to date. The annual budget in each given year is therefore based on expenditure on any new deployment on top of expenditure from the plants already supported. Therefore, if deployment is lower than budget in previous years, there will be additional headroom for new deployment in subsequent years.

73. Figure 1, below, shows the in-year spend estimates for each of the three sensitivities described above set against the budget cap in chart form for illustration.

74. Table 5 below shows the technology-level breakdown of the spend profile projected under the central estimate of deployment over the spending review period. Additional detail on the levels of deployment projected for each tariff under the central estimate is provided in Annex B.

Figure 1 - Estimated nominal spend compared with budgets in each financial year

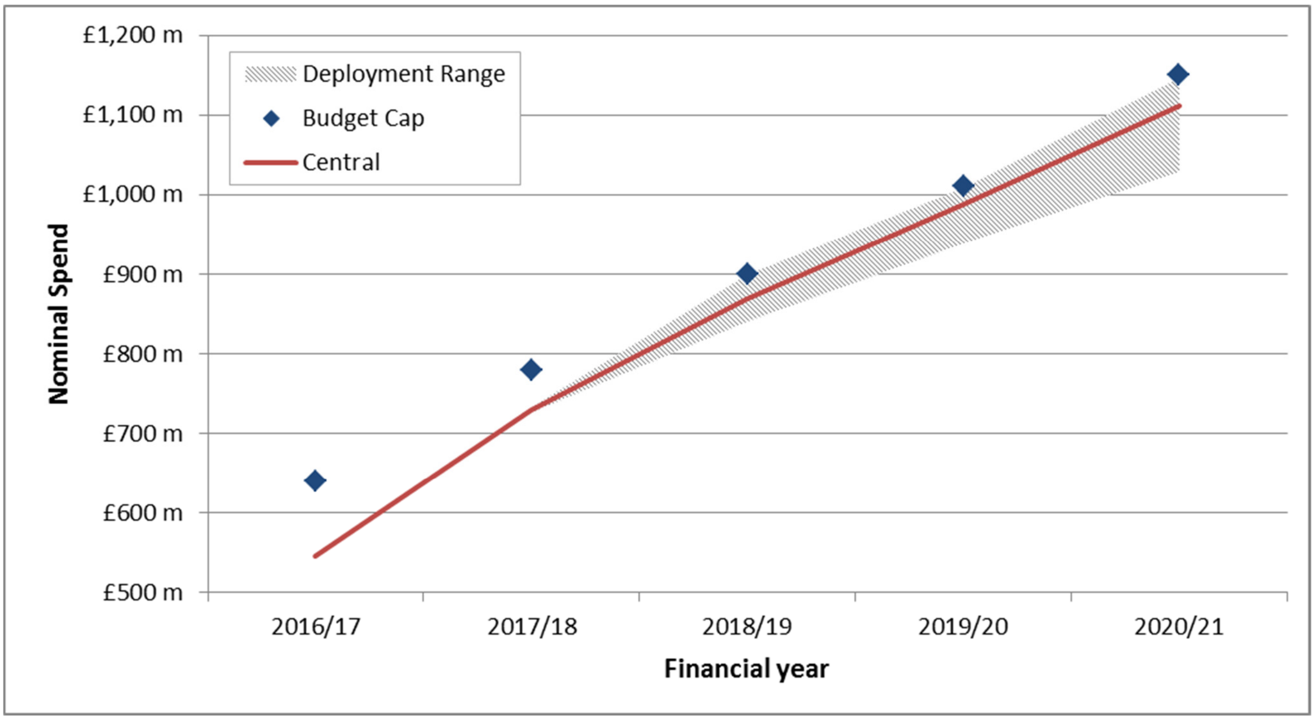


Table 5 - Central deployment spend breakdown over Spending Review period

	Nominal Expenditure in Year (£m)			
	2017/18	2018/19	2019/20	2020/21
Biomass	£4 m	£35 m	£50 m	£90 m
Anaerobic Digestion	£3 m	£30 m	£75 m	£115 m
Heat Pumps	£2 m	£15 m	£30 m	£50 m
Other	<£1 m	<£1 m	£2 m	£3 m
Reformed RHI Deployment	£10 m	£80 m	£160 m	£260 m
Committed Deployment	£720 m	£790 m	£830 m	£850 m
Total RHI	£730 m	£870 m	£990 m	£1,110 m

Note: Figures may not sum due to rounding.

4.4. Renewable Heat Supported

75. With the level of spending on the various technologies and the tariff proposals as described, the scheme is estimated to support approximately 5.7TWh of additional renewable heat by 2020/21.

76. Table 6 below provides estimates of the renewable heat generation in 2020/21 broken down by interim deployment, deployment under the Reformed RHI, as well as the total impact of the RHI (including previous deployment).

77. Different technologies differ in what proportion of heat delivered is eligible for Renewable Energy Directive (RED) purposes. For example, for biomass, the RED definition is on the basis of total input energy, rather than output energy.

Table 6 - Renewable heat supported in 2020/21

	Committed Deployment (up to Sept 17)	**Reformed RHI Deployment** (Sept 2017 – 2020/21)	**Total RHI Impact** (incl. existing plant)
Biomass (<1MW / ≥1MW)	11.0 TWh (8.6 / 2.4)	3.0 TWh (1.2 / 1.8)	13.9 TWh (9.8 / 4.2)
Anaerobic Digestion	4.6 TWh	2.3 TWh	6.9 TWh
Heat Pumps	0.2 TWh	0.3 TWh	0.6 TWh
Other	<0.1 TWh	<0.1 TWh	0.1 TWh
Total (Domestic / Non-Domestic)	**15.8 TWh** (0.6 / 15.1)	**5.7 TWh** (0.3 / 5.3)	**21.4 TWh** (1.0 / 20.5)

4.5. Greenhouse Gas Abatement

78. The greenhouse gas abatement which these proposals might support is dependent on the amount of heat supported by the RHI, the fossil fuel systems replaced, the feedstock used, and the efficiency of the systems. Table 7, below, provides a breakdown of the carbon savings estimated to be supported over Carbon Budget 4 (2023 - 2027), through deployment under the Reformed RHI as well as the total impact of the RHI including previous deployment. Similar levels of abatement are estimated over Carbon Budget 5 (2028 - 2032). These carbon savings represent the lifecycle emission abatement, so as to properly take into account the carbon emissions from biomass.

79. A large proportion of the savings arise from biomethane and biogas, largely due to upstream savings. Upstream savings are those which result from the avoidance of emissions which would have occurred if the feedstock had been put to a different use (rather than those avoided at the point of fuel combustion). For example, food waste, which is used in anaerobic digestion, might have ended up in landfill where it would have decomposed into methane – a very potent greenhouse gas. Using it in AD instead means that in addition to avoiding the emissions from the fossil fuel combustion, the emissions from the decomposition of the food waste into methane are also avoided.

80. However, there is significant uncertainty associated with the estimated carbon abatement which will result from upstream emissions abatement associated solely with the RHI. On balance, the uncertainty means the figures presented here for upstream savings should be interpreted as an upper bound, as shown in the sensitivity analysis in Section 5.2. This is because emerging evidence suggests that availability of feedstocks could limit overall deployment of the AD plant with the most carbon saving potential. Consideration of additional measures to increase the collection of unavoidable food waste, especially household food waste, would improve the likelihood of achieving

upstream savings. The counterfactual disposal of the feedstock is also highly uncertain. In the case of food waste, it is assumed that it is diverted from landfill, however, it may have been diverted from other uses (e.g. composting), which would result in fewer carbon savings. In addition, waste sector policies also impact the disposal of food waste to landfill, raising issues of attribution of upstream savings. Further discussion is provided in Annex C.

81. The table below shows the estimated carbon abatement over CB4 split out by technology and period of deployment. Additionally, the total savings from upstream emissions abatement for anaerobic digestion are separated out for clarity, because of the greater uncertainty.

Table 7 – Carbon abatement over CB4 in MtCO2e

	Committed Deployment (up to Sept 17)	**Reformed RHI Deployment** (Sept 2017 – 2020/21)	**Total RHI Impact** (incl. existing plant)
Biomass	9.5	2.6	12.1
Anaerobic Digestion (of which upstream)	13.6 (9.5)	8.3 (5.8)	21.9 (15.3)
Heat Pumps	0.4	0.8	1.2
Other	<0.1	0.1	0.1
Total (Traded/Non-Traded)*	23.5 (1.2 / 22.3)	11.8 (0.6 / 11.2)	35.3 (1.8 / 33.5)

* These splits are provided because only carbon savings in non-traded sectors (i.e. sectors not covered by the EU emissions trading scheme) count towards UK Carbon Budgets.

Table 8 - Profile of carbon savings over time in MtCO2e

(upstream savings in parentheses)	**CB3** (2018 - 2022)	**CB4** (2023 - 2027)	**CB5** (2028 - 2032)	**Lifetime**
Committed Deployment up to Sept 2017	23.3 (9.2)	23.5 (9.5)	23.1 (9.5)	91.7 (36.4)
Reform RHI Deployment Sept 2017 - March 2021	7.9 (3.8)	11.8 (5.8)	11.8 (5.8)	45.5 (22.1)
Total RHI Impact [Traded / Non-traded]	31.3 (13.0) [1.6 / 29.7]	35.3 (15.3) [1.8 / 33.5]	34.9 (15.3) [1.7 / 33.2]	137.3 (58.5) [6.9 / 130.4]

4.6. Monetised Costs and Benefits

82. The components of the NPV calculation are shown in more detail below. These are based around our central deployment scenario. NPV calculations are based on discounted values cumulative over the policy lifetime.

83. There is uncertainty around the benefits the RHI is likely to deliver for a variety of reasons including: the unknown deployment and performance of systems in this emerging market; not knowing the mix of deployment which may come forward; not knowing the mix of feedstocks that will be used, or how systems will be used by owners; and uncertainty over the carbon and air quality impacts. NPV should therefore be treated with caution and with consideration of the principle sensitivities presented in Section 5.2.

84. The NPV of the Domestic Scheme remains negative. This should be viewed in the context of the scheme's contributions to the non-monetised costs and benefits which the NPV is not able to capture but which should, if valued, have overall beneficial impacts. These are discussed further below.

Table 9 - Central NPV of new RHI deployment occurring during this spending review

	Resource Cost	Value of CO_2		Air Quality Benefits	NPV
		Traded	Non-traded		
Reformed RHI (Sept 2017 - March 2021)					
Non-Domestic	-£2,570 m	£90 m	£2,380 m	£150 m	£60 m
Domestic	-£260 m	£10 m	£160 m	£70 m	-£30 m
Total Reform Period	**-£2,830 m**	**£100 m**	**£2,540 m**	**£220 m**	**£30 m**

Note: Figures may not sum due to rounding.

4.7. Non- Monetised Costs and Benefits

85. As outlined in Section 2.5, there are a number of scheme impacts which cannot be quantified. Our overall qualitative assessment of the likely direction of impacts is set out in the table below; this assessment has not changed since the previous publication.

Table 10 - Impact of non-monetised costs and benefits

Non Monetised Impact	Likely impact on NPV of scheme reforms if quantified
Renewable Heat Generation	Positive – contribution currently not monetised
Innovation & Cost Reductions	Positive – improvements to technologies and cost reductions
Rebound Effect	Uncertain / mixed – potential reduced carbon savings with increased welfare benefits.

Electricity System Impacts	Negative - increased costs if all costs of expanding the grid as a result of greater heat pump take-up are not fully factored into electricity prices.
Environmental Impacts	Negative – some increased costs from unintended environmental impacts possible, for instance, due to land use change not being reflected in sustainability criteria. This risk is reduced as a result of scheme changes
Ammonia Release	Negative – air quality impacts of ammonia released from spreading digestate may be significant if the AD plants' waste feedstocks would otherwise be sent to landfill. However, these emissions might be able to be mitigated at a lower cost, suggesting the benefits of RHI might not be as large.
Food Waste Collection Costs	Negative – possible additional resource costs from food waste collection and separation are not reflected here.

86. Given the positive monetised NPV of the reformed scheme as a whole, the overall impact, combined with the non-monetised costs and benefits, is still likely to support the objectives of the policy and goals of the reform.

4.8. Marginal Impacts of Changes to the RHI

87. This section considers each proposed policy change in turn. In this section only, the consideration is against a counterfactual of the scheme remaining open but the individual change not having been applied – i.e. the marginal change of the policy proposal. Each table below qualitatively describes the impact of a change in terms of:
    a. Renewable heat generation
    b. Carbon savings
    c. Renewable heat/ carbon cost-effectiveness – the amount of renewable heat generated and/ or carbon saved per £ spent.

88. For a discussion of the evidence and responses received during consultation, refer to the December 2016 Government Response[16].

Table 12 – Marginal impacts of the new structure of biomass support

	Likely impact of reform
Renewable Heat Generation	The new structure of biomass support is expected to rebalance the scheme towards larger more cost effective plants. There may be an initial slowdown in the growth of renewable heat due to less small/ medium biomass, though long term the impact is expected to be positive. This is because of the strategic long term value of large biomass; it can deliver process heating (which is hard to decarbonise using other technologies) or support heat networks.

[16] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

Carbon Savings	In the short term, the direction of impact on carbon abatement is likely to be negative as lower tariffs for small and medium biomass systems lead to lower deployment for these measures (which have dominated RHI spend to date). However, in the longer term the level of carbon savings delivered by the RHI could increase. This is because the reform should make more RHI budget available for other technologies, such as heat pumps and biogas technologies, which are expected to play a more important role in the long term decarbonisation of heating, and for large biomass and biomethane which have better carbon cost effectiveness (mainly due to economies of scale relative to other smaller technologies).
Renewable Heat/ Carbon Cost-Effectiveness	The previous higher tariffs for small and medium biomass meant that they provided lower value for money (in subsidy terms) compared to large biomass. By equalising tariffs for all sizes of biomass system, the RHI will more cost-effectively deliver renewable heat and carbon savings per £ of government support will be higher. 'Social cost-effectiveness' could also improve as larger plant will benefit from economies of scale and could produce renewable heat (and associated carbon savings) more cheaply.

Table 13 – Marginal impacts of increased support for heat pumps

	Likely impact of reform
Renewable Heat Generation	Increased support for heat pumps is anticipated to lead to growth in the market with a consequential positive impact on renewable heat generation. In addition, the mandating of metering for domestic systems should encourage better performing systems with further positive impact on renewable heat generation.
Carbon Savings	As noted in Table 12, heat pumps are expected to play an important role in the long term decarbonisation of heating. This is particularly true for off-gas grid areas. This reform to the level of support for heat pumps is considered to have a positive long term impact on carbon abatement.
Renewable Heat/ Carbon Cost-Effectiveness	Heat pumps represent lower value for money in terms of renewable heat and carbon cost-effectiveness compared to other technologies supported on the scheme. The level of their deployment remains low; overall, there will likely be a small reduction in cost effectiveness as a result of increased HP deployment. However, heat pumps remain part of the future mix of low carbon heating and supporting deployment now will help bring costs down in future.

Table 14 – Marginal impacts of targeted anaerobic digestion (AD) support

	Likely impact of reform
Renewable Heat Generation	The resetting of the biomethane and biogas tariffs should lead to increased deployment of these technologies and, as a result, increased renewable heat generation. However, the proposed policy change would disincentivise the deployment of plants using agricultural feedstocks and so may lead to reduced deployment rates for those types of plant. Nevertheless, overall market intelligence suggests that these reforms will lead to greater deployment and increased renewable heat generation.
Carbon Savings	The proposed policy changes should increase the level of carbon abatement by incentivising the types of renewable heat generation that deliver more carbon savings per unit of heat. Therefore, every £ of RHI budget will be associated with a higher volume of carbon abatement. Furthermore, the overall impact on renewable heat generation is anticipated to be positive which will support further carbon emissions reductions.
Renewable Heat/ Carbon Cost-Effectiveness	Targeted AD support will lead to more cost effective carbon abatement. As a feedstock for biomethane production food waste is estimated to be considerably more carbon cost-effective than agricultural feedstocks, due to 'upstream' emissions abatement that is assumed to occur as a result of diverting food waste from landfill. In terms of removing digestate drying as an eligible heat use, this should also lead to more cost effective carbon abatement. Drying digestate may have significant disbenefits in circumstances where the release of ammonia through the evaporation of water causes significant greenhouse gas emissions.

Table 15 – Marginal impacts of tariff guarantees

	Likely impact of reform
Renewable Heat Generation	Providing certainty on tariff levels guarantees can be expected to increase investment in, and deployment of, larger renewable heat projects. Consequently, a positive impact on renewable heat generation is expected.
Carbon Savings	The long term impact of tariff guarantees on carbon abatement is expected to be positive. They will promote deployment of larger renewable heat projects of the type that will deliver process heating or support heat networks. These types of heat demand are difficult to decarbonise with other low carbon heating technologies.
Renewable Heat/ Carbon Cost-	Large plants can benefit from economies of scale and therefore produce heat more cheaply. As such, tariff guarantees may lead to more cost effective generation of renewable heat and carbon abatement. Additionally, they should allow investors to make better long-term decisions, to invest in the most efficient

Effectiveness	equipment and to commission the plant without speeding up progress to avoid tariff degressions. This should also support more cost effective production of renewable heat.

Table 16 – Marginal impacts of domestic heat demand limits

	Likely impact of reform
Renewable Heat Generation	The introduction of domestic heat demand limits will make renewable heat installations a less attractive proposition for larger households. In this respect the reform may negatively impact on renewable heat generation. However, bundled with the other reforms of increased heat pump tariffs and assignment of rights, the imposition of heat demand limits could free up RHI budget for renewable heat installations in smaller properties. This could offset any decline in uptake amongst larger properties and lead to an overall neutral or positive impact on renewable heat generation.
Carbon Savings	Similar to the impact on renewable heat generation the impact on carbon savings is uncertain. Carbon savings could decrease or increase, though they are unlikely to significantly change in either direction.
Renewable Heat/ Carbon Cost-Effectiveness	This reform should improve the cost-effectiveness of the delivery of renewable heat and carbon savings. Heat demand limits will reduce the risk of overcompensation of larger systems (which have proportionately lower capital costs and so do not require as much support) and thus lead to a value for money improvement.

Table 17 – Marginal impacts of assignment of rights (AoR)

	Likely impact of reform
Renewable Heat Generation	AoR should increase demand for renewable heat technologies by helping the least able to pay overcome the upfront costs of the equipment and installation. Therefore, this reform is likely to have a positive impact on renewable heat generation.
Carbon Savings	Since renewable heating installations typically offer carbon savings compared to conventional technologies, increased deployment of renewable technologies should lead to more carbon abatement.
Renewable Heat/ Carbon Cost-Effectiveness	AoR could more cost effectively deliver renewable heat/ carbon savings. This is because of 'rent seeking' from the supply chain who may have an incentive to find and deliver more cost effective installations (that is, the average resource cost per installation could be expected to fall). Overall, this impact on the scheme will likely be small.

Table 18 – Marginal impacts of CHP power efficiency threshold

	Likely impact of reform
Renewable Heat Generation	Overall, the proposed change could mean lower total deployment of biomass-CHP plant over the relevant period than if the previous threshold of 10% was left unchanged. The reduction is likely to be of the order of 0.2 TWh to 0.3 TWh of heat generation per year.
Carbon Savings	Based on assumed deployment assumptions above, this would result in a loss in benefits from the proposed change of around 0.3MTCO2e less non-traded carbon abatement over Carbon Budget 4.
Renewable Heat/ Carbon Cost-Effectiveness	CHP is one of the most energy efficient ways of using biomass fuels to generate heat and power. Compared to the separate generation of heat and power, biomass-CHP plants require less fuel use, thereby causing less carbon emissions. The CHP power efficiency threshold will ensure further support is focused on efficient installations and will improve the cost-effectiveness with which renewable heat and carbon savings are delivered.

Table 19 – Marginal impacts of the changes to eligible heat uses

	Likely impact of reform
Renewable Heat Generation	The changes to eligible heat uses are designed to exclude certain practices which were judged to be poor value for money for the scheme. These changes are expected to lead to lower renewable heat generation overall, although this could be partially offset by more budget being available for other applicants.
Carbon Savings	These changes will reduce the incentives for participants to generate more renewable heat than they would have using fossil fuels. RHI supporting consumption over the level which would occur without the RHI would not lead to additional carbon savings as it would not be displacing heat produced by fossil fuels. These changes will make the RHI more focused on displacing the use of fossil fuels, and so increase carbon savings.
Renewable Heat/ Carbon Cost-Effectiveness	This change will improve the cost effectiveness of carbon savings by reducing payment for wasteful overconsumption and better targeting the RHI at displacing fossil fuels. It is not expected to change the cost effectiveness of renewable heat generation.

Section 5) Uncertainty

5.1. Main Sources of Uncertainty

89. The market for renewable heat technologies is still in a relatively emerging state in the UK which means that data, evidence, and understanding of the technologies remains uncertain. This also means that market sizes and consumer awareness can change rapidly. The evidence on cost and performance can have large ranges for the same types of applications and varies from source to source.

90. The main sources of uncertainty can be best understood as affecting three key questions which need to be answered to set policy and determine the costs and benefits for the purpose of policy appraisal:

1. What is an appropriate level to set tariffs? → 2. How much deployment will there be of each technology? → 3. What benefits will be derived from the level of deployment seen?

91. The uncertainty affecting each of these has knock-on effects for each subsequent question. For example, if tariffs are not set correctly (either too low or too high) this will affect the likely deployment. Likewise, the main driver of the total benefits of the scheme (such as renewable heat generation supported) is the level of deployment. The principal uncertainties affecting each of these areas are summarised in Table 20.

Table 20 - Main sources of uncertainty

Uncertainty which affects tariff setting
Tariff setting is affected by the large amount of heterogeneity in heating systems. Both heat demand and renewable heat installations are extremely varied. This is particularly true in the non-domestic sector. For example, the cost per unit of heat varies considerably for a single technology, depending on factors such as location, heat load, size, and user behaviour. There is thus significant uncertainty about the appropriate level of tariff to offer. For example, the data on cost and performance can be combined in a number of ways which leads to a wide range of potential appropriate tariff levels.
Uncertainty in estimating deployment
The factors which lead households and firms to install renewable heating systems are not consistent or predictable. They are dependent on factors outside of the control of Government through this policy, such as fossil fuel prices. Coupled with the uncertainty about the cost and performance of technologies, this means that technical potential and likely deployment are very uncertain. As the RHI is a demand-led scheme, it is difficult to anticipate the level of deployment which will come forward as a result of the scheme reforms. Additional uncertainty comes from the potential changes in the market (e.g. variations in fossil fuel prices), and from interactions with other policies (e.g. support for renewable electricity is a competitor of solar thermal, but required for CHP).

Uncertainty of the costs and benefits deriving from deployment

The level of aggregate benefits will principally be determined by the total deployment and the mix of technologies. However, for any given level of deployment, there are a number of uncertainties remaining for quantifying the benefits which will accrue to the scheme. For example, the carbon savings of any renewable heat installation will depend on: the type of system which was replaced, the efficiency of the system, and how it is used. The latter is affected by changes in business conditions or the weather and the extent to which businesses ramp-up production over time – a particular uncertainty for biomethane production.

The largest source of uncertainty over carbon abatement for a given level of deployment is the upstream emissions saving based on the feedstocks used in AD and what would have occurred to the feedstock had it not been used in AD. However, a related uncertainty is the ammonia released from spreading the digestate on farmland, where the net impact depends on whether the feedstock is being diverted from a different source which also releases ammonia; this uncertainty has prevented its quantification to date.

Additional uncertainties include the lifecycle emissions from biomass (which are subject to a high degree of uncertainty and depend on sourcing) and the level of decarbonisation of the electricity grid. There is additional uncertainty about deployment in the final period of the scheme as it will be driven in part by what the policy landscape looks like post 2020/21, as installers enter or exit markets in anticipation of future changes.

92. For both tariff setting and deployment, market intelligence and stakeholder views expressed through consultation responses have been used to offer a more complete picture than our modelling, analysis, and data offer. In addition, the 6 years of experience with the operation of the scheme and the learning that has taken place from the reaction of markets to different changes in the past have been considered. The following sections outline the approach taken to appraisal for this IA given the challenges set out above.

5.2. Key Analysis Sensitivities

93. For reasons previously outlined in this Impact Assessment, there is uncertainty in many elements of this analysis. This section looks at the impact of the main uncertainties on NPV, carbon abatement and renewable energy generation.

The sensitivities shown below are only for the deployment included in this assessment, i.e. from October 2017 to March 2021. Sensitivities related to deployment previous to that period are not in scope of this Impact Assessment. More information on all the sensitivities can be found in Annex C.

94. The main sensitivities presented are:

a. **Central deployment range:** high/low impact on the scheme of around 15% higher overall deployment (resulting in hitting the budget cap in 2020/21) and 35% lower overall deployment, respectively.

b. **Low deployment:** a very low deployment scenario, representing an overall shift in the policy landscape demand for renewable heat technologies (RHTs), showing a roughly 50% drop.

c. **High counterfactual deployment:** impact of assuming around 30% of the renewable heat installations would have been installed even without the RHI.

d. **Carbon abatement potential from the system:** high/low savings due to system efficiency and carbon intensity variations, which result in a roughly 45% increase or 35% decrease in emissions abatement.

e. **No upstream AD savings:** this excludes upstream carbon emissions savings from biomethane or biogas feedstocks, such as food waste, which would otherwise go to landfill. This results in an approximately 50% reduction in carbon abatement.

f. **Carbon prices:** high/low variation in the monetised cost of carbon, as detailed in BEIS's carbon price projections. The variation in price is roughly +/- 50%.

g. **Air quality:** high/low variation in the monetised cost of NOx & PM emissions. Detailed assumptions can be found in Annex B: Appraisal Assumptions. The change in damage cost of NOx is roughly +/- 60%, while for PM it is +/- 15%.

h. **Heat pump performance:** high/low variation of the proportion of heat pumps which meet the minimum accounting requirements for RED, roughly +/- 10%.

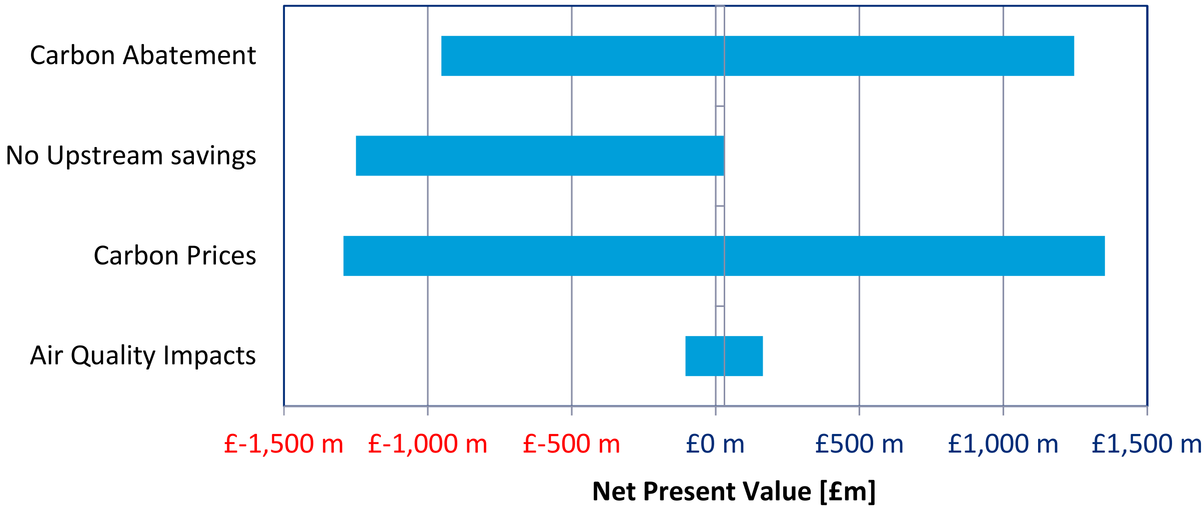
95. Table 21 and Figure 2 below illustrate the main impact of the sensitivities on the calculation of NPV. As these figures show, the principal sensitivities relate directly to the carbon abatement and its monetisation. This is because the principal benefit in the NPV calculation is the carbon value (see Section 4.5). Therefore, the two sensitivities which change the estimate of the amount of carbon abated – Carbon Abatement and No Upstream Abatement – impact this directly, as do the value attached to the carbon saved.

96. The level of deployment seen in the RHI over the period to 2020/21 will be a major factor in determining whether the scheme is successful. It will impact directly on the benefits achieved in the form of renewable heat generated and carbon abated. However, renewable heat is not a component of the NPV calculation, and furthermore when deployment is scaled up or down both the costs and benefits scale roughly in proportion. This means that NPV is less sensitive to overall deployment than to changes that affect only the benefits component of the calculation.

Table 21 - Sensitivity of NPV calculation

	Low	Central	High
Central Deployment Range	£20 m	£30 m	£35 m
Low Deployment	£10 m		N/A
Counterfactual Deployment[17]	£30 m		N/A
Carbon Abatement	-£950 m		£1,250 m
No Upstream savings	-£1,250 m		N/A
Carbon Prices	-£1,290 m		£1,350 m
Air Quality Impacts	-£100 m		£170 m

Figure 2 - Breakdown of principal NPV sensitivities



97. The sensitivities shown above are not additive and cannot be combined to create additional scenarios. However, it is possible that some of the variation could be correlated. For example, if installations are of low quality, this is likely to reduce the carbon abatement they will achieve, increase the harmful pollutants associated with air quality and increase the resource cost as they will not last the 20 years assumed.

98. This analysis of the NPV illustrates the uncertainty around the monetised benefits the RHI could deliver. For the purpose of IA appraisal, the range presented has been from the lowest to the highest of the sensitivities above. There are several sensitivities which would see the NPV become negative; however, not proceeding with the RHI could mean not meeting legal obligations under RED or Carbon Budgets.

99. More detail on the sensitivities assessed and their impacts on the carbon abatement and renewable heat generated are provided in Annex C.

[17] Counterfactual deployment reduces benefits and costs, so the impact is minimal.

Annex A) Evidence Base

Major Sources of Evidence

100. This annex provides an overview of the main sources of evidence used when analysing tariffs, returns, and appraising the costs and benefits of the scheme; it is not an exhaustive list. Additional information on evidence related to areas where there have been policy changes since the consultation proposal can be found in the sections below. More detail on the evidence used for policy proposals which have not changed since consultation can be found in the consultation stage Impact Assessment[18].

Table 22 - Main sources of evidence

Source	Description
Ofgem RHI Scheme Data	The administration of the scheme provides detailed information regarding the types of installations supported by the scheme. This is used to inform the design of the scheme as appropriate.
Market Intelligence	Through direct industry contact and through established channels such as the Industry Advisory Group, BEIS gathers market intelligence to support the development of policy and interpretation of evidence to inform scheme design.
Sweett Cost and Performance Report (2013)	Evidence collated on the cost, performance and use of low carbon heating systems.
Renewable Heat Premium Payment (RHPP) Metering Evidence	In-situ performance evidence for heat pumps supported under the RHPP.
NERA/AEA Report (2009 onwards)	Wide review of cost and performance of low carbon heating technologies in the domestic and non-domestic sector.
Evidence Collated from Previous Schemes	BEIS has previously run several heat schemes. Where possible, evidence from these has been used to inform the RHI evidence base, such as RHPP. This includes cost and performance data.
Industry Evidence Received During Consultations	During calls for evidence or consultation on changes, industry often provides evidence on a wide range of issues and questions. This

[18] https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

	includes data on costs, deployment and performance. BEIS publishes summaries of the evidence received during consultation in Government Responses[19].
Additional Engineering Consultancy Reports	BEIS engineers commission reports to address specific evidence gaps. Where possible, these are published on BEIS's website. These include reports on performance.
Air Quality Emissions and Damage Costs	Official guidance provided by Defra on the uses of emission data from the National Atmospheric Emissions Institute (NAEI) database, as well as the values to be used when valuing costs. Further information provided in Annex B.
Carbon Prices	Projections of carbon prices, both traded and non-traded, as provided within the Green Book guidance[20].
Emissions Values	Collation of work produced by BEIS scientists and engineers in quantifying carbon emission factors of RHT. Sources have remained the same from the Consultation Stage Impact Assessment.
Evidence on Availability of Feedstocks	Information on the availability of different feedstocks for biomethane and biogas has come from Defra and from WRAP. This information has been supplemented by evidence from the consultation as well as from stakeholders involved in the supply chain.

Tariff Setting

101. Tariffs are set to compensate businesses and households for the additional costs of installing renewable heat technologies compared to conventional heating technologies such as oil or gas (for non-domestic) fuelled systems. This takes into account additional capital costs, differences in operating and fuel costs, as well as a rate of return assumed to be required to compensate for the opportunity cost of funding the installation of the measure. Differences between the domestic and non-domestic tariffs are shown in Table 23 below:

[19] Links to RHI Consultations and Government Responses for both the Domestic and Non-Domestic scheme are at: https://www.gov.uk/government/publications/renewable-heat-incentive-policy-overview
[20] https://www.gov.uk/government/collections/energy-generation-cost-projections

Table 23 - Differences between domestic and non-domestic tariffs

Property	Domestic Scheme	Non-Domestic
Period payable	7 years	20 years
Rate of return on additional investment when setting tariff level	7.5%	12%
Payment basis	Deemed renewable heat output (metering required for bivalent systems and second homes)	Metered total heat output for eligible heat uses
Payment timing	Quarterly in arrears (following submission of meter readings for metered systems)	Quarterly in arrears when meter reading provided.
Degression	Tariffs can be reduced (degressed) if spending hits certain triggers; these are discussed further in the benefits management section.	
Other requirements (examples)	Microgeneration Certification Scheme (MCS) certification; Energy Performance Certificate and loft and cavity wall insulation where appropriate; Sustainability requirements for biomass installations; Metering standards.	Various (e.g. Coefficient of performance (COP) levels for heat pumps and design standards); Combined Heat and Power Quality Assurance (CHPQA) certification for Combined Heat and Power (CHP) systems); Sustainability requirements for biomass, biogas and biomethane installations; Metering standards.

102. In previous Impact Assessments, tariff setting was based on incentivising 50% of the supply curve of renewable heat. The objective of this method was to avoid overcompensation while also setting the tariff that would work for a reasonable proportion of technical potential. This method, however, required a high bar of evidence for cost and performance, but also the potential market size. This results in a high degree of uncertainty, particularly for non-domestic buildings.

103. The new tariff setting methodology retains the same overall objective as the previous one, but does recognise the evidence limitations. It uses the cost and performance information available to create a range of tariffs for different types of installation and targets what is anticipated to be the median installation.

104. This approach allows greater clarity about the potential impact of tariffs. For example, for various installations, this method matches policy objectives more closely and properly captures the benefits and impacts of issues such as capping payments.

105. Table 24 below sets out which tariffs have been set using the current or previous methodology, or where other considerations have been taken into account.

Table 24 - Tariff setting description for each technology

Technology		Tariff Setting Rationale	Notes
Non Domestic	Solid Biomass Boilers	Reset to target RoR	Tariff set to target large installations, with tiering thresholds set above previous levels to minimise difference between tier 1/2 tariffs, lower gaming potential, and encouraging higher HLF installations.
	CHP Biomass	Previously set to target RoR	
	Biomethane	Reset with deployment evidence	'Reset' tariff in April 2017 to the April 2016 level to ensure to degressions during bubble limit deployment of refocused (better carbon) scheme.
	Small Biogas	Previously set to target RoR	'Reset' tariff in April 2017 to the October 2016 level to ensure to degressions during bubble limit deployment of refocused (better carbon) scheme; and to ensure alignment with FITs tariff adjustments for the same period.
	Medium Biogas		
	Large Biogas		
	Ground Source HPs	At VfM cap	Shared loop analysis – limited evidence, but indication of limited risk of overcompensation.
	Air to Water HPs	Previously set to target RoR	
	Small Solar Thermal	At VfM cap	
	Deep Geothermal	Previously set to target RoR	
Domestic	ASHP	Reset to target RoR	Heat demand limit (HDL) accounted for in tariff and when assessing returns.
	Biomass	Reset with deployment evidence	'Reset' tariff in April 2017 to the Dec 2015 level, to take account of deployment evidence of what is needed for a viable market size. HDL accounted for in average return.
	GSHP	At VfM cap	HDL accounted for in average return calculations
	Solar Thermal		

106. In addition to the tariff level, there are other tools for limiting overcompensation. These include degression for all technologies, proposed caps on payments in the Domestic Scheme, tiering in the Non-Domestic Scheme. Taken together, these provide assurance on overcompensation risks.

Annex B) Appraisal Assumptions

Resource Costs

107. As noted within the monetised cost and benefits description in the main document above, one of the main variables affecting the calculation of the Net Present Value is the 'resource cost'.

108. The resource cost is intended to represent the true additional cost to the economy of an investor installing a renewable heating technology; it should strip out the transfer of benefits to the installer that is received from the overall subsidy cost. Our analysis is based on the same population assumed for tariff setting, i.e. the whole potential market.

109. The resource costs are estimated as a percentage of the relative tariff differing for each technology, which also means that they can change over time as tariffs change. For illustration, the level of resource cost per unit of heat generated for the reformed scheme period of 2017/18-2020/21 is given in Table 25 below. However, as the RHI is a demand-led scheme, it is likely that those people who choose to come forward are those for whom the scheme is most beneficial.

Table 25 - Reformed RHI resource cost estimates

Scheme	Technology	Reformed RHI Resource Cost [£ 2017/18] [p/kWh]
Non-Domestic	Small Solid Biomass Boiler	1.68
	Medium Solid Biomass Boiler	1.65
	Large Solid Biomass Boiler	1.53
	GSHP/WSHP	7.26
	Small Solar Thermal	10.44
	Small Biogas	4.50
	Biomethane	3.79
	Medium Biogas	3.53
	Large Biogas	1.32
	CHP- Biomass and Bioliquids	4.29
	Deep Geothermal	5.22
	ASHP	2.61
Domestic	ASHP	6.14
	Biomass	5.19
	GSHP	11.04
	Solar Thermal	20.60

Deployment

110. The majority of deployment to date seen under the RHI has been in the bioenergy market. For Non-Domestic RHI, this has been small biomass (<199kW) and biomethane, and to a lesser extent medium biomass (200-999kW). Within the Domestic RHI, biomass has also seen the largest spend by technology for new installations.

111. Our estimates of the potential market size of each technology have been revised in light of evidence received during the consultation as well as through additional stakeholder engagement. This has also included revising our understanding of the profile of deployment, which has been taken into account in the deployment sensitivities presented in the main analysis above.

112. There remains a high degree of uncertainty around the deployment profiles, particularly regarding how markets react to the increased certainty of the RHI continuing, as well as market response during 2016/17 and reaction to the proposals outlined in this consultation.

113. The table below presents a summary of an illustrative market size which would be consistent with the central deployment projection presented in this Impact Assessment. It should be noted that in reality the number, capacity, and heat load factor of installations will vary. Additionally, these figures do not represent the evidence or sizing upon which tariffs were set but are used as an illustrative understanding of the market size implications of our deployment profiles.

Table 26 - Illustrative market intelligence assessment of scheme deployment potential

	Technology	Illustrative annual deployment in 2019	
Non-Domestic	Biomass Boilers	30 per year 4,000 kW installations, and 500 per year systems under 1,000 kWh	HLF: 35%
	Biomass CHP	8 per year 8,000 kW installations	HLF: 65%
	GSHP	300 per year 100kW installations	HLF: 20%
	ASHP	150 per year 30 kW installations	HLF: 20%
	Deep Geothermal	Up to 1 per year 6,000 kW installations	HLF: 55%
	Biomethane	20 per year 6,000 kW installations	HLF: 80%
	Small Biogas	80 per year 160 kW installations	HLF: 40%
	Medium Biogas	10 per year 480 kW installations	HLF: 40%
	Large Biogas	4 per year 1,900 kW installations	HLF: 25%
	Solar Thermal	50 per year 15kW installations	HLF: 5%
Domestic	ASHP	7,000 per year 10kW installations	HLF: 17%
	GSHP	1,500 per year 12 kW installations	HLF: 17%
	Biomass	1,000 per year 20 kW installations	HLF: 14%
	Solar Thermal	800 per year 3 kW installations	HLF: 17%

Air Quality Impacts

114. Table 27 below shows the breakdown of the total air quality impacts into the constituent parts including Particulate Matter (PM) and Nitrogen Oxides (NOx), split by the Domestic and Non-Domestic Scheme. Ammonia (NH_3) impacts have not been quantified due to large uncertainties.

Table 27 - Air quality impact breakdown

	PM	NOx	Net Costs / Benefits
Non-Domestic	-£30 m	£180 m	£150 m
Domestic	£20 m	£50 m	£70 m
Total	**-£10 m**	**£230 m**	**£220 m**

115. In order to take account of the net costs on air quality, the analysis includes assumptions on the emissions per unit of heat and the associated cost of those emissions. These are derived from:

a. Emission factors from NAEI (see Table 28): 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. These values have been updated since the publication in December 2016 to reflect Defra's decision to move from US EPA[21] emission factors for NOx and PM from small combustion plant to the 2016 edition of the EEA/UNECE Emission Factor Guidebook[22].

b. Damage cost values from Defra (see Table 29): 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 used are sourced 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.

116. The sensitivities analysed are based on the central emission factors from NAEI and high/low damage cost values from Defra. These values are shown in Table 29 below. Variation between the damage cost values reflects uncertainty about the time lag between the exposure to air pollution and the associated negative health impact.

117. There are no sensitivity tests for domestic RHI technologies.

[21] https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors
[22] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

Table 28 - Air quality emissions factors

			Dec 2016 IA emissions factors		Revised emissions factors[23]	
			PM [kg/GWh]	NOx [kg/GWh]	PM [kg/GWh]	NOx [kg/GWh]
Renewable Heat Fuel		Biogas	36	863	36	863
		Biomethane	3	193	2.5	193
		Electricity	3	108	0.3	97
		Biomass	108	540	54	270
Counterfactual Fuels	Non-Domestic	Natural Gas	2.7	253	2.5	240
		LPG	12	240	2.6	248
		Coal	391	578	390	577
		Oil	68.4	1750	39	1026
		Electricity	1	100	0.3	97
		Biomass	108	540	108	540
	Domestic	Natural Gas	4.1	75.5	3.9	74
		LPG	12	240	4	171
		Coal	1110	425	1108	425
		Oil	6.5	174	6.4	173
		Electricity	1	100	0.3	97
		Biomass	108	540	108	540

Table 29 - Air quality damage costs

	Air Quality Damage costs [2015 £/t][24]		
	Low	Central	High
Nitrogen Oxides (NOx)			
Industry	£4,377	£10,943	£17,508
Domestic	£4,882	£12,205	£19,529
Particulate Matter (PM10)			
Domestic	£26,396	£33,713	£38,311
Industry	£23,665	£30,225	£34,347

[23] http://naei.defra.gov.uk/data/

[24] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/460398/air-quality-econanalysis-damagecost.pdf

Annex C) Analytical Detail

Sensitivities

118. This section provides additional detail on the main sensitivities assessed and the impacts on the NPV, carbon abatement, and renewable heat delivered by renewable heat technologies (RHT). A description of the changes in assumptions or figures which have been used to complete the sensitivity analysis in this impact assessment is included further down. Table 30, below, demonstrates the impact of sensitivities on renewable heat generated, carbon savings, and NPV.

Table 30 – Impact to benefits and NPV of sensitivities assessed

	Renewable Heat in 2020/21 [TWh]		**CB4 Carbon Savings** [$MtCO_2e$]		**NPV** [Lifetime, real, discounted]	
	Low	High	Low	High	Low	High
Central Estimates	5.7		11.8		£30 m	
Central Deployment	- 2.0	+ 0.8	- 2.9	+ 1.7	- £10m	+ £5m
Low Deployment	- 2.8	N/A	- 5.8	N/A	- £20m	N/A
Counterfactual Deployment	- 1.4	N/A	- 3.3	N/A	N/A	N/A
Carbon Abatement	N/A	N/A	- 4.4	+ 5.4	- £980m	+ £1,220m
No Upstream Savings	N/A	N/A	- 5.8	N/A	- £1,280m	N/A
Carbon Prices	N/A	N/A	N/A	N/A	- £1,320m	+ £1,320m
Air Quality Impacts	N/A	N/A	N/A	N/A	- £130m	+ £140m
Heat Pumps Performance	- <0.1	+ <0.1	N/A	N/A	N/A	N/A

Figure 3 - Breakdown of carbon abatement sensitivities

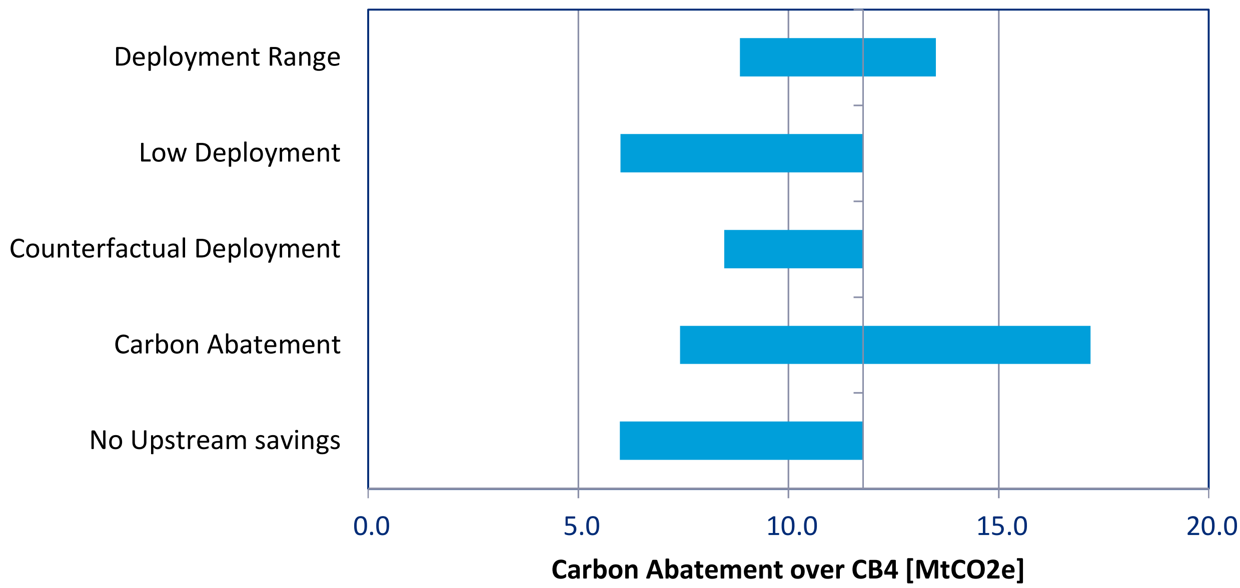


Figure 4 - Breakdown of renewable heat sensitivities

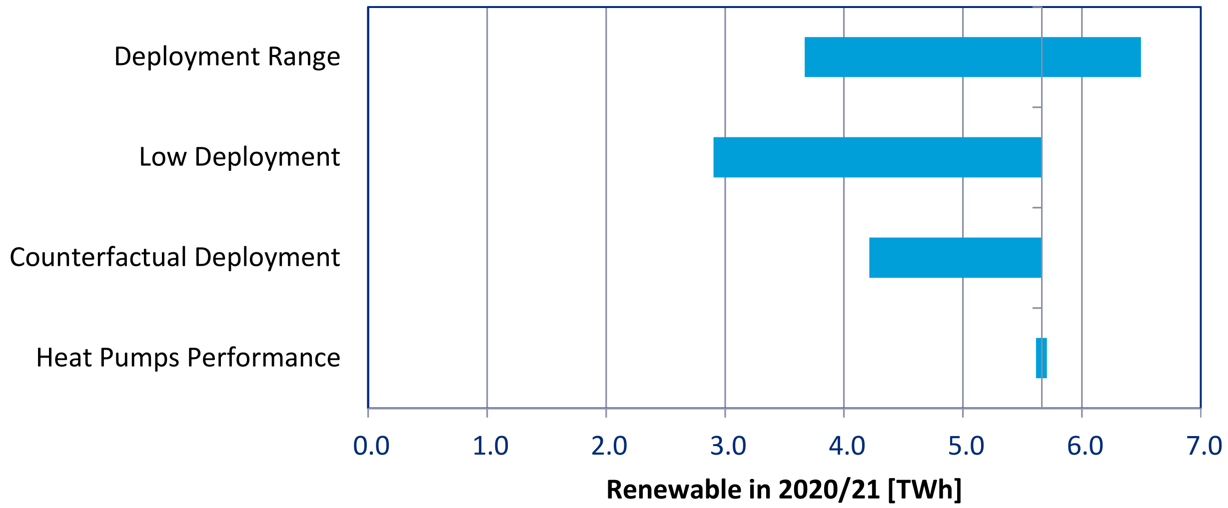


Table 31 - Details of sensitivity assumptions

Low	High
Central Deployment Range	
The low deployment in the central sensitivity shows the lower end of the possible range of central deployment for the scheme, assuming that several of the technologies do not see the level of deployment projected. A particular mix of technologies with low deployment has not been assumed as the mix could vary in practice.	The high sensitivity has been designed to show the level of benefits (renewable heat, carbon savings) which wold occur if the projected deployment were to ramp up to hit the budget cap over the last two years of the Spending Review. This sensitivity is well within the market potential for the technologies supported, however it would likely involve several technologies deploying highly, which could result in effects of degression on the markets. This sensitivity does not assume any degression takes place, and does not offer a view on when or if the scheme could close. In the event of higher than projected deployment, the budget management process will likely be engaged. More information can be found in Chapter 4 of the Government response to the consultation.
Low Scheme Deployment	
The low deployment sensitivity shows the outcome of the reformed scheme not having the intended effect on deployment. Broadly, it assumes that areas where the scheme is acting to increase deployment do not have any effect	N/A

and those technologies continue to deploy at rates similar to current levels. I also assumes that areas of eligibility restrictions have a greater than estimated negative impact on total deployment reducing uptake to very low levels.	
Counterfactual RHT Deployment	
This sensitivity is based on the evaluation evidence on whether respondents said they would have installed a Renewable Heat Technology (RHT) even without the RHI (either the same or different). One adjustment made is to not reduce deployment in the industrial sector, as this differs from space/water heating in that the process itself is an economic activity seeking profit. More detail is provided below.	N/A
Carbon Abatement	
Takes a low value for both technology efficiency and CO2 factors. Mix of counterfactual deployment for all technologies has been moved to 100% gas.	Takes a high value for both technology efficiency and CO2 factors. Mix of deployment against the counterfactuals for all technologies (apart from biomethane) has been moved to 100% oil.
No Upstream AD savings	
In this sensitivity, it is assumed that there are no upstream emissions savings from any of the feedstocks which are used in AD. This could be because, for example, though the calculation of savings from food wastes assume diversion from landfill, the food waste may be diverted from other uses such as composting resulting in fewer carbon savings.	N/A
Carbon Prices	
Low BEIS price series. See Annex B.	High BEIS price series. See Annex B.
Air Quality Impacts	
Uses the low estimates of air quality damage cost per tonne of emissions of Nitrous Oxides, and Particulate Matter, per Defra guidance. See Annex B.	Uses the high estimates of air quality damage cost per tonne of emissions of Nitrous Oxides, and Particulate Matter, per Defra guidance. See Annex B.
Heat Pumps Performance	
This sensitivity assumes both a higher number of domestic ASHP and GSHP do not meet the RED accounting target, and that the average SPF of those that do is lower for the purpose of RED accounting. This has no impact on carbon	This sensitivity assumes both a high number of domestic ASHP and GSHP do meet the RED accounting target, and that the average SPF of those that do is higher for the purpose of RED accounting. This has no impact on carbon

savings and thus no NPV impact as RED contributions are not monetised. See Heat Pump Performance section below.	savings and thus no NPV impact as RED contributions are not monetised. See Heat Pump Performance section below.

Counterfactual Renewable Heat Deployment Sensitivity

119. Evidence from the evaluations[25,26] was used to create the counterfactual RHT deployment projection sensitivity. The domestic evaluation provided figures split by technology, while there were not enough respondents in the non-domestic evaluation to split these out. One adjustment has been made to account for the share of heat generated by non-domestic technologies which is industrial in nature: these have not been considered to have any counterfactual RHT deployment, because they are economic activities in their own right. For example, a rural home or business may choose to pay more for an RHT (without subsidy) because they would like to make a difference for the environment. However, biomethane generation and injection to the gas grid is an industrial plant set up for the purpose of making a profit, and it is unlikely that without a subsidy a company would choose to invest large sums to do so while running at a loss each year. Table 32 shows the levels of assumed take-up of renewable heating technologies in the absence of the RHI subsidy.

Table 32 - Counterfactual renewable heat deployment sensitivity

	Technology	Counterfactual RHT deployment
Non Domestic	Small Biomass Boilers	33%
	Medium Biomass Boilers	30%
	Large Biomass Boilers	8%
	Ground Source Heat Pumps	36%
	Small Solar Thermal	36%
	Small Biogas	34%
	Biomethane	29%
	Medium Biogas	29%
	Large Biogas	29%
	CHP Biomass	28%
	Deep Geothermal	0%
	Air to Water HPs	36%
Domestic	ASHP	32%
	Biomass	13%
	GSHP	36%
	Solar Thermal	51%

[25] RHI Domestic Evaluation: https://www.gov.uk/government/news/evaluation-of-renewable-heat-incentive-rhi
[26] RHI Non-Domestic Evaluation: https://www.gov.uk/government/news/evaluation-of-renewable-heat-incentive-rhi

Anaerobic Digestion Feedstock Availability

120. The mix of feedstock used in anaerobic digestion is an important component of the overall benefits estimated to be achieved by the scheme, as different feedstocks have different levels of greenhouse gas abatement associated with them. It is important to note that estimates of total deployment are based on estimates of project pipelines, but that estimates of the likely availability of feedstock are highly uncertain and could limit the achievable deployment.

121. The benefits and NPV calculations for the RHI are sensitive to changes in the assumption of upstream carbon savings (which is highly uncertain), and are also affected by assumptions on total deployment of plant, the proportion of feedstock used which is food waste, and where that waste would have ended up if not in AD. This uncertainty is linked to the uncertainty on ammonia emissions discussed in Section 5, but not quantified. Differences in total realised deployment or feedstock type and what use that feedstock would have been put to in the counterfactual, will affect the realised benefits of the scheme. Carbon savings from upstream abatement are highlighted separately in Section 4 because of the particular sensitivity of abatement to AD feedstocks.

122. Within the consultation stage IA, it was recognised that feedstock constraints could be a potential risk to deployment. A number of consultation responses and recent market reports[27,28] highlighted food waste as a potential constraining factor to industry deployment, not due to the overall level of food waste being generated, but based on whether it is available for use in the AD sector. This is because the majority of food waste which is produced (in households, businesses and industry) ends up being mixed with other wastes which cannot be used for AD. It is also important to make the distinction between avoidable and unavoidable food waste, as action to limit the creation of food waste could reduce the supply of some feedstocks.

123. New market intelligence was compared with estimates of feedstock availability in order to understand whether feedstocks were likely to be a key constraint. In certain circumstances, food waste availability could be a constraint on AD deployment without measures to increase separate capture of food waste, particularly by Local Authorities (LA). These potential costs to LAs have not been accounted for in this Impact Assessment.

124. However, it must be noted that not all food waste in the RHI is assumed to come from Local Authority collection; there are some commercial arrangements which see large suppliers of food waste (e.g. food manufacturers, distilleries) contract directly with AD plant for the disposal of the waste. There could also be additional Industrial and Commercial collection of food waste to supply RHI plant, but further work will be

[27] WRAP (2012) http://www.wrap.org.uk/content/household-food-and-drink-waste-uk-2012
[28] Eunomia report

necessary to assess the carbon benefits of this when deployment occurs (to take into account what the counterfactual use of the food waste could have been).

125. Once other potential uses of food waste are taken into consideration, there is a risk that food waste availability would be constrained for the AD market as a whole, which could limit deployment within the RHI. As a result of this, as well as additional information on the likely pipeline of AD projects, the assumed mix of feedstocks has been revised in the current IA. It should be noted that availability of feedstock and therefore uncertainty of the level of deployment is not limited to food waste, but exists for all feedstocks.

126. Based on market intelligence and current deployment, the initial Impact Assessment assumed that the feedstock mix of plants supported under the reformed RHI would be around two thirds food waste, while our revised assessment assumes that around 40% of new deployment to use food waste as a feedstock (either from Local Authority or industrial/commercial sources), with the remainder coming from sewage sludge and agriculture (including energy crops, residues and farm waste such as manures and slurries). For more detail, see Table 33, below.

Table 33 - Proportions of AD plant using different feedstock assumed in the reformed RHI

	Food Waste	Sewage	Agriculture*
Consultation Stage IA	~67%	~25%	~7%
Government Response IA	~40%	~25%	~35%

*Agriculture includes energy crop, manures and slurries and also agricultural residues.

127. The change in assumption has a subsequent effect on the benefits reported for biomethane and biogas, as food waste generates the most carbon savings when accounting for upstream emissions, with further considerations discussed within the next section on carbon cost effectiveness.

128. The cost of disposing of food waste and the accessibility of food waste varies greatly depending on its location and source. Improved strategies for accessing food waste may continue to grow supply (e.g. from commercial and industrial sectors) where it is cost effective to do so. Market and technology developments may also result in a diversification to a wider range of feedstocks, for which there is a greater potential availability. If current barriers to the provision of LA collection of separate food waste are overcome, along with improved capture of the food waste, it may be able to offer additional supply in the future.

Carbon Cost Effectiveness (CCE) of Anaerobic Digestion

129. The consultation stage Impact Assessment demonstrated our initial consideration of the cost of abating 1 tonne of CO_2 through the production of biomethane.

130. The conclusion of said work was that, whilst there were a wide range of potential outcomes depending on the assumptions, the choice of feedstock has a significant effect on the abatement potential of biomethane production and its associated costs. Furthermore, in a typical scenario, wastes are more effective at delivering cost effective GHG emissions compared to crops.

131. As a part of the consultation process, views on whether limiting the use of some feedstocks would deliver more cost-effective carbon abatement (question 26a in the consultation) were requested. A wide range of responses was received, including a range of points relating to the carbon cost effectiveness work that was undertaken for the initial Impact Assessment.

132. The key analytical challenges brought up in the responses were:

a. The scope was too narrow, not including biogas or using a range of crops.

b. The overall approach was wrong due to: taking a typical plant type as opposed to a range of individual cases; mixing of attributional and consequential approaches; and using resource costs as oppose to subsidy costs.

c. Not accounting for factors that affect CCE such as: benefits of spreading digestate on land; the higher emissions associated with the transport and processing of wastes; carbon capture storage; the impact of RHI reforms on costs; and changes over time to feedstock prices.

d. The use of incorrect assumptions such as those concerning the spreading of digestate; the landfill counterfactual; and the suggestion that large efficient crop plants would be better performing than small waste ones.

133. In addition to these, a range of studies were cited as part of the responses, some of which supported the conclusions of the initial IA and others which raised different issues, such as the impact of biodiversity. They included alternative CCE analysis which challenged the idea that crops are not good value for money.

134. After considering the wide range of responses and exploring their implications for the analysis performed previously, it was concluded that:

a. Even when increasing the scope of analysis in terms of crops or biogas, the underlying findings that waste as feedstocks are better value for money than crops in terms of CCE still stand.

b. Our underlying approach was rightly conservative. This reasoned that a typical plant would be a more representative assumption than a “best individual case”, due to the need to understand the potential impact on a scheme-wide basis of the average deployment.

c. Though the CCE was calculated on a societal cost basis, rather than a purely subsidy cost basis so as to better reflect the true cost to society, this does not have any bearing on the relative merit order of feedstock CCE.

d. It was not possible to accurately calculate the impacts from most of the factors which feedback identified as missing, due to a lack of robust evidence to do so. However, it is believed that these factors would not change the underlying findings of the CCE work as their impacts are of a smaller order of magnitude.

135. There are additional pieces of analysis and evidence which would add value and understanding to the impacts appraisal of the AD feedstock supply chain. However, it was felt that the best available evidence is being used and that the overall impact of additional work would likely not change the merit order decisions for support. Additional analysis could be performed, in particular relating to the landfill counterfactual and the full resource costs of feedstocks reaching the market.

136. Our conclusion is that, while the number could change markedly, the overall findings of the CCE of waste versus crops are robust to a wide range of assumptions.

Domestic Returns and Heat Demand Limits

137. Figures below show the incentives across different sizes of households assumed to deploy renewable heating technologies. These also include the impact of the revision of the offer to biomass boilers, as well as the change in heat demand limit for ground source heat pumps.

138. The charts show the average returns estimated for households of a given size, taking heat demand limits into account. The actual return for any given household will vary depending on a range of factors including the cost and size of the system chosen, the efficiency and performance of the system, and how much the system is used.

139. The returns achieved by ground source heat pumps are particularly sensitive to system sizing and heat use due to the additional capital expenditure requirements for e.g. ground loops. For illustration, the chart therefore shows the returns achievable at the high end of heat load factors assumed for domestic systems of 21% (this is equivalent to installing a smaller system to supply the same total heat).

140. The ground source heat pump chart does not show the potential returns for shared loop systems which will be included in the Non-Domestic Scheme. Shared loops offer the potential for smaller domestic properties to achieve economies of scale and higher heat load factors by sharing the cost and use of a single larger ground loop, compared to having multiple smaller loops for each property.

Figure 5 - Financial returns for domestic biomass boilers

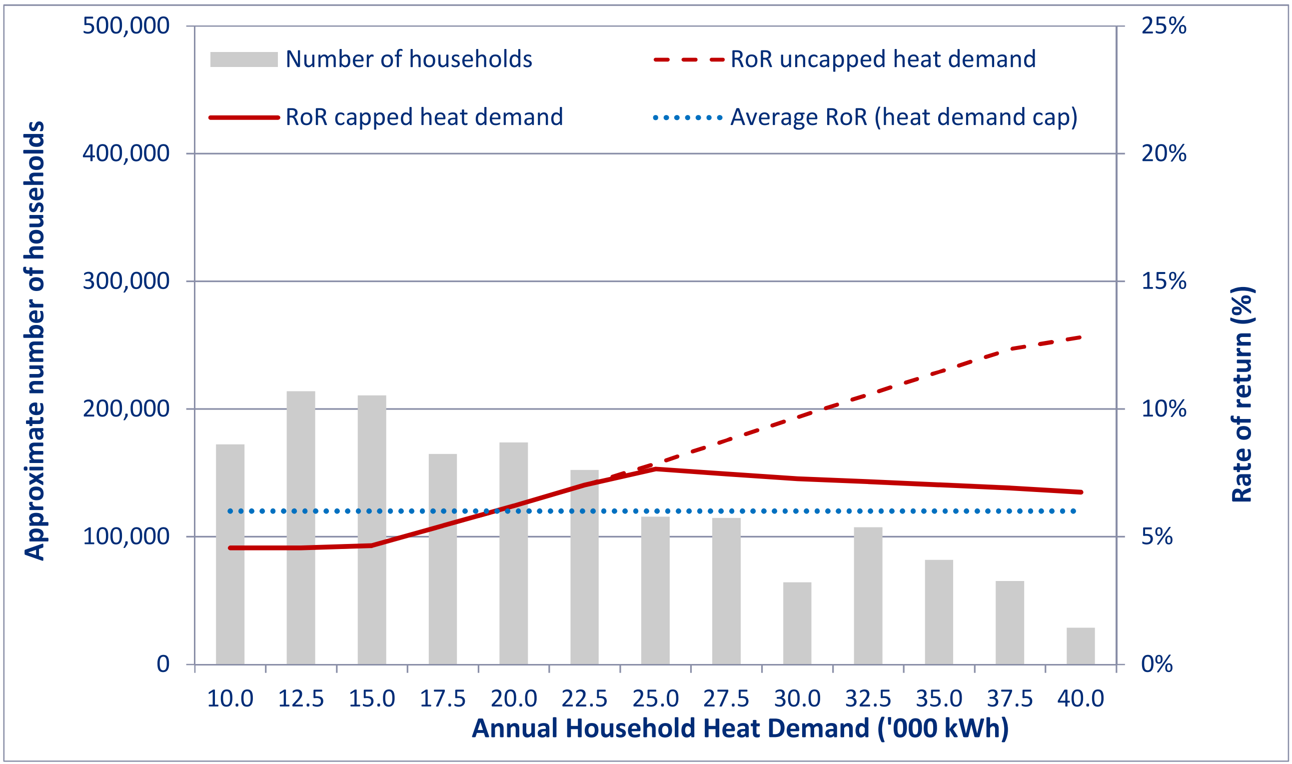


Figure 6 - Financial returns for domestic GSHP

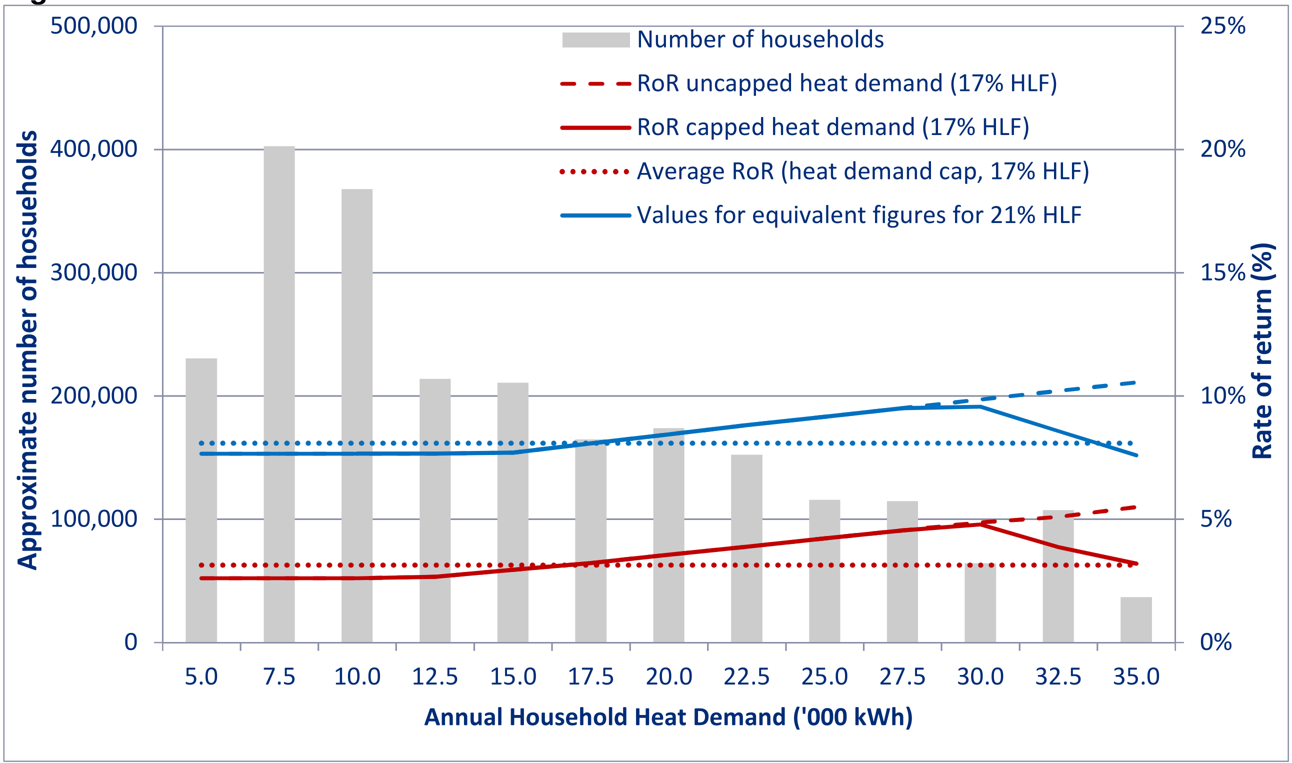
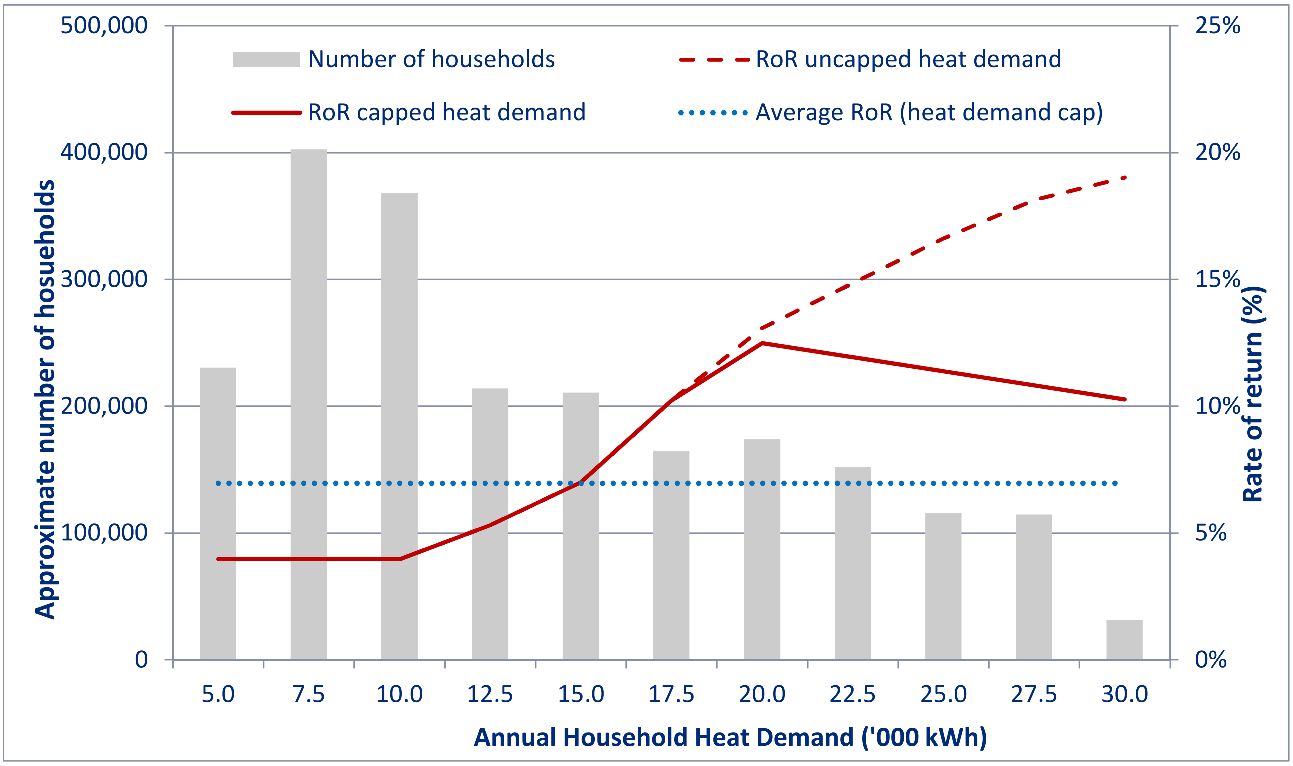


Figure 7 - Financial returns for domestic ASHP



Heat Pump Performance

141. The performance of a heat pump system is measured by the amount of heat produced per unit of input energy (electricity). This can vary between each case depending on the design, installation and operation of the system.

142. BEIS commissioned monitoring of just over 700 domestic heat pumps installed under the Renewable Heat Premium Payment (RHPP), carried out between 2011-2014, and 21 ground and water source heat pumps installed under the Non-Domestic Renewable Heat Incentive (NDRHI), carried out between 2012-2014, in order to establish the installed performance of heat pumps and identify causes of variations in heat pump performance.

143. The main findings from these reports[29,30] are that the in-situ performance of heat pumps is lower than their design specifications. Specifically, of the systems monitored, a proportion of both domestic ASHP and domestic GSHP had seasonal performance factors (SPF) lower than 2.5 and therefore did not meet the Renewable Energy Directive (RED) accounting definition of renewable heat.

[29] UCL Energy Institute (2016) "Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme" https://www.gov.uk/government/publications/detailed-analysis-of-data-from-heat-pumps-installed-via-the-renewable-heat-premium-payment-scheme

[30] Graham Energy Management (2016) "Monitoring of Non-Domestic Renewable Heat Incentive Ground-Source and Water-Source Heat Pumps Interim Report" https://www.gov.uk/government/publications/monitoring-of-non-domestic-renewable-heat-incentive-ground-source-and-water-source-heat-pumps-interim-report

144. Since the initial findings were published in February, engagement work with stakeholders has identified some anomalies in the data, and queried the degree to which the RHPP monitored sample is representative of heat pumps installed via the RHI. The Government has worked with our consultants to improve data sampling with the aim of removing major anomalies. On this basis, our assessment is that findings on mean and median SPF from the RHPP are relatively stable and not expected to be influenced significantly by the anomalies in the data. Other statistics, particularly the percentage of air source heat pumps meeting the renewable criterion, are likely to be more affected.

145. When using these findings in the context of the RHI, a judgement is required as to how indicative these RHPP monitoring results are of the population of heat pumps already and yet to be installed under the RHI. For example, the major revision of the Microgeneration Certification Scheme (MCS) standards which occurred during the period of RHPP heat pump installations, the introduction of a minimum design SPF in the RHI, financial support available for projects under each scheme, and the types of properties monitored may all have an impact. The impact of these factors is complex to assess and the evidence available to do so is limited. However, based on the information available and engineering judgement, it is the Department's view that performance of heat pumps installed under the RHI is likely to be similar to or better than the RHPP values.

146. The Government's current assessment of the evidence on in-situ performance of RHPP heat pumps, and how this compares to the previous assumptions, is presented in the table below. It should be noted that this evidence is expected to be a worst case for RHI installations.

Table 34 - Change in RED accounting assumptions for domestic heat pumps[31]

		Original Assumptions	December 2016 IA Evidence	Revised Evidence
Domestic ASHP	**Average in-situ SPF of heat pump stock**	2.51	2.52 (2.32 - 2.80)	2.52 (2.31 - 2.80)
	Proportion with in-situ SPF above 2.5	100%	63% (± 10%)	63% (±6%)
	Average in-situ SPF of those heat pumps	N/A	2.93 (± 0.02)	2.92 (±0.17)
Domestic GSHP	**Average in-situ SPF of heat pump stock**	2.84	2.81 (2.71 - 3.30)	2.81 (2.71 - 3.30)
	Heat pumps with in-situ SPF above 2.5	100%	81% (±10%)	80% (±8%)
	Average in-situ SPF of heat pumps above 2.5	N/A	3.10 (± 0.06)	3.10 (+0.29 / -0.32)

31 For the calculation of cost and benefits reporting the performance is calculated on the SPF H3 system boundary, however for RED reporting the relevant boundary is SPF H2

147. The main benefits reported in this Impact Assessment are based on the latest evidence, which is likely to be published shortly. Further evidence of the performance of RHI heat pumps may be available in time, and the installed performance of new systems is expected to continue to improve over time as the policy changes designed to increase performance take effect, and the supply chain and consumers become more familiar with the technology and its performance.

148. Policy measures are already in place in the Domestic RHI to increase both design and installed performance, including requirements for MCS standards compliance, requirement of a minimum design SPF of 2.5 and RHI payments being calculated on the basis of renewable heat. These may have driven performance improvements compared to the RHPP systems, but data is not available to assess whether this is the case. The RHPP analysis has also highlighted some detailed technology issues (for example, use of inappropriate controls) which led to underperformance, some of which have now been addressed by the market. Through the present reforms, the scheme will have a new requirement for all new ASHPs and GSHPs supported by the scheme to have installed one of a specified set of electrical metering arrangements alongside their heating system. This requirement will help to drive continued improvements in heat pump performance.

149. For non-domestic heat pumps, the evidence is more limited. The monitored NDRHI units do not include ASHPs and it was not possible to obtain a representative sample of ground- and water-source HPs. In general, non-domestic heat pump performance is expected to be different, and in some cases better, than domestic heat pump performance. However, the limited evidence to date does not support the hypothesis that non-domestic heat pumps are performing better than domestic heat pumps. Scheme metering data will be analysed to evaluate the performance on non-domestic heat pumps in the scheme.