Department of Energy & Climate Change

RHI Biomethane Injection to Grid Tariff Review

URN 14D/173

30 May 2014

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The consultation can be found on DECC's website:
https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi

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Contents

General information

Purpose of this consultation:

This consultation on the RHI biomethane injection to grid tariff seeks views from industry on the proposed adjustment to the biomethane to grid tariff. The consultation presents two tariff options: banding and tiering. For each option, scenarios are presented that illustrate how tariffs for different sizes of biomethane plant might be derived. We would like input from industry on the form and levels of support offered by these proposed illustrative tariffs, and the evidence that underpins them, to ensure that the RHI continues to support sustainable growth in the biomethane to grid market.

Issued: 30 May 2014

Respond by: 27 June 2014

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Consultation reference: URN 14D/173 – RHI Biomethane Injection to Grid Tariff Review

Territorial extent:

This consultation applies to England, Scotland and Wales

How to respond:

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also greatly welcome. Please provide as much evidence as possible to support your response. Please note that there is a technical annex that accompanies this document, which includes additional consultation questions.

Please respond to this consultation via email to: rhi@decc.gsi.gov.uk.

Online responses can also be submitted via DECC's consultation hub at the following link: https://econsultation.decc.gov.uk/decc-policy/rhi-biomethane-injection-to-grid-tariff-review/

Alternatively, hard copy replies should be sent to the address above.

Additional copies:

You may make copies of this document without seeking permission. An electronic version can be found at https://www.gov.uk/government/consultations/rhi-biomethane-injection-to-grid-tariff-review.

Other versions of the document in Braille, large print or audio-cassette are available on request. This includes a Welsh version. Please contact us under the above details to request alternative versions.

Confidentiality and data protection:

Information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004).

If you want information that you provide to be treated as confidential please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

We will summarise all responses and place this summary on our website at www.decc.gov.uk/en/content/cms/consultations/. This summary will include a list of names or organisations that responded but not people's personal names, addresses or other contact details.

Quality assurance:

This consultation has been carried out in accordance with the Government's Code of Practice on consultation, which can be found here:
http://www.bis.gov.uk/files/file47158.pdf

If you have any complaints about the consultation process (as opposed to comments about the issues which are the subject of the consultation) please address them to:

DECC Consultation Co-ordinator
3 Whitehall Place
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Email: consultation.coordinator@decc.gsi.gov.uk

Executive Summary

Biomethane to grid is a key renewable technology that has the potential to make a significant contribution to the UK's 2020 renewable energy commitments and is expected to deliver 15% of heat deployment under the Renewable Heat Incentive (RHI) in 2015/16. Therefore it is vital that we get the level of support right to ensure the market can grow with confidence.

When we first introduced the 'one size fits all' biomethane to grid tariff in November 2011 there were no full scale biomethane to grid plants in operation[1]. The tariff was based on a 1MW waste feedstock plant, although we recognised that over time, this level of support might need adjusting.

It is clear that the RHI has kick-started the market for biomethane to grid: there are now three plants registered to the RHI. Our current market intelligence indicates that many plants of much higher capacities are planned or in the pipeline. Larger plants benefit from economies of scale which can make them efficient generators of renewable energy, but our analysis now suggests that their costs may not justify RHI support at current levels. This represents a value for money risk for the taxpayer. The aims of this review are to:

- ensure continued growth in biomethane to grid deployment in order to support the Government's ambitions for renewable heat deployment and its commitments to carbon emissions abatement, including meeting the 2020 renewables target;
- ensure value for money in the use of RHI budgets, which require a tariff structure that incentivises deployment but does not routinely overcompensate biomethane to grid installations; and
- recognise and maintain the important role of large scale plant in the RHI;

In this consultation, we are proposing to introduce a well-managed adjustment to the biomethane to grid tariff, which will enable the market to continue to grow sustainably. We plan to lay the amended regulations as soon as possible after Parliament returns from Recess in Autumn 2014.

We are consulting on two tariff options: banding and tiering of the tariff; both options are familiar to the market and are used elsewhere in the scheme.

Banding operates by defining capacity bands for the technology and paying an appropriate tariff for an agreed level of plant capacity. Tiering operates by paying a higher tariff for the first designated amount of kilowatt hours of biomethane injected into the grid and a lower tariff for any subsequent biomethane injected over a period of 12 months.

[1] Although the Didcot biomethane plant, a demonstration scale project, first injected gas to grid in October 2010.

For both banding and tiering we provide scenarios to illustrate how tariffs for different sizes of biomethane plant might be derived. Essentially the scenarios serve to illustrate the levels of support we are considering, and we are seeking views from industry on what level and form of support is most appropriate to enable us to meet the objectives set out above. We are aware that the evidence on which the options are based carries a certain amount of uncertainty, for example gate fees and other capital costs identified in the technical annex, which appends this document.

In this consultation there are a total of 22 questions. There are 17 questions in the main consultation document and an additional 5 questions in the technical annex.

A decision on our final approach will be made based on the inputs from this consultation, stakeholder views and our updated evidence base.

Introduction

The Biomethane Tariff Review

1.1. The non-domestic RHI was launched in November 2011 as a financial support scheme aimed at driving deployment of renewable heat technologies in businesses and commercial, public or third sector organisations. Tariff levels were calculated to compensate for the typical financial gap between the cost of conventional and renewable heat systems and provide a rate of return sufficient to address barriers to uptake.

1.2. Support for biomethane to grid was introduced in line with the Coalition commitment to introduce measures to promote an increase in energy from waste through anaerobic digestion.

1.3. As for all technologies supported under the non-domestic RHI, tariffs were calculated on the basis of targeting a 12 per cent rate of return which we believed represented the appropriate level of compensation that professional and commercial market participants would require for installation of renewable heating technologies. This overall approach reflected the fact that the renewable heat market was starting from a relatively low base and needed a kick-start in order to encourage growth and to support meeting the 2020 renewable energy targets.

1.4. In order to control costs, and given that in 2011 the scheme was in its infancy, it was recognised that over time tariffs might need to be changed through scheduled reviews or early reviews. The conditions under which these early tariff reviews would take place were outlined within the Government Response to the 'Providing Certainty, Improving Performance' July 2012 consultation, published in February 2013.

1.5. We announced an early review of the biomethane tariff on 28 February 2014 because market intelligence, industry representations and our own evidence indicated there may be a risk of overcompensation for large biomethane to grid plants and / or plants that have existing assets that are converting to biomethane injection and this represents a value for money risk for the taxpayer. It is also a condition of our State Aid approval that we address risks of systematic overcompensation. In light of this, we believe that an early review is necessary and that at least two of the conditions for an "early review" have been met:

- evidence of a risk of over-subsidy; and
- better value for money and/or better synergies with other policies could be achieved.

1.6. Therefore, in this exceptional case, we have decided that there is a need to intervene to ensure value for money and that the market for biomethane grows sustainably. This is because the biomethane tariff does not currently recognise economies of scale, unlike other scheme technologies[2], and a well-managed tariff adjustment is necessary to deal

[2] For example, RHI support for biomass boilers is split into separate tariffs for different boiler capacity bands.

with the potential risk presented by large plant. Our policy continues to be that we will only revisit tariffs when the conditions for an early tariff review are met.

1.7. Within the Government Response titled 'Improving Support, Increasing Uptake' published in December 2013, and in response to the Consultation on the 'Non-Domestic Scheme Early Tariff Review' published in May 2013, we set out a range of criteria for use in making final decisions on tariffs. The criteria identified included:

- the level of forecast deployment;
- the range of modelling outputs;
- industry views;
- recommendations made by DECC engineering specialists;
- the nature of each technology and any specific risks of over- or under-deployment;
- the relativities between tariffs for comparable technologies; and
- the role each technology has to play in meeting DECC's medium and long-term objectives.

These criteria will be used to make the final decision on the biomethane tariff review, after consultation.

1.8. This document summarises the findings of the analysis of this issue and consults on policy options that seek to align the tariff more closely to the costs of different sizes of biomethane installation.

Objectives

1.9. The objectives of this review are to:

- ensure continued growth in biomethane to grid deployment in order to support the Government's ambitions for renewable heat deployment and its commitments to carbon emissions abatement, including meeting the 2020 renewables target;
- ensure value for money in the use of RHI budgets, which requires a tariff structure that incentivises deployment but does not routinely overcompensate biomethane to grid installations; and
- recognise and maintain the important role of large scale plant in the RHI.

Biomethane Injection into the Grid

1.10. This technology involves the production of biogas through anaerobic digestion (AD) of waste, crop, slurries or sewage feedstock. The biogas is then 'upgraded' to remove the carbon dioxide and other impurities in a process known as scrubbing, and propane is added to ensure the calorific value, or energy content, closely matches that of natural gas in the network. The resulting gas can then be odorised and compressed, and the processed biomethane injected into the gas grid, to displace fossil natural gas which has higher lifecycle CO_2 emissions. Injecting biomethane is a way of partly decarbonising the gas grid and has the advantage of using existing gas infrastructure.

1.11. There are existing regulations governing the composition of biomethane and its injection into the gas grid (Ofgem, National Grid and the Health and Safety Executive all have responsibility in this area). Ofgem administers the RHI scheme and requires specific

information, such as evidence of the Network Entry Agreement and process schematics, from biomethane plant applicants as part of the registration process.

The Risk of Overcompensation

1.12. Biomethane injection to the gas grid is a key RHI technology which is projected to generate approximately 15% of our total renewable heat deployment under the RHI by 2015 /16[3]. Therefore it is important that we ensure the sustainability of this emerging market.

1.13. There are a number of ways in which the capacity of a biomethane to grid plant is defined. In this document plant capacity is referred to in relation to the biogas generation capacity (MW) from the anaerobic digester. However, the current biomethane regulations refer to capacity in terms of volume of biomethane injected to the grid (m^3/hour). For ease of reference, Table 1 provides an approximate conversion between the size of plant based on biogas generation capacity, the volume of biomethane injected to the grid and the electrical capacity if the biogas was diverted to electricity generation.

Table 1 Conversion Table of plant biogas capacity – conversions are approximate[4]

Biogas Capacity (MW)	Biogas Capacity (m^3/hour)	Biomethane to Grid (m^3/hour)	Electrical Capacity (MWe)
1	150	100	0.4
5	800	500	2.0
10	1650	1000	4.0

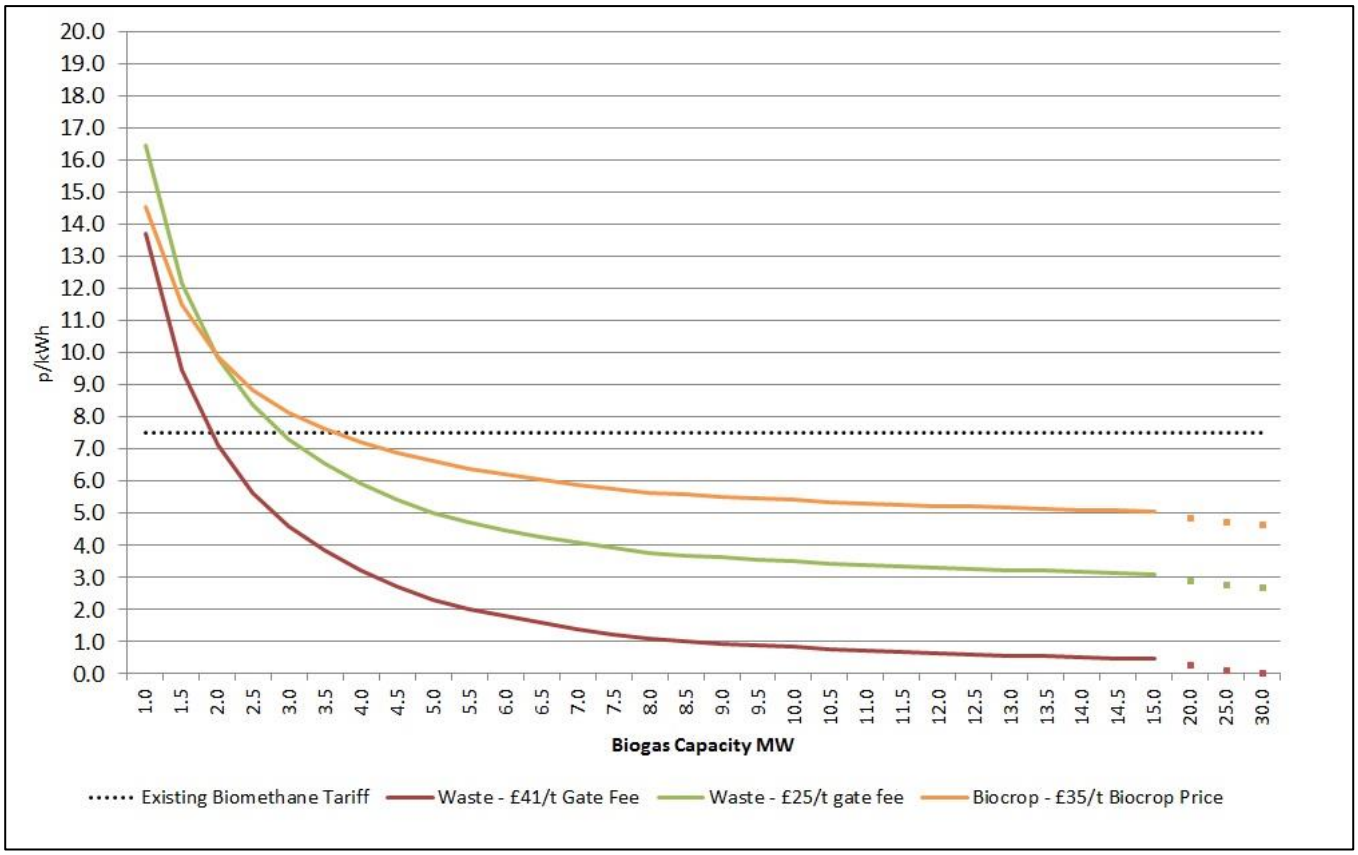
1.14. The current biomethane tariff is based upon a 1 MW waste feedstock plant. Our market intelligence and analysis suggests that plants coming forward are of higher capacities and that the internal rates of return (IRR) for larger sized plant are in excess of the 12% on which RHI tariffs are based. Current cost evidence suggests biomethane to grid plants of over 2 MW could earn significantly in excess of 12% rates of return. This represents a value for money risk.

[3] See Table 8 in RHI Tariff Review, Scheme Extension and Budget Management Impact Assessment (DECC0153) at: https://www.gov.uk/government/consultations/renewable-heat-incentive-expanding-the-non-domestic-scheme

[4] Assumes a volume to volume ratio of biomethane to biogas of 0.61:1, a calorific value of biomethane of 9.96kWh/nm^3 and a gas engine efficiency of 40%. Biogas capacity (nm^3/hour) figures have been rounded to the nearest 50nm^3/hour. These approximate conversions don't account for the parasitic load of the digester, the load factor of the upgrader or methane slippage in upgrading; these have been accounted for in the full modelling of the tariffs.

1.15. The Chart below demonstrates the tariff levels we believe are now required to generate a 12% rate of return at various capacities, based upon updated biomethane cost and performance data as of March 2014.There are still uncertainties in this evidence base, which we are seeking to address through this consultation. The Chart shows that the required tariff reduces significantly as the size of installation increases.

Chart 1 Required RHI tariff to provide a 12% internal rate of return (IRR)



1.16. Economies of scale for larger plant are borne out of the fact that some of the costs do not vary by plant size or do not increase proportionately with capacity. For example, the equipment required to monitor the quality of the gas (network entry unit) to ensure its chemical content is suitable for injection into the gas grid costs upwards of £400,000 per project and does not vary by size of installation. The clean-up equipment at the lower end of biomethane injection capacity incurs broadly the same costs whether a plant is dealing with 100 nm^3 or 1000 nm^3 of gas.

1.17. As well as presenting a value for money risk to the tax payer, it is a condition of the RHI State Aid approval that any risk of overcompensation is kept under review and addressed as necessary. Our State Aid approval from the European Commission requires us to ensure the scheme delivers tariffs which provide a typical potential project with a 12% IRR (recognising that some installations will achieve more than a 12% IRR, and some less).

Degression

1.18. In order to control RHI expenditure to agreed limits we operate a budget management mechanism known as ‘degression’. Degression reduces technology tariffs when overall

scheme deployment, or deployment for an individual technology, presents a risk to scheme affordability.

1.19. However, in this instance, we do not believe degression will mitigate the value for money risk as it would not fully address any risk of overcompensation of large plants quickly enough. Our evidence suggests multiple tariff degressions would be required to address the risk which would risk destabilising investor confidence. Relying upon degressions would also penalise smaller scale plants that need a higher tariff to ensure a 12% IRR; fundamentally the value for money risk stems from the current 'one size fits all' tariff structure.

1.20. Regulations set out the rules governing the circumstances under which a tariff reduction will be made in terms of the expenditure thresholds ('triggers') that must be met. When a trigger is met for a particular technology, tariffs are reduced by 5% in the first instance. If trigger conditions continue to be met, an individual technology tariff could be degressed by a further 10% and 20% in successive quarters[5].

1.21. The risk of overcompensation relating to biomethane to grid could therefore result in a series of increasingly significant quarterly degressions, which we believe has the potential to destabilise the market more than a well-managed adjustment to the biomethane tariff structure. As previously mentioned it is our aim that the outputs from this review will give clarity to the market, ensure sustainable growth, reduce the likelihood of multiple degressions and the risk of overcompensation.

[5] The % figures assume the total scheme trigger is not hit; an additional 5% reduction is made in a quarter if the total scheme trigger is also hit. Further information about the operation of the budget management mechanism can be found in the factsheet which is available on the GOV.UK website.

Policy Proposals

Summary of Options

1.22. We are proposing to adjust the tariff to link payments more closely to the costs of biomethane installations at different scales. We are consulting on two tariff structures that would enable this: banding and tiering. Although a number of options have been assessed, banding and tiering have been developed further because the market is familiar with them and they are tried and tested methods that are used elsewhere in the scheme. In addition, Ofgem, the scheme's administrator, is familiar with the delivery of these types of payment structure through the biomass tariff arrangements that are currently in place.

1.23. The tariff levels presented in this consultation are informed by our current cost and performance evidence base. However, there are areas where we still have uncertainty, for example, gate fees and certain capital costs. The options will be refined once consultation responses have been considered and our evidence base updated. Given the uncertainty around gate fees in particular, this consultation document sets out illustrative options for banding and tiering under two different scenarios:

- Scenario 1 assumes a gate fee of £41 per tonne;
- Scenario 2 assumes a gate fee of £25 per tonne.

1.24. Given uncertainty over gate fees, tariff options presented are considered under these two scenarios. These scenarios are based upon the current available evidence; with one based upon the median value of £41 per tonne in the WRAP (2013) survey and one based upon the lower end of the WRAP (2013) range at £25 per tonne.

1.25. More information on the method used to derive the options and the evidence base underpinning them is presented in the technical annex, at the end of this document.

Evidence Uncertainty

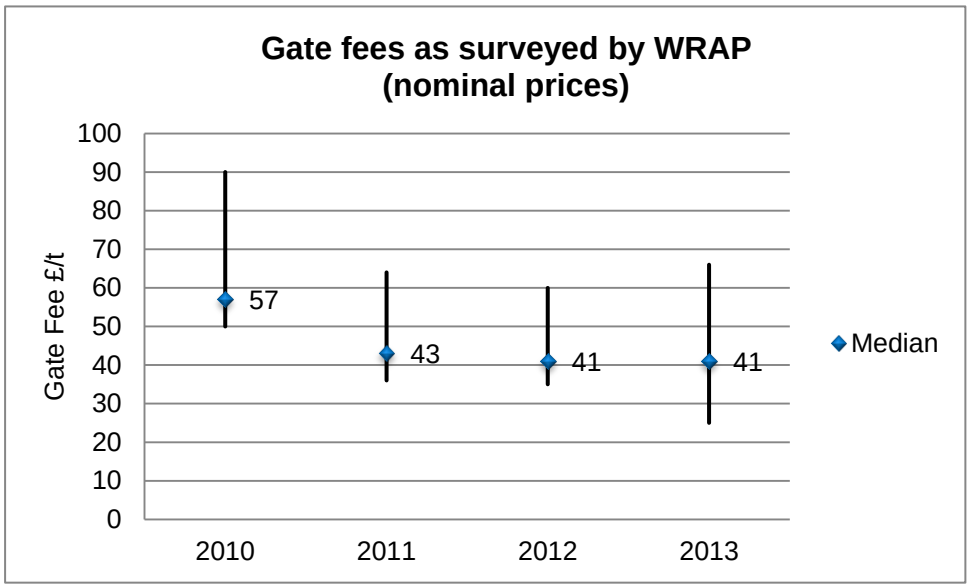
1.26. These tariff options rely upon the evidence detailed within the technical annex, which has been drawn from a process of desk research and dialogue with industry bodies, consultants, plant developers, equipment suppliers, gas grid operators and other government departments. The policy options and scenarios that we present have been created to illustrate how we could address the risk of overcompensation whilst continuing to stimulate sustainable growth in the market. We are aware that this evidence carries a certain amount of uncertainty, which is identified in the technical annex. Therefore we are seeking to address this through the consultation, to verify and structure our final approach.

1.27. In line with the policy to promote an increase in energy from waste, the current biomethane tariff is based upon the economics of waste feedstock plants. This accounts for the fact that waste biomethane to grid plants are able to earn a "gate fee" for receiving waste from those who want to dispose of it. Gate fees are a particular area of uncertainty, with evidence indicating a wide range of values.

1.28. Survey data on gate fees collected by the Waste Resources Action Programme (WRAP) in 2013[6] indicated median gate fees of £41 per tonne and a range of £25 - £66 per tonne. Variation in gate fees is driven by several factors, including the level of local competition for waste feedstock and the costs of landfill. In addition, we are aware that different types of waste collect different gate fees: for example, packaged food waste attracts a higher gate fee than unpackaged food waste.

1.29. Successive surveys by WRAP have indicated that the median gate fee values, as reported by Local Authorities have remained steady over the past 3 years. The 2013 report indicated that anaerobic digestion operators view gate fees as likely to 'fall slightly' over the coming years.

Chart 2 Gate fees as surveyed by WRAP (nominal prices)



1.30. The level of gate fees is a key assumption underpinning the level at which any revised tariff structure will be set. DECC's current view is to base the tariff upon the median value of £41 per tonne presented in the WRAP (2013) survey as this is the most recent, comprehensive, objective survey of gate fees that DECC is aware of. We acknowledge that this survey was conducted at the beginning of 2013 and are seeking views on whether that level remains appropriate.

[6] http://www.wrap.org.uk/content/wrap-gate-fees-report-2013

Consultation Questions	
1.	Is it appropriate to set tariffs for all plant on the basis of waste plant costs, which assume a 20 year revenue from current gate fees? Is it appropriate to assume gate fees at all scales of plant? If not, please provide reasons why.
2.	How are gate fees likely to change in future (if at all)? What are the factors driving any potential changes?

Tiering

1.31. Tiering operates by paying a higher tariff for the first designated amount of kilowatt hours of biomethane injected into the grid (the “tier 1” tariff), and a lower tariff for any subsequent biomethane injected (the “tier 2” tariff), over a period of 12 months. All installations would receive the higher tier 1 tariff payments for a set volume of biomethane injected into the grid, regardless of size of plant. This is a ‘2-tier’ tariff structure – tariff structures with higher numbers of tiers could be developed following the same approach.

1.32. Tiering provides for a gradual reduction in the average tariff earned as capacity increases – unlike banding where the average tariff falls in large steps. This reduces the likelihood of operators sizing plant for maximum financial benefit. Our analysis indicates that tiering can result in a relatively consistent rate of return across capacities.

1.33. Tiering is straightforward to understand and mirrors the approach taken elsewhere in the scheme; for example, we already have a form of tiering for other RHI technologies (biomass). Tiering would also mean there would be no need to determine system capacity or how additional capacity should be treated, which are both issues with a banding approach, covered elsewhere in this document. Ofgem already use meter readings of the amount of gas injected into the grid by the biomethane to grid plant, which have been submitted to them by the participant, so we expect it would be relatively straightforward to apply tiering to this measurement.

Tiering Scenarios

1.34. The following scenarios are illustrations of how tiering could work. Our evidence shows that, although tiering is a theoretically attractive option, the scenarios presented here have inherent drawbacks. Through refinement of our assumptions on the application of tiering, we will seek to find a proposal which avoids these drawbacks. Potential issues that we are seeking to address through consultation are:

- underlying assumptions (see annex);
- application of tiering e.g. tier break, number of tiers; and
- use of generic gate fees for waste plants.

1.35. Given the uncertainty, we have presented the tiering option under the two different gate fee scenarios. We have considered these scenarios on the basis that growth in anaerobic digestion will potentially increase competition for feedstocks, driving gate fees down in future from current levels. Conversely, an increase in landfill costs could cause gate fees to rise.

1.36. Scenario 1 has been set to provide a 12% IRR, for plant of different scale across the capacity range, under an assumption of £41 per tonne gate fees. Tier 1 would pay a tariff of 7.1p/kWh for the first 15,000 MWh of biomethane injected into the grid each year. This is the approximate output of a 2 MW plant[7]. After that, no tariff is paid for additional units of biomethane. Our analysis shows that, at this level of gate fee, the marginal revenue (gate fees plus the revenue from selling the gas - excluding RHI payments) exceeds the marginal costs (including incremental capital costs) for plants above 2 MW. This implies that no additional tariff would be required after the tier 1 threshold[8].

1.37. We recognise that one unintended consequence of this tariff scenario might be that installers limit the production of their biomethane installations to 15,000 MWh and opt either to use any surplus biogas for other purposes (and receive other subsidies for it); or they might simply size plants (approximately) to the Tier 1 capacity, in which case the RHI loses the benefits of economies of scale.

Table 2 Tiering option, with scenarios 1 and 2 at gate fees of £41/t and £25/t

	Scenario 1 at £41/t gate fee		Scenario 2 at £25/t gate fee	
	Tier 1	Tier 2	Tier 1	Tier 2
Biomethane Injected (per year)[a]	Up to 15,000 MWh	Above 15,000 MWh	Up to 15,000 MWh	Above 15,000 MWh
Tariff p/kWh on Biomethane Injected	7.1	0.0	9.9	2.1

[a] 15,000MWh per year is the approximate output of a 2MW biogas capacity plant

1.38. Table 2 also illustrates tiering under scenario 2 (£25 per tonne gate fees). Tier 1 pays a tariff of 9.9p/kWh for the first 15,000 MWh of biomethane injected into the grid each year and 2.1p/kWh on any additional biomethane injected. This scenario does provide support for biomethane production above 15,000 MWh, though we invite views on whether this is sufficient to incentivise deployment versus competing uses of biogas and whether a generic gate fee assumption for all scales of plants is appropriate.

[7] The tier break is set at 2MW to ensure that a plant of that size can get a 12% IRR. Given the strength of the current biomethane to grid project pipeline we do not see a compelling reason to offer a tariff higher than the current level of 7.5p/MWh. 2MW is the minimum capacity supported by the current tariff level under our updated evidence base.

[8] More detail on this is provided in the technical annex

Consultation Questions	
3.	What are your views on the tiering scenarios presented here, both in terms of the number and level of tiers and the tariff assigned?
4.	Would these scenarios be enough to drive growth?
5.	If the size of the tariff is wrong, are our underlying assumptions appropriate? Can you provide any additional evidence to support your assertions?

Banding

1.39. The following options and scenarios are illustrations of how banding could work. However, the options presented here also have inherent drawbacks. Through refinement of our assumptions on the application of banding, we will seek to find a proposal which avoids these drawbacks. Potential issues that we are seeking to address through consultation are:

- underlying assumptions (see annex);
- determining system capacity;
- avoiding gaming and deliberate resizing; and
- use of generic gate fees for waste plants.

1.40. Banding works by defining capacity bands for the technology and paying an appropriate tariff for each band. In this case, we would propose higher tariffs for the lower capacity bands and lower tariffs for higher capacity bands. Two approaches to banding are proposed in this consultation: banding option 1 and banding option 2.

Banding Option 1 (tariff curve)

1.41. Banding option 1 aims to follow the 12% waste plant tariff curve presented in Chart 1 as closely as possible. Plants up to 2 MW biogas capacity would receive the tariff that provides a 12% rate of return at 2 MW. Plants between 2 MW and 15 MW in capacity would receive a bespoke tariff specific to their capacity, as defined by the 12% tariff curve - e.g. if tariffs were set assuming a gate fee of £41 per tonne, a plant of 5 MW capacity would receive a tariff defined by the curve of 2.3p/kWh, whilst a plant of 10 MW capacity would receive a tariff defined by the curve of 0.8p/kWh. All plants above 15 MW in capacity would receive the same.

1.42. The advantage of this option is that it maintains a smoother rate of return over the capacity range and therefore mitigates incentives to re-size plant around band boundaries to maximise returns, which is a risk associated with our other options – banding option 2 in particular. It does however require further work to understand how feasible it would be to implement and any additional administrative costs this would introduce. This option would obviously also require an ability to accurately assess the capacity of each plant being registered under the scheme – see Determining System Capacity below.

Table 3 sets out the proposed tariffs under banding option 1, which reference to the tariff curves presented in Chart 1. This option is presented under two different gate fee scenarios.

Table 3 Banding option 1 (tariff curve)

Band	Capacity range (MW)	Scenario 1 - £41/t gate fee Suggested tariff (p/kWh)	Scenario 2 - £25/t gate fee Suggested tariff (p/kWh)
Band 1	>0-2	7.1	9.9
Band 2	>2-15	0.5 – 7.1p, as per £41/t gate fee tariff curve – Chart 1	3.1 – 9.9p, as per £25/t gate fee tariff curve – Chart 1
Band 3	>15	0.5	3.1

Banding Option 2 (4 bands)

1.43. The second approach to banding divides the capacity range into a number of capacity bands; for each band the tariff is set so that the mid-point capacity in the band is expected to generate a 12% IRR. Biomethane to grid plants would be registered as being within a particular capacity band and would earn that band's tariff on all units of biomethane injected into the grid.

1.44. Our analysis shows that this banding option runs a greater risk of operators deliberately sizing their installation around band thresholds to maximise returns, potentially at the expense of renewable heat deployment. This is because plant IRRs can vary significantly within bands, since the band tariff is only based upon the mid-point capacity.

1.45. Within banding option 2, we have analysed three, four and five band tariff structures, and have selected the four band approach as offering the best balance between reducing re-sizing incentives, and keeping the tariff structure as simple as possible. However, the incentives to resize plant in order to maximise returns remain strong under the 4 band option. Under a 4 band approach, we would propose the following bands, under the two gate fee scenarios:

Table 4 Banding option 2 (4 bands)

Band	Capacity range (MW)	Scenario 1 - £41/t gate fee Suggested tariff (p/kWh)	Scenario 2 - £25/t gate fee Suggested tariff (p/kWh)
Band 1	>0-3	7.1	9.9
Band 2	>3-6	2.7	5.4
Band 3	>6-9	1.2	3.9
Band 4	>9	0.5	3.1

1.46. More information on the method used to derive these bands is presented in the technical annex accompanying this consultation document.

1.47. As previously mentioned banding has been used elsewhere in the scheme to deal with scale issues and is familiar to the market. However, for both banding options presented, it does introduce complexity in terms of determining system capacity and dealing with increases in capacity after an installation has been registered in the RHI.

Consultation Questions	
6.	What are your views on the banding options presented and the associated tariffs? What are the relative advantages and disadvantages of banding options 1 and 2?
7.	Would these options be sufficient to drive growth?
8.	If the size of the tariff is wrong, are our underlying assumptions appropriate? Can you provide any additional evidence to support your assertions?

Summary

1.48. We have proposed to use either banding or tiering to adjust the biomethane tariff and link payments more closely to the costs relative to the size of biomethane installation. The scenarios we have presented under each option are illustrative proposals and they will be finalised once consultation responses have been considered and our evidence base has been updated.

1.49. The purpose of this consultation is to strengthen the evidence base that underpins these options and ensure that we introduce a tariff that is fair across the capacity range, delivers

value for money and incentivises efficient delivery of renewable heat through biomethane injection to the grid.

Consultation Questions	
9.	What is your general view on the relative merits of banding and tiering? Which mechanism is more effective at providing a fair tariff across the capacity range and addressing any potential overcompensation?
10.	Are there any unintended consequences of the banding / tiering options presented that we haven't considered?
11.	What tariff levels are required to maintain a comparable incentive for biomethane to grid compared to other uses of biogas?
12.	Should we be considering a combination of banding and tiering? Are there any other possible policy solutions that could meet the objectives of the review in another way?

Additional Issues

Determining System Capacity

1.50. To implement either of the banding options, it is necessary to determine the system capacity of the plant. The system capacity of biomethane plants is currently determined, for the purposes of degression and budget management, by the maximum flow rate specified in the Network Entry Agreement (NEA) the operator enters into with the gas network distributor (GND). This is defined in m^3/hr of biomethane multiplied by the number of hours in the year (8760) and then converted into kilowatt hours based on the pre-determined calorific value of the biomethane to be injected. The capacity is therefore determined by the maximum possible amount of biomethane that could be injected in a year.

1.51. We acknowledge that using the maximum flow rate on the NEA to determine system capacity is an overestimation of the actual capacity and that plant will inject less than the maximum flow rate specified in the NEA. In addition, the extent of overestimation in the NEA may vary geographically, as a result of capacity in the gas grid in that location. Therefore, we consider the maximum flow rate is not a suitable metric to determine plant capacity for the purposes of tariff setting under banding.

1.52. It is essential that a biomethane to grid plant's capacity is accurately measured ensuring payments are set at the right level. Whilst banding may introduce incentives to re-size, the method of determining system capacity should not exacerbate such incentives or introduce incentives to build plants in an inefficient way. It is also desirable that the chosen method does not impose disproportionate costs either for plant operators or for the scheme administrator Ofgem. The capacity should be a clear and definitive figure which is not open to gaming or manipulation.

1.53. In light of this, we have identified two ways in which we might determine system capacity to determine which tariff a plant should receive:

a) The maximum flow rate is adjusted to account for the load factor (or redundancy) of a biomethane plant. The load factor would need to be either: a notional load factor which is applied to the maximum flow rate of all plants; or a reasonable expectation for the specific plant which would need to be independently verified.

b) Determine system capacity based on the output of the biogas clean-up kit, which has been installed to meet plant demand.

Consultation Questions	
13.	What are your views on our proposals to determine system capacity? Which option best promotes accuracy of measurement, minimising costs for operators and the scheme administrator and avoiding unintended consequences? Are there any other alternative options to determine system capacity that are not presented here?
14.	If capacity was to be based on the Network Entry Agreement capacity, can you provide evidence of what an appropriate nominal load factor for all biomethane to grid plant should be?

Additional Capacity

1.54. If we introduce banding, we will also need to consider how to treat plant that increases capacity after registration to the scheme. The Renewable Heat Incentive Scheme (Amendment) Regulations 2014 require biomethane to grid plant owners to apply for any additional capacity (which is capacity over and above the maximum flow rate set out in the Network Entry Agreement) at the current tariff rate, rather than the tariff rate that was available when the applicant first registered for the RHI.

1.55. We consider that the issue of additional capacity falls out of the scope of a tariff review. Therefore if we did introduce banding, we propose that additional capacity would not be permitted and plants would only be able to receive an RHI tariff for injected biomethane which did not exceed the capacity of the plant registered. Once the tariff review had been undertaken we would consider revisiting the issue of additional capacity, if necessary, over a longer time frame.

Existing Assets

1.56. We are aware that planned biomethane to grid plants may use existing anaerobic digesters (existing assets) which are currently being used to either treat waste or to produce biogas for combined heat and power production. Such installations may be receiving a subsidy through the Renewables Obligation (RO) or through the Feed-in-Tariff (FiTs). Therefore, offering a full tariff to those that have existing assets and choose to install biomethane clean-up kit to access the RHI may represent a value for money risk for two reasons:

a) Plants with existing assets that have already been paid for will avoid the development and capital costs associated with having to install a digester. For example, sewage plants, which already treat waste with anaerobic digesters. However they would be compensated for the capital expenditure and costs associated with an anaerobic digester in the tariff.

b) Existing anaerobic digestion plants may have already been in receipt of the RO or FiTs before choosing to convert to biomethane injection. Although such plants would not be able to receive both RHI and RO/FiTs at the same time, for the same units of energy, such plants may receive a double subsidy because they will have already been compensated for some of the cost of their anaerobic digester.

1.57. We would like to use this consultation as an opportunity to seek views on this issue and gather evidence to assess the potential risk and inform potential policy options.

Consultation Questions	
15.	What are your views on the issue of existing assets and the interaction with RO and FiTs?
16.	The RO pays less for biogas from sewage plants. Should we apply the same principle here? If so, on what should we base the tariff?

Biogas Scrubbing and Fugitive Methane

1.58. There is an inevitable emission of methane from the biogas scrubbing process amounting to between 0.1% and 3% of the final injected methane - depending on the type of technology used[9]. As methane is a potent greenhouse gas[10], we are considering how we may address this in the future. Our intention is that we encourage use of the best available technology for the scrubbing process to avoid additional methane emissions, and invite views as to how this could be achieved in practice.

Consultation Questions	
17.	What are your views on this issue? What are your views on the most appropriate way to encourage use of the best available technology for the scrubbing process?

[9] For reference see:
(1) Bauer, F., Hulteberg, C., Persson, T., & Tamm D., (2013) Biogas upgrading – Review of commercial technologies. Available at: http://www.sgc.se/ckfinder/userfiles/files/SGC270.pdf
(2) Baltic Biogas Bus (2012) Methane losses in the biogas system. Available at http://www.balticbiogasbus.eu/web/Upload/Supply_of_biogas/Act_4_6/Annex/Methane%20losses.pdf
[10] IPCC Fifth Assessment Report (AR5). Available at: http://ipcc.ch/report/ar5/

Next Steps

1.59. This consultation will last for 4 weeks. During this time, the biomethane review team in DECC will be holding three consultation ‘surgery’ days, on 6 June, 12 June and 20 June 2014. On these dates, officials will be available to meet with any interested stakeholder that would like to discuss the proposals set out in this consultation. Please phone 0300 068 8014 or 0300 068 8069 if you would like to arrange a meeting with officials.

1.60. Following the consultation, our proposals will be finalised and a Government Response issued. Subject to consultation responses, we plan to lay the amended regulations as soon as possible after Parliament reconvenes in Autumn, 2014.

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Technical Annex

Introduction

3.1. This technical annex supports the consultation document for the biomethane tariff review. It sets out:

- the general approach undertaken by DECC in setting the original RHI biomethane tariff;
- the cost and performance evidence DECC has used to produce the illustrative policy options presented in the consultation;
- how the illustrative policy options proposed in the consultation have been derived; and
- further technical questions that DECC wants to answer through the consultation, in addition to those raised in the main consultation document.

3.2. Its purpose is to provide transparency over the policy options and support responders in addressing the questions asked in the consultation.

3.3. Note there are additional consultation questions to be addressed in this annex in addition to those raised in the consultation document.

Approach to Setting the Original RHI Biomethane Tariff

3.4. The current tariff was introduced at the launch of the RHI non-domestic scheme in 2011. The tariff was set to compensate a reference biomethane plant for capital and operating costs it would face - net of the revenue earned from selling the biomethane - and provide for a 12% internal rate of return (IRR)[11].

3.5. The reference plant used was a 1 MW (gross biogas capacity[12]) waste feedstock plant with cost and performance evidence taken from a 2011 report by SKM Enviros and CNG Services Ltd, commissioned by DECC[13]. The revenue earned from selling the biomethane was based upon the wholesale price of natural gas. To illustrate this approach, the original calculation of the existing biomethane tariff (in 2010 prices) is set out in Table 1.

3.6. In setting the policy options for this consultation, the same approach has been followed to establish potential tariffs for biomethane plants at different scales:

- tariffs have continued to be set based upon the economics of waste feedstock plants in line with the Government's policy of incentivising the reduction, re-use and recycling of waste resources. The consultation document asks for views on this approach;
- the original SKM Enviros and CNG cost and performance evidence base has been updated (by DECC) through desk research and information provided by the biomethane industry;
- the components of capital and operating costs have remained the same with the exception of development and civil works costs which have now been taken into account (these were not accounted for previously); and
- the updated evidence base has been used to derive "tariff curves" from which the proposed policy options for consultation are derived.

[11] An equivalent way of viewing this is that the tariff compensates for the difference in costs of supplying gas to the grid via a biomethane plant versus the costs of supplying the same amount of gas from natural gas. The latter cost is represented by the wholesale price of natural gas and is similarly subtracted from the costs associated with biomethane delivery under this view.

[12] Gross biogas refers to the biogas capacity before any biogas is recycled for the purposes of heating the anaerobic digester.

[13] https://www.gov.uk/government/publications/analysis-of-characteristics-and-growth-assumptions-regarding-ad-biogas-combustion-for-heat-electricity-and-transport

Table 1 – Calculation of the existing RHI biomethane to grid tariff - 2010 prices

1 MW Waste Feedstock Biomethane Plant	Annual Cost	Levelised Cost[5] - p/kWh
Capital Cost[1] – **A**	£674,490	9.6
Operating Cost[2] (excl. fuel) – **B**	£558,155	7.9
Feedstock Cost[3] – **C**	-£593,000	-8.4
Biomethane Revenue[4] – **D**	£159,870	2.3
Net Cost of Biomethane Plant **E = A+B+C-D**	£479,775	6.8
Tariff = **E** Adjusted for Quarterly Payment of RHI[6]		6.5

Notes

1. Total capital cost for a 1 MW waste biomethane plant estimated at £4.6m by SKM Enviros. This covers: waste treatment unit, digester, boiler, upgrader, injection and grid connection. Annuitised capital cost is the sum of the annuitised costs of each of these capital costs over their respective lifetimes using a discount rate of 12%.
2. Annual operating cost (excluding fuel) covers labour, propane, electricity, landfill costs (including taxes), insurance and digestate disposal costs.
3. Annual feedstock cost for a waste biomethane plant is the gate fee multiplied by the annual volume of waste used. This is a negative cost; the plant owner is paid a gate fee per tonne of waste received e.g. from a Local Authority.
4. Annual biomethane revenue is the revenue earned from the sale of the biomethane to the grid, based upon the wholesale cost of natural gas.
5. Levelised cost is derived by dividing total cost by the kWh of biomethane delivered to the grid. Under the SKM evidence base, a 1 MW gross capacity biogas plant was modelled to deliver an annual output of 7,049 MWh per year to the grid. The difference between this output and the 8,760 MWh per year (gross) output of biogas from the digester is accounted for by the parasitic load of the digester, upgrader load factor and methane slippage in the upgrader process.
6. The final tariff of 6.5p/kWh is an adjustment to the 6.8p/kWh to reflect the fact that RHI payments are made quarterly rather than annually. At a 12% discount rate the present value ratio of quarterly to yearly subsidies is 96%.

Overview of Evidence Underpinning Tariff Options

3.7. There are two main reasons for updating the evidence base underpinning the tariff.

3.8. First, the industry is still at a relatively early stage in the UK and it would be expected that costs have changed since the SKM Enviros / CNG research was conducted.

3.9. Second, that research only considered plants up to a scale of 5 MW (gross biogas) whilst market intelligence on forthcoming projects indicates biomethane plants can attain larger scales, some significantly so. To assess the risk of overcompensation it is necessary to consider how costs vary over a larger capacity range. In particular it is important for DECC to understand:

- how far economies of scale extend when increasing plant size as this appears to be driving the overcompensation risk; and
- how appropriate a tariff based upon the economics of waste feedstock biomethane plants is for driving growth in the biomethane to grid industry at different scales.

3.10. The purpose of this section is to set out the updated evidence base and assumptions that have been used within the tariff-setting framework. The update has been undertaken solely by DECC and has involved a process of desk research and dialogue with industry bodies, consultants, plant developers, equipment suppliers, gas grid operators and other government departments.

3.11. Evidence is presented below for each of the capital cost components, operating cost components and fuel costs. To avoid disclosing information provided in confidence, only average data values and "fitted curves" are displayed where information is not in the public domain. Costs have been adjusted to December 2013 prices using the Retail Price Index (RPI), commensurate with the existing tariff level of 7.5p/kWh[14].

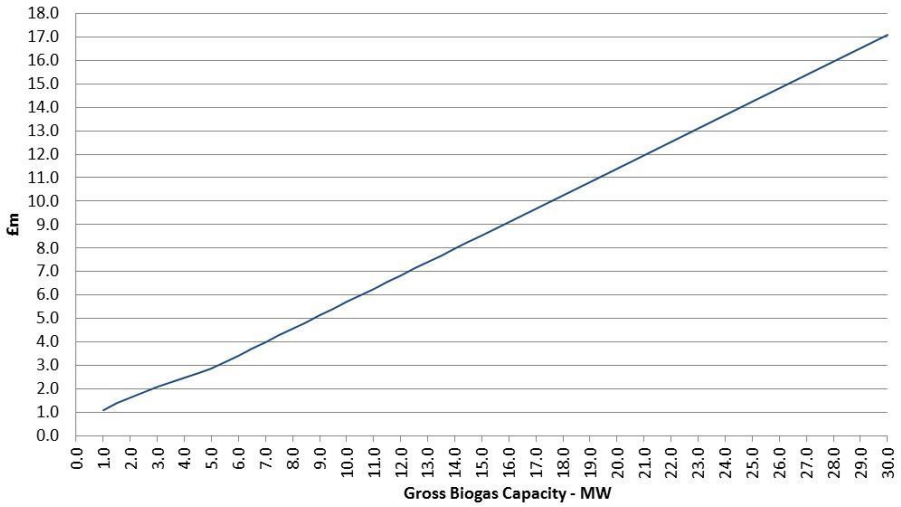
Capital Costs

Waste Treatment Unit

3.12. The biomethane tariff compensates for the cost of equipment needed to treat the waste feedstock prior to the anaerobic digestion process. The evidence update elicited no new data points for this equipment. As such we use the original SKM / CNG capital cost curve (adjusted for inflation) for waste plant scales up to 5 MW. This assumed that unit costs decrease as scale increases i.e. economies of scale. In the absence of data beyond that capacity we assume that per unit costs increase proportionately with scale, rather than assuming economies of scale continue. **However, this is an area where we would welcome more evidence at higher capacities to understand if economies of scale persist beyond a 5 MW plant capacity.**

[14] The 7.5p/kWh is equivalent to the 6.5p/kWh shown in Table 1 after annual RPI upratings have been applied.

Chart 1 - Capital cost of waste plant feedstock pre-treatment unit



Note: Unit costs are assumed to decrease up until 5 MW. Above this point unit costs are assumed to remain constant.

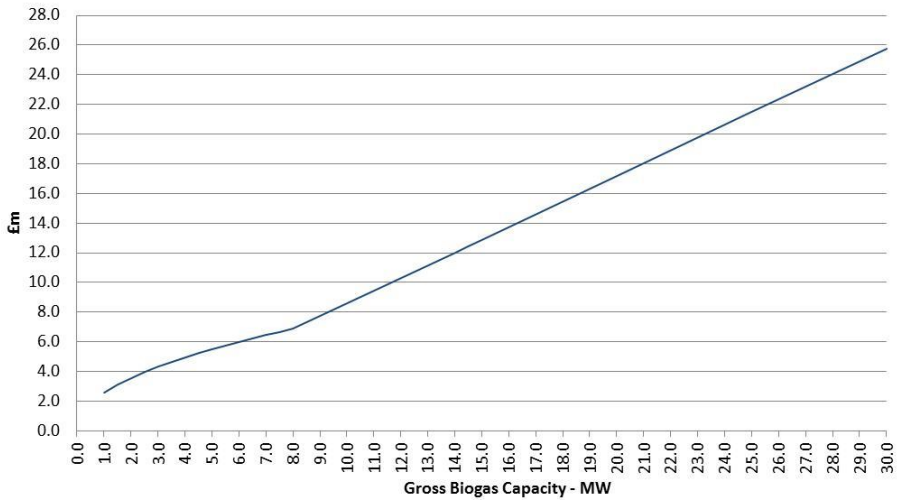
Digester

3.13. DECC has sourced several estimates of anaerobic digester capital costs based upon anaerobic digestion (AD) plants in situ. These were added to the original SKM/CNG estimates and this consolidated data set indicated economies of scale over this range (1-8 MW). As such (separate) curves were fitted over this range for waste and biocrop plant digesters.

3.14. Above this range (1-8 MW), proportionately increasing costs were assumed reflecting DECC's best view in the absence of cost estimates at higher capacities. There are plausible reasons why digester costs would increase proportionately after a certain point since developers might choose to build multiple smaller digesters[15]. **However, the capacity at which this typically occurs is uncertain (to DECC) and we would welcome additional estimates of digester capital costs for larger scale plants and views as to whether economies of scale continue beyond the point assumed here.**

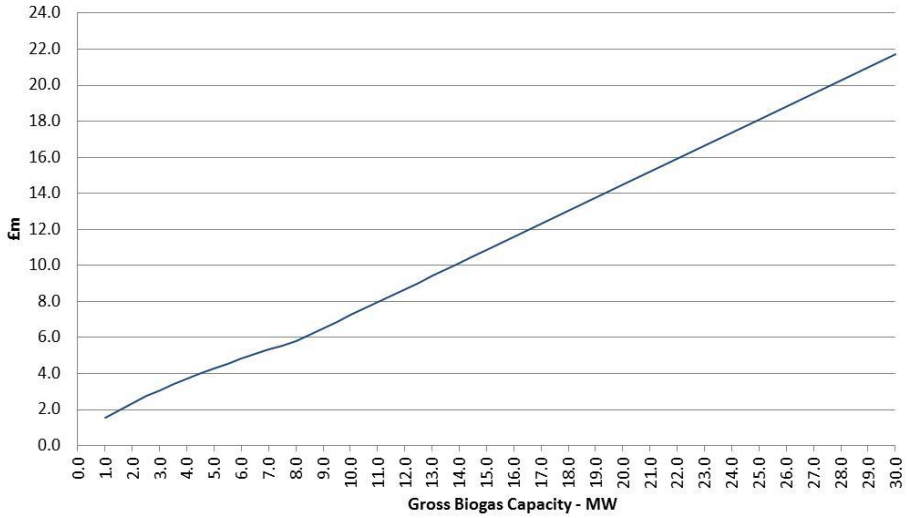
[15] These include the limit on how large digesters can practically be built and also the need to minimise the risk of equipment redundancy on plant output.

Chart 2 - Capital cost of waste plant digester



Note: Unit costs are assumed to decrease up until 8 MW. Above this point unit costs are assumed to remain constant.

Chart 3 - Capital cost of biocrop plant digester

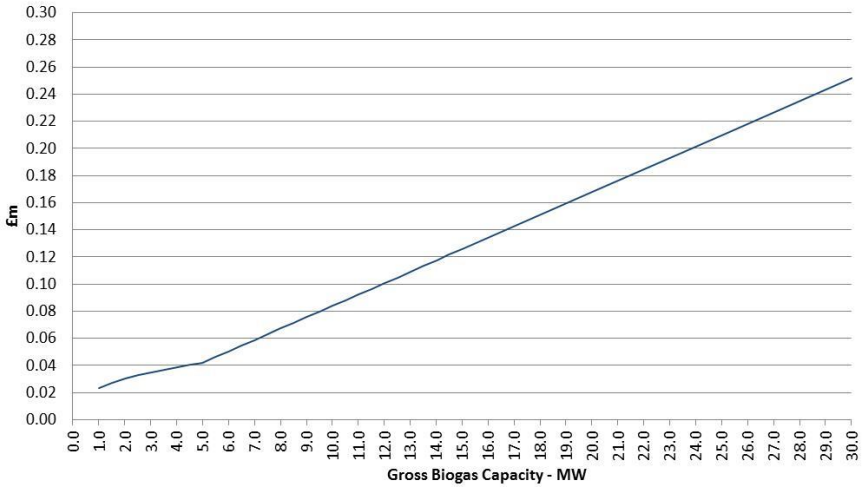


Note: Unit costs are assumed to decrease up until 8 MW. Above this point unit costs are assumed to remain constant.

Boiler

3.15. DECC has not sourced additional estimates for the cost of the boiler used to provide heat to the digester. Again, the assumption used has been based upon the SKM data for plants up to 5 MW capacity and assuming costs increase proportionately beyond that point.

Chart 4 - Capital cost of boiler

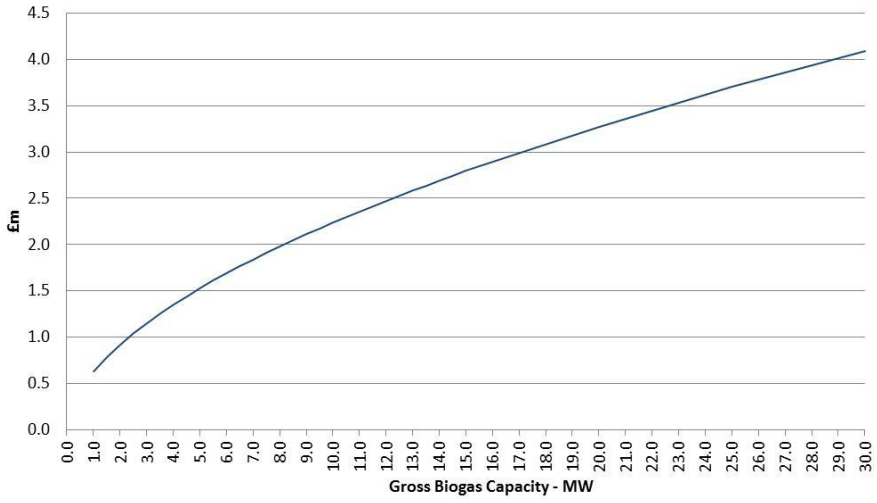


Note: Unit costs are assumed to decrease up until 5 MW. Above this point unit costs are assumed to remain constant.

Biogas Upgrader

3.16. DECC has sourced good evidence on biogas upgrader equipment costs across the entire capacity range from multiple sources: equipment suppliers, plant developers and the comprehensive report by the Swedish Gas Technology Centre[16]. These estimates span the breadth of technologies used for biogas upgrading (membrane, water wash, amine, pressure swing absorption and physical scrubbing). The estimates suggested economies of scale persist over the entire capacity range and a curve was fitted for the entire capacity range under consideration.

Chart 5 - Capital cost of upgrader



[16] Swedish Gas Technology Centre: Biogas Upgrading Technologies – Review of Commercial Technologies SGC Rapport 2013:270 http://www.sgc.se/en/?pg=1445651

Injection, Metering, Odorisation, Grid ROV and Telemetry

3.17. DECC sourced cost estimates from developers and equipment suppliers for the equipment needed to add propane and odour to the biomethane, measure the flow of gas into the grid and the Remote Operated Valve (ROV) and telemetry equipment required by the grid operator. We were advised that the costs of this equipment are broadly fixed for plants of any scale. As such we have assumed a fixed cost of approximately £0.85m for this equipment apportioned as: £0.1m for propane storage and injection, £0.45m for metering and odorisation and £0.3m for grid ROV and telemetry equipment.

Grid Connection

3.18. Cost estimates were sought for the costs of grid connection pipe infrastructure. These costs will depend upon a number of factors such as distance of the plant site to the grid and the grid pressure requirements. The average of the estimates obtained was approximately £0.25m and this has been applied to plants of all capacities.

Development & Civil Works

3.19. Development and civil works costs were not included in the derivation of the original biomethane tariff and these have now been added. The average of the quotes sourced for plant development costs was approximately £1.3m and the average for civil works £0.9m. We did not obtain a sufficient number of quotes to be able to infer any variability in these costs over the capacity range, though it is conceivable that these costs would increase with larger or more complicated projects. **Whilst we have assumed these costs are fixed over the capacity range we would welcome additional evidence to inform this relationship.**

Capital Equipment Lifetimes

3.20. For the purposes of annuitising the capital costs set out above we have used the capital equipment lifetimes provided by SKM/CNG's original review of the evidence. These are set out in Table 2. Development and civil works costs have each been annuitised based upon the cost weighted average lifetime of these components at each capacity. This gives a lifetime of ~17 years for annuitising the development and civil works costs.

Table 2 – Capital equipment lifetime assumptions

Capital Equipment	Lifetime Assumption (Years)
Waste Pre-Treatment Unit	10
Digester	20
Boiler	10
Upgrader	15
Injection	15
Gas Grid Connection	25

Operating Costs (Excluding Fuel Costs)

3.21. The operating costs included in the tariff include capital equipment maintenance costs, propane costs, electricity costs, landfill costs (for unusable feedstock), the costs of disposing of the digestate produced in anaerobic digestion and labour costs. The magnitude of these costs depends upon annual biomethane output or feedstock input. This input/output relationship has been modelled for different sizes of biomethane plant. Here we present the key assumptions that drive each of these operating costs in conjunction with the volume of feedstock used and biomethane produced.

Maintenance Costs

3.22. These are taken from SKM/CNG's evidence base with the exception of the upgrader maintenance costs which are based upon an average of the maintenance cost percentages given for upgrading technologies in the Swedish Gas Technology Centre (2013) report. Annual maintenance costs are expressed as a percentage of the equipment's capital cost.

Table 3 – Capital equipment maintenance cost assumptions (averages over capacity range)

Capital Equipment	Maintenance Cost Per Year - % of Capital Cost
Waste Pre-Treatment Unit	4.3%
Digester	1.6%
Boiler	6.5%
Upgrader	2.9%
Injection	4.7%
Gas Grid Connection	1.1%

Propane Cost

3.23. The propane cost was based upon a number of quotes provided in confidence which suggested a current cost of approximately £60 per MWh.

Electricity Costs

3.24. The electricity price has been based upon DECC's retail electricity price projection (for the services sector) published under the Updated Energy and Emissions Projections (2013)[17]. The figure used is £136/MWh based upon the average real price between 2014 and 2030.

Landfill Costs

3.25. The tariff calculations compensate for the costs of disposing of rejected waste feedstock. It is assumed that approximately 10% of the feedstock (by weight) cannot be used in the digestion process. The analysis assumes waste biomethane plants pay a landfill gate fee of £25 per tonne[18] of rejected feedstock plus landfill tax at the current level of £80 per tonne.

Digestate Disposal Costs

3.26. Biomethane plants face the cost of disposing of the digestate produced in the anaerobic digestion process. Digestate can be used as a fertiliser so a common means of disposal is to spread it on crop fields. The costs incurred will include those of transporting and

[17] See Annex F: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013. Services sector figures used on the basis that annual power consumption for biomethane plants over the range considered are more aligned with this sector than the industrial sector.

[18] http://www.wrap.org.uk/content/wrap-gate-fees-report-2013

spreading the digestate though these can be offset to an extent by the replacement value of the fertiliser.

3.27. For waste biomethane plants we assume a disposal cost of £4.6 per tonne of digestate. This is based upon an average of estimated low and high disposal costs using cost data from WRAP's Digestate Distribution Models (2013) report[19].

3.28. For biocrop plants we assume a zero cost of disposal i.e. the plants are able to dispose of the digestate at the farms providing the feedstock at negligible cost.

Labour Costs

3.29. Labour costs increase with the plant size as more full time employees (FTE) are required. The assumption used is that each FTE costs approximately £31,000 per year which is based upon the £30,000 per year figure assumed in the SKM/CNG report adjusted for wage inflation[20].

Insurance

3.30. Insurance costs are assumed to be 1% of capital costs as per the SKM/CNG report.

Fuel Costs - Gate Fees

3.31. AD plants using waste as a feedstock typically secure feedstock supplies from local authorities. Historically they have received a fee for taking the waste referred to as a 'gate fee'.

3.32. The Waste Resources Action Programme (WRAP) conducts annual surveys of gate fees for waste used in AD plants. Successive surveys by WRAP have indicated that the median gate fee value has remained steady over the past 3 years with the last survey (conducted over December 2012 - February 2013[21]) revealing a median gate fee of £41 per tonne and a range of £25 - £66 per tonne. This wide geographical variation in gate fees reflects a number of factors including the level of local competition for waste feedstock, local landfill costs and the specific risk-sharing arrangements in waste contracts between Local Authorities and AD plants. The tariff options presented in this consultation are based upon the economics of waste plants receiving gate fees over their full lifetime; we have asked questions in this consultation to seek views on this general approach and the appropriate extent to which gate fees should be recognised in plant economics and at what level.

3.33. Given the uncertainty over gate fees, tariff options presented are considered under two scenarios based upon the WRAP 2013 survey:

- scenario 1 assumes a gate fee of £41 per tonne

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[19] http://www.wrap.org.uk/sites/files/wrap/Digestate%20distribution%20models%20report.pdf (p.21) For the "Low" disposal cost estimate we use the low transport cost of £3/t plus low spreading cost of £2/t minus the sale of digestate (Fertiliser Replacement Value) at £4.3/t giving £0.7/t. For the "High" disposal cost estimate we use the high transport cost of £4/t and the high spreading cost of £4.5/t and assume no revenue from digestate sale i.e. £8.5/t. The "central" view of £4.6/t is an average of these low and high estimates.

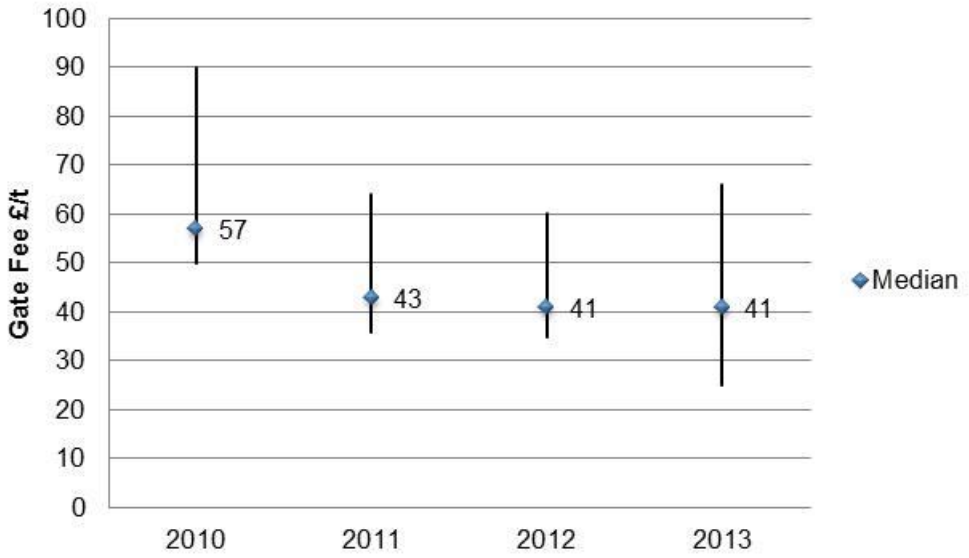
[20] This is based upon Office of National Statistics wage index figures for average weekly earnings in the Electricity, Gas and Water Supply sector. http://www.ons.gov.uk/ons/rel/lms/labour-market-statistics/april-2014/dataset--earnings.html

[21] http://www.wrap.org.uk/content/wrap-gate-fees-report-2013

- Scenario 2 assumes a gate fee of £25 per tonne

3.34. We recognise the potential for gate fees to vary over time as demand for waste from the AD industry and the costs of alternative disposal arrangements such as landfill change. WRAP's 2013 report itself indicated the view of AD operators that gate fees are likely to 'fall slightly' over the coming years and DECC has received views from industry indicating that fees have fallen since WRAP's 2013 report (hence the scenarios chosen). We aim to review our evidence on gate fees as a result of WRAP's forthcoming 2014 report and responses received in the consultation.

Chart 6 – Gate fees as surveyed by WRAP (nominal prices)



Fuel Costs – Biocrop Prices

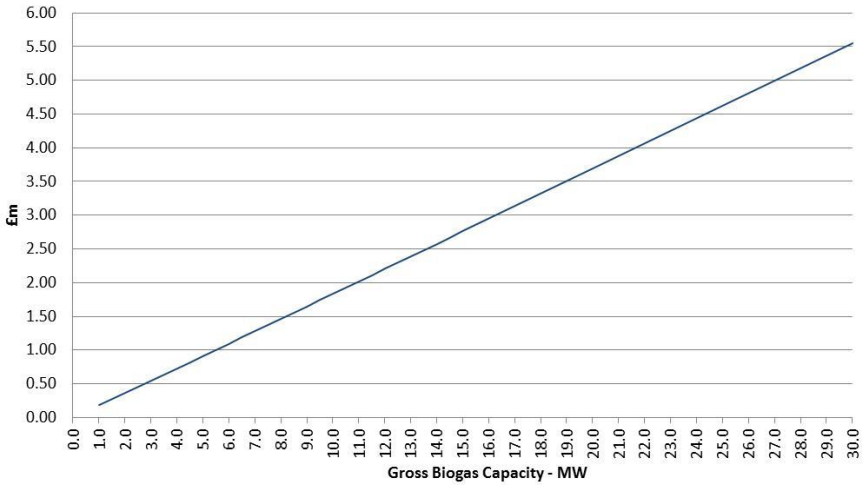
3.35. Biocrop biomethane plants use purpose grown energy crops such as maize as feedstock for AD. Agricultural prices are variable in nature given fluctuations in supply; an informal estimate is that biocrop prices can vary from £20-£50 per tonne. For the analysis of the tariff required by biocrop plants (used for illustration only), we have used an assumption of £35 per tonne which has been corroborated by industry as reflecting current prices.

Biomethane Revenue

3.36. The tariff is calculated on the basis of biomethane cost net of the revenue earned from selling the biomethane on the wholesale gas market. DECC publishes annual projections of wholesale gas prices[22] and we use the average projection for 2014 to 2030 of £24.8/MWh as our assumption. The revenue for the capacity range (based upon the estimated biomethane output at each capacity) is shown in Chart 7.

[22] See Annex F: https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013

Chart 7 – Annual revenue from sale of biomethane to grid

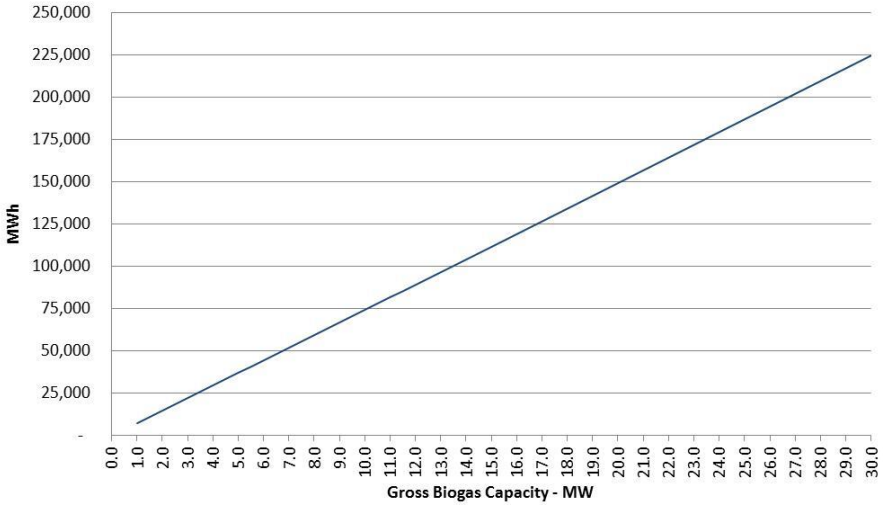


Performance Assumptions

3.37. To calculate feedstock requirements, operating costs and the overall levelised cost of biomethane plants, an assessment of biomethane output is needed. For the digesters we assume a 100% load factor and approximately 10% of the biogas output is required for the parasitic load i.e. to heat the digester. For the upgrader we assume a 95% load factor and 98% methane capture[23.] This gives an overall 'efficiency' ratio for plant of about 84% i.e. a 10 MW gross biogas capacity plant will produce approximately 8.4 MWh of biomethane per hour (on average throughout the year). Chart 8 shows the plant outputs at different scales used for the modelling.

[23] Upgrader characteristics are based upon data given in the Swedish Gas Technology Council (2013) report. The range of load factors given across all technologies is 95%-98%. We have chosen 95% here on the basis that this is representative of amine and water wash technologies which are those typically used for larger scale plants.

Chart 8 – Annual biomethane output



3.38. The Table below sets out questions on our evidence base that we invite responses to. Please provide additional evidence / data to support your views where possible, indicating where information is provided in commercial confidence.

3.39. To assist with this process we have also set out at the end of this annex a summary data set of key costs and revenues assumed at each plant capacity in deriving the tariff options presented (see Table 7). This is replicated in a separate Excel file, published alongside this document, which can be used to provide comments as well.

Technical Annex Consultation Questions	
18.	What are your views on the evidence base presented in the Technical Annex? Where could evidence be improved? Note: we have highlighted some areas above in bold text to indicate where we particularly need further evidence but we are interested in your views on all the cost and performance metrics presented
19.	In your view, how do individual capital costs change over the capacity range? How far do economies of scale persist along the capacity range for each?
20.	Are the assumptions underpinning operating costs reasonable? Note: views on gate fees are covered by questions in the main consultation document.
21.	The tariff calculation methodology assumes operating costs and revenues are incurred over the full lifetime of projects. To what extent is this assumed in investment appraisals of biomethane projects i.e. which costs and revenues are assumed to be 'bankable', at what level and over what period?
22.	In your view, how much potential is there for cost reductions or performance improvements in the components of biomethane plants? Please indicate any numerical estimates you have of either and the timescale over which you expect them to occur.

Tariff Curves Implied By Updated Evidence

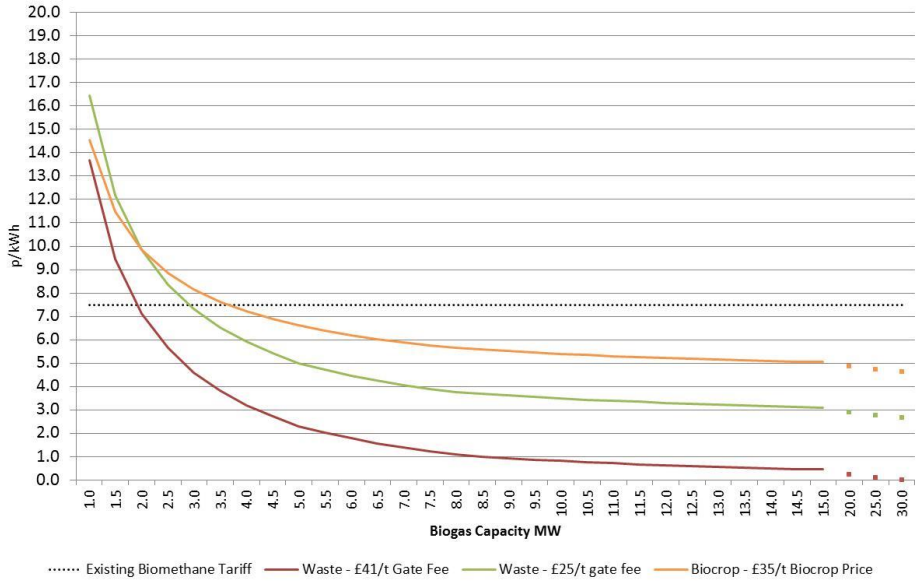
3.40. Using the updated evidence base in conjunction with the tariff setting approach described above, DECC has derived the required tariff to provide a 12% IRR for waste and biocrop plants at different scales (chart 9)[24].

3.41. This suggests the existing tariff is sufficient to compensate waste plants of around 2-3 MW (depending upon the gate fee assumed) and biocrop plants of 3-4 MW - but overcompensates larger scale plants that benefit from gate fees and/or are in line with our central cost estimates.

3.42. It also illustrates the tariff required to provide a 12% IRR is sensitive to the level of gate fees assumed. This is the reason why we are consulting on the appropriate level and degree to which gate fees should be factored in when setting the biomethane tariff.

[24] The tariff curve for biocrop plants follows the same methodology as for waste plants but assumes biocrop digester costs and does not compensate for the cost of a waste treatment unit. There are also differences in operating costs such as landfill and digestate disposal costs.

Chart 9 – RHI tariff required to provide a 12% IRR



Policy Options

3.43. The consultation proposes two tariff structures for addressing the risk of overcompensation – banding and tiering. This section sets out how the policy options have been derived. Each option aims to align the tariff structure with the waste plant tariff curves presented in Chart 9 above. Both options have been examined under alternative assumptions for the level of gate fees given the uncertainty around this input to the tariff calculation.

Banding

3.44. Banding works by defining capacity bands for the technology and paying an appropriate tariff for each band. Biomethane plants would be registered as being within a particular capacity band and would earn that band's tariff on all units of biomethane injected into the grid. We have produced two banding options which use different approaches to set the tariffs in each band. We are seeking views through the consultation as to whether the capacities used to define the band limits are the appropriate ones.

Banding Option 1

3.45. This banding option aims to follow the 12% waste plant tariff curve presented in Chart 9 as closely as possible.

3.46. The first band covers plants up to 2 MW biogas capacity - these plants would receive the tariff that provides a 12% rate of return at 2 MW[25].

3.47. The second band covers plants greater than 2 MW capacity and up to 15 MW. These plants would receive the tariff specific to their capacity as defined by the 12% tariff curve

[25] Given the strength of the current biomethane to grid project pipeline we do not see a compelling reason to offer a tariff higher than the current level of 7.5p/MWh. 2MW is the minimum capacity supported by the current tariff level under our updated evidence base.

e.g. if tariffs were set assuming a gate fee of £41 per tonne, a plant of 5 MW capacity would receive a tariff defined by the curve of 2.3p/kWh, whilst a plant of 10 MW capacity would receive a tariff defined by the curve of 0.8p/kWh.

3.48. Above 15 MW we would maintain the same tariff for all plants – at the same tariff required to provide a 15 MW plant with a 12% rate of return.

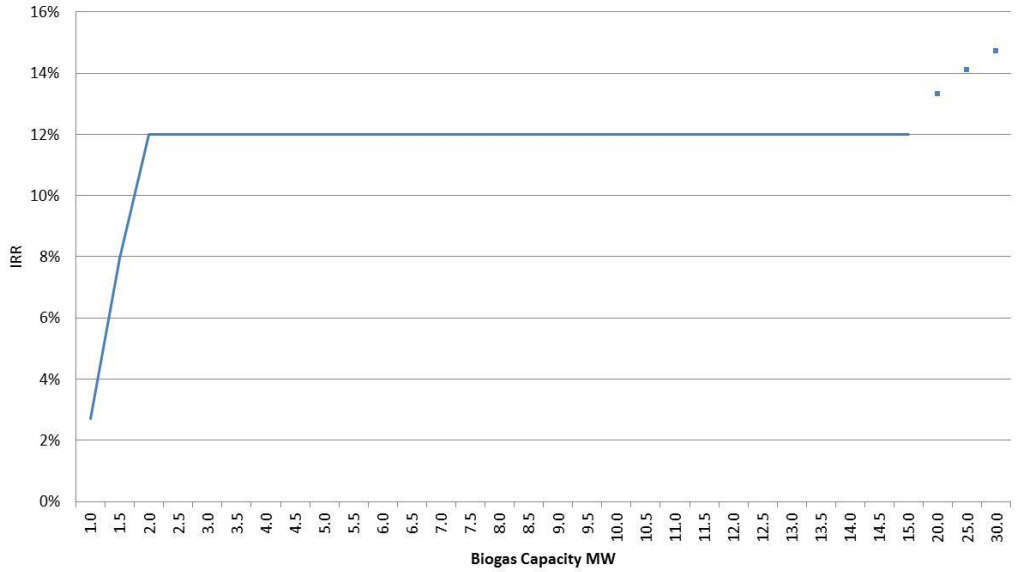
3.49. Table4 sets out the proposed tariffs under each of the gate fee scenarios using this approach with reference to the tariff curves presented in Chart 9; the higher tariffs under scenario 2 are required to compensate biomethane plants for the lower gate fees received.

Table 4 - Banding option 1 (tariff curve)

Band	Capacity range (MW)	Scenario 1 at £41/t gate fee Suggested tariff (p/kWh)	Scenario 2 at £25/t gate fee Suggested tariff (p/kWh)
Band 1	>0-2	7.1	9.9
Band 2	>2-15	0.5 – 7.1p, as per £41/t gate fee tariff curve – Chart 9	3.1 – 9.9p, as per £25/t gate fee tariff curve – Chart 9
Band 3	>15	0.5	3.1

3.50. By definition, adopting this approach maintains a 12% IRR over much of the capacity range as illustrated in Chart 10. The advantage of this is that it avoids significant variations in rates of return over most of the capacity range, which reduces the incentive for plant developers to re-size plants to maximise returns. Re-sizing incentives present a risk to the efficient delivery of renewable energy if they encourage smaller plants that operate at higher cost per kWh.

Chart 10 - Banding option 1 (tariff curve) – IRR by plant capacity[26]



Banding Option 2

3.51. Under this option we have divided the capacity range into bands and set the tariff for each band so that the mid-point capacity in the band generates a 12% IRR. All plants registered within a band would earn that band's tariff on all units of biomethane injected into the grid.

3.52. Table 5 sets out a 4 band banding option under each of the gate fee scenarios using this approach; the higher tariffs under scenario 2 at the gate fee of £25/t are required to compensate biomethane plants for the lower gate fees received.

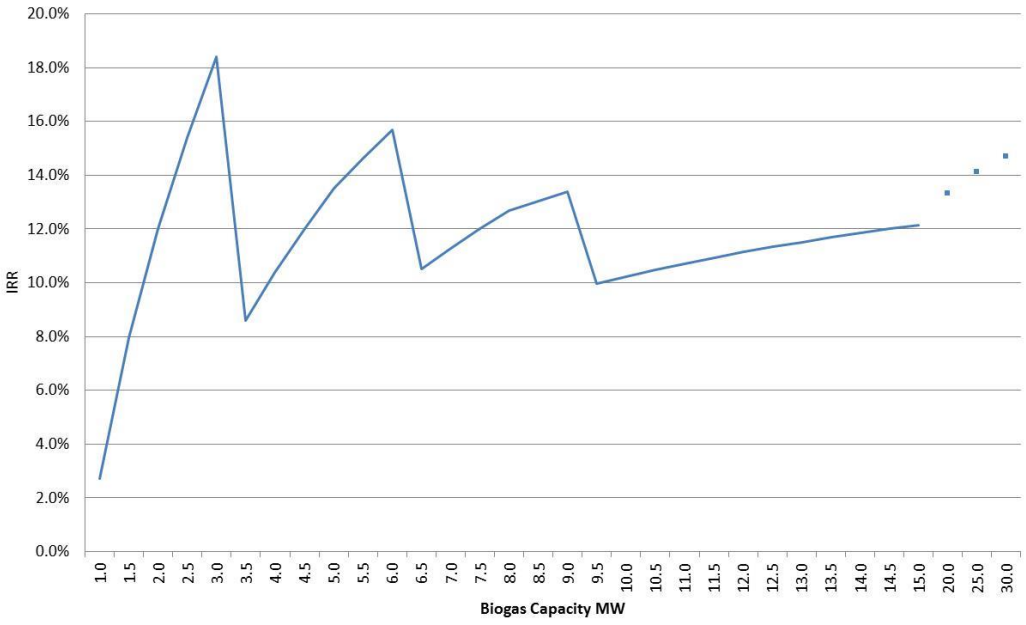
[26] The IRR chart is the same under both gate fee scenarios as the tariff is adjusted to provide a 12% rate of return at the same points. In practice, plants will of course receive different gate fees according to location.

Table 5 Banding option 2 (4 bands)

Band	Capacity range (MW)	Scenario 1 at £41/t gate fee Suggested tariff (p/kWh)	Scenario 2 at £25/t gate fee Suggested tariff (p/kWh)
Band 1	>0-3	7.1	9.9
Band 2	>3-6	2.7	5.4
Band 3	>6-9	1.2	3.9
Band 4	>9	0.5	3.1

3.53. Chart 11 indicates how the IRR changes over the capacity range for the 4 band option. Rates of return remain around 12% over the capacity range but there is significant variation in the IRR within bands with IRRs peaking around the band thresholds. The peak IRRs also differ across the set of bands.

Chart 11 – Banding option 2 – IRR by plant capacity[27]



[27] The IRR chart is the same under both gate fee scenarios as the tariff is adjusted to provide a 12% rate of return at the same points. In practice, plants will of course receive different gate fees according to location.

3.54. Given the differentials in IRRs within the bands and across the bands this means there would be very strong incentives to size plants in order to maximise rates of return. Although there are other constraints upon plant size such as feedstock availability and grid capacity we would expect this variation to exert a strong effect on sizing decisions. The banding option presented here could incentivise smaller plants which, given economies of scale in costs would be an inefficient outcome for the delivery of biomethane to grid[28].

3.55. Clustering effects under this option could be mitigated by increasing the number of bands. However, we have examined banding structures with more than 4 bands using the mid-point approach but discounted them on the grounds that they do not sufficiently reduce the incentives to re-size (without adding a significant number of bands).

Tiering

3.56. Tiering works by paying a higher tariff for the first designated amount of biomethane injected into the grid (the "tier 1" tariff), and successively lower tariff(s) for further increments of biomethane injected. I.e. the next designated amount of biomethane injected earns the "tier 2" tariff, the increment after that the "tier 3" tariff and so on. We propose setting the tiers in terms of annual biomethane output.

3.57. Tiering provides for a gradual reduction in the average tariff earned as capacity increases, unlike banding where the average tariff falls in large steps at the band capacity thresholds. This provides for less variation in the IRR as plant capacity changes which helps mitigate re-sizing incentives although there may be other re-sizing incentives under tiering, as described below.

3.58. The illustrative tiering option presented in the consultation document has a two tier structure. In setting the output and tariff associated with each tier the general approach has been to target a 12% IRR at each of the capacity mid-points associated with banding option 2 above.

3.59. That is, the tier 1 tariff has been set to provide a 12% IRR to the typical output of a 2 MW plant (the mid-point capacity of band 1). The tier 2 tariff is then set to ensure a 4.5 MW plant (the mid-point of band 2) would earn a 12% IRR based upon its total RHI revenue earned over tiers 1 and 2. We then checked to see if further tiers are required to ensure a 12% IRR at the mid-points of the third band and then if so, the fourth band (7.5 MW and 14.5 MW respectively).

3.60. In applying this approach we have found that the reference mid-point capacity plant for some bands has not required additional revenue over and above that provided under the previous tier in order to meet the 12% IRR target; this is has resulted in the two tier structure presented.

3.61. As with banding we have assessed what the tiering option would look like under different gate fee assumptions. Table 6 presents the tiered tariff under each of the gate fee scenarios.

[28] The variability in peak IRRs over the whole capacity range could be reduced to an extent through different sized capacity bands given the shape of the cost curve. However, this would not mitigate the incentive to size around the capacity bands.

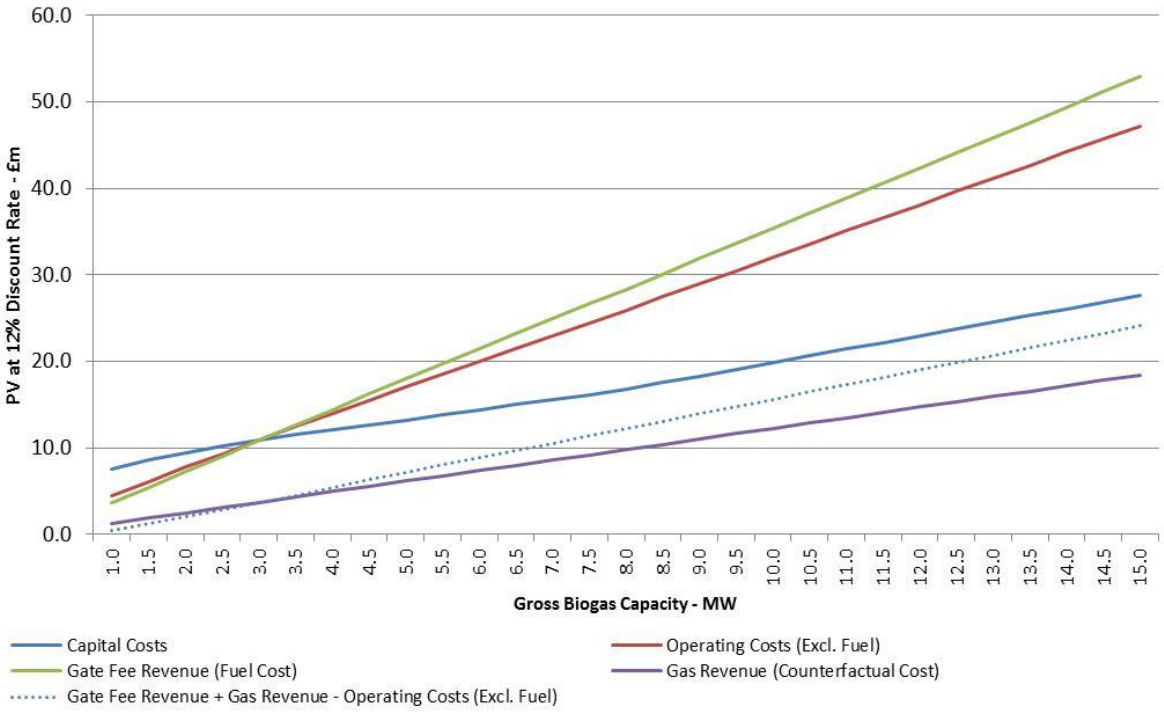
Table 6 Tiering option, with scenarios 1 and 2 at gate fees of £41/t and £25/t

	Scenario 1 at £41/t gate fee		Scenario 2 at £25/t gate fee	
	Tier 1	Tier 2	Tier 1	Tier 2
Biomethane Injected (per year)[a]	Up to 15,000 MWh	Above 15,000 MWh	Up to 15,000 MWh	Above 15,000 MWh
Tariff p/kWh on Biomethane Injected	7.1	0.0	9.9	2.1

[a] 15,000MWh per year is the approximate output of a 2MW biogas capacity plant

3.62. Tier 1 pays a tariff of 7.1p/kWh for the first 15,000 MWh of biomethane injected into the grid each year. After that no tariff is paid for additional units of biomethane. This result is a product of plant economics at this level of gate fee. Beyond 2 MW capacity, the marginal revenue (gate fees plus the revenue from selling the gas - excluding RHI payments) exceeds the marginal costs (including incremental capital costs) as capacity increases – Chart 12. This means that no further RHI payment is required beyond the Tier 1 tariff to ensure an IRR of 12% is maintained and in fact IRRs are closer to 14% (chart 13).

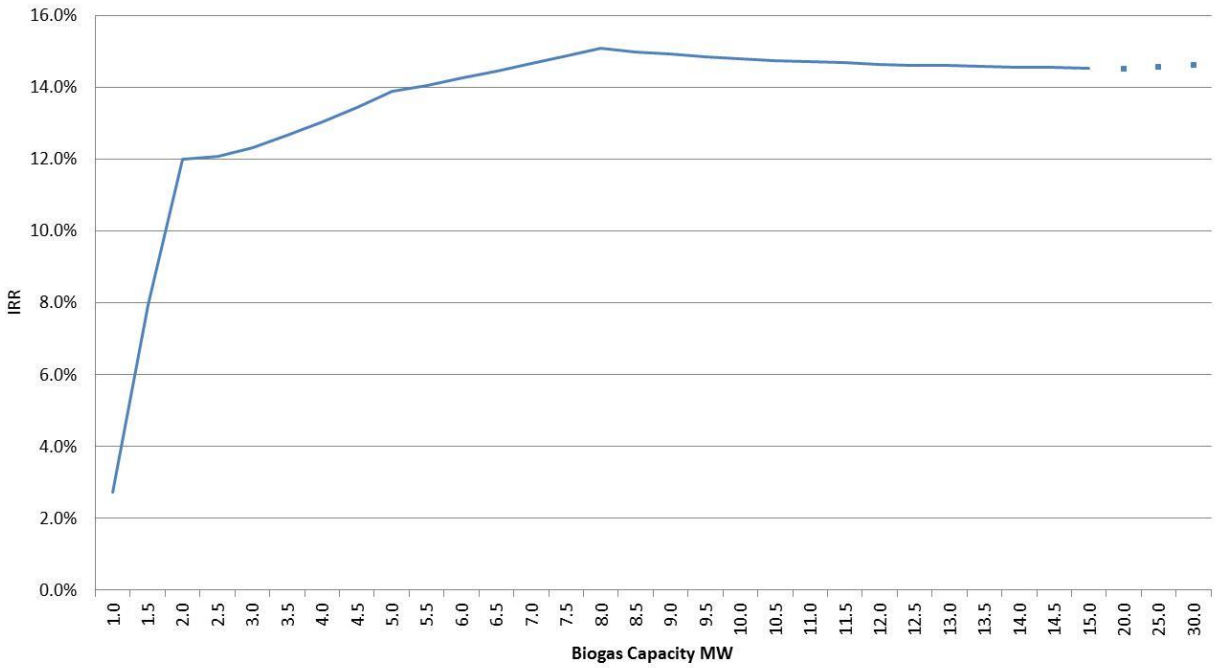
Chart 12 – Present value cashflow line items: £41/t gate fee



3.63. As Chart 13 illustrates, the advantage of tiering over banding option 2 is to significantly reduce the variation in IRRs across the capacity range, reducing incentives to "re-size" plant in that respect.

3.64. However, a clear implication of the tiering structure under this gate fee scenario is that biomethane plant developers would not be incentivised to inject biomethane above the tier 1 output given alternative uses for the biogas (e.g. electricity) and associated Government support. This would reduce the potential for renewable energy from biomethane to grid either through biomethane plants not being built at all or as a result of undesirable re-sizing of plant (e.g. reducing the upgrading equipment capacity to the tier 1 tariff output level) which would reduce the gains from economies of scale to the scheme.

Chart 13 – Tiering – IRR by plant capacity: £41/t gate fee



3.65. The tiered tariff under the alternative scenario of £25/tonne gate fees is also presented in Table 6. The evidence based and tariff setting approach implies a Tier 1 tariff of 9.9p/kWh.

3.66. Under this scenario, a second tier is required to ensure plants of larger capacities earn a return of 12% i.e. above the tier 1 output, marginal revenues are less than marginal costs (including capital costs) as capacity increases. To keep the tiering structure relatively simple we have based the tier 2 tariff of 2.1p/kWh upon that needed to provide a 12% IRR to a 15 MW capacity plant. This is the notional mid-point of the 4th capacity band under the 4 band option[29].

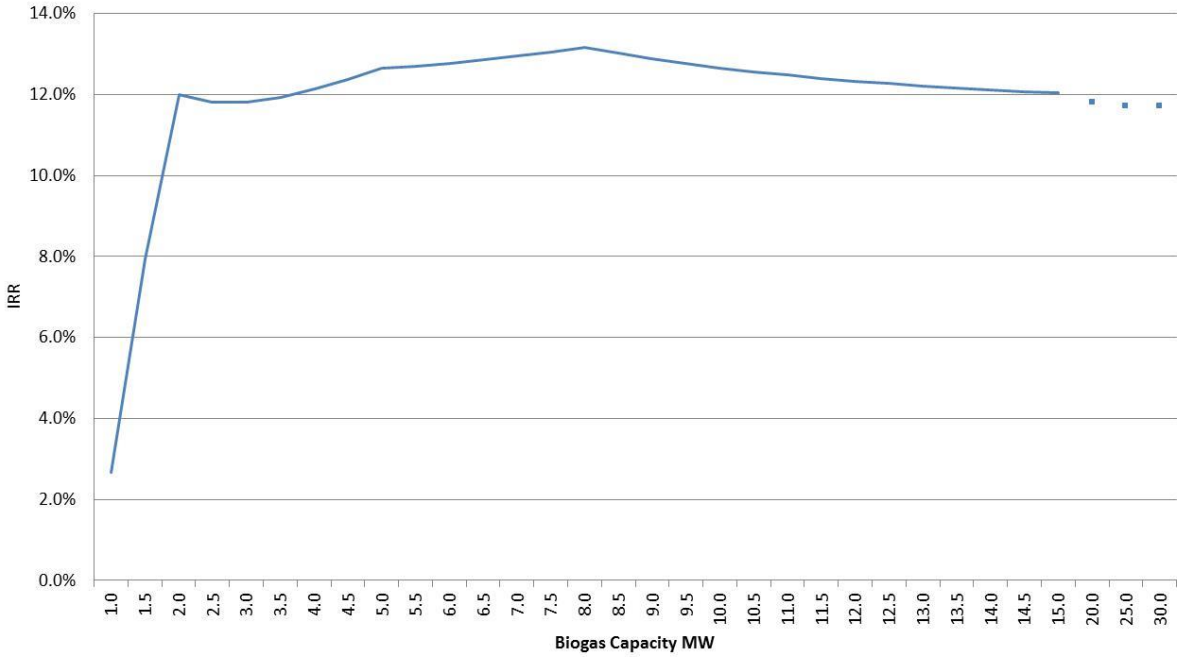
3.67. Under this scenario, the tariff structure provides a positive tariff for all units of biomethane. This maintains an incentive to produce biogas for biomethane to grid though we are

[29] The mid-point capacities of the 2nd and 3rd bands under the 4-band option require Tier 2 tariffs of 1.8p/kWh and 1.9p/kWh i.e. little optimisation is lost by simplifying the tariff structure to two tiers.

interested in views on whether the second tier tariff would be sufficient for this versus competing uses for the biogas.

3.68. Tiering here also ensures closer adherence to the 12% IRR than the current tariff across the capacity range. There is some deviation from this as a result of restricting the tiering structure to two tiers (for simplification) in conjunction with the assumption that digester costs beyond 8 MW of capacity are assumed to increase in proportion with capacity rather than less than proportionately; this is the reason for the change in trend at 8MW in Charts 13 and 14. As such, it is important we understand how digester costs vary over the full capacity range.

Chart 14 – Tiering – IRR by plant capacity: £25/t gate fee



3.69. Overall, tiering presents the potential to avoid the re-sizing incentives introduced by banding option 2, though there is a risk to biomethane deployment if the support provided for marginal units of gas under the higher tiers is insufficient to ensure biomethane injection remains an attractive use for biogas.

Table 7 – Waste plant costs and revenues assumed in deriving tariff options. Figures are £m in December 2013 prices unless otherwise stated

Note: this table is provided separately in Excel format to facilitate any comments you wish to provide on the evidence base.

Figures are in £m (December 2013 prices) unless otherwise stated		Gross Biogas Capacity MW																	
		1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	20.0	25.0	30.0
Capex Components £m	Development cost	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
	Civil Works	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Waste pre-treatment	1.09	1.64	2.10	2.49	2.85	3.42	3.99	4.56	5.13	5.70	6.27	6.84	7.41	7.98	8.55	11.40	14.25	17.10
	Digester Waste	2.56	3.55	4.31	4.94	5.49	5.99	6.45	6.87	7.73	8.59	9.45	10.30	11.16	12.02	12.88	17.17	21.47	25.76
	Boiler	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.17	0.21	0.25
	Upgrading	0.63	0.92	1.15	1.35	1.53	1.69	1.84	1.98	2.11	2.24	2.36	2.47	2.58	2.69	2.79	3.27	3.70	4.09
	Injection	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
	Gas grid connection	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Opex Components - Maintenance £m	Waste pre-treatment	0.05	0.08	0.10	0.11	0.13	0.15	0.17	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.45	0.55	0.64
	Digester Waste	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.11	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.26	0.32	0.37
	Boiler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Upgrading	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.09	0.11	0.12
	Injection	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	Gas grid connection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Opex Components - Other £m / year	Electricity	0.07	0.14	0.20	0.26	0.32	0.37	0.43	0.48	0.54	0.59	0.65	0.70	0.75	0.80	0.85	1.11	1.35	1.59
	Propane	0.05	0.10	0.15	0.21	0.26	0.31	0.36	0.41	0.47	0.52	0.57	0.62	0.68	0.73	0.78	1.05	1.31	1.58
	Labour	0.04	0.09	0.13	0.18	0.22	0.27	0.31	0.36	0.40	0.45	0.49	0.54	0.58	0.63	0.67	0.90	1.12	1.34
	Insurance	0.05	0.07	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.25	0.33	0.41	0.48
	Landfill costs	0.03	0.06	0.10	0.13	0.16	0.19	0.23	0.26	0.29	0.32	0.36	0.39	0.42	0.45	0.49	0.65	0.81	0.97
	Landfill Tax	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.85	0.95	1.06	1.16	1.27	1.37	1.48	1.59	2.11	2.64	3.17
	Digestate	0.12	0.24	0.35	0.47	0.59	0.71	0.82	0.94	1.06	1.18	1.29	1.41	1.53	1.65	1.76	2.35	2.94	3.53
	Feedstock Cost (£41 Gate Fee)	-0.53	-1.06	-1.59	-2.11	-2.64	-3.17	-3.70	-4.23	-4.76	-5.29	-5.81	-6.34	-6.87	-7.40	-7.93	-10.57	-13.21	-15.86
	Feedstock Cost (£25 Gate Fee)	-0.32	-0.64	-0.97	-1.29	-1.61	-1.93	-2.26	-2.58	-2.90	-3.22	-3.55	-3.87	-4.19	-4.51	-4.83	-6.45	-8.06	-9.67
Biomethane Revenues		0.18	0.36	0.54	0.73	0.91	1.09	1.28	1.46	1.65	1.83	2.02	2.20	2.39	2.57	2.76	3.69	4.62	5.56
Biomethane Output (Annual Output) MWh		7,200	14,529	21,900	29,296	36,712	44,143	51,586	59,038	66,500	73,969	81,445	88,927	96,415	103,908	111,406	148,954	186,583	224,275

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