Title: The Renewable Heat Incentive Scheme and Domestic Renewable Heat Incentive Scheme (Amendment) Regulations 2019 **IA No:** BEIS011(F)-19-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:** 28/08/2019 **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 (in 2019 prices)			
Total Net Present Social Value	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
£138m	N/A	N/A	Non-qualifying

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 amendments aim to build on reforms introduced in September 2017 and May 2018, which were designed to ensure the scheme's objectives were met in a manner which focusses on long-term decarbonisation; offers value for money, protects taxpayers and consumers and is affordable; and supports supply chain growth, enabling the market to deliver.

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

Option 0 (counterfactual): do nothing/leave RHI regulations as they were.

Option 1 (preferred): amend RHI regulations. The amendments make two changes to the RHI:

1. **Extending allocation of tariff guarantees**: in 2018, reforms to the RHI introduced tariff guarantees. These allowed some larger, more cost-effective projects on the non-domestic scheme to secure a tariff rate before commissioning, subject to a commissioning deadline of 31 January 2020. The amendments create an extended allocation of tariff guarantees under which plants are able to commission until 31 January 2021. This will consolidate the current pipeline of tariff guarantee plants and provide time for new renewable heat projects to develop.
2. **Updating degression triggers**: a degression mechanism lowers tariffs automatically when deployment reaches certain thresholds, known as triggers. The amendments update the degression trigger levels to ensure these levels are aligned with the latest market intelligence and deployment forecasting.

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?		Yes		
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:** -0.4	**Non-traded:** -6.7	

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 SELECT SIGNATORY: ______________ Date: 27/8/19

Summary: Analysis & Evidence — Policy Option 1

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 19/20	PV Base Year 19/20	Time Period Years 22	Net Benefit (Present Value (PV)) (£m)		
			Low: -£158m	**High:** £367m	**Best Estimate:** £138m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low				£96m
High				£564m
Best Estimate				£328m

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

The main cost of the amendments 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 £328m.

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

There are potential indirect impacts on air quality resulting from spreading digestate from anaerobic digestion plants. There may also be wider impacts, such as costs of Local Authorities' food waste collection.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low				£137m
High				£801m
Best Estimate				£466m

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

The main monetised benefit of the amendments to the RHI will be the reduction in carbon emissions, mostly occurring in the non-traded sector. The central estimate of carbon savings is £19m in the traded sector and £438m in the non-traded sector. There is also a smaller benefit of £9m from direct improvements to air quality.

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

A key benefit of the RHI is renewable heat generation, contributing to targets under the EU Renewable Energy Directive (RED): as there is no agreed value for renewable heat, this is not included in the net present value. By supporting low carbon heat deployment, the amendments 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.

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 some 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. 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

Table of Contents

1. Introduction and Background

1. The 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 legally binding Carbon Budgets.
2. The Non-domestic RHI was introduced in November 2011 and is open to producers of biomethane for injection into the gas 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 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. 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, known as triggers.
4. Reforms were introduced in September 2017 and May 2018[1] to ensure the scheme focusses on long-term decarbonisation, offers better value for money and protects consumers, and supports supply chain growth while enabling the market to deliver.
5. The reforms introduced tariff guarantees (TGs), which allowed some applicants[2] to the Non-domestic RHI 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. TG plants were required to commission by January 2020. In the year since the introduction of TGs, there has been a large intake of projects: 40 TGs have been granted[3], predominantly for biomethane plants.
6. This impact assessment (IA) relates to amendments to RHI regulations[4] laid in June 2019, which made two changes to the RHI:
    a. **Extending the allocation of tariff guarantees**: the amendments create an extended allocation of TGs able to commission up to 31 January 2021;
    b. **Updating degression triggers**: the amendments change some of the triggers for mechanically reducing tariffs to align with the latest deployment assumptions.

1.1 Rationale for Intervention

7. The current market for renewable heat is relatively small, 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).
8. 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.

[1] Relevant documents available here: https://www.gov.uk/government/consultations/the-renewable-heat-incentive-a-reformed-and-refocused-scheme

[2] 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 over 600KW and ground and water source heat pumps over 100KW.

[3] May 2019 RHI statistics: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-may-2019

[4] Regulations are published here: https://www.legislation.gov.uk/uksi/2019/1052/contents/made

9. 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 is not currently reflected in the cost of those systems.
    b. Renewable heat is expected to make a significant contribution to the 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. 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 targets.
    d. 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 UK economy's exposure to the volatility of oil and gas prices.
10. 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.
11. The rationale for the specific amendments to the RHI discussed in this IA is set out in Section 2.

1.2 Policy Objectives

12. The overarching aim of the RHI 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 generating 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.
13. The amendments to the RHI assessed in this IA aim to build on the reforms introduced in September 2017 and May 2018, which were designed to ensure the scheme's objectives were met in a manner which focusses on long-term decarbonisation; offers value for money, protects taxpayers and consumers and is affordable; and supports supply chain growth to enable the market to deliver.

2. Policy Options

15. The policy options considered in this impact assessment are:
    a. Option 0 (counterfactual): do nothing/leave the scheme regulations as they were
    b. Option 1: amend RHI regulations

Option 0 (counterfactual): do nothing/leave RHI regulations as they were

16. In this impact assessment, the quantified costs and benefits of amendments to the RHI regulations (Option 1) are estimated against a counterfactual where the scheme remains open and the regulations are unchanged. In this scenario, the tariff guarantee commissioning deadline would remain unchanged at 31 January 2020, and there would be no change to degression triggers.

Option 1: amend RHI regulations

17. BEIS has brought forward legislation to:
    a. Amend the RHI regulations by creating an extended allocation of tariff guarantees, under which plants are able to commission until 31 January 2021;
    b. Amend the degression trigger levels set out in Domestic and Non-domestic RHI regulations to ensure these levels are aligned with the latest market intelligence and deployment forecasting.

Extended allocation of tariff guarantees

18. Tariff guarantees allow some applicants to the Non-domestic RHI to secure a tariff rate before being fully commissioned and accredited, enabling larger, better value for money installations to commission onto the RHI by providing certainty for investment decisions. Option 1 would extend the deadline for commissioning from 31 January 2020 to 31 January 2021.
19. The extended allocation will provide additional time for new renewable heat projects to develop and commission. It will also allow plants in the current cohort of TGs to withdraw and re-apply to the extended allocation with a later commissioning date, securing the tariff rate at the date of reapplication. This will mitigate the risk of plants in the current cohort failing to commission where supply chain and network constraints make the January 2020 deadline difficult to achieve.
20. The deployment of biomethane plants, which generate gas for injection to the grid through anaerobic digestion (AD), has come almost exclusively through the tariff guarantee route since their introduction 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[5] 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'. In the long term, in the Committee on Climate Change (CCC)'s net zero report[6], 14TWh of biogas is assumed to be needed to achieve net zero emissions by 2050. Through supporting additional deployment of AD plants, the extended allocation will allow the AD supply chain to continue to develop, to maintain and expand a platform for future investment in the sector.
21. The extended allocation may also support the deployment of other technologies eligible for tariff guarantees, including solid biomass combined heat and power (CHP), large biomass plants and large ground and water source heat pumps. Plants applying through the tariff guarantee route are typically larger and better value for money than those applying through the standard Non-domestic RHI.

---

[5] 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

[6] 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/

Amendments to degression triggers

22. The degression process helps to control expenditure on the scheme by gradually lowering tariffs paid to new applicants where deployment is higher than anticipated. Degressions occur when estimated spend on a technology breaches certain thresholds, known as triggers. Degression triggers are reviewed periodically, using the latest deployment forecasts alongside considerations of affordability, risk management and scheme objectives to make changes where appropriate.

3. Analytical Approach

23. This section outlines the analytical approach to assessing the costs and benefits of the RHI. The methodology follows that used in the RHI Impact Assessment in February 2018[7]. Updates to the evidence base and deployment forecasts are detailed in sections 3.1 and 3.2.
24. 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 Option 1 (amending RHI regulations) relative to the counterfactual (leave RHI regulations as they were). The costs and benefits considered are set out in section 3.3. The appraisal period starts in 2019 and ends in 2041, when the final installations supported by the RHI come to the end of their 20-year lifetime.

3.1 Evidence Base

25. Analysis has been updated to take into account updates to standard appraisal values, including:
    a. **Carbon prices**: new values were published in the April 2019 update to HM Treasury's Green Book supplementary guidance on valuation of energy use and greenhouse gas emissions[8]
    b. **Electricity and fossil fuel carbon emissions factors**: as above, new values were published in the April 2019 update to the Green Book supplementary guidance
    c. **Air quality damage costs**: new values were published in the January 2019 update to the Department for Environment, Food and Rural Affairs (DEFRA)'s guidance on economic analysis of air quality[9]
26. Additional changes to the evidence base since the February 2018 IA include:
    a. **Deployment**: the analysis uses data on actual scheme deployment up to the end of April 2019, and revised estimates of future deployment (see section 3.2)
    b. **Counterfactual energy**: the mix of systems assumed to be installed in the absence of the RHI has been updated based on additional data from scheme applicants
    c. **Tariffs**: the tariffs paid to new installations[10,11] have been updated to take into account changes to tariffs due to degression and inflation
    d. **Sizing assumptions**: estimates of the average size of non-domestic installations to be deployed until the end of the scheme have been updated using the latest data[12] on the capacity of new applications
27. Finally, the **carbon emissions factor for biomethane** has been updated to incorporate the latest available evidence. This results in a slightly lower estimate of carbon savings from biomethane. See Annex A for detail.

3.2 Deployment

28. 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 before scheme closure in March 2021, under both Option 0 (counterfactual) and Option 1. The cost benefit analysis

---

[7] The IA document can be accessed here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/680624/ukia_20180029_en.pdf

[8] 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

[9] The guidance on air quality economic analysis can be found here: https://www.gov.uk/guidance/air-quality-economic-analysis

[10] Non-domestic RHI tariffs can be found here: https://www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-non-domestic-rhi

[11] Domestic RHI tariffs can be found here: https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/tariffs-and-payments-domestic-rhi/current-future-tariffs

[12] Data can be found in the RHI statistics here: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

assesses the impact of the additional deployment supported by the policy change relative to the counterfactual.

29. The impact of the extension of the tariff guarantee (TG) allocation on deployment forecasts is set out in points 30 and 31. The current cohort of TGs is dominated by plants which inject biomethane into the gas grid; however, applications for solid biomass combined heat and power (CHP), geothermal, large biogas, large biomass and large ground source heat pumps are also eligible.
30. **Biomethane**:
    a. Biomethane deployment has come almost exclusively through TGs since they were introduced in May 2018 and represents the 'new norm' for biomethane applications on the RHI. 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.
    b. Market intelligence and discussions with industry indicate that under Option 0, a significant proportion of the current pipeline of TGs are at risk of failing to commission by the January 2020 deadline due to supply chain and network constraints and that very few new projects would come forward under the standard Non-domestic RHI application route where a plant is required to construct prior to a tariff being secured.
    c. Extending the deadline under Option 1 is expected to consolidate the existing pipeline of TGs as well as provide time for new biomethane projects to develop and commission. Therefore, more biomethane plants are expected to deploy under Option 1 than under the counterfactual: in the central case, 15 additional plants are expected to commission under Option 1.
31. **Other technologies eligible for TGs**: solid biomass CHP, geothermal, large biogas plants, large biomass plants and large ground source heat pumps.
    a. Deployment in the other technologies eligible for tariff guarantees has come both through the tariff guarantee and the standard Non-domestic RHI route. Project lead times tend to be shorter, so there is less need for tariff certainty.
    b. The extension of the TG allocation may incentivise additional deployment for some very large projects[13]. However, these occur in low numbers and are difficult to forecast.
    c. Most installations (non-biomethane) would likely apply through the standard Non-domestic RHI route in the absence of TGs, so do not represent additional deployment relative to the counterfactual.
    d. As we do not have clear enough evidence to attribute additional deployment in these technologies to the policy change, for the purpose of the cost benefit analysis in this impact assessment we assume the same deployment occurs under Option 1 and the counterfactual.
32. In line with the approach taken in previous RHI IAs, the deployment forecasts in both Option 1 and the counterfactual assume no degressions occur: the high levels of uncertainty around how consumers would react to degressions make it very difficult to predict the impact of degression on deployment forecasts. This means that the impacts of the changes to the degression triggers are not quantified in the cost benefit analysis. Instead, a qualitative discussion of the likely impacts of the degression trigger review is included at section 4.2.6.

3.3 Costs and Benefits

33. To understand the impact of the extended allocation of tariff guarantees on the RHI, analysis has been conducted to estimate the costs and benefits associated with the additional renewable heating installations supported relative to the counterfactual.
34. The quantified costs and benefits contributing to the Net Present Value (NPV) are:

[13] TG regulations limit annual generated heat at the guaranteed tariff to 250GWh. This is to mitigate the risk of a single very large plant taking up a substantial part of the RHI budget and causing a significant reduction in available budget for smaller projects, or in extreme cases triggering a breach of the budget cap resulting in premature scheme closure.

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 carbon abated 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 and Particulate Matter.

35. There are also a number of non-monetised costs and benefits that are not captured in the cost benefit analysis, including:
    a. **Renewable heat generation**: there is no agreed value for renewable energy, so the contribution of installations supported by the amended 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**: by incentivising additional deployment of renewable heat technologies relative to the counterfactual, the amendments to the RHI will support the development of renewable heat supply chains. 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 2019 Spring Statement, the government committed to increasing the proportion of green gas in the grid, with a consultation on the appropriate mechanism to be held later this year. Continuing to support biomethane deployment through the extended TG allocation will ensure that the supply chain is well placed to deliver the deployment required to meet this commitment.
    c. **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. For example, continued development of the biomethane supply chain may bring down the costs of the future mechanism to increase the proportion of green gas in the gas grid as set out above.
    d. **Anaerobic digestion (AD) sector growth**: in 2017, the low carbon heat sector directly supported 6,300 jobs and exported £150m worth of goods and services[14]. The extended tariff guarantee allocation will help to secure the current supply chain in AD and other technologies and create the conditions for market expansion.
    e. **Air quality impacts from anaerobic digestion (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.
36. 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.

[14] ONS low carbon and renewable energy economy data, 2017 prices: https://www.ons.gov.uk/economy/environmentalaccounts/datasets/lowcarbonandrenewableenergyeconomyfirstestimatesdataset

4. Impacts Appraisal

37. This section first provides an update on the spend, carbon savings and renewable heat generated by the total RHI, from both installations currently on the scheme and deployment expected to come on to the scheme between May 2019 and March 2021.
38. It then goes on to assess the marginal impact of the amendments to the scheme (Option 1) relative to the counterfactual (Option 0).

4.1 Impacts of Whole Scheme

4.1.1 Headline Impacts of Whole Scheme

39. The updates to the evidence base and deployment forecasts described in Sections 3.1 and 3.2 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 May 2019 and March 2021 under Option 1. The headline results are shown in Table 1. Deployment already on the scheme is out of scope of the cost benefit analysis in this impact assessment.
40. Upstream carbon savings are those savings which result from the avoidance of emissions when certain feedstocks are used for AD rather than a different use. For more detail, see paragraphs 59-60.

Table 1 - Headline impacts of whole RHI

	Impact of whole RHI
Net present value (NPV) (£m)	*not in scope*
Nominal spend in 2020/21 (£m)	1,094
CB5 carbon savings (MtCO2e)	31.0
of which upstream	11.8
Renewable heat in 2020/21 (TWh)	21.6
Social non-traded cost of carbon (£/tCO2e)	*not in scope*

4.1.2 Deployment and Spend on Whole Scheme

41. This section gives an update on the spend on the RHI scheme as a whole, which includes the effects of the amendments analysed in this IA.
42. The deployment seen is critical to quantifying the spend, potential benefits and costs of the whole RHI as well as the impact of the changes proposed in Option 1. The number of plants deployed directly affects spend and the NPV of the amendments. Deployment projections are based on evidence from a number of sources including current trends in deployment, commercial intelligence and discussions with industry. More detail on deployment estimates is given in Section 3.2.
43. There is uncertainty around the level of deployment expected over the next few years, detailed in Section 5. Three deployment scenarios illustrate the impact on spend of varying the estimate of deployment from May 2019 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 due to the high level of uncertainty around how consumers would react to degression (see paragraph 32). The central scenario is BEIS' view on likely deployment during the period while the low and high scenarios provide an interval around this central estimate.

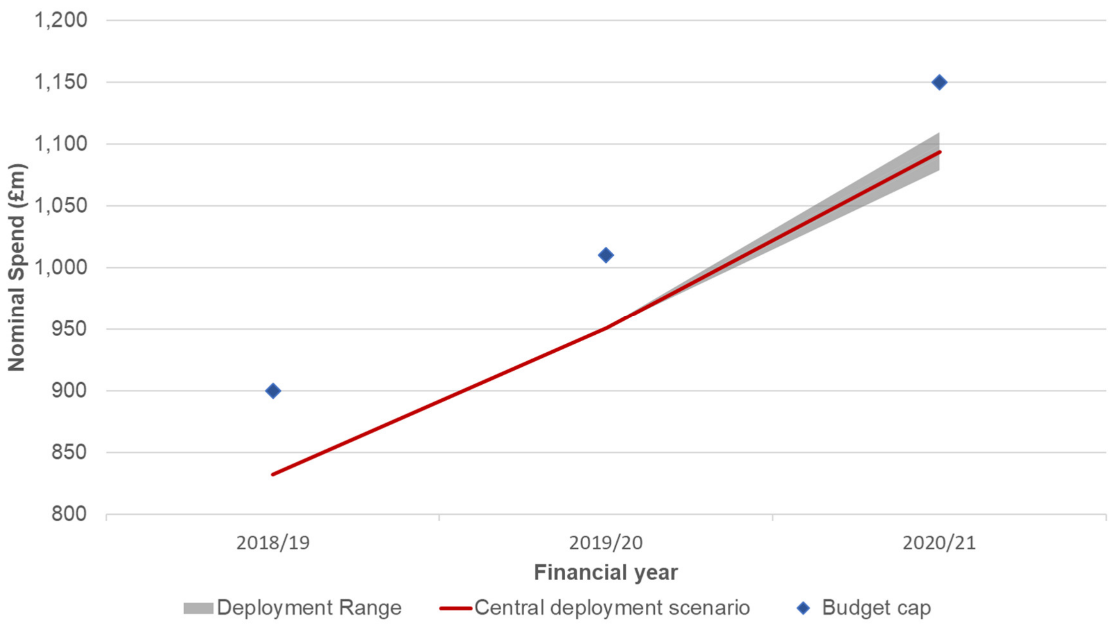
44. RHI payments are based on heat generated. On the domestic scheme, participants receive payments over 7 years, usually based on an estimate of their property's annual heat demand ('deemed' heat). On the non-domestic scheme, participants receive payments over 20 years, based on their metered total heat output for eligible heat uses.
45. 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. Budget caps have been announced for years up to and including 2020/21, and BEIS publishes monthly updates of estimated committed expenditure against the budget cap[15].
46. Table 2 below shows the in-year spend estimates for each of the three scenarios described above against the budget cap for 2019/20 and 2020/21: all scenarios are within the budget cap for both years. 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)[16].

Table 2 - Nominal spend estimates under main deployment sensitivities

Nominal spend (£m)	2019/20	2020/21
Budget cap	*1,010*	*1,150*
High deployment scenario	952	1,110
Central deployment scenario	951	1,094
Low deployment scenario	950	1,079

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

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



[15] RHI budget caps are published here: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

[16] This variation occurs predominantly on the non-domestic scheme, where participants are paid based on the amount of heat they generate, as recorded by meter readings. Annual heat generation can vary year on year: for example, where there is a particularly cold winter, heat generation and hence spend may increase.

4.1.3 Benefits of Whole Scheme

48. In line with the policy objectives, the RHI is expected to support a significant amount of greenhouse gas abatement and renewable heat.
49. The RHI as a whole is estimated to abate 31 MtCO2e in both Carbon Budgets (CB) 4 & 5, with over 122 MtCO2e greenhouse gas abatement over the entire lifetime of the installations supported by the scheme. Table 3 below shows the breakdown of these savings by committed / future deployment and shows how much of this is traded / non-traded and how much is due to upstream carbon savings.

Table 3 - Carbon abatement of whole RHI

Carbon abatement (MtCO2e)	CB4 (2023 - 2027)	CB5 (2028 - 2032)	Lifetime
Committed RHI deployment (up to April 2019)	26.6	26.2	103.8
of which upstream	10.0	10.0	38.4
Future RHI deployment (May 2019 - March 2021)	4.8	4.9	18.8
of which upstream	1.8	1.8	6.8
Total	31.4	31.0	122.6
(Traded / Non-traded)	(1.6 / 29.9)	(1.6 / 29.5)	(6.1 / 116.5)
of which upstream	11.8	11.8	45.3

Figures may not sum due to rounding

50. Table 4 below 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 4 - Renewable heat supported by whole RHI

Renewable heat generated (TWh)	2020/21	2030/31
Committed RHI deployment (up to April 2019)	19.7	20.2
Future RHI deployment (May 2019 - March 2021)	1.9	3.2
Total	21.6	23.4

Figures may not sum due to rounding

4.2 Marginal Impacts of Amendments

4.2.1 Headline Impacts

51. This section presents the quantified costs and benefits of amending the RHI regulations (Option 1) relative to the counterfactual (Option 0). It quantifies the impact of creating an extended allocation of tariff guarantees only, not the degression trigger review which is described qualitatively in section 4.2.6. The costs and benefits include renewable heat generated, air quality impacts, carbon savings and resource costs. Descriptions of updates to previous analysis and the costs and benefits assessed can be found in Section 3; uncertainty is discussed in Section 5.
52. Table 5 below sets out the headline impacts of amending the RHI regulations. These relate to the additional deployment expected between May 2019 and March 2021 as a result of the extended allocation of TGs.

Table 5 - Headline impacts of amendments to the RHI

	Impact of amendments
Net present value (NPV) (£m)	138
Nominal spend (whole scheme) in 2020/21 (£m)	1,094
CB5 carbon savings (MtCO2e)	1.9
of which upstream	1.2
Renewable heat in 2020/21 (TWh)	0.2
Social non-traded cost of carbon (£/tCO2e)	45

53. The amendment to the RHI regulations is estimated to support around 0.2 TWh of renewable heat in 2020/21 and abate up to around 1.9 MtCO2e over Carbon Budget (CB) 5. The total estimated NPV of the amendment is £138m.

4.2.2 Monetised Costs and Benefits

54. The components of the NPV calculation are shown in more detail in Table 6 below. These are based on the central deployment scenario. NPV calculations are based on discounted values cumulative over the policy lifetime.

Table 6 - Monetised costs and benefits of amendments to the RHI

Monetised costs and benefits (£m)	
Net present value (NPV)	138
Resource costs	-328
Traded carbon savings	19
Non-traded carbon savings	438
Air quality impacts	9

55. There is uncertainty around the precise benefits the amendments 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; air quality impacts; 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 5.2.

4.2.3 Non-monetised Costs and Benefits

56. As outlined in Section 3.3, there are several scheme impacts which cannot be quantified. Our overall qualitative assessment of the likely direction of impacts is set out in Table 7 below.

Table 7 - Non-monetised costs and benefits of amendments to the RHI

Non-Monetised Impact	Likely impact on NPV of amendments if quantified
Renewable Heat Generation	Positive – The value of renewable heat and contribution it makes towards RED targets is not monetised and therefore not reflected in the NPV.
Supply Chain Development	Positive – Continuing to support biomethane deployment through the extended TG allocation will

	ensure the supply chain is well placed to deliver future deployment required to meet decarbonisation commitments.
Innovation & Cost Reductions	Positive – Improvements to technologies and cost reductions will reduce the costs of the mass roll-out of low carbon heat.
Anaerobic Digestion (AD) Sector Growth	Positive – Extended TG allocation will help to secure current supply chain in AD and create market conditions for expansion.
Air Quality Impacts from Anaerobic Digestion (AD)	Negative – Ammonia released from spreading digestate may negatively impact air quality. The impact is dependent on the counterfactual use of the feedstock and how digestate is stored / used. The uncertainty around these factors prevents quantification at this stage.

57. Given the positive monetised NPV of the amendments, 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 reforms.

4.2.4 Greenhouse Gas Abatement

58. Table 8 below shows the additional greenhouse gas savings estimated to be supported over Carbon Budget 4 and 5 and the lifetime of the RHI by the amendments to the RHI regulations. The table also shows how much of this is traded / non-traded and how much of this is upstream savings.

Table 8 - Carbon abatement of amendments to the RHI

Carbon abatement (MtCO2e)	CB4 (2023 - 2027)	CB5 (2028 - 2032)	Lifetime
Carbon savings relative to counterfactual (Traded / Non-traded)	1.9 (0.1 / 1.8)	1.9 (0.1 / 1.8)	7.0 (0.4 / 6.7)
of which upstream	1.2	1.2	4.6

Figures may not sum due to rounding

59. Carbon Budget 4 (2023 – 2027) and 5(2028 – 2032) show similar levels of abatement at 1.9 MtCO2e each of which 1.2 MtCO2e is upstream savings.
60. These savings arise from the additional deployment of biomethane. The level of abatement is dependent on the amount of heat generated by the additional biomethane plants, the feedstock used and the efficiency of the systems.
61. As mentioned above, the savings include upstream savings, which 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 fossil fuel combustion, the emissions from the decomposition of the food waste into methane are also avoided. Although food waste can be disposed of in a number of ways, including disposal, energy recovery and recycling, we believe it is most likely that food waste used for AD is diverted from landfill.

This is because commercial intelligence suggests that plants on the RHI are more likely to use waste from business or industrial sources, which are more likely to dispose of food waste in landfill. For further detail on the counterfactual use of food waste used for AD, see paragraph 89.

62. For this IA, as noted in paragraph 27 and detailed in Annex A, the biomethane emissions factor (including upstream savings) has been refined with more up to date evidence where available. The outcome of this is lower emissions savings from biomethane per kWh compared to what was used in the February 2018 IA.
63. 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. 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. Further discussion of biomethane emissions and the related uncertainties is provided in Annex A.

4.2.5 Renewable Heat

64. With the extended tariff guarantee deadline under the amended RHI, the scheme is estimated to support approximately 0.2 TWh of additional renewable heat in 2020/21 and 0.7 TWh of renewable heat in 2030/31.
65. Table 9 below provides estimates of renewable heat generation in 2020/21 and 2030/31. The level of renewable heat generated increases between 2020/21 and 2030/31 due to the nature of biomethane installations (to which all of this renewable heat is attributable): the anaerobic digestion process typically results in a ‘ramp up’ of production of gas and hence renewable heat over time as conditions in the plant are optimised.

Table 9 - Renewable heat supported by amendments to the RHI

Renewable heat generated (TWh)	2020/21	2030/31
Renewable heat relative to counterfactual	0.2	0.7

66. Technologies differ in what proportion of heat delivered is eligible for Renewable Energy Directive (RED) purposes. For biomethane, all heat generated is considered to be renewable heat.

4.2.6 Degression Triggers

67. The amendments to the RHI regulations include extending the allocation of tariff guarantees and amending the degression trigger levels set out in Domestic and Non-domestic RHI regulations.
68. The results above in sections 4.2 to 4.2.5 quantify the impact of extending the commissioning deadline for tariff guarantees only. They do not include the impact of the review of degression triggers which instead is described qualitatively in this section. This is because the high levels of uncertainty around how consumers would react to degression make it very difficult to predict the impact of degression on deployment forecasts.
69. The degression trigger review reduces large headrooms which expected deployment will not fill, for example in biomethane and large biogas:
    a. This will ensure degressions are more timely, improving value for money from future deployment as degressions become more likely.
    b. It is possible that this may lead to less deployment if applicants are disincentivised by lower tariffs.

c. For biomethane and large biogas, the reduction in degression triggers will introduce a greater level of biomethane cost control alongside the expected increase in deployment due to the extended allocation of tariff guarantees.

70. Where growth has outstripped projected growth, the review increases headroom and resets trigger growth in line with deployment assumptions, for example in large non-domestic ground source heat pumps and domestic air source heat pumps:
    a. This will avoid a situation where deployment forces consecutive degressions and effectively ends any further deployment of a given technology.
    b. This may lead to increased deployment as degressions become less likely.

71. The degression trigger review does not affect the budget allocation for tariff guarantees.

5. Uncertainty

5.1 Sources of Uncertainty

72. Two areas of uncertainty affect this analysis: uncertainty in estimating deployment levels and uncertainty in the costs and benefits derived from this deployment.
73. **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 amendments. The factors leading households and firms to install renewable heating systems are not consistent or predictable.
74. **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.
75. Sensitivity analysis has been conducted to assess the impact of the key uncertainties on NPV and carbon abatement.

5.2 Sensitivity Analysis

76. The sensitivities considered in this section are:
    a. **High and low biomethane deployment relative to counterfactual**: as described in paragraph 73, there is uncertainty in estimating the number of additional plants brought forward under Option 1 (amend the RHI) relative to Option 0 (counterfactual), with a central estimate of 15 additional plants deployed (see row 1 of Table 10). High and low estimates of biomethane deployment under Options 0 and 1 were developed as part of the deployment projections described in section 3.2. The high deployment sensitivity assesses the impact of high deployment in Option 1 relative to low deployment in Option 0, resulting in 27 additional plants (see row 2 of Table 10). The low deployment sensitivity assesses the impact of low deployment in Option 1 relative to high deployment in Option 0, resulting in 5 additional plants (see row 3 of Table 10).

Table 10 - Deployment of biomethane plants in high and low biomethane deployment relative to counterfactual sensitivities

Number of biomethane plants deployed (May-19 to Mar-21)		**Description of scenario**	**Total plants deployed in Option 0 (counterfactual)** *(a)*	**Total plants deployed in Option 1 (amend the RHI)** *(b)*	**Additional plants deployed due to amendments** *(b) – (a)*
1	Central deployment estimate	Central deployment in Option 1 relative to central deployment in Option 0	7	22	**15**
2	High biomethane deployment relative to counterfactual sensitivity	High deployment in Option 1 relative to low deployment in Option 0	1	28	**27**
3	Low biomethane deployment relative to counterfactual sensitivity	Low deployment in Option 1 relative to high deployment in Option 0	11	16	**5**

b. **High and low 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[17]. There is uncertainty around these values. These sensitivities use the high and low carbon price series published in the Green Book supplementary guidance in April 2019[18].
c. **Food waste counterfactual**: as discussed in Annex A, there is uncertainty in the counterfactual disposal of food waste used for AD, which affects the emissions savings expected from AD from food waste. In the central case, we assume all food waste used for AD would otherwise have gone to landfill: the rationale behind this assumption is set out in paragraph 89. This sensitivity analyses the impact of assuming food waste used for AD would otherwise have been split between landfill and recovery in line with the proportions seen across the whole economy (29% landfill, 71% recovery) based on data from WRAP[19].
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 the disposal of waste in landfill, raising questions of attribution of carbon savings. This sensitivity assumes no upstream savings from AD.

77. The analysis focusses only on the deployment included in this assessment, from May 2019 to March 2021. Sensitivities related to deployment before that period are not in scope of this IA.
78. Table 11 shows the impacts of the sensitivities on the NPV and CB5 carbon abatement. No upstream savings results in the largest decrease (-£296m) in NPV, while high carbon price leads to the biggest increase (£229m). No upstream savings and low biomethane deployment lead to the biggest decrease in carbon abatement (-1.2 Mt and -1.3 Mt respectively), while high biomethane deployment leads to the largest increase (1.3 Mt).

Table 11 - sensitivity of NPV and carbon abatement

Sensitivity	NPV (£m)	Change in NPV (£m)	CB5 carbon abatement (MtCO2e)	Change in CB5 carbon abatement (MtCO2e)
Central	*138*	*n/a*	*1.9*	*n/a*
High biomethane deployment	238	100	3.2	1.3
Low biomethane deployment	41	-97	0.5	-1.3
High carbon price	367	229	1.9	0.0
Low carbon price	-91	-229	1.9	0.0
Food waste counterfactual	-42	-180	1.1	-0.7
No upstream savings	-158	-296	0.7	-1.2

Figures may not sum due to rounding

79. The no upstream savings sensitivity results in a significantly negative NPV (-£158m). However, this scenario is only intended to illustrate the lower bound of upstream emissions; it is highly unlikely that this scenario will materialise. The food waste counterfactual

17 Further details on BEIS's approach to valuing greenhouse gas emissions can be found here: https://www.gov.uk/government/collections/carbon-valuation--2
18 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
19 Table 1, Food Surplus and Waste in the UK key facts: http://www.wrap.org.uk/sites/files/wrap/Food%20Surplus%20and%20Waste%20in%20the%20UK%20Key%20Facts%2014%205%2019.pdf

sensitivity also results in a negative NPV (-£42m), illustrating the sensitivity of the NPV to the biomethane emissions factor.

80. In the high and low biomethane scenarios, carbon savings and NPV scale up and down in proportion to the number of plants deployed, as the sensitivity does not affect the balance of costs and benefits for individual plants. In the high and low carbon price scenarios, the NPV increases or decreases while carbon savings are unchanged, as by placing a higher or lower value on each unit of carbon saved, the benefits of each individual plant increase or decrease relative to the costs. In the food waste counterfactual and no upstream savings scenarios, the carbon abatement and NPV both decrease, as the amount of carbon saved by each plant decreases, so the benefits decrease relative to the costs.
81. The sensitivities shown above are not additive and cannot be combined to create additional scenarios.

A. Annex A: Biomethane Emissions Factor

82. The carbon emissions factor for biomethane has been updated to take into account the latest available evidence. Overall, this results in an increase in the biomethane emissions factor from -345gCO2e/kWh to -240gCO2e/kWh.
83. The emissions impact of biomethane from each feedstock has two components:
    a. **Biogeneration emissions**: the direct emissions associated with the production of biomethane through AD using a specific feedstock.
    b. **Upstream emissions savings**: the indirect emissions savings from using a particular feedstock in the AD process rather than its counterfactual use.
84. The biogeneration and upstream emissions are added together to give a total emissions factor for each feedstock. A weighted average based on the assumed mix of feedstocks used for AD plants supported by the RHI is then calculated to give an overall emissions factor. The assumed feedstock mix is unchanged from the previous RHI IA (40% food waste, 25% sewage, 35% agriculture including crops, manure and slurry).
85. Biogeneration emissions factors have been updated using the latest evidence from BEIS' biogas model. This results in a slight decrease in emissions from each feedstock.
86. Upstream emissions factors are as follows:
    a. For manure and slurry, upstream emissions savings are achieved by diverting manure away from storage in slurry tanks or lagoons. These may or may not be covered, and emit significant amounts of methane into the atmosphere. The estimate of upstream savings from manure is unchanged from the previous RHI IA, using evidence from an unpublished study by the University of Manchester.
    b. For food waste, upstream savings relate to diverting food waste away from landfill, where it would emit methane (for justification of the food waste counterfactual, see paragraph 89; for discussion of the related uncertainty, see paragraph 90). The estimate of upstream savings has been updated to take into account the latest published values for emissions from landfill[20]. This results in a reduction of approximately 25% in upstream emissions savings from food waste.
    c. For crop and sewage feedstocks, no upstream savings are assumed.
87. Table 12 shows the updated biomethane emissions factors for different feedstocks and the average emissions factor weighted by the feedstock mix.

Table 12 - Biomethane emissions factor for different feedstocks

Carbon emissions (gCO2e/kWh)	Biogeneration	Upstream	Total
Food waste	80	-561	-481
Maize	130	0	130
Wet manure	86	-600	-514
Sewage sludge	78	0	78
Average (weighted by feedstock mix)	89	-329	-240

88. There is significant uncertainty associated with the 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 mainly driven by uncertainty around the counterfactual disposal of the feedstock. In addition, waste sector policies also impact the disposal of food waste to landfill, raising issues of attribution of upstream savings. There is also uncertainty around the feedstock mix used: in particular, 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.

[20] Waste disposal emissions from full Greenhouse Gas Reporting Conversion Factors dataset here: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

89. As discussed above, we assume that all food waste used for AD would otherwise have been used for landfill. Food waste across the economy is disposed of through a number of routes, including disposal (including waste going to landfill or to sewer), energy recovery (including incineration of waste to create electricity), and recycling (AD and composting): WRAP publish data on this split[21]. On balance, we believe it is most likely that food waste used for AD is diverted from landfill, as:
    a. Some plants on the RHI have a dedicated source of waste feedstock, for example from distilleries, which discussions with industry suggest would have otherwise gone to landfill.
    b. Commercial intelligence also suggests that a number of food waste plants currently on the RHI use waste from business or industrial sources, which are more likely to send their waste to landfill than to use it in energy recovery.
    c. Another source of food waste is Local Authorities: these are more likely to send food waste to recovery, however often they are in long-term contracts to provide this waste, so it is more likely that Local Authorities would divert waste from landfill to AD rather than from recovery to AD.
90. However, this is still highly uncertain. To illustrate this, in Section 5.2 we present a sensitivity where food waste disposal is split between landfill and recovery in line with the proportions seen across the whole economy (29% disposal, 71% recovery), as shown in the WRAP data. This results in a significant reduction in upstream savings from food waste, as recovery is a source of renewable electricity displacing fossil fuels, and as such has associated emissions savings. Diverting food waste from recovery to AD would increase carbon savings in the heat sector but decrease carbon savings in the electricity sector.
91. We also present a sensitivity where we assume no upstream emissions savings at all: in addition to uncertainty around the counterfactual disposal of food waste, this takes into account the uncertainty around the attribution of emissions savings and the feedstock mix used.

[21] Table 1, Food Surplus and Waste in the UK key facts: http://www.wrap.org.uk/content/food-surplus-and-waste-uk-key-facts-nov18