Title: Impact Assessment on changes to the current non-domestic Renewable Heat Incentive scheme **IA No: DECC0098** **Lead department or agency:** Department of Energy and Climate Change **Other departments or agencies:** n/a	**Impact Assessment (IA)** **Date:** 20/09/2012 **Stage:** Consultation **Source of intervention:** Domestic **Type of measure:** Secondary legislation **Contact for enquiries:** Stephen Smith – 0300 068 5021 Andrej Miller – 0300 068 6155

Summary: Intervention and Options

RPC: n/a

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB in 2009 prices)	**In scope of One-In, One-Out?**	**Measure qualifies as**
See individual options	n/a	n/a	No	N/A

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

To help cost-effectively increase the level of deployment in renewable heat installations through the Renewable Heat Incentive (RHI). The rationale for the RHI is to help lower carbon emissions and meet the Government's renewables target which requires 15% of energy to be from renewable sources by 2020. The RHI was introduced in the non-domestic sector in November 2011. Since then more evidence has become available which potentially allows new technologies to be included and some tariffs to change. These changes are necessary to minimise any potential market distortion and obtain best value for money. It also ensures the RHI is based on the best available evidence.

What are the policy objectives and the intended effects?

To (1) ensure the RHI is based on the best available evidence (2) ensure changes represent value for money and (3) reduce the potential for market distortions in the renewable heat (and other renewable) markets. The intended effects are to increase renewable heat deployment and economic efficiency.

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

- Policy option 1: do nothing and keep all RHI tariffs unchanged;
- Policy option 2: create a separate RHI tariff for deep geothermal technology;
- Policy option 3a: make 'Air-to-Air' Air Source Heat Pumps eligible for the RHI and set tariff;
- Policy option 3b: make Air-to-Water' Air Source Heat Pumps eligible for the RHI and set tariff;
- Policy option 4: make biomass direct air heating eligible for the RHI and set tariff;
- Policy option 5a: have a separate RHI tariff for Combined Heat and Power including bioliquids;
- Policy option 5b: have a separate RHI tariff for Combined Heat and Power but excluding bioliquids;
- Policy option 6: create a three tier RHI biogas tariff;
- Policy option 7: make energy efficiency an RHI requirement;

The preferred policy options are 2 and 5a as they best meet the identified policy objectives. We see the merits of the other options but would like to use the consultation process to gather further information before making a final decision . Policy option 1 is not a preferred option.

Will the policy be reviewed? It will be reviewed. **If applicable, set review date:** 2014

Does implementation go beyond minimum EU requirements?			**N/A**		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** Yes	**< 20** Yes	**Small** Yes	**Medium** Yes	**Large** Yes
What is the CO2 equivalent change in greenhouse gas emissions? (Million tonnes CO2 equivalent)			**Traded:** -5.5	**Non-traded:** -0.4	

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

Signed by the responsible Minister: ______________________ Date: ____________

Summary: Analysis & Evidence — Policy Option 2

Description: Create a separate RHI tariff for deep geothermal technology. Current owners of deep geothermal technology can only claim the RHI tariff for Ground Source Heat Pumps (GSHPs). This tariff may not fully reflect the costs and benefits of this particular technology. This option involves creating an RHI tariff based solely on the costs and benefits of deep geothermal technology.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2011	Time Period Years 24	Net Benefit (Present Value (PV)) (£m)		
			Low: £0m	**High: -£9m**	**Best Estimate: -£4m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low			£0.7m	**£8m**
High			£0.9m	**£12m**
Best Estimate			£0.8m	**£10m**

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

This technology has an additional cost of £10m which consists of an additional capital cost of £18m less an operating cost saving of £8m.
NB Low and High refer to Low and High: capital, opex and carbon cost scenarios.
Subsidy costs to the taxpayer (transfers to recipients not included in Costs or NPV above) are estimated at: £24m for the central scenario (Present Value basis).

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

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			£0.2m	**£3m**
High			£0.7m	**£8m**
Best Estimate			£0.5m	**£6m**

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

The reduction in fossil fuel demand means an estimated 6,000 tonnes of CO_2 saved in the non-traded sector per year which is valued at £6m over 24 years.
NB Low and High refer to Low and High: capital, opex and carbon cost scenarios.

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

By creating its own tariff based on data that is relevant to this particular technology, there would be a reduction in any potential market distortions caused by the setting of an incorrect tariff. The effective increase in the tariff for this technology is likely to increase uptake and therefore the scope for long run cost reductions, innovation and economies of scale in this technology is enhanced. The estimated tariff of 5.0p/kilowatt hour (kWh) in 2012 prices is relatively cost-effective compared to other technologies.

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

For the appraisal of impacts we have assumed a 3.5% discount rate. However, to derive appropriate tariff rates we have assumed a 12% discount rate. This analysis is based on industry supplied data but we would welcome further evidence on this technology to help the setting of an appropriate tariff. Overall costs and benefits are based on an assumed uptake of one additional site as a result of this tariff. Sensitivity tests use lower and upper bound cost estimates and use High and Low carbon values. Carbon savings are assumed to be in the non-traded sector.

BUSINESS ASSESSMENT (Option 1)

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

Summary: Analysis & Evidence — Policy Options 3a & 3b

Description: Air Source Heat Pumps (ASHPs) – both 'air to air and 'air to water' - were previously excluded from the RHI because of concerns over (1) performance and (2) monitoring. The evidence surrounding these technologies has been reviewed. This option would mean ASHPs are able to claim a single tariff, though there would be conditions attached i.e. only supporting a heating only ASHP rather than a heating and cooling version.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2011	Time Period Years 34	Net Benefit (Present Value (PV)) (£m)		
			Low: £79m	**High: £1420m**	**Best Estimate: £653m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low			-£39m	**-£1331m**
High			-£1.5m	**-£49m**
Best Estimate			-£15.7m	**-£534m**

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

Negative additional cost of £534m due to demand substitution, largely from (more expensive) ground source heat pumps.
NB Low and High refer to Low and High technology-capital-cost scenarios.
Subsidy costs to the taxpayer (transfers to recipients not included in Costs or NPV above) are estimated at: £161m for the central scenario (Present Value basis).

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

Potential market distortions and inefficiencies from supporting a heating only ASHP if there is a heating and cooling demand at the location.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			£0.9m	**£30m**
High			£2.6m	**£88m**
Best Estimate			£3.5m	**£118m**

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

The increase in deployment from supporting ASHPs results in reduced demand for fossil fuel heating and leads to carbon saving equivalent to £118m over 34 years.
NB Low and High refer to Low and High technology-capital-cost scenarios. The best estimate is higher than the two sensitivity scenarios; see section 6.3.3 below for an explanation.

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

The inclusion of ASHPs within the RHI could mean there will be a reduction in potential market distortions (though note potential non-monetised cost above). Making ASHPs eligible for the RHI will also mean an increase in deployment which will (1) help with meeting the renewable target and (2) increase the scope for long run cost reductions, economies of scale and innovation. The cited tariffs for this technology (0.97p/kWh and 1.7p/kWh for air to air heat pumps and air to water heat pumps respectively) are also highly cost-effective compared to other technologies.

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

For cost-benefit analysis purposes we have assumed a 3.5% discount rate. However, to derive appropriate tariff rates we have assumed a 12% discount rate. The shape of the supply curve of opportunities influences the scale of response to changes in costs shown in the sensitivities. We have also assumed that the level of renewable heat generated can be effectively monitored and measured thus delivering the cited benefits above. Difficulties in measuring the output of air to air heat pumps mean uncertainty in the level of renewable heat (and carbon savings) achieved.

BUSINESS ASSESSMENT (Option 1)

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

Summary: Analysis & Evidence — Policy Option 4

Description: This option involves making biomass direct air heating eligible for the RHI and setting an appropriate tariff.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2011	Time Period Years 34	Net Benefit (Present Value (PV)) (£m)		
			Low: -£134m	High: -£26m	Best Estimate: -£63m

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low			£2.1m	**£72m**
High			£5.9m	**£200m**
Best Estimate			£3.0m	**£100m**

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

There is an additional resource cost of £100m over 34 years due to the increase in demand for this renewable heat technology.
NB Low and High refer to Low and High technology-capital-cost scenarios.
Subsidy costs to the taxpayer (transfers to recipients not included in Costs or NPV above) are estimated at: £116m for the central scenario (Present Value basis).

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

Difficulties in measuring the level of renewable heat produced means there is uncertainty on the level of benefits achieved with this policy option. Potential negative impact on air quality from increased levels of biomass combustion.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low			£1.3m	**£46m**
High			£1.9m	**£66m**
Best Estimate			£1.1m	**£38m**

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

The reduction in fossil fuel use and increase in renewable heat produced means a net carbon saving of 0.1m tonnes per year equating to around £38m over 34 years.
NB Low and High refer to Low and High technology-capital-cost scenarios. The best estimate is lower than the two sensitivity scenarios; see section 6.4.3 below for an explanation.

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

Increase in renewable heat and further diversification of potential renewable heat technologies supportive of broader heat strategy. Potential longer run achievement of long run cost reductions, economies of scale and innovation from supporting this technology. Estimated tariff of 2.1p/kWh is highly cost effective when compared against other technologies.

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

For cost-benefit analysis purposes we have assumed a 3.5% discount rate. However, to derive appropriate tariff rates we have assumed a 12% discount rate. The shape of the supply curve of opportunities influences the scale of response to changes in costs shown in the sensitivities. We have also assumed that the level of renewable heat generated can be effectively monitored and measured thus delivering the cited benefits above.

BUSINESS ASSESSMENT (Option 1)

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

Summary: Analysis & Evidence — Policy Options 5a & 5b

Description: Combined heat and power (CHP) is currently supported under the RHI for biomass, biogas and geothermal sources of heat. However, there is no specific CHP tariff, rather an installation is able to claim the tariff applicable to the technology it uses, subject to the banding and size limitations of that technology. This policy options involves creating a separate tariff for CHP. The difference between policy options 5a and 5b is whether bioliquids should be included.

FULL ECONOMIC ASSESSMENT

Price Base	PV Base	Time Period	Net Benefit (Present Value (PV)) (£m)		
Year 2012	**Year** 2011	**Years** 26	**Low: -£512m**	**High: £3m**	**Best Estimate: -£305m**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low			-£0.1m	**-£5m**
High			£26m	**£899m**
Best Estimate			£15m	**£504m**

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

There is an estimated increase in resource costs of £504m over 26 years following the increase in deployment of this technology.
NB Low and High refer to Low and High technology-capital-cost scenarios.
Subsidy costs to the taxpayer (transfers to recipients not included in Costs or NPV above) are estimated at: £1,844m for the central scenario (Present Value basis).

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

Potential negative impact on air quality from increased levels of biomass combustion.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low			-£0.1m	**-£2m**
High			£11m	**£387m**
Best Estimate			£6m	**£199m**

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

Increase in deployment of renewable heat and an associated reduction in demand for fossil fuel heating results in a carbon saving equating to £199m over 26 years.
NB Low and High refer to Low and High technology-capital-cost scenarios.

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

CHP is relatively cost effective compared to other renewable technologies (across the economy) and, therefore, its inclusion as a separate tariff (assuming the previous tariffs were too low to induce further uptake) helps support meeting the renewables target in a cost effective way. The estimated tariff of 4.1p/kWh (in 2012 prices) is also relatively cost effective compared to other renewable heat technologies. Potential longer run achievement of long run cost reductions, economies of scale and innovation from supporting this technology.

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

For cost-benefit analysis purposes we have assumed a 3.5% discount rate. However, to derive appropriate tariff rates we have assumed a 12% discount rate.

BUSINESS ASSESSMENT (Option 1)

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

Summary: Analysis & Evidence — Policy Option 6

Description: the current treatment of biogas in the RHI is a tariff equal to 7.1p/kWh for installations up to 200kWhs with zero subsidy for larger installations. This policy option involves creating a 3 tier tariff for biogas.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: n/a	**High: n/a**	**Best Estimate: n/a**

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	Not quantified		Not quantified	**Not quantified**
High	Not quantified		Not quantified	**Not quantified**
Best Estimate				

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

Not quantified.

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

The increase in support is likely to increase the production of renewable heat generated from biogas thereby resulting an increase in the costs to Government. The higher costs of biogas technology (net of the operating cost saving) will also be a cost to the owners of this technology. Size of costs (and benefits) are dependent on the marginal rate of substitution between biogas used for heat and biogas used for electricity generation. A higher tariff could lead to the payment of economic rents if the subsidy is higher than what is commercially required. Potentially removing inconsistencies between tariffs and perverse outcomes associated with the use of feedstock and its factors of production.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	Not quantified		Not quantified	**Not quantified**
High	Not quantified		Not quantified	**Not quantified**
Best Estimate				

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

Not quantified.

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

The increase in renewable heat produced supports the meeting of the 2020 renewables target and means a reduction in carbon emissions. The increase in the level of support from Government would represent a benefit to owners of this renewable heat technology. Adjusting the tariff so that it is similar to FITs could lead to efficient outcome where owners of biogas technologies produce heat or electricity depending on when it was efficient to do so.

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

Potential owners of renewable biogas installations are able to easily switch between heat production and electricity generation. Impact heavily dependent on marginal rate of substitution between heat and electricity generation.

BUSINESS ASSESSMENT (Option 1) [DQ do we need this section?]

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

Summary: Analysis & Evidence — Policy Option 7

Description: Currently there are no energy efficiency requirements associated with the non domestic RHI. This policy option involves introducing minimum energy efficiency standards as a requirement of entry to the scheme.

FULL ECONOMIC ASSESSMENT

Price Base Year 2012	PV Base Year 2011	Time Period Years 20	Net Benefit (Present Value (PV)) (£m)		
			Low: n/a	High: n/a	Best Estimate: n/a

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Not quantified		Not quantified	**Not quantified**
High	Not quantified		Not quantified	**Not quantified**
Best Estimate	Not quantified		Not quantified	**Not quantified**

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

Not quantified.

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

The introduction of energy efficiency minimum standards has an associated cost for the organisations (or households in district heat networks) who may apply for the RHI. This can be split into the cost of the actual assessment and the cost of implementing any energy efficiency measures. Overtime, the energy efficiency measures will deliver benefits that cover the high upfront capital cost. However, the Green Deal will reduce or eliminate the capital cost for eligible applicants.

The introduction of a new requirement to qualify for RHI payments may also act as a barrier to RHI uptake and therefore the uptake renewable heat sources. Administering the Energy Efficiency requirements will have an associated admin cost for Ofgem.

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Not quantified		Not quantified	**Not quantified**
High	Not quantified		Not quantified	**Not quantified**
Best Estimate	Not quantified		Not quantified	**Not quantified**

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

Not quantified.

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

The introduction of energy efficiency requirements will help to reduce energy costs in the form of fuel/electricity bills for the consumer. It will also reduce costs for Government through reduced RHI expenditure. These measures could also reduce carbon emissions from any remaining fossil fuel energy source that are still used.

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

There is a risk that introducing energy efficiency requirements could act as a barrier to take-up of the RHI and renewable heat deployment. Consumers do not (fully) offset the potential carbon savings achieved through increased energy efficiency.

BUSINESS ASSESSMENT (Option 1) [DQ do we need this section?]

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

Evidence Base (for summary sheets)

1. Background

1. The Renewable Heat Incentive (RHI) is a 20 year inflation-linked subsidy to owners of renewable heat installations based on the amount of renewable heat produced. It was introduced in November 2011 for the non-domestic sector and will be later introduced in the domestic sector (for which a separate Impact Assessment exists).

2. The UK is subject to a legally binding commitment to generate 15% of its energy demand from renewable sources by 2020. The Renewable Energy Strategy (published in 2009[1]) found that, on analysis of opportunities across electricity, transport and heat, a suitable contribution from the heat sector was 12% of heat being delivered from renewable sources by 2020. Renewable heat is also a key part of DECC's Carbon Plan[2] and longer-term Heat Strategy, which set out the important role of renewable heat in contributing to the long-term de-carbonisation of energy supply.

3. Full details and a list of assumptions used in the non-domestic modelling can be found in Annexes 1 to 3. Tariffs for both the non-domestic and domestic RHI schemes were calculated in the following way (the table below provides a list of all current non-domestic RHI tariffs):

   - Estimate the additional cost of installing and running a renewable heating system. This is used to calculate the cost per unit of heat produced for renewable technologies less the cost of the conventional technology alternative. Added to this cost are the additional barrier costs. Calculations are made using costs, use and performance data for each technology in each category of building (broken down by commercial, industrial, counterfactual fuel and location).

   - Estimate the heat demand of each building category, the number of such buildings and the proportion of them suitable for each renewable technology.

   - From these figures, a "supply curve" is produced for each technology which estimates the amount of renewable heat potential fundable at each tariff level.

   - From these curves we are able to identify the tariff required to potentially incentivise the targeted percentage of the potential installations. This targeted percentage is the 50% point on the supply curve (**unless** the tariff reaches the level consistent with the marginal cost of meeting the Renewables target)[3].

Table 1: Current RHI tariffs

Tariff	Eligible technology	Eligible size	Tier (tariff applicable up to tier break)	RPI adjusted tariff (pence / kWh) from 1 April 2012
Small commercial biomass	Solid biomass including solid biomass contained in municipal solid waste (incl. CHP)	Less than 200 kWh	Tier 1	8.3
			Tier 2	2.1
Medium commercial biomass		200 kWh and above; less than 1,000 kWh	Tier 1	5.1
			Tier 2	2.1
Large commercial biomass		1,000 kWh and above	N/A	1
Small commercial heat pumps	Ground-source heat pumps; water	Less than 100 kWh	N/A	4.7

1 http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/renewable%20energy%20strategy/1_20090717120647_e_@@_theukrenewableenergystrategy2009.pdf

2 http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx

3 RHI tariffs are capped at 8.3p per kilowatt hour (2010 prices for offshore wind).

Large commercial heat pumps	source heat pumps; deep geothermal	100 kWh and above	N/A	3.4
All solar collectors	Solar collectors	Less than 200 kWh	N/A	8.9
Biomethane and biogas combustion	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion, except from landfill gas	N/A	7.1

4. The tariffs vary by technology because of the different costs associated with each technology. However, while certain technologies cost more per kilowatt (kW) of heat produced, a range of technologies are supported because (a) there is likely to be greater potential for cost reductions in the more expensive (and generally less mature) technologies and (b) all the above technologies are expected to be important sources of supply to meet future heat demand post-2020.

1.1 What has changed since 2011?

5. The launch of the RHI in the non-domestic sector was in November 2011. We are now consulting on the potential introduction of the RHI to the domestic sector and the potential inclusion of new technologies in the non-domestic scheme. When the RHI was originally introduced, the eligibility of certain technologies and the estimated tariff levels were based on the best available data at the time. For various reasons (discussed later), this meant certain technologies – such as Air Source Heat Pumps (ASHPs) - were excluded, and certain technologies did not have their 'own' individual tariff e.g. Combined Heat and Power (CHP) and deep geothermal. Since the scheme was introduced, we have gathered further data from industry about the cost and performance of different technologies including updated assumptions from AEA which means there is a case for certain aspects of the non-domestic scheme to change. This enables the scheme to continue to be based on the best available evidence. We asked AEA to carry out some further data gathering and assessments of specific technologies, non-domestic and domestic, for the RHI Phase II Project. In the non-domestic sector, AEA reviewed technological assumptions for large biomass, air-to-air heat pumps, air to water heat pumps, conversion of existing plant to renewable heat, and biogas. In the domestic sector, Air to Air heat pumps, Air to Water heat pumps, biomass stoves with back boilers, and specific assumptions relating to New Build housing were reviewed. The results of this review form the basis for the final technical assumptions for made for these technologies in our analysis. The report on the results of this review, which were finalised in February 2012 will be published alongside this IA.

6. A key part of this consultation is to work with stakeholders to ensure data on costs and performance used to set tariffs is as accurate as possible. A data collection exercise is being launched (reporting in October), which aims to provide a comprehensive update to this data set through examination of evidence from Renewable Heat Premium Payments (RHPP), other government departments and stakeholder surveys and interviews. In addition, the Impact Assessment annexes and the accompanying spreadsheet are intended to demonstrate as fully as possible the data that DECC currently holds and how it has been used to arrive at the indicative tariffs in this Impact Assessment. DECC welcomes any evidence which could help improve this evidence base over the consultation period. This can be submitted as part of consultation responses or separately. We will also be approaching stakeholders as part of our wider engagement at events during the consultation period to get direct feedback on evidence.

7. The Impact Assessment (IA) accompanying the launch of the RHI suggested the RHI would help increase the proportion of renewable heat as a share of total heat demand from 1.5% to 12% by 2020. The IA also provided illustrative renewable heat 'shares' for each technology as shown in the table below.[4]

Table 2: proportion of renewable heat generated by different technologies in 2020

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[4] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/3775-renewable-heat-incentive-impact-assessment-dec-20.pdf

Technology	Composition of additional renewable resource
Biomass (including district heating)	48%
Ground Source Heat Pumps	21%
Biogas	7%
Combined Heat and Power	9%
Air Source Heat Pumps	15%

8. As the above table demonstrates, the bulk of the additional renewable heat generated was forecast to be from biomass and ground source heat pumps. However, air source heat pumps, CHP and biogas are expected to play a significant role.

2. Problem under consideration

9. The meeting of the renewables target, reducing carbon emissions and driving innovation[5] in different renewable heat technologies are all key objectives of the RHI. These objectives provide the rationale for the range of tariffs available to different technologies as set out in Table 1. However, it is important that the estimated tariff levels are based on the best available data on technology costs. If they are not, tariffs may end up being too high for particular installations resulting in the payment of economic rents while if tariffs are too low they may not incentivise sufficient levels of deployment and / or innovation.

10. When the RHI was first introduced, certain technologies were excluded due to concerns about performance and measurement, while other technologies did not have their own technology-specific tariff. Since then, evidence on commercial installations, cost and performance information is now available which potentially permits new technologies to be included and some tariffs to change. Continuing to set tariffs for some technologies which are not based on data specifically related to that technology and / or continuing to exclude certain renewable heat technologies from the RHI when new cost and performance information is available would potentially distort the market for renewable heat technologies. These changes are therefore necessary to ensure the RHI does not distort the market and is based on the best available evidence.

3. Rationale for intervention

11. The overarching aim of the RHI is to incentivise the cost effective installation and generation of renewable heat to contribute to the heat proportion of the renewables target whilst ensuring the foundations are set to deliver the Heat Strategy and meet future carbon reduction targets. The current market for renewable heat is relatively small and these technologies are largely unable to compete on cost with conventional heating options such as gas, oil and electricity. In addition to cost differences there are a number of non-financial barriers to the uptake of renewable heat. The following describes the rationale for subsidising non-domestic renewable heating:

- the negative carbon externality associated with the conventional heating of buildings. Renewable heat technologies enable buildings to be heated using significantly less fossil fuels thereby reducing greenhouse gas emissions;
- the UK operates under the EU's Renewable Energy Directive (RED) which sets out a legally binding target for the UK of 15% of energy coming from renewable sources by 2020. Although the infraction penalty for not meeting this target is not currently monetised, it is described as being commensurate with the costs of meeting the target;[6]

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[5] In this context innovation can be defined as the achievement of cost reductions and / or improved technological performance as a result of greater demand for the technology in question.
[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

- driving innovation and cost reductions in renewable heat technologies is also a key rationale to support the longer term sustainable heating of buildings;
- renewable technologies add a further non-monetized benefit through diversifying the UK's energy demand, reducing the exposure of the UK to the price of oil and gas through further diversification of energy supply;

12. However, any intervention in the market should ensure economic inefficiencies – such as deadweight loss – and the payment of economic rents are minimised. Minimising inefficiencies and economic rents will mean an improvement in the value for money of the scheme and ensure market distortions are minimised. The rationale for the potential changes to the non-domestic scheme are specifically designed to ensure the external carbon benefits of lower carbon emissions, potential innovation and minimal distortions are maintained.

4. Policy objectives

13. The key policy objectives of the changes to the non-domestic scheme are to:
    - support the deployment of renewable heat installations thereby helping meet the 2020 renewables target; and
    - ensure the tariffs set for the non-domestic scheme are based on the best available evidence thus ensuring value for money and minimal levels of economic inefficiency and market distortion;

5. Description of options considered

5.1 Introduction

14. For each technology, the policy options considered were either:
    - Do nothing: this would mean the technology would continue not to receive the RHI or would continue to be eligible for a particular tariff level; or
    - Make the technology eligible for the RHI or change the existing tariff;
15. A summary of how this translates into the different technologies considered in this IA is given in the table below:[7]

[7] Please note that some of these policy options could involve obtaining State Aid clearance.

Table 3: Summary of do nothing and do something options for each technology

Technology	Current treatment (do nothing option)	Do something option
Deep geothermal	Receive Ground Source Heat pump tariff	Create a separate RHI tariff
Air source heat pumps	Not eligible for the RHI	Make 'Air-to-Air' and / or 'Air-to-Water' technologies eligible and set tariff
Biomass direct air heating	Not eligible for the RHI	Make technology eligible for the RHI and set tariff
Combined Heat & Power	Receive biomass or biogas tariff	Create a separate RHI tariff for CHP (potentially including bioliquids)
Biogas	Flat single tariff of 7p per kWh up to 200kWh	Create a three tier biogas tariff;
Energy efficiency	No energy efficiency measures associated with the non domestic RHI	Introduce minimum Energy Efficiency standards as condition of eligibility for RHI

16. A detailed description of each policy option is discussed below. We define each policy option as:
    - Policy option 1: do nothing and keep all RHI tariffs unchanged;
    - Policy option 2: create a separate RHI tariff for deep geothermal technology;
    - Policy option 3a: make 'Air-to-Air' Air Source Heat Pumps (ASHPs) eligible for the RHI and set tariff;
    - Policy option 3b: make Air-to-Water' ASHPS eligible for the RHI and set tariff;
    - Policy option 4: make biomass direct air heating eligible for the RHI and set tariff;
    - Policy option 5a: have a separate RHI tariff for Combined Heat and Power (CHP) including bioliquids;
    - Policy option 5b: have a separate RHI tariff for Combined Heat and Power (CHP) excluding bioliquids;
    - Policy option 6: create a three tier RHI biogas tariff;
    - Policy option 7: make energy efficiency an RHI requirement;

5.2 Deep geothermal (policy option 2)

Proposal: To introduce a separate RHI tariff for deep geothermal technology equal to around 5.0p per kWh (2012 prices)

Questions: (1) Is it right to have a separate deep geothermal tariff (2) Are the assumptions made (and therefore tariff estimates) reasonable? (3) What alternative evidence is there?

5.2.1 Background

17. Deep geothermal technology is effectively the generation of heat from drilling up to 5,000 metres below ground level where there is sufficient heat available. There is currently only one deep geothermal site in the UK located in Southampton (and this is currently being refurbished), though there may be potential

other sites in the future (e.g. Newcastle and Manchester). However, in order for this technology to be competitive with conventional fossil fuel heating an RHI subsidy may be required. A report by SKM suggests that for projects with a heat component (heat only and CHP) the following minimum RHI tariffs were required: around £30/MWh for CHP projects, around £50/MWh for Hot Sedimentary Aquifer (HAS) direct heat projects over 5 MW and approximately £70/MWh for HAS applications using a heat pump or under 5MW.[8]

18. In many respects, deep geothermal technology is unique as the investment required to make a potential site commercial tends to be highly front loaded but the technology has potentially low operating costs. However, once this initial sunk cost is incurred, geothermal power installations have lifetimes of potentially over 20 years. We have a limited amount of data on the costs and performance of this technology though one data source is an AEA report which suggests typical upfront capital costs of around £14.6m for 2 wells with 6-7MW of capacity (which AEA suggest equates to around £2,250 per Kilowatt (kW) to £2,500/kW).[9] The large upfront cost – such as planning and survey work – and the potential for unexpected geology and loss of capital are particularly relevant for deep geothermal technology. It can also mean potentially long lead in times – for example up to 3 years – from the date the initial costs are incurred until renewable heat can be produced.

19. AEA also suggest that a deep geothermal site would also have annual operating costs equal to around 1% of total capital expenditure. However, operating costs are likely to vary according to the location of the site. With the potential for deep geothermal sites being most prevalent in urban areas – given urban areas have a greater potential for heat networks and therefore deep geothermal technology to supply the heat – rental costs are likely to be higher. As well as AEA's estimates of capital and operating costs, we also have cost and performance data provided to us by Geothermal Engineering Ltd . Their estimates of capital costs are similar to AEAs (£2,466/kW). However, their estimated operating costs are higher (they suggest fixed operating costs per kW per year to be around £39 and a further £6/MWh in fuel costs). This is for an average heat extraction of 30,000 MWh. Geothermal Engineering Ltd also estimate there to be an annual 6,000 tonne saving in CO_2 from deep geothermal technology.

5.2.2 Do nothing

20. Although deep geothermal technology does not currently have its own RHI tariff, owners of geothermal technologies which produce renewable heat are able to claim the tariff for Large Commercial Ground Source Heat Pumps (GSHPs) of 3.4p/kWh (£34/MWh). This is less than the estimated tariff levels required outlined in the SKM report. In addition, due to the lack of data and potential links with other renewable heat technologies, the GSHP tariff is not based on any deep geothermal data. This would suggest the current tariff for deep geothermal is not based on the relevant data and may not be suitable for this particular technology.

21. Although there is one site in Southampton and potentially others, there is a high degree of uncertainty on the potential uptake of deep geothermal sites. The high upfront capital costs, potentially high risk nature of the investment and potentially limited areas where deep geothermal sites would be suitable mean we might expect relatively little uptake of deep geothermal sites **up to 2020**. The potential uptake post-2020 could be larger as costs fall and the technology matures. The SKM report identifies (page xi) 7 potential deep geothermal sites for the purposes of generating electricity, a further 7 for CHP and 4 for heat. While these sites are deemed 'conceptual', a key issue is to what extent would these sites be developed with the current RHI tariff of 3.4p unchanged. A conservative assumption is that up to 2020, assuming no change in the GSHP tariff for deep geothermal technologies, there would be no additional sites over and above that in Southampton. However, we would welcome evidence as to whether this is a realistic assumption to make or not.

5.2.3 Do something

22. This policy option is to include a standalone tariff for deep geothermal technology.[10] However, as mentioned above, there is potentially a lack of data in relation to deep geothermal technology. This means the estimated tariff and uptake levels have not been estimated in precisely the same way as the other technologies. However, to estimate the required tariff we have used the same methodology that seeks to compensate potential owners of renewable heat technologies for:

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[8] SKM (2012), *Geothermal Energy Potential*, pxii.
[9] AEA (2012), *RHI Phase II – Technology Assumptions*
[10] Any creation of a new and separate tariff is likely to require State Aid clearance.

- The difference in the upfront capital costs taking into account lower operating costs;
- Potential 'hassle' costs; and
- A return on capital of 12%;[11]

23. Unlike other technologies, we do not have a large range of cost and performance data to estimate a supply curve. Therefore, we have based our tariff estimate on an average of the data in the AEA report and the data supplied to DECC by Geothermal Engineering Ltd. The clear drawback with this approach is the limited amount of data and therefore we would welcome further evidence to help estimate an appropriate tariff for this technology. The key assumptions we have made are:

Table 4: Suggested deep geothermal cost and performance assumptions(provided by AEA and Geothermal Engineering Ltd)

Assumption	Deep geothermal[12]	Counterfactual technology (assumed to be gas)
Capital expenditure (£/kW)	£2,440 to £2,700	£70
Operating expenditure (£/kW/year)	£24 to £43 (the latter excludes an additional £6.5/MWh to cover fuel costs – this additional cost is added below)	£141
Efficiency	99%	94%
Load factor	55%	55%
Size (kW)	6,000	6,000
Lifetime (years)	20	20
Annual output (MWh)	28,908	28,908

24. Using these assumptions and a discount rate of 12%, we estimate the following:

Table 5: Implied capital and operating costs from Table 4 (rounded to nearest thousand)

	Annuitised capital costs	Annual operating costs (including fuel costs)
Deep geothermal	£1,957,000 to £2,175,000	£146,000 to £255,000
Counterfactual technology	£57,000	£845,000
Difference	£1,900,000 to £2,118,000	(£590,000) to (£699,000)

25. With these costs, we estimate the following tariff:

[11] This assumed post tax real discount rate, as per remainder of non-domestic RHI tariff, tries to cover the cost of capital or opportunity cost of using scarce capital and the risks associated with the technology
[12] Numbers have been converted to 2012 prices using an 8.3% Retail Price Index (RPI) uplift (original numbers were assumed to be in 2010 prices).

Table 6: Implied required RHI tariff from capital and operating costs in Table 5

	Levelised capital costs (p/kWh)	Levelised ongoing technology costs (including fuel costs) (p/kWh)
Deep geothermal	6.8 to 7.4	0.5 to 1.5
Counterfactual technology	0.2	2.9
Difference	6.6 to 7.2	(1.4) to (2.4)
Total tariff	4.2 to 5.8	
Average tariff (p/kWh)	5.0	

26. A tariff of around 5.0p/kWh (2012 prices) is an **increase** on deep geothermal's current GSHP tariff of 3.4p/kWh (for 2012). To assess the impact of the change in this tariff , we need to form some assumptions on the potential take-up of this technology up to 2020. When taking this into account, there are several issues to consider:

- There is currently only one geothermal site in the UK which is currently being refurbished; and
- There is a relatively large upfront capital cost and long lead in time associated with deep geothermal technology;

27. Both these issues suggest that up to 2020, there are likely to be relatively few potential deep geothermal sites producing renewable heat. In addition, it is also questionable whether this form of technology – which requires particular types of land and locations (unlike other technologies) – is a genuine substitute for other technologies. This would suggest the development of a deep geothermal site may not lead to a significant reduction in the demand for other renewable heat technologies. Industry has advised that the likely approach to any potential future development of heat only plants would be the development of large 6-7MWh systems serving large public sites such as hospitals and universities. Therefore, we propose that:

- We assume a small uptake of deep geothermal sites, equal to one additional site over and above a do nothing approach up to 2020;
- In the absence of any alternative information, we assume the site produces the same amount of renewable heat at the same cost as per assumptions in Tables 4 to 5;

28. Therefore, we have assumed that by 2020, with a tariff of around 5.0p, there is to be an additional 1 site over and above the do nothing option (we assume this additional site becomes operational in 2016 meaning our appraisal period is 24 years i.e. 20 years – the assumed lifetime of the technology – from 2016). We recognise that alternative sites are likely to vary in cost, particularly in cities where land and rental costs are at a premium, and that future costs may change as the technology matures, but in the absence of further information we have taken an average of the potential costs supplied by AEA and Geothermal Engineering. As discussed above, given the limited amount of information in this area we would welcome any evidence on alternative assumptions for this technology and potential uptake to 2020.

5.3 Air source heat pumps (policy options 3a and 3b)

Proposal: To use the consultation process to gather further evidence on the potential substitution between 'heating only' and 'heating and cooling' air source heat pumps. To use the consultation process to gather evidence in respect of metering.

Questions: (1) In what circumstances / buildings would there be demand for a 'heating only' air source heat pump? What is the evidence? (2) Should we only subsidise 'heating only' air source heat pumps? What are the implications of doing so? (3) What is the degree of substitution between heating and cooling technologies and 'heating only' ones? (4) Would a banded (two bands) air source heat pump tariff be more appropriate? (5) What evidence is there in relation to potential gaming if a deeming approach to metering is adopted? (6) What evidence is there on the performance and cost of a 'heating only' technology and a 'heating and cooling' technology? Is the performance of a 'heating only' technology 'superior' to a heating and cooling one?

5.3.1 Background

29. There are broadly two forms of ASHPs: 'Air to air' heat pumps (AAHPs) and 'Air to water' heat pumps (AWHPs). Both these technologies were excluded from the RHI when it was introduced in November 2011 due to concerns over performance and the measurement of the heat produced. These issues, and further detail on each of these technologies is given below.

5.3.1.1 Air to air heat pumps

30. While AAHPs were included in the initial RHI consultation in 2011, a lack of data and concerns over measuring the renewable heat produced prevented their inclusion.[13] AAHPs effectively produce warm air which is circulated by fans to heat a building. Heat from the outside air is absorbed into a fluid which is pumped through a heat exchanger in the heat pump. Low grade heat is then extracted by the refrigeration system and, after passing through the heat pump compressor, is concentrated into useful heat at a higher temperature which is then used for space heating. Note it is also possible to reverse this process and move the heat from inside the building to outside, providing a cooling function.

31. There is a large and growing market for AAHP devices in the UK. The vast majority is for devices capable of providing both heating and cooling with approximately 220,000 AAHP terminals (both domestic and non-domestic) being sold in 2011, worth an estimated £600million in first point sales. Discussions with the industry have indicated that the growing market is reflected in the cost of the technology and prices are decreasing. The heating output of both reversible and heating only AAHPs, is considered renewable because a small amount of electricity is used to produce a greater amount of heat. The cooling output of heat pumps is not deemed "renewable" under the Renewable Energy Directive. This means it cannot be counted towards the UK's share of the EU's 2020 renewable energy target and is not supported under the RHI.

5.3.1.2 Air to water heat pumps

32. AWHPs extract heat from the outside air and produce hot water and can replace existing commercial oil (or gas) boilers. AWHPs are most efficient at delivering heated water that is cooler than a typical boiler. This means they are normally coupled with heating systems requiring relatively low operating temperatures, such as under-floor heating. This form of heat pump was originally excluded from the RHI due to insufficient data on the associated costs and consequent inability to set an accurate tariff.

5.3.2 Do nothing

33. Under this policy option, both forms of ASHPs would continue to be ineligible for the RHI. Using DECC's RHI model we estimate that in the absence of RHI support, by 2020 there will be around 3.1 Terawatt hours (TWhs) of renewable heat produced by ASHPs.

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[13] There is currently no established methodology or standard for metering the output of air to air source heat pumps. While metering would be possible, it is unlikely to be economically viable and still require an element of estimation.

5.3.3 Do something

5.3.3.1 AAHPs (policy option 3a)

34. Using DECC's RHI model, the inclusion of ASHPs (both AAHPs and AWHPs) is forecast to contribute an additional 0.4 TWh of renewable heat by 2020.

35. Using the methodology set out in section 1, DECC modelling suggests a potential tariff rate of around 0.97p/kWh (in 2012 prices).[14] This relatively low tariff reflects the fact that this technology is reasonably cost-effective in the absence of support. However, a key reason why demand for AAHPs is relatively high is due to the demand for reversible heat pumps that provide a cooling benefit. The high demand for such technologies in the absence of subsidy suggests including AAHPs which provide a cooling benefit in the RHI would result in non-additionality and would not therefore represent value for money. In addition, there would be difficulties in having to distinguish between the heat output, which would be eligible for the RHI, and the cooling output, which would not. The modelled characteristics and costs of the reference installation (i.e. closest to the 50% point on the supply curve) are shown in Table 7 below.

36. 'Heating only' AAHPs on the other hand are still an emerging technology. Technically these are virtually identical to reversible models but optimised for heating, meaning the costs, and therefore the required tariff, are the same. The majority of public and commercial buildings in the UK do not cool currently. Therefore, the market for heating only AAHPs is in large buildings with a heat demand but no need for cooling, such as schools, libraries and other public infrastructure. In these buildings (where there is no demand for cooling), the choice could be either between conventional fossil fuel heating or renewable technology. Introducing support for heating only AAHP does not face the same issue as reversible heat pumps of having to discount the cooling element - all of their activity would be eligible for the RHI.

37. Given the renewable energy potential for AAHPs and the relative low cost of providing the incentive, one option is to support heating-only AAHPs but not reversible devices capable of heating and cooling.

38. While we expect one tariff applied to all AAHPs to provide adequate support to this technology at a low rate, we would welcome evidence on whether it is more appropriate to have a banded (two bands) tariff approach similar to the tariff structure for GSHPs. A banded approach may be appropriate if there is sufficient evidence that suggests there is considerable variation in the costs associated with delivering particular levels output.

39. AAHPs typically use fan assisted ducts as the heat delivery method, meaning that the existing RHI water or steam based metering approach will not work for this technology. Therefore, in order to introduce support for this technology, a different method of calculating payment, either a different form of metering or through estimating the heat load using methodology such as the Simplified Building Energy Model (SBEM) is required.

40. One difficulty with metering the heat output from air based delivery systems is the expected cost and uncertainty of doing so. Industry have advised the cost could increase by as much as 20% and is considered unreliable. For this reason, there could be no requirement to meter the output of AAHPs, and instead have a deeming approach. There are obvious risks in respect of potential gaming – such as potential inflating of deemed heat levels and / or not using the renewable heat technology as much as expected – and so we would welcome evidence on whether this is potentially a significant issue or not.

41. The ratio of the heating output relative to the amount of electricity used gives the coefficient of performance (COP). The seasonal performance factor (SPF) is the average COP over a year and reflects the efficiency of the technology when installed. A more efficient technology delivers more renewable heat for every unit of electricity used. To count as 'renewable' in a European context, a technology must achieve a minimum SPF. The European Commission is committed to issuing guidance for determining whether a heat pump can be counted as renewable by January 2013 and we recommend proposing SPF standards consistent with the latest Commission position when the tariffs are announced.

[14] Please note that all tariffs quoted in this IA are in 2012 prices. If any of these tariffs are introduced they will need to be adjusted to the relevant price base to account for changes in inflation.

Table 7: modelled characteristics and costs of the AAHP reference installation (i.e. closest to the 50% point on the supply curve)

Assumption	**AAHP** (2012 prices)	**Counterfactual fuel (assumed to be gas)**
Capital expenditure (£/kW)	£476	£102
Operating expenditure (£/kW/year)	£13.3	£3.7
Efficiency	320%	95%
Load factor	35%	20%
Size (kW)	55	96
Lifetime (years)	20	20
Annual output (MWh)	168	168

5.3.3.2 AWHPs (policy option 3b)

42. The expected renewable heat contribution from all ASHPs if they are included in the RHI is around 4.4TWh (business as usual energy of around 3.1 plus 1.3 from the estimated policy impact of bringing ASHPs into RHI).

Table 8: modelled characteristics and costs of the AWHP reference installation (i.e. closest to the 50% point on the supply curve)

Assumption	**ATW**(2012 prices)	**Counterfactual fuel (assumed to be gas)**
Capital expenditure (£/kW)	£586	£72
Operating expenditure (£/kW/year)	£4.3	£1.3
Efficiency	320%	90%
Load factor	35%	20%
Size (kW)	300	525
Lifetime (years)	20	20
Annual output (MWh)	920	920

43. Our current modelling suggests that the tariff required to incentivise 50% of the available potential of AWHPs would be around 1.7p/kWh (2012 prices). This tariff would apply to all installations regardless of size. However, while we expect the one tariff to provide adequate support to this technology, we would welcome views on whether an alternative two banded approach is more suitable. The characteristics of the reference installation (i.e. closest to the 50% point on the supply curve) are shown in Table 8 above.

44. This form of heat pump was originally excluded from the RHI due to insufficient data on the associated costs and consequent inability to set an accurate tariff. However, following the previous consultation on the RHI we have received cost information from stakeholders (set out in recent AEA report).

45. Like other heat pumps, AWHPs will be required to meet a certain level of efficiency to be counted as 'renewable'. We recommend dealing with this technology in the same manner as AAHPs and proposing SPF standards consistent with the latest Commission position but also taking into account the current RHI requirements for ground source heat pumps (which require a minimum CoP of 2.9).

5.4 Biomass direct air heating (policy option 4)

Proposal: To use the consultation process to gather further evidence on metering.

Questions: (1) What approach should be adopted to the measure the amount of renewable heat produced? (2) What are the costs and benefits of this approach?

5.4.1 Background

46. The RHI currently supports only installations where the heat is delivered via liquid (e.g. water, thermal oil) or steam because equipment and standards exist for the metering this type of heat. However, there are other applications where direct air heating could be used and would be more appropriate e.g. if a separate biomass boiler and wet heating system have been installed.

47. There is a diverse use for these types of installation, ranging from space heating to agricultural uses such a grain drying and in wood processing industry. As a result, the potential size of applications is very large. For example, currently the largest renewable heating installations in the UK are biomass direct air heaters of >30MW.

5.4.2 Do nothing

48. The do nothing option would mean biomass direct air heating would continue to be ineligible for the RHI. In the absence of an RHI tariff we estimate that there will be around 0.6TWhs of renewable heat generated from biomass direct air heating.

5.4.3 Do something

49. The do something option is to make this technology eligible for the RHI. As biomass direct heating systems tend to less costly than biomass boilers - partly because a wet heating system does not have to be installed - a potential RHI tariff will, in general, be lower than biomass boilers, making this a cost effective technology. The RHI model suggests a tariff of around 2.1p/kWh (2012 prices) would be sufficient to incentivise 50% of potential take-up for biomass direct air installations with a capacity of less than 1MW. The table below shows costs and characteristics associated with the reference installation (i.e. closest to the 50% point on the supply curve). With these tariff levels, there is a forecast level of uptake of 0.9TWh of renewable direct air heating by 2020 (business as usual energy of around 0.6 plus 0.3 from the estimated policy impact of bringing biomass direct air heating into RHI).

Table 9: modelled characteristics and costs of the biomass direct air reference installation (i.e. closest to the 50% point on the supply curve)

Assumption	**Biomass Direct Air**(2012 prices)	**Counterfactual fuel (assumed to be gas)**
Capital expenditure (£/kW)	£291	£36
Operating expenditure (£/kW/year)	£7	£0.8
Efficiency	77%	91%
Load factor	20%	20%

Size (kW)	200	200
Lifetime (years)	20	20
Annual output (MWh)	350	350

50. The key issue is how to measure the output of these installations. It is likely we would have to adopt a differentiated approach based on capacity. Measurement of flow and air temperature may be possible within reasonable tolerances, although, unlike for water and steam metering, there is no current accepted standard for this type of metering.

5.5 Combined Heat and Power (policy options 5a and 5b)

Proposal: To introduce a separate combined heat and power RHI tariff equal to around 4.1p/kWh (2012 prices).

Questions: (1) Should we introduce a separate (higher) RHI tariff for combined heat and power? (2) Is the estimated tariff reasonable? (3) Should bioliquids be included in this CHP tariff?

5.5.1 Background

51. Combined heat and power (CHP) is currently supported under the RHI for biomass, biogas and geothermal sources of heat. However, there is no specific renewable heat CHP tariff, rather an installation is able to claim the tariff applicable to the technology it uses, subject to the banding and size limitations of that technology.

52. Due to the nature of CHP there is more interaction between the RHI and the Renewables Obligation[15] (RO) than some other technologies. An eligible renewable CHP plant will be able to claim both the RO and RHI on its power and heat output respectively. Biomass, biogas and geothermal CHP are currently eligible for the RHI providing the installation is not a CHP generating station which has received the ½ Renewables Obligation Certificate (ROC)[16] uplift under the RO.

53. The RO is a more attractive mechanism for supporting CHP currently. However, the extra CHP support under the RO, in the form of the ½ ROC uplift, will end in 2015, leaving the RHI as the primary mechanism for supporting the heat output and therefore incentivising CHP. Given the relatively long lead-in times for this technology, it is important that any incentive is put in place relatively soon to ensure the RHI provides the right support to CHP plants.

54. CHP has specific costs and risks associated with it so we have gathered further evidence, in conjunction with the RO banding review, in order to set tariffs for Good Quality[17] biomass and / or bioliquid CHP. Good Quality CHP is a more efficient way of utilising renewable fuels (compared with separate heat and power production). The UK renewables regime should therefore ensure that incentives appropriately reflect this efficiency. Given the relative complexity and size of CHP plants the market requires policy clarity about how they will be supported beyond 2015 and that clarity is required now in order that long-term investments are made.

[15] The Renewables Obligation was introduced in 2002 and is currently the main financial mechanism which the Government incentivises the deployment of large-scale renewable electricity generation. The RO places an obligation on UK electricity suppliers to source an increasing proportion of electricity they supply to customers from renewable sources.

[16] A Renewables Obligation Certificate (ROC) is issued to operators of accredited renewable generating stations for the eligible renewable electricity they generate. Operators can then buy or sell ROCs with other parties, with the ROCs ultimately being used by suppliers to demonstrate they have met their renewables obligation.

[17] As certified under the CHP Quality Assurance scheme http://chpqa.decc.gov.uk/

5.5.1.1 Bioliquids (policy option 5a)

55. The inclusion of bioliquid CHP under the RHI has not previously been proposed. However, Good Quality delivers more total useful energy per unit of input fuel and higher levels of greenhouse gas savings than for equivalent use in electricity only, heat only or transport sectors. Bioliquids have a high energy density and are a good source of energy for industry.

56. CHP plants can take a wide range of bioliquids, including those that are not suitable in the transport sector. Over 80% of bioliquids used in the RO in 2009/2010 were bioliquids not used in the transport sector.

57. CHP can also use advanced bioliquids made from waste and solid biomass sources which do not have high sustainability risks, and have potentially high greenhouse gas savings. We are aware of a number of producers who are seeking to use CHP as a stepping stone to generate advanced biofuels such as aviation fuel, which are strategically important to decarbonise the transport sector between 2020 and 2050.

5.5.2 Do nothing

58. This option would mean CHP continues to be supported under the RHI for biomass, biogas and geothermal sources of heat. However, there would be no separate Good Quality renewable CHP RHI tariff.

5.5.3 Do something

59. This policy option would involve creating a separate renewable heat tariff (which could include bioliquids). The calculation of an RHI tariff has been carried out by AEA and a list of the key assumptions used in their analysis is published alongside this IA on the DECC website. This tariff includes both biomass and bioliquids data and we have produced one single tariff to cover both forms of CHP – an approach consistent with the RO. AEA's analysis suggests a tariff of around 4.1p/kWh (2012 prices) will incentivise 50% of potential uptake. The projections of renewable CHP deployment are calculated using a combination of two models. The first provides estimates of the number of sites that are suitable for CHP and also calculates what sort of CHP unit is most suitable for each site. It therefore determines the heat to power ratio used, the heat and power output and the type of unit deployed (eg. size and bioliquid or biomass).

60. Once we have estimates of where CHP could potentially be deployed we put these projections through the second CHP model that calculates which of the sites are economic to build. It does this by taking into account projections of energy prices and policies and calculating an internal rate of return. If this rate of return passes a specified hurdle rate the unit will be built. This model also takes into account the trade off between building gas fired of renewable CHP so the more attractive gas is, the less attractive renewable becomes (if everything else remains the same). The creation of a 4.1p CHP tariff is projected to result in 9TWh of renewable heat in 2020 (business as usual energy of around 6.5 plus 2.5 from the estimated policy impact of having a tariff of 4.1p/kWh in the RHI). This tariff is based on data from a range of sizes of CHP plants and we propose applying this tariff across all sizes of installation.

5.6 Biogas (policy option 6)

Proposal: To use the consultation process to gather evidence on whether the introduction of an RHI tariff similar to Feed-in-Tariff levels of support is appropriate. To use the consultation process to gather evidence on the appropriate banding of the biogas RHI tariff.

Questions: (1) Is the current treatment of biogas in the RHI appropriate? (2) What alternative evidence is available to suggest a subsidy similar to a Feed-in-Tariff level of support is more appropriate? (3) Would changing the biogas RHI subsidy increase market distortions? (4) Would a higher RHI biogas tariff lead to an increase in feedstock for heat over other uses (except electricity)? (5) What evidence is available to suggest an alternative banding arrangement for the biogas tariff is needed?

5.6.1 Background

61. The RHI currently supports biogas combustion from gas produced from solid biomass, solid waste and liquid waste (except landfill gas which is excluded). In practice, the support can be divided into 3 main categories, gas produced from sewage plants, anaerobic digestion (AD) and advanced conversion technologies. All support is limited to plants with an installed thermal capacity of less than 200kW due to a lack of data on larger plants.

62. We are not considering making changes to existing biogas combustion support (those plants which are under 200kW thermal capacity). However, we are consulting on the introduction of support to biogas combustion plants over 200kW.

63. AD is expected to make a significant contribution to our renewable targets and including that which is converted to biomethane and injected into the grid, could generate up to 4 TWh of heat per year by 2020. In terms of our 2020 renewables target, not only could larger plants provide a greater heat contribution, but they will also present better value to the taxpayer in terms of subsidy required per KWh of renewable heat. Feedstocks used by larger industrial sites are likely to be by-products of the industrial processes carried out on site; by-products which usually would have to be paid to be removed to landfill. Sites that use food waste also get gate fees for disposing of others' waste. This makes AD particularly economical for these sites. Farms on the other hand may not pay to dispose of what would become their feedstock, meaning that a higher subsidy may be required to incentivise this form of AD.

64. As part of the tariff setting process we have sought a consistent approach with both the RO and Feed-in-Tariffs (FITs). It is important that the tariffs are set so any potential distortions are minimised. For example, a higher subsidy to generate electricity could mean there are potentially perverse incentives to produce electricity in circumstances where heat generation is the most efficient use for the biogas produced. A perverse incentive of this nature could create the dual problems of greater cost to the taxpayer, due to the higher tariffs for electricity; and increased carbon emissions, due to gas being imported for heating whilst electricity is exported. However, while an increased RHI tariff would reduce the incentive to use feedstock to generate electricity over heat, it would also create an incentive to use the feedstock for heat over other uses (see section 6.6 for further details).

5.6.2 Do nothing

65. This option would continue to have the small scale biogas tariff but anything above 200kWh would not be supported. However, under FITs, tariffs for Anaerobic Digestion (AD) in 2012/13 are set at 14.7p/kWh for installed capacity of up to 250kWh, 13.6p/kWh for installed capacity of between 250-500kWh and 9.9p/kWh for installed capacity of greater than 500kWh's. This could suggest a potentially inefficient use of resources if subsidy is being diverted to electricity generation rather than heat generation, particularly if there is a high demand for heat which is then met by conventional fossil fuel heating. As such, we would expect to see a lower level of deployment of renewable heat from biogas than what otherwise would be the case.

5.6.3 Do something

66. This policy option is whether to adjust the biogas RHI tariff to ensure consistency with AD FITs levels of support. The current FITs levels of support suggest it would generally be commercially attractive to produce electricity than heat. This could be an inefficient outcome in instances where there is a large heat load. For example, an organisation or individual is likely to choose to build a biogas plant and generate electricity which they then export back to the grid and continue to meet their heating demand through conventional fossil fuel heating. Creating a tariff structure consistent with FITs would reduce this distortion. An example of this tariff structure is as follows:

- Estimate of the (wholesale) electricity price used in FITs estimates (2012 prices). Equal to 7.9p/kWh in 2012;
- Value of FITs AD subsidy (2012 prices). Equal to 13.6p/kWh (250-500kW) and 9.9p/kWh (greater than 500kW);
- Difference between the wholesale price and FITs subsidy (2012 prices): 5.7p/kWh and 2.0p/kWh;

67. The difference between these two values – the value of the subsidy less the value of the electricity - could potentially be an RHI biogas tariff.[18] At these tariff rates, it could mean when it was efficient to produce heat, producers would do so, and when it was efficient to generate electricity, producers would do so. This methodology results in a medium (200-500kW) biogas tariff of around 5.7p/kWh and a large (>500kW) biogas tariff of around 2.0p/kWh (in 2012 prices).[19]

68. To ensure consistency with FITs, and to reflect the differences between the medium-sized plants primarily located on farms and larger industrial sites, this option would involve introducing three size bands for biogas combustion. These banding are:

- Small biogas combustion- capacities of up to 200kW;
- Medium biogas combustion- capacities of 200kW- 500kW; and
- Large biogas combustion- 500kW and above;

69. We are inviting views and evidence on whether there is any evidence to support an alternative RHI tariff for biogas as per a "FITs equivalent" biogas RHI tariff. We are also on seeking views on whether an alternative and less complex banding is more appropriate. This would mean including a slightly larger range of 200kW-1MW in the medium tariff to account for the fundamental capacity differences between electricity and heat. This would also be consistent with the current banding on biomass heat installations.

5.7 Energy efficiency (policy option 7)

Proposal: To use the consultation to (1) gather evidence on whether to introduce energy efficiency measures as a condition for receiving the RHI and (2) what these measures should be.

Questions: (1) Is it appropriate to consider the introduction of energy efficiency requirements for the non-domestic RHI? What are the benefits and costs? (2) Should process heat be excluded from energy efficiency requirements? (3) Should a range of energy efficiency assessments methods be allowed to prove compliance for non-domestic space and water heating? (4) Is there evidence that this would present any barriers to potential RHI applicants?

5.7.1 Background

70. Increased energy efficiency is a cost-effective means of reducing carbon emissions. There are currently no energy efficiency requirements for the non-domestic RHI. The non-domestic RHI was launched without explicit energy efficiency measures because of:

- the diversity of the non-domestic customer base;
- the assumption that businesses were rationale and would therefore maximise profits by implementing energy efficiency measures;
- the planned launch of the non-domestic Green Deal; and
- the importance of launching the non-domestic RHI;

71. The non-domestic RHI was launched with the intention that energy efficiency measures – such as the number of 'green ticks' for district heating (see Consultation document for further details) - could be developed and added at a later date. The scheme has been running for 10 months and DECC is now in a position to review the energy efficiency requirements within this scheme. However, it is important that if standards are introduced, they should not act as a barrier to accessing the RHI and the switch to renewable heat.

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[18] Please note that we have assumed the producers of electricity under FITSs sell the electricity on and do not use it themselves. The FITs tariff compensates producers by paying the wholesale price of electricity plus a mark-up (to account for additional costs when using renewable technologies). In contrast, we assume the renewable heat producers consume the heat they generate and so forgo opportunity costs (levelised counterfactual costs of heat). The RHI tariff therefore does take opportunity costs into account and only compensates for the costs over and above the levelised counterfactual costs of heat.

[19] Changing the tariffs in such a way would also require State Aid clearance.

5.7.2 Do nothing

72. This option would mean the RHI continues as it stands without requiring energy efficiency standards.

5.7.3 Do something

73. This policy option would introduce a range of energy efficiency measures required to receive the RHI which would support the drive to increase energy efficiency (see consultation document for further details).

6. Monetised and non-monetised costs and benefits of each option (including administrative burden)

6.1 Introduction

74. This section sets out the monetised and non-monetised impacts of each policy option relative to a do nothing option. For certain policy options, the estimated impacts are highly dependent on the assumptions made and we would like to use the consultation process to gather further evidence on these assumptions. For other policy options, the cited impacts are qualitative and would like to use the consultation process to gather further evidence in relation to the issues identified. It is also important to note that projections are on the basis of modelling and there is significant uncertainty on key variables which are likely to impact on the level of renewable heat produced. For example, fossil fuel prices, customer attitudes, the cost of renewable heat technology and the ability of the supply chain to meet demand are all key drivers of potential uptake. Changes to anyone of these variables will impact on the demand for renewable heat meaning projections should be viewed with a degree of caution. An assessment of the potentially administrative burden of these policy options is given in section 7.7.

6.2 Deep geothermal (policy option 2)

6.2.1 Benefits

75. As discussed in section 5.2, the limited data on deep geothermal technology means estimating its own tariff is problematic. The key benefit of giving this technology its own tariff – estimated to be around 5.0p (2012 prices) – is that it is a subsidy tailored more closely to the 'true' costs of this particular technology rather than the costs of GSHPs. With a more tailored tariff, there is an increase in efficiency and a reduction in potential market distortion caused by changes in the relative cost of competing renewable heat technologies. At this tariff rate, this form of technology is relatively cost-effective compared against some other technologies despite high upfront costs and the high risk nature of the investment. However, this assumes the underlying data used to estimate the tariff is correct (if the data is not, any potential distortions or inefficiencies could be exacerbated). That is why we would welcome any further evidence to that set out in section 5.2 on the potential costs and benefits of this particular technology.

76. Based on the costs and assumptions set out in section 5.2, each deep geothermal site would have the potential to reduce fossil fuel demand, thereby delivering potential carbon savings in the region of 6,000 tonnes per year, equating to £6m over 24 years. It would also increase the level of renewable heat produced by around 29MWh in 2020. We would particularly welcome views on whether, and by how much, the take-up of deep geothermal technologies will increase over and above our baseline estimates as a result of a 5.0p tariff. Our assumption is that in the absence of a separate deep geothermal tariff, uptake will remain relatively low with only the existing site in Southampton. Given the potential long lead in times with deep geothermal sites, we have assumed that a separate tariff increases demand by one site over and above the baseline. This conservative assumption simply reflects the fact that this technology has high upfront costs, has a relatively high investment risk and that there is potentially a need for successful schemes to be demonstrated before further installations are likely. However, we would welcome evidence on alternative assumptions.

77. The inclusion of this technology further supports the longer term heat strategy by supporting a range of technologies which could have the potential for larger cost reductions in the future that could be

supported by the early deployment of the technologies. A range of technologies will be required to meet future energy and heat demand.

6.2.2 Costs

78. There is an increase in capital costs from the increase in deep geothermal technology equal to around £18m over 24 years (in present value terms) and a operating cost saving of £8m over 24 years (based on the assumptions in section 5 the capital cost range is between £17m and £19m over 24 years and the operating cost saving is between £7-9m). This means there is a net resource cost of £10m over 24 years. The increase in support to this technology will mean an increase in the cost to Government of £24m over 24 years (though this is considered a transfer as it is a corresponding benefit to potential owners of renewable heat technologies).

6.2.3 Sensitivity tests

79. To analyse how sensitive the analysis is to key assumptions we have used the upper and lower estimated capital and operating costs as set out in section 5.2.3 as well as DECC's high and low valuations of carbon. Changes in costs will impact on expected deployment which in turn will impact on the level of RHI subsidy. However, as set out in section 5.2.3, we have assumed that by 2020, with a tariff of around 5.0p, there is to be an additional 1 site over and above the do nothing option. Making alternative assumptions on uptake based on different costs will add a further layer of uncertainty and therefore we do not propose to make assumptions on different levels of deployment at this stage (which means the subsidy costs for the upper and lower capital costs will be the same as in the central scenario). However, we would welcome evidence on how deployment might change given different assumptions on costs. The lower capital and operating costs of £2,440/kW and £24/kW year respectively, reduces the total resource costs of achieving the same level of deployment as in the central scenario to £8m over 24 years while the higher value of carbon increases the external benefit to society to £8m over 24 years. This means the Net Present Value (NPV) – the difference between benefits and costs – is £0m (£4m greater than under the central scenario).

80. Using the upper capital and operating costs of £2,700/kW and £43/kW respectively (as set out in Table 6), there is an increase the resource costs of achieving the central level of deployment to £12m compared to £10m in the central scenario. The lower valuation on carbon reduces the external benefit to society to £3m over 24 years. This means the NPV is -£9m. Therefore, based on the evidence and assumptions set out in section 5.2, our estimated NPV of this policy option is between 0 and -£9m. It should be noted that in the low cost sensitivity, no adjustment has been made for the potential degression of tariffs as proposed in the consultation document "RHI providing certainty and improving performance".[20]

6.3 Air Source Heat Pumps (policy options 3a and 3b)

6.3.1 Benefits

81. Making ASHPs eligible for the RHI with tariffs of around 0.97p/kWh and 1.7p/kWh for AAHPs and AWHPs respectively is forecast to increase the level of renewable heat from all ASHPs from 3.1 TWhs to 4.4TWhs (though the total net increase in renewable heat is around 0.4 TWhs due to substitution from other renewable heat technologies). These tariff levels are extremely cost-effective when compared against other technologies (see Table 1). The increase in the demand for renewable heat has an associated net carbon saving which equates to £118m over 34 years. Including ASHPs will provide an important source of cost-effective renewable heat towards the renewables target.

82. The inclusion of a further technology within the RHI also helps diversify the mix of technologies that will be required to support UK heat demand in the longer term, including through learning how best to adapt the technology that has proven effective in other countries to UK buildings. In addition, as many other renewable heat technologies are being supported through the RHI, setting a tariff level on a consistent basis as the other competing technologies will help reduce the distortions in the market by "levelling the playing" field with other technologies.

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[20] "RHI providing certainty and improving performance" URL: http://www.decc.gov.uk/en/content/cms/consultations/rhi_cert_perf/rhi_cert_perf.aspx

83. The proposal is to have a single tariff for each of the ASHPs which has the added advantage of being relatively simple to administer. However, we would welcome evidence on whether a single tariff scheme is most appropriate or whether a two tier approach – like the tariff structure for GSHPs - is a more desirable approach.

6.3.2 Costs

84. The additional resource cost of this technology is estimated to be negative and equal to £534m over 34 years. We estimate a negative resource cost because our modelling suggests that by subsidising ASHPs there will be some substitution of demand away from (more expensive) GSHPs thereby delivering some potential resource cost savings. Making ASHPs eligible for the RHI also increases the cost to Government by around £161m over 34 years as overall deployment increases and non-additional ASHPs still receive the tariff (this is a transfer).

85. As identified in section 5.3, there are broadly two types of AAHPs; one which provides a 'heating only' function and one that provides both a heating and cooling function. To date, the demand for the latter has been significantly higher. Therefore, there is a question about whether a 'heating only' device should be supported. The key issue is whether the effect of the policy is to increase the demand for a 'heating only' AAHP at the expense of a dual heating and cooling AAHP in a building where there is a demand for cooling. If the AAHP is only required for heating, there is a rationale to support only this technology. There is an added rationale if the performance of heating only AAHPs is superior to the dual heating and cooling technologies. However, there may be instances when there is demand for both heating and cooling. In this instance, encouraging the purchase of a particular form of technology that is not appropriate would not result in an efficient outcome. However, the focus of this subsidy is to encourage the uptake of renewable technology in buildings where there is a demand for 'heating only' (e.g. schools) and which, in the absence of any subsidy, the alternative form of heating is conventional fossil fuel heating. The consultation document sets out where a heating only AAHP might be most appropriate – for example schools and other public buildings – but we would welcome evidence on this issue.

86. To help understand these costs further, we would welcome evidence on the potential substitution between heating and cooling technologies and 'heating only' technologies, and whether the assumptions made on places where there is a heating only demand are appropriate. We would also welcome evidence on whether the performance and costs of heating only technologies are superior to dual heating and cooling technologies.

6.3.3 Sensitivity tests

87. The demand for a renewable heat technology depends crucially on its total cost and the cost of potential substitutes as well as the ability of the supply chain to meet demand. The sensitivity analysis assumes that the capital costs of ASHPs are either 20% higher or 20% lower than the central estimate. It is important to note that in order to 'isolate' the impact of this policy option – the inclusion of ASHPs in the RHI – our baseline forecasts must also have the assumed renewable heat technology costs reduced or increased by 20%. This in turn will impact on the forecast uptake of renewable heat in the baseline. A summary of the key impacts in each scenario is given below.

Table 10: Summary of present value impacts (appraisal period is 34 years)

	Central forecast	20% higher capital cost	20% lower capital cost
Resource costs	-£534m	-£49m	-£1331m
Carbon benefits	£118m	£30m	£88m
Subsidy	£161m	£319m	-£112m
NPV	£653m	£79m	£1420m
Change in renewable heat in 2020 (TWhs)	0.4	0.1	0.3
Percentage of renewable heat deployment from ASHPs in 2020 (TWhs)	11%	9%	15%
Percentage of renewable heat deployment from GSHPs in 2020 (TWhs)	14%	15%	11%

88. In the high capital cost scenario, as ASHPs are more expensive, modelling predicts that the tariff will result in less deployment, and therefore less substitution of GSHPs for ASHPs. As a result of this, resource cost savings (£49m saving) from the introduction of the tariff are lower than in the central case (£534m saving), as are the carbon benefits (£30m), as overall deployment falls. Subsidy costs are higher (£319m) in this scenario than the central case (£161m) as fewer low tariff ASHPs are replacing higher tariff GSHPs.

89. In the low capital cost scenario, as ASHPs are less expensive we see greater deployment, here they provide a mixture of additional renewable heat and substitution from both GSHPs and Biomass. As a result of this resource cost savings are higher (£1331m saving) than the central scenario (£534m saving), driven by two main effects. Firstly, as more low cost ASHPs are substituting for more expensive technologies, there are more cost savings. Secondly, each unit of ASHP comes at a lower cost than in the central scenario as capital costs are reduced. Carbon benefits, however are lower (£88m) than in the central scenario (£118m) as ASHPs save less carbon per unit of renewable energy than the biomass and GSHPs they are replacing. Subsidy costs are lower in this scenario (in fact they result in a subsidy saving of £112m), as the impact of substitution of low tariff ASHPs for GSHPs and Biomass results in a large fall in subsidy costs which is larger than the rise in subsidy costs caused by additional deployment and payments made to non-additional ASHPs.

90. This sensitivity analysis therefore implies the NPV of this policy option lies between £79m to £1420m depending on assumptions on the capital cost of renewable heat technologies. It should be noted that in the low cost sensitivity, no adjustment has been made for the potential degression of tariffs as proposed in the consultation document "RHI providing certainty and improving performance".[21]

91. A sensitivity on supply chain constraints has also been carried out. The supply in the ASHP market may not grow fast enough to meet the demand for the technology in every year. When this is the case,

[21] "RHI providing certainty and improving performance" URL: http://www.decc.gov.uk/en/content/cms/consultations/rhi_cert_perf/rhi_cert_perf.aspx

excess demand will lead to a rise in prices, an increase of profits for suppliers and so attract new companies into the market. In subsequent years the industry may grow faster until it catches up with demand. In some years, however, supply chain constraints may bite and limit the renewable heat that can be deployed that year.

92. To model supply-side growth-constraints the calculations underlying this IA simplify the above process and assume that the growth of the supply chain is limited to a fixed number of additional MWh's each year. As the industry develops over time this limiting additional technical potential per year increases whenever the market has reached a predefined size. The annual growth limits and threshold market sizes are modelling assumptions and uncertain.

93. To investigate how strongly estimated uptake reacts to a variation of these assumptions we have carried out a sensitivity analysis on the supply-chain growth-constraint. It assumes that the additional technical potential (MWh) the industry can grow per year is 20% higher or 20% lower than for the central estimate.

94. As before in the cost-sensitivity example, the renewable heat technology supply growth-constraint is also assumed to be loosened or tightened by 20% in the baseline in order to isolate the impact of the introduction of ASHPs to the RHI. This will have an impact on the estimated uptake of renewable heat in the baseline scenario.

95. In the scenario (see Table 11) with loosened growth constraint we observe an additional 1.1TWh (+3%) of overall renewable heat deployment by 2020, over and above that of the central scenario, whereas tightening leads to a reduction of deployment by 0.8TWh (-2%).

Table 11: sensitivity analysis on supply chain growth in 2020

	Supply chain growth constraint (central)	**Supply chain growth constraint loosened**	**Supply chain growth constraint tightened**
Additional renewable resource ASHP only - input basis (2020) [TWh]	4.4	5.8	2.9
Change in total additional renewable resource from central scenario (2020) [TWh]		1.1 (+3%)	-0.8 (-2%)

96. Considering the additional heat generated by 2020 by ASHPs alone, a similar pattern emerges: loosening the constraint increases the deployment by 1.5TWh (+33%) to 5.8TWh and tightening the growth constraint reduces it by 1.5TWh (-34%) to 2.9TWh. This would suggest that if the supply constraints bite, this could limit the increase in deployment seen in the low cost sensitivity i.e. the supply side must be putting some downward pressure on the increased deployment in some years.

97. The impacts on the additional renewable deployment suggest that in some years the supply chain constraint bites, as uptake cumulated to 2020 rises and falls with the loosened and tightened constraint. Although the variation of the growth constraint seems to have a modest impact (20% change per year only leads to a change of 34%, or less, cumulative over all years) it underlines the uncertainty over deployment estimates. The supply constraint sensitivities therefore suggest that it is the supply side that is likely to limit deployment but we would welcome evidence on whether this is a reasonable conclusion to draw.

6.4 Biomass direct air (DA) heating (policy option 4)

6.4.1 Benefits

98. Supporting this form of technology will mean there is an increase in renewable heat use of around 0.2 TWhs by 2020. The increase in renewable heat deployment therefore supports the meeting of the 2020

renewables target. The reduction in demand for fossil fuel heating also means there will be a potential carbon saving equating to around £38m over 34 years.

99. Further diversification of support is consistent with the heat strategy which envisages biomass as playing a key long-term role in decarbonising process heating and many of the uses of these types of installations would be for such heating.

100. The estimated tariff of 2.1p/kWh is also highly cost-effective compared to other technologies (see Table 1). It will therefore help to cost-effectively meet the 2020 renewables target.

6.4.2 Costs

101. The additional resource cost of this technology is estimated to be around £100m over 34 years which is a result of higher deployment. The introduction of an RHI tariff will also increase the level of Government expenditure by £116m over 34 years (though the £116m difference is a transfer to the private sector). There is also the potential for a negative air quality impact given the small forecast increase in the levels of biomass combustion. However, similar air quality restrictions may be applied as per July 2012 consultation.[22]

102. In order for a subsidy to be effective and represent value for money it is important that the level of renewable heat generated (and therefore carbon saving achieved) can be effectively monitored. However, as with AAHPs, effectively measuring the heat produced will mean a potentially differentiated approach based on capacity is needed. We would welcome input on evidence on how the output of this technology can be effectively measured.

6.4.3 Sensitivity tests

103. As with the ASHP sensitivity analysis, we have assumed that the capital costs of biomass direct air is either 20% higher or 20% lower than the central estimate. We then analyse the impact of including biomass direct air heating by making this technology eligible for the RHI. A summary of the key impacts in each scenario is given below.

Table 12: Summary of present value impacts (appraisal period is 34 years)

	Central forecast	**20% higher capital cost**	**20% lower capital cost**
Resource costs	£100m	£200m	£72m
Carbon benefits	£38m	£66m	£46m
Change in subsidy	£116m	£121m	£118m
NPV	-£63m	-£134m	-£26m
Change in renewable heat in 2020 (TWhs)	0.2	0.4	0.3

104. In the high capital cost scenario, as Biomass DA is more expensive, modelling predicts that there will be much lower deployment in the baseline. This means that when introducing a tariff, this tariff has a larger impact on deployment than it did in the central cost case. So although deployment in total does not rise, additional deployment as a result of tariffs does. This leads to a higher resource cost, as more costs are a direct result of the introduction of a tariff, and each unit is more expensive (resource costs

[22] http://www.decc.gov.uk/en/content/cms/consultations/rhi_cert_perf/rhi_cert_perf.aspx

rise from £100m to £200m). Similarly, as more deployment is directly attributed to the tariff carbon savings rise (£66m from £38m).

105. In the low capital cost scenario, as Biomass DA is cheaper, modelling predicts that the deployment in the baseline will be slightly higher than in the central case. When a tariff is introduced deployment is expected to be again only slightly higher than the central scenario. So in sum we see that additional deployment as a result of tariffs is slightly increased by lower capex. However, this deployment comes at lower cost, so resource costs fall (from £100m to £72m). Carbon benefits, however rise slightly (£46m from £38m) as deployment has risen slightly. Likewise subsidy costs are slightly higher, due to slightly higher overall deployment. This sensitivity analysis therefore implies the NPV of this policy option lies between -£26m to -£134m depending on assumptions on the capital cost of renewable heat technologies.

106. As with ASHPs we have also carried out a sensitivity analysis on the supply chain growth-constraint, assuming the additional technical-potential the industry can grow per year is increased and reduced by 20%.

Table 13: Sensitivity analysis on supply chain growth

	Supply chain growth constraint (central)	**Supply chain growth constraint loosened**	**Supply chain growth constraint tightened**
Additional renewable resource Biomass DA only - input basis [TWh]	0.9	1.1	0.9
Change in total additional renewable resource from central scenario [TWh]		0.1 (+0.3%)	-0.1 (-0.1%)

Note: Looser constraint = supply chain growth constraint rates increased by 20%; Tighter constraint = supply chain growth constraint rates reduced by 20%

107. A loosened growth constraint increases renewable heat deployment by 2020 by 0.1TWh (+0.3%) over the central scenario, a tightening leads to a reduction by 0.1TWh (-0.1%).

108. Considering again the additional heat generated by 2020 by biomass direct air alone we observe an increase of deployment by 0.15TWh (+16%) to 1.1TWh when loosening the constraint and a reduction by 0.1TWh (-9%) to a level of 0.9TWh when tightening it.

109. The impact of the variation of the supply chain growth constraint on the estimated additional renewable TWhs of heat produced suggests that in some years the supply chain constraint seems to bite. The variation of the growth constraint has a very modest impact. As with ASHPs, this would suggest that if the supply constraints bite, this could limit the increase in deployment seen in the low cost sensitivity i.e. the supply side must be putting some downward pressure on the increased deployment in some years. As with ASHPs, the supply constraint sensitivities therefore suggest that it is the supply side that is likely to limit deployment but we would welcome evidence on whether this is a reasonable conclusion to draw.

6.5 Combined Heat and Power (policy options 5a and 5b)

6.5.1 Benefits

110. As discussed in section 5.5, there is no specific CHP tariff so potential owners of CHP technology can only claim the tariff that is applicable to the technology it uses. The estimated biomass / bioliquid Good Quality CHP tariff of around 4.1p/kWh (2012 prices) indicates that this technology is relatively cost-effective compared to other renewable technologies. The added advantage of creating a specific CHP tariff is that it helps in tailoring the subsidy. In particular, CHP has specific costs and risks associated with it, so creating a specific CHP tariff would help minimise economic distortions. The setting of a tariff of around 4.1p is projected to increase the level of renewable heat by around 2.5TWh to 2020 (to 9TWh)

thus supporting meeting the 2020 renewables target and lowering carbon emissions. The total value of the reduction in carbon emissions is £199m over 26 years.

111. The ending of support for CHP through the ROC uplift means creating a separate RHI CHP tariff would mean there is a continuation of long term support for the heat dimension of a cost-effective technology. The case for the inclusion of bioliquids is the fact that it is an additional renewable option to industry given its high energy density. It also fits with DECC's wider strategic objectives of broadening the sources of energy supply post-2020 and a further source of carbon savings.

6.5.2 Costs

112. The increase in uptake increases resource costs to the private sector by £504m. CHP is already potentially eligible for the RHI biomass tariff, though the existing RHI biomass tariff is less than the proposed 4.1p/kWh CHP specific tariff. The higher tariff is forecast to increase the costs to Government by around £1.84bn over 26 years, though this is considered a transfer from public to private sector and therefore not classified as a resource cost. The inclusion of bioliquids could also raise sustainability issues. However, generators of 1MWh and above will be required to report on the sustainability of their biomass feedstocks. Smaller generators and wastes will be exempt from this reporting requirement. In addition, there is also the potential for a negative air quality impact given increased levels of biomass combustion. However, existing air quality standards for CHP would still apply.

6.5.3 Sensitivity tests

113. As with the ASHPs and biomass direct air sensitivity analysis, in the CHP analysis we have assumed the capital costs of renewable CHP is either 20% higher or 20% lower than the central estimate (note due to the way CHP is modelled – with renewable CHP projections being supplied using a different model (see section 5.5.3) - we have not undertaken a supply constraint sensitivity for this policy option).

Table 14: Summary of present value impacts (appraisal period is 34 years)

	Central forecast (2012 prices)	**20% higher capital cost** (2012 prices)	**20% lower capital cost** (2012 prices)
Resource costs	£503m	-£5m	£899m
Carbon benefits	£199m	-£2m	£387m
NPV	-£305m	£3m	-£512
Subsidy	£1,844m	£988m	£2,824m
Change in renewable CHP heat in 2020 (TWhs)	2.5	0	5

114. In the scenario where capital costs are assumed to be 20% higher compared to the central scenario, the creation of a separate CHP tariff does not decrease the amount of renewable heat produced by 2020 (though due to the uncertain nature of modelling we would urge caution when interpreting this result). It is likely to be the lumpy nature of the modelled CHP supply curve that prevents increased take up when subsidy is applied. In reality there is likely to be a noticeable response to the subsidy.

115. In the scenario where capital costs are assumed to be 20% lower, take up responds very significantly with an extra 5 TWh of renewable heat in 2020 (an increase from 7 to 12 TWh between the low cost baseline and the low cost scenario with RHI in place). Subsidy payments would also increase significantly to £2,824m. It should be noted that in the low cost sensitivity, no adjustment has been

made for the potential degression of tariffs as proposed in the consultation document "RHI providing certainty and improving performance".[23]

6.6 Biogas (policy option 6)

6.6.1 Benefits

116. As discussed in section 5.6, the potential availability of a FITS AD subsidy means there is potentially more of an incentive to generate electricity than heat. The question is whether this leads to an inefficient outcome.

117. The advantage of moving to a three tier tariff such as the example set out in section 5.6, is that in theory, potential owners of biogas technology would have an incentive to produce heat or electricity whenever it was efficient to do so. In the absence of moving to such a subsidy, there could potentially be an inefficient outcome as owners of this technology switch entirely to electricity generation and do not produce the required levels of renewable heat.

118. The estimated potential RHI tariffs for 200kW to 500kW and 500+kW in section 5.6 are around 5.7p/kWh and 2.0p/kWh respectively (2012 prices). As these tariffs are higher than the existing levels we would expect to see an increase in the amount of renewable heat produced relative to a do nothing approach which helps support meeting the 2020 renewables target. However, given the complexity of modelling such a scenario, at this stage we are unable to quantify the likely uptake in demand and therefore the corresponding increase in benefits (reduced carbon emissions) and costs associated with this approach. We would welcome evidence on this policy as well as alternative banding arrangements.

6.6.2 Costs

119. The key issue as to whether reforming the biogas tariff in this way is desirable or not is whether this option will minimise distortions. While including a high tariff in the RHI will reduce the incentive to use feedstock to generate electricity over heat, it will also create an incentive to use the feedstock for heat over other uses. The level of this potential distortion depends on the potential substitution between heat and electricity production. If the substitution is concentrated between electricity and heat, and not between electricity / heat and other uses, then the level of distortion is likely to be low. In addition, the increase in the RHI biogas tariff is, given the existence of gate fees (and the fact that in setting the ROC band for AD no RHI tariff for biogas was assumed), likely to mean an increase in rents to potential owners of biogas technology. We would welcome evidence on the potential substitution of this technology between heat and electricity generation and the effect of having a potential 'FITs equivalent' tariff structure similar to that set out in section 5.6. We would also welcome evidence on whether an alternative approach (compared to the current RHI treatment of biogas) is likely to increase rather than reduce potential market distortions.

120. As well as the above issue, supporting biogas by changing the biogas tariff structure in a manner consistent with the AD FITs level of support would be to increase resource costs to the private sector and the costs to Government, though the latter is a transfer from public to private sectors.

[23] "RHI providing certainty and improving performance" URL:
http://www.decc.gov.uk/en/content/cms/consultations/rhi_cert_perf/rhi_cert_perf.aspx

6.7 Energy efficiency (policy option 7)

6.7.1 Benefits

121. We will be using the consultation process to gather evidence on the costs and benefits of this policy option. However, increasing the energy efficiency of those claiming RHI would lead to less energy being used resulting in both savings to the Government, in the form of reduced of RHI payments, and to the consumer, in the form of reduced energy or fuel costs. The increased energy efficiency may also help reduce carbon emissions. The key assumption underpinning the potential benefits of this option is that firms / people are irrational and not maximising profits. This could potentially be due to information failures whereby firms / people are not aware of the potential commercial benefits energy efficiency can deliver.

6.7.2 Costs

122. New energy requirements will result in additional costs being incurred by both the consumer and the Government. The cost to the consumer will be meeting the energy efficiency requirements and the cost to Government will be in carrying out assessments to firstly establish what measures need to be taken and then to ensure the standards have been met. These costs could act as an additional barrier to claiming RHI and may impact on the number of new renewable heat installations. There is also a potential administrative cost to Ofgem who would be administering the Energy Efficiency requirements.

7 Wider impacts

7.1 Impact on small firms

123. The RHI is a voluntary scheme so a full Small Firms Impact Test (SFIT) has not been carried out. However, the RHI is available to all firms and the tariff structure takes into account the size of particular installations. Therefore, small firms are able to benefit from the RHI.

7.2 Competition assessment

124. As set out in section 1, tariffs have been estimated by incentivising 50% of the technical potential of different technologies taking into account the additional cost of renewable heat and the higher risks and uncertainties associated with its use. Therefore, subsidies from the RHI are not expected to have a detrimental impact on competition, even if they compete with firms who use conventional fossil fuel heating. Ensuring tariffs are based on the best available evidence will help ensure value for money and the minimisation of any potential market distortions.

7.3 Rural proofing

125. A more detailed rural proofing analysis on the introduction of the non-domestic RHI scheme was set out in the IA accompanying its launch.[24] This section sets out whether there are any additional issues over and above those considered when the scheme was launched that need to be considered as a result of the potential non-domestic changes. However, the key difficulty in assessing spatial impacts is in predicting uptake patterns of renewable heat in terms of geographical locations 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 where the operating costs of heating are relatively high. Wider constraints to installing certain renewable heat installations such as requirement of storage for biomass feedstock used in biomass boilers, need for planning permission (especially in areas of protected landscape) or the space requirements for the installation of GSHPs may allow rural areas to benefit more from the RHI than businesses / organisations in urban areas. The key policy options

[24] http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/renewable-energy/3775-renewable-heat-incentive-impact-assessment-dec-20.pdf

considered in this IA suggests the biogas and CHP options could benefit rural areas given the potentially lower constraints. However, as section 5.2 sets out, urban areas are potentially better able to benefit from deep geothermal technology. These policy options would also affect both urban and rural communities living in the vicinity of the new developments.

7.4 Sustainable development

126. As set out in the 2011 IA, we recognise the important 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. Generators of 1MWh 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.

7.5 Statutory equalities duties

127. The RHI is a voluntary subsidy scheme which covers a range of renewable heat technologies. All applications for funding will be treated equally and in line with the eligibility criteria which do not discriminate against age, disability, gender reassignment, marriage and civil partnerships, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

7.6 Justice system

128. As set out in the 2011 IA, 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.

7.7 Admin burden

129. The estimated administrative burden of the RHI was set out in the IA when the scheme was launched in November 2011. As this IA is setting out the costs and benefits of each of the policy options relative to a do nothing option, it is important to examine whether there is any additional administrative burden over and above the do nothing option. 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. Of the policy options assessed in this IA, there will be no admin burden associated with Policy Options 2, 5 and 6. This is because potential owners of renewable heat installations of the technologies associated with each of these policy options are already able to claim the RHI. Of the remaining policy options, these technologies are not currently eligible to claim the RHI. However, the administrative burden from the 2011 IA already included the admin costs associated with these technologies and therefore there is no additional impact except for the energy efficiency policy option where we will be using the consultation process to gather further evidence. Since the scheme was launched there have been a various difficulties in administering the scheme and we will therefore be reviewing whether the administrative burden set out in the 2011 IA still holds.

8 Summary of preferred option and implementation plan

130. The preferred policy options are policy option 2 (the creation of a separate geothermal tariff) and policy option 5a (the creation of a separate CHP tariff). These policy options are forecast to deliver an increase in renewable heat and a reduction in carbon emissions in a cost-effective manner. We recognise the significant contribution that other policy options could make in helping meet the renewables target and delivering an increase in renewable heat but we want to ensure that we minimise any potential market distortions. We would like to use the consultation process to gather information on the potential market distortions that could result from introducing the other policy options before making a final decision.

131. There are scheduled reviews of the RHI every two years with the first review starting in 2014. These reviews allow for adjustments to be made to a part, or whole of the scheme, to deal with any significant change to the assumptions which underpin the RHI e.g. a significant and unexpected uptake of a particular technology or a significant change to the relative cost of renewable and fossil fuels.