Title: **Renewable Heat Incentive** **Lead department:** **Department of Energy and Climate Change**	Impact Assessment (IA) **IA No: DECC 0057** **Date: 20/06/2011** **Stage:** Final Proposal

Summary: Intervention and Options

What is the problem under consideration? Why is government intervention necessary?
The renewable heat market is largely undeveloped and has been identified as a sector that could and will have to provide a strong contribution to the UK Government's target of 15% of energy from renewables by 2020 if the target is to be met. A step change in the uptake of renewable heat generating technologies is required. Currently these technologies are unable to compete financially with fossil fuel alternatives and there are a number of market failures that prevent their deployment such as information asymmetries, perceived risks associated with new technologies, and costs of disruption associated with switching. Without government intervention, the private sector is not expected to invest sufficiently to achieve the required uptake levels.

What are the policy objectives and the intended effects?
The objective of the Renewable Heat Incentive (RHI) is to drive a step change in the uptake of renewable heat technologies in order to help deliver an increase in renewable heat from the current 1.5% of total heat demand to a level of 12% by 2020. In order to achieve this the RHI scheme will create a subsidy framework for small, medium and large scale renewable heat generating technologies aimed at, commercial, public and industrial consumer groups. This will enable broad participation of organisations in the transition to a low-carbon economy. As well as providing a direct contribution to the 2020 Renewable Energy Target, the policy is in line with longer-term energy and climate change goals.

What policy options have been considered? Please justify preferred option (further details in Evidence Base)
The RHI consists of tariffs paid to companies who choose to add to the generation of renewable heat. The policy differentiates support levels by technology, size and consumer groups to better target support levels. In order to maximise value for money in achieving the required renewable uptake the Coalition Government has reassessed the proposals put forward under the previous Administration in February 2010 and has decided to: a) Maintain the RHI for the non domestic sector with some adjustments since the February consultation in order to improve value for money. b) Delay the introduction of the RHI for the domestic sector until 2012 in order to further consider cost effective ways of increasing deployment of renewable heat at this scale. The chosen approach improves the value for money of the scheme for the non-domestic sector while maintaining a policy that builds a credible path towards delivering a 12% deployment ambition for renewable heat by 2020. This IA focuses on the costs and benefits of the RHI policy in the non-domestic sector.

When will the policy be reviewed to establish its impact and the extent to which the policy objectives have been achieved?	It will be reviewed 2014
Are there arrangements in place that will allow a systematic collection of monitoring information for future policy review?	Yes

[1] Please put 'RHI IMPACT ASSESSMENT' in the subject line of your email when emailing the RFI inbox

URN 11D/0018

<u>SELECT SIGNATORY Sign-off</u> For final proposal stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that (a) it represents a fair and reasonable view of the expected costs, benefits and impact of the policy, and (b) the benefits justify the costs.

Signed by the responsible Minister:Greg Barker.. Date: 16th June 2011 ....

Summary: Analysis and Evidence

Final Proposal

Description: Final proposals of Renewable Heat support for the non-domestic sector

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2010	2010	30	**Low: -£13.7bn**	**High: £10.5bn**	**Best Estimate: - £4.2bn**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	N/A		£0.25bn	**£4.8bn**
High	N/A		£1.00bn	**£18.6bn**
Best Estimate	N/A		£0.75bn	**£14bn**

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

Cumulative gross resource costs of RHI tariffs over the lifetime of the policy are estimated at around £11.5bn. Estimated subsidy costs over the same period are approximately £22bn.Lifetime monetised health (air quality) costs associated with the use of biomass are estimated at around £1.8bn while ancillary costs projections (e.g. metering and admin burdens) are £0.7bn. All these costs are included in the Present Value calculations

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

Costs of future biomass sustainability regimes are not reflected in this IA.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	N/A		£0.25bn	**£4.9bn**
High	N/A		£0.85bn	**£15.3bn**
Best Estimate	N/A		£0.55bn	**£9.8bn**

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

Monetised benefits include both traded and non-traded carbon savings. Much of the renewable heat uptake will be outside the EU ETS and will represent additional UK carbon savings. Carbon savings inside the EU ETS are valued at £1bn over the lifetime of the policy. Carbon savings outside the EU ETS are valued at £8.8bn over the lifetime of the policy.

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

Additional benefits include: greater diversification of the fuel mix, improved UK competitiveness in green technologies, innovation benefits and reduced technology costs due to learning from wider deployment. These benefits have not been monetised and are not included in the Present Value calculations

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

The analysis assumes a private discount rate of 12% for the assessment of the required tariffs and projected uptake and a 3.5% social discount rate for the calculation of the net present value of costs and benefits. Assumptions on the private discount rate as well as fossil fuel and carbon price are key drivers of the PV ranges. Changes in the renewable technology costs and performance will also affect the above estimates. Costs and benefits of lifecycle carbon emissions are not included in this IA.
The cost estimates also include uptake and costs and benefits of certain non-domestic technologies which are expected to enter the RHI in 2012. Further analysis on these technologies could also affect the composition of projected uptake and the associated costs.

Direct impact on business (Equivalent Annual) £m):			**In scope of OIOO?**	**Measure qualifies as**
Costs: N/A		**Net: N/A**	**No**	Yes/No

Enforcement, Implementation and Wider Impacts

What is the geographic coverage of the policy/option?			Great Britain		
From what date will the policy be implemented?			30/09/2011		
Which organisation(s) will enforce the policy?			Ofgem		
What is the annual change in enforcement cost (£m)?			N/A		
Does enforcement comply with Hampton principles?			Yes		
Does implementation go beyond minimum EU requirements?			No		
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:** -36	**Non-traded:** -209	
Does the proposal have an impact on competition?			Yes		
Distribution of annual cost (%) by organisation size (excl. Transition) (Constant Price)			**Costs:** 0%	**Benefits:** 0%	
Annual cost (£m) per organisation (excl. Transition) (Constant Price)	**Micro**	**< 20**	**Small**	**Medium**	**Large**
Are any of these organisations exempt?	No	No	No	No	No

Specific Impact Tests: Checklist

Set out in the table below where information on any SITs undertaken as part of the analysis of the policy options can be found in the evidence base. For guidance on how to complete each test, double-click on the link for the guidance provided by the relevant department.

Please note this checklist is not intended to list each and every statutory consideration that departments should take into account when deciding which policy option to follow. It is the responsibility of departments to make sure that their duties are complied with.

Does your policy option/proposal have an impact on…?	**Impact**	**Page ref within IA**
Statutory equality duties[2] Statutory Equality Duties Impact Test guidance	Screening	29
Economic impacts		
Competition Competition Assessment Impact Test guidance	Yes	28
Small firms Small Firms Impact Test guidance	Yes	27
Environmental impacts		
Greenhouse gas assessment Greenhouse Gas Assessment Impact Test guidance	Yes	22
Wider environmental issues Wider Environmental Issues Impact Test guidance	No	
Social impacts		
Health and well-being Health and Well-being Impact Test guidance	No	
Human rights Human Rights Impact Test guidance	No	
Justice system Justice Impact Test guidance	Yes	29
Rural proofing Rural Proofing Impact Test guidance	Yes	28
Sustainable development Sustainable Development Impact Test guidance	Yes	29

[2] Race, disability and gender Impact assessments are statutory requirements for relevant policies. Equality statutory requirements will be expanded 2011, once the Equality Bill comes into force. Statutory equality duties part of the Equality Bill apply to GB only. The Toolkit provides advice on statutory equality duties for public authorities with a remit in Northern Ireland.

Evidence Base (for summary sheets) – Notes

Use this space to set out the relevant references, evidence, analysis and detailed narrative from which you have generated your policy options or proposal. Please fill in **References** section.

References

Include the links to relevant legislation and publications, such as public impact assessment of earlier stages (e.g. Consultation, Final, Enactment).

No.	Legislation or publication
1	RHI final Impact Assessment (2011) – www.decc.gsi.gov.uk/rhi
2	RHI consultation (2010) - http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
3	RHI consultation IA (2010) - http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
4	NERA/AEA 2009: The UK supply curve for renewable heat http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/policy/incentive/supply_curve/supply_curve.aspx
5	NERA 2010: Design of the Renewable Heat Incentive http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
6	AEA 2010: Review of technical information of renewable heat technologies. http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
7	SKM-Enviros 2010: Analysis of characteristics and growth assumptions regarding AD biogas combustion for heat, biomethane production and injection to the grid (forthcoming) http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
8	GasTech 2010: Report to DECC on heat metering for the RHI http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
9	Analytical Annex to the Renewable Heat Incentive Impact Assessment (2011) http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx
9	AEA 2011: UK and Global Bioenergy Resource (forthcoming) http://www.decc.gov.uk/en/content/cms/consultations/rhi/rhi.aspx

Evidence Base

Ensure that the information in this section provides clear evidence of the information provided in the summary pages of this form (recommended maximum of 30 pages). Complete the **Annual profile of monetised costs and benefits** (transition and recurring) below over the life of the preferred policy (use the spreadsheet attached if the period is longer than 10 years).

The spreadsheet also contains an emission changes table that you will need to fill in if your measure has an impact on greenhouse gas emissions.

Annual profile of monetised costs and benefits* - (£m) constant prices - INCLUDED AT END OF IA – ANNEX 6

Contents

Strategic overview

1. The UK has a legally-binding commitment to generate 15% of its energy from renewable sources by 2020. The Renewable Energy Strategy (published by the previous administration in July 2009) showed that in order to meet the 2020 target heat, electricity and transport will need to deliver at broadly equally stretching levels. The balance between 12% renewable heat, around 30% renewable electricity and 10% transport was set out as representing the optimal balance of delivering against this target while considering wider objectives such as cost effectiveness, deployment risk, prices impacts, security of supply and initiating investor confidence.

2. The Energy Act 2008 made provision for establishing a Renewable Heat Incentive (RHI) scheme to facilitate and encourage renewable generation of heat. Proposals of how the RHI could be structured to achieve the required deployment in the heat sector were set out in the previous Administration's RHI consultation document in February 2010.

3. The Coalition Government's final RHI policy reflects stakeholder feedback received through that consultation and aim to create a scheme that improves value for money and maximises deployment of renewable heat. The policy also includes a phased approach to implementing the RHI with non-domestic sector being supported from 2011 and the domestic sector coming into the scheme from 2012. This phased approach will allow further consideration of the most cost effective way of increasing renewable heat deployment at this scale.

4. This Impact Assessment (IA) focuses on the costs and benefits of delivery of renewable heat in the non-domestic sector as set out in the RHI policy document. Analysis of the options for the domestic sector and the associated costs and benefits will be published alongside the relevant policy proposals. It updates the Impact Assessment published in March 2011 with additional detail on the impact of the RHI on the woody biomass sector.

Policy Objective / Rational for government intervention

5. The overarching objective of the RHI scheme is to facilitate the heat sector's contributions to the Government's legally binding target of supplying 15% of total energy consumption from renewable sources by 2020 while also delivering significant reduction in the carbon emissions from fossil fuels used for heating. The policy will do this by delivering a step change in the uptake of renewable heat technologies helping to increase renewable heat from its current level of around 1.5% to around 12%.

6. Currently, renewable heat technologies are unable to compete financially with fossil fuel alternatives and there are a number of non-financial barriers which prevent their deployment, such as information asymmetries, perceived risks associated with new technologies and costs of disruption associated with switching. Without government intervention, the private sector is not expected to take investment decisions which will maximize social benefits. In addition the lack of a carbon price outside the EU ETS means that there are limited incentives for investments in low carbon technologies in these sectors. If these failures are not addressed they will prevent the UK from meeting its legally-binding renewables target and from delivering carbon savings through the use of low carbon renewable technologies.

7. In order to achieve this step change the RHI will compensate generators of renewable heat for the difference in up-front and ongoing costs between renewable and fossil fuel generated heat, provide additional compensation to overcome non-financial barriers associated with the uptake of renewable technologies, and pay generators a return on the up-front investment (in order to compensate for the financial opportunity costs of the additional capital expenditure). This support will be encompassed in a pence per KWh subsidy (tariff) for every unit of renewable heat generated.

8. In doing so the RHI will seek to incentivise uptake across a range of technologies and sectors while also minimising the costs to society and avoiding the creation of perverse incentives (e.g. over generation of heat). Details of the operation of the scheme and eligible technologies can be found in the policy document that this IA accompanies.

Final policy proposal

9. This IA assesses the expected impact of the final RHI proposals against a do nothing option. Under business as usual where no RHI or other renewable heat policy is put in place renewable heat is expected to remain at around 10TWh by 2020, representing around 1.5% of the total heat demand in the UK. The RHI final proposals aim to increase that deployment to 68TWh by offering the following support levels to commercial, public and industrial sectors:

Table 1: Final proposals for RHI support levels

Technology	Tariff category (band)	Tariff (p/KWh)	Support formula
Biomass	Small (below 200KWth)	Tier 1: 7.6 Tier 2: 1.9	Tier 1 applies annually up to the Tier 1 Break, tier 2 applies for generation above the Tier Break. The Tier Beak is defined as: installed capacity (KWth) x 15% peak load hours (i.e. 1,314)
	Medium (200KWth and above, but below 1MWth)	Tier 1: 4.7 Tier 2: 1.9	
	Large (1MWth and above)	2.6	Applied to all annual output
Ground Source Heat Pump	Small (below 100KWth)	4.3	Applied to all annual output
	Large (100KWth and above)	3.0	Applied to all annual output
Solar thermal	All (below 200KW)	8.5	Applied to all annual output
Biomethane	All (below 200KWth for onsite biogas combustion)	6.5	Applied to all annual output

10. These support levels aim to improve the cost effectiveness of the scheme compared to consultation proposals published in February 2010 (Annex 2 includes for comparison the support levels as set out in the RHI 2010 consultation).

11. Table 2 compares the costs and benefits of the final proposals with the February 2010 consultation assessment (all the costs are additional to the business as usual).

Table 2: Summary of changes in the costs and benefits of the RHI non-domestic sector from consultation proposals to final proposal[3].

£mn 2010 prices (discounted)	**RHI consultation** (non-domestic only)	**Final Proposal**
TWh of renewable heat		
RHI incentivised TWh	63	57
Business as usual assumption	8	10
Total TWh	**71**	**68**
Total renewable heat as a share of total energy by 2020	**12%**	**11%**
Per annum in 2020		
Subsidy costs	1,700	1,400
Resource costs	1,100	710
Carbon Benefits inside the EU ETS	40	20
Carbon Benefits outside the EU ETS	500	440
Tariff NPV	**-560**	**-250**
Cumulative to 2020		
Subsidy costs	6,380	5,400
Resource costs	4,130	2,750
Carbon Benefits inside the EU ETS	190	100
Carbon Benefits outside the EU ETS	1,800	1,600
Tariff NPV	**-2,140**	**-1,050**
Policy lifetime		
Subsidy costs	24,900	22,000
Resource costs	16,000	11,500
Carbon Benefits inside the EU ETS	630	1,000
Carbon Benefits outside the EU ETS	8,140	8,810
Tariff NPV	**-7,230**	**-1,690**
Ancillary costs		
Air Quality costs	**N/A**	**1,850**
Metering costs	**N/A**	**375**
Admin burdens	**N/A**	**295**
Total NPV	**-7,230**	**-4,210**

All figures are discounted and presented in 2010 prices; figures may not add up due to rounding.
All figures reflect costs and benefits as a result of the impact of the RHI tariffs on consumer attitudes towards renewable heat technologies from 2011 onwards and exclude potential uptake as a result of building regulations or installations put in place from July 2009 to the launch of the scheme.

[3] The costs presented in this table include estimates of costs for CHP and Air to Air heat pumps in the non-domestic sector based on <u>illustrative</u> tariff levels. Further analysis in these areas will be undertaken in the coming years and will be reflected in future IAs as appropriate.

12. This IA sets out changes in the evidence base and the policy that have taken place since the February consultation and explains the wider impacts of the final proposals including carbon savings, air quality and admin burdens.

Approach to assessing costs and benefits

13. The RHI analysis has been carried out using an economic and technical model built by independent consultants (NERA). The model was designed to test possible renewable heat deployment levels under different supply and demand side growth assumptions and to enable testing of various tariff designs (e.g. different tariff levels, tariff bands or tariff lifetimes) and the impact of alternative policy designs on key metrics (e.g. uptake of renewable heat, subsidy and resource costs, CO2 savings, etc.).

14. The below diagram outlines at a very high-level how the model works, and what the key inputs and outputs are. More information can be found in the NERA 2009 and 2010 supporting reports that are referenced in the summary sheets:

Table 3: High-level explanation of the RHI modelling methodology

Key input assumptions	How the model works	Key outputs
- Technology costs, performance and suitability characteristics – both renewable and conventional. - Fuel costs – both renewable and conventional. - The hurdle rate required by investors to invest in renewable heat (discount rate). - The extent to which non-financial barriers to the deployment of renewable heat exist, and the cost of overcoming them. - The capacity of supply chains in the renewable technology markets and the extent to which they could develop between now and 2020.	Tariff levels are set using the principle of a reference installation for each technology band. The final tariffs are based on the difference between the cost (capital and operating) of the renewable and relevant counterfactual technology for each reference installation, taking into account non-financial barriers and a RoR on the additional capital invested. The model then determines potential uptake rates across all segments, based on economically optimal behaviour, once supply side constraints and demand side considerations are taken into account.	- Projected number of installations taken up in the commercial/public, and industrial sectors. - Renewable heat delivered (TWh) and the fossil fuels displaced. - Carbon saved (MtC02). - Resource cost.

Assumptions

15. As shown in the table above a number of economic, technical, and behavioural assumptions underpin the operations of the RHI model and therefore affect the modelling projections. These key assumptions include:

- Renewable and conventional technology assumptions: Uptake of renewable technologies is highly dependent on the relative costs of heat generation from a renewable source compared to conventional fossil fuel heating. The RHI model uses a series of assumptions on renewable and conventional heat costs, sizes, lifetimes and performance characteristics and expected learning rates based on consultants', manufacturers' and other stakeholders' data[4].

[4] See references list, page 4

- Fossil fuel prices and energy demand: The model uses DECC's central published projections for fossil fuel prices and energy demand.
- Investor hurdle rates: In order to model investor behaviour, the modelling assumes that for investments to take place the real rates of return on capital offered by the tariff levels, given technology costs, must be comparable to the assumed investor hurdle rates. The analysis assumes a hurdle rate of 12% based on analysis undertaken by NERA economic consultants[5].
- Maximum supply chain growth rate assumptions: The model also assumes certain expected growth in the supply chain over the period 2011-2020. These growth rate assumptions were based on work undertaken by consultants AEA[6].
- Non-Financial barriers: In addition to the high financial costs associated with the uptake of renewable heat, analysis also shows that investors could face significant non-financial barriers when deciding whether to invest in renewable heat (e.g. the hassle of taking fuel deliveries for biomass boilers). Such costs are included in the RHI model and are based on analysis conducted by Enviros Consultants in this area[7].

Technical changes to incorporate stakeholder feedback

16. Since February 2010 the analysis underpinning the proposed RHI support levels has been updated to reflect information received through the consultation on the technical assumptions as well as the latest published statistics on energy demand and fossil fuel prices. In particular the model used to derive the proposed tariffs and associated costs and benefits of the RHI has been revised in the following areas.
    - Technical assumptions including renewable heat technology costs, efficiency and lifetime assumptions were revised based on work undertaken by independent consultants AEA who reviewed stakeholder feedback on air source heat pumps (ASHP), ground source heat pumps (GSHP), biomass boilers and solar thermal (ST). Details of the revised analysis can be found in accompanying AEA report[8]
    - Costs, potential uptake and required support levels for biomethane injection to the grid were updated based on analysis undertaken by SKM-Enviros , with input from a number of stakeholders - Annex 5 sets out in detail the key assumptions used[9].
    - Energy demand and fossil fuel price assumptions leading up to 2020 were updated in line with the latest DECC projections adjusted for the removal of the RHI levy as announced in the Comprehensive Spending Review in October 2010[10].
    - Biomass availability and price assumptions were revised based on new analysis undertaken by AEA .
    - Business as usual renewable heat deployment was revised to 10TWh (from previous 7TWh) in line with DUKES 2010

However stakeholder feedback did not provide any additional evidence on the behavioural assumptions and the non-financial barriers used in the RHI model. Therefore these remain as published in the February 2010 IA

17. The impacts of these changes in the costs and benefits of the previous proposals are set out in Table 5, page 16

[5] This assumed post tax real discount rate tries to cover the cost of capital or opportunity costs of using scarce capital and the risk associated with the technology
[6] NERA/AEA (2009): The UK Supply Curve for Renewable Heat
[7] Enviros Consulting (2008), *Barriers to renewable heat part 1: supply side*, report for BERR
[8] AEA (2010): Review of technical information on renewable heat technologies
[9] A full report from SKM-Enviros will follow the publication of this IA
[10] See analytical annex for full list of assumptions

Analysis of policy options

Amendments to improve value for money

18. In addition to the above technical changes options for improving the value for money of the non-domestic proposals were also considered. The RHI tariffs have been set with the aim to deliver sufficient renewable heat deployment to enable the UK to meet its renewable target while minimising delivery risks and maximising value for money.

19. For small and medium biomass boilers as well as large GSHP the method for setting the RHI tariffs is to offer the following compensation elements for a reference installation which is close to the median (50%) of the technical potential TWh for each tariff category:

    - Compensation for the difference in up-front and ongoing costs between the renewable technology and an alternative heating source fuelled by gas
    - Compensation for the assumed non-financial barriers (such as the time required to understand what the renewable heat technologies options are)
    - Compensation for the financial opportunity cost of the additional upfront capital investment based on a 12% discount rate assumption.

20. However due to significant variations in the cost effectiveness of individual technologies or due to data limitations in some cases a different approach is used. This is particular the case for the following technologies:

- **Large biomass tariff** (above 1MWth)[11]: As Chart 1 below shows large scale biomass represents the most cost effective of the renewable heat technologies supported under the RHI. In order to ensure that deployment from this cost effective segment is maximised RHI tariffs have been set at a level that gives a 12% rate of return and compensation for the other tariff elements to a reference installation that is at the maximum level of the current costs of this segment.
- **Solar thermal**: Although one of the most developed and best know renewable heat technologies current evidence suggests that solar thermal is the most expensive of the renewable heat technologies in terms of £ per MWh. This resulted under previous proposals in a solar thermal support level that was more than twice that of the next most expensive technology.

  Therefore providing support levels based on the same principle as for all other technologies risks dedicating significant part of the limited RHI resources to a technology that would make relatively limited contributions to the overarching objective of the RHI (i.e. generation of renewable heat).

  One could argue that on this basis solar thermal should not be supported under the RHI. However recognising the uncertainties associated with the future costs and performance of the equipment the final RHI proposals include tariffs for solar thermal installations that are set at a level which is roughly equivalent, in terms of financial support per unit energy output, to the level allocated to what is currently considered to be the marginal cost effective technology required to deliver the UK's 15% renewable target, offshore wind. This results in a support level of 8.5p/KWh[12] .This approach insulates the taxpayer from the risk of over deployment of a very high cost technology while giving some support to consumers that want to install a solar thermal measure at a high costs to themselves and allowing tax payers and consumers to benefit should the cost of installations fall in the future (e.g. due to innovation abroad).

  Under this final proposal although modelled uptake of solar thermal to 2020 is zero in reality some uptake is expected given the experience under the Low Carbon Buildings Programme.

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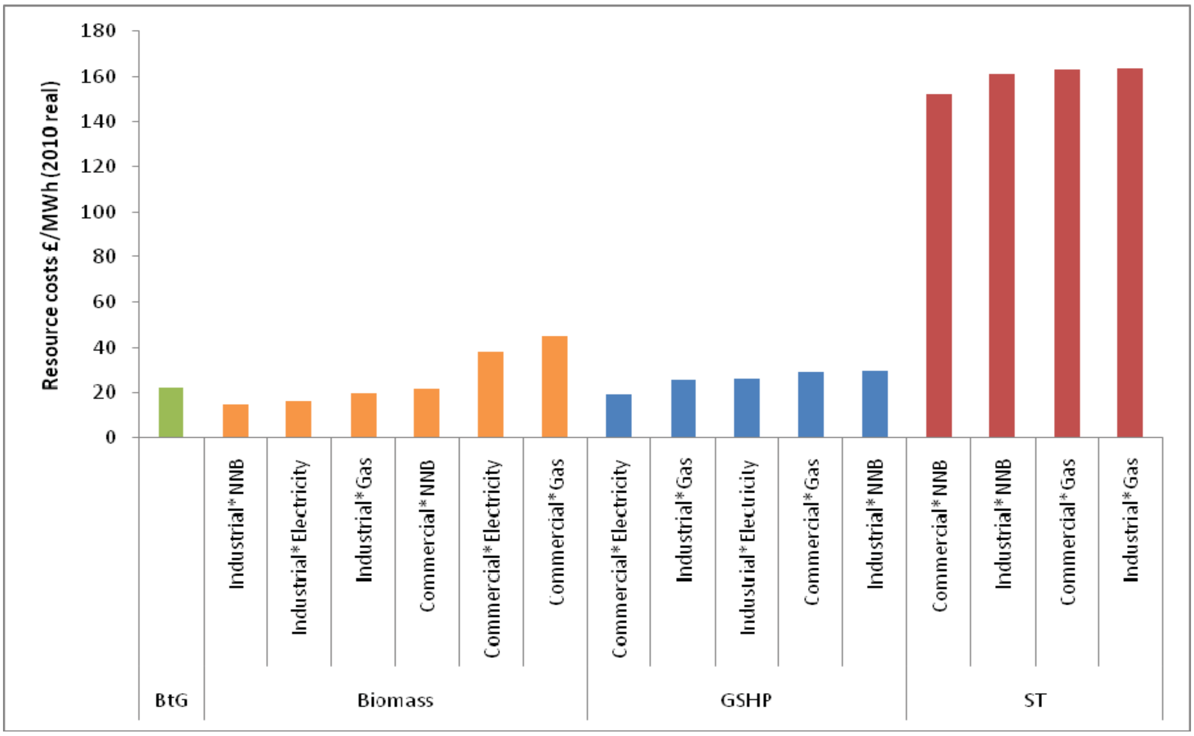
[11]Changes in the biomass boiler tariffs also affect district heating (DH) which as explained in the policy document will receive the same support as the underlying technology they use to produce the heat (which in the modelling is assumed to be biomass boilers)

[12] This is based on the assumptions of average expected ROC prices of approximately £40.69 and LEC value of approximately £5/MWh (all in 2010/2011 prices)

- **Biomethane to grid**: Analysis undertaken by SKM-Enviros provided a series of cost and uptake potential data for biomethane injection to the grid plants under different feedstock assumptions. Based on this data the RHI tariffs were set at a level that based on the analysis allowed the all of the potential TWh from waste injection plants to come forward while also incentivising some of the larger and more costs effective plants that could be using different feedstocks, such as energy crops. (see Annex 5 for details on the assumptions used).

Chart 1: Resource costs per MWh in 2020 of key renewable heat technologies[13]



Note: All the above costs are depended on underlying assumptions on the costs and efficiencies of the technology.
BtG stands for Biomethane to Grid

21. Details of the reference installations selected for each tariff category under the final proposals are presented in Annex 3. An example of the calculation is provided in Annex 4.

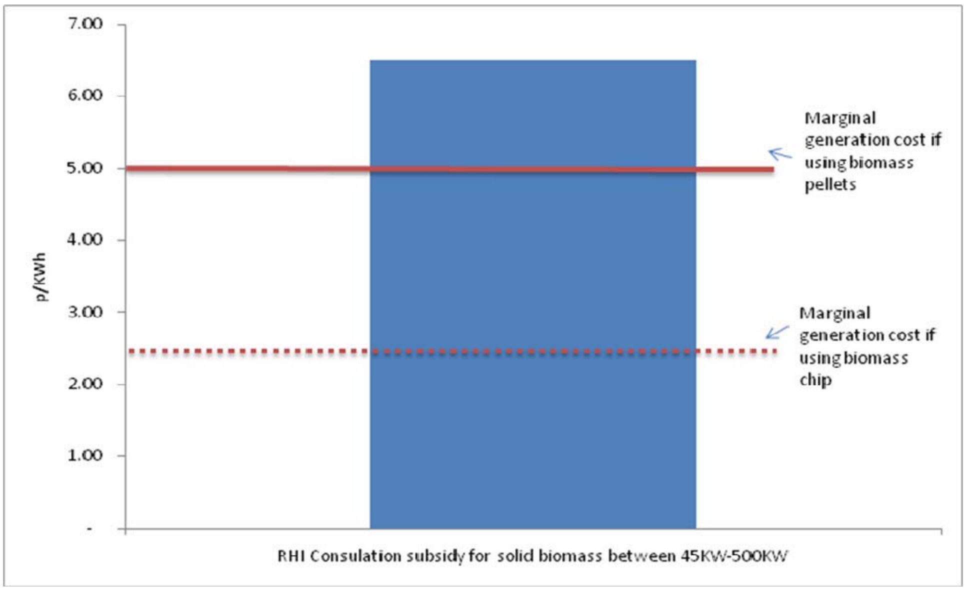
Tiered biomass tariff

22. In addition to the above changes a further modification was undertaken to address the inherent risk of over generation of heat that arose from the structure of the RHI tariffs as set out in the February consultation. As noted in the policy document payments for non-domestic installations will be calculated on the basis of metered output. This reflects the complexity of building occupancy and usage which makes it very difficult to derive a standard deeming methodology across the non-domestic sector. However this means that when installations have the opportunity to receive a tariff that exceeds their marginal costs of generating an extra unit of output the use of metering creates the perverse incentive to over generate heat.

23. An example of this is presented in the graph below which compares the RHI consultation tariff for the 45KW-200KW segment with the marginal costs of generating a unit of heat through biomass pellets and chip[14].

[13] Chart 1 shows an illustration of the costs effectiveness of renewable heat technologies based on the revised technical data in terms of the expected resource cost to society of each TWh of heat generated in 2020 (i.e. not including any transfers or subsidies that may arise out of a particular policy regime). The cost effectiveness is sub-divided by sector (industrial and commercial) and fossil fuel displaced (gas, electricity and "non-net bound" (NNB) fuels such as heating oil and coal).
[14] This assumes 2010 costs based on analysis undertaken by AEA and set out in detail in the accompanying analytical annex.

Chart 2: Perverse incentive to over generate:
RHI consultation subsidy vs marginal generation cost from woodchip and pellets for 45KW-500KW biomass boilers



24. This perverse incentive is expected to be significant for non-domestic biomass space heating installations that are less than 1MWth and which could face heat generation costs below the RHI consultation support levels (originally set 6.5p/MWh for installations between 45kW-500KW).

25. On the other hand we think that this perverse incentive presents less of a problem in the following areas:

- Large (>1MW) biomass plants (process heating): Although venting heat in that segment could be attractive if generators have access to cheap or free fuel, our analysis suggests that at the proposed tariff levels of 2.6p/KWh these installations would have little incentive to over generate (as shows in the graph above). However we will keep this area under review and propose changes to the tariff structure under future RHI reviews if required.
- Solar thermal: The amount of generation is limited by the sun rather than the operator of the installation and we expect solar thermal equipment to be able to have a limited generation capability (about 50% of hot water requirements over a year);
- Biomethane injection: Support for biomethane injection is related to the amount of generation that the plant produces and injects to the grid, not to a specific heat load. Therefore additional generation/ injection that goes directly into the gas grid will always be useful so should be encouraged;
- Heat pumps: depending on the future electricity price and the efficiency of the heat pump, the RHI non-domestic heat pump tariff payments could be higher than the cost of the electricity needed to generate the heat. As Table 4 below shows this is expected to be more of an issue in the 0-100KW segment (for example if in this segment a heat pump has a coefficient of performance of 300% the marginal costs of generating an extra unit of heat will be 3.5p/KW against an RHI tariff of 4.3p/KWh).

Table 4: Illustration of perverse incentive to overgenerate for non-domestic GSHPs

		Cost of electrical input under central electricity cost assumption (p/KWh)		
	RHI tariff (p/KWh)	If 350% COP*	If 300% COP	If 250% COP
0-100KW	4.3	3.0	3.5	4.2
100KW+	3.0	3.0	3.5	4.2

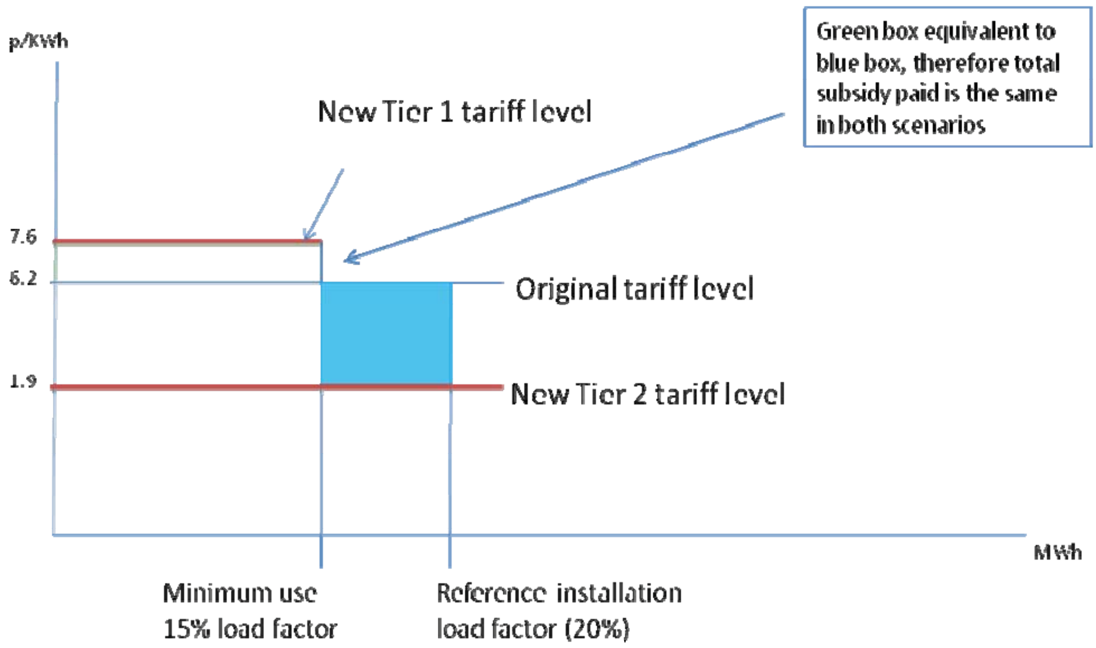
*COP stands for Coefficient of Performance

- However, even if tariffs are higher than electricity costs, generators are unlikely to have sufficient information on the coefficient of performance (COP) at each point in time to exploit this opportunity. Therefore although the risk of perverse incentive could exist in that category it is not considered as acute as for the medium biomass segments. Although no change in the tariff structure is proposed we will monitor this area and if required propose changes in future reviews.

26. In order to address the problem for biomass heat generators in the below 1MW segment the final proposals of the RHI include a 2 part biomass tariff (or tiered tariff). The tiered tariff is split into a Tier 1 higher tariff available for the first 1,300KWh of heat[15] (aiming to cover mainly the capital costs repayment) and a tier 2 lower tariff applicable upon reaching the maximum of the Tier 1 tariff (aiming to cover the fuel costs of the installation). The Tier 2 tariff (at 1.9p/KWh) has been set in a way that removes the perverse incentive to over generate and vent heat for that segment while based on our evidence on gas and biomass prices also provides generators with sufficient support to cover the net cost of the renewable fuel (in line with the principle of the RHI).

27. Chart 3 below shows an example of how the tiered tariff has been calculated for the reference installation in the below 200KW biomass segment.

Chart 3: Calculation of tiered tariff for below 200KW biomass segment



28. In addition to the elimination of the perverse incentive the two tiered tariff also provides the additional advantage of eliminating rents for installations that have higher heat requirements than the reference installation and face lower costs (this is achieved as the installations receive a lower ongoing fuel costs tariff (tier 2) to cover their higher operational time instead of the previously proposed high single tariff which aimed to also cover capital costs)

Additional changes

29. Finally modelling projections were also adjusted to reflect stakeholder feedback on the tariff boundaries and DECC's phased approach on the implementation of the scheme (see policy document for more details). These included in particular:

    - **Rebanding of GSHP and biomass boilers**: Reflecting stakeholder feedback the size boundaries between the bands for GSHP, biomass boilers and solar thermal have been

[15] Based on a minimum heat load factor of 15%.

revised to better target the costs in each size segment as well as better match expected typical installation sizes. The final proposed bands are shown in Annex 2.

- **Phased introduction of certain technologies:**
  - Air Source Heat Pumps and kilns: Due to implementation difficulties associated with the usage and metering of air-to-air heat pumps and biomass non-boilers (for instance kilns) eligibility of these two technologies is delayed and expected to be introduced from 2012 subject to sufficient evidence on costs and eligibility. To reflect the fact that these technologies are expected to become eligible and therefore contribute towards the RHI targets their projected uptake is included in the cost benefit analysis from 2012 onwards.
  - Biomass CHP: Although biomass CHP will be eligible from the beginning of the scheme CHP installations will only be eligible for the dedicated biomass tariff. Introduction of specific tariffs for CHP heat will be considered in time for possible introduction in 2012, and announcements in this respect will be made in line with the timeline for announcements of proposals and decisions on the Banding Review currently underway for the Renewables Obligation. In this interim period it is assumed that CHP installations will opt for the ½ ROC uplift under the RO rather than choose RHI support for the heat output. To account for the CHP potential output in the interim period this cost benefit analysis includes an illustrative profile of CHP uptake under the RO up to 2013 as well as an illustrative uptake under the RHI from 2014 onwards[16]. However actual RHI CHP support levels and related impacts on uptake and RHI costs are subject to further analysis and policy decisions

Additional changes since March IA – impact on industries using woody biomass (including wood panel industry)

30. Following the publication of the RHI Impact Assessment in March 2011 concerns were raised about the impact of the RHI on non-energy users of biomass from wood such as the Wood Panel industry. Isolating the potential impact of the RHI on these sectors is extremely difficult given the potential impact of other policies on the demand of the relevant feedstocks. Nevertheless in order to reflect the finite nature of the feedstocks for biomass including from wood and their competing uses, the AEA Technology analysis that underpinned the availability and prices of feedstocks for the RHI considered other potential uses of biomass and took account of the alternative uses before determining available resources for energy. The conclusions of this work were reflected in the modelling of biomass uptake for this Impact Assessment.

31. Based on final proposals it is estimated that the RHI could incentivise around 28 Terawatt-hours of biomass heat on an input basis by 2020. This is equivalent to a possible overall demand for biomass in the heat sector in 2020 of around 5.3 million oven dried tonnes (odt).

32. AEA Technology analysis looked at various scenarios of the supply of bioenergy feestocks across the economy. This analysis took account of demands of other sectors, including the wood panel industry, before assessing how much could be available for the energy sector. Nevertheless it could be the case that other sectors compete with the energy sector for demand for biomass feedstocks.

33. However, the AEA Technology analysis suggests that there could be sufficient supply (5.3million odt) of UK biomass not suitable for the wood panel industry, namely UK perennial energy crops, agricultural residues and arboricultural arisings to meet all renewable heat demands by 2020. If the RHI used all of this, there would be no impact on the wood panel

[16] Illustrative CHP uptake is based on analysis undertaken by AEA in 2009 and assumes RO driven CHP uptake to 2013 and RHI driven CHP uptake between 2014-2020 under a 2.5p/KWh support.

industry. Current data suggest that wood based panel mills consume just over 2million odt of forest products and residues, the vast majority of which comes from UK sources. The AEA Technology analysis suggests that UK feedstocks suitable for wood panels (stemwood, SRF, sawmill co-products and forestry residues) could be more than double this amount by 2020. In addition, the analysis suggests there could be significant scope for imports of wood based biomass products into the UK. Should supply develop in this way, this would reduce the pressure of the RHI on other sectors. Therefore, while it will be important to monitor the impact on other sectors' demand for feedstocks that compete with the energy sector, initial analysis suggests that UK supply alone could be more than enough to meet the demands of both the wood panel sector and our biomass heat ambition.

34. Despite these estimates it is recognised that the full impact of the RHI on the demand and prices for these feedstocks is very difficult to estimate. To the extent that the biomass market becomes more internationally traded in the future, the impact of the RHI on demand or prices is likely to be limited. . An analysis of the potential impacts of UK bio-energy policies on other sectors of the economy will be considered as part of the Government 's review of the bio-energy strategy which is currently under way and expected to be completed in Autumn 2011.

Sum of impacts

35. Table 5 below shows the impact of the technical changes and the policy options on the tariff part of the RHI costs and benefits. This table repeats information included in Table 2 but additionally disaggregates the impact of the technical changes only.

Table 5: Summary of changes in the costs and benefits of the RHI non-domestic sector from consultation proposals to technical changes and final proposal[17].

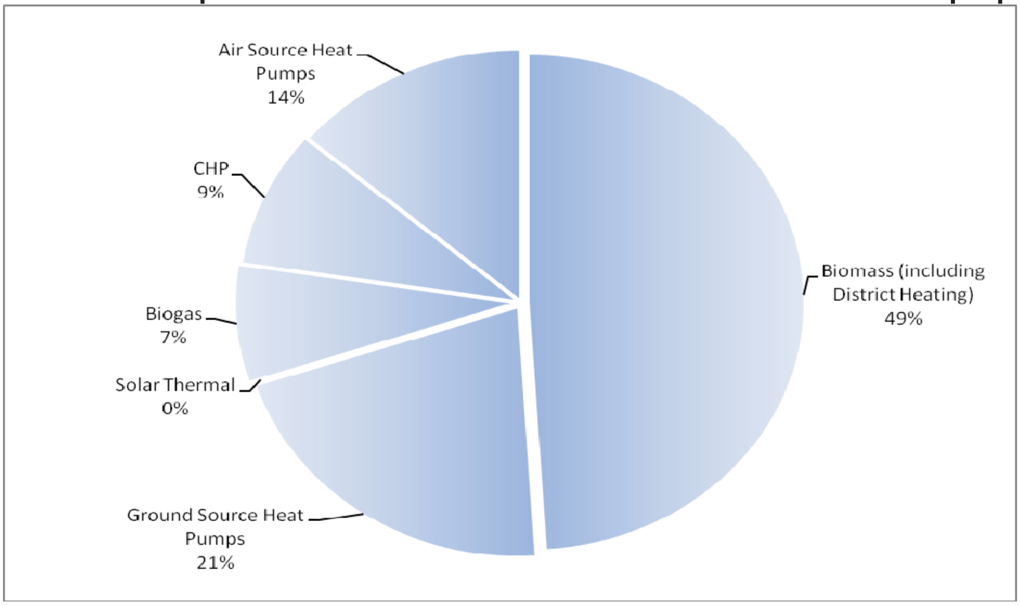
£mn 2010 prices (discounted)	RHI consultation (non-domestic only)	Technical changes	Final Proposal
TWh of renewable heat			
RHI incentivised TWh	63	53	57
Business as usual assumption	8	10	10
Total renewable heat as a share of total energy by 2020	**12%**	**10%**	**11%**
Per annum in 2020			
Subsidy costs (costs to consumers)	1,700	1,300	1,400
Resource costs	1,100	870	710
Carbon Benefits inside the EU ETS	40	25	20
Carbon Benefits outside the EU ETS	500	390	440
Tariff NPV	**-560**	**-455**	**-250**
Cumulative to 2020			
Subsidy costs (costs to consumers)	6,380	5,220	5,400
Resource costs	4,130	3,480	2,750
Carbon Benefits inside the EU ETS	190	110	100
Carbon Benefits outside the EU ETS	1,800	1,500	1,600
Tariff NPV	**-2,140**	**-1,870**	**-1,050**
Policy lifetime			
Subsidy costs (costs to consumers)	24,900	20,400	22,000
Resource costs	16,000	14,200	11,500
Carbon Benefits inside the EU ETS	630	1,200	1,000
Carbon Benefits outside the EU ETS	8,140	7,730	8,810
Tariff NPV	**-7,230**	**-5,270**	**-1,690**

All figures are discounted and presented in 2010 prices; figures may not add up due to rounding.
All figures reflect costs and benefits as a result of the RHI tariffs on consumer attitudes towards renewable heat technologies from 2011 onwards and exclude potential uptake as a result of building regulations or installations put in place from July 2009 to the launch of the scheme.

[17] The costs presented in this table include estimates of costs for CHP and Air to Air heat pumps in the non-domestic sector based on illustrative tariff levels. Further analysis in these areas will be undertaken in the coming years and will be reflected in future IAs as appropriate.

36. Chart 4 below provides an illustration of the potential composition of additional renewable uptake by 2020 based on the proposed tariffs. This composition is based on the RHI model projections and does not represent a technology specific ambition. As modelling assumptions are uncertain in reality it is likely that the final mix will be different from this illustration.

Chart 4: Illustrative composition of additional renewable resource in final RHI proposal, 2020



37. The rest of the IA focuses on the wider impacts of the final proposals and also present some key sensitivity analysis..

Climate Change Policy Cost Effectiveness Indicator[18]

38. Cost effectiveness (CE) analysis provides an estimate of the net social cost per tonne of GHG reduction resulting from the policy. The calculation of the CE indicator is based on the following methodology:

$$\text{Cost effectiveness of traded carbon} = \frac{\text{PV costs– PV Benefits (traded carbon savings)}}{\text{Carbon saved in traded carbon}}$$

$$\text{Cost effectiveness of non- traded carbon} = \frac{\text{PV costs – PV Benefits (non traded carbon savings)}}{\text{Carbon saved in non - traded sector}}$$

39. Because of the large variation in size and sectors covered by the Renewable Heat Incentive the policy is expected to contribute to carbon savings both inside and outside the already capped emissions of the EU Emissions Trading Scheme. The policy wide cost effectiveness indicators presented in Table 6 capture the carbon savings related to the uptake of renewable heat due to the RHI support mechanism.

40.

[18] http://www.decc.gov.uk/assets/decc/statistics/analysis_group/122-valuationenergyuseggemissions.pdf

Table 6: Policy lifetime cost effectiveness indicators under lead scenario [19]

£/tCO2	**Cost Effectiveness**
Policy lifetime cost effectiveness per tonne of traded carbon	£35/tCO2
Policy lifetime cost effectiveness per tonne of non- traded sector	£48/tCO2

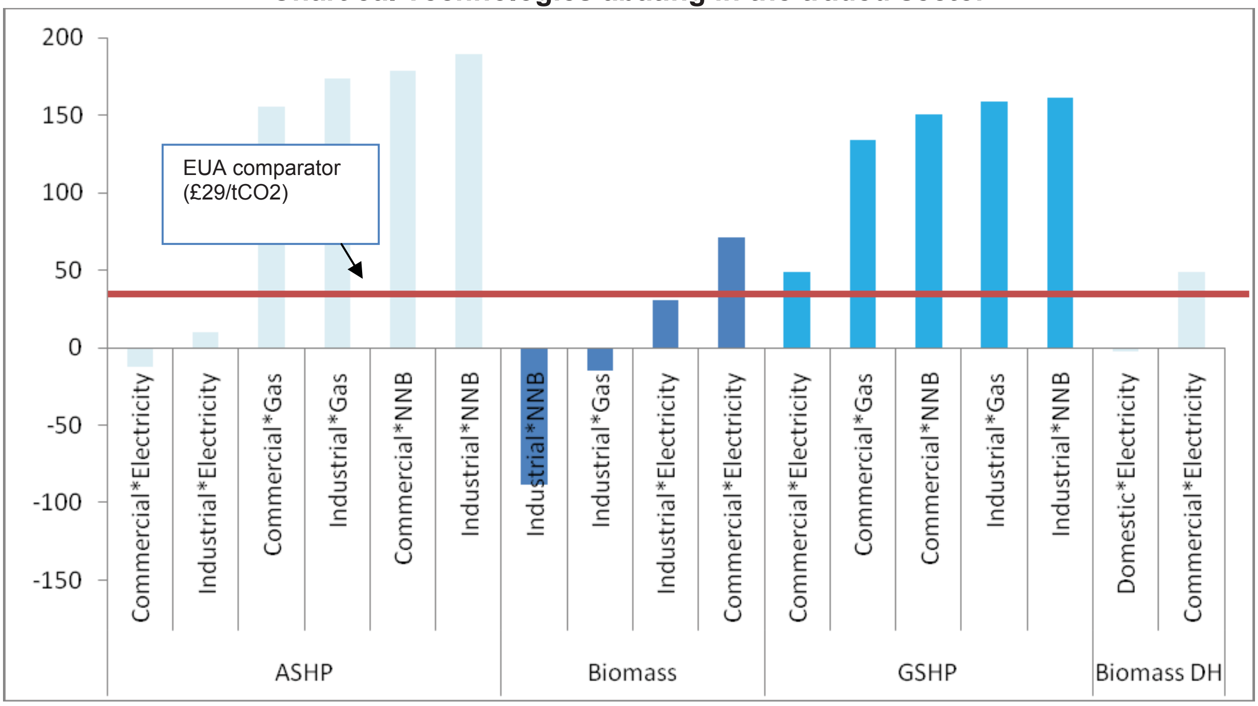
41. However the above cost effectiveness indicators are policy wide indicators and do not reflect the fact that cost effectiveness of individual technologies will vary significantly (especially depending on the fuel that the renewable heat displaces). Graphs 5a and 5b below show the cost effectiveness of individual technologies that could be undertaken under the RHI based on the final proposed tariffs against the comparators of a weighted average discounted non traded carbon price (£42/tCO2) and a weighted average EU Allowance price (£29/tCO2).

42. Based on the breakdown shown in Graphs 5a and 5b modelling projections show that around 63% of the carbon savings projected to occur through the RHI could be cost-effective on an average basis. i.e. occur below the weighted average discounted non traded price of carbon or the weighted average discounted EU allowances price.

43. It should however be noted that these indicators illustrate cost effectiveness based on the modelled assumptions of costs and technology efficiencies. In reality costs effectiveness will depend on the exact characteristics of the technology and the patterns of renewable uptake (which are likely to differ from the modelling results presented here).

Chart 5: Cost effectiveness indicators of key renewable heat technologies[20,21]

Chart 5a. Technologies abating in the traded sector

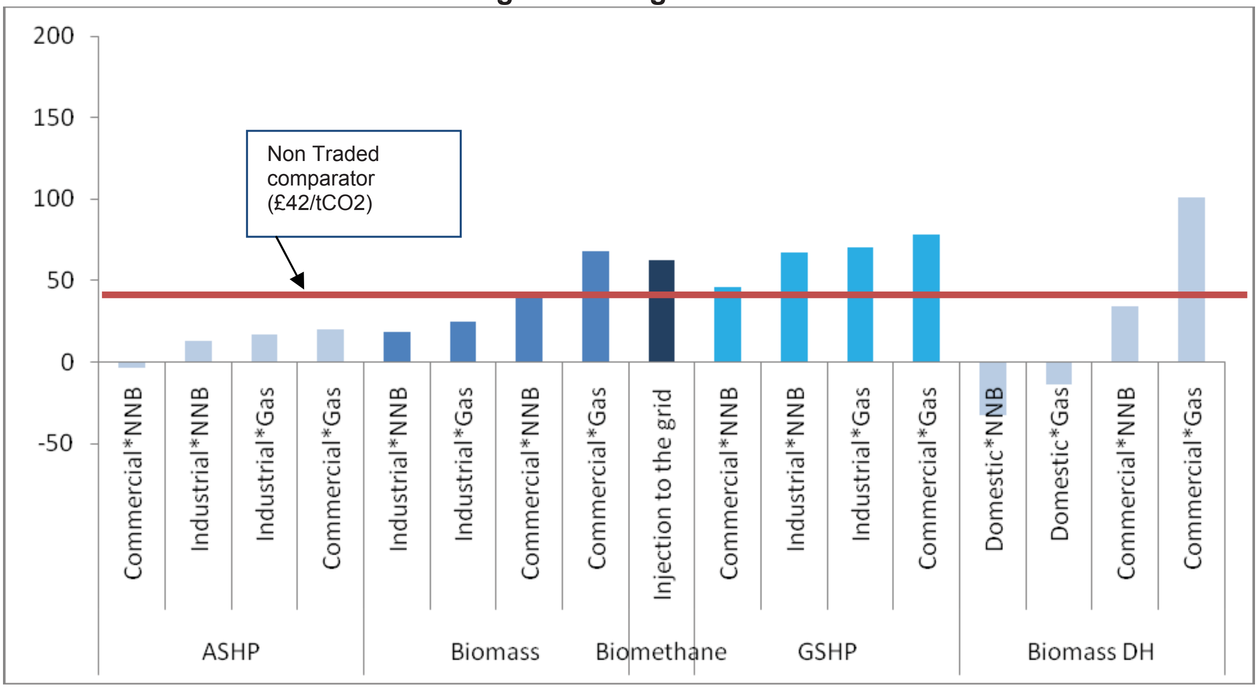


[19] The cost effectiveness numbers do not include ancillary impacts such as air quality. This is because air quality impacts are calculated through a separate DEFRA model leading to the following limitations: the impacts are based on the biomass uptake patterns as set out in the RHI February consultation; no details are available of how these impacts will be spilt between EU ETS and non EU ETS sectors.

[20] The cost effectiveness tables include estimates for Air to Air heat pumps in the non-domestic sector based on uptake patterns under illustrative tariff levels. Further analysis in these areas will be undertaken in the coming years and will be reflected in future IAs as appropriate.

[21] The domestic biomass district heating cost effectiveness indicators are based on 1.2MWth installations that serve domestic properties through a district heating network. As explained in the RHI policy these installations are covered by the RHI policy from 2011. The DH cost effectiveness estimates are based on cost data as set out in the NERA/AEA 2009 report and it is used here for illustrative purposes as this data and the associated uptake based on the RHI biomass tariffs is highly uncertain and has not been used for any of the tariff setting.

Chart 5b: Technologies abating in the non- traded sector:



Notes:

- NNB refers to Non-Net Bound fuels (e.g. off the gas grid fuels which include coal, heating oil and LPG)
- The calculations do not reflect lifecycle emissions factors
- The costs are net of the counterfactual costs

Qualitative statement:

44. Even though some of the RHI supported technologies do not meet the above cost effectiveness test, their deployment is crucial in enabling the UK to meet its legally binding EU target of 15% renewable energy by 2020. The above cost effectiveness indicators also fail to capture wider benefits related to innovation (including long-term benefits of bringing new technologies to market and reducing their costs by deploying them), business development, community engagement and diversification of energy supplies, which although less tangible can be equally important to the UK economy and our long-term carbon and energy security goals.

Sensitivities and general uncertainties

45. The central estimates presented above are based on a series of assumptions that affect the modelled uptake patterns of renewable heat. Although the economic model used to estimate these costs provides the best available evidence base for projecting the overall costs of the RHI policy it should be recognised that this represents just one potential deployment scenario which is highly sensitive on the modelling assumptions used.

46. In looking at sensitivities around the RHI projections there are number of parameters that will affect the realised costs and uptake (e.g. how the actual incentives affect investors' behaviour compared to the modelling projections and whether incentives are adjusted to reflect the differences between projected and real uptake). Capturing all these parameters is extremely difficult. However for illustrative purposes we have undertaken two sets of sensitivities[22]:

    a. Sensitivities on parameters that are not easily observable (e.g. hurdle rates and supply and demand side constraints that are different than assumed) and as a result initial support levels are maintained constant and

    b. Sensitivities of parameters that are easily observable (e.g. fossil fuel, carbon and biomass prices) and where support levels are revised at the time of the first RHI review (2014) to bring deployment back in line with central projections.

47. In all the above sensitivities modelling projections do not take into account degression mechanisms expected to be put in place in 2012 and which could lead to changes in the RHI support levels for new installations affecting uptake before the planned RHI review in 2014.

[22] In all these sensitivities CHP uptake and costs are kept constant

a) Sensitivity of the projected uptake under different hurdle rates, supply and demand side constraints

48. In this sensitivity RHI support levels are maintained constant throughout the period of the scheme while assumptions on hurdle rates and demand and supply side constraints are changed to represent different states of the world. In these sensitivities, as support levels are constant, the total TWh of renewables deployed changes according to the relative attractiveness of the incentives under the different scenarios.

49. As the results in Table 7 show if supply and demand side constraints were higher than assumed in the central projections, and support levels were not changed accordingly, the TWh of renewable deployment by 2020 could be reduced to 53TWh, i.e. around 15TWh lower than currently projected.

50. On the other hand modelling shows that should investors hurdle rates be higher than projected (e.g. 16% instead of 12%) then the support levels provided by the scheme may still be able to bring forward sufficient deployment to generate 65TWh of renewable heat by 2020. This implies that if this was the only parameter that changed the support levels could have sufficient buffer in them for the majority of the modelled installations to come forward.

51. However if hurdle rates were lower than assumed (e.g. 8% instead of 12%) one would expected significantly higher uptake since the support levels would be more generous than required. However modelling shows that supply-side (growth) and demand-side (suitability and penetration) constraints are likely to prevent uptake from increasing significantly, even if the tariffs are highly attractive. In this sensitivity uptake increases from 68TWh to 70TWh.

52. Finally under all these sensitivities the different assumptions will also affect the composition of the uptake, therefore affecting the total subsidy costs of the scheme. This impact is more pronounced on the lifetime subsidy costs of the scheme. However 2014 subsidy costs could also be affected with the sensitivities showing approximately a +/- 10% variation in the costs.

Table 7: Hurdle rate, supply side and demand side growth sensitivities on final tariff proposals

				Hurdle rate price sensitivities	
£mn 2010 prices (discounted)	**Best Estimate**	**Higher supply side constraints**[23]	**High demand side constraints (market penetration)**[24]	**Low hurdle rate (8%)**	**High hurdle rate (16%)**
Total TWh (including BAU)					
in 2014	18	18	18	19	18
in 2020	68	53	53	70	65
Costs					
Cumulative to 2014					
Subsidy costs	505	485	470	555	435
Resource costs	250	245	265	220	265
Policy lifetime					
Subsidy costs (costs to consumers)	22,000	16,600	16,900	23,900	20,200
Resource costs	11,500	7,960	9,330	10,400	13,100
Carbon Benefits (inside and outside the EU ETS)	9,810	7,390	7,220	10,280	9,420
NPV	-1,690	-570	-2,110	-120	-3,680

23 In this sensitivity supply chain growth assumptions for ASHP, GSHP and biomass boilers fall to a maximum growth rate of 25% (on average) over the period 2016-2020 from the central assumptions of 33%

24 In this sensitivity the renewable heat share in new heating equipment is reduced from a maximum of around 90% in the central scenario to 50%. This means that the expected penetration of renewable heat as part of the total demand for new heating equipment is reduced.

b) Sensitivities of the projected costs under different fossil fuel, carbon prices and biomass prices

53. Under these sensitivities the RHI modelling is carried out in a way that allows the RHI tariffs to be amended in 2014 (the time of the first scheduled review) in order to ensure that the RHI continues to deliver a similar amount of uptake by 2020 as under the central projections.

54. In general the higher the prices of fossil fuels the more attractive renewable technologies become as the opportunity cost of not using renewable technologies increases (with the exception of heat pumps which can be disincentivised as fossil fuel prices rise since they require electricity to run). As Table 8 shows this means that by 2014 the resource costs of the scheme will be significantly lower (due to the fossil fuel technologies becoming more expensive) - £60mn resource costs instead of £250mn under the best estimate projections, while the subsidy costs of the scheme could marginally increase as uptake also increases.

55. However once support levels are adjusted to reflect these higher fuel costs the tariff lifetime subsidy costs of the scheme will be lower than under the central projections (from £14.7bn from £22bn). At the same time the higher fossil fuel prices combined with higher carbon prices will also significantly improve the NPV of the policy (to £12.9bn from -£1.7bn). The opposite situation occurs under the low fossil fuel prices assumption.

56. The relative price of biomass fuel will also affect the composition of the renewable technologies uptake and the associated RHI costs. For example low biomass prices will make biomass installations more attractive compared to fossil fuel technologies or other renewable alternatives. By 2014 this could mean different composition of renewable uptake (and therefore potentially lower costs). However once tariffs are adjusted lifetime subsidy costs could be significantly lower for the same degree of renewable deployment (e.g. £17.6bn from £22bn).

57. Although biomass sensitivities are important, modelling shows that the impact of these sensitivities is less pronounced than the impact of fossil fuel prices. Therefore the range of costs and benefits presented in the summary sheets reflects the fossil fuel prices sensitivities presented in Table 8 below.

Table 8: Fossil fuel, carbon price and biomass price sensitivities on final proposals

		Fossil fuel and carbon price sensitivities[25]		Biomass price sensitivities[26]	
£mn 2010 prices (discounted)	**Best Estimate**	**Low FF prices, low carbon prices**	**High-High FF prices, high carbon prices**	**Low biomass prices**	**High biomass prices**
Total TWh (including BAU)					
in 2014	18	18	19	18	18
in 2020	68	67	70	68	68
Costs					
Cumulative to 2014					
Subsidy costs	505	510	515	495	490
Resource costs	250	305	60	205	258
Policy lifetime					
Subsidy costs (costs to consumers)	22,000	29,900	14,700	17,600	24,600
Resource costs	11,500	16,000	2,430	8,840	13,400
Carbon Benefits (inside and outside the EU ETS)	9,810	4900	15,300	9,850	9,830
Tariff NPV	-1,690	-11,100	12,870	1,010	-3,570

General uncertainties:

58. As noted above all the costs presented in this IA are based on key assumptions about uptake patterns which are determined by underlying growth and other modelling parameters. As with any model all these assumptions are subject to a degree of uncertainty. Although we have tried to partly capture this uncertainty through the above mentioned sensitivities the model outputs should be regarded as illustrative best estimates and treated with the appropriate degree of caution. In reality the uptake under the RHI will be demand-led and will be driven by uncontrollable factors, and therefore even short term projections of costs are subject to a wide range of uncertainty.

59. The numbers also fail to accurately capture the fact that the policy options presented here will be subject to regular reviews over the period leading up to 2020 which will allow adjustments of the support levels and structure of the scheme based on the latest available information including up-to-date information of uptake as well as underlying technology costs and fossil fuel prices. The costs presented here also include illustrative estimates for certain technologies that are currently expected to be phased in the RHI in 2012 – namely non domestic Air Source Heat Pumps, large scale biomass kilns and CHP. Further analysis in these areas is expected to impact on the currently estimated costs.

60. Finally although the above sensitivities highlight the impact of certain assumptions on the RHI uptake and tariffs, in reality big changes in these core underlying parameters will require a full review of the support levels and their impacts of deployment (which is beyond the scope of this IA). Therefore even the ranges of costs and benefits presented in the summary sheet should be treated with caution.

[25] Fossil fuel price assumptions correspond to oil prices of $60 (low), $80 (central) and $150 (high-high) per barrel of oil in 2020

[26] Biomass price assumptions correspond to £38/MWh (low), £53/MWh (central) and £61/MWh (high) for pellets in 2020 and £17/MWh (low), £23/MWh (central) and £27/MWh (high) for woodchip.

Ancillary Impacts

Impacts on bills

61. When the previous Impact Assessment was published the previous administration was still considering the way in which the RHI should be funded. The IA contained an assessment of the impacts of a potential levy on gas bills that was the primary option for funding the RHI. As announced in the 2010 Spending Review the current administration has decided against introducing such a levy. There will therefore be no direct impact on fossil fuel bills arising from the RHI and as a result no energy bill impact analysis is presented here.

62. It should however be noted that under the high levels of renewable heat uptake projected in our lead scenario, a number of businesses are expected to switch from using fossil fuels to a renewable technology as their primary source of heating. These investors will benefit from the receipt of a tariff payment under the RHI scheme. Depending on the patterns of uptake between different heat user segments (e.g. with respect to business-type and location) the RHI could have different distributional impacts. These uptake patterns will be monitored once the scheme is launched through detailed data collection which will be undertaken by Ofgem.

Impacts on Carbon Emissions

63. The widespread deployment of renewable heat technologies supported by the RHI tariff is expected to reduce the amount of carbon emitted into the atmosphere as these technologies emit less carbon than the fuels they replace (or do not emit carbon at all).

64. Table 9 below shows estimated carbon savings both inside and outside the EU ETS, split by Carbon Budget periods as a result of the RHI support levels under the final proposals.

Table 9: Projected carbon savings under final proposals

MtCO2 (NET)	Total	In EU ETS	Outside EU ETS
1st Carbon Budget Period (2008-2012)	1	0	1
2nd Carbon Budget Period (2013-2017)	15	3	11
3rd Carbon Budget Period (2018-2022)	52	8	44
Total policy lifetime	245	36	209
Cumulative to 2020	44	8	36

Figures may not add up due to rounding

Impacts on electricity market

65. Heat pumps (both air source and ground source) will require electricity to run. Current analysis suggests that in 2020 heat pumps could require approximately 5.4TWh of electricity in order to operate. However at the same time renewable heat technologies will be reducing electricity demand by displacing electric heating. The reduction in electricity demand based on current analysis is estimated at around 5.3TWh. This suggests that the net impact of the RHI on the electricity market will be minimal.

Impacts on Air Quality from RHI

66. The RHI is expected to incentivise biomass installations which result in negative air quality impacts where they replace gas heating. DECC has worked with Defra to assess and quantify the air quality impacts of the RHI.

67. The most significant air quality impacts are expected to come from particulate matter (PM10) and nitrogen oxide (NOx) emissions from the combustion of biomass. Where the counterfactual

technology being replaced is a non net-bound fuel such as heating oil or coal, the impacts can be positive, however, where biomass is displacing electricity or gas fired heat, the impacts are negative. These impacts are felt more strongly in areas of high population density, or urban areas, but are less pronounced in rural areas.

68. The impacts also depend on the size of the biomass installation. The regulatory regimes that apply to different sizes are:

- Large scale (over 50MW): Emissions from biomass installations are regulated by the Integrated Pollution Prevention Control (IPPC) legislation administered by the Environment Agency or the Scottish Environment Protection Agency.
- 20 to 50MW: Individual units are regulated by the Scottish Environment Protection Agency or local authorities in England and Wales.
- Below 20MW, there is currently no regulation that applies across the UK. The Government will look to introduce emission performance standards in 2012 for biomass boilers under 20 MW size which are not currently adequately covered by other legislation.

Air quality impact modelling

69. The RHI air quality modelling assumes maximum emission standards for biomass boilers of 30 g/GJ for particulate matter and 150 g/GJ for nitrogen oxide from 2012 onwards. In the results presented below these limits are referred to as emission limit values (ELVs). In order to reflect these requirements the modelling assumes that each biomass installation will install an emissions filter. The cost of this filter has been assumed to be 10% of the upfront capital costs of the installation based on a consultancy estimate. The overall cost of these filters is reported within the present value cost estimate shown for each scenario presented in this IA.

70. However even with these filters burning of biomass is expected to result in social costs due to health and ecosystem impacts. Modelling of these costs is undertaken by DEFRA using the UK's 2006 National Atmospheric Emissions Inventory (NAEI) and the Defra Impact Pathway approach[27].

71. Owing to the length of time required to model the air quality impacts this IA uses impacts derived from a range of biomass uptake based on the February 2010 consultation proposals . Table 10 below shows a summary of the different scenarios used for the AQ impacts.

72. The February 2010 consultation scenario shown in the table was that presented in the previous RHI Impact Assessment, which contained an assessment of the impact on the domestic sector. The high biomass uptake scenario is based on this scenario, but assumes high-high fossil fuel prices and that investors have a lower hurdle rate of 8%. The low biomass uptake scenario has high biomass prices and a higher hurdle rate of 20%. Although these scenarios are illustrative and do not relate directly to the final proposals the scenario closest to the final proposal scenario in terms of biomass burned is the consultation scenario.

Table 10: Assumptions on biomass burned for calculation of Air Quality Impacts

TWh by 2020	Consultation scenario	High biomass uptake	Low biomass uptake
Rural	21	24	16
Suburban	7	12	6
Urban	2	3	2
Total	**30**	**39**	**24**

[27] http://www.defra.gov.uk/environment/quality/air/airquality/panels/igcb/pathway.htm

73. Based on these potential uptakes the following AQ impacts were estimated[28]

Table 11: Estimated air quality costs

Lifetime social cost of air quality impacts (£m, Present Value, 2010 prices)	RHI scenario		
	Consultation scenario	**High biomass uptake**	**Low biomass uptake**
ELVs of PM_{10} – 30g / GJ and NO_x – 150g / GJ are introduced in 2012	£1,850	£2,600	£1,900

**Value used in summary sheet*

74. The impacts of biomass burning on AQ depend not only on the amount of biomass burned but also on the composition of this uptake (e.g. urban vs suburban, large vs small etc). For this reason as table 11 shows although the low biomass scenario has 6TWh less biomass than the previous lead scenario it has a higher AQ impact owing to the greater amount of biomass being burned in urban areas.

75. The final RHI proposals could lead to 28TWh of biomass burned. This is closest to the consultation scenario. However, owing to the reasons mentioned above the AQ impacts of this uptake could be higher or lower than this scenario. In addition all the above scenarios include some uptake of domestic biomass which is not included in the final proposals. Therefore the above costs may overestimate the actual AQ impacts of the final proposals (although domestic biomass only accounts for 5% of the modelled uptake).

76. Despite these limitations for completeness the summary costs and benefits of this IA includes the estimated costs of the burning of biomass as derived based on the February 2010 consultation scenario. The Impact Assessment accompanying the final version of the regulations will contain an air quality assessment based on the final RHI proposals.

Metering costs

77. The total RHI subsidy to each installation is paid on the basis of multiplying the kWhth of heat generated by the renewable heat technology by the relevant tariff. The Government has decided that due to the complexity of building occupancy and usage, it is not feasible to establish a suitable methodology for estimating ("deeming") heat demand in the non-domestic sector. This, combined with analysis that showed that the relative costs of heat meters should not be an obstacle to deployment, led to a decision that the non-domestic renewable heat output will be metered.

78. For organisations to claim the RHI, a Class 2 heat meter is required to determine the amount of heat generated by the renewable heat installation. Further heat meters will also be required for complex installations, but these have not been included in the analysis presented here.

79. In this IA we have estimated a potential range of costs associated with the metering requirements for Class 2 meters based on a report from Gastec consultants, which is published alongside the consultation.

80. The projected uptake of different renewable heat technologies from the RHI model, in different size categories, has been combined with estimates of metering costs from the GasTec report. As for each size of installation category there are a range of metering costs which could apply this has resulted in a range of metering costs.

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[28] The costs quantifies and monetises the following impacts:

- Mortality effects - life years lost, deaths brought forward
- Morbidity effects - hospital admissions and restricted activity days
- Change in amenity
- Productivity impacts
- Ecosystem impacts
-

81. Given the large variation of costs arising from differences in size of installation, for the purposes of this IA we have assumed upper and lower bounds for metering costs, reflecting the range of costs in each size category. These costs are presented in Table 12 (note that it is very unlikely the upper or lower bound will be met as that would mean only the smallest or largest installations in each category are incentivised through the RHI)

Table 12: Estimated metering costs

	Lower estimate	Upper estimate
Total Present Value of metering costs (2010 prices)	£250 million	£500 million

82. The summary of the costs and benefits of the final proposals includes in the best estimate the midpoint of this range.

Admin costs and Admin Burdens

Non-domestic admin costs

83. Firms may incur costs when investigating renewable heat technology options. These costs, such as the time required to research what a suitable renewable technology may be, have been included in the non-financial barriers of the tariff setting and uptake modelling.

Admin Burdens

84. As part of the Government's Better Regulation agenda[29,] DECC is monitoring the impact of its regulations on business and taking initiatives to minimise the administrative burden they impose. An administrative burden is the cost to business of the administrative activities that it is required to conduct in order to comply with information obligations imposed on it through central government regulation. This includes activities businesses have to perform in order to remain eligible for continued funding, grants and other applied for schemes, such as the RHI.

85. The UK has adopted the Standard Cost Model (SCM) method of providing an indicative measurement of admin burdens[30]. This approach requires a regulation to be broken down into each of the information obligations that it imposes on business. These obligations are then broken down further into each data requirement and subsequent activity required. An estimate of the cost to business of each activity is then given by the following formula:

Activity Cost = Price X Quantity = (wage x time) X (population x frequency)

86. The time taken to complete an activity and the wage rate of the person undertaking the task are based on the figures for a normally efficient business, and are typically estimated by hiring consultants or via interviews with businesses. The population is given by the number of businesses affected; and the frequency is the number of times per year that business has to undertake the activity.

87. DECC has estimated the admin burdens by using the unit burden of similar obligations from existing DECC regulations, such as the Renewables Obligation and Feed in Tariffs as a proxy for the key activities likely to result from the RHI. Table 13 below shows two key activities that are likely to be required of business to be eligible for funding under the RHI, and the proxy activity used for the estimates presented here.

[29] http://www.bis.gov.uk/bre

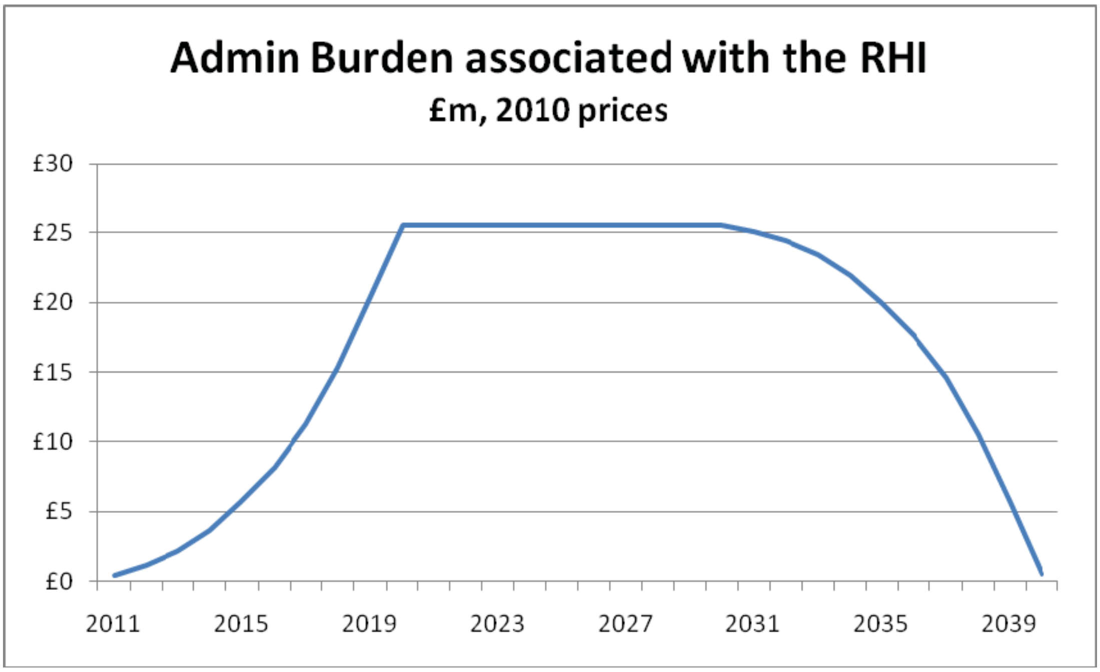
[30] http://www.bis.gov.uk/assets/biscore/better-regulation/docs/10-927-new-simplification-programme-2010-2015-methodological-framework

Table 13: The unit admin burden associated with the two information obligations

RHI activity	RHI activity type	Proxy activity	Proxy unit burden	RHI Frequency	RHI Population
Businesses will have to register with Ofgem and present a certificate in order to receive tariffs from generating renewable heat	Entry in a register	Renewables Obligation Order 2005 - providing evidence to the Gas and Electricity Markets Authority of your identify and details of persons authorised to act on your behalf in order to be registered as a holder of a ROCS or have an entry made or amended within the Register	£26.61	Occurs once over the period of the scheme	The number of projected installations in the industrial, commercial, and public sectors
Non-domestic organisations will need to provide Ofgem with meter readings illustrating how much renewable heat they have generated	Applications for subsidies or grants	Renewables Obligation Order 2005 - informing the Authority of the amount of your renewables obligation (in megawatt hours) for the last obligation period, and the amount of all electricity supplied in the period by you to customers in England and Wales	£51.72	Quarterly assumed, but potentially monthly for some large installations	The number of projected installations in the industrial, commercial and public sectors

88. The estimated admin burden of the RHI will vary according to the population (the number of businesses that sign up to receive the incentive). The population used in these estimates is taken from the final proposal presented in this IA, and is expected to increase every year until 2020 as the level of renewable heat deployed increases. Under these assumptions the admin burden associated with the two activities described above is illustrated in the graph below:

Chart 6: Estimates of admin burdens arising from the RHI



89. It should be noted that the admin burdens presented in this IA are significantly higher than those presented in the February 2010 consultation IA. This is due to the decision that all non-domestic installations will be metered (instead of the mixed deeming and metering approach proposed in the February consultation).

Wider Impacts

Impact on small firms

90. The RHI is a voluntary subsidy scheme. Therefore a full Small Firms Impact Test (SFIT) is not undertaken here. However as noted in the February 2010 IA small firms who install renewable heat technologies will benefit from the RHI tariffs. We expect that the design of the tariff structure, which differentiates support according to scale, will encourage uptake in the small firms segment as tariff levels should be attractive enough despite potential higher costs of borrowing by this segment (e.g. compared to big firms and industry).

91. Small firms are also expected to benefit from business and job creation opportunities generated from the increased demand for renewable technologies. Currently, a significant proportion of the firms which carry out domestic and other small scale installations are small firms. Therefore, we expect a proportion of the installation and maintenance of the projected uptake to be carried out by small firms.

Competition Assessment

92. The RHI tariff aims to compensate for the additional costs of the renewable heat equipment and for the higher risks and uncertainties associated with its use. Therefore subsidies that are received by firms for the installation of a renewable technology are not expected to impact on the competitiveness of these firms relative to other firms that operate in the same market and choose fossil fuels for their generation of heat. To ensure that the RHI support does not distort competition both within and outside the UK all subsidies proposed under the RHI will need to be in compliance with the European State aid rules. This assessment will be finalised before the RHI is launched in 2011.

93. However the RHI is expected to have an impact on the competitiveness of the UK in the field of renewable heat technologies, both in terms of manufacturing, installation and maintenance. Firms that currently operate in those segments are expected to see an improvement in their market position relative to the counterfactual of no renewables support. Entry barriers are also expected to be lower than before as the RHI stimulates demand for the technologies and provides demand certainty for new entrants.

94. Finally the RHI is expected to impact on the underlying cost of renewable technologies with two possible opposite effects:

- Increased support could lead to inflationary pressures on the retail prices of renewable heat equipment while on the other hand
- Support levels are expected to kick start growth in a very immature UK market promoting economies of scale and technological advance which could drive manufacturing and supply chain costs downwards in the long term.

95. These effects are captured to a certain extent through the future learning rate assumptions that are included in the RHI analysis . Scheduled reviews of the RHI will allow for these impacts to be monitored and better reflected in the scheme going forward.

Rural Proofing

96. Predicting uptake patterns of renewable heat in terms of geographical locations and type of communities is an extremely difficult task given the limited historical evidence in this area. However renewable heat technologies are likely to be particularly attractive to fossil fuel consumers outside the gas network especially under the revised tariff structure which targets installations that currently use more expensive heating fuels such as heating oil. In addition, constraints associated with the use of certain technologies, such as requirement of storage for biomass feedstock used in biomass boilers, or the space requirements for the installation of Ground Source Heat Pumps, may allow rural populations to benefit more from the RHI than suburban dwellings.

97. Increased use of renewable energy is also expected to benefit rural businesses involved in the generation of the renewable energy such as the forestry sector, farmers who produce energy crops and biofuels, or who use anaerobic digestion to process agricultural waste. Although we have not quantified these benefits they could add significantly to farm income as prices for biomass and food may rise due to the increased demand for agricultural products. This would also affect rural communities living in the vicinity of the new developments.

98. However for certain technologies the planning system could impose significant constraints, especially in areas of protected landscape, in conservation areas and green belts. This is expected to be particularly pertinent for non-domestic installations. Certain businesses for example may face difficulties in acquiring planning permission in protected areas from erecting new chimneys, and developing the plant necessary to service biomass supply chains. Also there may be indirect negative environmental consequences associated with the production of feedstock for the biomass supply chain. For example the use of large areas of land in a local area for fast growing wood products may reduce the quality of biodiversity.

Sustainable development

99. We recognise the crucial contribution bio-energy can make to the generation of renewable heat. However, it is important that encouraging the uptake of bio-energy does not result in untoward environmental and social impacts and this has been a guiding principle in devising our policy approach.

100. As laid out in more detail in the policy document, from 2011, generators of 1MWth and above will be required to report on the sustainability of their biomass feedstocks for both combustion and where they are used to produce biogas. Smaller generators and wastes will be exempt from this reporting requirement. This IA does not include any monetised sustainability regime costs.

101. Our approach has been informed by the approach currently being used by the Renewables Obligation (RO) and we will continue to follow closely the experience of the RO when it introduces reporting on greenhouse gas emission savings and compliance with restrictions on using materials from land important on carbon or biodiversity grounds from April next year. We will use this experience to inform the design of the RHI's mandatory sustainability criteria which we expect to take effect from 2013.

102. This period of sustainability reporting will provide us with valuable information on the sourcing trends of medium/large generators and an opportunity to identify issues which need to be addressed when we design the RHI's sustainability criteria, whilst not placing an onerous data collection burden on smaller non-professional heat generators.

Statutory equality duties

103. RHI is a voluntary subsidy scheme which covers a range of renewable heat technologies. Through these technologies a wide range of businesses with specific needs will be able to access the scheme should they wish to do so. We have conducted an initial assessment of the equality impacts of the scheme, considering the possible impacts on the protected characteristics of: age; disability; gender reassignment; marriage and civil partnerships; pregnancy and maternity; race; religion or belief; sex; and sexual orientation, in line with the public sector duty due to come into effect in April 2011. All applications for funding will be treated equally and in line with the eligibility criteria which do not discriminate against any of the above protected characteristics. We therefore do not expect the RHI to have any adverse equality effects.

Justice system

104. Ofgem will be responsible for administering the RHI. As part of this role it will be responsible for ensuring compliance with the eligibility criteria of the scheme. Where it identifies non-compliance it may decide to take enforcement action. Ofgem will have a range of enforcement tools, including: the power to withhold payments (temporarily or permanently), power to reduce payments, the power to suspend participants and the power to exclude them altogether. These sanctions will be issued by Ofgem and appeals will be heard internally. The courts will not be involved with the process of imposing a sanction. For incidences of fraud, Ofgem will be able to refer the case to the relevant authority to decide whether to prosecute through the criminal courts. Additionally, where a participant has been overpaid and refuses to repay the money, Ofgem may pursue the money through the normal civil debt recovery process. The impact on the judicial system has been deemed as negligible.

Annex 1: Post Implementation Review (PIR) Plan

Basis of the review: The Department of Energy and Climate Change intend that scheduled reviews of the Renewable Heat Incentive (RHI) will take place every four years with the first review starting in 2014 so that any changes needed can be implemented through legislation in April 2015. The review process is a commitment set out in the RHI Policy Document which is published alongside the RHI draft regulations and IA. In addition the Secretary of State may call an early review so that adjustments can be made to a part of whole of the scheme, to deal with any significant change to the assumptions which underpin the RHI. For example, a significant and unexpected uptake of a particular technology or a significant change to the relative cost of renewable and fossil fuels.
Review objective: Reviews will seek to assess and provide information to improve the operation of the scheme. In particular we will monitor uptake under the scheme; progress towards the UK's share of the EU 20% by 2020 renewable energy target; cost-effectiveness; fraud prevention; and how well the administrative processes are working.
Review approach and rationale: The first reviews will follow a timetable as set out in the RHI Policy Document. This is as follows: - January 2014, review formally initiated - January to June 2014, informal consultation with stakeholders and analysis - July to September 2014, formal consultation on proposed changes - December 2014, final decisions and draft regulations published - January 2015, draft regulations laid before Parliament - April 2015, review changes implemented through regulation We anticipate that subsequent reviews would follow a similar timetable. Reviews will have regard to the following when considering changes to the RHI: - Total heat demand and technical potential for each technology - Feasible deployment potential after demand and supply side barriers (e.g. growth rates) - Technology costs (capital and operating) by technology type and scale - Technology performance (load factors, efficiency etc) - Rates of return required by different investor types (commercial/public, industry) - Fossil fuel prices and carbon prices - Affordability within the Government's overall deficit reduction plans Reviews will also consider eligibility criteria for technologies and sectors. DECC will lead the review and anticipates that input and data will come from a wide range of stakeholders including: renewable generators, trade associations, investors, the 'Big 6' energy companies, local authorities, industrial heat users as well as small business and individuals. Information and data will be sourced from these stakeholders as well as independent consultants (appointed as required), who will gather technical and economic data on the technologies from renewable heat industry sources and their own renewables experience. In addition, Ofgem as administrators of the RHI scheme will collect technology and economic data on each installation which receives the RHI, providing a rich dataset of information Reviews prior to the 2014 review will only occur when a specific set of criteria are met. These criteria have yet to be resolved and will be subject to consultation for implementation in 2012.
Baseline: Each review will update the assumption on the level of renewable heat which would have been installed in the absence of the RHI to determine the additional impact of the RHI.

Success criteria: The objective of the Renewable Heat Incentive (RHI) is to drive a step change in the uptake of renewable heat technologies, helping to take renewable heat from the current 1.5% of total heat demand to a level of 12%. In order to achieve this the RHI scheme aims to create a subsidy framework aimed at commercial, public and industrial consumer groups that deliver renewable heat while maximising value for money. In light of this the success criteria will be: • Actual deployment of renewable heat installations • Actual % of heat demand met by renewable heat (against trajectory) • Cost of the scheme in relation to deployment levels The RHI reviews will ensure that the scheme remains in line with its key delivery objectives.
Monitoring information arrangements: Ofgem, in administering the scheme, will collect a wide variety of technical and economic data on each non-domestic renewable heat installation. This will be reported to DECC on a monthly basis, supplemented by more detailed annual reports. Some of the key metrics will be: • Technology type • Installed thermal capacity • Type of heat generation technology replaced • Cost of equipment • Type of input fuel
Reasons for not planning a PIR: N/A

Annex 2: RHI support levels under February 2010 consultation

Small installations:

Technology	Scale	Proposed tariff (pence/kWh)	Tariff lifetime (years)
Solid biomass	Up to 45 kW	9	15
Bioliquids	Up to 45 kW	6.5	15
Biogas on-site combustion	Up to 45 kW	5.5	10
Ground source heat pumps	Up to 45 kW	7	23
Air source heat pumps	Up to 45 kW	7.5	18
Solar thermal	Up to 20 kW	18	20

Medium installations:

Technology	Scale	Proposed tariff (pence/kWh)	Tariff lifetime (years)
Solid biomass	45-500 kW	6.5	15
		2 (fuel tariff)	15
Biogas on-site combustion	45-200 kW	5.5	10
Ground source heat pumps	45-350 kW	5.5	20
Air source heat pumps	45-350 kW	2	20
Solar thermal	20-100 kW	17	20

Large installations:

Technology	Scale	Proposed tariff (pence/kWh)	Tariff lifetime (years)
Solid biomass	500 kW and above	1.6 – 2.5	15
Ground source heat pumps	350 kW and above	1.5	20

Biomethane injection:

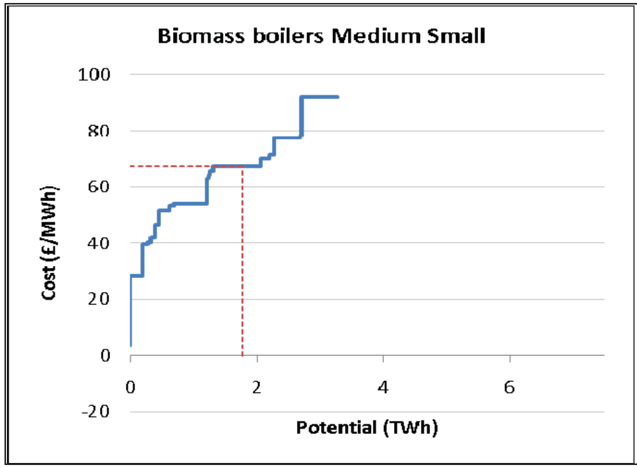
Technology	Scale	Proposed tariff (pence/kWh)	Tariff lifetime (years)
Biomethane	All scales	4	15

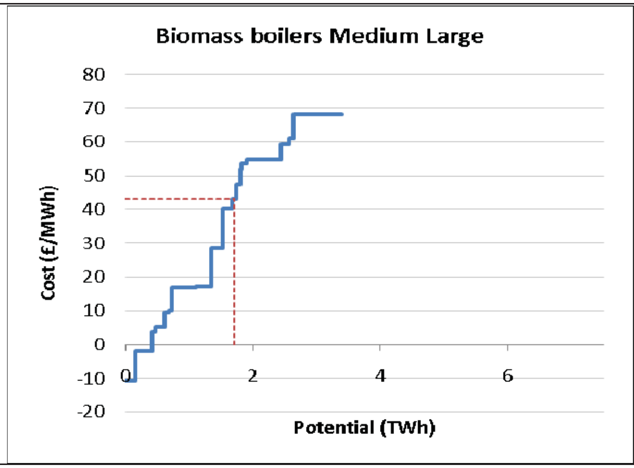
Annex 3: Reference installations used for tariff setting

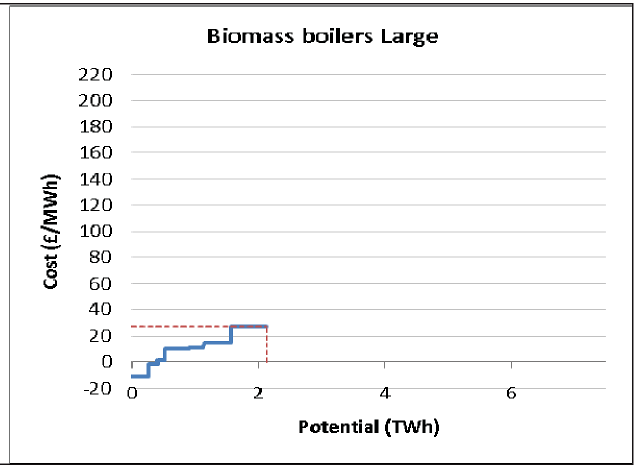
This annex shows a representation of the curves used for the selection of the reference installations in the case of small, medium and large biomass boilers and large GSHP. It also presents details on the assumptions used for the setting of the final proposed RHI support levels.

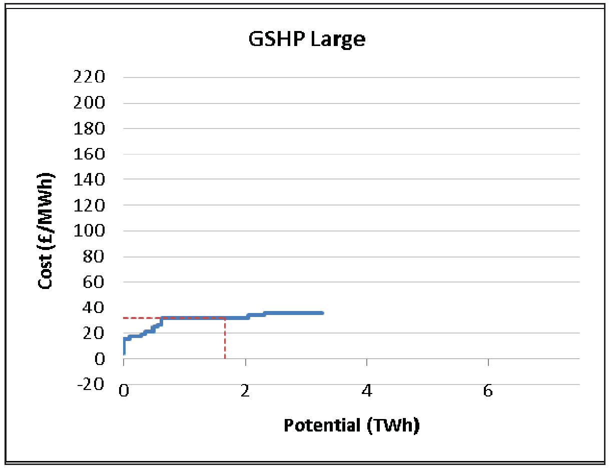
Reference installation graphs:

Each graph represents the technical potential captured by the relevant tariff band. The red lines show the reference installations that are used to calculate subsidies. These graphs represent the total of levelised upfront technology costs and non-financial barrier costs (both discounted with the relevant assumed discount rate), plus ongoing costs (i.e. they shows the full cost as perceived by the consumers). Tariffs have been calculated by assuming that barrier costs are undiscounted (i.e. no rate of return is paid on these). For this reason the prevailing subsidy levels are different to the ones identified by the horizontal red dotted line on the reference installation.









Reference installation characteristics:

The table below sets out in detail the technology assumptions used for the setting of the final proposed RHI support levels for biomass boilers and Ground Source Heat Pumps (details of the assumptions used for the biomethane tariff are provided in Annex 5)

Segment assumptions							Technical assumptions						Non-Financial Barrier assumption	
Technology	**Size**	**Consumer segment**	**Fuel counterfactual**	**Sub-segment**	**Location**	**Building age**	**CAPEX costs**	**OPEX costs**	**Efficiency**	**Load factor**	**Size**	**Lifetime**	**Upfront**	**Ongoing**
							£/KW	£/KW/year	%	%	KW	Years	£	£/year
Biomass boilers	Small	Commercial / Public	Gas	Small private	Urban	Post-1990	448	10	81%	20%	107	20	6,965	828
	Medium	Commercial / Public	Gas	Large private	Rural	Pre-1990	526	27	81%	20%	350	20	8,070	878
	Large	Commercial / Public	Gas	Large public	Urban	Post-1990	412	20	81%	45%	1602	20	8,070	878
GSHP	Medium	Commercial / Public	Gas	Small public	Suburban	Post-1990	1,312	7	400%	35%	30	20	6,333	16
	Large	Commercial / Public	Gas	Large private	Urban	Post-1990	962	0.7	400%	35%	300	20	6,469	66

All the costs and performance data are for 2011 in 2010 prices

Annex 4: Example of tariff calculation: Large GSHP

In order to set the RHI tariffs the characteristics of the reference installations set out in Annex 3 are combined with the assumptions on the gas counterfactual. In the case of large GSHP these assumptions are:

Costs in 2010 prices	**CAPEX**	**OPEX**	**Efficiency**	**Load Factor**	**Size**	**Lifetime**	**Fuel cost**	**Upfront costs (including admin costs)**	**Ongoing costs (including admin costs)**
Units	£/kW	£/kW/year	%	%	kW	Years	£/MWh	£	£/year
Large GSHP	962	0.7	400%	35%	300	20	150	6,469	66
Gas	68	1.2	90%	20%	525	15	38	N/A	N/A

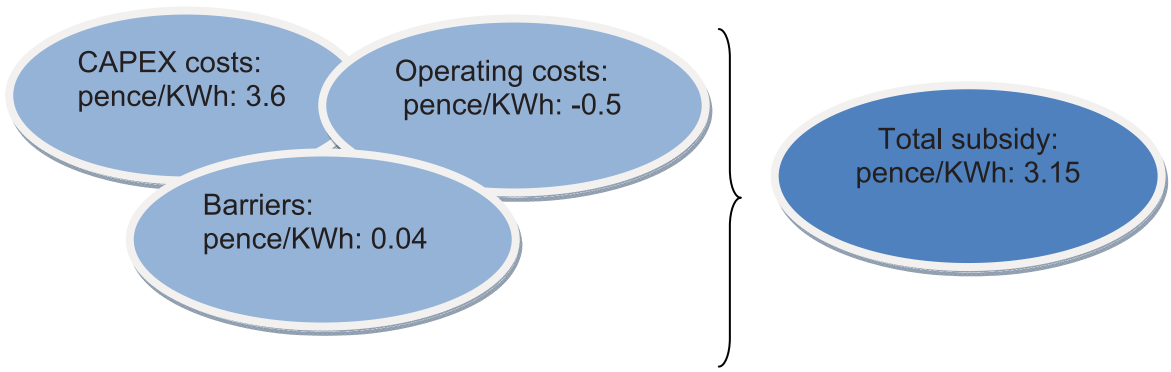
Using these technology characteristics we calculate the following elements of the tariff as follows:

- Compensation for the capital costs: Difference between the conventional and renewable technology while applying a 12% discount rate on this differential over the technology lifetime to calculate the annualised upfront payment.
- Compensation for the operating costs (including fuel costs): Difference between the conventional and renewable technology.
- Compensation for non financial barriers: Barriers associated with the renewable technology under the relevant counterfactual.

This calculation and the components of the tariffs are presented below:

Annual costs in 2010 prices	**Annualised Capital cost at 12% rate**	**Annual operating costs**	**Annual fuel costs**	**Annuitized Upfront barrier costs**	**Ongoing barrier costs**
Units	£	£	£	£	£
Large GSHP	£38,637	£210	£34,493	£323	£66
Gas	£5,242	£630	£38,734		
Difference	£33,396	-£420	-£4,241	£323	£66
Renewable technology resource costs	£29,124 (sum of difference row)				

As both installation produce the same output of 920MWh this means that the total subsidy in terms of p/KWh is approximately 3.15p/KWh. These elements are illustrated below in pence/KWh values:



Since the RHI payments for the non-domestic sector will be made on a quarterly basis rather than annually this means that the above tariff can be reduced to reflect the fact that consumers do not have to wait a whole year for their money. At a 12% discount rate the ratio of quarterly to yearly subsidies is 96%. The final tariff for large GSHP is therefore 3p/kWh.

Annex 5: Details on the calculation of the biomethane to grid RHI tariffs

The support levels for biomethane injection have been set using evidence developed from independent consultants[31] on the potential growth and associated costs of different biomethane plants over the period 2011-2020. This analysis showed that the majority of biomethane uptake expected to come forward will be from plants of 1MWth size or above. A reference installation of 1MW waste biomethane plant was therefore selected and tariffs were set in order to make this type of plant financially viable.

The characteristics of the reference Biomethane installation and of the counterfactual gas heating technology used for the tariff setting are as follows:

Costs in 2010 prices	**CAPEX**	**OPEX**	**Efficiency**	**Load Factor**	**Size**	**Life time**	**Fuel cost**	**Upfront barrier costs**	**Ongoing barrier costs**
Units	£/kW	£/year	%	%	kW	Years	£/MWh	£	£/year
Bio methane (AD waste)	**£4,600**	**£600,000**	**80%**	**93%**	**1,000**	**20**[32]	**-84.1***	**N/A**	**N/A**
Counter factual: Natural gas from the grid**							**22.7**		

*"Fuel cost" for AD plant running on waste is the gate fee, which is a negative cost.
** The counterfactual for the production of the biogas generators is the wholesale price of gas

Using the same principle as described in Annex 4 the following tariff components were derived:

Annual costs in 2010 prices	Annuitised Capital cost at 12% rate	Annual operating costs	Annual fuel costs	Annuitized Upfront barrier costs	Ongoing barrier costs
	£	£	£	£	£
Renewable	£674,490	£558,155	-£593,000	N/A	N/A
Fossil fuel	0	0	£159,870		
Difference	£674,490	£558,154	-£752,870	N/A	N/A
Renewable technology Resource costs	£479,775 (sum of difference row)				

Given an annual output of 7,000MWh (i.e. [size]x [8760 hours per year] x [efficiency[33]] from the table above) the resulting subsidy is 6.8p/KWh (i.e. £479,775/7,000MWh).

Based on a 96% adjustments for the quarterly natured for the subsidies (see annex 4) the final proposed biomethane tariff is 6.5p/KWh.

[31] A full SKM-Enviros report will follow the publication of this IA
[32] Waste digester.
[33] For AD plant "efficiency" is used instead of "load factor" to take account of (deduct) the renewable heat output that is used to warm the plant's digester.

Annex 6: Annual profile of monetised costs and benefits* - (£m) constant prices

Annual profile costs and benefits - (£m, discounted) constant (2010) prices

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Transition costs															
Annual recurring cost	£25	£58	£104	£159	£224	£303	£415	£554	£709	£863	£826	£800	£773	£748	£724
Total annual costs	£25	£58	£104	£159	£224	£303	£415	£554	£709	£863	£826	£800	£773	£748	£724
Transition benefits															
Annual recurring benefits	£10	£25	£46	£73	£108	£151	£209	£281	£373	£465	£463	£461	£458	£455	£452
Total annual benefits	£10	£25	£46	£73	£108	£151	£209	£281	£373	£465	£463	£461	£458	£455	£452

	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transition costs														
Annual recurring cost	£682	£663	£644	£622	£559	£528	£492	£449	£402	£349	£281	£197	£103	£17
Total annual costs	£682	£663	£644	£622	£559	£528	£492	£449	£402	£349	£281	£197	£103	£17
Transition benefits														
Annual recurring benefits	£444	£440	£436	£431	£448	£458	£459	£452	£434	£399	£344	£265	£157	£38
Total annual benefits	£444	£440	£436	£431	£448	£458	£459	£452	£434	£399	£344	£265	£157	£38

Emission changes

Version of GHG guidance used:	Jun-2010

Sector		Emission Changes* (MtCO2e) - By Budget Period			Emission Changes (MtCO2e) - Annual Projections									
		CB I; 2008-2012	CB II; 2013-2017	CB III; 2018-2022	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Power sector	Traded	0	0	0										
	Non-traded	0	0	0										
Transport	Traded	0	0	0										
	Non-traded	0	0	0										
Workplaces & Industry	Traded	0.264009	3.553241	9.886744				0.08	0.18	0.30	0.43	0.59	0.96	1.26
	Non-traded	0.367392	7.554762	29.78387				0.10	0.27	0.53	0.89	1.31	1.98	2.85
Homes	Traded	0.013775	0.097621	0.101744				0.01	0.01	0.01	0.02	0.02	0.02	0.02
	Non-traded	0.02132	0.587536	1.747421				0.02	0.00	0.00	0.10	0.14	0.14	0.20
Waste	Traded	0	0	0										
	Non-traded	0	0	0										
Agriculture	Traded	0	0	0										
	Non-traded	0	0	0										
Public	Traded	0.001414	-0.23983	-1.69401				0.00	0.00	0.00	-0.02	-0.05	-0.07	-0.10
	Non-traded	0.144823	3.111735	12.60731				0.04	0.11	0.21	0.38	0.62	0.81	1.09
Total	Traded	0.279199	3.411035	8.29448	0	0	0	0.086453	0.192745	0.31395	0.430062	0.560746	0.91809	1.188186
	Non-traded	0.533536	11.25403	44.13859	0	0	0	0.158869	0.374667	0.748201	1.366273	2.07232	2.93074	4.136499

Cost effectiveness	% of lifetime emissions below traded cost comparator	52%
	% of lifetime emissions below non-traded cost comparator	57%

Sector		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Power sector	Traded												
	Non-traded												
Transport	Traded												
	Non-traded												
Workplaces & Industry	Traded	1.51	2.00	2.13	2.13	2.13	2.13	2.13	2.13	2.10	2.08	2.06	2.04
	Non-traded	3.91	5.42	6.82	6.82	6.82	6.82	6.82	6.82	6.82	6.82	6.82	6.82
Homes	Traded	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Non-traded	0.28	0.30	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Waste	Traded												
	Non-traded												
Agriculture	Traded												
	Non-traded												
Public	Traded	-0.17	-0.29	-0.41	-0.41	-0.41	-0.41	-0.41	-0.41	-0.39	-0.36	-0.33	-0.31
	Non-traded	1.60	2.26	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
Total	Traded	1.362714	1.728735	1.734344	1.734344	1.734344	1.734344	1.734344	1.734344	1.737568	1.740792	1.744016	1.74724
	Non-traded	5.792832	7.982516	10.12108	10.12108	10.12108	10.12108	10.12108	10.12108	10.12108	10.12108	10.12108	10.12108

Sector		2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Power sector	Traded											
	Non-traded											
Transport	Traded											
	Non-traded											
Workplaces & Industry	Traded	2.02	1.97	1.92	1.85	1.77	1.68	1.47	1.17	0.82	0.45	0.01
	Non-traded	6.82	6.73	6.55	6.28	5.92	5.47	4.83	3.95	2.86	1.56	0.20
Homes	Traded	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	Non-traded	0.39	0.38	0.38	0.36	0.34	0.32	0.29	0.25	0.19	0.11	0.03
Waste	Traded											
	Non-traded											
Agriculture	Traded											
	Non-traded											
Public	Traded	-0.28	-0.26	-0.23	-0.20	-0.17	-0.13	-0.11	-0.08	-0.05	-0.01	0.00
	Non-traded	2.92	2.89	2.84	2.76	2.63	2.43	2.28	2.04	1.58	0.99	0.38
Total	Traded	1.750464	1.722581	1.703834	1.663636	1.611391	1.559517	1.370402	1.102306	0.784604	0.442906	0.005864
	Non-traded	10.12109	9.999241	9.764331	9.40175	8.897716	8.216362	7.399192	6.239018	4.628206	2.660644	0.608261