Department of Energy & Climate Change

TECHNICAL ANNEX TO SUPPORT THE CONSULTATION ON THE NON-DOMESTIC RHI EARLY TARIFF REVIEW

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Contents

Introduction

1. This technical annex is intended to explain in detail the approach taken to set the consultation tariffs. It also provides the economic rationale and reviews the evidence base that was drawn on in setting tariffs. DECC has not produced a full Impact Assessment setting out the potential effects of the tariff changes. A full Impact Assessment encompassing all changes to the RHI will be published in the autumn when a fuller picture of the combined impacts of the changes to the scheme can be provided.

Background

2. The current market for renewable heat is relatively small and these technologies are largely unable to compete on cost with conventional fossil fuel heating options such as gas, oil and electricity. In addition to cost differences, there are a number of non-financial barriers to the uptake of renewable heat. The following describes the rationale for subsidising renewable heating and the launch of the RHI:

   - The negative carbon externality associated with the conventional heating of buildings. Renewable heat technologies enable buildings to be heated using significantly less fossil fuels thereby reducing greenhouse gas emissions;

   - The UK operates under the EU's Renewable Energy Directive (RED) which sets out a legally binding target for the UK of 15% of energy coming from renewable sources by 2020. Although the infraction penalty for not meeting this target is not currently monetised, it is described as being commensurate with the costs of meeting the target;[1]

   - Driving innovation and cost reductions in renewable heat technologies is also a key rationale to support the longer term sustainable heating of buildings and industrial processes;

   - Renewable technologies add a further non-monetised benefit through diversifying the UK's energy demand, reducing the exposure of the UK to the price of oil and gas through further diversification of energy supply;

3. The Renewable Energy Strategy (published in 2009[2]) found that, on analysis of opportunities across electricity, transport and heat, a suitable contribution from the heat sector was 12% of heat being delivered from renewable sources by 2020. Renewable heat is also a key part of DECC's Carbon Plan[3] and longer-term Heat Strategy,[4] which set out the important role of renewable heat in contributing to the long-term de-carbonisation of energy supply. The current RHI tariffs are set out in the table below.

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[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF
[2] http://www.official-documents.gov.uk/document/cm76/7686/7686.pdf
[3] https://www.gov.uk/government/publications/the-carbon-plan-reducing-greenhouse-gas-emissions--2
[4] https://www.gov.uk/government/publications/the-future-of-heating-a-strategic-framework-for-low-carbon-heat

Table 1: Current RHI tariffs

Tariff	Eligible technology	Eligible size	RPI adjusted tariff (p/kWh) from 1 April 2013
Small commercial biomass	Solid biomass including solid biomass contained in municipal solid waste (incl. CHP)	Less than 200 kW	Tier 1: 8.6
			Tier 2: 2.2
Medium commercial biomass		200 kW and above; less than 1,000 kW	Tier 1: 5.3
			Tier 2: 2.2
Large commercial biomass		1,000 kW and above	1
Small commercial heat pumps	Ground source heat pumps; water source heat pumps; deep geothermal	Less than 100 kW	4.8
Large commercial heat pumps		100 kW and above	3.5
All solar collectors	Solar collectors	Less than 200 kW	9.2
Biomethane and biogas combustion	Biomethane injection and biogas combustion, except from landfill gas	Biomethane - all scales Biogas combustion, except from landfill gas - less than 200kW	7.3

4. The RHI tariffs are a payment for each kilowatt hour of eligible heat produced by participating installations. The tariffs are intended to bridge the financial gap and barriers between fossil fuel heat and renewable heat alternatives and are based on estimates of the costs and performance of the technologies supported through the scheme.

5. In August 2012, DECC commissioned new evidence on costs and performance assumptions of renewable heat technologies from the Sweett Group[5] and on the 21st January 2013 announced a review of the evidence base used to set the non-domestic RHI tariffs, in light of the new data, stakeholder evidence and scheme performance so far. DECC then announced on 27 February that the conditions in which DECC expects to carry out an early tariff review had been met.

[5] Sweett group report is published alongside the consultation documents: https://www.gov.uk/government/consultations/non-domestic-rhi-early-tariff-review

Problem under consideration

6. The key reason for the tariff review is that deployment to date of key technologies has been significantly below our original forecasts and therefore below the trajectories needed to remain on track to meeting the 2020 renewables target (see Table 2 for spend forecasts). In addition, new evidence on costs and performance from research and stakeholder feedback has also become available. The range of data now available highlights the variability of heating use and associated costs in the non-domestic sector as well as the uncertainty there is in the data we use to set our tariffs.

7. When the RHI was introduced, tariffs were based on the best available data at the time – the AEA reports from 2009[6] and 2010[7]. DECC now has four key data sources that can be used to inform our tariff setting, the original AEA data, the latest data from Sweett, actual scheme deployment data and the data collected from stakeholder engagement. The relative strengths and weaknesses of these data sources are discussed throughout this technical annex.

8. A key issue DECC faces in this review is how to combine or draw on the evidence base in order to determine where current tariffs are insufficient and to what extent they need to be altered in order to provide an incentive in line with the original policy intent. DECC is proposing to use the broader range of evidence as set out in the previous paragraph rather than having to rely so heavily on the outputs of the RHI model. The proposed new approach is described on page 12 after the next section which reviews the evidence base. The original approach is set out briefly in Box 1.

Box 1: RHI tariff setting methodology used in 2011:

1. Estimate the additional cost of installing and running a renewable heating system. This is used to calculate the cost per unit of heat produced for renewable technologies less the cost of the conventional technology alternative. Added to this cost are the additional barrier costs. Calculations are made using costs, use and performance data for each technology in each category of building (broken down by commercial, industrial, counterfactual fuel and location).
2. Estimate the heat demand of each building category, the number of such buildings and the proportion of them suitable for each renewable technology.
3. From these figures, a "supply curve" is produced for each technology which estimates the amount of renewable heat potentially fundable at each tariff level.
4. From these curves we are able to identify the tariff required to potentially incentivise the targeted percentage of the potential installations. This targeted percentage is the 50% point on the supply curve (unless the tariff is capped for value for money reasons).

A more detailed description of this tariff setting methodology can be found in A**nnex 1**.

[6] NERA/AEA (2009): The UK Supply Curve for Renewable Heat; http://www.nera.com/67_5462.htm
[7] http://webarchive.nationalarchives.gov.uk/20121217150421/http://decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/renewable%20energy%20policy/1394-review-of-tech-info-on-rhi-.pdf

Rationale for Intervention

9. The RHI is the key policy mechanism that DECC has put in place to help the heat sector meet its contribution to the 2020 renewables target. Low deployment to date from the scheme increases the risk that the UK will not be able to generate 12% of its heat demand through renewables. This could have consequences for the UK's ability to use renewable heat to meet its legally binding renewables target. Current deployment for GSHPs in particular is very low and there is a significant risk that the industry will not sustain itself out to 2020. Without higher levels of deployment in the short term it is likely to be more expensive for the UK to meet longer term decarbonisation objectives in the 2020s and 2030s.

10. Without this early review of tariffs, it is unlikely that DECC would be in a position to bring any new tariffs into force until after the planned 2014 review of the scheme which, if deployment continues along current trends, would mean deployment in subsequent years would have to be even higher in order to remain on course to meeting renewable heat's intended share of the 2020 renewables target. Such high growth rates would be difficult to achieve and would most likely require even higher tariffs and/or additional policy measures to stimulate the market sufficiently.

11. There may be other, non-tariff related reasons for deployment being lower than anticipated. Policy uncertainty, economic conditions and delayed launch of the RHI could all have contributed to the low deployment seen to date. However, this review of tariffs is not seeking to review the wider structure of the scheme but instead ensuring that as full an evidence base as possible is used in setting the tariffs paid through the RHI so that there is as little delay as possible to suitable tariffs becoming available.

Review of evidence base

12. The four key data sources available to DECC are:

    a. AEA data
    b. Sweett data
    c. Stakeholder evidence
    d. Scheme data

13. Of these, only the first two are in a format that can easily be incorporated into DECC's RHI model. However, in order to ensure that the tariffs incentivise sufficient deployment whilst avoiding over-compensation and also offering value for money and being affordable all available evidence sources should be used to inform tariff levels.

Scheme deployment to date

14. Table 2 below sets out how the forecast spend over the next year for each technology compares to the anticipated[8] spend. The table shows that current spend for the whole scheme is roughly half of what DECC had expected at launch with deployment rates for large biomass and GSHPs particularly low. The low deployment suggests the current tariffs offered through the RHI need to be changed if greater deployment is to be incentivised in the

[8] The anticipated deployment is based on the modelling carried out for the 2011 Impact Assessment, The projected deployment for some technologies such as large GSHPs or Solar Thermal is very low, especially in the early years of the scheme.

future. When this is combined with other evidence from the Sweett Group and stakeholder evidence, the argument that some tariffs should be revised becomes stronger.

Table 2: 12 month forecast spend based on data up to 30th April 2013

Tariff	Forecast expenditure as % of anticipated
Small Biomass	126%
Medium Biomass	169%
Large Biomass	23%
Small GSHP	1%
Large GSHP	10%
Solar thermal	1%
*Biomethane and biogas (**not in scope of review**)*	13%
Total	48%

15. As well as data on the number of applications and installed capacity, the scheme data collected so far provides an insight into heat usage patterns. The limited outturn data from the non-domestic RHI suggests that the estimated AEA heat loads (the proportion of time heating equipment is run) are relatively high. Outturn data suggests load factors of between 6% and 29% as opposed to the 35% suggested by AEA. This range of load factors from the scheme data is also close to the range proposed by the Sweett Group (see Table 4). The load factor is a key assumption in tariff setting, assuming too high a load factor would lead to a lower tariff (all else held constant) and therefore lower deployment.

Overview of DECC cost and heat use data

16. DECC now has access to two commissioned datasets that provide an overview of renewable heat costs and heat use in the non-domestic sector. For each dataset, costs and performance have been derived using a different approach. For example in calculating heat demand associated with different building types:

- The older AEA data used expert opinion and stakeholder engagement to disaggregate total non-domestic heat demand to build a picture of how heat demand varies across different sectors, e.g. factories, commercial buildings etc. From this they estimated the typical heat demand in different building categories and how this could be met with different technologies, thereby inferring sizes and load factors of renewable heat installations.

- In contrast, the Sweett Group used a case study approach, i.e. a set of example buildings (school, office etc.), to build up a picture of non-domestic heat demand. That is, they extrapolated from a number of real life examples to infer appropriate sizes and load factors of renewable heat technologies for different building categories. However, this was based on a relatively small number of examples.

17. The two datasets give different pictures of capital costs associated with different size installations, reflecting the different approaches that have been used:

- AEA used industry interviews and expert opinion to create a set of cost data that they considered appropriate and calibrated this to the categories of heat demand they identified.

- The Sweett Group used primary data, i.e. receipts, collected from industry, to calculate the expected cost of different size installations. Although sample sizes for some technologies and larger installations are very limited.

Box 2: Description of key findings from Sweett Group report

A key input to this consultation and the accompanying analysis has been the research carried out by the Sweett Group on heat costs and performance. Sweett Group was commissioned in August 2012 to look at costs of renewable heating technologies including an examination of evidence from Renewable Heat Premium Payments (RHPP). This research has recently concluded and was subject to independent peer review in January 2013. It is being published alongside this consultation.

A key finding from the Sweett Group research is that, in general, the costs of renewable heating systems are higher than the previous estimates made by AEA. However, the coverage of the Sweett data is not as wide as the AEA data and for some technologies – such as Air to Air Heat Pumps and large capacity installations – there are too few observations in the Sweett data to draw significant conclusions.

On load factors and heat outputs, there is a lack of representative measured data available in the non-domestic sector. This is because the capacity of a system and the load factor are influenced by a range of factors that are highly variable and not directly linked to a generic building type. They are more influenced by the type of heat use so will therefore vary greatly between sectors and whether heat is for process or space use. In addition, non-domestic properties may also have multiple heat sources, meaning that the size and load factor of any one of them is down to the discretion of the owner and can be altered in response to incentives. For example, a non-domestic entity may have one technology for its base load heating and another to meet peak loads.

The non-domestic heat outputs and load factors were provided by Burro Happold (as part of the consortium with Sweett Group who undertook this research). In many cases, these heat outputs (and load factors) represent a significant reduction to AEA's evidence. The impact of incorporating these assumptions would be to increase tariffs significantly in the non-domestic sector, particularly for GSHPs.

However, it should also be noted that Sweett Group and Burro Happold have advised DECC that their non-domestic load factor estimates are highly uncertain. In particular, given the time available, it was difficult for them to source a wide range of data on heat use in industrial applications so the heat use data in these cases is drawn from a narrow sample and is not sufficiently representative of the UK industrial sector as a whole.

18. A detailed picture of heat demand in the UK non-domestic sector is not currently available, which makes determining tariffs using cost and performance assumptions alone highly uncertain, given the sensitivity of tariff levels to changes in key assumptions. For example load factors vary hugely across different building types and heat uses. It is therefore difficult to make generalisations which are representative of the non-domestic sector as a whole.

19. However, where this research provided data and assumptions that are potentially closer to the 'true' cost of a renewable heating system, then using it to inform the setting of a more suitable tariff is desirable and should help mitigate the risk of any market distortions arising where tariffs are less representative of the 'true' costs.

20. The Sweett Group report, this technical annex and previously published AEA data are intended to demonstrate as fully as possible the data that DECC currently holds and how it has been used to arrive at the indicative tariffs presented in this document. Summary tables that illustrate the high level differences between capex and load factor estimates from AEA and Sweett are shown below. The ranges indicate highest and lowest figures used in DECC's tariff modelling.

Table 3: Comparison of AEA and Sweett capex estimate ranges (£/kW)

Technology (£/kWh)	Commercial		Industrial	
	AEA	Sweett	AEA	Sweett
ATW ASHPS	588-827	725-1,070	-	-
Biomass boilers	350-723	520-754	304-467	520-1,076
Biomass District Heating	701-1,380	631-725	701-1,380	643-737
GSHPs	950-1,579	1,292-1,868	950-1,579	1,593-2,136
Solar Thermal	1,439	1,250-1,269	1,439	1,269

Table 4: Comparison of AEA and Sweett load factor estimate ranges (% of time spent operating in a year)

Technology	Commercial		Industrial	
	AEA	Sweett	AEA	Sweett
ATW ASHPS	35%	10-26%	-	-
Biomass boilers	20-45%	13-29%	20-82%	8-50%
Biomass District Heating	20-45%	20-45%	20%	20%
GSHPs	35%	10-26%	35%	8-23%
Solar Thermal	6%	4-7%	6%	4%

Stakeholder evidence

21. The industry views and market intelligence we have used come from a variety of sources including the tariffs presented by trade associations, individual companies, or investors in response to consultations and as part of our on-going engagements with them.

22. Table 5 shows a summary of the views on appropriate tariff levels which we have collected.

Table 5: Range of industry and market views on required RHI tariffs by technology

Tariff (p/kWh)		Current tariffs (2013 Prices) or September 2012 consultation tariffs	Range of industry and market views	
			Min	Max
Biomass	Small	Tier 1: 8.6	N/A	N/A
	Medium	Tier 1: 5.3	3.5	6.5
	Large	1.0	1.6	2.7
GSHPs	Small	4.8	8	10.7
	Large	3.5	3	8
Air to Water Heat Pumps (AWHP) (consulted on)		1.7	1	3.2
Solar Thermal		9.2	N/A	N/A
Biomass Direct Air Heating (BDAH) (consulted tariffs)	Small and medium	2.1	N/A	3
	Large	1	1.5	2.7

Modelled tariffs

24. As discussed above, there is considerable uncertainty over which cost, heat demand and load factor assumptions are most appropriate to use in tariff setting. Limitations in both the AEA and Sweet data have been highlighted. As part of this tariff review DECC has used the RHI model with different combinations of data to produce a range of possible tariffs. This range does not capture all uncertainty, but does capture the major variations that exist between evidence gathered by Sweett and AEA.

25. There is a very large range of possible data combinations where either costs or load factors for each technology are taken from either or both data sets. In order to provide an illustrative range of tariffs three core combinations of data have been put together:

    1. **All AEA –** This provides an illustration of how changes to the model (as opposed to its input assumptions) since 2011 have impacted on the tariff setting. Box 3 provides more detail on changes to the model.

    2. **Sweett costs with AEA heat loads –** Where Sweett have been able to provide updated cost assessments based on large enough samples it is sensible to use them in tariff calculations. Sweett heat load data is less certain and was heavily caveated; this combination of data shows the impact of keeping the AEA load factor assumptions for tariff calculations.

    3. **Sweett costs and commercial load factors but AEA industrial heat loads –** A key finding of the evidence base review is that the load factor assumptions used by AEA are generally high. This combination of data illustrates the effect on tariff levels of the lower load factors in the commercial Sweett data but retains the industrial load factors from AEA as the Sweett data for this sector was particularly limited.

Table 6: Range of model outputs for different input assumptions

Tariff (p/kWh)		**Current tariff** (2013 Prices) or September 2012 consultation tariff (2012 Prices)	**Data combinations**		
			1: All AEA	**2: Sweett costs and AEA heat loads**	**3: Sweett costs, but AEA heat loads for industrial**
Biomass	**Small**[9]	Tier 1: 8.6	Tier 1: 6.2	Tier 1: 7.7	Tier 1: 10.6
	Medium[9]	Tier 1: 5.3	Tier 1: 3.9	Tier 1: 4.0	Tier 1: 8.3
	Large	1.0	1.1	2.2	0.0
GSHPs	**Medium**	4.8	5.2	6.2	11.7
	Large	3.5	3.2	7.2	10.8
AWHPs (consulted on)		1.7	3.8	3.8	6.6
Solar Thermal		9.2[10]	26.5	27.8	24.2
Biomass direct air (consulted on)		2.1	3.2	6.3**	6.4**

**Cost data based on a relatively small sample size

[9] Tier 2 is set at 2.2p/kWh

[10] Current Solar Thermal tariff is capped at 9.2p/kWh, modelled tariffs are shown uncapped for info.

26. The ranges of tariffs in Table 6 have been used to inform the levels of the proposed tariffs.

> **Box 3:** Changes to the RHI model since the November 2011 Impact Assessment
>
> Whilst the analysis for the original RHI Impact Assessment and the launch of the non-domestic RHI Phase I in November 2011 was based on the best available data at the time, the evidence base and assumptions feeding into the RHI model have evolved. Changes to the model and its input assumptions that will have affected tariffs include the following:
>
> 1. New evidence providing information on costs, heat loads and load factors for RHI technologies became available in spring 2013 and has been integrated into the evidence base of the RHI model.
>
> 2. Projections of fossil fuel prices, carbon prices and energy demand were updated.
>
> 3. New evidence on the suitability of technologies became available for each area of heat demand. In aggregate these show that initial estimates were too optimistic on the ability of technologies to replace non-renewable alternatives.

Approach to setting the proposed tariffs

27. The aim of the tariffs set in the scheme remains to incentivise up to the 50th percentile of the heat potential for each technology, whilst providing a rate of return of 12% to the reference installation. However, given the range of tariffs suggested by the model and the difficulties in determining which tariffs or data combination are most appropriate DECC has drawn heavily on the full range of evidence described in the previous section.

28. To make judgements about the appropriate level for tariffs, the following considerations have been taken into account:

- The level of forecast deployment, based on projected expenditure of current applications, for those technologies already supported.
- The range of modelling outputs resulting from different combinations of evidence set out in Table 6.
- The tariffs presented by the renewable heat industry in response to consultations and as part of our on-going engagements with them, the range of which is set out in
- Table 5.
- The recommendations of DECC engineering specialists.
- The nature of each technology in question and specific risks around over- or under-compensation of that technology i.e. some technologies could ramp-up deployment very quickly if over-subsidised and so pose an affordability risk.
- The levels of tariffs relative to one and other, where there are clear parallels between the technologies and their applications, e.g. biomass boilers and biomass direct air heating.
- How each technology is used and therefore the deployment that can be achieved, or the role it has to play in meeting DECC's medium and long-term objectives.

29. For different technologies, the evidence from the different sources available to DECC is weighted differently according to the considerations above. The exact approach taken for each of the technologies covered by this review is set out in more detail in the consultation document[11].

30. Table 7 shows the tariffs being proposed as part of this consultation. Aside from the proposed increase in tariff levels for all technologies apart from small and medium biomass there are a number of other changes proposed as part of this consultation. The tiered tariff approach currently applied to small and medium biomass will be extended to GSHPs. This tiered tariff will apply to all sizes of GSHP so there would no longer be two tariff bands. In addition, the range proposed for the GSHP and Solar Thermal tariffs exceed the “Value for Money” (VfM) cap that was calculated at scheme launch. These changes are discussed in more detail below.

Table 7 : Proposals for review of tariffs

Technology		Current tariffs (2013 Prices)	Proposed or updated tariffs (2014 Prices)
Biomass Boilers	**Small**	Tier 1: 8.6 Tier 2: 2.2	**NO CHANGE[12]**
	Medium	Tier 1: 5.3 Tier 2: 2.2	
	Large	1.0	**2.0**
GSHPs	**Small**	4.8	**7.2[13] – 8.2[14]**
	Large	3.5	
Solar Thermal		9.2	**10.0[15] – 11.3**

31. The current tariffs in Table 7 are shown in 2013 prices. For a version of the above table with directly comparable tariffs in 2014 prices, please refer to Annex 3.

[11] https://www.gov.uk/government/consultations/non-domestic-rhi-early-tariff-review
[12] Tariffs are subject to existing budget management mechanism.
[13] Equivalent to 10.0p/kWh of renewable heat
[14] Equivalent to 11.3p/kWh of renewable heat
[15] This is the projected value of the current solar thermal tariff in 2014/15 taking into account an increase for RPI

32. ***Introduction of a tiered tariff for GSHPs*** – The use of tiered tariffs is designed to remove the incentive to over-produce and vent renewable heat (see Box 4 overleaf). With the tariffs in place at the time of the RHI launch DECC concluded that, because of the tariff levels, the incentive to over-produce heat was only a serious issue for small and medium biomass.

33. In the case of large biomass or other technologies the incentive was either not present or not large enough to justify the added complexity of a tiered tariff. For GSHPs our evidence suggested the cost of the electrical input needed to produce a unit of renewable heat would be close to the current tariffs.

34. This meant that the incentive to over-produce and vent heat would be less pronounced for GSHPs; even in the cases where tariffs are slightly higher than electricity costs, generators would be unlikely to have sufficient information on the COP (Coefficient Of Performance) of their kit at each point in time to exploit this opportunity, making it difficult to tell if it would be profitable to run a heat pump more than necessary in order to generate more RHI revenue.

35. DECC is now proposing a GSHP tariff that is roughly twice the existing tariff which means that it will be well above the marginal cost of generating an extra unit of heat from a GSHP. This makes the incentive to overproduce heat for GSHP installations a lot clearer and introduces a risk to both the value for money offered by the RHI and its affordability.

36. In order to address this DECC is proposing to extend the tiered tariff methodology to GSHPs. The principles would be the same as for biomass, the second tier would need to compensate for the on-going costs of the GSHP[16] and the break point between tiers would need to be set at a level that reflects a reasonable estimate of a low load factor for a GSHP.

37. However, the appropriate level for both of these factors is not clear because of the large range of load factors and the variation in on-going costs between different installation types. Therefore, for this consultation DECC is proposing to apply the same second tier tariff and break point as is used for both small and medium biomass. Further work on choosing the level of both factors will be carried out during the consultation period and using any relevant responses received from stakeholders.

Table 8: Proposed tariff and VfM cap with tiering

Proposed GSHP tariff (p/kWh for all heat output)		**Tier 1** (first 15% of heat output only)	**Tier 2** (any remaining heat output)
Max	8.2	10.2	2.3
Min	7.2	8.9	2.3

38. ***Single tariff for GSHPs*** – The modelled tariffs for small and medium GSHPs are relatively close to one another and when using some data combinations the model suggests a higher tariff would be needed by large installations than for smaller ones. This is due to different load factor assumptions making a very big impact on tariffs even when levelised capex costs are lower for large installations i.e. many large installations will have lower load factors

[16] In order to minimise the risk that the owner switches back to using a conventional heat source once tier 1 tariff payments cease.

meaning they require higher tariffs. In addition, some key stakeholders have suggested a single tariff for GSHPs would be preferable. Given the lack of strong evidence for separate tariffs DECC have opted to consult on a single tariff. This will make the scheme simpler and also removes the incentive for installers to under-size kit in order to access a higher tariff (see Box 4).

Box 4: The incentive to over-produce heat in the RHI and impacts of tiered tariffs

Because of the way RHI tariffs are designed to compensate users for **both** the extra capex and opex involved in installing a renewable heating system, tariffs will often be higher than the short run marginal cost of generating an extra unit of heat (i.e. the fuel or electricity cost). This can lead to an incentive to over-produce heat in order to maximise revenue from RHI payments. This excess heat would not be useful and would not be displacing heat produced from conventional sources.

To address this, a tiered tariff was introduced for small and medium biomass installations as these are the installations where the incentive to over-produce is clearest. The tiered tariff is split into a tier 1 tariff which is available for the eligible heat generated in the first 1,314* hours of operation each year (this tier aims to mainly cover the capital cost repayment) and a tier 2 payment that covers the fuel costs of the installation (which in 2014 would be set at around 2.3p/kWh). This second tier tariff applies once the maximum of the tier 1 tariff has been reached. The tier 2 tariff is set at a level that should remove the incentive to over-produce and vent heat whilst still compensating for the net cost of the renewable fuel.

Whilst tiered tariffs are designed to avoid the incentive to over-produce heat they can also introduce a secondary incentive to oversize the kit being installed. This is because the point at which tariffs change from tier 1 to tier 2 (referred to as the break point) is determined by the capacity of kit (see note below *). So if it is relatively cheap for installers to increase the size of kit they will be able to earn larger revenues through the RHI by claiming for a larger proportion of their heat needs at the tier 1 tariff.

The deployment data for biomass boilers that we have received to date does show a bias towards the larger sizes within size bands. However, it is difficult to identify how much of this is due to oversizing to take advantage of the higher tier 1 tariffs and how much is due to other factors.

The availability of a higher tariff for smaller installations creates an incentive to install kit that falls into the smaller band, even where it may have been more efficient to use larger kit. This incentive would also lead to larger numbers of installations at the top end of banding thresholds as has been seen in the scheme deployment data. Given the uncertainty in identifying the key drivers of behaviour DECC will continue to monitor this issue and most likely revisit it as part of the wider 2014 review of the scheme.

*This is the number of hours associated with a 15% load factor which is an estimate of the lower-end of the range of possible load factors. The amount of heat an installation will receive at the tier 1 tariff is a product of its capacity and 1,314 hours. e.g. a 100kW system would be eligible for the tier 1 tariff on up 131,400kWh of heat

Value for Money of the proposed tariffs

39. When the non-domestic scheme was launched in November 2011, DECC set out that none of the tariffs should be set above the support provided to offshore wind, as this was judged to be the marginal technology that could be deployed to meet the 2020 renewables target. Therefore paying more than this level was considered not to offer good value for money in terms of contributing to meet the 2020 renewable targets.

40. The cap was estimated to be 8.5p/kWh in 2011, based on the value of Government support for offshore wind, which after increases to take into account inflation would equate to 9.5p/kWh in 2014/15 prices – when any proposals in this consultation will be implemented. At the time the scheme launched, the only technology affected by the cap was solar thermal, due to its high cost per unit of renewable heat. The rest of the tariffs were below the cap.

41. ***Consideration of additional impacts on VfM -*** Alongside the tariff review DECC has considered whether the current benchmark for VfM should be revised. There are additional factors that could be taken into account when determining the cap for RHI tariffs.

42. The current cap was based on the support that offshore wind receives from the Renewables Obligation (RO); it also took into account the support received from Levy Exemption Certificates (LEC). Taking into account the latest assumptions about the value of the RO and LEC would increase the VfM cap to around 10p/kWh (in 14/15 prices).

43. Also, in setting the original cap, the impacts of the Carbon Price Floor (CPF) and the EU Emissions Trading Scheme (ETS) on the wholesale electricity price were not taken into account.

44. While neither the EU ETS nor the CPF are subsidies paid to the renewables sector, they impose costs on fossil fuel based forms of electricity generation. This provides an additional advantage to renewable electricity producers, such as producers of offshore wind. If these costs were factored into the cap calculation, the price of support would be up to around 11.3p/kWh (in 14/15 prices).

45. As well as playing a crucial role in meeting the 2020 renewables target, renewable heat technologies are key contributors to the Government's long term aim to increase energy efficiency, and the deployment of low carbon energy with the potential for cost reduction, as outlined in the Government's heat strategy[17]. We are therefore consulting on a range of support for GSHP and Solar Thermal up to the level of support provided to offshore wind that would include the advantages provided by the CPF and the ETS (i.e. from 10.0p to 11.3p/Kwh).

46. ***GSHPs –*** Given the very low level of deployment to date a substantial increase is likely to be required to incentivise up to 50% of the heat potential for GSHPs. The updated model outputs in Table 6 show that the tariff may need to be as high as 10.8 and 11.7p/kWh if the 50th percentiles of the small and large bands respectively are targeted. In addition, the industry has also submitted evidence which indicates that tariffs of up to 8.0 and 10.7p/kWh would be needed to incentivise the small and large bands respectively. Taking into account the range of evidence, DECC has assessed that a 9.0p/kWh tariff would be appropriate to

[17] https://www.gov.uk/government/publications/the-future-of-heating-meeting-the-challenge

incentivise up to 50% of the heat potential of GSHPs, i.e. targeting the upper end of the range of industry evidence, which is lower than the upper end of the range of model outputs.

47. Such a tariff would be equivalent to 12.5p/kWh of renewable heat, which, as set out above, is beyond the VfM cap. DECC is therefore consulting on supporting GSHPs in the range between the updated cap and that cap plus the impacts of wider Government policy on the wholesale electricity price, i.e. between 7.2 and 8.2p/kWh on all heat output which is equivalent to 10.0 to 11.3p/kW of renewable heat. The current degression policy will be applied to this tariff to ensure value for money and control costs.

48. ***Solar Thermal –*** The range of tariffs required for Solar Thermal suggested by the model (24.2-27.8 p/kWh) are well above the support available to offshore wind and would not represent good value for money. Therefore the proposed tariff would limit support to Solar Thermal at the level adopted for GSHPs.

Annexes

ANNEX 1: Approach to setting tariffs through the RHI model

Please note: this is adapted from an annex to the non-domestic extensions IA and is intended only as an illustration of the tariff setting methodology used by the RHI model.

1. The methodology that the RHI model uses to calculate tariffs is to identify the amount of subsidy per kWh required to compensate for the difference between the lifetime costs of renewable heating technologies and the lifetimes costs of counterfactual technologies. This calculation is carried out for each technology and each building type. These calculations are described in detail and worked through using an example of an air-to-air air source heat pump below.

2. **Please Note:** there are some exceptions where this methodology is slightly different; for example for Solar Thermal, no counterfactual capex is considered. For electric heating the cost of water heating is added to the counterfactual.

Calculating a levelised cost

3. In setting tariffs DECC has calculated the levelised cost, and the tariff required to offset additional costs, for each technology in each building type.

4. The levelised cost of a renewable technology is the present value of all costs and benefits of the renewable technology divided by the lifetime energy output of that technology. This gives a cost figure expressed in £/MWh, which essentially demonstrates the cost of producing a unit of energy using that technology, by spreading out all the associated costs across all the heat produced.

5. The net levelised cost of a renewable technology is the levelised cost of the renewable technology minus the levelised cost of the counterfactual technology. In calculating RHI tariffs this net levelised cost is used as the aim is to compensate for the additional costs of installing renewable heat only, for properties that need to replace their existing heating equipment. In calculating a levelised cost DECC has assumed an average cost of capital of 12%.

6. **Example:** For an air source heat pump, using illustrative values, the levelised cost is calculated as follows:

   First the heat output of the heat pump is adjusted to account for increases in efficiencies of the property (e.g. insulation) over time. This is shown below:

$$Adjusted\ Heat\ Output = Annual\ Heat\ Load * Efficiency\ Factor \quad (1)$$

$$Adjusted\ Heat\ Output = 919.80 * 0.93 = 853.22MWh \quad (2)$$

   Following this the annuitised capital expenditure is calculated over the lifetime of technology using equation 3 and a rate of return equal to the cost of capital, 12%.

$$Annuitised\ Capex = \frac{Present\ Value * Rate\ of\ Return * (1+Rate\ of\ Return)^{Lifetime}}{(1+Rate\ of\ Return)^{Lifetime}-1} \quad (3)$$

$$Annuitised\ Capex = \frac{619.65 * 0.12 * (1.12)^{20}}{(1.12)^{20}-1} = £82.96/kW \quad (4)$$

From this the levelised capital expenditure (capex) of the heat pump can be calculated.

$$Levelised\ Capex = \frac{Annuitised\ Capex * Capacity}{Heat\ Output} \quad (5)$$

$$Levelised\ Capex = \frac{82.96 * 300}{853.22} = £29.17/MWh \quad (6)$$

The same calculations are carried out to calculate the capital expenditure of the counterfactual technology.

$$Adjusted\ Heat\ Output = 919.80 * 0.93 = 853.22MWh \quad (7)$$

$$Annuitised\ Capex = \frac{73.63 * 0.12 * (1.12)^{20}}{(1.12)^{20} - 1} = £9.86/kWh \quad (8)$$

$$Levelised\ Capex = \frac{9.86\ *\ 525}{853.22} = £6.07/MWh \quad (9)$$

7. Using the illustrative values, the total costs of the heat pump and the counterfactual (CF) technology, per MWh, are calculated below.

$$Capex\ \&\ Operating\ Costs = Levelised\ capex + Opex + Fuel\ cost \quad (10)$$

$$RH\ Capex\ \&\ Operating\ Costs = 29.17 + 1.55 + 47.68 = £78.40/MWh \quad (11)$$

$$CF\ Capex\ \&\ Operating\ Costs = 6.07 + 0.79 + 53.51 = £60.36/MWh \quad (12)$$

Calculating the required tariff

8. The next step is to calculate the net cost which is the difference between the total costs. In calculating the net costs the non-financial barriers associated with installing the renewable heat technology and the counterfactual also need to be considered.

9. For the air source heat pump the net upfront explicit barriers (e.g. admin burdens, demand side barriers and inconvenience to the property owner/occupier) are calculated to be £0.41/MWh. The upfront implicit barriers (e.g. perceived risk barriers) are zero for air source heat pumps. These have been calculated using a rate of return of zero, as they are non-financial costs and as such, no cost of capital should apply to them.

10. The on-going explicit barriers for the renewable technology are the recurring admin and demand side barriers. For an air source heat pump in this specific building type this is estimated to be £0.08/MWh.

11. The net cost is then calculated as follows:

$$Net\ Cost = Levelised\ RH\ Cost - Levelised\ CF\ Cost + Levelised\ Barriers \quad (13)$$

$$Net\ Cost = (78.40 - 60.36) + 0.41 + 0.08 = £18.53/MWh \quad (14)$$

12. The non-domestic scheme differs from the domestic scheme, as the subsidy is paid over the lifetime of the property. In the proposed domestic scheme a shorter payment period is used to overcome some of the barriers that cause home owners to demand high future compensation in order to make early capital investments.

13. The net cost is also the required tariff for that technology.

Establishing a Cost Curve

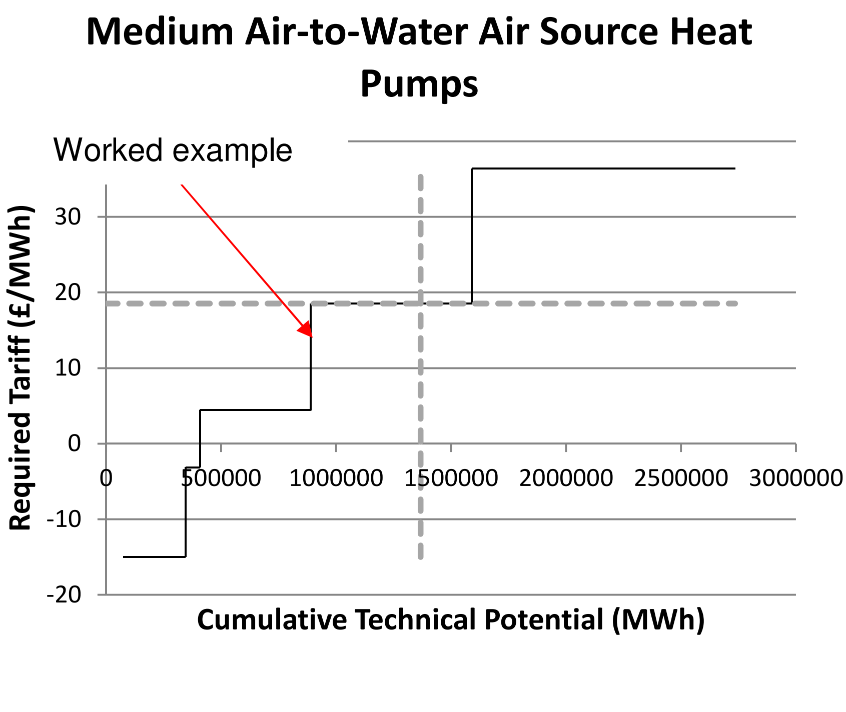
14. Having established the net cost for each property type, the next step is to establish a cost curve for 2014. For this the technical potential of the renewable technology is used. The technical potential is the number of the dwellings of each property type which will be replacing their heating system in 2014 for each building type, multiplied by the proportion of that property type which is considered suitable for that technology and the average heat use of each property.

15. For each technology, all the required tariff data is taken, for all the different property types, and matched with the technical potential for that property type[18.]

16. This data is ordered by the net cost, so the lowest cost opportunities are first, and plotted with the cumulative technical potential to form a cost curve.

17. **Example:** For air-to-air air source heat pumps the net cost in 2013 and technical potentials are taken for all property types which could install a medium size air source heat pump. The data is then ordered in terms of net cost, with the lowest net cost (and therefore the most cost effective) technology first and the highest net cost last. The technical potential is then converted to cumulative figures by considering the technical potential of all the property types which have a lower cost.

18. An illustrative cost curve for all medium air source heat pumps is shown below.



19. The steps in the curve are different building types. The length of the step is how much renewable heat could be produced by that property type and the height of the step indicates its cost per MWh. The arrow on the graph indicates where the worked example is on the curve. For medium air-to-air air source heat pumps, the required tariff is also at around 0.97p/kWh.

[18] This is a slight simplification to the more detailed methodology which excludes barrier costs when deriving the cost curve and adds them back in for the final tariff calculation. For this worked example we have not included these steps, but it makes only a very marginal difference.

Setting the Final Tariff

20. The tariff is then taken as the median cost opportunity. This is the net cost half way along the cost curve which refers to the cost associated with half the technical potential of that technology.

21. For the medium air source heat pump curve, the 50th percentile is at 1,368GWh which corresponds to £18.5/MWh. This is shown in the graph above by the dashed lines.

22. The maximum subsidy rate is capped which is equal to the total support available to off-shore wind in 2014/15 (£113/MWh). If the median net cost (the point halfway up the cost curve) is greater than this levelised cost then the capped subsidy is used. In this instance the tariff is lower than the capped subsidy so this is used as the tariff for all medium air-to-air air source heat pumps.

23. For our example, the air source heat pump is at the same net costs as the median point on the cost curve, which means that all of the additional costs of installing the air source heat pump in that property type will be compensated by the proposed subsidy.

ANNEX 2: Illustration of the impact of uncertainty in cost curves on technical potential and tariff changes

Different combinations of data can lead to different amounts of technical potential for some technologies and different shaped supply curves will also lead to a different scale of impacts from under-incentivising some technologies. Figure 1 shows how the three combinations of data in Table 6 produce radically different supply curves with different underlying technical potentials. Figure 2 illustrates how different supply curves can also lead to very different changes in deployment for the same change in tariff.

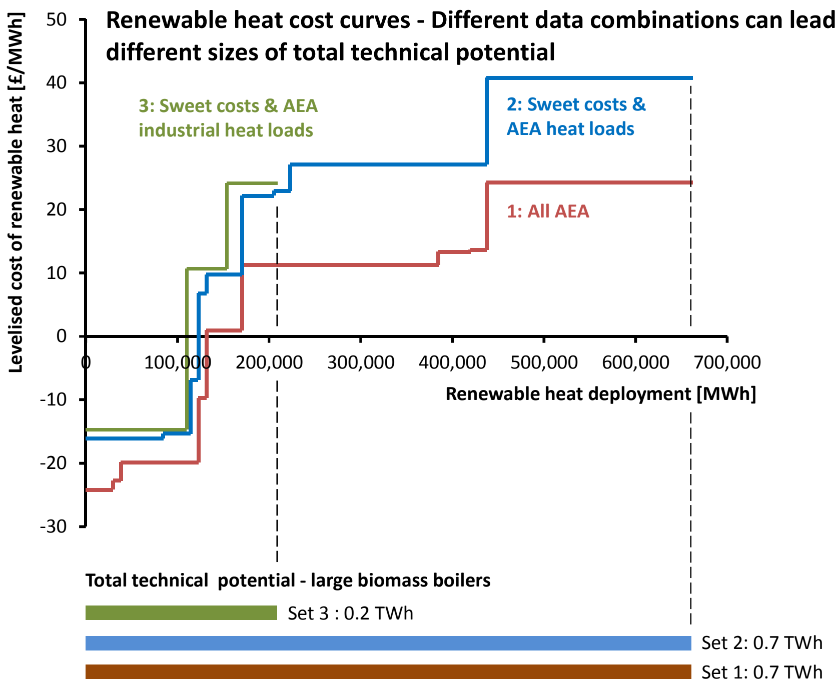


Figure 1: Illustration of the different cost curves produced by different dataset combinations

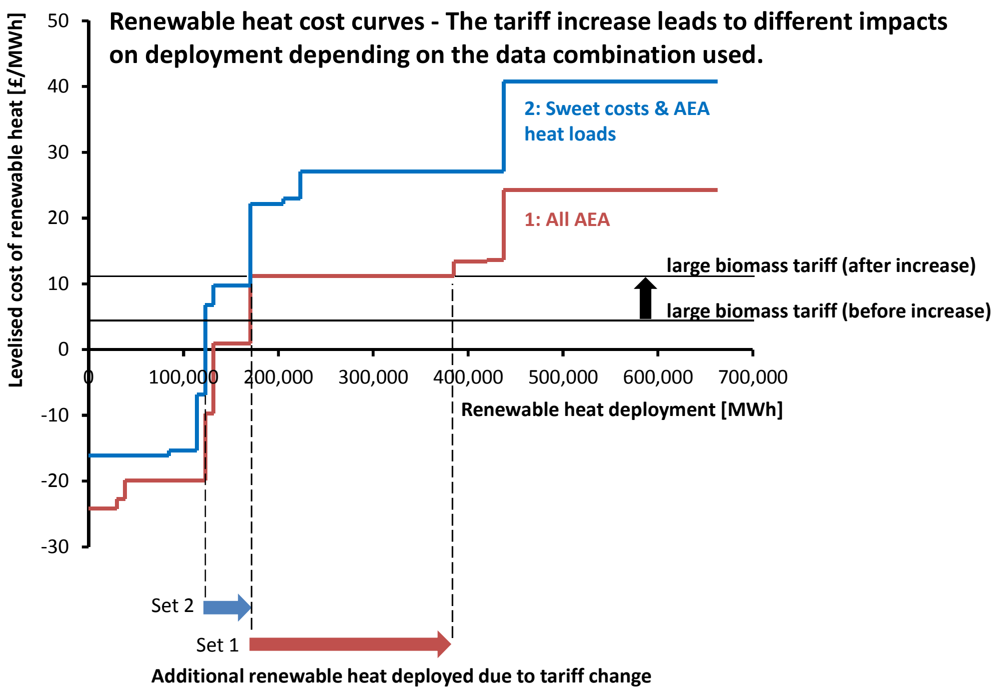


Figure 2: Impact of different cost curves on the amount of additional renewable heat incentivised by a tariff change

ANNEX 3: Comparison of Existing and Proposed Tariffs in 2014 Prices

Table 8: Comparison of Existing and Proposed Tariffs (2014 prices)

Technology		Current Tariffs (2014 Prices)	Proposed Tariffs (2014 Prices)
Biomass Boilers	**Small**	Tier 1: 8.8 Tier 2: 2.3	**NO CHANGE*** **
	Medium	Tier 1: 5.5 Tier 2: 2.3	
	Large	1.0	**2.0**
GSHPs	**Small**	4.9	**7.2*** Implemented as Tier 1: **8.9** Tier 2: **2.3**
	Large	3.6	**8.2**** Implemented as Tier 1: **10.2** Tier 2: **2.3**
Solar Thermal		9.5	**10.0 - 11.3**

* This is equivalent to 10.0p/kWh of renewable heat only
** This is equivalent to 11.3p/kWh of renewable heat only
***Tariffs are subject to existing budget management mechanism / degression.