CONFIDENTIAL

Northern Ireland Renewable Heat Incentive (RHI) scheme

State Aid notification

ADDENDUM

Department of Enterprise, Trade and Investment
20 February 2012

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The Northern Ireland Renewable Heat Incentive

Background

1. On 21 December 2011, the Department of Enterprise, Trade and Investment (DETI) submitted a State Aid notification to the EU Commission relating to the potential introduction of a Northern Ireland Renewable Heat Incentive (RHI). In this submission it was noted that DETI was carrying out further analysis on the potential design of the scheme following issues raised by local stakeholders during a public consultation process. This analysis has now completed and informed final proposals, in terms of tariff levels and banding, for the Northern Ireland scheme. The additional analysis was carried out by independent economic consultants and is available at **Annex A**.

2. It is therefore appropriate for an addendum to be submitted to the Commission to provide detail on proposed changes to the scheme, as detailed in the December 2011 submission, and seek the Commission's views on the proposed levels of incentive.

3. The changes to the scheme, as described in this paper, are focussed on the banding and tariff levels of the Northern Ireland RHI. Explanations are provided why changes have been made. All other elements of the scheme remain unchanged and therefore this paper should be read in conjunction with the previous submission.

The Northern Ireland RHI

4. DETI has chosen to develop a separate RHI for Northern Ireland rather than adopting the GB scheme given the differences in the two heat markets. The most significant difference is the composition of the heating market. Northern Ireland is very reliant on oil with only an emerging natural gas market, in comparison to the GB market which is dominated by natural gas with a much smaller oil market. This fundamental difference in the heat markets means that different levels of incentive are required to encourage people to switch to renewable heat, i.e. there is a different counterfactual position.

5. DETI has also considered a number of other issues in the development of its RHI policy – including, the impact on fuel poverty (there are much higher levels in NI), the differences in energy prices (both fossil fuel and renewable) and the role of additional technologies (deep geothermal, bioliquids and air-source heat pumps (ASHPs)). However the introduction of additional technologies will not be until phase 2 of the scheme (likely to be in early 2013).

6. The final design of the Northern Ireland RHI is very similar to that already approved by the EU Commission and in place in GB; however there are differences in terms of tariffs and banding of technologies. As for GB, the financial support provided by the Northern Ireland RHI scheme is in the form of a range of pence/kWh tariffs for useful heat generated from renewable technologies. The tariffs cover the cost difference between heat generated from renewable

technologies and heat generated from fossil fuel sources (and vary by technology and size of the installation).

7. DETI intends to introduce the RHI scheme as soon as possible because of the need to meet the targets set by 2020 and to utilise funding allocated by the UK Government for the scheme. In addition, the longer the scheme is delayed, the greater the disadvantage faced by both Northern Ireland consumers and those within the renewable heat sector, given that the scheme has already been implemented across the rest of the UK.

8. It should be noted that DETI will not seek to introduce the scheme until the Commission has commented on the proposals and agreed that the RHI can be introduced in Northern Ireland.

Proposed tariff and banding levels

9. Following the public consultation on the Northern Ireland RHI, comments and evidence presented by stakeholders and additional economic analysis, carried out by independent economic consultants, the proposed tariffs for the NI RHI are detailed the table below.

Proposed NI RHI Tariffs (changes to previous submission explained)

Tariff name	Eligible Technologies	Size range (kW)[1]	Tariff in original report	Updated tariff[2]	Notes
Biogas injection	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200kWth	2.5	3.0	Change to assumption on gate fee
Biomass boilers	Solid biomass; Municipal solid waste[3] (inc. CHP)	0-20[4]	4.5	6.2	Increase due to inflation, switch to 2011/12 reference installation and inclusion of ongoing barrier costs

[1] The range should be read as including the lower end, but not the upper end. For example, the range 20-100 includes 20kW boilers but not 100kW boilers – the latter are covered by the 100-500 range.
[2] Includes inflation, and effect of changes to technology costs and tariff bands
[3] Defined under the Waste and Emissions Trading Act 2003, Section 21
[4] The 0-20kw band for biomass and GSHP is primarily a domestic banding. Whilst the RHI will not be open to domestic customers until phase 2 of the scheme we have included for your information and consideration. In reality, in phase 1 of the scheme, there will be little or no applications within these bandings.

Tariff name	Eligible Technologies	Size range (kW)[1]	Tariff in original report	Updated tariff[2]	Notes
		20-100	4.5 (<45kW) 1.3 (45kW+)	5.9	Intermediate tariff based on 50kW boiler. Increase due to inflation and inclusion of ongoing barrier costs
		100-1,000	1.3	1.5	Increase due to inflation and switch to 2011/12 reference installation
		1,000+	-		
GSHP	Including water source heat pumps and deep geothermal	0-20	4.0	8.4[5]	Change to the reference installation means a higher tariff
		20-100	4.0 (<45kW) 0.9 (45kW+)	4.3	Intermediate tariff based on 30kW pump
		100+	0.9	1.3	Increase due to inflation and switch to 2011/12 reference installation
Solar Thermal		0 - 200	8.5	8.5	No change has been made to the proposed tariff for solar thermal, it remains at 8.5p for installations up to 200kwth

[5] This tariff reflects a *'deeming approaching'* for the domestic sector rather than a metered approach.

10. As can be seen, the tariffs have changed for all technologies, although in many cases the changes are very small and explained by inflation and a slight shift in reference installation.

11. Comparing the tariffs directly to those in Great Britain is difficult, since the tariff bands are different. However, in general our proposed tariffs are lower. The main reason for this is the higher cost of oil heating in NI compared to gas heating which predominates in GB. This is less the case for heat pumps, since they use electricity which is relatively expensive in Northern Ireland.

Proposed NI RHI Tariffs (in comparison to GB tariffs)

Biogas injection	All	3.0	6.8
Biomass boilers	20-100	5.9	7.9 for the first 1314 peak load hours and then 2.0
	100-1,000	1.5	4.9 for the first 1314 peak load hours and then 2.0
	1,000+	-	1.0
GSHP	20-100	4.3	4.5
	100+	1.3	3.2
Solar Thermal	0 - 200	8.5	8.5

Changes from previous submission

12. As detailed in table 1, the proposed NI RHI tariffs have changed since the previous submission. The reasons vary from taking into account inflationary pressures, changes in banding (and therefore reference installation) or changes in previously held assumptions.

Changes in banding

13. The most significant changes in the tariffs have been a result of changes in proposed banding, primarily this relates to biomass boilers and GSHPs. The bands have been revised following concerns that the 0-45 and 45+ bands were too generic and, in particular, the 45+ band was too wide given the varying applications for renewable heat. These bands have therefore been revised to attempt to group more similar installation types.

14. It should be noted that one addition is a banding between 0-20kw for both biomass and GSHP. This band is designed primarily with domestic consumers in mind and as the scheme won't be available for domestic customers until phase 2 (provisionally scheduled for early 2013) there is unlikely to be significant uptake, in the first instance, amongst these bands. Small and medium sized commercial applications will primarily fall into the 20-100kw banding.

Using a current reference installation

15. Previously tariffs had been set using a 'future' reference installation i.e. one from 2014/2015. Given our assumptions that renewable heat technologies will reduce in cost as uptake increases, using a future reference installation meant a lower assumed capital cost for renewable technologies. On reflection, it has been considered more appropriate to set tariffs against current prices and in comparison to 2011/2012 reference installations; this ensures tariffs are appropriate from the outset of the scheme. The danger of setting tariffs against future installation prices is that they are not sufficient to generate uptake that will, in turn, drive prices down.

16. Tariffs have therefore been amended to be set against a 2011/2012 reference installation; this will, of course, be revised during future reviews of the Northern Ireland RHI.

Application of ongoing barrier costs

17. An additional change is the inclusion of on-going barrier costs, this follows the GB RHI approach and costs. In most cases, these ongoing barriers make little difference to the tariffs, because they are small in comparison to the other costs.

Biomethane

18. Following our review, we have updated our estimate of the annual operating cost to £350 per kW. It was previously £600 per kW. We have also changed our estimate of the efficiency to 85%. These changes were made following a review of additional evidence made available from SKM/Enviros[6] in their report to DECC published May 2011.

19. Further to this, we have revisited our assumption on fuel input, and have assumed a 50:50 split between waste and fuel crops.

20. The changes in these assumptions have resulted in the tariff being revised to 3p (previously 2.5p).

Biomass

[6] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/2711-SKM-enviros-report-rhi.pdf

21. The previous biomass bandings (less than 45kW and above 45kW) have been considered as too broad, especially in regards to the above 45kW category where there would be a wide range of biomass applications. DETI has therefore sought to revise the bands as follows;

Band size	Comments
0-20kW	Based upon 11kW biomass boiler
20-100kW	Based upon 50kW size biomass boiler (originally based on 20kW)[7].
100-1,000kW	Based upon 200kW boiler. This would encompass the majority of the 'large commercial/public'.
1,000kW+	[8]It is proposed that there is no tariff for large (>1MW) biomass boilers. In arriving at this recommendation, we have used the same methodology as for other technologies. This indicates that large industrial biomass should be viable without subsidy, taking into account current technology costs and current and expected oil and biomass costs. In particular, the low price of woodchips relative to oil, when coupled with the high load factor of an industrial boiler, more than outweighs the higher capital cost of a biomass boiler.

22. The bands, as above, do not follow those in place in GB because the average boiler size in Northern Ireland is expected to be smaller than in GB. Therefore a tailored tariff to reflect the Northern Ireland market is expected to generate a greater uptake from consumers.

23. The 0-20kw band will primarily be for domestic customers, when the RHI is widened to include domestic consumers in future years. The bands above 20kw will primarily be for commercial users.

Ground Source Heat Pumps

24. As for biomass, we have revisited the banding for GSHPs. The previous banding had the same issues as the biomass (described above) as well as concerns that the differences in tariff between the lower and upper bands were too much of a dramatic step change (which does not exist in actual project cost).

[7] In reality 20kW is very small for a non-domestic boiler and many of the installations are likely to be larger i.e. 50kW+. In a very small office it would probably not be practical from a load factor perspective that biomass would be viable. It is also likely that small office premises may be connected to larger biomass boiler heating a either one larger building with several different businesses or via a small district heat network such as holiday lets/farm business.

[8] There are two caveats to this conclusion. The first is that it depends on our assumption about woodchips – both their price, and that they are the fuel of choice for industrial biomass. If the price were to increase in future, or industrial customers were to shift to using mostly pellets, this could argue for revisiting our conclusion. This will be considered as part of ongoing reviews.

25. As with biomass, we propose to introduce what is in effect a domestic tariff; this is based upon the existing 11kW boiler size. Further, it is proposed to use a 30kW GSHP size for small commercial installations, instead of 11kW. We consider that it is more likely that small commercial installations will be by landlords installing heating systems to serve multiple small businesses, rather than each business in a building installing its own heating systems. We have therefore proposed a reference size which would cover the demand from two or three small businesses, rather than just one. The 30kW reference size will also act as an interim point between domestic and large commercial installations (reference size 200kW).

Band size	Reference size
0-20kW	11kW
20-100kW	30kW (original 11kW)
100kW +	200kW

Tariff setting methodology

26. Whilst changes to costs and tariff bands required us to recalculate tariffs for some technologies the basic methodology for doing so has remained the same. It is briefly summarised below; further details can be found in **Annex B**.

27. Our approach to setting the NI RHI tariffs can be summarised as: first, identify the required subsidy level, in pence per kWh that just covers the additional cost of a *reference* renewable heat installation compared to a conventional oil boiler. For example, suppose that over its lifetime, an oil boiler costs 5p per kWh of heat produced, and a reference biomass boiler of similar size costs 7p per kWh. The subsidy is therefore 7p-5p=2p per kWh.

28. This leads to two questions: (i) what is a reference installation; and (ii) how is the average lifetime cost of a boiler or renewable heat installation calculated?

29. Following the GB RHI approach, we say that the reference installation for a particular technology size is the one with the average[9] cost for that technology size over all the sites where it could be installed. Also included in the tariff calculations is the-going barrier costs, this follows the GB RHI approach and costs.

30. To calculate the average lifetime cost, we calculate the annual operating and fuel cost, and add this to the annuitized cost of the upfront capital, installation and barrier costs[10]. We then divide this cost per year by the average annual heat produced to obtain a figure for cost per unit of heat. Further details of the proposed tariffs are available at **Annex C**.

[9] More precisely, the median.
[10] Barrier costs divide into two types – upfront and ongoing costs. Upfront costs are determined as a number of days required to install the new equipment, times an assumed hassle cost per day (following the approach used for the GB RHI). Ongoing costs are taken from those used in the GB RHI.

Expected impact

31. The expected impact of the tariffs proposed by this scheme, in terms of CO_2 emissions displaced, additional renewable heat and number installations, is detailed below.

Overall impact of the Northern Ireland RHI

Year	Total CO_2 emissions displaced (millions of tonnes)	Additional renewable heat resource (GWh)	Number of installations	Subsidies paid (£m, 2010 prices)
2012	0.01	46	754	1.61
2013	0.03	111	2,290	3.77
2014	0.05	185	4,256	6.41
2015	0.08	272	6,880	10.00
2016	0.11	364	9,623	13.59
2017	0.15	466	12,971	17.89
2018	0.19	581	17,123	23.07
2019	0.23	712	22,329	29.38
2020	0.27	872	29,081	37.54
2021	0.27	872	29,081	37.54
2022	0.27	872	29,081	37.54
2023	0.27	872	29,081	37.54
2024	0.27	872	29,081	37.54
2025	0.27	872	29,081	37.54
2026	0.27	872	29,081	37.54
2027	0.28	872	29,081	37.54
2028	0.28	872	29,081	37.40
2029	0.28	872	29,081	37.26
2030	0.28	872	29,081	37.12
2031	0.29	872	29,081	36.98
2032	0.29	826	28,327	35.23
2033	0.29	761	26,791	33.08
2034	0.30	687	24,824	30.43
2035	0.30	600	22,201	26.84
2036	0.30	508	19,457	23.39
2037	0.30	406	16,110	19.23
2038	0.31	291	11,957	14.20
2039	0.31	160	6,752	8.02
2040	0.31	-	-	-

Annex A – ***A Renewable Heat Incentive for Northern Ireland (Addendum report) by Cambridge Economic Policy Associates Ltd and AEA Technology Limited***

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Annex B –Tariff setting methodology

These rates are calculated to provide a large proportion of "investor segments"[11] with sufficient incentive to install a range of renewable technologies.

Characteristics

The proposed rates are set on the following basis:

- ***Periodic payments per unit of heat*** – Subsidies are paid as a fixed £ / kWh heat generated from qualifying renewable technologies over the expected life of the installation.
- ***Calculated for reference installations*** – Rates are calculated for a reference installation to meet the forecast difference between the discounted value per unit of heat from a renewable technology and its conventional fuel counterfactual (oil).
- ***Differentiated by band*** – Rates are set independently for a set of "technology / installed capacity" bands, with independently selected reference installations to reflect variation in the cost of each technology relative to its counterfactual.
- ***Incentivise up to half potential output subject to having an oil counterfactual*** – The reference installation is selected such that the subsidy level would make half of the potential heat output within its band economically viable.

The rates proposed are designed to provide a reasonable incentive for each technology in isolation and do not take account of investors' post-subsidy preferences across technologies, or presuppose rankings of rival claims on limited installation capacity or subsidy budget. This approach aims to ensure that there is an incentive for take-up across technologies, providing a set of rates that are more robust than if designed to optimise against any given take-up algorithm.

Assessing subsidy levels required

A renewable technology is considered to be economically viable for an investor if its all-in, discounted cost of heat over time is less than the non-renewable counterfactual. Valuations are based on both the investor and boiler characteristics that define the technical demands of each installation. Values considered in these calculations are the levelised cost per unit of heat over the life of the boiler of[12]:

- upfront capital costs;
- expected upfront "hassle costs;"
- ongoing operational expenses (including ongoing "hassle costs"); and
- forecast yearly fuel expense.

[11] Heat installation investors are characterised as domestic, commercial or public entities differentiated by their size, type, location and access to fuels.
[12] This process implies a required return on upfront costs equal to the discount rate used.

The difference in the value of each technology can be expressed as a net £ / kWh. If the renewable technology is more costly than the counterfactual, this difference shows the per unit subsidy required to make that investor indifferent between the technologies.

Expected technology costs and performance specifications were provided by AEA. Conventional fuel forecasts are based on "Central" projections by DECC, with uplifts applied to reflect higher costs in Northern Ireland. Valuations were levelised across expected heat output using discount rates differentiated for domestic and non-domestic investors[13].

Selecting the bands

Subsidy bands are defined by observable technology and capacity ranges, pooling together investors with similar costs per unit of heat. This allows technologies to be economically viable across a range of scales and investor types while reducing the need to over-subsidise investors requiring comparatively little subsidy.

The bands ultimately selected group domestic, small commercial and small public sector installation capacities together, while providing separate rates for medium sized commercial and public sector installations. Incentive rates for large capacity industrial installations were considered to be inappropriate as any sites with potential to use a renewable option would able to do so without RHI support.

Selecting the reference installation

A fixed incentive rate is calculated for each band based on the £ / kWh subsidy required to make a reference installation viable. In line with DECC's methodology, the reference installation is chosen as the installation requiring a subsidy that would incentivise half of the total potential output from the technology that could be taken up across the period 2011-20 if that rate was offered to that band in every year. Total potential output is calculated as heat output that could be achieved if all technically viable segments within the band installed the technology.

Differences from DECC methodology

The main difference between the method used to calculate the rates is that positive and uniform discount rates are used to value costs in future years and recover upfront costs across heat output in all years.

[13] 16 percent for domestic and eight percent for non-domestic investors sourced from NERA's "Mid-Low" scenario in NERA/AEA (2009) "Study on the UK Supply Curve for Renewable Heat" accessed at http://www.rhincentive.co.uk/library/regulation/0907Heat_Supply_Curve.pdf

Annex C: Tariff tables

In this section we set out the technology assumptions, and proposed tariffs, for each technology. This includes those technologies where we do not consider that subsidy is required. In those cases, we have shown why the average cost of energy from the renewable heat technology is less than that from oil.

Please note that in the tariff calculation tables, the figures are all on an annual basis except the final figure which for consistency with the GB RHI and our previous report is on the basis of quarterly payments. As in our previous report, we have converted to quarterly payments by multiplying the annual figure by 0.96. We have also increased all tariffs in line with 2011 inflation of 4.8%[14].

Note that cost figures have been rounded to the nearest pound (except where otherwise noted or for small sums) and tariff figures to the nearest 0.1p. Totals may therefore not add exactly.

Ground Source Heat Pumps – domestic

Ground Source Heat Pumps (domestic) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)[15]	Upfront barrier costs (£)[16]	Ongoing barrier costs (£/ year)
Ground Source Heat Pump	1,480[17]	4.94	325%	19%	11	20	14.4	605	3.40

[14] Source: December 2011 RPI figure, Office of National Statistics
http://www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/december-2011/stb---consumer-price-indices---november-2011.html
[15] Note that this is the fuel cost in 2012. The model takes account of expected future fuel costs in determining tariffs.
[16] Calculated following the GB RHI approach (i.e. a number of days times an assumed hassle cost per day).
[17] This is the figure for an urban installation, since our reference installation is in an urban area. The corresponding figure for an urban installation is £940.

Oil	183	9.41	93%	10.5%	20	15	5.11	0	0

Ground Source Heat Pumps (domestic) – technology resource costs in £ per year

	Annuitised Capital cost at 16%[18]	**Annual operating costs**	**Annual fuel costs**	**Annuitised Upfront barrier costs**	**Ongoing barrier costs**
Ground Source Heat Pump	2,746	54	815	81	3.40
Oil	657	188	1,004	0	0
Difference	2,089	-134	-189	81	3.40
Sum of difference	1,872				

Ground Source Heat Pumps (domestic) – tariff breakdown, in pence per kWh

Subsidy for	**Amount**
Annualised capital and barrier costs	9.9
Operating costs	-0.7
Fuel costs	-0.8
TOTAL	8.4
Convert to quarterly basis[19]	8.0
Adjust for inflation	8.4

[18] Since the reference installation is domestic, we assume a discount rate of 16% to reflect a typical consumer discount rate.
[19] Following the GB RHI approach, we multiply annual tariffs by 0.96 to calculate quarterly tariffs. This is to reflect the benefit to consumers of not having to wait a full year for payments under the RHI.

Ground Source Heat Pumps – small commercial

Ground Source Heat Pumps (small commercial) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs (£/ year)
Ground Source Heat Pump	1,228	7.00	360%	29%	30	20	12.14	3,951	16
Oil	97	3.45	93%	17%	50	15	4.86	0	0

Ground Source Heat Pumps (small commercial) – technology resource costs in £ per year

	Annuitised Capital cost at 12%	Annual operating costs	Annual fuel costs	Annuitised Upfront barrier costs	Ongoing barrier costs
Ground Source Heat Pump	4,932	210	2,526	529	16
Oil	710	173	3,902	-	0
Difference	4,222	37	-1,376	529	16
Sum of difference	3,428				

Ground Source Heat Pumps (small commercial) – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	5.5
Operating costs	0.0
Fuel costs	-1.3

TOTAL	4.3
Convert to quarterly basis	4.1
Adjust for inflation	4.3

Ground Source Heat Pumps – larger commercial

Ground Source Heat Pumps (larger commercial) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs
Ground Source Heat Pump	900	1.05	360%	36%	200	20	12.14	3,951	66
Oil	68	1.47	89%	20%	360	15	4.86	0	0

Ground Source Heat Pumps (larger commercial) – technology resource costs in £ per year

	Annuitised Capital cost at 12%	Annual operating costs	Annual fuel costs	Annuitised Upfront barrier costs	Ongoing barrier costs
Ground Source Heat Pump	24,098	209	21,276.	529	66
Oil	3,594	529	34,479	-	0
Difference	20,504	-320	-13,203	529	66
Sum of difference	7,576				

Ground Source Heat Pumps (larger commercial) – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	2.9
Operating costs	-0.1
Fuel costs	-1.6
TOTAL	1.3
Convert to quarterly basis	1.2
Adjust for inflation	1.3

Biomass – domestic

Biomass (domestic) – technology parameters

	Capex (£/kW)	**Opex (£/kW/year)**	**Efficiency (%)**	**Load Factor (%)**	**Size (kW)**	**Lifetime (years)**	**Fuel cost (p/kWh)**	**Upfront barrier costs (£)**	**Ongoing barrier costs (£/ year)** [20]
Biomass	662	19	85%	17.5%	12	20	5.54	908	177
Oil	183	9.41	93%	10.5%	20	15	5.11	0	0

[20] Takes from the figure used in the GB RHI for 107kW commercial biomass boilers, scaled to reflect the assumed difference in the cost of time between domestic (£15/ hour) and non-domestic (£70/ hour) consumers.

Biomass (domestic) – technology resource costs in £ per year

	Annuitised Capital cost at 16%	Annual operating costs	Annual fuel costs	Annuitised Upfront barrier costs	Ongoing barrier costs
Biomass	1,339	230	1,196	122	177
Oil	657	188	1,004	0	0
Difference	682	42	192	122	177
Sum of difference	1,246				

Biomass (domestic) – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	4.8
Operating costs	0.2
Fuel costs	1.2
TOTAL	6.2
Convert to quarterly basis	6.0
Adjust for inflation	6.2

Biomass – small commercial

Biomass (small commercial) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs (£/ year)
Biomass	608	4.60	85%	17%	50	20	4.39	3,951	828[21]
Oil	97	3.45	93%	17%	50	15	4.86	0	0

Biomass (small commercial) – technology resource costs in £ per year

	Annuitised Capital cost at 12%	Annual operating costs	Annual fuel costs	Annuitised Upfront barrier costs	Ongoing barrier costs
Biomass	4,073	230	3,868	718	828
Oil	710	173	3,902	-	0
Difference	3,362	58	-34	718	828
Sum of difference	4,932				

Biomass (small commercial) – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	5.9
Operating costs	0.2

[21] Source: GB RHI impact assessment

Fuel costs	-0.1
TOTAL	5.9
Convert to quarterly basis	5.6
Adjust for inflation	5.9

Biomass – larger commercial

Biomass (larger commercial) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs (£/ year)
Biomass	486[22]	4.60	81%	36%	200	20	4.4	5,364	878[23]
Oil	68	1.47	89%	20%	360	15	4.86	0	0

Biomass (larger commercial) – technology resource costs in £ per year

	Annuitised Capital cost at 12%	Annual operating costs	Annual fuel costs	Annuitised Upfront barrier costs	Ongoing barrier costs
Biomass	13,031	920	34,185	718	878
Oil	3,594	529	34,479	-	0
Difference	9,437	391	-486	718	878
Sum of difference	11,130				

[22] This is the figure for our reference installation, which is in a rural building. The corresponding figure for an urban installation is £508.80.
[23] Source: GB RHI Impact Assessment

Biomass (larger commercial) – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	1.5
Operating costs	0.1
Fuel costs	-0.1
TOTAL	1.5
Convert to quarterly basis	1.4
Adjust for inflation	1.5

Biomass – industrial

Biomass (industrial) – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs (£/ year)
Biomass	316	14,38	81%	82%	16,086	20	2.52	5,364	878
Oil	31	0.23	89%	82%	16,086	20	4.77	0	0

Biomass (industrial) – technology resource costs in £ per year

Biomass	681,375	231,341	3,613,079	718	878
Oil	67,574	3,701	6,226,764	0	0
Difference	613,801	227,639	-2,613,686	718	878
Sum of difference	-1,770,650				

Biomass (industrial) – tariff breakdown, in pence per kWh

Subsidy for	**Amount**
Annualised capital and barrier costs	No subsidy required
Operating costs	
Fuel costs	
TOTAL	
Convert to quarterly basis	
Adjust for inflation	

Biogas (biomethane)

The table below shows the technology costs for the production of biomethane for injection into the gas grid. One point to note is that fuel costs are shown as negative. This is because some of the fuel for biomethane production is waste, which has a negative cost (a "gate fee").

Also, the counterfactual for biogas is conventional wholesale gas. The viability of biomethane is therefore assessed based on its cost per kWh against the 2.9p per kWh we assume for wholesale gas prices.

Biomethane – technology parameters

	Capex (£/kW)	Opex (£/kW/year)	Efficiency (%)	Load Factor (%)	Size (kW)	Lifetime (years)	Fuel cost (p/kWh)	Upfront barrier costs (£)	Ongoing barrier costs (£/ year)
Biomethane	4,600	350[24]	85%	93%	1,000	20	-4.1	0[25]	0
Wholesale gas	-	-	-	-	-	-	2.9		-

Biomethane – tariff breakdown, in pence per kWh

Subsidy for	Amount
Annualised capital and barrier costs	6.7
Operating costs	4.3
Fuel costs	-8.1
TOTAL	3.0
Convert to quarterly basis	2.9
Adjust for inflation	3.0

[24] Note that this figure is lower than that used in the GB RHI. AEA have received additional information on biomethane opex since the last review, notably SKM's report to DECC. This has been taken into account and reflects the lower opex compared to that previously reported

[25] Source: GB RHI Impact Assessment. Biomethane is assumed under the GB RHI to have no upfront or ongoing barrier costs.