Title: Changes to RHI Support **IA No:** BEIS008(C)-20-CG **RPC Reference No:** N/A **Lead department or agency:** Department for Business, Energy and Industrial Strategy (BEIS) **Other departments or agencies:** N/A	**Impact Assessment (IA)** **Date:** 28/04/2020 **Stage:** Consultation **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 (in 2019/20 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
-£65m	N/A	N/A	Non-qualifying

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

The Renewable Heat Incentive (RHI) offers an incentive to owners of renewable heat installations and producers of biomethane. 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 target of net zero emissions by 2050.

What are the policy objectives and the intended effects?

The aim of the RHI is to incentivise the cost-effective installation of low carbon heating systems and generation of renewable heat in order to: reduce carbon emissions from heat, contributing to Carbon Budget targets and the obligation to reach net zero emissions by 2050; contribute to the UK's renewable energy targets; and develop the renewable heat market and supply chain so that it can support the mass roll-out of low carbon heating systems. The proposed changes contribute to these objectives while also ensuring a smooth transition into future schemes to maximise the benefits from these schemes.

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

Option 0 (counterfactual): close the RHI in March 2021

Option 1 (preferred): changes to RHI support. The proposed changes are:

1. **Domestic RHI extension**: extend applications to the Domestic RHI (DRHI) by a year, to 31 March 2022;
2. **Flexible third allocation of Tariff Guarantees**: create a flexible third allocation of Tariff Guarantees which can commission until 31 March 2022;
3. **Extension of commissioning deadline for existing Tariff Guarantees**: give additional time for applicants with a Tariff Guarantee to commission in response to delays due to COVID-19.
4. **Non-Domestic RHI closure and reforms**: close the Non-Domestic RHI (NDRHI) to new applicants as planned on 31 March 2021 and implement a package of reforms to the NDRHI which would apply to existing participants over the duration of payments.

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

Does implementation go beyond minimum EU requirements?		N/A		
Is this measure likely to impact on trade and investment?		No		
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? (Million tonnes CO_2 equivalent)		**Traded:** 0.1	**Non-traded:** -4.4	

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: Kwasi Kwarteng   Date: 28 April 2020

Summary: Analysis & Evidence

Policy Option 1

Description:

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
Year 19/20	**Year** 19/20	**Years** 21	**Low:** -£168m	**High:** £86m	**Best Estimate:** -£65m

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low				£274m
High				£527m
Best Estimate				£381m

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

The main cost of the changes to the RHI will be the resource cost, which represents the additional cost of installing low carbon heating installations in place of conventional systems. The central estimate of resource costs is £378m. There is also a much smaller cost of £3m due to an increase in carbon emissions in the traded sector.

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

There may be a 'rebound effect' where the installation of a low carbon heating system and associated energy efficiency measures could lead to a decrease in fuel bills and hence a possible increase in energy consumption. This has not been quantified due to heterogeneity in household responses and the lack of evidence for this effect in heating.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low				£211m
High				£468m
Best Estimate				£315m

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

The main monetised benefit of the changes to the RHI will be the reduction in carbon emissions in the non-traded sector. The central estimate of non-traded carbon savings is £306m. Air quality impacts result in a net benefit of £4m, and fertiliser savings result in a benefit of £6m.

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

There is no agreed value for renewable energy, so the contribution of installations supported by the RHI towards renewable energy targets is not included in the NPV. By supporting low carbon heat deployment and ensuring a smooth transition into future support schemes, the changes to the RHI will allow supply chains to continue to develop, providing a base for the mass roll-out of low carbon heating over the coming decades. Continued deployment may bring down costs and improve performance as supply chains grow and learning by doing effects reduce the barriers that customers currently face. There may also be benefits to health as installing low carbon heating systems in place of fossil fuels and making associated energy efficiency improvements can lead to improved indoor air quality and a warmer home.

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. There is also uncertainty around the costs and benefits deriving from a given level of deployment. As installations have lifetimes of 20 years, the appraisal period runs to 2041 (20 years from the last month of possible deployment). Estimating costs and benefits over this period introduces significant uncertainty. The price of carbon is a key sensitivity affecting the NPV of the scheme: the current central carbon value is likely to be an underestimate (see paragraph 53). There is also a large uncertainty around the carbon emissions from anaerobic digestion, which are highly sensitive to the feedstock used and the counterfactual use of the feedstock.

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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1. Introduction and Background

1. The Renewable Heat Incentive (RHI) aims to facilitate and encourage the transition from conventional forms of heating to low carbon alternatives. The scheme is an important contributor to the government's stretching targets for both renewable heat, through the EU Renewable Energy Directive (RED), and carbon savings through both legally binding Carbon Budgets and the government's target of net zero emissions by 2050.
2. The Non-Domestic RHI (NDRHI) was introduced in November 2011 and is open to producers of biomethane for injection into the agas grid and to renewable heat installations that provide heat to buildings and for purposes other than heating a single domestic property. This includes, for example, systems providing renewable heating to public buildings or commercial properties, for industrial or agricultural uses, or for heating a block of flats. The Domestic RHI (DRHI) followed in April 2014 and is open to renewable heat installations that provide heat to single domestic properties.
3. The scheme provides financial incentives to households and non-domestic consumers, including public bodies and charities, to help bridge the gap between the cost of renewable heating systems and the conventional alternatives.
4. In 2018, reforms to the RHI introduced Tariff Guarantees (TGs), which allowed some applications[1] to the NDRHI to secure a tariff rate before being fully commissioned and accredited. This was intended to help larger, more cost-effective projects come forward through providing the necessary level of certainty for investment decisions.
5. The RHI currently has budget agreed for new applications until 31 March 2021. The government has recently published the following documents on support for renewable heat:
    a. 'Changes to RHI support' stakeholder notice[2]: this notifies the public of the government's intention to extend applications to the DRHI for an additional year, until 31 March 2022; introduces a flexible third allocation of Tariff Guarantees (TGs); and extends the commissioning deadline for plants in the current allocation of TGs in response to delays due to COVID-19;
    b. 'The Non-Domestic Renewable Heat Incentive – ensuring a sustainable scheme' consultation document[3]: this aims to enact the timetabled closure of the NDRHI to new applicants on 31 March 2021, while also consulting on reforms to future-proof the scheme for accredited applicants;
    c. 'Future Support for Low Carbon Heat' consultation document[4]: this proposes future support after the closure of the RHI for biomethane injection into the gas grid and small-scale heat pumps and biomass.
6. This impact assessment (IA) relates to the reforms to the RHI proposed in the 'Changes to RHI support' stakeholder notice and the 'Non-Domestic Renewable Heat Incentive – ensuring a sustainable scheme' consultation document. The proposals for support beyond the RHI set out in the 'Future Support for Low Carbon Heat' consultation document are considered in a separate IA[5], and as such are out of scope of this IA.

[1] Tariff Guarantees are available for solid biomass combined heat and power (CHP), geothermal and biomethane applications of all sizes, as well as for biomass over 1MW, biogas combustion over 600KW and ground and water source heat pumps over 100KW.

[2] The 'Changes to RHI support' stakeholder notice is published on the same web page as this document.

[3] 'The Non-Domestic Renewable Heat Incentive – ensuring a sustainable scheme' consultation document is published on the same web page as this document.

[4] Please see the 'Future Support for Low Carbon Heat' consultation for more information.

[5] This IA is published on the same web page as the 'Future Support for Low Carbon Heat' consultation.

1.1 Rationale for Intervention

7. The economic rationale for subsidising renewable heating in the domestic and non-domestic sectors is as follows:
    a. The negative carbon externality associated with fossil fuel-based heating is not currently reflected in the cost of those systems, so fossil fuel systems are cheaper than renewable systems. This represents an inefficiency in the market, as the market price of fossil fuel systems does not reflect the full cost to society of the greenhouse gas emissions associated with using fossil fuels. To address this market failure, the RHI subsidises renewable heating installations, reducing the cost differential between fossil fuel and renewable systems and hence encouraging deployment of renewable systems.
    b. As renewable heat is an emerging market, it does not benefit from economies of scale or mature supply chains to the same degree as more established technologies. This contributes to the cost differential between renewable and fossil fuel systems which the RHI aims to address through subsidy. Preparation of the supply chain (installer and manufacturer) for the mass roll-out and deployment of low carbon heating is needed to reduce the cost of decarbonising heat use in buildings and industrial processes, as well as meeting legally binding Carbon Budget targets.
    c. Renewable heat is expected to make a significant contribution to the UK meeting its renewable energy targets, for example the target set under the EU Renewable Energy Directive (RED) to generate 15% of UK energy demand from renewable sources by 2020.
    d. There are several non-financial barriers to the uptake of renewable heat, including awareness of technologies, availability of local suppliers and the hassle involved in changing heating systems. Raising consumer awareness, reducing deployment barriers and increasing innovation through increased deployment result in spill-over benefits to society (of marginal increases in performance or marginal decreases in costs) which 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 the UK economy's exposure to the volatility of oil and gas prices.
8. 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.
9. The rationale for the specific changes to the RHI discussed in this IA is set out in Section 2.

1.2 Policy Objectives

10. The overarching aim of the RHI is to incentivise the cost-effective installation of renewable heating systems and generation of renewable heat in order to:
    a. Contribute to **decarbonising heating** in the UK and to meeting Carbon Budget targets;
    b. Contribute to **renewable energy generation** in order to help meet the UK's renewable energy targets;
    c. Develop the **renewable heat market and supply chain** to support the mass roll out of low carbon heating required in the 2020s and onwards to meet the UK's target of net zero carbon emissions by 2050.
11. Extending the DRHI scheme and introducing a flexible third allocation of TGs on the NDRHI scheme will support these objectives by:

a. Delivering additional low carbon heat deployment, facilitating the heat sector's contribution to Carbon Budget targets;

b. Minimising disruption to supply chains for technologies which will continue to be supported after the RHI, ensuring a smooth transition into future schemes and hence maximising the benefits from these schemes.

12. Extending the commissioning deadline for existing plants with a TG in response to delays caused by COVID-19 will support the above objectives by:

a. Securing the current pipeline of TG plants, which will make contributions to renewable heat generation and carbon abatement;

b. Supporting the renewable heat supply chain through the impacts of COVID-19.

13. The proposed reforms to the NDRHI aim to ensure that after closing to new applicants, the scheme will continue to deliver the above objectives, while also:

a. Future-proofing the scheme to maximise the contribution the NDRHI makes to the decarbonisation of heating in the UK;

b. Improving the consumer experience for existing participants on the scheme;

c. Ensuring robust management of the scheme for existing participants for the remainder of the payment term;

d. Delivering ongoing value for money to the taxpayer.

2. Policy Options

15. The policy options considered in this IA are:
    a. Option 0 (counterfactual): close the RHI in March 2021;
    b. Option 1: changes to RHI support.

2.1 Option 0 (counterfactual): close the RHI in March 2021

16. In this IA, the quantified costs and benefits of Option 1 are assessed against a counterfactual where both the Domestic and Non-Domestic RHI close to new applicants on 31 March 2021, with no additional reforms implemented. Plants with a Tariff Guarantee are required to commission by 31 January 2021 or 183 days after the agreed commissioning date, whichever is earlier; failure to meet this deadline means a plant will no longer be able to claim the tariff secured under the TG, and must reapply at the current tariff.
17. Under Option 0, spend on the RHI is managed through the following mechanisms:
    a. **Annual budget caps**: budget caps[6] for the combined DRHI and NDRHI were set for years up to and including 2020/21 in the 2015 Spending Review.
    b. **TG budget allocation**: TG spend is controlled through a TG budget allocation set by the Secretary of State for BEIS, covering years up to and including 2020/21. New TG applications will only be accepted if there is budget available within this allocation.
    c. **Degression**: spend on new applications is controlled through degression, a mechanism to reduce tariffs for new applicants. For each technology, or group of technologies, once deployment hits a specified level (‘trigger’) as set out in the regulations, the tariff decreases by a determined amount dependent on several factors. Degression triggers are currently set out quarterly up to the end of 2020/21.

2.2 Option 1: changes to RHI support

18. The government is proposing the following changes to RHI support:
    a. **Domestic RHI extension**: this would extend new applications to the DRHI by a year, to 31 March 2022;
    b. **Flexible third allocation of Tariff Guarantees**: this would create a third allocation of Tariff Guarantees, which would require plants to submit financial close information by 31 March 2021 and commission by 31 March 2022 (see Annex A for further details);
    c. **Extension of commissioning deadline for existing Tariff Guarantees**: this would change the final commissioning deadline for the current cohort of TGs from 31 January 2021 to at least mid-March 2021, and remove the requirement to commission within 183 days of the commissioning date given on application for a TG;
    d. **Non-Domestic RHI closure and reforms**: this would close the NDRHI to new applicants as planned on 31 March 2021, while implementing a package of reforms to the NDRHI which would apply to existing participants over the duration of payments.

Domestic RHI extension

[6] BEIS publish monthly estimates of estimated committed expenditure against the budget cap here: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

19. Under Option 1, the DRHI would remain open to new applicants until 31 March 2022. This allows for an additional year of DRHI deployment relative to Option 0, where the DRHI would close to new applicants on 31 March 2021.

20. Through supporting additional deployment of low carbon heating systems in 2021/22, the extension to the DRHI will deliver carbon savings which will contribute towards the government's Net Zero target.

21. To meet this target, almost all heat in buildings needs to be decarbonised, and heat pumps are expected to play a key role in this transition. The Committee on Climate Change has identified heat pumps as a key technology for decarbonising domestic heat. In 2019, over 90% of accreditations on the DRHI were for air source or ground source heat pumps[7]. The extension of the DRHI will enable the domestic heat pump supply chain and installer base to continue to develop, providing a base for the mass roll-out of heat pumps in the 2020s.

22. The extension of the DRHI also enables further deployment under the Assignment of Rights (AoR). AoR was introduced in 2018 to enable households and organisations to access finance to overcome the upfront costs of a renewable heating system. Nearly 20 investors have registered to date and AoR installations have begun to be accredited. An additional year of the scheme provides greater opportunity for AoR deployment to increase significantly.

23. The extension of the DRHI to the end of 2021/22 will smooth the transition into future support schemes for domestic low carbon heat. The 'Future Support for Low Carbon Heat' consultation proposes introducing a Clean Heat Grant scheme supporting heat pumps and some biomass deployment in buildings[8] in 2022/23. The extension of the DRHI will ensure continuous support for domestic heat pumps and some biomass, which means that the supply chain and installers will be well-placed to deliver the installations required to maximise the benefits from the Clean Heat Grant scheme. Although the majority of accredited installations in the DRHI are heat pumps, extending the entire scheme enables the government to provide another year of support for biomass and solar thermal technologies.

24. To facilitate the DRHI extension while protecting taxpayer funds, we are also proposing the following budget management mechanisms in addition to those set out in Option 0:
    a. We will set a **DRHI-only budget cap** for 2021/22, which will operate in the same way as the combined DRHI and NDRHI budget cap for years up to 2020/21;
    b. We will set new **degression triggers** for DRHI technologies, extending to the end of 2021/22.

Flexible third allocation of Tariff Guarantees

25. TGs were introduced to provide investment certainty to projects with long lead times and requiring significant up-front investment. Plants applying through the TG route are typically larger and better value for money than those applying through the standard NDRHI.

26. A flexible third allocation of TGs would be created under Option 1. Plants with a TG under this third allocation would be required to submit financial close information by 31 March 2021 but could commission at any time up to 31 March 2022. Annex A sets out how this would work in more detail.

27. The third allocation of TGs will provide additional time for new renewable heat projects to develop and commission. Similarly to the DRHI extension, by encouraging additional low

[7] RHI statistics, January 2020, Table 2.1 https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2020

[8] This proposes providing grants for heat pumps and biomass with a capacity of less than or equal to 45kW, starting in financial year 2022/23. Biomass will only be supported in limited circumstances, where there is evidence that a heat pump would not be appropriate.

carbon heat deployment, the third allocation of TGs will contribute to carbon abatement targets and increase renewable energy generation.

28. The deployment of biomethane plants, which generate biogas for injection into the gas grid through anaerobic digestion (AD), has come almost exclusively through the TG route since TGs were introduced in May 2018. Biomethane will continue to have a role to play in the decarbonisation of the economy over the coming decades. In the short term, the government's waste strategy aims to introduce separate food waste collections in England from 2023; AD will be important as the 'best environmental outcome for food waste that cannot be prevented'[9]. In the long term, in the Committee on Climate Change (CCC)'s Net Zero report, 14TWh of biogas is assumed to be needed to achieve net zero emissions by 2050[10]. Through supporting additional deployment of AD plants, the third allocation of TGs will allow the AD supply chain to continue to grow, maintaining and expanding a platform for future investment in the sector.

29. In particular, in the 'Future Support for Low Carbon Heat' consultation, the government is proposing to introduce a Green Gas Support Scheme which would provide support for biomethane plants beyond the RHI, opening to new applications in 2021/22. As the flexible third allocation will allow RHI plants to continue to commission throughout 2021/22, it will enable a continuous pipeline of biomethane projects between the RHI and the Green Gas Support Scheme. This will avoid disruption to the biomethane supply chain and maximise the deployment on the Green Gas Support Scheme, unlocking significant additional benefits.

30. There has also been strong deployment of large ground and water source heat pumps (G&WSHPs) through the TG route, which is expected to continue under the flexible third allocation of TGs. The third allocation of TGs may also support the deployment of other technologies eligible for TGs, including solid biomass combined heat and power (CHP) and large biomass plants.

31. To manage the budgetary impact of the third allocation of TGs, we are proposing to introduce technology-specific TG budget allocations for the 2021/22 and 2022/23 financial years. These will operate in the same way as the current TG budget allocation.

Extension of commissioning deadline for existing Tariff Guarantees

32. In Option 0, plants with a TG must commission by 31 January 2021 or 183 days after the agreed commissioning date, whichever is earlier. Delays in development and construction of plants due to COVID-19 mean that plants are at risk of failing to meet these deadlines and hence losing their guaranteed tariff.

33. Under Option 1, the final commissioning deadline would be extended to mid-March 2021 and the 183-day deadline would be removed. This would give projects additional time to commission with the tariff secured under the TG. As some projects currently have commissioning deadlines as early as May 2020, this change would secure up to an additional 9 months for plants to commission.

Non-Domestic RHI closure and reforms

34. In Option 1, the NDRHI would close to new applicants on 31 March 2021 as planned.

35. In addition to closing the NDRHI to new applicants, this option proposes a package of reforms to regulations which will apply to existing participants over the duration of payments, until 2041. The reforms aim to ensure that the scheme offers value for money and delivers its benefits, while also future-proofing the scheme for existing participants.

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[9] Resources and waste strategy for England, pages 70-71 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf

[10] Net Zero – the UK's contribution to stopping global warming, page 149 https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

36. The proposed package of reforms for the non-domestic scheme include:

   a. The introduction of fuel quality requirements for woody biomass;
   b. Facilitation of change of registered producer provisions for biomethane plants; and
   c. Increasing flexibility around the injection of biomethane into the gas grid.

   Further detail on the individual reforms can be found in the consultation document.

3. Domestic RHI Extension and Flexible Third Allocation of Tariff Guarantees

3.1 Analytical Approach

37. This section outlines the analytical approach to assessing the costs and benefits of the DRHI extension and flexible third allocation of TGs. Section 6 qualitatively describes the impact of the extension of the commissioning deadline for the current allocation of TGs; due to the high level of uncertainty around the impacts of COVID-19 on the RHI, a quantitative approach is not possible at this time. A qualitative approach, detailed in Section 7, is used to assess the impacts of the NDRHI closure reforms because of the large number of interacting reforms with a small impact when considered separately.
38. Quantified cost benefit analysis is used to assess the impact of the DRHI extension and the flexible third allocation of TGs. In the cost benefit analysis, we use appraisal assumptions alongside estimates of the expected deployment of each technology to assess the costs and benefits of additional deployment brought forward under Option 1 relative to the counterfactual (Option 0). The appraisal period starts in 2021 and ends in 2042, when the final installations supported by the extended RHI come to the end of their 20-year lifetime.

3.1.1 Evidence Base

39. The cost benefit analysis uses standard appraisal values, including:
    a. **Carbon prices**: value placed on traded and non-traded greenhouse gas emissions, from HMT Green Book supplementary guidance on valuation of energy use and greenhouse gas emissions[11].
    b. **Electricity and fossil fuel carbon emissions factors**: greenhouse gas emissions from energy use, published in the HMT Green Book supplementary guidance as above.
    c. **Long run variable costs (LRVC) of energy supply**: value placed on changes in energy consumption, published in the HMT Green Book supplementary guidance as above.
    d. **Air quality damage costs:** value of damage caused by emissions of particulate matter (PM), nitrous oxides (NOx) and ammonia, from the HMT Green Book supplementary guidance and air quality advice from the Department for Environment, Food and Rural Affairs (DEFRA)[12].
    e. **Fuel costs**: cost of different fuels, published in the HMT Green Book supplementary guidance.
40. Most of the evidence used in the analysis is in line with the August 2019 RHI IA[13]. The updates to the evidence base are set out below.
41. For **biomethane**, the key changes in assumptions relative to previous RHI analysis are:
    a. **Feedstock mix**: biomethane plants can produce gas using a variety of feedstocks, including food waste, manure, sewage and crops. The feedstock mix has been updated to take into account the expected increase in food waste availability as a result of the proposed introduction of mandatory separate food waste collection set out in the

[11] The Green Book supplementary guidance can be found here: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[12] Guidance on air quality economic analysis can be found here: https://www.gov.uk/guidance/air-quality-economic-analysis
[13] The IA can be accessed here: https://www.legislation.gov.uk/ukia/2019/143/pdfs/ukia_20190143_en.pdf

government's Environment Bill. Further information on the estimation of the feedstock mix can be found in Annex C of the 'Future Support for Low Carbon Heat' IA. The feedstock mix affects the carbon savings, costs and air quality impact of biomethane plants. Further detail on the costs of different feedstocks can be found in Annex D of the 'Future Support for Low Carbon Heat' IA.

b. **Resource costs**: evidence on biomethane cost and performance has been updated where new evidence is available, including estimates of gate fees (payments to biomethane plants for collecting food waste) and the opportunity cost of capital. Further information can be found in Annex D of the 'Future Support for Low Carbon Heat' IA.

c. **Air quality impacts**: digestate is a by-product of the AD process which is typically spread on agricultural land as a fertiliser. However, it contains nitrogen that can be lost to the atmosphere as ammonia, a pollutant which can have significant effects on human health and the environment. BEIS have worked with DEFRA to estimate the impact of biomethane plants on ammonia emissions, an impact which was not quantified in previous RHI analysis. Further information can be found in Annex E of the 'Future Support for Low Carbon Heat' IA.

d. **Carbon emissions factor**: the carbon emissions factor has been updated to reflect the updated feedstock mix described above. Further information can be found in Annex F of the 'Future Support for Low Carbon Heat' IA.

e. **Fertiliser savings**: using digestate as a fertiliser can displace the use of synthetic fertilisers, resulting in cost savings for the agricultural sector, which are now included in the cost benefit analysis. Further information can be found in Section 4.7.1 of the 'Future Support for Low Carbon Heat' IA.

42. For domestic **heat pumps** we use updated evidence on resource costs. Further information can be found in Annex H of the 'Future Support for Low Carbon Heat' IA.

43. For **biomass**, we use updated emissions factors for particulate matter (PM) and nitrogen oxides (NOx). Previously, emissions factors were estimated using emissions certificates from RHI installations, which show the emissions from an installation tested under laboratory conditions. The previous and updated emissions factors for both domestic and large non-domestic biomass boilers are shown in Table 1.

a. **Domestic**: for domestic biomass supported through the DRHI rollover, emissions factors have been updated based on research into the level of performance of biomass boilers under the RHI[14]. The emissions factors are higher than used in previous analysis, as they reflect the real-world performance of boilers rather than tests performed under laboratory conditions.

b. **Non-domestic**: for non-domestic biomass and biomass CHP supported through the third allocation of TGs, we use emissions factors published in the European Monitoring and Evaluation Programme (EMEP) and European Environment Agency (EEA) air pollutant emission inventory guidebook 2016[15]. Data from the study on RHI boilers described above cannot be used for non-domestic boilers as the sample size is too small. However, the PM2.5 emissions from the tests that were carried out in the study were considerably higher than the assumptions from the EMEP/EEA guidebook due to installation and operating practice: in particular, installing oversized boilers and starting up and shutting down boilers many times a day lead to higher PM emissions. Avoiding boiler oversizing and encouraging appropriately sized heat stores would reduce PM emissions. Proposals in the NDRHI closure consultation document to introduce fuel

[14] Biomass boilers: measurement of in-situ performance: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance

[15] EMEP/EEA air pollutant emission inventory guidebook 2016, section 1.A.4: https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-4-small-combustion-2016/view

quality and maintenance standards for biomass boilers could further reduce the air quality impact of biomass (see Section 7.1.4 for discussion of fuel quality standards).

Table 1 - Biomass air quality assumptions

Emission factors (kg/kWh)	PM2.5	NOx
Previous assumption – all biomass	0.000054	0.000270
Updated assumption – domestic biomass	0.000216	0.000360
Updated assumption – large non-domestic biomass	0.000119	0.000756

44. For all technologies, the analysis uses data on actual scheme deployment up to the end of November 2019, and updated forecasts of future deployment described in Section 3.1.2.

3.1.2 Deployment

45. Deployment forecasts draw on a range of sources, including current trends in deployment, commercial intelligence and discussions with industry. These are used to develop central estimates of the likely deployment for each technology under Option 1 and the counterfactual. The cost benefit analysis assesses the impact of the additional deployment supported by Option 1 relative to the counterfactual.

Domestic RHI extension

46. The DRHI extension is expected to bring forward additional deployment of all technologies supported under the DRHI. In line with trends observed over the last few years[16], we expect the majority of deployment to be air source and ground source heat pumps, with a small number of biomass and solar thermal applications.

Flexible third allocation of Tariff Guarantees

47. Tarif Guarantees are available for the following technologies:
    a. Biomethane plants of all sizes;
    b. Ground and water source heat pumps (G&WSHPs) with capacity over 100KW;
    c. Solid biomass combined heat and power (CHP) plants of all sizes;
    d. Solid biomass boilers with capacity over 1MW;
    e. Biogas combustion plants with capacity over 600KW;
    f. Deep geothermal plants of all sizes.
48. TG applications so far have been dominated by biomethane plants and G&WSHPs, with a small number of CHP and biomass applications. As of February 2020, there had been no TG applications for biogas or geothermal plants[17].
49. Under Option 0, TG plants are required to commission by 31 January 2021. The third allocation of TGs is expected to bring forward additional deployment relative to Option 0 by allowing plants to commission until 31 March 2022 as long as financial close information is submitted by 31 March 2021. The impact of the third allocation of TGs on deployment for each technology is estimated based on recent trends in applications for TGs and the wider NDRHI and market intelligence.

[16] Monthly deployment data by technology on the DRHI can be found in table M2.2 of RHI statistics https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

[17] Tariff Guarantee application data by technology can be found in table 1.6 of RHI statistics https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

50. The impact of Option 1 on deployment by technology is estimated as follows:

    a. **Biomethane**: biomethane deployment has come almost exclusively through TGs since they were introduced in May 2018. Biomethane plants are typically very large projects with a long lead time for construction and requiring significant up-front investment, and TGs provide the certainty on tariff levels needed for investors to fund projects. By providing additional time for new projects to develop and commission, the third allocation of TGs under Option 1 is expected to bring forward 6 additional biomethane plants in the central case.

    b. **G&WSHPs**: there has been strong deployment of G&WSHPs through the TG route: as of February 2020, there were 84 G&WSHP TG applications, of which 19 had been granted. The third allocation of TGs is expected to bring forward 60 additional large G&WSHPs in the central case.

    c. **Large biomass and solid biomass CHP**: there have been a small number of TG applications for large biomass and CHP, we therefore expect a limited amount of additional deployment of each through the third allocation of TGs.

    d. **Large biogas and deep geothermal**: we have seen no TG applications for either large biogas or deep geothermal, so in the central case we assume there will be no additional deployment of either technology.

3.1.3 Costs and Benefits

51. Analysis has been conducted to estimate the costs and benefits associated with the additional renewable heating installations supported as a result of Option 1 relative to the counterfactual of closing the RHI in March 2021.

52. The quantified costs and benefits contributing 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 costs, including capital, fuel and running costs.

    b. **Carbon savings**: the estimated value of the changes in carbon emissions in both the traded and non-traded sectors due to heat from renewable sources replacing heat from fossil fuels.

    c. **Air quality impacts**: the estimated value of the health impacts of changes to emissions of nitrogen oxides, particulate matter and ammonia. In previous RHI IAs, ammonia emissions were not quantified, but as described in paragraph 41, BEIS and DEFRA have now developed a methodology to estimate the ammonia emissions from biomethane production. These emissions can be monetised using air quality damage costs, and therefore now contribute to the NPV. Inclusion of ammonia emissions results in a significant decrease in NPV relative to previous RHI analysis.

    d. **Fertiliser savings**: the fertiliser costs avoided by the agricultural sector from the use of digestate, where it displaces synthetic fertiliser use. In previous RHI IAs, this benefit had not been quantified, but it is now monetised as described in paragraph 41.

53. The value placed on changes in greenhouse gas (GHG) emissions described in point b is currently under review, as the UK has now increased its domestic and international ambitions. Accordingly, current central carbon values[18] are likely to undervalue GHG emissions, though the scale of undervaluation is still unclear. The potential impact of placing a higher value on GHG emissions can be illustrated by using the existing high carbon values

[18] The Green Book Supplementary Guidance on valuing energy use and greenhouse gas emissions publishes low, central and high values of carbon for sensitivity analysis: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

series, in addition to the prescribed central values (see sensitivity analysis in Section 4.2). The government is planning to review the carbon values during 2020.

54. There are also a number of costs and benefits that are not captured in the cost benefit analysis, including:

   a. **Renewable heat generation**: renewable heat generation is one of the main objectives of the RHI. There is no agreed value for renewable energy, so the contribution of installations supported by the RHI towards targets under the EU Renewable Energy Directive (RED) is not monetised. In the absence of the RHI, additional action would be required to meet our RED targets, the cost of which is not reflected in the NPV.

   b. **Supply chain development and smooth transition to future schemes**: by incentivising additional deployment of renewable heat technologies relative to the counterfactual, the changes to the RHI will support the development of renewable heat supply chains in technologies which the government is planning to support through various policy mechanisms in future years. This will provide a base for the mass roll-out of low-carbon heating in the 2020s which will be needed to achieve the government's target of net zero carbon emissions by 2050. For example, in the 'Future Support for Low Carbon Heat' consultation, the government is proposing to continue support for biomethane injection and small-scale heat pumps, and some biomass in buildings where heat pumps are not appropriate. The DRHI extension and the flexible TG allocation will support additional deployment in all of these technologies, ensuring that the supply chain is well placed to deliver the deployment required to unlock the benefits from future support schemes.

   c. **Innovation and cost reductions**: continued support for low carbon heat deployment could reduce costs and increase performance over time, as supply chains develop and barriers that customers currently face are reduced through technologies being deployed successfully.

   d. **Low carbon heat sector growth**: in 2018, the UK renewable heat sector directly supported 5,300 jobs and had a turnover of £1.2bn[19]. The extension of RHI support will help to secure the current supply chain and create the conditions for market expansion.

   e. **Health benefits**: for buildings-level installations, switching away from fossil fuels can lead to improved indoor air quality for occupants, improving their health. In addition, making energy efficiency improvements ahead of installing a low-carbon technology can improve the health of occupants, for example by reducing their risk of cardiovascular and respiratory diseases from warmer internal temperatures.

   f. **Rebound effect:** for some heat users, installing a low carbon heat technology and associated energy efficiency measures could lead to an efficiency-driven overall lowering of fuel bills. Lower bills may then lead to an overall increase in energy consumption. This has not been quantified because of the heterogeneity in household responses and the lack of evidence for heating. If monetised, the impact on the social net present value is uncertain: there would be a potential reduction in carbon savings, but increased welfare benefits.

55. 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 the UK's forested area.

[19] ONS low carbon and renewable energy economy data, 2018: https://www.ons.gov.uk/economy/environmentalaccounts/datasets/lowcarbonandrenewableenergyeconomyfirstestimatesdataset

3.2 Impacts Appraisal

3.2.1 Headline Impacts

56. This section sets out the impacts of the additional deployment driven by the changes to the RHI under Option 1, using the approach set out in Section 3.1. Uncertainty is discussed in Section 4.
57. Table 2 below sets out the headline impacts of change to the RHI. These relate to the additional deployment expected as a result of the DRHI extension and the flexible third allocation of TGs. The impacts of the NDRHI closure and reforms are discussed in Section 7.
58. Upstream carbon savings are those which result from the avoidance of emissions when certain feedstocks are used for AD rather than a different use. For more detail, see paragraphs 68-69.

Table 2 - Headline impacts of changes to the RHI

	Impact of changes
Net present value (NPV) (£m)	-65
Nominal spend (whole scheme) in 2020/21 (£m)	1,044
CB5 carbon savings (MtCO2e)	1.1
of which upstream	0.5
Renewable heat in 2030/31 (TWh)	0.7
Social non-traded cost of carbon (£/tCO2e)	84

3.2.2 Monetised Costs and Benefits

59. The components of the NPV calculation are shown in more detail in Table 3 below. They are based on the central deployment scenario. NPV calculations are based on discounted values cumulative over the policy lifetime.

Table 3 - Costs and benefits of changes to the RHI

Monetised costs and benefits (£m)	**DRHI extension**	**Third TG allocation**	**Total**
Net present value (NPV)	63	-128	-65
Resource costs	-80	-298	-378
Traded carbon savings	-5	2	-3
Non-traded carbon savings	92	214	306
Air quality impacts	56	-52	4
Fertiliser benefits	0	6	6

Figures may not sum due to rounding

60. There is uncertainty around the precise costs and benefits the changes to the RHI are likely to deliver for a variety of reasons including: the unknown deployment and performance of systems which may come forward; not knowing the mix of feedstocks that will be used, or how systems will be used by owners; and in particular the upstream greenhouse gas abatement from biomethane. The NPV is therefore subject to uncertainty - the impacts of key sensitivities are assessed in Section 4.2.
61. The NPV for the DRHI extension is positive: the value of carbon savings in the non-traded sector and improved air quality is higher than the resource cost incurred as a result of the policy.

62. The NPV for the third TG allocation is negative: although the policy offers significant carbon savings in the non-traded sector, there are also substantial resource costs as low carbon heating installations are more expensive than fossil fuel systems. There are also air quality costs as a result of ammonia emissions from the spreading of digestate in AD and PM and NOx emissions from biomass boilers. Relative to previous RHI analysis, the monetised air quality impacts of biomass and biomethane are significantly higher due to the newly quantified impact of ammonia emissions described in paragraph 41 and the improved evidence on biomass emissions factors described in paragraph 43.

63. The NPV for the changes to the RHI is negative overall in the central case, with costs of £381m and benefits of £315m. However, this analysis does not take into account a range of non-monetised benefits described in paragraph 54. As described in Section 3.2.3, these would increase the NPV if monetised. Additionally, as described in paragraph 53, the value of carbon savings in the non-traded sector, the key benefit of this policy, is likely to be an underestimate. As shown in Section 4.2, using a higher value for carbon emissions results in a positive NPV.

3.2.3 Non-monetised Costs and Benefits

64. As outlined in paragraph 54, there are a number of non-monetised costs and benefits of the changes to the RHI. Our overall qualitative assessment of the likely direction of impacts is set out in Table 4.

Table 4 - Non-monetised costs and benefits

Non-monetised impact	Likely impact on NPV if quantified
Renewable heat generation	**Positive** – the value of renewable heat and the contribution it makes towards renewable energy targets is not monetised. In the absence of the proposed changes to the RHI, additional action would be required to meet our renewable energy targets, the cost of which is not reflected in the NPV.
Supply chain development and smooth transition to future schemes	**Positive** – continuing to support low carbon heat deployment through the changes to the RHI will ensure the supply chain is well placed to deliver deployment on future schemes required to meet decarbonisation commitments. For example, the flexible third allocation of TGs will smooth the transition between the RHI and the Green Gas Support Scheme, minimising disruption to the biomethane supply chain and hence increasing biomethane deployment under the Green Gas Support Scheme relative to a scenario where no changes to the RHI are made. Market intelligence suggests that the changes to the RHI could unlock additional biomethane capacity on the future scheme, delivering an additional 3.4 $MtCO_2e$ of carbon savings over the lifetime of plants and worth £16m in NPV terms. This is not included in the NPV of the changes to the RHI to avoid double-counting the benefits of deployment under the Low Carbon Heat Support Mechanism.
Innovation & cost reductions	**Positive** – improvements to technologies will reduce the costs of low carbon heating systems, reducing the cost of the mass rollout of low carbon heat which will be required in the 2020s to meet the Net Zero target.

Low carbon heat sector growth	**Positive** – continued support for low carbon heat will help to secure jobs and businesses in the low carbon heat sector and create market conditions for expansion. However, this needs to be balanced against changes in the fossil fuel heating sector, therefore the overall economic impact on the heating market is uncertain.
Health benefits	**Positive** – switching away from fossil fuels can lead to improved indoor air quality for occupants, having a positive impact on health. In addition, making energy efficiency improvements ahead of installing a low carbon heating system can lead to a warmer home, further improving the health of occupants.
Rebound effect	**Uncertain** – a reduction in bills could lead to an increase in energy use. This would result in a decrease in carbon savings but an increase in welfare benefits, so it is uncertain whether the net effect would be positive or negative.

65. Overall, the non-monetised impacts are likely to have a significant positive impact on NPV if quantified.

3.2.4 Greenhouse Gas Abatement

66. Table 5 below shows the additional greenhouse gas savings estimated to be supported over Carbon Budgets (CB) 4 and 5 and the lifetime of the RHI due to the proposed changes to the RHI. The table also shows how much of the savings occur in the traded and non-traded sectors, and how much of the savings are upstream.

Table 5 - Carbon abatement of changes to the RHI

Carbon abatement (MtCO2e)	CB4 (2023 - 2027)	CB5 (2028 - 2032)	Lifetime
Carbon savings relative to counterfactual	1.0	1.1	4.4
(Traded / Non-traded)	(-0.0 / 1.1)	(-0.1 / 1.1)	(-0.1 / 4.4)
of which upstream	0.4	0.5	1.8

Figures may not sum due to rounding

67. These savings arise from additional deployment as a result of the proposed changes to the RHI. There is uncertainty in these estimates: for a given level of deployment, the level of carbon abatement is dependent on the amount of heat generated by the additional installations and the efficiency of the systems, as well as the feedstock used for biomethane plants.

68. The carbon savings estimates include upstream savings from biomethane plants. Direct emissions savings are those which occur at the point of fuel combustion, while upstream savings result from the avoidance of emissions which would have occurred if biomethane feedstock had been put to a different use. 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 the emissions from the decomposition of the food waste into methane are avoided.

69. There is significant uncertainty associated with the estimated greenhouse gas abatement which will result from upstream emissions abatement associated solely with the RHI, driven by uncertainties around the counterfactual disposal of feedstocks, the feedstock mix used, and the attribution of savings between the RHI and policies in the waste sector. For example, a lower proportion of deployment from plants using feedstocks with high potential

for upstream savings (food waste and manure) would result in lower emissions savings. On balance, the uncertainty means the figures presented here for upstream savings should be interpreted as an upper bound. For further detail on the impact of upstream savings, see the 'no upstream savings' sensitivity analysis in Section 4.2.

70. In particular, there is uncertainty around the counterfactual disposal of food waste. In the central case, we assume all of the additional food waste used would otherwise have gone to landfill. The rationale for this assumption is described in Annex A of the August 2019 RHI IA[20], and further detail on the impact of this assumption can be found in the 'food waste counterfactual' sensitivity analysis in Section 4.2.

71. Table 6 shows the carbon abatement from the DRHI extension and the third allocation of TGs. Note that as upstream savings only occur in AD, which is not supported in the DRHI, there are no upstream savings from the DRHI.

Table 6 - Carbon abatement of DRHI extension and third TG allocation

Carbon abatement (MtCO2e)	CB4 (2023 - 2027)	CB5 (2028 - 2032)	Lifetime
DRHI extension	0.3	0.3	1.2
Third TG allocation	0.8	0.8	3.1
of which upstream	0.4	0.5	1.8
Total	1.0	1.1	4.4

Figures may not sum due to rounding

3.2.5 Renewable Heat

72. Table 7 below provides estimates of renewable heat generation as a result of the proposed changes to the RHI in 2030/31.

Table 7 - Renewable heat supported by changes to the RHI

Renewable heat (TWh)	2030/31
DRHI extension	0.2
Third TG allocation	0.5
Total	0.7

73. The proportion of heat which is eligible for RED accounting varies by technology. For example, for biomass, the RED definition is on the basis of total input energy rather than output energy. Therefore, the renewable heat figures in the table are not equal to the total heat generated by the installations supported by the changes to the RHI.

3.2.6 Air Quality Impact

74. Table 8 below shows the additional annual ammonia emissions from biomethane as a result of the proposed changes to the RHI. The methodology used to estimate these emissions is described in Annex E of the 'Future Support for Low Carbon Heat' IA.

[20] The August 2019 RHI IA can be accessed here: https://www.legislation.gov.uk/ukia/2019/143/pdfs/ukia_20190143_en.pdf

Table 8 - Annual ammonia emissions from changes to the RHI

Feedstock	Energy mix	Feedstock processing and storage (Kt)	Digestate storage (Kt)	Digestate spreading (Kt)	Total ammonia emissions* (Kt)
Food Waste	50%	0.003	0.026	0.13	0.15
Maize	20%			0.07	0.08
Manure	5%			0.10	0.11
Sewage	25%	-	-	-	-
Total additional emissions from digestate					**0.33**
Net ammonia emissions where 50% of digestate nitrogen displaces fertilisers					0.32

*processing and storage emissions been apportioned by quantity of feedstock or digestate, as appropriate

3.2.7 Spend Impact

75. The forecasts of deployment under the DRHI extension and flexible third allocation of TGs described in Section 3.1.2 can be used to estimate the additional government spend as a result of the changes to the RHI, set out in Table 9.

76. There is uncertainty around these deployment forecasts, detailed in Section 4. To illustrate the impact of this uncertainty on spend, Table 9 also shows the spend under high and low deployment scenarios.

77. Payments are made for seven years after accreditation on the DRHI, so spend on the DRHI extension will continue until 2028/29. On the standard NDRHI, payments are made for twenty years after accreditation. However under the third allocation of TGs, as detailed in Annex A, the twenty year payment period will start from the submission of Stage 2 information, which must take place by 31 March 2021. Therefore, spend on the new TG allocation will continue until 2040/41.

Table 9 - Spend on changes to the RHI

Spend on changes to RHI (nominal, £m)	2021/22	2022/23	2023/24	2024/25	2025/26 - 2040/41	Total
Central deployment scenario	17	39	42	45	529	**672**
Of which DRHI extension	12	22	23	23	83	**162**
Of which third TG allocation	5	17	20	22	447	**510**
High deployment scenario	20	50	55	59	749	**933**
Of which DRHI extension	15	27	27	28	99	**195**
Of which third TG allocation	6	23	28	32	650	**739**
Low deployment scenario	13	29	32	34	376	**485**
Of which DRHI extension	10	18	18	18	66	**130**
Of which third TG allocation	4	12	14	15	310	**355**

Figures may not sum due to rounding

3.2.8 Administrative Costs

78. Ofgem will administer the proposed changes to the RHI as part of their ongoing administration of the whole scheme. Estimates of the additional administrative costs as a result of the proposed changes to the RHI are shown in Table 10.

79. Keeping the DRHI open for another year will incur additional costs in 2021/22 relative to the counterfactual as Ofgem continue to process new applications. The cost of delivering an additional year of the DRHI in 2021/22 is based on the latest annual administration cost of the DRHI.

80. The flexible third allocation of TGs will also incur additional costs in 2020/21 and 2021/22 relative to the counterfactual, as Ofgem will need to process additional TG applications and stage 2 and 3 information (see Annex A for details of application process). The cost of delivering the third allocation of TGs is informed by the latest annual administration cost of administering the NDRHI, adjusted to take into account the fact that only certain installations are eligible for TGs; these costs are uncertain and will depend on the volume of applications.

81. Beyond 2021/22, where the RHI will be closed to new applications and administration will only involve existing applicants, the proposed changes to the RHI are not expected to have a significant impact on administrative costs relative to the counterfactual.

Table 10 - Administrative costs of changes to the RHI

Administrative costs (£m)	2020/21	2021/22	2022/23 onwards
DRHI extension	0	5	0
Flexible third allocation of TGs	1	0.5	0
Total	1	5.5	0

4. Uncertainty

4.1 Sources of Uncertainty

82. This section discusses the uncertainty around the analysis in Section 3. Two areas of uncertainty affect this analysis: uncertainty in estimating deployment levels and uncertainty in the costs and benefits derived from this deployment.

    a. **Uncertainty in estimating deployment levels**: the RHI is a demand-led scheme, making it difficult to anticipate the level of deployment which will come forward as a result of the extension to the scheme. The factors leading households and firms to install renewable heating systems are not consistent or predictable.

    b. **Uncertainty in the costs and benefits deriving from deployment**: there are a number of uncertainties around the costs and benefits of any given installation, dependent on how the system is used, what it is replacing, and how we monetise the benefits accrued.

83. Sensitivity analysis has been conducted to assess the impact of the key uncertainties on the NPV and carbon abatement.

4.2 Sensitivity Analysis

84. The sensitivities considered in this section are:

    a. **High and low deployment**: there is uncertainty around the level of deployment that will be brought forward by the extension to the RHI. These sensitivities use high and low deployment estimates as set out in Section 3.1.2.

    b. **High carbon price**: in valuing carbon emissions for appraisal purposes, the UK government adopts a target-consistent approach, based on estimates of the abatement costs that will need to be incurred in order to meet specific emissions reduction targets[21]. There is uncertainty around these values. As described in paragraph 53, the central carbon values are likely to undervalue GHG emissions; this sensitivity uses the high carbon price series published in the Green Book supplementary guidance in April 2019[22] to show the impact of placing a higher value on GHG emissions.

    c. **Food waste counterfactual**: there is uncertainty in the counterfactual disposal of food waste used for AD which has an impact on the emissions savings associated with use of food waste as a feedstock. In the central case, we assume all of the additional food waste used would otherwise have gone to landfill. To test this assumption with sensitivity analysis, we assume that food waste used for AD would otherwise have been split between landfill and incineration (with or without energy recovery) in the same proportions as Local Authority collected waste disposal in 2018/19 (20% landfill, 80% incineration)[23].

    d. **No upstream carbon savings from AD**: there is significant uncertainty in the upstream emissions savings from AD driven by uncertainty around the mix and counterfactual disposal of feedstocks. Additionally, there are policies in the waste sector which impact

[21] Further details on BEIS's approach to valuing greenhouse gas emissions can be found here: https://www.gov.uk/government/collections/carbon-valuation--2

[22] The Green Book supplementary guidance can be found here: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[23] Calculated from Table 2, Statistics on waste managed by local authorities in England in 2018/19 (MHCLG): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/849167/201819_LA_collected_waste_mgt_annual_Stats_Notice_FINAL_Accessible_v4.pdf

the disposal of waste in landfill, raising questions of attribution of carbon savings. This sensitivity assumes no upstream savings from AD.

85. The analysis focusses only on the additional deployment as a result of the DRHI extension and flexible third allocation of TGs. Sensitivities related to deployment in the counterfactual are not in scope of this IA.

86. Table 11 shows the impacts of the sensitivities on the NPV and CB5 carbon abatement. No upstream savings results in the largest decrease (-£103m) in NPV, while high carbon price leads to the biggest increase (£151m), reflecting the sensitivity of the NPV to assumptions around carbon savings and the value associated with them. No upstream savings and food waste counterfactual lead to the biggest decrease in carbon abatement (-0.5 and -0.4 $MtCO_2e$ respectively), while high deployment leads to the largest increase (0.5 $MtCO_2e$).

Table 11 - Sensitivity analysis

Sensitivity	NPV (£m)	Change in NPV (£m)	CB5 carbon abatement ($MtCO_2e$)	Change in CB5 carbon abatement ($MtCO_2e$)
Central	*-65*	*n/a*	*1.1*	*n/a*
High deployment	-81	-16	1.6	0.5
Low deployment	-43	23	0.8	-0.3
High carbon price	86	151	1.1	0.0
Food waste counterfactual	-156	-91	0.6	-0.4
No upstream savings	-168	-103	0.6	-0.5

5. Impacts of Whole Scheme

5.1 Headline Impacts of Whole Scheme

87. The updates to the evidence base and deployment forecasts described in Section 3 have been used to update estimates of spend, carbon savings and renewable heat generated by the whole RHI. This includes both installations currently on the scheme and deployment expected to come on to the scheme between December 2019 and March 2022 under Option 1. The headline results are shown in Table 12. As this IA is focussed on the proposed changes to the RHI, the cost benefit analysis focusses on the marginal impact of these changes; therefore, we do not present an NPV or social non-traded cost of carbon for the whole scheme.

Table 12 - Headline impacts of whole RHI

	Impact of whole RHI
Net present value (NPV) (£m)	*not in scope*
Nominal spend (whole scheme) in 2020/21 (£m)	1,044
CB5 carbon savings (MtCO2e)	30.6
of which upstream	11.6
Renewable heat in 2020/21 (TWh)	20.3
Social non-traded cost of carbon (£/tCO2e)	*not in scope*

5.2 Deployment and Spend on Whole Scheme

88. Table 13 shows the estimated spend on the RHI against the scheme budget cap in 2020/21. There is uncertainty around the level of deployment expected; to illustrate this uncertainty, we present expected spend under central, high and low deployment scenarios, which are all within the scope of market potential. Note that these scenarios do not capture the uncertainty around spend on committed installations: on the NDRHI, where participants are paid based on the amount of heat they generate, spend can vary in line with annual heat generation. For example, when there is a cold winter, heat generation and hence spend may increase.

Table 13 - Spend on the whole RHI

Nominal spend (£m)	2020/21
Budget cap	*1,150*
High deployment scenario	1,056
Central deployment scenario	1,044
Low deployment scenario	1,031

5.3 Benefits of Whole Scheme

89. In line with the policy objectives, the RHI is expected to support a significant amount of greenhouse gas abatement and renewable heat, contributing to Carbon Budget targets.

90. Table 14 details the expected carbon abatement of the RHI, including the split of carbon savings between the traded and non-traded sectors. As discussed in paragraph 69, there is significant uncertainty around upstream carbon abatement, and as such the estimates of upstream carbon savings should be treated as an upper bound.

Table 14 - Carbon abatement from the whole RHI

Carbon abatement (MtCO2e)	CB4 (2023 - 2027)	CB5 (2028 - 2032)	Lifetime
Committed RHI deployment (up to Nov 2019)	27.6	27.2	107.5
of which upstream	10.6	10.6	40.7
Future RHI deployment (Dec 2019 - March 2022)	3.4	3.5	13.5
of which upstream	1.0	1.0	3.8
Total (Traded / Non-traded)	30.9 (1.5 / 29.4)	30.6 (1.5 / 29.1)	121.1 (6.1 / 115.0)
of which upstream	11.6	11.6	44.6

Figures may not sum due to rounding

91. Table 15 shows how much renewable heat the whole scheme is expected to support in 2020/21 and 2030/31, broken down by committed and future deployment.

Table 15 - Renewable heat supported by whole RHI

Renewable heat generated (TWh)	2020/21	2030/31
Committed RHI deployment (up to Nov 2019)	19.3	20.2
Future RHI deployment (Dec 2019 - March 2022)	1.0	2.4
Total	20.3	22.6

Figures may not sum due to rounding

6. Extension of Commissioning Deadline for Existing Tariff Guarantees

92. This section qualitatively describes the likely impact of the extension of the commissioning deadline for existing TGs proposed under Option 1. This proposal is intended to mitigate the impact of delays to development and construction of low carbon heat projects as a result of the COVID-19 outbreak. Such delays are putting projects at risk of failing to commission by the current deadline.

93. There is currently significant uncertainty around the impacts of the COVID-19 outbreak on the RHI, due to uncertainty around the duration and scope of restrictions and their impacts on different parts of the supply chain. At this stage, it is therefore not possible to accurately quantify the impacts of this proposal.

94. Under Option 0, it is likely that some plants will not be able to meet their commissioning deadline due to COVID-19-related delays. They would therefore lose their guaranteed tariff and could only secure RHI support by reapplying for the current tariff, which may be lower as a result of degression. If a degression occurs, some projects will become unviable at a lower tariff and will therefore drop out of the scheme entirely. There is also an admin burden associated with reapplying; for some applicants, this burden may be too great given the wider stresses on the industry due to COVID-19, so these projects would not reapply and hence would also fail to commission.

95. The extension of the commissioning deadline for the current cohort of TGs under Option 1 will give applicants more time to commission and keep their guaranteed tariff compared to Option 0. Therefore, Option 1 will reduce the number of installations dropping out of the RHI as a result of COVID-19-related delays, so the deployment of low carbon heating installations will be higher under Option 1 than Option 0. The additional deployment under Option 1 will result in higher carbon savings and renewable heat generation relative to the counterfactual, providing vital contributions to the government's Carbon Budget targets.

96. In addition, by preventing the failure of projects, Option 1 will reduce the impact of the COVID-19 outbreak on the renewable heat supply chain and businesses investing in renewable heat. As TG plants are typically large installations requiring significant up-front investment, projects being abandoned could result in substantial cost to businesses where capital has already been invested. The failure of projects would also damage investor confidence in the renewable heat sector; this could discourage investment in low carbon heat in the longer term, which would affect the government's ability to meet its target of net zero emissions by 2050. Option 1 would mitigate these impacts by giving more time for projects to commission, reducing the number of projects that fail.

7. Non-Domestic RHI Closure and Reforms

97. This section assesses the impacts of the reforms to the NDRHI proposed in the 'Non-Domestic Renewable Heat Incentive – ensuring a sustainable scheme' consultation document. There are many interacting reforms proposed in Option 1, each with a small impact when considered separately; it was not considered proportionate to attempt to quantify every reform individually. Instead, a qualitative assessment of each reform has been produced. The impact of the NDRHI reforms proposed in Option 1 is therefore not presented in net present value terms.

98. The impact of each policy proposal is considered relative to a counterfactual where the scheme closes but the particular change is not applied, to show the marginal impact of each reform. Each table below qualitatively describes the impact of a specific policy 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 pound of subsidy spent;

    d. Other impacts not covered by the above.

99. These criteria were chosen for the qualitative assessment of the proposed reforms as they best demonstrate the impacts of these reforms on delivering the objectives of the RHI, namely renewable heat generation and reduction in carbon emissions.

100. This section covers the specific measures proposed in the consultation document that are likely to have a significant impact on renewable heat, carbon savings or cost-effectiveness. It does not cover sections of the consultation document which seek input from the public without proposing a specific change[24]. Other minor changes to the NDRHI that form part of the consultation have also not been assessed; these are likely to only affect a small number of installations, hence their impact is expected to be limited[25].

101. Further detail on each of the proposals can be found in the consultation document.

7.1 Marginal impact of proposed reforms

7.1.1 Modified capacity for shared ground loop systems

	Likely impact of reform
Reform objective	This reform makes a provision for shared ground loop applicants to modify capacity after scheme closure to respond to increased/reduced heat demand. For example, new heat pumps could be added to an existing loop. This aims to ensure installed capacity is fully utilised and hence maximise the benefits from shared ground loop systems supported on the RHI.
Renewable heat generation	This reform may lead to an increase/reduction in renewable heat being generated by individual shared ground loops, depending on whether capacity is added or removed. We expect that this provision will mainly be utilised by applicants wishing to add new

[24] This includes the following sections of the consultation document: (i) shared ground loops for domestic properties; (ii) additional changes for heat pumps; (iii) biomass maintenance and air quality; (iv) combined heat and power; (v) solar thermal; (vi) replacement plant; (vii) future technology; (viii) other NDRHI issues.

[25] The impact of the following minor changes to the NDRHI has not been assessed: (i) contamination of feedstocks for biomethane; (ii) waste wood for biomass; (iii) installation meters;

	heat pumps onto existing ground loops, hence increasing capacity and therefore renewable heat generation from shared ground loops overall.
Carbon savings	Assuming that the increased heat demand would be met by fossil fuels were it not possible to add heat pumps to an existing loop, this reform will likely have a positive impact on carbon savings.
Renewable heat/carbon cost-effectiveness	Participants on the NDRHI are paid a tariff per kWh of heat generated. Making a provision to modify capacity of shared ground loop systems following RHI closure does not have an impact on the tariff, i.e. it does not change the cost to the taxpayer of generating a unit of renewable heat or abating a unit of carbon emissions. Therefore, this reform will not have an impact on renewable heat/carbon cost-effectiveness.
Other impacts	This reform allows for a more efficient utilisation of assets, preventing shared ground-loops from being underutilised and allowing capacity to be adjusted to changes in heat demand. By allowing capacity to commission in phases rather than requiring all capacity to be online by the closure date, this reform may also encourage deployment of projects with long lead-in times close to the RHI closure date; in absence of this reform, total planned capacity of these projects would not be commissioned with confidence prior to closure. Adding capacity to an existing shared ground loop will likely involve increased upfront cost (as new heat pumps will need to be installed). However, this cost is likely to be marginal compared to the initial cost of setting up a shared ground loop. By adding capacity, the upfront cost of setting up a shared ground loop will be spread over larger heat generation, making it more cost-effective for RHI participants to undergo the investment associated with installing a shared ground loop. Finally, there will be a cost to the administrator associated with processing these changes in capacity.

7.1.2 Biomethane: change of registered producer

	Likely impact of reform
Reform objective	This reform introduces a provision to allow the transfer of registration for production of biomethane and the associated RHI payments between two parties, avoiding stranded assets and allowing plants to continue operating for the lifetime of their RHI payments.
Renewable heat generation	Allowing the registration for production to be transferred between owners will make it possible for biomethane plants to continue injecting gas when the original registered producer does not wish to continue operating the plant. This will allow high-value assets to continue to be utilised and increase the amount of renewable heat being generated.
Carbon savings	With a higher amount of biomethane being injected in the gas grid, the grid’s carbon intensity will decrease, and any given unit of heat will be less carbon intensive. This translates into increased carbon savings.

Renewable heat/carbon cost-effectiveness	As RHI payments for biomethane are administered through tariffs on injected biomethane, this reform will not have a significant impact on renewable heat/carbon cost-effectiveness. The reform will lead to increased biomethane production and a corresponding increase in payments.
Other impacts	This reform entails positive benefits for the biomethane industry: biomethane plant owners will be able to sell their plants and hence avoid stranded assets, while prospective buyers will be able to acquire new plants and their associated RHI payments. In addition, there will be a cost to the administrator associated with transferring registrations for production.

7.1.3 Biomethane: interaction with other schemes

	Likely impact of reform
Reform objective	This reform aims to maximise biomethane injection and enables plants to benefit from diversified revenue streams by allowing biomethane producers to claim support from both the RHI and other schemes, such as the Renewable Transport Fuel Obligation (RTFO)[26], within a given quarter. Under both the RHI and RTFO, producers claim payments after gas is injected into the gas grid; this gas can then be extracted for use in either heating or transport.
Renewable heat generation	This reform will likely lead to increased biomethane injection, as biomethane producers will have an incentive to continue generation even beyond the limit for tier 1 payments, at which point being able to claim Renewable Transport Fuel Certificates (RTFCs) on some of the biomethane produced in a quarter may represent an incentive to continue generation. Increasing the proportion of biomethane in the gas grid will result in increased renewable heat generation.
Carbon savings	With a higher amount of biomethane being injected in the gas grid, the grid's carbon intensity will decrease. This translates into increased carbon savings.
Renewable heat/carbon cost-effectiveness	The impact of this reform on the cost-effectiveness of biomethane supported by the RHI is uncertain. The cost-effectiveness depends on the proportion of biomethane produced at each tier of tariff. In general, the higher the proportion of biomethane produced at Tiers 2 and 3, the more cost-effective biomethane supported by the RHI becomes, as the tariff is lower at Tiers 2 and 3 than at Tier 1. Although the reform aims to maximise biomethane injection across all schemes, the amount of biomethane supported by the RHI at each tier will vary depending on: • the relative value of RHI tariffs at Tier 1, Tier 2 and Tier 3; • the price of RTFCs, which is market-driven and hence fluctuates over time; and • any support from other schemes that have not yet been implemented.

[26] RTFO guidance can be found here: https://www.gov.uk/guidance/renewable-transport-fuels-obligation

	Due to the uncertainty around RTFC prices and future support, it is not possible to predict how the share of biomethane produced at each tier will change over the duration of the payment lifetime, hence the impact on cost-effectiveness of the RHI is uncertain.
Other impacts	This reform gives biomethane producers the opportunity to diversify their revenue streams. In particular, the ability to claim RHI payments alongside RTFC payments gives producers additional certainty regarding the amount they receive per kWh of heat generated; while the RTFC price is market-driven and can fluctuate, RHI tariffs are constant. The reform may also have an impact on the RHI budget. For example, if biomethane producers diverted biomethane away from the RHI if support from another scheme was more appealing, RHI spend would decrease. Similarly, RHI spend would increase if support from another scheme was less appealing and RHI support attracted additional biomethane production. Finally, this reform makes the scheme more complex to administer, which may incur additional costs to the scheme administrator.

7.1.4 Biomass fuel quality standards

	Likely impact of reform
Reform objective	This reform aims to reduce the impact of biomass boilers on air quality by introducing fuel quality standards to improve fuel efficiency and reduce emissions of harmful pollutants (nitrogen oxides and particulate matter).
Renewable heat generation	The impact on renewable heat generation is not expected to be significant, as the amount of heat generated is unlikely to change.
Carbon savings	Increased fuel efficiency stemming from stricter fuel quality standards will likely result in a decrease in the amount of fuel needed to generate a given quantity of heat. This will likely result in higher carbon savings.
Renewable heat/carbon cost-effectiveness	Participants on the NDRHI are paid a tariff per kWh of heat generated. Because it is expected that fuel efficiency increases with fuel quality standards, more kWh of heat will be generated by each unit of higher-quality fuel. This reform will lead to more carbon savings per kWh of heat. As a result, this change will improve the carbon savings per pound of government subsidy, hence improving carbon cost-effectiveness. As the tariff per kWh of renewable heat generated is not impacted by this reform, renewable heat cost-effectiveness is not expected to change.
Other impacts	The introduction of fuel quality standards will lead to improved air quality by reducing emissions of harmful substances such as particulate matter. It will also lead to consumers using higher-quality fuel. It is expected that fuel efficiency increases with fuel quality; consumers will therefore use less fuel to meet a given heat demand. This reform will likely result in increased energy savings for consumers. In addition, using higher-quality biomass is likely to increase the lifespan of biomass boilers. This represents a benefit to RHI claimants, who would replace their boiler less frequently than if lower-quality fuel is used.

	However, higher-quality fuel may be more expensive than the fuel used prior to this reform. If an increase in fuel costs is not outweighed by the gains in efficiency, RHI claimants may face higher fuel costs. There may also be one-off costs to fuel suppliers in introducing the standard. Finally, there may be additional costs to the Biomass Suppliers' List and the scheme administrator who will be responsible for enforcing the fuel quality standard.

7.1.5 Removal of additional capacity regulations

	Likely impact of reform
Reform objective	This reform aims to remove the option to add capacity to an existing installation following the closure of the RHI to new applicants from 1st April 2021.
Renewable heat generation	In absence of this reform, capacity could be added to existing installations subject to installation constraints. Adding capacity would increase renewable heat being generated. Following this reform, as capacity cannot be added to existing installations, renewable heat generation may be lower than prior to this reform being introduced.
Carbon savings	If heat demand that would have been met by renewable generation prior to this reform is now met by conventional fossil fuels, the impact on carbon savings may be negative.
Renewable heat/carbon cost-effectiveness	Participants on the NDRHI are paid a tariff per kWh of heat generated. Ending the option to add capacity to an existing installation does not have an impact on the tariff, i.e. it does not change the cost to the taxpayer of generating a unit of renewable heat or abating a unit of carbon emissions. Therefore, this reform will not have an impact on renewable heat/carbon cost-effectiveness.
Other impacts	By removing the option to add capacity after closure, this reform will result in greater certainty in protecting the allocated budget for the RHI over the remaining lifetime of payments. There is a cost to the scheme administrator associated with managing requests to add capacity to an existing installation. By removing the option to add capacity, this reform will likely reduce scheme administrator costs.

8. Monitoring and Evaluation

102. An externally commissioned evaluation is already underway for the Domestic and Non-Domestic RHI scheme, so it is not deemed proportionate to commission a bespoke evaluation to cover the changes to the RHI proposed here. Instead, the BEIS evaluation team are planning to extend the current evaluation contract; this is going through internal approvals. The current monitoring arrangements whereby Ofgem collect detailed information from applicants is expected to continue in order to support budget management, reporting of official statistics and the evaluation.

103. Assuming that the current evaluation contract can be extended, the new work on the extended RHI scheme will be integrated into the wider evaluation project. The current evaluation is adopting a theory-based evaluation method which uses multiple sources of evidence collection and analysis to assess the causal impact of the RHI on renewable heat deployment, as well as generating evidence which can inform future policy development.

104. The current evaluation already has resources planned to target detailed evidence collection and analysis at domestic heat pump applicants, Tariff Guarantee applicants and the supply chain covering both areas. It is expected that these workstreams will be retained while their timing will be adapted to align more effectively with the scheme extension.

105. A final evaluation report was due to be completed 6 months after the scheduled close of the RHI scheme in March 2021. The timing of this will be reassessed to align with the extension of the RHI.

A. Annex A: Flexible Third Allocation of Tariff Guarantees

106. This annex provides some detail on how the flexible third allocation of Tariff Guarantees (TGs) would work. TGs were introduced in 2018 to provide investment certainty to larger, better value for money installations. From an applicant's perspective there are three stages to the TG process:

a. **Stage 1**: expression of interest to the scheme administrator with high level detail about the plant. At this point a Provisional Tariff Guarantee Notice (PTGN) is granted.

b. **Stage 2**: once an applicant has received a PTGN they are required to reach financial close on the project before a tariff will be granted, there are also requirements for biomethane developers to evidence grid entry agreements by this point. Once evidence of financial close has been approved by the scheme administrator, a guaranteed tariff will be awarded.

c. **Stage 3**: the plant is built and commissions. The scheme administrator then accredits the plant for payments as they would do with a plant that might have applied through the standard NDRHI route. Plants receive payments for 20 years from the point Stage 3 has been passed.

107. For the flexible third allocation of TGs, we are proposing to change the administration of TGs so that developers will only have to submit properly made Stage 2 financial close information by 31 March 2021, when the NDRHI is currently scheduled to close. The 20-year payment period would start from Stage 2 evidence being submitted rather than Stage 3 under the current system. Plants would have to commission by 31 March 2022 to receive payments.

108. In a worked example, if a plant submitted financial close (Stage 2) information on 30 March 2021, had a tariff granted on 20 April 2021 and commissioned on 30 March 2022, that plant would receive 19 years of NDRHI payments. Figure 1 illustrates this example.

Figure 1: timeline for third allocation of TGs