Title: Final Stage IA: Green Gas Support Scheme/Green Gas Levy **IA No:** BEIS009(F)-21-CG **Lead department or agency:** Department for Business, Energy and Industrial Strategy (BEIS) **Other departments or agencies:** N/A	Impact Assessment (IA) **Date:** 16/09/2021 **Stage:** Final **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** greengassupport@beis.gov.uk
Summary: Intervention and Options	**RPC Opinion:** N/A

Cost of Preferred (or more likely) Option (in 2020 prices)			
Total Net Present Social	**Business Net Present Value**	**Net cost to business per year**	**Business Impact Target Status**
£120m	N/A	N/A	N/A

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

To meet our legally binding emissions reduction targets, we need to move away from burning fossil fuels to heat our buildings. Biomethane injection into the gas grid accelerates the decarbonisation of gas supplies, by increasing the proportion of green gas in the grid. This transition is a necessary step towards meeting our carbon reduction targets, including the UK's net zero greenhouse gas emissions target. We are proposing to fund this transition by imposing a levy on gas suppliers, to support biomethane production through the Green Gas Support Scheme. We anticipate that suppliers will pass the costs of the levy onto gas bill payers in the domestic and non-domestic sectors. Given the benefits of decarbonisation through green gas injection will be shared by all users of the gas grid, it is considered appropriate for gas users to fund the next stage of this transition.

What are the policy objectives of the action or intervention and the intended effects?

The Green Gas Support Scheme will contribute to decarbonising heating, in addition to meeting carbon budgets and the UK Government's legal obligation to reach net zero emissions by 2050. The Green Gas Levy will be a sustainable source of funding for the lifetime of the Green Gas Support Scheme. We have ensured that our levy design, as closely as possible, aligns with the following key principles. The levy must: be compatible with existing processes, be deliverable, take account of lessons learned, reflect the need for predictability of costs, accurately reflect Green Gas Support Scheme costs and minimise opportunities for non-compliance.

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

The options considered for the Green Gas Support Scheme are:

Option 0 (counterfactual): Do nothing/do not support biomethane injection into the gas grid through the Green Gas Support Scheme (GGSS) and do not introduce Green Gas Levy.
Option 1 (preferred option): Continue support for biomethane by a tariff paid on a p/kWh basis for all eligible units injected into the gas grid for 15-years from first injection. The tariff will be tiered to account for economies of scale, with Tier 1 payments to the first 60,000MWh of eligible biomethane injected each year.
Option 2: Continue support for biomethane by a tariff paid on a p/kWh basis for all eligible units injected into the gas grid for 15-years from first injection. The tariff will be in line with the current Renewable Heat Incentive (RHI) tiering structure, with Tier 1 payments extended to the first 40,000MWh only.

The options considered for the Green Gas Levy are shown below. All policy options for the Green Gas Levy are based on our preferred Green Gas Support Scheme option above:

Option A-i: Distribute Green Gas Levy costs between suppliers according to the number of gas supply meter points that they serve, with no tiering by gas consumption or consumer type.
Option A-ii: Distribute Green Gas Levy costs between suppliers according to the number of gas supply meter points that they serve, with two charging tiers (Tier 1: domestic and micro businesses; Tier 2: remaining non-domestic consumers).
Option A-iii: Distribute Green Gas Levy costs between suppliers according to the number gas supply meter points they serve, with three charging tiers (Tier 1: domestic and micro businesses; Tier 2: medium-sized non-domestic consumers; Tier 3: largest non-domestic consumers).
Option B: Distribute Green Gas Levy costs between suppliers according to the amount of gas supplied to their customers.
Option C (preferred option): Distribute Green Gas Levy costs between suppliers according to the number of gas supply meter points that they serve at the start of the scheme, before transitioning to distributing costs according to the amount of gas supplied to their customers.

<table>
<tr><td colspan="5">Will the policy be reviewed? We will consider need for review</td></tr>
<tr><td colspan="2">Is this measure likely to impact on international trade and investment?</td><td colspan="3">No</td></tr>
<tr><td>Are any of these organisations in scope?</td><td>Micro
Yes</td><td>Small
Yes</td><td>Medium
Yes</td><td>Large
Yes</td></tr>
<tr><td colspan="2">What is the CO_2 equivalent change in greenhouse gas emissions?
(Million tonnes CO_2 equivalent)</td><td colspan="2">Traded:
0</td><td>Non-traded:
-8.2</td></tr>
</table>

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

Signed by the responsible Minister:  Date: 10th September 2021

Summary: Analysis & Evidence Policy Option 1

Description:

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2020	2020	25	**Low:** N/A	**High:** N/A	**Best Estimate: £120m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant	**Total Cost** (Present Value)
Low	N/A		N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£2,325m**

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

The monetised social costs of the Green Gas Support Scheme are resource costs and the impact of ammonia emissions arising from digestate (a by-product of biomethane production) on air quality.

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

N/A

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant	**Total Benefit** (Present Value)
Low	N/A		N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£2,445m**

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

The monetised benefits of the Green Gas Support Scheme are the reduction in non-traded carbon emissions, fertiliser savings and the value of fossil fuels replaced through the production of biomethane.

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

The main non-monetised benefits include additional UK investment and improving the rural economy.

Key assumptions/sensitivities/risks **Discount rate** 3.5%

The estimates of social costs and benefits presented are subject to significant uncertainty. Key sensitivities include changes in assumptions surrounding deployment, carbon prices, fuel costs and the counterfactual.

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**

Summary: Analysis & Evidence Policy Option 2

Description:

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
2020	2020	25	**Low:** N/A	**High:** N/A	**Best Estimate: £-5m**

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Cost (Present Value)
Low	N/A		N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£2,205m**

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

The monetised social costs of the Green Gas Support Scheme are resource costs and the impact of ammonia emissions arising from digestate (a by-product of biomethane production) on air quality.

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

N/A

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant	Total Benefit (Present Value)
Low	N/A		N/A	**N/A**
High	N/A		N/A	**N/A**
Best Estimate	N/A		N/A	**£2,200m**

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

The monetised benefits of the Green Gas Support Scheme are the reduction in non-traded carbon emissions, fertiliser savings and the value of fossil fuels replaced through the production of biomethane.

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

The main non-monetised benefits include additional UK investment and improving the rural economy.

Key assumptions/sensitivities/risks | **Discount rate** | 3.5%

The estimates of social costs and benefits presented are subject to significant uncertainty. Key sensitivities include changes in assumptions surrounding deployment, carbon prices, fuel costs and the counterfactual.

BUSINESS ASSESSMENT (Option 2)

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**

Summary: Analysis & Evidence Policy Options A-i, A-ii, A-iii, B, C

Description:

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	**High:** Optional	**Best Estimate:**

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

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

N/A – The overall costs and benefits of the levy and the Green Gas Support Scheme are covered in analysis of the Green Gas Support Scheme. Impact analysis for the Green Gas Levy covers how these costs are recovered and distributed.

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

N/A

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

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

N/A

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

N/A

Key assumptions/sensitivities/risks	Discount rate	
N/A		

BUSINESS ASSESSMENT (Option A-i)

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**

Executive Summary

1. This final stage impact assessment accompanies the government response on the Green Gas Support Scheme and the Green Gas Levy. The aim of this document is to provide the Government's assessment of the main impacts of the **Green Gas Support Scheme,** which is to be funded by the **Green Gas Levy.**
2. We set out our proposals to support biomethane injection into the gas grid through the Green Gas Support Scheme, which is expected to run from 2021 until 2025, in the Future Support for Low Carbon Heat and the Green Gas Levy government response.[1]
3. To assess the impact of the Green Gas Support Scheme, we have developed deployment scenarios, which set out potential profiles for spend, carbon savings and renewable heat supported. These estimates have been produced by drawing on a range of sources, including market intelligence and evidence from the Renewable Heat Incentive (RHI).
4. We anticipate that the scheme could deliver annual generation of 2.8TWh of renewable heat in 2030/31 and deliver 3.7MtCO2e of non-traded carbon abatement over carbon budgets 4 and 5. There is considerable uncertainty about these impacts, which are explored in more detail in Annexes F and G.
5. There are also significant uncertainties in the Social Net Present Value (SNPV) of the scheme. Our central estimate of the SNPV, presented in this impact assessment, is £120m
6. We have carried out sensitivity analysis to show the impact on the SNPV, when several modelling assumptions are changed.
7. The key changes to the analytical outputs since the consultation stage impact assessment are outlined below. These are discussed in detail in Annex A:

   - Update to the feedstock mix, and the underlying biomethane potentials and carbon emissions factors of those feedstocks, which has impacted carbon abatement and air quality and led to a net increase in the policy SNPV. Further detail can be found in Annex C.
   - Update to the modelling of ammonia emissions, including assumptions relating to storage and spreading of digestate to ensure consistency with new ammonia mitigating requirements and an update to published Defra Air Quality Damage Costs. These changes have led to a net increase in the policy SNPV. Further detail can be found in Annex E.
   - Inclusion of Green Gas Certificate revenue in the tariff setting in light of new evidence to suggest that anaerobic digestion (AD) plants account for Green Gas Certificates in their cost models. Including this new revenue stream has a minor impact on the GGSS tariff. Further detail can be found in Annex B.
   - Update to assumptions on upstream food waste carbon savings, reflecting interactions with waste disposal policy. This change has led to a reduction in the estimated carbon savings of the scheme, and the SNPV of the policy. Further detail can be found in Section 3.1.4 and Annex F.
   - Updates to carbon values, long-run variable cost of natural gas and the emissions factor of natural gas in line with latest Green Book supplementary guidance[2]. Further detail can be found in Annex A.
   - Inclusion of a third major option which sets out a transition from an initial levy charged based on meter points to a levy charged on volumes of gas consumed. A detailed description of this option can be found in Section 5.3.5.
   - Update to modelling for the Green Gas Levy to include rollover of underspend from one year to the next, which serves to lower the amount needed to be collected to cover GGSS spend costs and therefore reduce the impacts on consumers.

[1] Future Support for Low Carbon Heat and the Green Gas Levy government response: https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

[2] Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

- Increased headroom allocated to the Green Gas Levy to ensure sufficient funds are collected. In addition to covering uncertainty in meter and gas consumptions forecasts, this now covers gas suppliers unexpectedly becoming green gas suppliers, and therefore becoming exempt from the levy, uncertainty in forecasts of underspend, and underpayment by suppliers where the amount owed is too small for mutualisation to be viable. This has led to a small increase in levy collection amounts for this additional headroom. Further detail can be found in Section 5.11.
- Update to the administrative costs for gas suppliers in implementing and running the scheme based on feedback from the consultation, including representing administrative costs from transitioning from the initial per meter point-based levy to the consumption volume-based levy. Further details can be found in Section 5.2.

8. Since the consultation stage impact assessment and publication of the government response, there has been consideration of how the Green Gas Support Scheme will interact with Defra's policy on consistency in recycling. This relates to the supply of separated food waste as a feedstock for AD and how that waste has been diverted from landfill, or other destinations.
9. There is uncertainty on the relative contribution of both policies in removing food waste from landfill, or other destinations, for diversion to AD. As a result, there is uncertainty on the attribution of the resultant carbon savings between these policies.
10. There is limited evidence to inform this attribution. To enable consistent analysis across both policies, this impact assessment does not quantify carbon savings linked to the diversion of food waste from landfill or other destinations to AD. This has reduced reported lifetime carbon savings of the Green Gas Support Scheme from 21.6 MTCO2e to 8.2 MTCO2e. This conservative assumption is likely to underestimate the carbon savings of the policy.
11. Due to the interactions between policies, the SNPV and carbon savings reported in this impact assessment should be considered jointly with the SNPV and carbon savings reported in the final stage impact assessment for Defra's policy on consistency in recycling once published. Further details are provided in Section 3.1.4.
12. In addition to the quantified benefits outlined for the Green Gas Support Scheme, we expect an additional non-monetised benefit from an increase in investment. In particular, we expect an increase in jobs in rural areas. Internal analysis suggests that over two-thirds of existing biomethane plants are currently located in rural areas[3] and we would expect this to continue under the Green Gas Support Scheme. Further, we expect that the GGSS will support approximately 500-900 direct jobs per annum during the construction phase of plants supported under the scheme and 500-550 direct operational jobs over the lifetime of the plants as well as supporting further indirect jobs[4]. Further details on non-monetised benefits can be found in Annex H.
13. The Green Gas Support Scheme will be funded by a Green Gas Levy. The Green Gas Levy is expected to launch in autumn 2021, with the first levy payment from suppliers expected to be collected in Quarter 1 of 2022. Levy payments will be collected for the duration of Green Gas Support Scheme tariff payments, which will end in 2040.
14. We propose that the levy costs are distributed based on gas suppliers' share of the overall gas market at the launch of the scheme before a transition to being levied according to the amount of gas supplied to their customers as soon as possible thereafter, subject to feasibility challenges being overcome.
15. Under our proposed approach, Option C, we estimate the policy impact on the average domestic gas bills to be around £1.40 per annum in the first year of the scheme, before rising to around £4.70 per annum at the peak in 2028 follow the transition to a volumetric approach. This equates to around 1% of the average household gas bill in 2028.

[3] Based on internal analysis, and as defined using 2011 Urban Rural Classifications https://www.gov.uk/government/statistics/2011-rural-urban-classification

[4] Lower bound estimates are drawn from internal BEIS calculations based on operational job estimates from the internal RHI modelling and adjusted to reflect that the ADBA Market Report July 2018 states that there are roughly equal numbers of jobs in the development/construction of new plants and the maintenance of operational plants, whilst deployment continues to grow. Upper bound estimates are based on market intelligence and the occupational impacts estimated in the Annual Business Survey.

16. For non-domestic customers we expect the bill impacts to be an increase of around 1% to their gas bills by 2028.
17. Our estimates show that the impact of the levy on fuel poverty metrics, such as the average fuel poverty gap and the Low Income Low Energy Efficiency (LILEE), is minimal.

Contents

1 Introduction

1.1 Background

1. The current primary support scheme for low carbon heating, the Renewable Heat Incentive (RHI), was set up to facilitate and encourage the transition from conventional forms of heating to low carbon alternatives. The scheme provides financial incentives to households and non-domestic consumers, to help bridge the gap between the cost of low carbon heating systems and conventional alternatives. To date, biomethane (along with many other technologies) has been supported by the Non-Domestic Renewable Heat Incentive (NDRHI), which has helped build up a nascent industry and supply chain able to deliver additional biomethane capacity. As of December 2020, the RHI has supported 95 biomethane to grid plants[5] and in 2019 supported the production of ~3.6TWh[6] of biomethane injected into the gas grid.
2. The existing NDRHI closed to new applications at midnight on 31 March 2021. Post-RHI policy support for biomethane plants will be provided by the Green Gas Support Scheme, which learns lessons from the RHI and aims to deliver better value for money. In order to better target the scheme, we have increased the tier 1 limit for biomethane production, reduced the tariff payment period by 25%, and included robust mechanisms for reviewing the tariff.

1.2 Problem under consideration

3. To meet our legally binding emissions reduction targets, we need to move away from burning fossil fuels to heat our homes, businesses and industry. Biomethane injection into the gas grid accelerates the decarbonisation of gas supplies by increasing the proportion of green gas in the grid. This transition is a necessary step towards meeting our carbon reduction targets, including the UK's net zero greenhouse gas emissions target. We are proposing to fund this transition by imposing a levy on gas suppliers, to support biomethane production through the Green Gas Support Scheme.
4. The Green Gas Support Scheme will drive increasing proportions of green gas in the grid and the resulting reduction in emissions will benefit all gas users and society more widely. We expect the Green Gas Support Scheme will contribute 3.7MtCO2e of carbon savings over Carbon Budgets 4 and 5, and 8.2MtCO2e of carbon savings over its lifetime based on the final policy proposals set out in the Government Response[7]. This will serve to reduce our dependence on burning natural gas to heat our buildings.

1.3 Rationale for intervention

5. Decarbonising heat is one of the biggest challenges we face in meeting our climate targets. Currently, heating is responsible for a third of the UK's greenhouse gas emissions. Biomethane injection into the gas grid is a low-regrets, cost-effective way of contributing to near term legally binding carbon budgets and decarbonising our gas supplies. The Climate Change Committee (CCC) state that biomethane will be valuable across all decarbonisation pathways, as it is a practical and established way of reducing carbon emissions.[8]
6. To deliver this, the Government recognises that continued policy action is essential for maintaining investment in the anaerobic digestion (AD) industry, enabling the development of new production plants for the injection of biomethane in the grid. In supporting investment in this new AD capacity through the Green Gas Support Scheme, we expect to support the development of a sustainable biomethane AD industry.

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[5] Renewable Heat Incentive Official Statistics: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

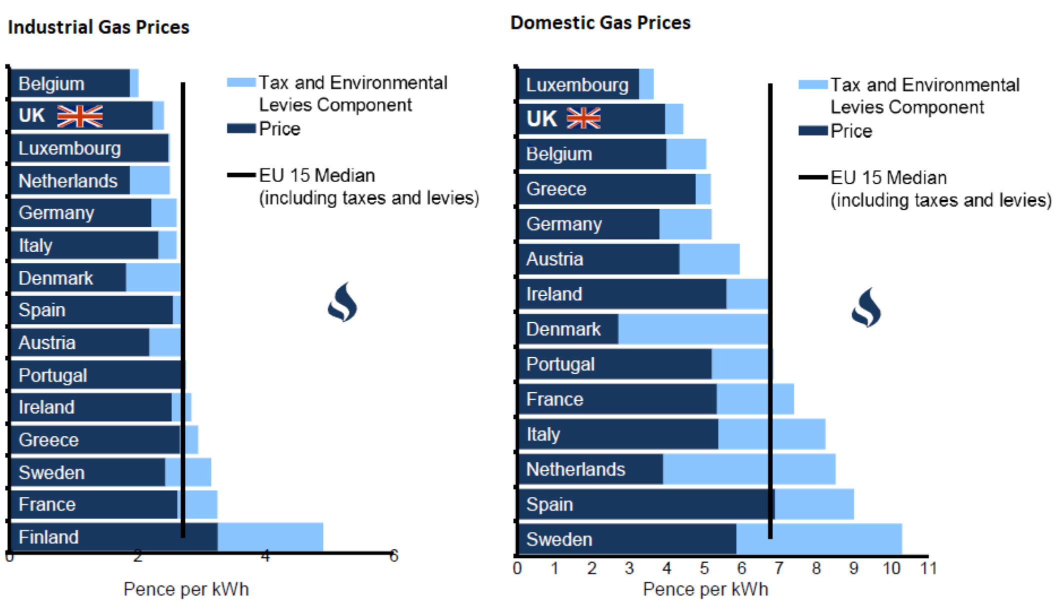
[6] Based on unpublished internal BEIS data on biomethane injection in the grid.

[7] Future support for low carbon heat and the green gas levy: government response: https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

[8] An independent assessment of the UK's Clean Growth Strategy: https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf

7. The full societal costs of fossil fuel combustion are not reflected in their market prices (examples include the impacts on health and climate change), representing a negative externality. Biomethane from AD is currently the only commercially produced green gas in the UK and without government support, it is unlikely that green gas will be deployed instead of natural gas in the grid over the period of the Green Gas Support Scheme. Producing biomethane is unable to compete on cost with producing natural gas, due to large up-front capital costs (e.g. bespoke equipment) and significant ongoing operational costs (e.g. acquiring and processing the biomass feedstocks), which is why tariff support is well-suited to support its production above other mechanisms that cater less well for high ongoing operational costs. By subsidising biomethane injection into the gas grid through the proposed tariff mechanism, the scheme will reduce the cost differential between fossil fuels and biomethane, hence incentivising deployment of biomethane production from AD.
8. Low carbon heat diversifies the UK's energy supply and reduces the UK economy's exposure to the volatility of oil and natural gas prices, which is an additional non-monetised benefit.
9. Given that the benefits of decarbonisation through green gas injection will be shared by all users of the gas grid, it is our view that it is appropriate for gas users to fund the next stage of this transition.
10. The Energy Act 2008 (section 100) allows the Secretary of State to require the payment of a levy by designated fossil fuel suppliers, where supply is used 'for the purpose of generating heat.' We propose to place a levy on licensed gas suppliers across Great Britain for domestic and non-domestic customers to fund the Green Gas Support Scheme.[9]
11. Currently, UK industrial and domestic gas prices are relatively competitive; as shown in Figure 1, at the time of publication, in comparison to the EU14, they are the second lowest.[10]
12. In addition, as can be seen in Figure 2, costs imposed by energy and climate policies form a larger portion of electricity prices than gas prices, for both industrial and domestic customers. This fails to reflect the societal costs of burning natural gas as a fossil fuel, which the Green Gas Levy will begin to address.

Figure 1: Comparison of Industrial and Domestic Gas Prices between the UK and EU14[11]

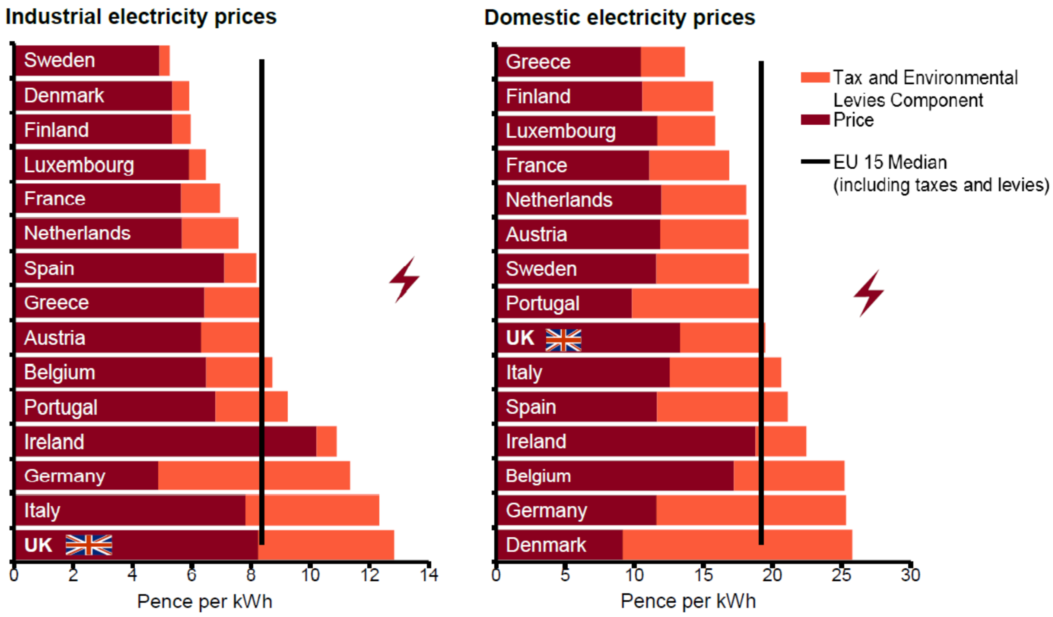


[9] If a gas supplier is supplying green gas exclusively (and none of the gas they supply falls within the section 100 definition of 'fossil fuel'), they would not be subject to the levy, as they would not be encompassed by the section 100 definition of a 'designated fossil fuel supplier'.

[10] The 'EU14' refers to the number of member countries in the European Union prior to the accession of ten candidate countries on 1 May 2004. The EU14 comprised the following 14 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden.

[11] BEIS (2019) Quarterly Energy Prices: June 2020: https://www.gov.uk/government/statistics/quarterly-energy-prices-june-2020

Figure 2: Comparison of Industrial and Domestic Electricity Prices between the UK and EU14, July-December 2019[10]



1.4 Policy objectives

13. The Green Gas Support Scheme has two main policy objectives:

- Encourage deployment of AD biomethane plants in order to increase the proportion of green gas in the gas grid and contribute to carbon savings. We expect the GGSS will contribute 3.7MtCO2e of carbon savings over Carbon Budgets 4 and 5, and 8.2MtCO2e of carbon savings over its lifetime.
- Contribute to the UK Government's legal obligation to reach net zero emissions by 2050.

14. The Green Gas Support Scheme contributes to Objective 4 of the BEIS Single Departmental Plan (SDP): 'Ensure the UK has a reliable, low cost and clean energy system'; and specifically, Objective 4.2: 'Support clean growth and promote global action to tackle climate change', where 'starting to implement plans to decarbonise heat in the 2020s' is referenced specifically.[12] In addition to contributing to the decarbonisation of the gas grid, harnessing the potential of biomethane plays an important role in reducing greenhouse gas emissions from waste and agriculture. Further, we expect that the Green Gas Support Scheme will help support jobs, particularly in rural areas. Estimates of the number of jobs supported are outlined in Annex H.

15. It is essential that the Green Gas Support Scheme is financially sustainable. We have ensured that the Green Gas Levy design, as closely as possible, aligns with the following key principles. The levy should, wherever possible:

a) Be compatible with existing industry processes and practices, utilising existing industry data flows.
b) Be deliverable, in that it must be feasible to implement the financial management systems within the scheme's implementation timescales.
c) Take account of the lessons learned from other relevant government levy schemes to maximise its efficiency and minimise the administrative burden on all parties.
d) Reflect the need for predictability of costs for gas suppliers and have sufficient lead time to ensure suppliers can prepare for payment of the levy.
e) Appropriately reflect Green Gas Support Scheme costs, ensuring no budget deficits.
f) Minimise surpluses and outstanding cash balances, which in turn will minimise the impact on consumer bills.

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[12] BEIS Single Departmental Plan: https://www.gov.uk/government/publications/department-for-business-energy-and-industrial-strategy-single-departmental-plan/department-for-business-energy-and-industrial-strategy-single-departmental-plan-june-2019

g) Be equitable and proportionate for bill payers.
h) Minimise opportunities for non-compliance.

2 Policy Options

16. This impact assessment considers multiple options for the Green Gas Support Scheme and the Green Gas Levy.

2.1 Options Assessment for the Green Gas Support Scheme

17. The Green Gas Support Scheme policy options considered are:

a) **Option 0 (counterfactual):** The quantified impacts of implementing the Green Gas Support Scheme are estimated against a counterfactual where there is no support mechanism for biomethane injection into the gas grid after the flexible third allocation of tariff guarantees under the existing non-domestic RHI. These tariff guarantees have a commissioning deadline of March 2022.[13] There is no Green Gas Levy in the counterfactual policy option.

b) **Option 1 (preferred option):** In this scenario we propose to continue support for biomethane by a tariff paid on a p/kWh basis for all eligible units injected into the gas grid for 15-years from first injection. The tariff will be tiered to account for economies of scale, to ensure value for money, and mitigate the risk of over-compensating plants for their biomethane production, according to the structure in Table 1 below.

Table 1: Option 1 tiering structure

Tier	
Tier 1	First 60,000 MWh of eligible biomethane
Tier 2	Next 40,000 MWh of eligible biomethane
Tier 3	Remaining eligible biomethane

c) **Option 2 (alternative option):** This option proposes a scheme similar to Option 1 given the rationale set out above but with a different tiering structure. Instead of extending Tier 1 payments to the first 60,000 MWh of eligible biomethane injected each year, Tier 1 payments extend to the first 40,000 MWh only. This is in line with the current RHI tiering structure, under which we have seen deployment in the industry. The tiering structure for this option is shown in Table 2 below.

Table 2: Option 2 tiering structure

Tier	
Tier 1	First 40,000 MWh of eligible biomethane
Tier 2	Next 40,000 MWh of eligible biomethane
Tier 3	Remaining eligible biomethane

[13] Changes to the Renewable Heat Incentive (RHI schemes: https://www.gov.uk/government/publications/changes-to-the-renewable-heat-incentive-rhi-schemes

2.2 Overview of proposals for the Green Gas Support Scheme

2.2.1 Support mechanism

18. Biomethane production is characterised by high upfront capital costs as well as high ongoing operational costs. To illustrate, deploying a 6MW waste AD plant for biomethane to grid injection requires over £16m of capital expenditure and incurs operational costs of around 3.2p/kWh[14] – whilst the current wholesale price of gas is less than 1.8p/kWh.[15] There is no evidence to suggest that any new biomethane capacity development would occur in the absence of a support mechanism.
19. Industry feedback indicates that the long-term payments under the NDRHI have created project bankability essential for biomethane projects and have been instrumental in creating a stable financial environment for investors. Tariffs can help to overcome the high ongoing operating costs of AD and continue to incentivise biomethane production after the capital costs are paid off.
20. We have considered different mechanisms to support biomethane but only tariffs have been judged to be suitable for the financial requirements of biomethane plants and deliverable in 2021/22 to avoid a market hiatus and drive additional carbon savings to contribute to near term carbon budgets.
21. Loans and grants do not provide an ongoing incentive for biomethane plants to continue to produce biomethane. They can be used to help overcome initial high upfront capital costs, enabling new AD plants to be built if access to credit is a barrier to deployment, but do not address the ongoing operational costs of plants. Further, they come with associated risks of safeguarding public funds, such as challenges to reclaiming public funds should developers encounter financial difficulties and stop producing biomethane after having received a grant or loan.
22. Value for money mechanisms and budget management are outlined in the Future Support for Low Carbon Heat & The Green Gas Levy government response publication[16].

2.3 Options considered for the Green Gas Levy

23. The options considered for the Green Gas Levy are shown below. All policy options for the Green Gas Levy are based on our preferred Green Gas Support Scheme option described in Section 2.1.

2.3.1 Option A: Distribute Green Gas Levy costs between suppliers according to the number of gas supply meter points that they serve.

24. Under Option A, gas suppliers would be levied according to their share of the overall gas market. This would be determined by the number of meter points on the gas network supplied by each supplier.[17] The annual levy rate would be set approximately six months in advance of the first scheme year, based on maximum projected costs of the Green Gas Support Scheme and the total number of meter points in the market, and three months in advance of future years. For future years, the timing of the levy rate setting process would align with Ofgem's calculation of the price cap. Three tiering options have been considered:

    a) **Option A-i:** Flat rate across all gas consumers.
    b) **Option A-ii – two tiers**:
        - Tier 1: domestic consumers and micro businesses (up to 73,200 kWh/annum).
        - Tier 2: remaining non-domestic consumers (above 73,200 kWh/annum).

[14] Calculated from internal BEIS Biomass Heat Pathways Model assumptions (from the Bioenergy Heat Pathways to 2050 Rapid Evidence Assessment), Ecofys & E4Tech (for BEIS) 2018, unpublished.

[15] Fossil fuel prices assumptions: BEIS FFPA19, table 1: https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2019

[16] https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

[17] Data on the number of meters held by each supplier will be provided to Ofgem, at the beginning of each quarter to align with the payment cycle. See the Financial Management section of the Proposals for Green Gas Levy consultation for more details.

c) **Option A-iii – three tiers**:
   - Tier 1: domestic consumers and micro businesses (up to 73,200 kWh/annum).
   - Tier 2: medium-sized non-domestic consumers (73,200 kWh/annum to 732,000 kWh/annum).
   - Tier 3: large non-domestic consumers (above 732,000 kWh/annum).

25. The tiers align with End User Category (EUC) bands, which is a categorisation system for meters already used within the industry. Up to 73,200 kWh/annum covers the vast majority of domestic users and micro gas-use businesses, while the division above and below 732,000 kWh/annum are standard segmentations between small and large meter points.
26. These options are presented as, following investigation, they were found to be possible to implement and avoid any particular groups of non-domestic customers paying a significantly disproportionate amount relative to their gas use.
27. See the Future Support for Low Carbon Heat & The Green Gas Levy government response for further information on the per meter point approach, including proposals for timings of payments and notice for suppliers.

2.3.2 Option B: Distribute Green Gas Levy costs according to the amount of gas supplied to their customers.

28. Under Option B, gas suppliers would be levied according to the amount of gas supplied to their customers. Following the consultation process, there is no clear consensus for any of the three options previously set out for a volumetric levy design. Having considered consultation feedback, the government intends to work closely with stakeholders going forwards to explore and refine its approach for delivering a workable volumetric levy. These approaches could include but are not limited to:

    - a levy charged at a p/MWh rate based on volumes of gas supplied, with headroom incorporated into the levy rate to account for the variability in gas demand; and
    - setting the size of the levy to be recovered according to a supplier's market share in terms of the volume of gas they supply, with suppliers responsible for managing the recovery of the fixed scheme costs.

29. For these options, and any others that may be considered, we will also explore whether a cut-off could be applied to gas settlement to address the issue of long settlement tails, which follows the precedent set by some renewable electricity support schemes.
30. For the purposes of analysis within this impact assessment, it has been assumed a levy charge would be calculated for each meter point based on the updated Rolling Annual Quantity (Rolling AQ, which is the estimated gas consumption of a meter point over the last 12 months) for that meter each quarter, applying a levy rate per kWh of gas consumed, rather than being fixed for the year. For those meters where monthly readings are not provided, the Rolling AQ would remain based on estimates. However, impacts across different approaches within this option are expected to have very similar impacts.

2.3.3 Option C: Distribute Green Gas Levy costs between suppliers according to the number of gas supply meter points that they serve at the start of the scheme, before transitioning to distributing costs according to the amount of gas supplied to their customers.

31. Under Option C, gas suppliers would be levied according to their share of the overall gas market at the launch of the scheme (as under Option A-i), before a transition to a being levied according to the amount of gas supplied to their customers (as under Option B) as soon as possible, subject to feasibility issues being overcome.
32. The annual levy rate would be set approximately six months in advance of the first scheme year, based on maximum projected costs of the Green Gas Support Scheme and the total number of meter points in the market, and three months in advance of future years. For future years, the timing of the levy rate setting process would align with Ofgem's calculation of the price cap.

33. For the purposes of analysis within this impact assessment, it is assumed that the transition to a volumetric levy will occur around 2024/25, though the date of the transition is not yet confirmed and will happen as soon as is feasibly possible. Further consultation and assessments of the impacts will be made ahead of any new proposals in the area being implemented.

2.4 Overview of proposals for the Green Gas Levy

34. This impact assessment sets out our proposals for initially implementing a per meter point approach in autumn 2021 before transitioning to a volumetric approach as soon as feasibly possible, Option C. At launch, a per meter point design for the Green Gas Levy is preferable due to its reduced complexity and provides greater certainty to suppliers and consumers. It is important to launch the Green Gas Support scheme in autumn 2021 to avoid a hiatus in biomethane deployment that could lead to lost carbon savings, as well as job losses and damage to the UK biomethane industry.
35. However, in the long term, a volumetric levy provides a fairer distribution of costs, as those consuming more gas pay more towards the greening of the gas grid. It is the government's intention to transition to a volumetric levy as soon as possible, subject to feasibility issues being overcome. We will seek to work closely with stakeholders going forwards to explore and refine the approach for delivering a workable volumetric levy.
36. A consultation and impact assessment on the move to a volumetric levy will take place ahead of any such change.
37. Table 3 sets out how these options relate to the key principles of the levy. Each principle is rated on a red-amber-green scale, based on how well it meets the principle (with green indicating good alignment, and red indicating poor alignment). The reasoning is presented below.

Table 3: Options and key principles of the levy

		Option A-i	**Option A-ii**	**Option A-iii**	**Option B**	**Option C** *Preferred option*
Key principles of the levy	Compatibility with existing processes	Green	Green	Green	Amber	Green
	Deliverability for GGSS launch in Autumn 2021	Green	Amber	Amber	Red	Green
	Taking account of lessons learned	Green	Green	Green	Green	Green
	Predictability of costs	Amber	Amber	Amber	Red	Amber
	Appropriately reflected GGSS costs	Green	Green	Green	Amber	Green
	Minimise surpluses and outstanding cash balances	Green	Green	Green	Amber	Green
	Be equitable and proportionate for bill payers.	Amber	Amber	Amber	Green	Green
	Minimise opportunities for non-compliance	Green	Green	Green	Green	Green

38. While a volumetric levy, as set in Option B, aligns policy costs more closely with energy consumption than the other options, there are a number of feasibility challenges, including

settlement timings, the impact on energy intensive industries (EIIs), and seasonal variations in gas consumption and consumption proxies that will need to be overcome before adopting a volumetric levy, as set out in Option B.

39. A per meter point design, as set out in Option A, is less complex than a volumetric levy and provides greater certainty to suppliers and consumers on costs. Any significant delay to the launch of the GGSS would result in lost carbon savings, damage to the biomethane industry and job losses.

40. Options A-ii and A-iii consider two approaches to a tiered design of the levy, where meter points are grouped by gas consumption and those that consume more gas per annum are charged a higher rate. We have found there to be no suitable approach to tiering that is effective in aligning costs more closely to gas consumption, without heavily affecting small, less gas-intensive businesses. Similarly, the approach suggested by a few respondents for increasing the number of tiers provided quite marginal improvements in reducing bill costs and 'cliff edges' between tiers.[18]

41. However, Options A-i, A-ii and A-iii decouple gas consumption from the cost of the levy to the consumer. As such, those who are consuming the most fossil fuels do not contribute more to making the gas grid green under these options. As domestic and micro-business consumers typically consume less gas than other businesses, this approach is expected to distribute cost disproportionally on domestic and microbusiness consumers when considering gas consumption. Under Option B, consumers are charged in accordance with their gas usage, avoiding this issue and ensuring a more equitable distribution of costs. This increased equitability of cost distribution is a key driver for a transition to a volumetric levy under Option C, where the per-meter point approach will be in place while overall costs and bill impacts remain low, and the transition occurs some time before the peak of costs in the Green Gas Support Scheme in 2028.

42. Each option would be backed by a robust enforcement and compliance regime to ensure non-compliance was minimised.

[18] Cliff edges occur where there are sizable jumps in the cost of the levy from one tier to the next, where consumers on the edges of those tiers may find their costs increasing or decreasing substantially with little change in their incomes.

3 Analytical Approach

43. This section outlines the evidence base on which impacts of the policy proposals have been modelled.

3.1 Green Gas Support Scheme

3.1.1 Reference Plants

44. The principle underpinning the analysis of the Green Gas Support Scheme is to use a ‘reference plant’, for costs, benefits, revenues, and other impacts. This is in line with the principle under the NDRHI and uses a number of inputs that affect the overall costs and carbon savings associated with biomethane produced. The reference plant is effectively the weighted average plant we expect to be built on the scheme. It does not attempt to directly reflect the costs and carbon savings associated with each individual plant supported under the scheme, nor does it try to represent a ‘typical’ plant, but rather the reference plant is used to show the expected costs and benefits of all biomethane produced across all plants deployed on the scheme. For example, the feedstock mix assumed in this impact assessment is not the feedstock mix we would expect an individual plant to use, but rather represents the feedstocks that we might expect to be used for the total biomethane produced from plants under the scheme (see Annex C for further information on the feedstock mix and reference plants).

3.1.2 Tariff Setting

45. **Payment length** – the Green Gas Support Scheme consultation proposed the tariff payment period to be set at 15 years, which is shorter than the 20 years offered under the NDHRI. This is to reflect that the AD biomethane market has matured since the start of the RHI in 2011 and will reduce the overall payments made to plants over the lifetime of the scheme. The consultation stage impact assessment also analysed the impacts of a shorter tariff length of 10 or 12 years, however shortening the tariff payment period beyond the proposed 15 years is expected to have an impact on the amount of biomethane produced under the Green Gas Support Scheme because there is the potential for a significant risk to deployment. The primary reason for this is that it gives finance providers a shorter window to recover from delays. Market intelligence indicates that debt financiers typically require a buffer period between the end of the loan repayment and the end of tariff support for any delays in project delivery, plant construction, and operational issues that the plant may encounter. A shorter tariff period could increase the impact of this buffer period on the overall project. With a significantly shorter tariff of 10 or 12 years, there is a risk of a lack of time to make up for any delays to construction which poses an expected serious risk to deployment, as investors may perceive biomethane as too risky an investment. We therefore believe a 15-year tariff length is appropriate and strikes the right balance between achieving the key scheme objective of delivering carbon savings, while also ensuring value for money.
46. **Tier limits** –the Green Gas Support Scheme consultation proposed to increase the Tier 1 limit to 60,000MWh compared to the NDHRI Tier 1 limit (40,000MWh) to encourage larger plants to come online where there are suitable conditions to do so and allow them to take advantage of economies of scale. This in turn will stimulate production of larger volumes of biomethane and increased carbon savings. Setting the limit for Tier 1 below 60,000MWh would be unlikely to make a material difference to the market and could result in limited benefits. Conversely, a very high limit (above 60,000MWh) would pose risks to deployment levels due to feedstock and grid capacity constraints, as well as increased risks around feedstock and digestate travelling over longer distances to feed larger plants. The tiering structure is outlined further in Annex B.

3.1.3 Key assumptions

47. Below are the key assumptions used in the Green Gas Support Scheme impacts appraisal:

Assumption	Description
Counterfactual	The costs and benefits of the Green Gas Support Scheme are measured relative to the use of natural gas in the grid.
Economic lifetime	Additional plant capacity deployed under the Green Gas Support Scheme is appraised over its assumed economic lifetime of 20 years[19]. The 20-year appraisal period is greater than the 15-year tariff payment length, but this is in line with guidance on policy appraisal. Should a biomethane plant stop producing after the tariff ends, realised biomethane production and carbon savings would reduce. The impact of this is explored in sensitivity analysis in Section 4.5.
Additionality	Biomethane production is characterised by high upfront capital costs, as well as high ongoing operational costs. Whilst there are other government policies that encourage use of biomethane production, such as Renewable Transport Fuel Obligation policy[20], the return for producers from such schemes is not designed to fully compensate them for the full costs of building and running an AD plant and will therefore not provide sufficient investment certainty to deploy new biomethane capacity over the lifetime of this scheme. Therefore, there is no evidence to suggest that any new biomethane capacity development would occur in the absence of a support mechanism, and full additionality is assumed.
Deployment	Deployment estimates are critical to quantifying the potential benefits and costs of the policy proposals by driving the amount of biomethane produced and resource costs associated with the plants producing that biomethane. Given the uncertainty around projecting deployment, sensitivity analysis using different scenarios are used. See Annex G below for more details on deployment under the Green Gas Support Scheme.
Feedstock mix	Feedstock mix is the proportion of each type of feedstock that we expect to deploy over the whole population of biomethane plants deployed under the GGSS. This affects several monetised impacts, including carbon savings through the biomethane emissions factor. See Annex C for further information on feedstock mix.
Biomethane carbon emissions factor	Net greenhouse gas emissions are estimated by considering the emissions from producing biomethane (biogeneration), the upstream savings associated with diverting waste feedstocks away from their counterfactual use, minus the emissions factor for natural gas as the counterfactual fossil fuel displaced by biomethane. See Annex F for further information.
Ammonia emissions factor	Ammonia emissions from digestate have been estimated and quantified. Emissions factors used are consistent with those used to compile the 2019 National Atmospheric Emissions Inventory.[21] See Annex E for further information.

[19] Economic lifetime assumption is drawn from the internal BEIS Biomass Heat Pathways Model assumptions (from the Bioenergy Heat Pathways to 2050 Rapid Evidence Assessment), Ecofys & E4Tech (for BEIS) 2018, unpublished.

[20] Another example of Government policy is Defra's Waste and Consistency policy which may provide additional food waste to be used for biomethane production.

[21] National Atmospheric Emissions Inventory, 1990-2019: https://naei.beis.gov.uk/reports/

3.1.4 Assumptions on upstream carbon savings from food waste

48. Diverting food waste from other destinations to AD will generate carbon savings. Green Gas Support Scheme AD plants, that use food waste, are likely to use separated food waste generated by Defra's Consistency in Household and Business Recycling policy. This policy has recently been consulted on for a second time and will divert food waste from both landfill and incineration by mandating separate collections. It will put in place regulatory requirements that include local authorities introducing weekly separate food waste collections and for specified municipal businesses that produce food waste to have separate collections. Further details on this are available in the Consistency in Household and Business Recycling – Consultation Document[22].
49. Both policies play key roles in diverting food waste from landfill and incineration to AD. Defra's policy on consistency in recycling creates a supply of separately collected food waste for which extra AD capacity will be needed. The GGSS helps incentivise the supply of AD, allowing consistency policy to generate carbon savings by creating a destination for separated food waste.
50. There is insufficient evidence to disaggregate the relative contribution of both policies in diverting food waste to AD and therefore it is not possible to apportion the resultant carbon savings between policies. In the recently published consistency in recycling policy consultation impact assessment, there were an estimated £3.7bn of carbon savings[23].
51. To enable consistent analysis across impact assessments, the analysis presented in this impact assessment does not quantify carbon savings associated with the diversion of food waste from landfill and incineration. These carbon savings will be included in the final stage consistency in recycling policy impact assessment. This approach allows analysis to be considered jointly across both impact assessments, reflecting policy interactions.
52. This approach assumes that all food waste used by Green Gas Support Scheme AD plants will be municipal food waste. However, the Green Gas Support Scheme does not specify where AD plants need to source food waste feedstocks from. Therefore, plants could use separated food waste that is outside the scope of Defra policy. This is likely to include food waste from industrial sources, such as distilleries. However, it is not possible to accurately estimate the expected sources of food waste for plants on the scheme.
53. Hence it is assumed that all food waste Green Gas Support Scheme AD plants will use municipal food waste and the carbon savings for the Green Gas Support Scheme are likely to be underestimated following this approach.
54. Further detail on this assumption is included in Annex F.

3.1.5 Monetised Impacts and Evidence Base

55. All prices in this analysis have been converted into 2020 prices using the November 2020 GDP deflator.[24]
56. The Green Book social time preference rate ('discount rate') of 3.5% has been applied for all social present values.
57. The quantified costs and benefits which are used to undertake cost-benefit analysis and contribute to the social net present value (SNPV) for the Green Gas Support Scheme policy design mechanism, are:

    - **Resource Costs** – the net economic cost of installing and operating new biomethane capacity over and above the counterfactual costs. This includes capital costs, operating costs, net feedstock costs and revenues from Green Gas Certificates. Revenues from Green Gas Certificates have been added since consultation stage due to increasing

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[22] https://consult.defra.gov.uk/waste-and-recycling/consistency-in-household-and-business-recycling/

[23] In 2019 prices, discounted to 2023. Note this figure has been calculated using 2018 carbon prices (https://www.gov.uk/government/collections/carbon-valuation--2) and will be updated for the final stage impact assessment in line with updated carbon prices.

[24] GDP deflators for November 2020: https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp

evidence showing that an increasing number of AD plants account for Green Gas Certificates in their cost models. Further information on resource costs and data sources can be found in Annex D.

- **Air Quality Costs** – The negative impact of ammonia emissions, arising from digestate, on air quality. Ammonia damage costs are taken from Defra air quality appraisal guidance.[25] Further information on ammonia emissions calculations can be found in Annex E.
- **Generation Benefits** – Biomethane displaces the use of natural gas in the grid and is valued using the change in fossil fuel use, using the long run variable costs (LRVC) of gas supply as per HMT Green Book supplementary guidance.[26]
- **Carbon Savings** – The estimated value of the carbon abated due to biomethane displacing natural gas (assumed to be attributable in full to the non-traded sector). Further information on carbon saving calculations can be found in Annex F. To value greenhouse gas savings HMT Green Book supplementary guidance on valuation of energy use and greenhouse gas emissions is used.[27]
- **Fertiliser Savings** – Where digestate displaces synthetic fertiliser use in the agricultural sector. The value of avoided synthetic fertiliser costs is the average of monthly spot prices from 2017-2020 published by Agriculture and Horticulture Development Board.[28]

3.1.6 Uncertainties

58. The main uncertainties around the assumptions outlined in Section 3.1.3 relate to:

a) **Biomethane plant deployment –** Assumed deployment levels are derived from a combination of commercial intelligence and the deployment of biomethane plants under the RHI, adjusted for the anticipated impact of the GGSS policy proposals. The biomethane injected by each plant in relation to its 'capacity' is assumed to follow the BEIS internal modelling, which is based on RHI data and averaged over appropriate intervals to estimate the annual proportion of capacity injected[29] . In addition to the central deployment scenario, high and low scenarios have been developed to reflect different levels of industry investment. Further details on these scenarios are outlined in Annex G.

b) **Feedstock mix and counterfactual use of feedstocks** – There are large variations in the stock of existing biomethane plants, and we expect new plants supported by these proposals will also be heterogeneous[30]. There is variation in plant feedstock and the counterfactual use of their feedstock as well as resource costs. For this reason, it is not possible to accurately predict the exact plants which will deploy on the scheme. Counterfactual uses of feedstocks are subject to a high degree of uncertainty and are discussed in more detail in Annex F.

c) **Upstream savings from food waste diversion** – as described in Section 3.1.4, we expect that some Green Gas Support Scheme AD plants that use food waste feedstocks will use food waste separated by Defra's policy on consistency in recycling. There are uncertainties on the relative contributions of both policies in diverting food waste to AD and therefore the attribution of carbon savings between policies. Further details on this are included in Annex F.

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[25] Air Quality Appraisal: Damage Cost Guidance: https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance

[26] Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

[27] HMT Green Book supplementary guidance: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/793632/data-tables-1-19.xlsx

[28] Great Britain fertiliser prices: https://ahdb.org.uk/GB-fertiliser-prices

[29] An adjustment to the averaging method was applied since the consultation IA to better reflect the source data, but with a negligible impact on results.

[30] These differences arise from a wide range of variables including feedstock inputs, equipment required, location, and costs. Resource costs of biomethane production per unit of gas produced therefore vary within the biomethane market. Other characteristics of individual plants, such as the efficiency of equipment used, may also impact on emissions but due to evidence constraints and the size of the expected impacts, these are not considered here.

59. These uncertainties can influence both areas of policy design and the modelled impact of the proposed support scheme. The main areas in which uncertainties in assumptions feed through into quantified impacts are:

a) **Biomethane produced** – Uncertainty around deployment, influenced by both policy design and external factors, has a direct impact on the quantity of biomethane supported under this policy proposal in addition to plant performance assumptions.
b) **Carbon savings** – The assumed carbon savings are based upon assumptions about deployment, the counterfactual use of feedstocks, the interactions between the Green Gas Support Scheme and Defra's policy on consistency in recycling, and the emissions factors associated with our feedstock mix. As indicated, deployment affects the amount of carbon savings through the amount of biomethane produced under the policy, whilst the emissions factor uncertainty affects the greenhouse gas impact of each unit of biomethane produced. Further details on how the counterfactual use of feedstocks and policy interactions affect carbon savings are outlined in Annex F.
c) **Tariff setting** – Tariffs are based on a reference plant using an assumed feedstock mix and are set by the methodology outlined in Annex B. The heterogeneity of plants expected to deploy on the scheme means there are uncertainties surrounding rate of return for individual plants.

60. Sensitivity analysis on how uncertainties in these assumptions, and others outlined in Section 3.1.3, could affect the Green Gas Support Scheme social net present value (SNPV) is included in Section 4.5.

4 Green Gas Support Scheme Impacts Appraisal

61. This section of the impact assessment quantifies the costs and benefits of the Green Gas Support Scheme, with analysis based on assumptions outlined in Section 3.1.3.

4.1 Social net present value (SNPV)

62. The descriptions of quantified costs and benefits contributing to the SNPV are provided in Section 3.1.5.
63. Costs and benefits are discounted to a base year of 2020, to allow comparison with analysis presented in the consultation stage impact assessment.
64. Table 4 is a breakdown of the components of the SNPV for each option, where each element of the monetised costs and benefits are shown. The table shows that Option 1 provides the best value for money.

Table 4: SNPV components	**Option 1 (£m)**	**Option 2 (£m)**
Resource costs	-2,065	–1,975
Air quality (ammonia) damage costs	–260	–230
Generation benefits	+775	+695
Carbon savings	+1,540	+1,385
Fertiliser savings	+130	+115
SNPV	**120**	**–5**

Figures are rounded to the nearest £5m and may not sum due to rounding. Note that the SNPV reflects the analytical approach to attribute carbon savings between the Green Gas Support Scheme and Defra's policy on consistency in recycling. The SNPV should be interpreted jointly with the SNPV reported in Defra's final stage impact assessment when published.

4.2 Renewable heat supported

65. Due to the nature of biomethane installations, the level of renewable heat generated increases for a period of time following commissioning as the AD process typically results in a 'ramp up' of production of biomethane gas until conditions in the plants optimise. For further details on plant ramp up see Annex D.
66. Table 5 shows the estimated annual renewable heat generated by the Green Gas Support Scheme during the years of peak production, from 2029/30 to 2040/41, assuming central deployment and biomethane 'ramp-up' outlined above.

Table 5: Annual renewable heat generated

TWh	**Option 1**	**Option 2**
Annual renewable heat during peak production (2029/30 - 2040/41)	2.8	2.5

4.3 Greenhouse gas abatement

67. Table 6 shows the greenhouse gas savings estimated to be supported over carbon budgets 4 and 5 as a result of the Green Gas Support Scheme.
68. The greenhouse gas abatement potential of the proposed policies is highly dependent on several factors, including the deployment and counterfactual assumptions. Further details can be found in Annex F.

Table 6: Profile of greenhouse gas abatement (central deployment assumptions)

Carbon savings* (MtCO2e)		Option 1		Option 2	
CB4 (2023-27)	(of which upstream)	1.6	(0.6)	1.4	(0.6)
CB5 (2028-32)	(of which upstream)	2.1	(0.8)	1.9	(0.8)
Lifetime	(of which upstream)	8.2	(3.3)	7.4	(2.9)

*Reported carbon savings reflect the attribution of upstream carbon savings from food waste diversion between the Green Gas Support Scheme and Defra's policy on consistency in recycling. They should be interpreted jointly with the carbon savings reported in Defra's final stage impact assessment when published.

69. Table 6 shows the proportion of non-traded carbon savings which are estimated to be upstream savings. The upstream savings all relate to the avoidance of emissions that would have occurred if AD feedstocks had been put to a different use. For example, food waste assumed in our feedstock mix might have otherwise ended up in landfill or incineration. More detail on upstream emissions savings can be found in Annex F.

4.4 Carbon Cost Effectiveness

70. Under central modelling assumptions the Carbon Cost Effectiveness (CCE) for Option 1 (preferred option) is £173/tCO2e, while the CCE for Option 2 (alternative option) is £188/tCO2e.[31]. These results show that the social cost per tonne of carbon abated for Option 1 is lower than Option 2.
71. Policies with a lower or negative number are generally thought to be better value for money. Where the cost effectiveness number is negative it implies there is net benefit to the economy per tonne of CO2 equivalent abated.

4.5 Sensitivity analysis

72. The SNPV is sensitive to a range of uncertainties such as deployment and feedstock mix. To investigate the impact of these uncertainties, sensitivity analysis has been carried out to illustrate the effects on the SNPV of varying the assumptions which have the most influence on the overall outputs. The key results from this analysis are summarised and discussed below. Table 7 contains detail on the full range of sensitivities tested and the rationale behind these.

Table 7: Summaries of sensitivities tested

Assumption	Sensitivities tested	Rationale
Deployment	High	Deployment estimates are developed from the NDRHI and market intelligence and there is inherent uncertainty. The costs and benefits of this scheme are very dependent on deployment so high and low sensitivities are used. See Annex G for more details.
	Low	

[31] Note that due to interactions with Defra's policy on consistency in recycling and the analytical approach to attributing carbon savings between policies, these estimates may overstate the social cost per tonne of carbon abated. Further details on CCE calculations can be found in the HMT Green Book supplementary guidance: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794737/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal-2018.pdf

Assumption	Sensitivities tested	Rationale
Carbon values	Green Book high	In line with the ranges presented in the Green Book supplementary guidance.
	Green book low	
Long run variable cost of gas	Green Book high	In line with the ranges presented in the Green Book supplementary guidance.
	Green Book low	
Air quality damage costs	Green Book high	In line with Defra's air quality damage cost guidance.
	Green Book low	
Upstream food waste carbon savings	Upstream carbon savings resulting from 50% diversion of food waste to AD	There is significant uncertainty in the amount of food waste diverted from landfill to AD and the attribution of the resultant carbon savings between the Green Gas Support Scheme and Defra's policy on consistency in recycling, as discussed in Section 3.1.4. This sensitivity shows an indicative impact of assuming 50% of the food waste used by GGSS AD plants is diverted from landfill to AD, with the resultant carbon savings attributed to the Green Gas Support Scheme.
All upstream carbon savings	No upstream carbon savings from either food or agricultural waste diversion to AD	There is significant uncertainty in feedstock mix and counterfactual use. This sensitivity shows the impact of the scheme without any upstream savings. For more detail on upstream savings, see Annex F.
Production during tariff payment period only	15 years production	As described in Section 3.1.3., the Green Gas Support Scheme is appraised over its assumed economic lifetime of 20 years. If an AD plant stopped producing at the end of the tariff support period (15 years), instead of economic life, it would reduce carbon savings.
Crop feedstock	50% crop	The scheme requires at least 50% of waste in feedstock mix, as such it is technically possible for plants to use 50% non-waste (crop) feedstock. This is unlikely but would have large impacts on the ammonia and carbon savings. See Annex E for further details.

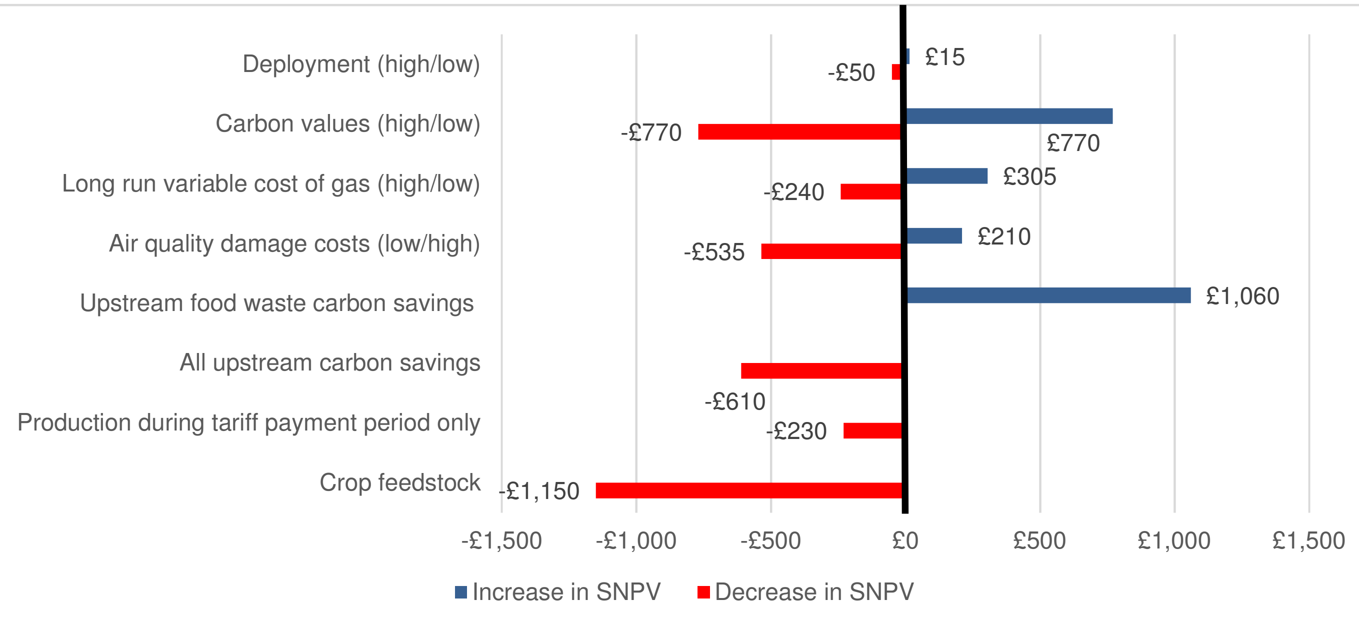
73. The estimated impacts of these sensitivities on the SNPV and lifetime non-traded carbon savings are included in Table 8 below and illustrated in Figure 3.

Table 8: Sensitivity analysis

Scenario	Sensitivity	SNPV (£m)	Lifetime non-traded carbon savings (MtCO2e)
Deployment	High	135	9.2
	Low	70	4.8
Carbon values	Green Book High	890	8.2
	Green Book Low	-650	8.2
Long run variable cost of gas	Green Book High	425	8.2
	Green Book Low	-120	8.2
Air quality damage costs	Green Book High	-415	8.2
	Green Book Low	330	8.2
Upstream food waste carbon savings	Upstream carbon savings resulting from 50% diversion of food waste from landfill to AD, attributed to GGSS	1,180	13.8
All upstream carbon savings	No upstream carbon savings from food or agricultural waste diversion to AD	-490	4.9
Production during tariff payment period only	15 years production	-110	6.1
Crop feedstock	50% crop	-1,030	6.1

SNPV figures are rounded to nearest £5m, lifetime non-traded carbon savings are rounded to the nearest 0.1MtCO2e

Figure 3: Sensitivity analysis



4.6 Non-monetised costs and benefits

74. The table below shows the non-monetised benefits that are not captured in the cost-benefit analysis. There are no additional non-monetised costs to include. Further details on these non-monetised benefits are included in Annex H.

Impact	Description of impact	Direction of potential impact on SNPV
Investment in jobs	The majority of investment in biomethane plants in the UK adds to domestic jobs and gross value added. Future decarbonisation will be more cost effective.	Positive
Investment in innovation	The future of decarbonising heat will benefit from cost reductions and become more cost effective. The current market for low carbon heat is relatively small, and these technologies are largely unable to compete on cost with conventional heating options, such as natural gas. This is partly due to the emerging nature of low carbon heating, which means that it does not benefit from economies of scale or from mature supply chains to the same degree as conventional technologies. We expect economies of scale and innovation to increase as the market matures.	Positive
Rural impact	Over two thirds of biomethane plants are in rural areas.	Positive
Net zero contributions	Carbon savings are not considered in view of UK Government net zero requirements. In the absence of the scheme, additional action would be required to meet these requirements.	Positive

Impact	Description of impact	Direction of potential impact on SNPV
Eliminating food waste	Food waste sent to AD supports a more circular economy and contributes to England meeting its target to eliminate food waste to landfill by 2030, to recycle 65% of municipal waste by 2035 and reduce municipal waste to landfill to 10% by 2035.	Positive

4.7 Preferred option

75. Option 0 (offering no support mechanism for biomethane injection into the gas grid) fails to provide additional carbon savings to contribute to decarbonising heating in the UK and meeting carbon budgets. Of the two options we developed, Option 1 (with a Tier 1 limit of 60,000 MWh), is our preferred option, compared to Option 2 (with a Tier 1 limit of 40,000 MWh), as it is expected to lead to:

a) more deployed capacity and biomethane production, allowing more carbon abatement to be realised.
b) a better carbon cost effectiveness as the higher tier limit is expected to encourage larger plants to deploy, benefiting from economies of scale.

4.8 Risks and mitigations

76. Below are the key risks of the GGSS and the mitigations that have been put in place:

Risk	Mitigation
The tariff rates are set at levels that do not generate desired incentives for producers	The tariff rates will be reviewed annually through the Annual Tariff Review process. This process will compare emerging data against the data used to set the existing tariff rates. This will then inform any necessary changes to the tariff rate to maintain desired incentives for producers.
GGSS benefits are lower than expected	This could result from lower than expected deployment, injections of biomethane into the grid, or carbon savings. The monitoring and evaluation plan for the GGSS will allow the scheme's benefits to be tracked. There will also be a mid-scheme review, which will consider possible changes to the scheme that could increase the realisation of benefits.

77. As proposed in the Government Response[32], the government will base the compliance and auditing processes for the GGSS on the existing one for the RHI where appropriate, though there are some areas of compliance that have been updated to reflect improvements in environmental requirements or to strengthen the regulations. We are committed to ensuring that the administrator has all relevant powers to ensure an effective compliance regime and mitigate risks of non-compliance. Further details are provided in the Government Response.

[32] Future Support for Low Carbon Heat and the Green Gas Levy government response: https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

5 Green Gas Levy Impacts Appraisal

79. This section of the impact assessment sets out the costs and distributional impacts of the Green Gas Levy.

5.1 Key Assumptions and Data Sources

80. Below are the key assumptions used in estimating the impact of the Green Gas Levy:

Assumption	Description
Gas suppliers will pass on costs to their customers in the same way as the charges are set.	The levy imposes a charge on gas suppliers which we assume will be fully passed on to bill payers, and in the same way it is set. However, The Energy Act 2008 (section 100), which provides the power to set this levy, does not include powers to dictate how suppliers pass costs on to their customers. In addition, we assume costs incurred by gas suppliers to administer the levy are fully passed on to bill payers.
Current trends in gas consumption continue for the duration of the scheme	The analysis conducted to date on price and bill impacts is based on projections of gas consumption under current policies and current average gas consumption.
Suppliers not required to pay the levy form a negligible portion of the market	A gas supplier will be subject to full levy costs if any proportion of their gas falls within the definition of fossil fuel in s.100 Energy Act 2008 (and accordingly within the definition of 'natural gas' in the Energy Act 1976). This follows the same principle as levies applied on the electricity market and avoids market distortion. If a gas supplier is supplying 100% green gas (and none of the gas they supply falls within the s.100 definition of "fossil fuel"), they would not be subject to the levy, as they would not be encompassed by the s.100 definition of a 'designated fossil fuel supplier.' Currently, the portion of the market served by such suppliers is negligible; however, it is possible this market share may grow over time.
Each gas customer has one gas meter point	Options A-i, A-ii and A-iii divide the costs of the levy by the number of meters. For the purposes of calculating impacts on customers for these options, it is assumed each customer has one meter. Some larger customers will have more than one meter per premises, and so will see larger impacts from the levy under Options A-i, A-ii and A-iii. The effect of this is expected to be small as these customers inherently consume large amounts of gas, meaning the levy rate under Option A-i is a negligible impact on their bills and the tiered Options A-ii and A-iii consider consumption per meter point.

81. The data sources used to assess the impact of the Green Gas Levy are:

    a) **Projected gas consumption –** BEIS Energy Emissions Projections[33] are used to estimate future gas consumption for households and businesses, this is then used to calculate the expected bill impacts of the levy.
    b) **Projected gas meter numbers –** Historical trends as described in published sub-national gas consumption data[34] have been projected forwards using ONS household

[33] Energy and emissions projections: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2018

[34] Regional and local authority gas consumption statistics: https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority

projections.[35] for domestic meters and projected gas consumption for non-domestic meters.

c) **Projected gas prices –** Gas prices used in this analysis are based on BEIS fossil fuel price projections.[36] This is used to estimate the expected gas price impact of the levy.

d) **Annual levy cost profile –** The levy cost profile is based on spend estimates of the Green Gas Support Scheme.

5.2 Policy costs and gas supplier administrative burden

82. The estimated levy profiles to support the Green Gas Support Scheme, based on different deployment profiles, are shown in Table 9. Spend increases during the initial years of the scheme because the first biomethane plants on the scheme ramp-up production over time and new biomethane plants begin deploying. Spend peaks at £150m in 2028/29 until 2035/36, after which spend declines as tariff payment periods for supported plants end.
83. Table 9 also shows Ofgem's predicted administrative cost that will be recovered via the levy.
84. Costs incurred by gas suppliers to administer the levy are also expected to be passed on to bill payers. Estimates of the administrative burden on gas suppliers is shown in Table 10.

Table 9: Estimated scheme funding profile (£m, 2020 prices)

Figures are rounded to the nearest £5m.

		2022/23	2023/24	2024/25	2025/26	2026/27 to 2035/36 (total)	2022/23 to 2035/36 (total)
Deployment scenario spending profile[37]	Central	20	50	90	125	1,480	1,765
	Low	10	30	55	70	860	1,020
	High	25	60	100	140	1,665	1,985
Administrative Costs		5	5	5	5	25	45

Figures may not sum due to rounding.

85. As discussed further in Section 5.3, the levy will need to collect payments to cover the maximum spend based on the available forecasts at the time it is set. As such, the costs to be covered are expected to be close to the currently projected maximum deployment early in the scheme, with the projected deployment range narrowing, most likely toward the central scenario, over its lifetime.
86. The first collection of the levy is expected to occur in Quarter 1 of 2022, and so the first quarter of the levy will cover backdated Green Gas Support Scheme payments, as well as Q1 payments for the levy and collection for Q2 which will be needed to establish as 'quarterly lag', whereby the levy collection for a given quarter will pay for GGSS payments in the next quarter to allow for time to invoice, collect and process payments ahead of the point where GGSS payments need to be made.
87. The administrative costs presented for Ofgem are current best estimates and will remain uncertain as the scheme is implemented. The costs are therefore subject to change.
88. Suppliers will incur administrative costs through familiarising themselves with the policy, updating systems and engagement to notify customers of the levy. These activities will result in some costs in the run-up to and immediately after the policy comes into effect in 2022. Once the policy is in place, suppliers will also face recurring costs from providing information to Ofgem, making

[35] Household projections for England: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/householdprojectionsforengland

[36] Fossil fuel price assumptions: https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2019

[37] See Future Support for Low Carbon Heat Impact Assessment for further information on the Green Gas Support Scheme deployment scenarios.

levy payments and lodging credit cover with Ofgem, so that they are able to cover their levy obligations for each quarter.

89. The follow assumptions have been taken to estimate the administrative costs of the scheme:

- It will take the equivalent of 3 to 6 months of FTE staff to for companies to familiarise themselves with the policy, undertake the necessary changes to systems and notify customers under our preferred option of Option C.
- Following this, it will take between 1 and 2 months of FTE staff each year to cover the recurring elements of the scheme and make the necessary payments in the early years of the scheme, prior to the transition to a volumetric levy.
- The transition to a volumetric levy will bring further one-off costs, due to further need for familiarisation, updates to systems and communications with customers, which are expected to be require between 6 and 12 months FTE staff.
- The volumetric scheme is additionally expected to be somewhat more complex to manage, requiring 2 to 4 months FTE staff each year for suppliers to manage.
- The average annual salary of these staff members is estimated to be around £38,000.[38]

90. The consultation tested these assumptions. The main points raised within the responses were ensuring the assumptions covered the range of administrative activities suppliers would be required to undertake. For example, engagement with customers and Ofgem; that administration of a volumetric levy would be more time consuming and expensive for suppliers than a per meter point levy; and that administrative costs associated with the transition needed to be set out. These comments have been implemented, with costs for the transition under Option C set out under that option, the range of activities that are covered within the costs more clearly set out and higher costs set out under a volumetric levy (Option B and Option C).

91. A full breakdown, including low and high estimates, of the expected administrative costs for each supplier can be found in Table 10.[39]

92. We expect gas suppliers to pass through these costs to customers, resulting in an additional bill increase of approximately less than 5p before the transition to a volumetric levy, the transition will then increase bills by around 10p in the year it occurs, following which the increase from administrative costs will fall again to less than 5p.

Table 10: Estimated administrative burden on suppliers (£m, 2020 prices)

Figures are rounded to the nearest £0.1m.

	Option A-i		Options A-ii & A-iii		Option B	
	Initiation costs	Recurring annual costs	Initiation costs	Recurring annual costs	Initiation costs	Recurring annual costs
Low	0.6	0.2	0.6	0.2	1.2	0.4
Central	1.3	0.3	1.7	0.3	2.6	0.9
High	2.3	0.4	3.5	0.4	4.7	1.6

	Option C			
	Initiation costs - per metre point	Recurring annual costs - per metre point	Transition costs - Volumetric	Recurring costs after transition - Volumetric
Low	0.6	0.2	1.2	0.4
Central	1.3	0.3	2.6	0.9
High	2.3	0.4	4.7	1.6

[38] This estimate is based on the median full time salary of a business and management consultant, from Annual Survey of Earnings and Hours (ASHE) 2019, Table 16, for SIC code 7022 (Business and other management consultancy activities), converted to 2020 prices: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/industry4digitsic2007ashetable16

[39] The modelling of these costs has been done in line with the Standard Cost Model for analysing administrative burdens: https://ec.europa.eu/eurostat/documents/64157/4374310/11-STANDARD-COST-MODEL-DK-SE-NO-BE-UK-NL-2004-EN-1.pdf/e703a6d8-42b8-48c8-bdd9-572ab4484dd3

5.3 Impact on gas bills for households and businesses

93. As is set out in the government response[40], it is assumed that suppliers pass on all policy costs imposed on them as an expense they need to recoup. Since we expect the pass through of costs to consumers, we expect consumer bills to increase.
94. The Green Gas Support Scheme has applications open for four years starting in 2021/22. Spend on the Green Gas Support Scheme increases during the initial years of the scheme because the first biomethane plants on the scheme ramp up production over time and new biomethane plants begin deploying. Spend peaks at £151m in 2027/28 until 2036/37. Spend is expected to decrease thereafter, as plants that deployed at the start of the scheme stop receiving payments. All plants will have stopped receiving payments by 2040/41, when spend will end. The impact on gas bills for households and businesses will follow a similar pattern.
95. We are proposing that launching with Option C – a levy calculated on a flat rate per meter basis before transitioning to a volumetric levy – is the most appropriate option. This is the only option that has been assessed to be feasible to deliver that avoids any particular group of bill-payers being unacceptably burdened with higher costs relative to their gas consumption. It leads to the same amount being added to all gas bills in the early years of the scheme when costs are lowest, before transitioning to costs being distributed according to a user's gas consumption. The estimated impact of this lead proposal is shown in Section 5.3.5 below.
96. The estimated annual increase in gas bills and gas prices by affected groups are also shown for all policy options. This information is summarised in Table 11 below:

Table 11: Estimated annual increase on gas bills, Options A-I, A-ii, A-iii, B and C (2020 prices)

			Estimated impact in 2022	Estimated impact at peak (2028)
Option A-i	Bill increase per meter		£1.40	£6.20
Option A-ii	Bill increase per meter	Tier 1 (Up to 73.2MWh/year)	£1.40	£6.10
		Tier 2 (More than 73.2MWh/year)	£4.80	£21.00
Option A-iii	Bill increase per meter	Tier 1 (Up to 73.2MWh/year)	£1.30	£6.00
		Tier 2 (73.2 to 732 MWh/year)	£4.80	£21.00
		Tier 3 (More than 732 MWh/year)	£50.00	£220.00
Option B	Price increase per MWh		£0.08	£0.34
	Bill increase for an average household		£1.20	£4.70
Option C	Bill increase per meter		£1.40	-
	Price increase per MWh		-	£0.34
	Bill increase for an average household		£1.40	£4.70

5.3.1 Impact on gas bills: Option A-i

97. Table 12 shows the impact on gas bills under Option A-i. In this case, the levy is distributed between suppliers according to their market share, as determined by the number of gas supply meter points that they serve. This analysis assumes there is no tiering, and so the levy is calculated on a flat rate £/meter point basis.
98. This approach leads to the lowest total levy collection, and therefore overall bill impacts. The reasons for this are set out below.

[40] https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

99. This approach uses meter point information, which is highly accurate. As a result, there would be no need for reconciliation processes, which minimises administration costs.

100. Option A-i also provides more certainty on costs for suppliers, and in turn customers, than other approaches, as it would be calculated on meter point ownership as opposed to gas demand and total number of meter points and the number of meter points served by individual suppliers is less volatile than yearly gas demand. This is explored further in the Green Gas Levy uncertainties section (3.1.6). Moreover, it would not be subject to seasonal variations in gas demand. This would substantially reduce the need to collect additional funds to cover such variability and ensure that the Green Gas Levy more accurately reflects Green Gas Support Scheme costs, while overall levy collections are kept to a minimum.

101. This option is more resilient to market shocks compared to a volumetric approach, such as in Option B or tiered approach, such as in Options A-ii or A-iii. Consumption projections based on historic consumption are vulnerable to shocks or structural changes to demand. For example, the recent fall in gas demand as a result of COVID-19 has shown the susceptibility of the calculation to unexpected events and has led to additional administrative effort to correct consumption estimates as much as possible to manage this variation and try to minimise inaccuracies. Changes in the number of meter points, however, have been much more modest. This further reduces administrative costs and reduces the need to account for potential variations.

102. However, this approach decouples gas consumption from the cost of the levy to the consumer. As such, those who are consuming the most fossil fuels do not contribute more to making the gas grid green.

103. As domestic consumers typically consume less gas than businesses, this approach is expected to distribute cost disproportionally on domestic and micro-gas-consumption business consumers when considering gas consumption. This is explored further in Sections 5.5 and 5.6 on distributional impacts.

Table 12: Estimated annual increase on gas bills, Option A-i (2020 prices)

		Estimated impact in 2022	Estimated impact at peak (from 2028)
Annual bill increase per meter (£)		£1.40	£6.20
Bill increase (%)	**Average household**	<0.5%	1.0%
	Business consuming 140 MWh/year [41]	<0.5%	<0.5%
	Business consuming 1,400 MWh/year	<0.5%	<0.5%

5.3.2 Impact on gas bills: Option A-ii

104. Table 13 shows the impact on gas bills under Option A-ii. In this case, the levy is distributed between suppliers according to their market share, as determined by the number of gas supply meter points that they serve. There are two charging tiers, based upon Xoserve's End User Category (UEC) bands, which are in turn based upon annual gas consumption:

a) Tier 1: Domestic consumers and microbusinesses.
b) Tier 2: Remaining non-domestic consumers.

105. Tier 1 aligns with Xoserve's lowest band, band 1, the upper end of which is set at 73,200 kWh/year. This tier covers the vast majority of domestic users and micro gas-use businesses. Tier 2 covers all meters in higher bands, consuming more than 73,200 kWh/year.

[41] Example businesses consuming 140 MWh/year and 1,400 MWh/year of gas have been chosen to illustrate the effects on businesses with different scales of gas use, falling within the industry recognised small supply points and large supply points respectively.

106. The levy rate for Tier 2 has been set such that none in the tier pay significantly disproportionate amounts compared to their gas use. The remaining costs are divided amongst Tier 1. This approach has been taken due to the very wide range of gas consumption amongst non-domestic users. Setting the levy rate, for example, in line with average consumption within the non-domestic band would mean those at the bottom of this band would be paying a levy rate that was hugely disproportionate to their gas consumption. Domestic consumption covers a much narrower band, and so this effect is much less apparent.

107. This approach has many of the same advantages as option A-i. In addition to these, through the tiering approach, this option reallocates some of the costs from lower gas use consumers to higher use consumers. This helps to better align contributions to the levy to gas consumption.

108. However, as can be seen from the limited reduction in costs for an average domestic household, the impact of this limited. The reason for this is that 99% of all meters fall into Tier 1, so large increases in costs for Tier 2 are required for substantial change to be seen in the costs for Tier 1.

109. In addition to this, the system adds administrative burden to suppliers compared to Option A-i, and presents a sizable cliff edge between tiers, as the cost of the levy roughly triples from Tier 1 to Tier 2. It is our view that this additional administrative burden is not merited for the minimal impact it has on domestic bills.

Table 13: Estimated annual increase on gas bills by affected group, Option A-ii (2020 prices)

		Estimated impact in 2022	Estimated impact at peak (2028)
Annual bill increase per meter (£)	**Tier 1 (Up to 73.2 MWh/year)**	£1.40	£6.10
	Tier 2 (More than 73.2 MWh/year)	£4.80	£21.00
Bill increase (%)	**Average household**	<0.5%	1%
	Business consuming 140 MWh/year	<0.5%	Up to 1%
	Business consuming 1,400 MWh/year	<0.5%	<0.5%

5.3.3 Impact on gas bills: Option A-iii

110. Table 14 shows the impact on gas bills under Option A-iii. In this case, the levy is distributed between suppliers according to their market share, as determined by the number of gas supply meter points that they serve. There are three charging tiers:

a) Tier 1: Domestic consumers.
b) Tier 2: Medium-sized non-domestic consumers.
c) Tier 3: Large non-domestic consumers.

111. As with Option A-ii, Tier 1 aligns with Xoserve's lowest band, band 1, the upper end of which is set at 73,200 kWh/year. Tier 2 covers meters in bands 2 and band 3, consuming between 73,200 kWh/year and 732,000 kWh/year. And Tier 3 covers all meters in bands 4 and above, consuming more than 732,000 kWh/year. As before, Tier 1 covers the vast majority of domestic users and micro gas-use businesses. The additional segmentation between Tier 2 and Tier 3 are industry standard segmentations between small and large meter points.

112. The levy rates for Tier 2 and Tier 3 have been set such that those at the lower end of the tiers pay an equivalent amount to what they would pay under option 2. The remaining cost were divided amongst Tier 1. As before, this is due to the wide range of consumption present in the non-domestic bands. While narrower under a three tier system, the difference in consumption between those at the top and bottom of tier 2 remains considerable.

113. This option builds on Option A-ii, and amplifies both its advantages, in shifting costs onto those consuming more gas, and disadvantages, in further increasing the administrative burdens and creating cliff-edges – particularly the latter, as Tier 3 is around 10 times the cost of Tier 2.

114. As before, the small impact on domestic bills has been judged as not being sufficient to justify these disadvantages.

Table 14: Estimated annual increase on gas bills by affected group, Option A-iii (2020 prices)

		Estimated impact in 2022	Estimated impact at peak (2028)
Annual bill increase per meter (£)	Tier 1 (Up to 73.2 MWh/year)	£1.30	£6.00
	Tier 2 (73.2 to 732 MWh/year)	£4.80	£21.00
	Tier 3 (More than 732 MWh/year)	£50.00	£220.00
Bill increase (%)	Average household	<0.5%	1%
	Business consuming 140 MWh/year	<0.5%	Up to 1%
	Business consuming 1,400 MWh/year	<0.5%	Up to 1%

5.3.4 Impact on gas bills: Option B

115. Table 15 shows the impact on gas bills under Option B. In this case, the levy is distributed between suppliers according to amount of gas supplied to their customers.
116. The primary advantage of this option is the alignment between gas use and levy cost to consumers. However, as detailed under Option A-i, this option exposes suppliers and consumers to the volatility of the gas market and presents a substantial challenge to the key principle of providing predictability of costs and to government in ensuring levies collected meet Green Gas Support Scheme budget requirements without significant headroom.
117. In addition, it is more administratively complex due to longer time lags on the availability of accurate gas consumption data, which can be up to 3 years. This requires reconciliation of projections with actual data which is both costly and complicated. The complexity makes this option unlikely to be deliverable in time for the Green Gas Support Scheme launch.

Table 15: Estimated annual increase on gas bills, Option B (2020 prices)

	Estimated impact in 2022	Estimated impact at peak (2028)
Price increase per MWh (£)	£0.08	£0.34
Bill increase for an average household (£)	£1.20	£4.70
Price increase (%)	<0.5%	Up to 1%

5.3.5 Impact on gas bills: Option C (preferred option)

118. Table 16 shows the impact of gas bills under Option C. Under this option, the levy begins being distributed on a per-meter-point basis, as in Option A-i, before transitioning to a volumetric basis where costs are distributed between suppliers according to amount of gas supplied to their customers, as in Option B. This transition is planned to occur as soon as feasibly possible. For the purpose of the IA, we have assumed this will occur around 2024/25.
119. The advantage of this option is that it can be implemented in time for 2022, as with Option A-I, due to the initial simplicity of administration. However, the transition then allows for time to develop a deliverable volumetric approach, providing the alignment of costs from the levy to consumption of gas, as discussed in Option B.
120. The disadvantage of this option is that the transition incurs additional administrative burden and complexity when it occurs, as Ofgem and suppliers will need to update systems and processes to move to the new system. This is discussed in Section 82.d), on administrative burdens.

Table 16: Estimated annual increase on gas bills by affected group, Option C (2020 prices)

		Estimated impact in 2022	Estimated impact at peak (2028)
Bill increase per meter (£)		£1.40	-
Price increase per MWh (£)		-	£0.34
Bill increase (%)	**Average household**	<0.5%	-
	Business consuming 140MWh per annum	<0.5%	-
	Business consuming 1400MWh per annum	<0.5%	-
Bill increase for an average household (£)		£1.40	£4.70
Price increase (%)		<0.5%	1%

5.4 Distribution of domestic impacts

121. This section of the impact assessment shows the distributional impacts of the Green Gas Levy on domestic consumers. The levy impacts on businesses will be presented in Sections 5.6 and 5.7.
122. This analysis expands on previous assessments of the expected bill impact on the 'average' household. It aims to provide greater insights into the distributional impacts of the levy options proposed on domestic gas consumers. To analyse these impacts, two approaches have been taken, namely:
    a) Analysis by income decile, using ONS' Living Costs and Food survey[42]
    b) Analysis by protected characteristics of household members. This used a custom version of the fuel poverty supplementary tables[43], which are based on the English Housing Survey[44].
123. We have taken two different approaches to analyse the domestic distributional impacts for this Impact Assessment, since evidence suggests that income alone does not indicate gas consumption. A range of other factors such as differences in household composition, the number of occupants, lifestyles, building efficiency and working patterns may influence gas consumption, and consequently the levy rate.
124. Looking at protected characteristics enables us to determine whether the Green Gas Levy will impact on the equality of opportunity between people who share a protected characteristic and those who do not, which is a requirement of the Public Sector Equality Duty. Further detail is given in Section 6.

5.4.1 Analysis by income decile

125. Under Options A-i, A-ii and A-iii, the cost to households consuming gas regardless of their characteristics will be costs set out in Table 11. For Options B and C, the cost will vary by the amount of gas consumed, which varies by income decile; the bill impact in the peak year (2028) for each income decile is shown in Table 17.

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[42] Average weekly household expenditure on fuel by gross income decile group, UK, financial year ending 2018 - https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/adhocs/009534averageweeklyhouseholdexpenditureonfuelbygrossincomedecilegroupukfinancialyearending2018

[43] https://www.gov.uk/government/statistics/fuel-poverty-supplementary-tables-2021

[44] https://www.gov.uk/government/collections/english-housing-survey

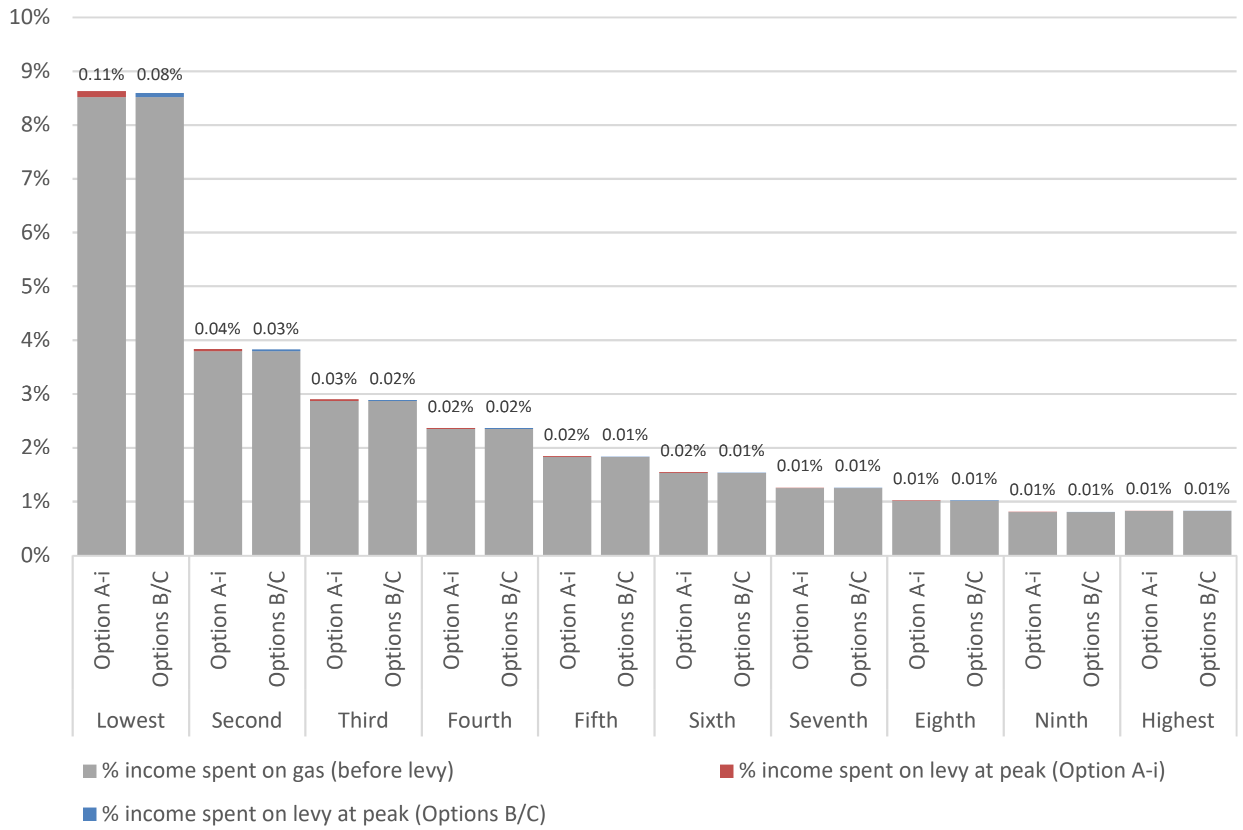
Table 17: Percentage of household income spent on gas

Income decile	Peak bill impact from the levy – Options B/C (2020 prices)
Lowest	£4.30
Second	£4.40
Third	£4.50
Fourth	£4.80
Fifth	£4.60
Sixth	£4.70
Seventh	£4.50
Eighth	£4.40
Ninth	£4.70
Highest	£6.10

126. The percentage of household income spent on gas by income decile is shown in Figure 4. The counterfactual proportion is based on the latest published ONS Living Costs and Food survey data (linked below), which reports gas expenditure and incomes in the financial year ending 2018. The percentage of income spent on gas under Options A-i/A-ii/A-iii and Options B/C are estimates of the additional impact of the levy during its peak year (2028), in addition to the baseline counterfactual proportion of income spent on gas (based on 2018 data). Although there will be minor differences in domestic bill impacts under tiering Options A-ii and A-iii compared to Option A-i (see Section 5.3), the impact of the levy on the proportion of household income spent on gas is expected to be equal under these options, since all households will face an equal bill impact under these proposals.

127. Under Option B and Option C, the impact of the levy on the proportion of household income spent on gas are also expected to be equal in 2028, since we expect that a transition to a volumetric approach under Option C will be complete by 2028. However, for Option C in earlier years, the levy impact on percentage of household expenditure on gas will be more closely aligned to those under Option A-i/A-ii/A-iii, prior to the transition.

Figure 4: Gas expenditure by income decile – Options A, B & C



128. Whilst Option A-i/A-ii/A-iii proposes an equal levy rate for all gas consuming households, lower income groups spend an increasingly higher proportion of income on gas bills as seen in Figure 4. Therefore, the levy under Option A-i/A-ii/A-iii will have a greater proportional impact on lower income groups.
129. Under Option A-i, the lowest income group are expected to spend an additional 0.12% of their income on gas, whilst the highest income groups are expected to see an increase of 0.01%, compared to the counterfactual.
130. Although the per-meter point approach will have a greater proportional impact on lower income groups, the magnitude of this impact is relatively small. Given Option A-i is currently the standard way of allocating market share within the industry, hence providing Ofgem with access to timely and accurate data and allowing accurate allocation of levy costs with existing systems, this is the only option that is deliverable for the GGSS launch in Autumn 2021 without significant challenges. The per-meter point approach therefore continues to be the preferred option until feasibility challenges to adopting a volumetric approach to levy design can be overcome, allowing a transition to a consumption based approach under Option C.
131. Under Option B and Option C (post-transition), consumers are charged based on individual household consumption, leading to differences in levy rate across households. There is no clear trend in levy bill impact with income, with the first nine income deciles facing little variation in levy rate, whilst the highest income decile faces a considerably higher levy rate.
132. Lower income groups spend a higher proportion of income on gas, however. Table 17 shows that, under the volumetric approach of Options B/C, the lowest income group are expected to spend an additional 0.08% of their income on gas in 2028, whilst the highest income groups are expected to see an increase of 0.01%, compared to the counterfactual.
133. Although lower income households see a greater proportional impact, the magnitude of the increase is again very small. Ultimately a consumption based levy will ensure that those who consume more gas will contribute more to the greening of the gas grid, and therefore it is the Government’s intention to transition to a volumetric as soon as feasibly possible (Option C).

5.4.2 Analysis by household types

134. In line with the Public Sector Equality Duty, and particularly the duty to have due regard to the advancement of equality of opportunity between people who share a protected characteristic and those who don't, further analysis has been conducted looking at impacts by available protected characteristics to provide further insights on the domestic distributional impacts of the levy.
135. The data on protected characteristics is provided by the Fuel Poverty Supplementary Tables 2021[45]. This uses the English Housing Survey to determine household characteristics based on the household reference person (i.e. the head of household) where relevant, and models energy requirements based on property characteristics. This means that the consumption figures show the required consumption rather actual consumption, as this may be lower if financial difficulties mean the household underheats their home.
136. Table 18 and Figure 5 present the expected bill impact across protected characteristics at the peak levy year (i.e. 2028) under Option B, and Option C following the transition to a volumetric levy. They show the mean income and consumption for each characteristic.
137. In Table 18, three protected characteristics are shown: ethnicity of household reference person, whether a household member has a disability or long-term illness[46], and age of the oldest household member. For the remaining characteristics, the characteristics are either less relevant at a household level and/or available evidence does not suggest that the levy would present disadvantages; these characteristics are sex, gender reassignment, sexual orientation, marriage, religion or belief, and pregnancy and maternity.

Table 18: Protected characteristics analysis

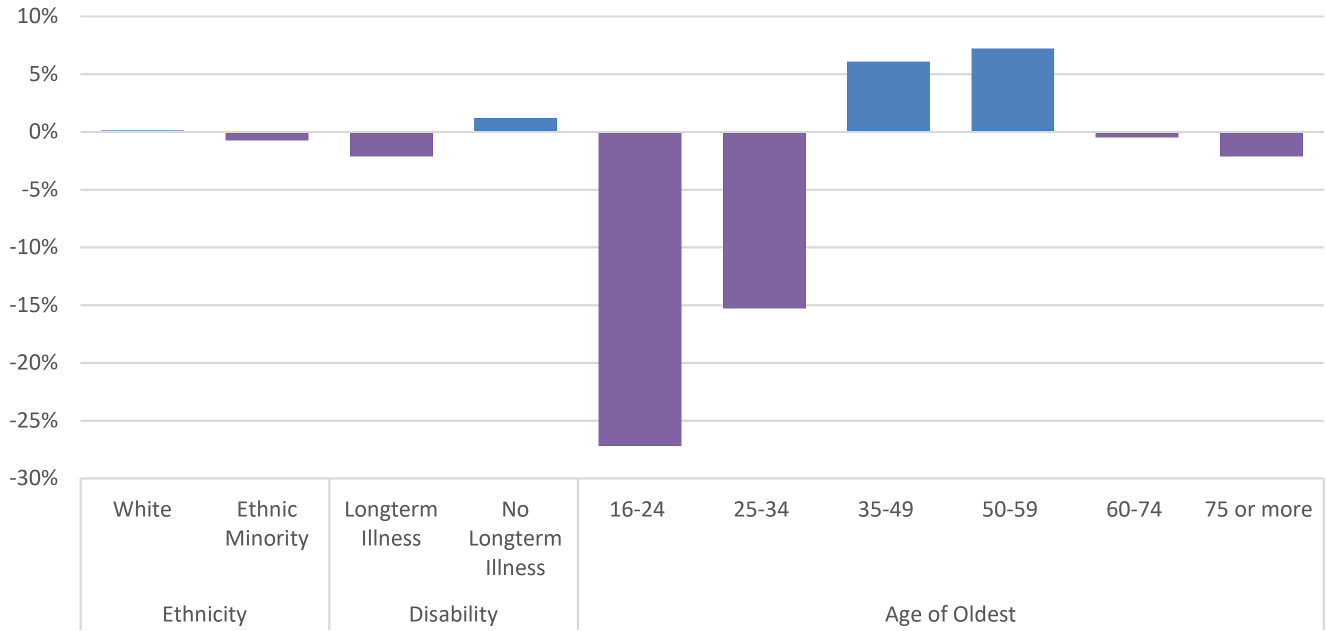
Protected characteristic		Median household annual income	Average gas consumption (kWh)	Peak bill impact under Options B and C (2020 prices)
Ethnicity	White	£28,900	12,760	£4.70
	Ethnic Minority	£28,600	12,660	£4.70
Longterm illness/ Disability	Longterm Illness	£24,100	12,480	£4.60
	No Longterm Illness[47]	£31,800	12,900	£4.70
Age of oldest member of household	16-24	£23,600	9,290	£3.40
	25-34	£31,000	10,800	£4.00
	35-49	£34,800	13,520	£5.00
	50-59	£33,700	13,670	£5.00
	60-74	£25,500	12,690	£4.70
	75 or more	£21,200	12,480	£4.60

[45] Fuel poverty supplementary tables 2021: https://www.gov.uk/government/statistics/fuel-poverty-supplementary-tables-2021

[46] A household that contains someone with a long-term illness/disability that states their condition reduces their ability to carry out day-to-day activities. Examples of long-term illnesses/disabilities include, but are not limited to, conditions which affect vision, hearing, mobility and/or mental health.

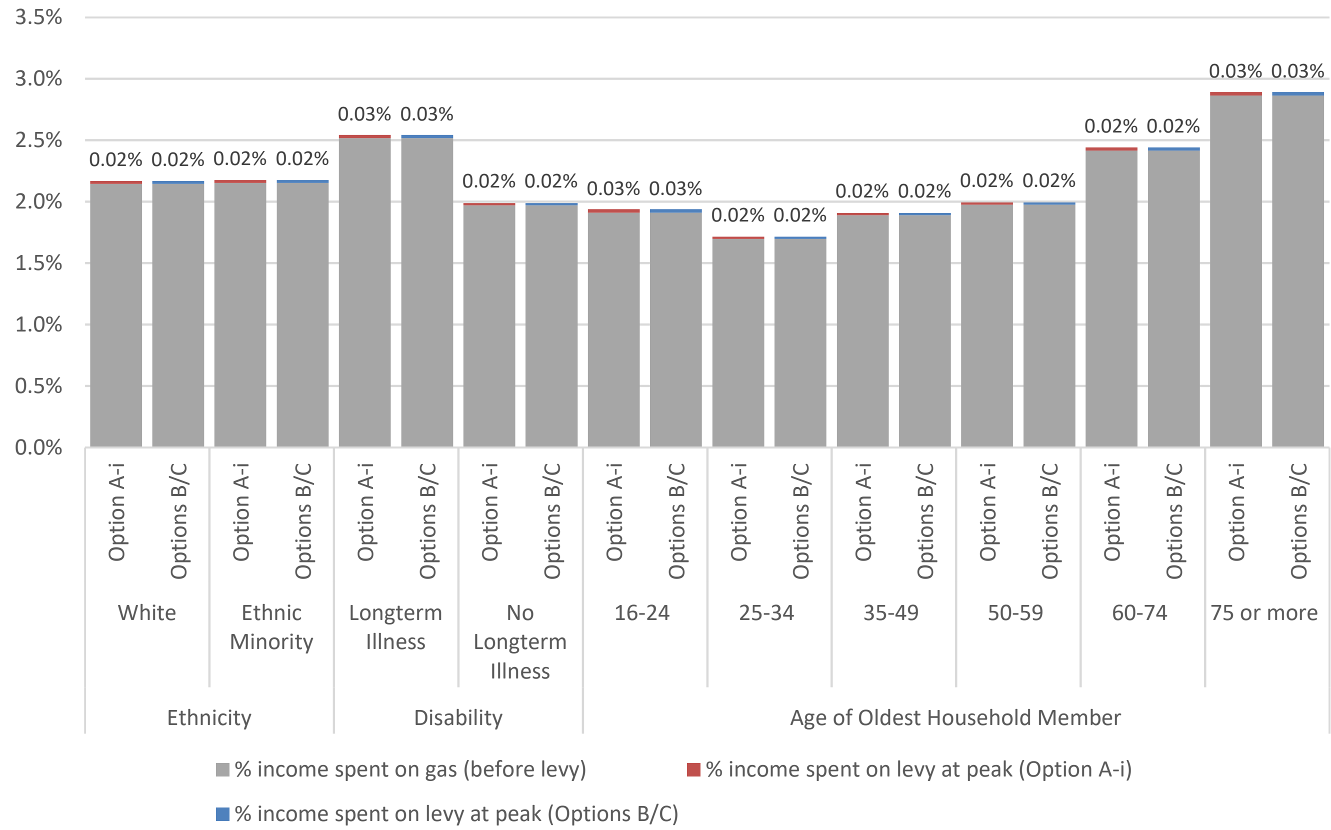
[47] Households who did not give an answer when asked if their household contained someone with a long term illness/disability are included in the "No" category

Figure 5: Comparison to average bill impact in 2028



138. Analysis of protected characteristics shows that, whilst those with a long-term illness or disability have similar consumption levels to other households, their average income is almost 20% lower. Similarly, the youngest and oldest households (as defined by age of oldest household member) have similar household incomes, but the latter has higher consumption.
139. For ethnicity and disability, the impact on each group is largely the same, with none differing from the average bill impact by more than 5%.
140. For age, the most impacted group is those where the oldest household member is between 35 and 59. However, these households also have the highest annual household incomes.
141. The least impacted age groups are those where the oldest household member is between 16 and 34, where the expected impact is over 25% less than the average bill impact. Whilst those aged 16 to 24 are the second lowest income group, the remainder (those aged 25 to 34) have one of the higher household incomes.
142. The percentage of household income spent on gas by protected characteristic is shown in Figure 6. This shows that the impact from the levy as a proportion of household income varies little between the different options and different groups, all falling between 0.02% and 0.03% of household income. This is due to both the small size of the levy, regardless of the option, at less than £10 per annum, and while option A-i and options B/C have a notable percentage difference at the peak of the levy, the absolute difference remains less than £3 per annum even for the 16-24 year old group, where the difference is greatest.
143. The counterfactual proportions are based on the gas consumption data for each household type and the projected average cost of gas for domestic consumers in 2028. The percentage of income spent on gas under Option A-i and Options B/C are estimates of the additional impact of the levy during its peak year (2028), in addition to the baseline counterfactual proportion of income spent on gas (based on 2018 data).
144. Under Option B and Option C, the impact of the levy on the proportion of household income spent on gas are also expected to be equal in 2028, since we expect that a transition to a volumetric approach under Option C will be complete by 2028. However, for Option C in earlier years, the levy impact on percentage of household expenditure on gas will be more closely aligned to those under Option A-i, prior to the transition.

Figure 6: Gas expenditure by protected characteristic – Options A, B & C



145. Ultimately, a volumetric levy (Option B/C) will ensure that those consuming more gas will pay more towards the greening of the gas grid and may incentivise behaviour change. Since levy costs are directly influenced by consumption, this may result in lower consumption and generally lead to positive impacts such as lower emissions from reduced gas usage. There is a possibility it could result in unintended consequences however, such as under-heating in lower income households leading to negative health impacts. However, there are several government policies and support in place for domestic consumers and vulnerable groups in relation to their energy use and costs. For example, the Energy Company Obligation has upgraded 2.2 million homes by delivering over 2.7 million energy efficiency measures, and the Warm Home Discount scheme supports over two million households with a £140 rebate for fuel poor customers.

146. The Government recognises however that a consumption-based levy will ensure that those who consume more gas contribute more to the greening of the grid. Under Option C, our preferred option, we intend to transition to a volumetric approach in 2024/25 or as soon as feasibility challenges are overcome. Most households will experience lower bill impacts following a transition to a volumetric approach, due to re-distribution of levy costs between the domestic and non-domestic sectors.

147. We expect small variations in bill impacts across domestic households following a transition to a volumetric levy. Although analysis of protected characteristics can provide an indication of likely levy distribution, and impact on various groups, ultimately the levy bill impact will depend on individual household consumption which is heterogenous and may be influenced by variety of factors.

5.5 Fuel poverty impact

148. A household is considered to be in fuel poverty if it has above average energy costs and when they spend the required amount to heat their home, they are left with a residual income below the poverty line.

149. The impact of the proposed levy on fuel poverty is dependent on the size of the increase in gas prices. Households that do not use mains gas to heat their homes will not be affected.
150. When assessing the impacts of the levy, our estimates show that although the per-meter point approach of Options A-i, A-ii and A-iii may have a greater proportional impact on the lower income groups, the magnitude of this would be relatively small.
151. However, fuel poverty is a devolved issue and each country in Great Britain has its own fuel poverty indicator for measuring the issue.
152. In England, where the Low Income Low Energy Efficiency (LILEE) indicator is used, we estimate that the impact on the number of households in fuel poverty would be minimal. The fuel poverty gap is a measure of the depth of fuel poverty in England. Our estimates show that the impact of the levy on the average fuel poverty gap, under all options presented, is minimal compared to the baseline scenario where the levy is not imposed.
153. Similarly, estimates undertaken by the Welsh Government suggest that under their measures, any impact of the levy would be a most marginal.
154. Estimates undertaken by the Scottish Government suggest up to 5,000 additional households may enter fuel poverty from this levy in Scotland. In 2018, the average (median) fuel poverty gap, for the 619,000 households in fuel poverty, was estimated at about £650. For those entering fuel poverty because of this measure, their depth of fuel poverty would be a maximum of around £7, only a fraction of the depth experienced by other fuel poor households.
155. We will continue to monitor the impacts of the levy throughout the life of the scheme as there will be a monitoring and evaluation process for both the scheme and levy, including monitoring costs on consumers and impacts on fuel poverty.

5.6 Small and Micro Business Assessment (SaMBA)

156. In this SaMBA we have considered the impacts of the levy on both gas suppliers and businesses who will face a higher gas bill due to the levy. For gas suppliers, the make-up of the gas supply market is variable. There is a very uneven distribution regarding the amount of meter supply points that each supplier serves, and while we do not collect data on the sizes of their businesses, given the number of meter points served, we expect that a number of gas suppliers are small or micro businesses.
157. As it is our expectation that suppliers will pass costs onto their customers, we are not proposing any exemptions from the levy for small gas suppliers. It is our view that small supplier exemptions are more relevant for schemes where suppliers have significant delivery obligations, which would otherwise pose a disproportionate administrative burden on small suppliers. Options A-i, A-ii and A-iii seek to minimise theses costs, while Option B will involve greater burdens on suppliers under the current high level design. Option C will start with the lower impacts of Option A-i, but will incur higher costs on transition to a volumetric levy, similar to Option B.
158. The flat-rate per meter option proposed will provide a high degree of certainty on costs for suppliers, compared to the volumetric approach. Any disruption or uncertainty resulting from reconciling projected gas consumption, to actual consumption once the data becomes available, would disproportionately affect small gas suppliers.
159. In addition to this, Option A-i reduces administrative costs and burden on suppliers compared to the tiering and volumetric approaches considered (see Table 10), making the levy more manageable for smaller suppliers.
160. We will work with gas suppliers as the volumetric approach is further developed ahead of the transition set out in Option C, including to work to minimise administrative burdens faced. While Option C is expected to have the highest administrative burdens overall of the three approaches, given the additional impacts of the transition, the advantages of the lower complexity and greater certainty as the levy is introduced and the fairer distribution of impacts following the transition outweigh this disadvantage.
161. Because these costs will be passed through, we have considered the impact on small and micro businesses who consume gas. In this SaMBA, we follow the standard gas industry cut-off point of

73,200 kWh to determine whether a customer is domestic or non-domestic. This threshold is widely used, for example in Sub-National Gas National Statistics[48].

162. The impact under each option are set out below:

- **Option A-i** - The expected addition to SaMB bills will represent a small proportional increase. Peak levy costs are estimated to be £6.20 in 2028, leading to a corresponding bill increase of up to 0.5% for small businesses with annual gas consumption over 73,200 kWh. However, there is significant variation in energy consumption amongst the non-domestic sector, and we recognise that gas consumption for some micro-businesses may fall below this threshold. For these businesses, we would expect a bill increase of up to around 1% during the peak period[49], in line with expected impact on the average household gas bill (see Table 12). Overall, these increases are negligible when compared to total operating costs and turnover and are not expected to impact SaMB competitiveness.
- **Option A-ii and A-iii** - Of the tiering options considered, we did not find a way to satisfactorily reduce the micro-business bill costs substantially without leading to other businesses paying substantially disproportionate amounts relative to their gas use. This outcome stems from the wide variability in volumes of non-domestic gas use, and the fact that domestic consumers account for 99% of meter points in Great Britain[50]. At the peak of the levy in 2028, micro-businesses would save approximately 10p per year under Option A-ii and approximately 20p per year under Option A-iii, compared to no tiering. On the other hand, we expect the peak flat-rate levy of £6.20 would increase to £21 under Option A-ii for larger businesses (consuming more than 73.2MWh/year). For businesses consuming more than 732 MWh/year, the levy rate is expected to increase to £220 under Option A-iii (see Table 11).
- **Option B** - As the charge is a consistent per unit charge, the impact on bills for all businesses will be around 1%, with some variation dependent on the base price they pay for gas. Due to the heterogeneity of non-domestic gas consumers, business size is not well aligned with gas consumption. For example, a small restaurant may use a large amount of gas for the size of the business due to the use in cooking, while a large office with many employees may use relatively little. Under this option, a business consuming 140 MWh per annum would expect pay around £50 per annum, and a business consuming 1,400 MWh per annum would expect to pay around £500.

163. It should also be noted that we do not have the powers to dictate how suppliers pass costs on to their customers under the section 100 Energy Act 2008 powers. Whilst our preferred option will have a larger proportional impact on SaMB gas bills, compared to larger businesses with higher gas consumption, we will implement robust budgetary controls to ensure costs do not rise unexpectedly.

5.7 Impacts on Energy Intensive Industries

164. Energy-intensive industries are defined as companies whose energy intensity is more than 3%. This means that their energy costs are at least 3% or more of their total production costs. For gas intensive industries, gas costs make up a notable portion of production costs, and so the additional costs of a volumetric levy (Options B or C) could have a notable impact on their operation. Among the highest consumers of gas, levy costs are expected to be above £10,000 per annum by 2028. As set out in the main option analysis, this is around 1% of total gas costs.

165. 10% of the non-domestic consumers make up around 75% of non-domestic gas consumption. These very large consumers are expected to contribute around 25% of the total levy collection of the Green Gas Levy under a non-domestic option.

48 https://www.gov.uk/government/collections/sub-national-gas-consumption-data#methodology

49 This assumes that these micro-businesses exhibit similar annual consumption as domestic customers.

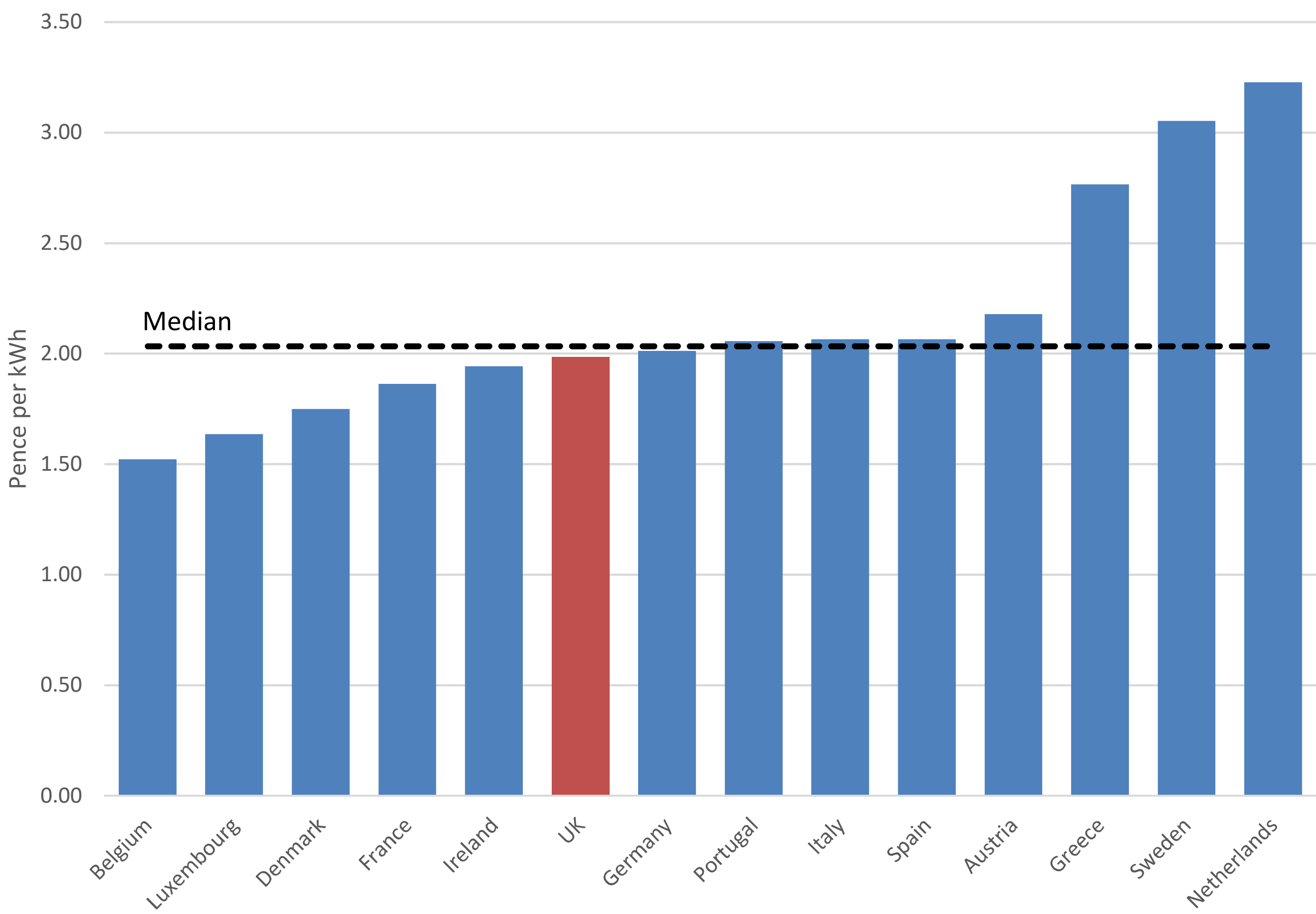
50 BEIS (2013) Regional and local authority gas consumption statistics: https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority

166. At its peak, the GGL leads to a price increase of around 0.03p per kWh over the base price. This is within the same scale as per annum increases in price over recent years (between 2016 and 2020), which have been an average of 0.06p per kWh for large consumers.

167. Gas prices for large gas consumers are below the EU14 and EU27 medians, though EU medians have fallen in recent years. As can be seen in Figure 7, the increase from the GGL would bring gas prices for large consumers in line with those in Germany and remain lower than the median.

168. As the volumetric component of Option C is further developed ahead of the transition, further evidence gathering will be conducted to ensure the impact on EIIs is manageable.

Figure 7: Industrial gas prices for large customers, inc. tax, comparing the UK and EU14, Jan-June 2020



5.8 Regional impacts

169. To analyse the regional impact of the levy we have looked at the following metrics for each local authority:

a) Percentage of households with a gas meter [51]
b) Share of meter numbers and consumption by domestic and non-domestic customers
c) Average consumption per meter

170. The rationale for choosing these metrics is that the data is readily available at local authority level [52], the meter number metrics will give an indication of the impact of the per-meter point approach, as used in Options A-i, A-ii and A-iii and the start of Option C, and the consumption

[51] In the sub-national gas data, customers are categorised as domestic or non-domestic based on their annual consumption, so some small industrial and commercial consumers will be counted as domestic. This results in the percentage of households for some regions being greater than 100.

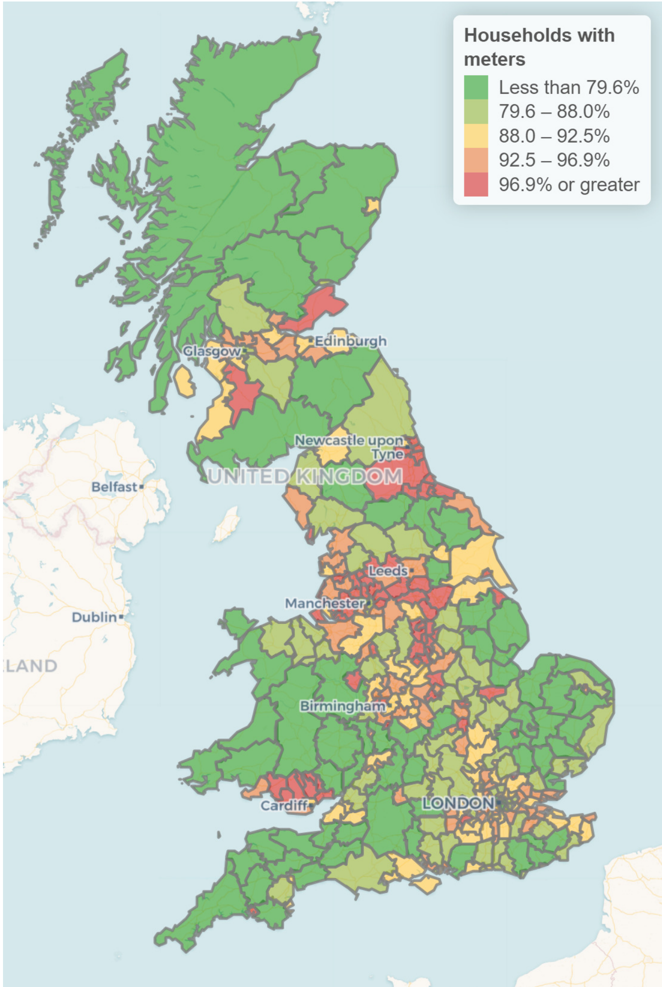
[52] Regional and local authority gas consumption statistics: https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority

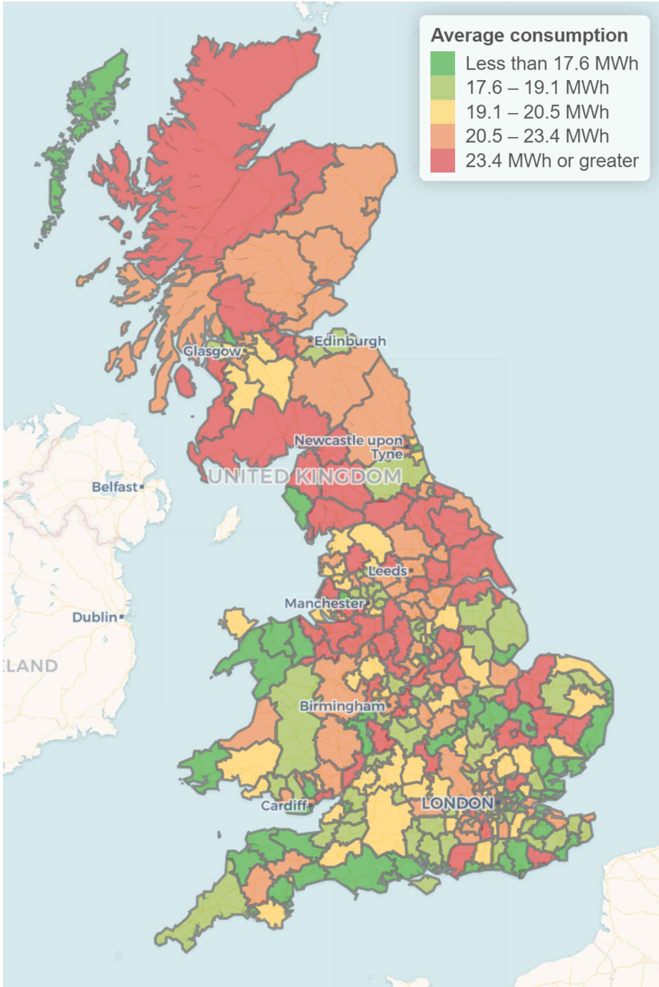
metrics will give an indication of the impact of the volumetric approach, as used in Options B and C (post transition). These should therefore highlight if any region is likely to be adversely impacted by either approach.

171. Figure 8 shows maps of the percentage of households with gas meters and average consumption per meter (both domestic and non-domestic). They show that regions of high meter numbers and consumption are spread throughout the country.

172. The maps also show that, although there is variation, it is not by a substantial amount – average usage in local authorities in the highest band is only 33% more than that of local authorities in the lowest band.

Figure 8: Maps of households with gas meters (left) and average usage per meter (right)





173. These meter-based metrics were also compared to other regional metrics. There was generally little or no relationship between meter numbers/usage compared to economic activity, employment, or population density.

174. A potential link was identified between the percentage of households with gas meters and the percentage of population classed as rural,[53] which were negatively correlated. This suggests that regions with larger rural populations may be less impacted by the levy under Option A-i, A-ii, A-iii and Option C (prior to transition), as there are fewer households with gas meters. The scale of this corelation was small, however.

175. Overall, the evidence suggests that while there is some variation between areas in impacts from the levy, this variation is not clearly driven by differences in the characteristics or locations of

[53] The definition of rural and urban differs across the nations of the UK, so for consistency we have defined rural populations to be those in settlements of fewer than 10,000 people, and urban to be 10,000 or greater.

those areas, particularly under the Option B preferred option of Option C after the transition, where costs will be highest.

5.9 Compliance and Enforcement

176. As set out in the government response [54],the government intends implement a financial penalty of up to 10% of a licensed gas supplier's annual turnover in the event of non-compliance. This maximum limit is consistent with financial penalty limits set in other government schemes, including the RO, FITs and ECO. This will not include any additional maximum penalty limit other than the percentage basis we have outlined. In the event of non-compliance, the level of each penalty issued to non-compliant suppliers would be set at Ofgem's discretion according to the nature and severity of the case.
177. The government recognises that a financial penalty may not work in all cases, such as for a supplier that is struggling financially. However, Ofgem will be reviewing each instance of non-compliance on a case-by-case basis.
178. Where a gas supplier is in payment default, Ofgem will have the power to recover specific unpaid amounts as a civil debt through the courts. The main examples of civil debts could include where an outstanding amount, in relation to a gas supplier's quarterly levy obligation, is not paid by a given due date, and any financial penalties that are outstanding.
179. Ofgem have so far not been required to raise proceedings through the courts to recover a debt under any of the other E-Serve schemes that they enforce, either by way of proceedings to enforce compliance with a provisional or final order, or by way of pursuing recovery as a civil debt. We would expect only very few cases to be dealt with in the courts, if any. As such, the impact on the justice system is expected to be minimal.

5.10 Maximum Levy Collection Figure

180. The government will publish the maximum levy collection figure (as a fixed total value) in advance of the launch of the GGSS. The mechanism and deadline for calculating and publishing this figure will be stipulated in regulations and will be aligned to the maximum projected budget cap for the GGSS. This approach aligns with the precedent set by the RHI and the GGSS proposals for publishing budget caps rather than setting them in regulations.
181. The government believes that publishing the maximum levy collection figure will provide greater certainty compared to publishing a maximum levy rate. Any published maximum levy rate would likely have to be inflated to account for unexpected drops in the number of leviable meter points, making it less useful as an indicator of future costs compared to a maximum levy collection figure, which will not need to account for meter point number variability.
182. Based on projections of high deployment under the Green Gas Support Scheme, it is expected this will be around £190m in 2020 prices.

5.11 Uncertainties, Risks and Mitigations

183. There are several uncertainties around the size of the levy required to cover the costs of the Green Gas Support Scheme. To account for these uncertainties, a headroom has been applied to the levy, ensuring sufficient funds are collected to cover the necessary expenditure. The factors which cause this uncertainty, and the size of the headroom allocated to them, are set out below:

    a) **Uncertainty regarding biomethane production** - Biomethane production is largely stable and predictable, however available evidence on the uptake of the scheme, and where it falls within projections, will be limited at the start of the scheme as it embeds. This uncertainty applies to all policy options described in Section 2.3. Rather than being

[54] Future support for low carbon heat and the green gas levy: government response - https://www.gov.uk/government/consultations/future-support-for-low-carbon-heat

accounted for through headroom, the levy will be set in line with the Green Gas Support Scheme budget cap and expected to begin in line with high deployment projections and narrow, most likely toward central projections, over time as there is greater certainty in the amount of expected to be spent.

b) **Uncertainty in consumption forecasts** - In the near term, gas consumption is subject to significant uncertainty, due to factors including weather effects, housing development and external shocks, such as those seen from COVID-19. This uncertainty applies if the levy is distributed between suppliers according to amount of gas supplied to consumers (Options B and C). Year-on-year change between 2009 and 2018 varied between -8.1% and +3.7%. Assuming a normal distribution for the variation and ensuring that variation for 99.7% (equivalent to 3 standard deviations) of years is covered, a headroom of 10.8% of the total levy collection has been assigned, in the event that gas consumption is below projections. This has been chosen to minimise the chance of actual consumption being above the projected value.

   More broadly, it is important to recognise that this analysis is based upon projected gas consumption based under a continuation of current policies and trends. Over a longer time period, there may be significant changes to these and gas consumption behaviours across the system. As such, the projections used to inform the setting of the levy will need to updated over time to reflect any changes to the underlying system.

c) **Uncertainty in gas meter point projections** - Gas meter point numbers are also subject to uncertainty, though to a much lesser extent than gas consumption forecasts, due to factors such as housing developments. This uncertainty applies if the levy is distributed between suppliers according to the number of gas supply meter points that they serve (Options A-i, A-ii, A-iii and C). Between 2009 and 2018 the difference from the overall trend year-on-year has been within 1%. As before, assuming a normal distribution for the variation and ensuring that variation for 99.7% of years is covered, a headroom of 1.0% of the total levy collection has been assigned in the event that consumption is below projections.

d) **Unanticipated transition of one or more suppliers to non-fossil fuels** – Suppliers of 95% or more green gas are exempt from the levy. While these suppliers will be factored into projections for the levy, the potential for one or more suppliers to unanticipatedly fall within this exemption means there is some uncertainty regarding the total proportion of the market that will be within scope for the levy. Headroom has been assigned to allow for up to two or three smaller suppliers to unexpectedly transition to supplying green gas, and so become outside of the scope of the levy and potentially be eligible for a refund at the end of the scheme year. A large majority of gas suppliers provide less than 1% of gas meters, with over half providing less than 0.5%. A headroom of 1% of the total levy collection would account for potentially two or three smaller suppliers unexpectedly going ‘green’ in a year and therefore legally not being subject to the levy. While a formal assessment of the number of gas suppliers, using the methodology to be used in the scheme, has not yet taken place, it is expected that currently there is just one such supplier in the UK market. This, in combination with the expectation that at the peak of the scheme, green gas will account for around 5% of all gas in the grid, is expected to be sufficient to cover any unexpected transitions. Given the expectation of this being reviewed in the 2020s upon the transition to a volumetric levy, this was judged as sufficient as larger moves away from fossil fuels, particularly for larger suppliers, are not expected until the 2030s.

e) **Uncertainty in underspend forecasts** – Underspend in one year will be carried over from one year to the next. However, the levy rate will be set in Q3 each year, so the exact amount of any underspend will not yet be confirmed, and the adjustments to the levy rate to account for the underspend will need to be based on forecasts of the remaining Green Gas Support Scheme expenditure for that scheme year. A headroom of 4% of the total levy collection has been assigned to cover the potential increased spend above the projection. This amount has been set as a conservative estimate, based on the difference between the budget cap and central estimates for one quarter, allowing for spending to be substantially higher in the final quarter than expected. In practice, it is very unlikely that the forecasting error would be this large but, given difficulties in quantifying potential error in this area, a cautious approach has been taken.

f) **Potential shortfalls in levy payments to avoid mutualisation** - Usually, if one or more gas suppliers fail to pay their levy payment, and their credit cover is insufficient to cover this, the mutualisation process will occur automatically to recover outstanding costs. However, to avoid triggering mutualisation when Ofgem's administrative costs to run the process are higher than the levy shortfalls, a threshold will be set for outstanding levy payments, where the amount to be recovered must be greater than Ofgem's administrative costs of running the mutualisation process. The mutualisation process would only be triggered above this threshold, based on the estimated administrative cost for Ofgem to run the mutualisation process.

The exact size of the headroom needed to cover small shortfalls in the levy below the threshold has not yet been determined and will be announced as part of the levy launch. However, it is expected to be a small proportion of levy collections, less than £500,000 per annum.

184. In addition to these uncertainties mitigated through headroom, the GGL has the following additional risks, with the mitigations that have been put in place for them:

Risk	Mitigation
The GGL collects insufficient funding to cover the GGSS budget	The GGL rates are informed by expected expenditure under the GGSS, that inform the annual budget caps for the scheme, and incorporates headroom for identified areas where collection could be lower than projected. This headroom has been set at a conservative rate to ensure the collection meets the requirements of the GGSS. Both the rate itself and the headroom will be reviewed and published on an annual basis to ensure the most recent evidence is incorporated into both.
One or more suppliers are unable to pay	As set out in the government response, suppliers must lodge credit cover ahead of time which can be drawn upon in the event they are unable to pay. If this is insufficient, Ofgem will be able to undertake mutualisation, spreading the cost amongst suppliers. This is further supported by a robust compliance and enforcement mechanism, as discussed in section 5.5.

6. Equalities Assessment

185. We completed a Public Sector Equality Duty (the equality duty) assessment for both the GGSS and GGL.
186. We expect the GGSS to have no disproportionately negative impacts on people with protected characteristics. Scheme participants will be biomethane producers, which as a group of businesses do not have any protected characteristics and the intended outcomes of the scheme are expected to benefit the entire population without distributional impacts for specific groups.
187. Due to patterns of gas consumption and income, some groups with protected characteristics will see marginally different impacts from the GGL. This is of relevance to the duty to have due regard to the advancement of equality of opportunity between people who share a protected characteristic and those who don't. Under a per meter point levy, prior to the transition to a volumetric levy, all gas users will pay the same amount. While this means groups with lower average incomes will pay a larger portion of their income, in practice the small size of the levy during the early years means this effect is marginal.
188. Following the transition to a volumetric levy, the absolute amount paid will vary by consumption and so the effects are also more varied. Based on analysis of protected characteristics given in Section 5.4.2, younger consumers and pensioners consume less gas than average consumers and therefore are expected to pay less than the average amount for the levy. The scale of this effect varies across different groups, with the those in households where to oldest person is aged 16-24 paying the least, at £1.30 less per annum on average at the peak of the levy. Similarly, BME households and households with people with long-term disabilities have lower than average gas consumption and so are expected to pay less than the average amount. However, the scale of these effects is much smaller, being only up to 10p less per annum on average at the peak of the levy. Further details can be found in section 5.4.
189. Overall, these variations are small and are broadly in the favour of those on lower incomes and in groups with protected characteristics.
190. Regarding the other duties outlined in the Public Sector Equality Duty - to eliminate unlawful discrimination and to encourage good relations between people who share a protected characteristic and those who don't - the GGSS and GGL are not expected to have any impact.

7. Monitoring and Evaluation

191. Monitoring and evaluation from the RHI, in addition to wider evidence, has been used to inform development of the Green Gas Support Scheme.
192. Given the high-profile nature and substantial spend of the Green Gas Support Scheme, and the bespoke nature of the Green Gas Levy design, a robust monitoring and evaluation approach will be implemented for both.
193. The Green Gas Levy monitoring and evaluation plan concerns a per meter point levy design only and not a volumetric design. In the event of a transition to volumetric design from a per meter point design, subject to the current feasibility challenges being overcome, a new M&E plan will be needed to cover the subsequent volumetric levy. This would need to include a reassessment of the monitoring metrics to determine whether metrics need amending/removing or whether new metrics are required for a volumetric design.
194. The monitoring and evaluation will demonstrate the process, impact and outcomes of the scheme and levy, providing a measure of success against the aims set out in Section 1, as well as providing evidence throughout the two schemes to inform future low carbon policy development and funding support mechanisms. The monitoring will also be required to provide sufficient evidence to support robust scheme and budget management.
195. We will monitor deployment, as well as spend and benefits of the Green Gas Support Scheme following implementation. For the Green Gas Levy, we will monitor levy collection and scheme compliance and enforcement. We will work closely with the scheme administrator to ensure information collected from applicants and gas suppliers enables effective monitoring of the scheme and levy against the key aims to increase deployment of Anaerobic Digestion plants and contribute to decarbonising heating in the UK.
196. A robust cost control framework will be put in place to ensure levy costs and bill impacts do not rise unexpectedly. We will continue to monitor potential impacts of this policy on affected groups.
197. Evaluation projects throughout the lifetime of the GGSS and GGL will provide further analysis of information not collected by the administrator. A thorough evaluation plan will be developed in advance of the scheme implementation and will be integrated into scheme delivery. The evaluation will comprise impact and process evaluation components.
198. The impact evaluation will consider whether the GGSS and GGL achieved their objectives. It is expected that the impact evaluation will assess the extent to which the GGSS did the following:

- Increased deployment of AD plants.
- Reduced GHG emissions.
- Delivered the forecasted carbon savings.
- Increased investment in the UK AD sector.

Consideration will also be paid as to whether the GGL provided adequate funding for the GGSS.

199. The process evaluation will consider whether design, implementation and administration of the GGSS and GGL facilitated participation in the scheme and effective delivery.
200. Impact and process evaluations may be supported by other activities, such as economic evaluation components.
201. It is expected that the evaluation approach will be similar to that being applied in the evaluation of the RHI scheme and will draw upon key lessons learned. As a theory-based realist evaluation, the RHI evaluation not only assesses the overall impact of the scheme, but also identifies the impact that the scheme is having in a range of different contexts with a range of different consumers. If this approach is adopted for the GGSS/GGL evaluation, then it would include further analysis of scheme monitoring data, bespoke data collection from applicants through surveys and interviews, and wider evidence gathering to assess impacts on the market for renewable heating systems.

202. Monitoring and evaluation will begin after the scheme is launched in Autumn 2021 and will continue for the duration of the scheme. A final evaluation report will be published following scheme closure.

Annexes

Annex A – Overview of key changes since consultation stage impact assessment

Table A-1: Changes since consultation

Change	Summary of change	Impact of change
Resource Costs	Following publication of the consultation, BEIS have undertaken work to verify the resource cost inputs used for Green Gas Support Scheme modelling. Phase 1 was conducted internally and included a series of stakeholder workshops intended to discuss the current evidence base and update where necessary. The outputs of this showed that BEIS cost data was roughly in line with those stakeholders who were engaged. Given differences in data classification, and to get a broader range of evidence, BEIS then initiated a Phase 2 which involved an external cost review with the National Non-Food Crops Centre (NNFCC). This project used a survey with industry stakeholders to gather information and resulted in an updated cost data and evidence base. This was then used to verify BEIS cost assumptions and to inform the tariff setting and cost-benefit analysis.	No impact to underlying resource costs. Impacts of the GDP deflator on resource costs are discussed below.
Revenue Streams	Evidence gathered through stakeholder engagement and data received by NNFCC (described above) show an increasing number of AD plants receive Green Gas Certificate (GGC) revenues. GGCs are tradeable, with variable values dependent on the feedstock types used to generate the green gas and the carbon intensity of the final product and demand for the certificates. Previously GGCs were excluded from the Green Gas Support Scheme tariff setting model due to lack of evidence to support this assumption and lower demand for GGCs. However, industry engagement and evidence received suggests GGCs are priced at around £2/MWh in financial models, and therefore we have included a £2/MWh assumption for GGCs in the Green Gas Support Scheme tariff setting.	Including an assumption for Green Gas Certificate revenue in the Green Gas Support Scheme tariff setting led to a slight reduction in the tariff offered at each tier. The net tariff impact of all changes to our modelling is positive for Tier 1 however, and negative for Tier 2 and 3, due to changes in underlying data (see Annex B below). This change has no impact on the SNPV of the policy.
Feedstock Mix – agricultural waste	For the consultation stage analysis, agricultural wastes were represented only by 'wet manures', and therefore only a subset of all potential agricultural waste feedstocks were represented. Based on stakeholder engagement and evidence from operational plants, it is understood that the potential is greater than previously estimated, and therefore the 'wet manure' category has now been updated to 'agricultural waste', which includes both wet manure and chicken litter,	Changing the feedstock mix has wide-ranging impacts on a number of areas that will impact the SNPV through: • **Ammonia emissions** - chicken litter spread as digestate releases less ammonia than the counterfactual disposal of chicken litter. Furthermore, the

	weighted by manure availability (see Annex C). Refining the agricultural waste category has led to revisions in the following: • **Biomethane potential** - wet manure has a low biomethane potential. To reflect other wastes included in this feedstock, we have revised the biomethane potential to reflect 'agricultural wastes' in total i.e. with the inclusion of higher energy content such as chicken litter. See Annex C for further details. • **Biomethane emissions factor -** the use of chicken litter leads to fewer upstream carbon savings and slightly higher biogeneration emissions (i.e. emissions from the cultivation, processing and transport of each feedstock) compared to the counterfactual use wet manure. See Annex F for further details. • **Overall feedstock mix proportion -** to account for agricultural wastes other than wet manure. See below and Annex C for further details.	biomethane potential of agricultural waste is much higher than wet manure, so less digestate is produced when producing the same amount of biomethane. Both changes lead to a decrease in ammonia emissions. • **Nitrogen content of digestate** - chicken litter has a higher nitrogen content than wet manure therefore the nitrogen content of digestate will increase with the inclusion of chicken litter. Higher nitrogen content means higher quality digestate and so more synthetic fertiliser is displaced, having a positive impact on the SNPV through increased fertiliser savings. • **Biomethane emissions factor -** the update has reduced the upstream emissions for agricultural waste (compared to wet manure alone). There has been a negligible change to the biogeneration emissions factor meaning an overall reduction in the biomethane emissions factor for agricultural waste.
Feedstock Mix – overall proportions	The feedstock mix has been updated to reflect BEIS' view on the most likely feedstocks to be used for biomethane production under the Green Gas Support Scheme. Market intelligence suggests that a significant amount of water treatment plants for which AD to biomethane is commercially viable will already be operating such sites, and therefore we have revised down our estimate to reflect a lower anticipated level of production on the Green Gas Support Scheme (25% to 10%). The overall proportion of agricultural waste (previously wet manure) has increased from 5% to 20% of the feedstock mix.	This change has a net positive impact on the SNPV. Since the proportion of feedstock that is agricultural waste has increased from 5% to 20%, at the expense of the use of sewage, this has resulted in a net increase in carbon savings across all feedstocks despite a slight reduction in the agricultural waste upstream emissions factor as described under

	This will have an impact on: • **Upstream savings factor -** due to the counterfactual disposal of both feedstocks. It is assumed that sewage does not lead to upstream carbon savings, whilst the use of agricultural waste as feedstock does. See Annex F for further details. • **Ammonia emissions** – an increase in agricultural waste proportions, compared to sewage, means more digestate is being produced overall since AD treated sewage is not used as digestate. See Annex E for further details.	'Feedstock mix – agricultural waste' above. Although there is a potential for ammonia emissions to increase, due to an increase in digestate produced, much of this ammonia potential is not realised due to changes in the digestate storage and spreading assumption outlined below.
Digestate storage and spreading	The approach to modelling digestate storage and spreading has been reviewed and updated due to new ammonia mitigating requirements for digestate store covers and low-emission spreading. Further data updates have been made in light of revisions to the treatment of manures and slurries in the National Atmospheric Emissions Inventory. Further details are found in in Annex E.	This has a net positive impact on the SNPV due to a fall in overall ammonia emissions. Furthermore, the data updates mean that ammonia emissions impacts are compatible with the inventory.
Updated Air Quality Damage Costs	Ammonia damage costs were revised up by around 30% by Defra in their 2020 guidance.	Significant increase in the monetised ammonia impact which negatively impacts the overall SNPV of our options. However, despite this data update, the net impact of all changes on ammonia costs is positive (i.e., a reduction in monetised ammonia costs) due to emissions reductions through the other changes outlined above.
Biomethane Ramp-Up Model	We have updated the method for estimating the annual proportion of capacity injected from the BEIS internal Biomethane Ramp-Up Model which is based on RHI plant performance. The update has ensured that the average applied to fitted data points coincides with month-ends only (instead of all data points within the relevant periods) to better represent the fact that the underlying data is also monthly. We have also used ramp-up data from January 2020 instead of the most recent data because market intelligence suggests that COVID-19 has had a temporary adverse impact on feedstock supply and so pre COVID-19 data will be most representative	As a result of this change, plants' assumed proportion of capacity injected in their first year increases from 53% to 55%. Overall, these changes had a small impact on the tariff rate and no impact on the SNPV.

	of a plant on the Green Gas Support Scheme as we expect the market and feedstock supply to return to pre COVID-19 conditions.	
GDP Deflator	Data update to reflect recent revisions to GDP deflators considering the long-term negative impacts of COVID-19 on the economy. (November 2020 GDP deflator[55]). See Annex B for further details.	This data update has uplifted resource costs and increased the tariff slightly for each tier.
Fertiliser Prices	We have updated the calculation of average fertiliser prices to include multiple years' data (instead of the most recent year only). This is done to account for the fact that fertiliser prices can be volatile year on year depending on weather and other external shocks.	Minor positive impact on SNPV.
Fertiliser Mix	Most recent data have been used to reflect the most accurate fertiliser mix. See Annex E for further details.	Negligible impact - slight increase in ammonia costs and decrease in SNPV of all options.
Food Waste counterfactual and upstream savings	We have revised our modelling of how food waste is diverted to AD, to reflect interactions between the Green Gas Support Scheme and Defra's policy on consistency in recycling. Upstream carbon savings from diverting food waste from landfill are excluded in this impact assessment. Further details are provided in Section 3.1.4 and Annex F.	This has reduced the estimated upstream carbon savings from food waste.
Updated Carbon Values	Analysis updated to use the most up to date Green Book carbon values.	An increase in the valuation of carbon in the latest Green Book supplementary guidance has resulted in an increase in the policy SNPV, despite the exclusion of upstream carbon savings from food waste (see above).
Updated long run variable cost of gas (LRVCs)	Analysis updated to use the most up to date Green Book long run variable cost of gas[56].	A slight reduction in LRVCs has resulted in a small decrease in generation benefits and the SNPV.
High deployment estimates	High deployment estimates were previously based on estimates of the maximum amount of food waste estimated based on Defra food waste projections. Evidence and data concerns have led to reduced confidence in this approach. The updated high estimates are now based on a similar method to the central estimate. See Annex G for further details.	The high scenario has been reduced following this change, resulting in lower overall policy costs for 'high' deployment scenario. No impact on central estimates. This lowers the levy rate, and therefore impacts on gas consumers, in the early years of the scheme where the levy is most closely tied to the high deployment scenario.

55 GDP deflators: https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-november-2020-spending-review

56 Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Option C – Transition from a Per Meter Point Levy to a Volumetric Levy	The new option sets out a transition from an initial levy charged based on meter points to a levy charged on volumes of gas consumed.	No impact
Rollover	Modelling for the Green Gas Levy now includes the rollover of any money collected which is not spent by the GSSS, referred to as underspend, from one year to the next. This follows a policy decision that was outstanding at the time of the consultation.	Reduction in the levy impacts on consumers after the first year, as the amount needed to be collected to cover GGSS spend costs is reduced.
Headroom	The headroom allocated to the Green Gas Levy has been increased to ensure sufficient funds are collected. In addition to covering uncertainty in meter and gas consumptions forecasts, this now covers gas suppliers unexpectedly becoming green gas suppliers, and therefore becoming exempt from the levy, uncertainty in forecasts of underspend, and underpayment by suppliers where the amount owed is too small for mutualisation to be viable.	A small increase in levy the collection, leading to a small increase in the impacts on consumers.
Administrative costs for gas suppliers	The administrative costs for gas suppliers in implementing and running the scheme has been updated based on feedback from the consultation, including representing administrative costs from transitioning from the initial per meter point based levy to the consumption volume based levy.	A small increase in levy the collection, leading to a small increase in the impacts on consumers.

Annex B – Biomethane tariff setting methodology

1. Tariffs are set to compensate developers for the additional cost of producing biomethane relative to revenues received. Costs taken into account are the additional capital, operating and net feedstock costs,[57] while revenues in the absence of policy support are the wholesale gas revenues earned from selling the biomethane to the grid and revenues from Green Gas Certificates. After accounting for corporation tax and capital allowances, a discounted cash flow model calculates the tariff required per unit of energy produced to provide developers with additional biomethane revenue to achieve a 10% post-tax nominal rate of return. The tariff would be payable on all eligible units[58] of biomethane injected into the grid for a proposed length of 15 years from a project commissioning. Tariff setting and scheme costs and benefits of shorter tariff payment lengths are discussed in Section 3.1.2. Descriptions of the cost and revenue assumptions are set out in Annex D and changes since consultation are set out in Annex A.
2. Elements of capital and operating costs do not increase proportionally with output, and therefore, as production increases, the marginal cost decreases and the average cost per unit of biomethane decreases. In addition, we expect plant characteristics to change at higher levels of production and have taken into account the feedstock mix when setting tariffs. To account for these economies of scale, a tiered structure is proposed, which provides a gradual reduction in the average tariff earned as capacity increases and attempts to provide a relatively consistent rate of return across the range of desirable plants which can deploy whilst ensuring value for money.
3. Tiering operates by paying a higher tariff for the first designated amount of biomethane injected into the grid (the 'Tier 1' tariff), and a lower tariff for subsequent biomethane injected (the 'Tier 2' and 'Tier 3' tariffs). The payment is based on the amount of biomethane produced by a plant over a period of 12 months. All biomethane plants are compensated according to this tiering mechanism, regardless of plant size and overall production in a given year. Tiering more accurately reflects these economies of scale and plant characteristics and therefore pays a rate proportionate to the production of biomethane in a given year.
4. For the preferred option, the tiers have been set based on the following assessment:

    a) Tier 1: Set the limit to 60,000MWh. We propose to increase the Tier 1 limit compared to the RHI (40,000MWh), encouraging larger plants which can achieve better economies of scale.
    b) Tier 2: Set the limit for the next 40,000MWh. In some circumstances there may be sufficient feedstock available to generate greater volumes of biomethane and we want to incentivise plants to unlock greater economies of scale and continue producing biomethane under the Tier 2 tariff. This would bring the overall allowance under the first two tiers up to 100,000MWh.
    c) Tier 3: This is for levels of production above 100,000MWh. In rare circumstances where a plant can produce more than 100,000MWh of biomethane annually and achieve the very greatest economies of scale, it should be encouraged to do so.

5. To set Tier 1 and Tier 2 tariffs, the expected costs and revenues for an assumed representative plant producing an amount of biomethane close to the corresponding tier limit are used. Tier 3 tariffs are set using a reference plant with significant production falling under the Tier 3 tariff. The use of reference plants allows the calculation of the average tariff required for plants with specific costs, revenues, and performance assumptions according to their size. The tariffs calculated for Tier 2 and Tier 3 reflect both the average tariff rate required for the corresponding reference plant size and the revenues already received under preceding tiers.
6. The most recent plant cost information held by BEIS is for a 6MW plant and is based on internal BEIS modelling,[59] which in turn is based on the 2014 Biomethane Tariff Review underlying data. Capital and operating costs for different sized reference plants are estimated from costs for the

[57] Operating costs also include the cost of propane enrichment to prepare biomethane for grid injection. Feedstock costs are 'net' because food waste attracts gate fees which represent a revenue stream for plants.
[58] After allowances for the addition of propane and parasitic heat load provided from sources other than the biogas produced at the biomethane plant.
[59] Bioenergy Heat Pathways to 2050 Rapid Evidence Assessment, Ecofys & E4Tech (for BEIS) 2018, unpublished.

6MW plant and scaled up accordingly, whilst reflecting economies of scale identified within the 2014 Biomethane Tariff Review underlying data.

7. The tariffs proposed in the Future Support for Low Carbon Heat consultation offered a range for each of the available tiers, shown in Table B-1 below.

Table B-1: Consultation tariff ranges

Tier	Tier Limit	Tariff Range (p/kWh)
Tier 1	First 60,000MWh	4.90 – 5.50
Tier 2	60,000MWh – 100,000MWh	3.25 – 3.75
Tier 3	>100,000MWh	1.50 – 2.50

8. The consultation stage cost assumptions have been verified against commercially sensitive financial models received by BEIS since consultation closure in July 2020, and against data collected through an industry survey and cost review commissioned by BEIS, which was awarded to the National Non-Food Crops Centre (NNFCC).

9. Incorporating new evidence on Green Gas Certificates, and updates to underlying data used in tariff setting modelling has led to slight movements in the tariff offered to plants under the GGSS for the final stage Impact Assessment. The tariff for Tier 1 is slightly higher (+0.01p/kWh) than the range proposed at consultation stage, whereas the tariff for Tier 2 and 3 remain within the range proposed in the consultation stage Impact Assessment. Changes in the tariff have resulted due to the inclusion of Green Gas Certificates in the tariff setting model, which has decreased the tariff for each tier slightly, and updates to November 2020 GDP deflators[60], which have increased the tariff slightly for each tier. The net impact of these changes on the overall tariff are minor. The tariffs offered are shown in Table B-2. For further information on cost and performance metrics, and reference plants used for tariff setting see Annex D.

Table B-2: Tariff rates – final stage Impact Assessment

Tier	Tier Limit	Reference Plant	Tariff Rate
Tier 1	First 60,000MWh	7.5MW	5.51p/kWh
Tier 2	60,000MWh – 100,000MWh	13MW	3.53p/kWh
Tier 3	>100,000MWh	30MW*	1.56p/kWh

*Note the Tier 3 reference plant does not use the central feedstock mix discussed in Annex C but uses 95% food waste and 5% maize. This is because plants of this significantly larger size are assumed to operate differently to smaller sized plants[61].

10. The tariff rates in Table B-2 are paid on the basis of the criteria set out in Table B-3.

Table B-3: Proposed tariff payment basis

Biomethane Plants	
Period Payable	15 years
Internal Rate of Return	10%

60 https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-november-2020-spending-review

61 It is assumed that very large plants are likely to be available only in specific circumstances, where there is a large volume of dedicated waste feedstock and a location which permits a high volume of production and gas injection.

Payment basis	Metered total biomethane output for eligible heat uses (biomethane output injected into the gas grid).
Payment timing	Quarterly in arrears when meter reading provided.
Tiering	Tariffs are paid for biomethane production at the appropriate tier rate.
Degression	Tariffs can be reduced ('degressed') if spending hits certain triggers.

Annex C – Biomethane feedstock mix

1. As discussed in Section 3, the assumed feedstock mix that underpins the analysis for the policy proposals is the average feedstocks that we expect will be used to produce biomethane across the whole population of biomethane plants deployed under the Green Gas Support Scheme. The use of reference plants does not try to reflect the feedstock mix we assume an individual plant will use, but rather the total feedstocks used to produce biomethane supported under the scheme. Costs and carbon savings are sensitive to the feedstock mix, which in turn affects both the tariff setting results and the cost-benefit analysis. Further, the assumed feedstock mix has an impact on the expected ammonia emissions.
2. The feedstock mix assumed in the consultation took into account RHI assumptions used in previous impact assessments, adjusted to reflect the expected impact of the policy proposals, and using commercial intelligence. Further, other policies that could affect biomethane plant feedstock mix were considered. The main policies that are expected to affect the feedstock mix under the proposals set out in this impact assessment are:

    a) <u>Government's Environment Bill</u>: The government's recently published Environment Bill would require that every household and business in England have a separate collection for food waste, so that this can be recycled. We would expect these measures to commence from 2023 and this will significantly increase the amount of food waste available for AD.
    b) <u>Minimum Waste Feedstock Requirements</u>: Following consultation, the Green Gas Support Scheme will require a minimum waste feedstock threshold of 50% for plants on the scheme. This is consistent with the NDHRI, where applicants must generate at least 50% of their biomethane from waste or residue feedstock. The government will undertake a mid-scheme review of the waste feedstock threshold, with the potential of increasing this threshold.

3. During the consultation stage, we have refined our estimated feedstock mix that we might expect under the Green Gas Support Scheme. This is based on market intelligence suggesting that there may be less commercial opportunity for water treatment plants to build new AD capacity for production of biomethane under this scheme, which has led to a reduction of the sewage proportion of feedstock mix from 25% to 10%. Further, the consultation stage Impact Assessment assumed that agricultural wastes were only represented by 'wet manure' and this only represented 5% of all biomethane produced under the Green Gas Support Scheme. However, it is understood that 'wet manure' only represents a subset of agricultural wastes that can be used in AD to produce biomethane and it has been determined that we are likely underestimating total agricultural waste potential. Both the feedstock mix assumed in the consultation IA and the updated feedstock mix are shown in Table C-1.

Table C-1: Feedstock mix assumptions

Feedstock	Consultation stage Impact Assessment proportion (energy content)	Final stage Impact Assessment proportion (energy content)
Food Waste	50%	50%
Energy Crop (maize)	20%	20%
Sewage	25%	10%
Wet Manure	5%	-
Agricultural Waste (of which 80% wet manure and 20% chicken litter)*	-	20%

*Agricultural wastes consist of wet manure (cattle/pigs) and chicken litter (both broiler and layers), weighted by proportions of GB manure availability from unpublished data provided to BEIS by Rothamsted Research.

Biomethane potentials

4. Biomethane potentials used in the consultation stage IA are shown in Table C-2 for each feedstock are those within the UK and Global Bioenergy Resource Model[62]. No changes have been made to the biomethane potentials since the consultation stage Impact Assessment, except for the biomethane potential of 'agricultural waste'.
5. The biomethane potential for 'agricultural waste' is weighted by wet manure and chicken litter availability, with the biomethane potentials for both types of manure derived from the 'Implementation of anaerobic digestion in England and Wales balancing optimal outputs with minimal environmental impacts' (AC0409) report[63] commissioned by Defra in 2011.
6. As described above, the feedstock mix has been updated to reflect that there are more agricultural wastes than 'wet manure'. Wet manure has a low biomethane potential when compared with other agricultural wastes and therefore, as a result of the feedstock mix changes, we need to update the biomethane potential to reflect this. Table C-2 shows the updated biomethane potentials of our feedstock mix.

Table C-2: Biomethane Potentials

Feedstock	Consultation stage Impact Assessment Biomethane Potential (kWh/tonne)	Final stage Impact Assessment Biomethane Potential (kWh/tonne)
Food Waste	1,100	1,100
Energy Crop (maize)	642	642
Sewage	139	139
Wet Manure	124*	-
Agricultural Waste (of which 80% wet manure and 20% chicken litter)	-	313

(*The UK and Global Bioenergy Resource Model expresses the biogas potential of wet manure in volatile solids terms. The figure shown is for fresh weight assuming that wet manure contains 8% solids, of which 80% are volatile solids)

[62] UK and Global Bioenergy and Resources Model: https://www.gov.uk/government/publications/uk-and-global-bioenergy-resource-model

[63] Implementation of anaerobic digestion in England and Wales balancing optimal outputs with minimal environmental impacts (AC0409) report: http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17396

Annex D – Biomethane cost and performance

D.1 Summary

1. Table D-1 shows the main sources for the underlying tariff calculations and proposals set out in the Future Support for Low Carbon Heat & Green Gas Levy Government Response. This includes sources of the associated resource costs (capital, operating and feedstock costs), as well as assumed gas revenues from injecting biomethane into the grid and from Green Gas Certificates. These costs have been checked against cost information collected through market intelligence, the Non-Domestic RHI Evaluation, and an NNFCC review of AD plant costs. The additional evidence gathered validates internal BEIS Biomass Heat Pathways Model cost assumptions. We are therefore confident that the costs contained within the analysis and the basis of the tariff are based on the best available evidence at this time.
2. We will continue to review AD plant costs as evidence is collected by BEIS, in particular prior to the Green Gas Support Scheme annual tariff reviews, as outlined in the Government Response.

Table D-1: Cost and Performance Assumptions

Component	Assumption
Reference plant capacity	Tier 1: 7.5MW Tier 2: 13MW Tier 3: 30MW
Capex (for 6MW reference plant)	Internal BEIS Biomass Heat Pathways Model
Opex (for 6MW reference plant)	Internal BEIS Biomass Heat Pathways Model
Feedstock costs	Sources set out below
Feedstock mix	Set out in Annex C
Wholesale gas price	BEIS Fossil Fuel Price Assumptions: 2019[64]
Plant revenues	Market intelligence, Non-Domestic RHI Evaluation, and NNFCC Anaerobic Digestion plant costs database
Plant load factor	Plant Ramp-Up set out below

D.2 Costs

3. The principle for estimating costs and revenues for a plant, and therefore, the principle underlying the tariff setting for biomethane plants and the cost-benefit analysis for the Green Gas Support Scheme is to use costs of a reference installation. This is in-line with the principle of tariff setting used under the NDRHI for biomethane and is judged to be the best available method for setting the tariff rates, because it allows the calculation of a single tariff to represent the biomethane production from a heterogenous range of plants supported under the scheme. As described in Section 3.1.1 the reference plant uses a number of inputs that affect the overall costs and carbon savings associated with biomethane production, for example the feedstock mix used. As described in Annex B, the tier limits and associated tariffs are based on the estimated production of a reference plant that is assumed to produce up to the tier limit.
4. The assumed annual costs for our reference plants are shown in Table D2.

[64] Fossil fuel price assumptions: https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2019

Table D-2: Reference Plant Costs

Figures rounded to nearest £0.1m.

Reference Plant	Capital Costs (£m)	Operating Costs (full load, £m/year)	Feedstock Costs (p/kWh)
7.5MW	18.3	1.9	0.77*
13MW	26.9	3.1	0.77*
30MW	53.4	6.9	-0.37†

* See Annex C for feedstock mix.
† With a feedstock mix of 5% energy crop (maize) and 95% food waste.

D.2.1 Capital and operating costs

5. Based on the 6MW reference plant, costs have been scaled to reflect the increase in capital costs and operating costs, which it is estimated larger biomethane plants face, to more accurately reflect the costs incurred by the range of plants considered under our tariff tiering system. As described in Annex B, biomethane plants benefit from economies of scale in production as capital and operating costs increase proportionally less than the associated increase in biomethane production as capacity increases, reducing the average cost of production. This is reflected in costs shown in Table D2.
6. It is assumed that construction, and therefore capital investment, takes place in the year prior to first biomethane production. Examples of the costs represented here are costs incurred on labour to conduct civil engineering work and the purchase of capital equipment. Operational costs presented in full (100%) load terms are assumed be directly proportional to biomethane injection.
7. Since biomethane plants are large investments that are likely to affect private sector capital allocation decisions, an opportunity cost of capital of 7.5% has been included within the resource costs presented[65].
8. Following CCC guidance, this rate is applied to capital expenditure, in the year in which capital expenditure is incurred. This is then discounted using the Green Book social time preference rate of 3.5%.
9. This has been included to account for possible real social risk from investing in AD plants, compared to alternative investments.
10. The extent of this risk, and therefore the extent of any social cost, is uncertain in the biomethane market. In particular, the AD biomethane market has matured since the start of the RHI in 2011. Hence it is possible the social cost could be lower than the estimates presented here.
11. There are alternative approaches to accounting for the opportunity cost of capital in social cost-benefit analysis. We have followed the most proportionate approach for the analysis included in this impact assessment, given the uncertainties in this cost. Alternative approaches could result in higher or lower estimates, however we would not expect this to significantly affect the SNPV.

D.2.2 Feedstock costs

12. Tariff setting and the cost-benefit analysis are affected by the estimated feedstock costs used within the analysis, and feedstock costs vary proportionately to output of biomethane. A variety of sources have been used to estimate each feedstock cost, described below.

[65] Green Book supplementary guidance recommends including cost of finance within appraisals. The rate of opportunity cost of capital was informed by a note produced by the Climate Change Committee for the Renewable Energy Review (2011): https://www.theccc.org.uk/wp-content/uploads/2011/05/The-renewable-energy-review_Printout.pdf

D.2.2.1 Food waste

13. Food waste collections are characterised by gate fees, i.e., an amount charged for waste disposal, usually measured per tonne. Gate fees are paid to biomethane plants for collecting waste and constitute a revenue stream. Gate fees for AD purposes have seen a downward trend over recent years[66]. In 2019, the median gate fees reported by local authorities was £35/tonne, an increase from the £27/tonne in 2018. However, the figure is skewed by longer-term contracts, and when we consider only those that have started in the past 3 years, the median is £20/tonne. It should be noted that there are significant geographical variations due to differences in local competition, as well as national legislation and policy.
14. Market intelligence and evidence from the NDRHI evaluation[67] suggest that long term, secure contracts are becoming difficult to access, leading to a reduction in the certainty of this income stream when making investment decisions. It is difficult to estimate the impact of Defra's policy on consistency in recycling on gate fees because, although it will increase the supply of food waste, there may be competing demand side impacts that counter these effects.
15. Overall, based on the evidence from market intelligence gathered, the NDRHI evaluation, and the latest WRAP Gate Fees (2020) report, and accounting for the fact that there will be a proportion of plants that do not receive a gate fee as they do not use food waste, a central gate fee assumption of £7.50/tonne has been included in the analysis for this policy proposal. This has been estimated based on an understanding that gate fees are low and have been decreasing in recent years but do constitute a revenue stream for biomethane plants. This is a conservative estimate, given the uncertainty associated with gate fees.

D.2.2.2 Energy crops

16. Although energy crops can be used in biomethane production, the proportion used in the feedstock mix is restricted by the minimum waste feedstock requirements. In our feedstock mix, we have used maize to represent energy crops as this is the most widely used energy crop. Evidence on the cost of maize is based on the UK and Global Bioenergy and Resources Model[68], evidence gathered during the RHI evaluation, and market intelligence. The estimated cost of maize is £35/tonne, which has been used in the analysis in this impact assessment.

D.2.2.3 Sewage Sludge

17. Although it is possible that water treatment plants apply an internal transfer price for the use of sewage sludge in AD for biomethane, given the methodological approach set out in this impact assessment for determining costs and revenues incurred, it does not appear appropriate to include any actual cost incurred for sewage sludge in AD.

D.2.2.4 Agricultural Waste

18. For the consultation stage analysis, zero cost was applied to the use of wet manure as a feedstock, and for this analysis we have continued to use an assumption of zero cost for agricultural wastes. Although there is evidence to show that in some circumstances there is potentially a cost associated with the purchase of agricultural wastes for AD, it is not clear that this is applicable across the population of plants we might expect to deploy under the Green Gas Support Scheme. Given the analytical approach we have taken attempts to reflect the population of plants supported under the Green Gas Support Scheme, it does not appear appropriate to include a feedstock cost here.

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[66] Based on the Waste and Resources Action Plan (WRAP) Gate Fees report 2020: https://wrap.org.uk/resources/report/gate-fees-report-2020
[67] Renewable Heat Incentive evaluation collection: https://www.gov.uk/government/collections/renewable-heat-incentive-evaluation.
[68] UK and Global Bioenergy Resource Model: https://www.gov.uk/government/publications/uk-and-global-bioenergy-resource-model

D.3 Revenues

19. The main source of non-tariff revenue for biomethane plants is assumed to be the price received for injecting the gas produced into the gas grid. Biomethane injected into the grid is paid at the same rate as natural gas, therefore BEIS Fossil Fuel Price Assumptions: 2019[69] are used within the analysis for tariff setting. The revenues also depend on the amount of biomethane injected into the grid, and this is dependent on a BEIS ramp-up profile (see Section D.4 below).
20. Another revenue stream for biomethane plants are revenues from Green Gas Certificates (GGC). As described in Annex A, these have been included in the tariff setting for the final stage impact assessment given increasing evidence that AD plants receive GGC revenue. We understand that the market price has increased significantly in recent years which has led to developers including the revenue stream in their models. However, the price of GGC is volatile, have limited transparency, and have a short price history therefore plants may exclude, or include a low-price assumption in order to take a prudent approach to financial modelling for investment appraisal. Since prices are risky, investors will heavily discount market prices when they appraise an investment. Industry engagement and evidence received suggests GGC are priced around £2/MWh in financial models, and therefore a conservative assumption of £2/MWh for GGC has been included in the GGSS tariff setting.
21. A by-product of biomethane production is digestate (see Annex E), which can be used as a fertiliser and therefore could constitute a revenue stream for biomethane plants should they sell this as fertiliser. Commercial intelligence suggests that digestate does not constitute a revenue stream. This is because of the relatively little information on digestate quality, which can vary depending on a number of factors including the feedstock and the lack of a formal market for digestate. Potential digestate revenue is therefore excluded from Green Gas Support Scheme tariff setting.

D.4 Performance

22. Costs and revenues, and therefore the tariff rate analysis and cost-benefit analysis, are affected by the estimated production of biomethane plants. It is estimated that it takes time for biomethane plants to optimise once they have commissioned, until they reach their assumed production capacity. This is reflected in a 'ramp-up profile' that is applied to the analysis of biomethane production under the Green Gas Support Scheme. Table D-3 below shows the ramp-up profile[70].

Table D-3: Plant ramp-up profile

Year	1	2	3	4	5+
Capacity	55%	71%	84%	92%	92%

23. The cost, revenue, and performance assumptions and evidence presented above are the basis on which the tariffs have been set, and the cost-benefit analysis of the scheme undertaken.

[69] Fossil fuel price assumptions: https://www.gov.uk/government/publications/fossil-fuel-price-assumptions-2019
[70] Based on an internal modelling of RHI data, which is based on past data of plant injections over time.

Annex E – Biomethane air quality impacts

1. The cost-benefit analysis undertaken for this policy proposal includes monetised air quality impacts of ammonia emissions resulting from supporting biomethane production. Digestate is a by-product of the AD process that is typically spread on agricultural land as a bio-fertiliser and can displace the use of synthetic fertilisers. However, it contains nitrogen that can be lost to the atmosphere as ammonia, an air pollutant that has significant effects on human health and natural ecosystems. The digestion process increases the emission potential compared to manure or slurry. The UK Government has committed to reducing ammonia emissions by 16% by 2030 (compared with 2005 levels). Ammonia from all digestate from AD currently accounts for around 5% of UK ammonia emissions, and biomethane plants are a subset of all AD plants.
2. BEIS have worked with Defra to estimate the impact from our policy proposal on air quality. Ammonia emitted from the processing of feedstocks into digestate, the storage of digestate, and the spreading of digestate on land are estimated from feedstock tonnages used to produce biomethane – based on deployment and feedstock assumptions. This is partially offset by avoided ammonia emissions from the storage and spreading of manures and slurries and the displacement of synthetic nitrogen fertilisers (which also emit ammonia when used). We assume that 50% of the nitrogen content in digestate displaces nitrogen from synthetic fertilisers.
3. Different synthetic nitrogen fertilisers emit varying levels of ammonia, so the fertilisers displaced are assumed to be in the same proportions as used in Britain for crops in 2019.[71] See Table E-2.
4. Emissions factors used are consistent with those used to compile the 2019 National Atmospheric Emissions Inventory (NAEI).[72] Sewage sludge in the AD process is assumed to have no additional ammonia impact, compared to its counterfactual emissions from its disposal by conventional means. Spreading emissions for manure-based digestate have been partially offset by a reduction in emissions from the land-spreading of manure (both wet manure and chicken litter) and spreading emissions for food waste-based digestate are reduced slightly by a reduction in upstream landfill emissions.[73]
5. Given the ammonia mitigation requirements of the Environment Agency (which requires all AD plants to cover stores of digestate), and the low-emission digestate spreading requirements of the Green Gas Support Scheme, as set out in the Government Response, we have updated the assumptions in the accompanying final stage impact assessment to align with these requirements. It is therefore assumed that digestate produced under the Green Gas Support Scheme will be kept in covered stores and that low-emissions spreading techniques are applied, however we assume that the least effective low emissions spreading technique is applied given the technical barriers to adopting the most efficient low-emissions spreading techniques. The counterfactual manure spreading and storage assumption has also been updated to reflect the increasing uptake of low-emissions spreading of manures in the industry. This assumption change has led to a fall in overall ammonia emissions of the Green Gas Support Scheme, compared to our analysis for the consultation stage impact assessment.
6. Under the central scenario, it is estimated that at full ramp-up this produces 2.15 kilo-tonnes of ammonia emissions but is reduced to 1.73 kilo-tonnes under the assumption that half of the nitrogen in digestate displaces synthetic fertilisers. A breakdown by feedstock and by process is shown in Table E-1 below.

[71] Calculated from British Survey of Fertiliser Practice 2019: https://www.gov.uk/government/statistics/british-survey-of-fertiliser-practice-2019
[72] UK Informative Inventory Report (1990 to 2019): https://naei.beis.gov.uk/reports/reports?report_id=1016
[73] Tomlinson S.J., Thomas I.N., Carnell E.J., and Dragosits U. (2019) Reviewing estimates of UK ammonia emissions from landfill, composting & anaerobic digestion: Improvement Plan 2018. Report for Defra (AQ_IP_2018_20). April 2019. 63pp

Table E-1: Annual Ammonia Emissions at Full Ramp-Up

Feedstock	Energy mix	Feedstock processing and storage (Kt)	Digestate storage (Kt)	Digestate spreading (Kt)	Total ammonia emissions* (Kt)
Food waste	50%			1.29	1.40
Maize	20%	0.02	0.16	0.71	0.78
Agricultural waste	20%	Net figure provided			-0.03
Sewage	10%	-	-	-	-
Total additional emissions from digestate					**2.15**
Net ammonia emissions where 50% of digestate nitrogen displaces fertilisers					**1.73**

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

7. The net ammonia emissions from the digestion of agricultural wastes are negative following the inclusion of chicken litter in the 'agricultural waste' category. Chicken litter digestion results in ammonia emission savings compared to the counterfactual disposal of chicken litter. The overall figure for agricultural waste has been weighted by wet manure and chicken litter in proportions outlined in Table C-2.

Table E-2: Fertiliser Mix

Fertiliser	Proportion (by weight)
Urea	7.5%
Urea ammonium nitrate	13.2%
Ammonium nitrate	36.5%
Other	42.8%

8. Biomethane plants that deploy under the Green Gas Support Scheme will be required to use at least 50% of waste in their feedstock mix by output. As such, we present sensitivity analysis to understand the impact of ammonia emissions under a scenario in which it is assumed that biomethane plants use up to 50% energy crops (e.g. maize) in their feedstock mix. Although it is technically possible for the feedstock mix to be made up of 50% energy crops, given the requirements imposed in order to receive the tariff payment, we do not expect this to be the case. This is because food waste plants do not typically use significant proportions of energy crops; given the biological processes involved, and because of the cost associated with purchasing energy crops. Changing feedstock mix can take several months, and food waste plants often will have contractual commitments to accept food waste (as opposed to supply a particular volume of gas).
9. The feedstock mix in Table E-3 shows a potential scenario in which maize makes up 50% of the feedstock mix by biomethane output. For this we have assumed a proportional reduction in each of the waste feedstocks, so that the remaining mix is 32% food waste, 12% agricultural waste and 6% sewage.
10. Including a higher proportion of maize increases ammonia emissions resulting from the increased spreading of maize-based digestate, which are high in ammonia emissions. This also leads to a reduction in the SNPV as seen in the sensitivity analysis in Section 4.5.

Table E-3: 50% Energy Crop Ammonia Emissions at Full Ramp-Up

Feedstock	Energy mix	Feedstock processing and storage (Kt)	Digestate storage (Kt)	Digestate spreading (Kt)	Total ammonia emissions* (Kt)
Food waste	32%			0.83	0.89
Maize	50%	0.03	0.22	1.76	1.94
Agricultural waste	12%	Net figure provided			-0.02
Sewage	6%	-	-	-	-
Total additional emissions from digestate					**2.82**
Net ammonia emissions where 50% of digestate nitrogen displaces fertilisers					**2.49**

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

Annex F– Biomethane carbon emissions factor

1. The carbon emissions factors for biomethane production have been calculated in order to inform the carbon savings associated with the proposed policy, taking into account the most recent evidence available. The overall biomethane emissions factor for the policy proposal under our central scenario assumptions is 30gCO2e/kWh which is lower than our previous assumption of -221gCO2e/kWh. This is due to the change to our feedstock mix assumption (see Annex C) and revised assumptions on the upstream carbon savings from food waste. This is discussed further below.
2. There are three components to the biomethane emissions impact from each feedstock in our assumed mix. They are:

    a) **Bio-generation emissions:** direct emissions associated with the production of biomethane. These emissions are based on the latest available evidence to BEIS held in the internal Biomass Heat Pathways Model, and include emissions associated with all stages of the process i.e. pre-processing, transport, conversion (including methane slip), final conversion, and transport in the gas pipeline, for each of the feedstocks.
    b) **Upstream savings:** savings associated with avoiding the counterfactual use of feedstocks, which is explained in further detail below.
    c) **Downstream savings:** savings associated with reducing fossil fuel consumption as a result of biomethane replacing natural gas in the gas grid.

3. These components are added together to produce an overall emissions factor for each feedstock, which are then weighted based on our assumed feedstock mix (50% food waste; 20% maize; 10% sewage; 20% agricultural waste).
4. Upstream emissions savings are as follows:

    a) **Agricultural waste:** upstream savings relate to the diversion of manure (both wet manure and chicken litter) away from storage in slurry tanks or lagoons, and the spreading of these manures. These emit a significant amount of methane into the atmosphere. The estimated upstream savings from manure has been estimated using internal BEIS analysis based on data provided by Rothamsted Research and are consistent with those used to compile the 1990-2019 National Atmospheric Emissions Inventory (NAEI)[74]. The data source for wet manure upstream savings has been updated since the consultation stage Impact Assessment, in which figures were based on data from an unpublished study by the University of Manchester.

5. There remains uncertainty on the upstream carbon savings related to the diversion of food waste from landfill. Food waste can go to other destinations than landfill, such as incineration. The destination of food waste is likely to depend on the source of food waste. For example, household food waste is more likely to be sent to energy from waste than landfill, whereas municipal business food waste is more likely to be sent to landfill.
6. The Green Gas Support Scheme does not specify where food waste feedstocks need to be diverted from and we are not able to predict the sources of food waste that supported AD plants will use. As such there is considerable uncertainty around the percentage of food waste diverted from landfill for use in Green Gas Support Scheme AD plants.
7. Diversion from incineration generates significantly lower carbon savings than diversion from landfill. This is because incineration with energy 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. However, diverting food waste from incineration frees up further incineration capacity. This would be replaced by mixed waste that otherwise would have gone to landfill. Mixed waste contains biodegradable content, including food waste, and so carbon savings are expected though this would not be equivalent to removing a tonne of food waste from landfill.

[74] UK Informative Inventory Report (1990 to 2019): https://naei.beis.gov.uk/reports/reports?report_id=1016

8. There is also uncertainty on how to attribute the carbon savings of diverting food waste to AD, between the Green Gas Support Scheme and Defra's policy on consistency in recycling, as discussed in Section 3.1.4.
9. Due to these uncertainties, and interactions with Defra's policy on consistency, upstream savings from diverting food waste from landfill are not included in the analysis for this final stage impact assessment. All carbon savings relating to the diversion of food waste from landfill will be accounted for in Defra's IA, and will contribute to the SNPV of Defra's policy on waste. Therefore, the carbon savings and SNPV presented in this impact assessment are likely to be underestimated and should be interpreted jointly with Defra's IA.
10. Table F-1 below shows the biomethane emissions factors for different feedstocks assumed in the consultation stage impact assessment. Upstream emissions values are negative for food waste and wet manure because they represent emissions saving.

Table F-1: Biomethane Emissions Factor – Consultation Stage Impact Assessment

Feedstock	Proportion	Bio-generation (gCO2e/kWh)	Upstream (gCO2e/kWh)
Food Waste	50%	80	–561
Maize	20%	130	0
Wet Manure	5%	86	–600
Sewage Sludge	25%	78	0
Weighted Average	**-**	**90**	**–310**

11. As discussed in Annex C, for the final stage impact assessment we have revised our feedstock mix assumption to incorporate agricultural wastes, other than wet manure, that are commonly used in AD, also increasing the overall percentage of agricultural waste to 20%. We have lowered the expected proportion of sewage plants on the Green Gas Support Scheme to 5% due to market intelligence suggesting that there may be less commercial opportunity for water treatment plants to build new AD capacity for production of biomethane under this scheme. This change in feedstock assumptions has led to changes in the overall biomethane emissions factor of the Green Gas Support Scheme in numerous ways:

    a) The bio-generation emissions factor for 'agricultural waste' remains unchanged (compared to the pervious 'wet manure' assumption), however the weighted bio-generation emissions factor across all feedstock types has increased marginally from 90gCO2e/kWh to 91gCO2e/kWh, given the increased proportion of agricultural waste in the overall feedstock mix.
    b) The upstream emissions factor for 'agricultural waste' has fallen compared to the previous figure for 'wet manure' (from -600gCO2e/kWh to -306gCO2e/kWh). This is partly due to change in data source, with the updated upstream savings emissions factor for 'agricultural waste' derived from data provided by Rothamsted Research, which is consistent with those used to compile the National Atmospheric Emissions Inventory (NAEI). The fall in upstream savings emissions factor for 'agricultural waste' is also driven by the inclusion of chicken litter, as well as wet manure, in this category. The avoided upstream savings are lower for chicken litter, than for wet manure, and therefore the weighted average upstream emissions factor for 'agricultural waste' has fallen.

12. These impacts on upstream savings from 'agricultural waste' have been offset by the increase in proportion of 'agricultural waste', which increases upstream carbon savings, and the smaller proportion of sewage sludge, which is assumed to yield no upstream savings.

13. However, revised assumptions on upstream savings from food waste have resulted in a decrease in the overall weighted upstream emissions factor across all feedstocks.
14. The consultation stage impact assessment assumed that all food waste used by Green Gas Support Scheme AD plants was diverted from landfill and that the resultant upstream savings were entirely attributable to the Green Gas Support Scheme.
15. This impact assessment does not quantify the carbon savings of food waste diversion from other destinations to Green Gas Support Scheme AD plants. This is due to the uncertainties on the sources of food waste and the attribution of carbon savings between the Green Gas Support Scheme and Defra policy. Further details on this are provided in Section 3.1.4.
16. This attribution is equivalent to an unweighted upstream emissions factor for food waste of 0gCO2e/kWh.
17. The overall weighted upstream emissions factor, across all feedstocks, has fallen to -61gCO2e/kWh.

Table F-2: Biomethane Emissions Factor – Final Stage Impact Assessment

Feedstock	Proportion	Bio-generation (gCO2e/kWh)	Upstream (gCO2e/kWh)
Food Waste	50%	80	0*
Maize	20%	130	0
Agricultural waste	20%	86	–306
Sewage Sludge	10%	78	0
Weighted Average	**-**	**91**	**–61**

*The upstream emissions factor for food waste reflects the attribution of carbon savings between the Green Gas Support Scheme and Defra's policy on consistency in recycling.

18. Downstream emissions avoided are equal to the emissions factor of natural gas, 184gCO2e/kWh.
19. There is significant uncertainty associated with the upstream emissions abatement associated solely with biomethane deployment under the Green Gas Support Scheme. This is mainly driven by uncertainty around the counterfactual disposal of feedstocks and how waste sector policies also impact the disposal of feedstocks, affecting the attribution of upstream savings. There is also uncertainty around the potential gas yield from food waste which is a highly variable feedstock being a broad category. Food waste composition may change locally and seasonally as well as in the long term from measures to reduce its arising. In addition, waste sector policies also impact the disposal of feedstocks, 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.

Annex G – Deployment Scenarios

G.1 Green Gas Support Scheme Deployment Uncertainty

1. This section presents three deployment scenarios used in the appraisal of the scheme. Additional plant capacity deployed under the Green Gas Support Scheme is appraised over its assumed economic lifetime of 20 years.[75] The impacts of deployment scenarios on the SNPV are explored in Section 4.5. Under the counterfactual scenario (Option 0), we expect no new biomethane capacity development over the period of the scheme, and therefore deployment for this option is zero. It should be noted that the analysis does not consider the potential impact on deployment from a degression event.
2. Three deployment scenarios are used:
   a) **Central –** This is our best estimate of deployment based on the methodology described in Section 3.1.6
   b) **Low –** These estimates are based on BEIS judgement of the potential scenario in which the proposals set out for this scheme do not lead to the expected levels of industry investment. The basis of these estimates follows the same rationale as central estimates but adjusted to reflect a weaker demand response from industry.
   c) **High –** These estimates are based on a scenario in which the demand response is greater than anticipated for the Green Gas Support Scheme, taking into account judgement on the policy proposals against constraints such as feedstocks and other investment opportunities. Although this is a demand-led scheme, BEIS expects there is sufficient feedstock available to produce biomethane to the high estimate.
3. Under the RHI, the majority of biomethane was produced under Tier 1, and there appeared to be some potential clustering of plant sizes around the level required to produce biomethane up to the Tier 1 limit. Therefore, we assume that the average plant size deployed on the Green Gas Support Scheme will be that which will produce to the Tier 1 limit for each option. Therefore, the reference plants differ because Option 1 incentivises a larger plant size by offering a greater band under which Tier 1 payments can be made, and Option 2 has a smaller band leading to a smaller average plant. The larger plant size results in economies of scale, and therefore in a lower cost per unit of gas produced.
4. Deployment of plants increases over the duration of the scheme and overall biomethane produced increases. Production peaks between 2029/30 and 2040/41 per annum, before declining as earlier plants reach the end of their economic life, at which point we assume they cease production as significant capital investment is required to continue operating and it is not clear whether it would be economical to do so.

G.1.1 Option 1 deployment

5. Table G-1 shows the biomethane production (GWh) that we expect to see on the Green Gas Support Scheme for Option 1 (preferred option) for the scenarios outlined above. The assumed size of plants is 7.5 MW,[76] equal to the size of reference plant used for setting the Tier 1 tariff. For further information and for capital and operating expenditure associated with this size of plant, see Annex D.

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[75] Economic lifetime assumption from unpublished internal BEIS Biomass Heat Pathways Model (from the Bioenergy Heat Pathways to 2050 Rapid Evidence Assessment), Ecofys & E4Tech (for BEIS) 2018, unpublished.

[76] Biomethane plants do not have a true 'capacity' like power generation technologies, but it is convenient to represent different plant sizes using capacities according to the amount of gas they produce.

Table G-1: Biomethane production (GWh) under deployment scenarios

Deployment Scenario	2021/22	2022/23	2023/24	2024/25	2025/26 to 2044/45 (average per annum)	Total (2020/21 to 2044/45)
Central	100	400	900	1,700	2,500	**53,300**
Low	0	200	500	1,000	1,500	**30,900**
High	100	400	1,100	1,900	2,800	**59,900**

G.1.2 Option 2 deployment

6. Table G-2 shows the biomethane production (GWh) that we expect to see on the Green Gas Support Scheme for Option 2, for the deployment scenarios outlined above. The assumed size of plants deploying under Option 2 with a Tier 1 limit of 40,000 MWh is 6 MW, equal to the size of *reference plant* used for setting the Tier 1 tariff under this option. For capital and operational costs associated with this size of plant, see Annex D.

Table G-2: Biomethane production (GWh) under deployment scenarios

Deployment Scenario	2021/22	2022/23	2023/24	2024/25	2025/26 to 2044/45 (average per annum)	Total (2020/21 to 2044/45)
Central	100	300	800	1,500	2,300	**48,000**
Low	0	200	500	900	1,300	**27,800**
High	100	400	1,000	1,700	2,500	**53,900**

Annex H – Non-monetised costs and benefits

1. There are several non-monetised costs and benefits that are not captured in the cost-benefit analysis, including:

   a) **Investment** – Internal BEIS analysis and commercial intelligence suggests the majority of investment in biomethane plants in the UK adds to domestic jobs and GVA. The Anaerobic Digestion and Bioresources Association estimate that there are between 3,000 to 4,000 jobs in the UK AD sector[77]. We anticipate that, overall the Green Gas Support Scheme will support 500-900 direct jobs and 450-700 indirect jobs per annum during the construction phase of AD plants. Further, once plants are operational, we estimate the Green Gas Support Scheme will support 500-550 direct jobs and 400-450 indirect jobs, during the lifetime of the plants (assumed to be 20 years)[78].

      Additional benefits include innovation benefits and potential cost reductions due to learning from wider deployment driven by the scheme, leading to future decarbonisation being more cost effective. If monetised, these would have a positive impact on the SNPV of the scheme. Job estimates are not included in the cost benefit analysis because this could lead to double counting (due to the underlying energy appraisal methodology).

   b) **Rural economy** – Internal analysis suggests that over two thirds of biomethane plants are located in rural areas[79], with 80% of all GB plants located in areas with a lower than average GVA[80]. If monetised, this distributional effect would have a positive impact on the SNPV of the Green Gas Support Scheme.

   c) **Net zero contributions** – The carbon savings and renewable heat generation associated with these policy proposals are not considered in view of the requirements needed to meet the UK Government legislation to reach net zero emissions by 2050. In the absence of the scheme, additional action would be required to meet these requirements. If monetised, this would have a positive impact on the SNPV of the Green Gas Support Scheme.

   d) **Wider sustainability impacts** –

      i) The Green Gas Support Scheme will require 50% of all biomethane (by energy content) to be produced using waste or residue feedstocks. Waste feedstocks offer significant carbon savings when compared with other feedstocks, such as energy crops, largely due to upstream savings. These are avoided emissions that would have occurred if the feedstock had been put to a different use. For example, food waste that is sent to landfill releases methane, a potent greenhouse gas. Diverting it to AD to produce biomethane can provide significant emission savings. Food waste sent to AD also helps to support a more circular economy and contributes to England meeting its target to work towards eliminating food waste to landfill by 2030 and to recycle 65% of municipal waste by 2035. AD represents the waste treatment route with the best environmental outcome for food waste that cannot be prevented or redistributed. This is because AD produces digestate (a bio-fertiliser) and generates renewable energy, which is more environmentally beneficial than producing compost. Biomethane production from other waste feedstocks, including agricultural wastes, can also reduce emissions on farms. Increasing the minimum percentage waste feedstock requirement may lead to food waste being transported long distances for use in AD plants, however we will

[77] 'Anaerobic Digestion Market Report July 2018', ADBA, 2018

[78] Lower bound estimates are drawn from internal BEIS calculations based on operational job estimates from internal RHI modelling, and adjusted to reflect that the ADBA Market Report July 2018 states that there are roughly equal numbers of jobs in the development/construction of new plants and the maintenance of operational plants, whilst deployment continues to grow. Upper bound estimates are based on market intelligence and the occupational impacts estimated in the Annual Business Survey.

[79] As defined using 2011 Urban Rural Classifications: https://www.gov.uk/government/statistics/2011-rural-urban-classification

[80] Based on internal analysis of NNFCC data on the location of AD plants and GVA data by NUTS2 region.

undertake a mid-scheme review (around financial year 2023/24) of the waste feedstock threshold.

ii) The Green Gas Support Scheme limits the amount of energy crops that can be used as feedstock at 50% of biomethane (by energy content) as the use of crop to displace waste feedstock can have adverse impacts such as: impact on food security; biodiversity loss; taking up space which could be used for green space, afforestation or renewable technologies such as solar; emissions from indirect land use change; soil health. However, energy crops have practical importance for many biomethane producers by providing a stable feedstock supply when waste supply fluctuates particularly with uncertainty in gate fees and waste contracts. Crops used in AD can have wider sustainability benefits such as: balancing end-product nitrogen content in high nitrogen feedstocks such as poultry manure and broader environmental benefits when grown as part of a sustainable crop rotation regime.

iii) If monetised, the 50% threshold to encourage the use of waste feedstocks in AD and limit the amount of crop used as feedstock would have a positive impact on the SNPV of the Green Gas Support Scheme.