Public Consultation

On the Design and Implementation of a Renewable Heat Incentive in Ireland

26 January 2017
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### Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AD</td>
<td>Anaerobic digestion</td>
</tr>
<tr>
<td>ASHP</td>
<td>Air source heat pump</td>
</tr>
<tr>
<td>CF</td>
<td>Counterfactual technology</td>
</tr>
<tr>
<td>CHP</td>
<td>Combined heat and power</td>
</tr>
<tr>
<td>CO\textsubscript{2}-eq</td>
<td>Carbon dioxide equivalent</td>
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<tr>
<td>CPI</td>
<td>Consumer price index</td>
</tr>
<tr>
<td>EfW</td>
<td>Energy from waste</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse gas</td>
</tr>
<tr>
<td>GSHP</td>
<td>Ground source heat pump</td>
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<tr>
<td>HHL</td>
<td>High heat load</td>
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<tr>
<td>IRR</td>
<td>Internal rate of return</td>
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<tr>
<td>LHL</td>
<td>Low heat load</td>
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<tr>
<td>MHL</td>
<td>Medium heat load</td>
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<tr>
<td>MSW</td>
<td>Municipal solid waste</td>
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<tr>
<td>NPC</td>
<td>Net present cost</td>
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<tr>
<td>NPV</td>
<td>Net present value</td>
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<tr>
<td>RH</td>
<td>Renewable heat</td>
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<tr>
<td>RHI</td>
<td>Renewable heat incentive</td>
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<tr>
<td>RHT</td>
<td>Renewable heating technology</td>
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<tr>
<td>WSHP</td>
<td>Water source heat pump</td>
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1 Executive Summary

This public consultation focuses on the design and implementation of a Renewable Heat Incentive (RHI) for Ireland. This consultation paper builds on the first 2015 Technology Review consultation that highlighted many of the high-level issues to be addressed in considering a RHI.

As part of Ireland’s strategy to meet its obligations under the 2009 Renewable Energy Directive, the Government targets the delivery of 12% of final heating demand from renewable sources by 2020. While the deployment of renewable heating technologies has progressed significantly in recent years, reaching 6.5% of heat demand in 2015, recent analysis by the Sustainable Energy Authority of Ireland (SEAI) states that under the current set of policies the 2020 target will not be met.¹

In order to address this policy ‘gap’, the Department of Communications, Climate Action and Environment (DCCAE) is leading the process to consult upon and design an Exchequer-funded Renewable Heat Incentive (RHI) for Ireland. This is the final public consultation on the RHI for Ireland before a final decision will be made on the scheme. The primary focus of this consultation is to present a range of questions on some of the key design parameters for the new scheme and seek feedback on these.

The structure of this consultation is as follows:

- Section 2 provides an overview of the RHI development process to date;
- Section 3 provides a list of the Renewable Heat Technologies under consideration for support and discusses the RHI development process in more detail.
- Section 4 presents the range of assessment criteria that underpin the RHI scheme;
- Section 5 offers a brief overview of some of the key design options identified;
- Section 6 presents a range of questions on key aspects of the RHI support scheme.

Submissions

Written submissions to this public consultation can be made from the 26th of January, 2017 to the 3rd of March, 2017. This consultation will conclude at 17:00pm on Friday the 3rd of March, 2017. Submissions received after the closing date will not be considered.

You can make a submission:

1. By email to the following email address only: rhi@dccae.gov.ie

Email submissions must include in the subject heading: RHI consultation and the [name of respondent]

Or

2. Writing to the following address:

Renewable Heat Incentive consultation
Department of Communications, Climate Action and Environment
29 – 31 Adelaide Road, Dublin, D02 X285

Please make your submission by one medium only, either electronic or hard copy. All submissions must include the following:

- Your name and details of any organisation, community group or company you represent.
- An address for correspondence.
- Your submission, relevant to the design options only of the RHI.

Please note submissions may be published on our website and subject to Freedom of Information
2 Introduction

As part of Ireland’s strategy to meet its obligations under the 2009 Renewable Energy Directive, the Government has set a target that 12% of final heating demand is to be derived from renewable sources by 2020.

While the deployment of renewable heating technologies has progressed significantly in recent years, reaching 6.5% of heat demand in 2015, recent analysis\(^2\) by the Sustainable Energy Authority of Ireland (SEAI) states that under the current set of policies the 2020 target will not be met. It is estimated that the shortfall could be in the region of 2 to 2.5 percentage points of the 12%, equating to approximately 1,200 gigawatt hours (GWh).\(^3\)

This represents approximately 1 percentage point in terms of the overall national target of 16% mandated to Ireland under the 2009 Renewable Energy Directive.

In order to address this policy ‘gap’, a cross-governmental working group has recommended\(^4\) that an Exchequer-funded Renewable Heat Incentive (RHI) could be implemented. The Department of Communications, Climate Action and Environment (DCCAE) is leading the process to consult upon and design this policy.

The basic structure of the RHI is proposed to be a payment offered to producers of renewable heat on a ‘per unit of heat produced’ basis (or to producers of biomethane on a ‘per unit of biomethane produced’ basis). The payment is intended to cover the additional cost of producing heat using a renewable technology as compared with a fossil fuel alternative (or biomethane as compared with methane), and includes the additional cost associated with barriers to deployment.

The 2014 State Aid guidelines published by the European Commission\(^5\) will inform and shape the development of the scheme, as ultimately the scheme will be the subject of a formal State Aid application to the European Commission.

The first Technology Review public consultation on the RHI was published in 2015 and the Department received 75 submissions to this consultation. Following this consultation, the Department appointed Element Energy and Frontier Economics in May 2016 to undertake an economic assessment of the cost of introducing a RHI with the objective of meeting Ireland’s 2020

\(^2\) Ireland’s Energy Targets. Progress, Ambition & Impacts. Summary for Policy Makers (2016)
\(^3\) This figures is based on updated analysis undertaken by Element Energy and Frontier Economics
\(^4\) Draft Bioenergy Plan, Department of Communications, Energy and Natural Resources (October 2014)
\(^5\) http://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52014XC0628(01)&from=E
renewable heat target and to develop a set of cost-effective design options for the RHI structured in such a way as to support investment in the efficient and effective design, installation and operation of renewable heating technologies.

In addition to the RHI analysis undertaken by Element Energy/Frontier Economics, Ricardo Energy & Environment are currently carrying out an economic assessment of deploying biogas and biomethane in Ireland.\(^6\) In order to ensure a full and robust assessment of the viability and cost-effectiveness of supporting biogas and biomethane under the RHI and the associated optimal design of such an RHI tariff, Ricardo Energy & Environment and Element Energy have carried out an ‘interface’ piece of work. This work has ensured that all appropriate information is available to consider potential support for biomethane under an RHI alongside other renewable heat technologies.

The findings from the work undertaken by Element Energy/Frontier Economics and the work undertaken by Ricardo Energy & Environment form the basis of this public consultation, the purpose of which is to focus on a range of Design Options or design parameters for the RHI in Ireland.

It is important to note that a detailed assessment of the structures required to administer the scheme and to ensure adequate monitoring and evaluation will be undertaken separately, and are not covered in this consultation. The extent and cost of the administration requirements that are needed to manage the scheme may have a bearing on the final design of the RHI.

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\(^6\) The 2014 draft Bioenergy Plan recognised that biogas and biomethane have a potentially important role to play in Ireland’s future renewable energy mix. In order to assess the full potential of biogas and biomethane, SEAI commissioned Ricardo Energy and Environment to conduct a broader economic assessment of the potential for biogas and biomethane in Ireland. The decision to commission a separate study on biogas and biomethane was designed to fulfil Action 13 of the draft Bioenergy Plan. In addition, it is worth noting that this path was also set out in the July 2015 RHI Technology Review consultation where it was announced that a separate workstream under the draft Bioenergy Plan would conduct an economic assessment of biogas/biomethane, the findings of which would be taken into account in the development of the RHI.
3 Renewable Heat Technologies (RHTs)

The 2015 Technology Review consultation identified a range of Renewable Heat Technologies (RHTs) that would be considered for support under the RHI. Following stakeholder feedback, the following RHTs represent the final list of technologies to be included for consideration.

- Biomass boiler
- Biomass combined heat and power (CHP) 7
- Biomass direct air heating 8
- Ground-source heat pump
- Air-source heat pump
- Water-source heat pump
- Deep geothermal
- Anaerobic digestion (AD) CHP
- Anaerobic digestion (AD) boiler
- Biomethane grid injection
- Energy-from-Waste
- Solar thermal

The DCCAE is proposing that each technology listed will remain open for consideration under a range of final scenarios that will be developed. The findings from this consultation will help to inform the final scenario and the technologies that will be supported.

While it is recognised that each renewable heat technology/fuel can, in principle, contribute towards the renewable heat target, it is also important to take account of the fact that some renewable heat technologies are more market ready and more cost effective than others, meaning they are more likely to be in a position to deploy faster and at a lower cost to the taxpayer.

In undertaking an economic assessment of the RHI, Element Energy and Ricardo Energy & Environment were directed by the DCCAE and SEAI to engage with industry, government departments, and energy associations to

7 It is important to note that under State Aid rules a new CHP unit can avail of support under a renewable electricity support scheme for the electricity generated and the RHI for the heat produced. However, issues related to the accumulation of aid (in order to exclude overcompensation) would need to be addressed. If a CHP plant was already in receipt of support for the electricity generated (via REFIT) but not the heat, then this plant would not meet the conditions under state aid to avail of support under the RHI. This is because the plant is determined to be receiving enough support to compensate the extra costs of the technology ( i.e. the cost of heat and electricity production was already factored into the REFIT payment).

8 Biomass direct air heating refers to the case where biomass is combusted to heat air which is circulated directly around a room or building or into an industrial process, rather than being used to heat water to be circulated for space heating or hot water provision.
get a fuller understanding of the operating issue, costs and environmental impacts/constraints associated with each technology under consideration.

This process formed a crucial part in the RHI development process and helped to capture the additional costs and identify the barriers associated with each RHT that are not directly obvious. Forty-three different organisations and groups responded to the invitation to engage in this work. In addition, a stakeholder workshop was held as part of the economic assessment on biogas and bio methane that sought inputs from a wider set of stakeholders. The full list of the respondents is provided in the box below:

<table>
<thead>
<tr>
<th>Element Energy Industry Engagement Process</th>
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</thead>
<tbody>
<tr>
<td>Ashgrove</td>
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<td>Bord Na Mona</td>
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<td>Codema</td>
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<td>Coillte</td>
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<tr>
<td>Confederation of European Waste-to-Energy Plants Ireland (CEWEP Ireland)</td>
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<td>Cre</td>
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<tr>
<td>Dept. of Agriculture</td>
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<tr>
<td>Dept. of Environment – Northern Ireland</td>
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<tr>
<td>Dept. of Environment – Republic of Ireland</td>
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<tr>
<td>Electricity Supply Board</td>
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<td>Environmental Protection Agency</td>
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<tr>
<td>Gaelectric</td>
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<tr>
<td>Gas Networks Ireland</td>
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<tr>
<td>Geothermal Association of Ireland (GAI)</td>
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<td>GI Energy</td>
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<tr>
<td>Glen Dimplex</td>
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<tr>
<td>Green Energy Engineering</td>
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<tr>
<td>Heat Pump Association of Ireland (HPA)</td>
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<tr>
<td>Irish BioEnergy Association (IrBEA)</td>
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<tr>
<td>Letterkenny IT</td>
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<tr>
<td>Renewable Gas Forum – Irish Green Gas Ltd</td>
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<tr>
<td>Sustainable Energy Authority of Ireland (SEAI)</td>
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<td>Teagasc</td>
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<tr>
<td>Terawatt Ireland</td>
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<tr>
<td>Tipperary Energy Agency</td>
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<tr>
<td>University College Dublin</td>
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<table>
<thead>
<tr>
<th>Ricardo Energy &amp; Environment Industry Engagement Process</th>
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<tr>
<td>Ormonde Organics</td>
</tr>
<tr>
<td>Fingleton White</td>
</tr>
<tr>
<td>FLI Group</td>
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</tbody>
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NRGE Ltd
Technology Centre for Biorefining and Bioenergy (TCBB)
Calor
Cré
Farmgas
Gas Networks Ireland
Green Forty Development Ltd.
Renewable Gas Forum Ireland (RGFI)
Siemens
Stream Bioenergy
IrBea
AbbVie Ireland NL B.V
Commission for Energy Regulation
International Energy Research Centre

While this engagement process is a necessary part of developing the RHI, it was a departure from the normal public policy consultation process in that it focused primarily on the views of industry. This consultation is designed to fulfil a broader Departmental commitment to seek the wider views of all interested stakeholders on the final design of the RHI.
4 RHI Assessment Criteria

The aim of the Renewable Heat Incentive is to help meet Ireland’s 12% renewable energy heat target by 2020. Where the design and focus of the RHI can derive additional public policy benefits and value for the consumer then this is the preferred approach of the Department. Focusing the RHI on installations in non-Emission Trading System (ETS) sectors is one way to accrue broader benefits to consumers. Ultimately, the RHI support scheme must be designed in a way to ensure value for money to tax payers, and structured in a way to attract investment into the renewable heating sector.

In order to ensure the RHI is designed in a way to meet the objectives outlined, a set of baseline assessment criteria was developed. The final design of the RHI must be consistent with the full list of assessment criteria to the fullest extent possible. The assessment criteria identified for the RHI are as follows:

<table>
<thead>
<tr>
<th>Assessment criterion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Incentivising an efficient level of investment to meet the target</td>
<td>Does the design option have the potential to meet the RES-H target, and would it result in the overall least cost mix of investment to reach the target?</td>
</tr>
<tr>
<td>2. Minimising costs to the Exchequer (and appropriately profiling overall costs)</td>
<td>Does the design option minimise costs, and find the right balance between lowest overall cost, and short term budget pressures?</td>
</tr>
<tr>
<td>3. Impact on CO₂ Emissions</td>
<td>What impact would the design option have on CO₂ emissions in the non-ETS?</td>
</tr>
<tr>
<td>4. Impact on particulate matter emissions from solid biomass combustion</td>
<td>What impact would the design option have on particle emissions from biomass?</td>
</tr>
<tr>
<td>5. Allocating risks efficiently</td>
<td>Does the design option allocate risk efficiently, such as between government and the heat sector?</td>
</tr>
<tr>
<td>6. Incentivising efficiency at the system specification, installation and operation stages</td>
<td>Does the design option promote efficient and effective design, installation and use of systems?</td>
</tr>
<tr>
<td>7. Impact on the diversity of the renewable heating technology mix</td>
<td>Would the design option lead to a diverse technology mix?</td>
</tr>
<tr>
<td>8. Complexity/clarity</td>
<td>Would the complexity of the design option deter investors?</td>
</tr>
<tr>
<td>9. Impact on the long-term sustainability of the market</td>
<td>What is the impact of the design option on the low-carbon heating sector in Ireland beyond 2020?</td>
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5 Overview of RHI design options identified

Drawing on the key assessment criteria above, this section provides a brief overview of the main RHI design options identified and considered as part of the RHI assessment process. All of the design options presented in this section are considered to be an important part of helping to achieve the assessment criteria identified in section 4. It is not an exhaustive list, but does represent the main design elements that can materially impact on the cost of the scheme.

The Department is not seeking feedback on this section. The design options presented in this section are provided for information purposes and help to frame the detailed discussion on the design options and questions to be addressed in the next section.

5.1 Differentiation of RHI Tariff by renewable technology

Each technology has a distinct set of upfront and ongoing costs. Differentiating the tariffs by technology allows these differences to be taken into account. Without any differentiation by technology, it is likely that only the cheapest, most cost-effective technologies will be incentivised. While this may lead to a cost-effective outcome, there is a risk of over-reliance on a single technology, which would not be prudent from a long-term security of supply perspective. In addition, without any tariff differentiation by technology it is possible that lower cost technologies may be over-compensated in order to ensure higher cost technologies are incentivised to deploy. The relative merits of the cost of the policy on one hand, and the diversity of the renewable heat installations incentivised on the other, will need to be weighed against each other.

Design options considered:

- A single tariff or set of tariffs across all technologies
- Different tariffs for certain groups of technologies
- A separate tariff for each technology

5.2 Differentiation of RHI Tariff by installation size

The upfront and ongoing costs of producing a unit of renewable heat vary with installation size, typically decreasing for larger installations. In order to ensure a sufficient incentive for smaller installations, without over incentivising larger installations, the tariffs may need to be differentiated by size.
**Design options considered:**

- No tariff banding by installation size
- Tariff banding by installation size, no tiering
- Tariff banding by installation size, with tiering based on percentage output
- No tariff banding, tiering based on absolute kWh output

### 5.3 Minimum energy efficiency criteria for participants

A risk of offering a tariff payable on every unit of heat produced is that it does not promote efficient use of heat, and in certain circumstances could incentivise over-production of heat. The RHI could be used to incentivise energy efficiency improvements by including minimum energy efficiency criteria for RHI eligibility. This would also help align renewable heat policy with the requirements of the Energy Efficiency Directive (2012/27/EU).

**Design options considered:**

- No minimum energy efficiency eligibility criteria
- Include minimum energy efficiency eligibility criteria linked to an existing energy efficiency accreditation system
- Include minimum energy efficiency eligibility criteria linked to a new energy efficiency accreditation system

### 5.4 Minimum criteria and/or tariff differentiation on biomass sustainability

In order to ensure biomass fuels used under the RHI are *sustainable* – in terms of their impact on carbon dioxide and other emissions, biodiversity, soil and watershed protection and other aspects – sustainability criteria could be included as a condition for RHI eligibility. Given that one of the primary objectives of the RHI is to reduce carbon dioxide emissions, it is particularly important that the policy is designed to promote a sustainable reduction in carbon emissions.

**Design options considered:**

- No sustainability criteria beyond the minimum EU standards
- Inclusion of sustainability criteria beyond the minimum EU standards
Differentiation of tariffs for biomass technologies based on the sustainability of the biomass fuel used

5.5 Minimum criteria and/or tariff differentiation on particulate matter and nitrogen oxides emissions from biomass

In order to minimise the impact of particulate matter and nitrogen oxides (NOx) emissions from biomass fuels used under the RHI, minimum criteria and/or tariff differentiation on such emissions could be included in the RHI.

Design options considered:

- No emissions criteria beyond the minimum EU standards
- Inclusion of emissions criteria beyond the minimum EU standards
- Differentiation of tariffs for biomass technologies based on the emissions

5.6 Duration of support and profile of payments to scheme participants

The RHI tariffs are designed to cover all the additional costs required to operate the renewable heating technologies over their lifetime, relative to the counterfactual technology. However, a policy design choice is whether the duration of support should be equal to the lifetime of the technology, or shorter, and whether the profile of payment should be flat, or front-loaded towards the earlier years. These factors are likely to impact on the attractiveness of the offer to the consumer, but also on the way the technology is used throughout its lifetime.

Design options considered:

Duration of support

- 20 years (same as United Kingdom (U.K.) Non-domestic RHI)
- 15 years
- 10 years
- 7 years (same as U.K. Domestic RHI)

Profile of payments

- On-going payments only – flat rate (same tariffs over duration of support)
- On-going payments only – front loading (higher tariffs in the earlier years of support)
On-going payments and an upfront grant

5.7 Payment based on metered or deemed heat use

RHI payments will be made, entirely or in part, on the basis of units of heat generated (i.e. per kWh). The payments could be determined based on metered heat output, or based on deemed heat output – that is, on predicted or modelled heat output determined according to the type and size of building (or process) using the heat.

Design options considered:

- Payment based on metered heat use for all installations
- Payment based on deemed heat use for all installations
- Payment based on metered heat use for large installations and on deemed heat use for small installations (with the option for small installations to use metered heat output)

5.8 Systematic Adjustment to Tariffs

Costs associated with both renewable heat and counterfactual technologies change over time, as the price of the technologies and fuels changes. These changes could be reflected in the tariffs via systematic adjustments. In addition, mechanisms for controlling the Exchequer budget – for example, reducing tariffs as the level of uptake increases – could be included.

Design options considered:

- No systematic adjustment of tariffs
- Systematic adjustments of tariffs to reflect evolution of key input costs over time
- Systematic adjustments of tariffs to reflect Consumer Price Index
- Option 1, 2 or 3 with no inclusion of budget management mechanisms
- Option 1, 2 or 3 with the inclusion of budget management mechanisms – degression and/or budget cap

5.9 Allowed rate of return

The allowed internal rate of return (IRR) of the initial investment should reflect the cost of capital and the risks associated with deployment of the renewable heat technologies, whilst remaining cost-effective for the Exchequer. A range of IRRs were identified by Element Energy and Frontier Economic in the assessment of the RHTs, including:
Design options considered:

- 6% IRR
- 8% IRR
- 12% IRR

5.10 Age of the existing fossil fuel systems being targeted for replacement

The age of heating technologies being targeted for replacement has a large impact on the potential market size. To the extent that the RHI is intended to incentivise a substantial increase in the deployment of renewable heating to 2020, it may be necessary to incentivise the early replacement of fossil fuel technologies. However, this is likely to be less cost-effective, given that consumers may seek to be compensated for the residual value of the existing system in order to replace it with a new system. The final decision on the age of the technologies to be targeted and any compensation for residual value of the existing system will be a substantive decision required as part of the State Aid clearance.

Design options considered:

- Target replacement of technologies at the end of life only
- Target replacement of technologies at the end of life or near the end of life
- Target replacement of technologies not only at the end of life or near the end of life

5.11 Existing fossil fuel heating systems targeted for replacement

The counterfactual heating technologies are largely gas, oil, electricity and solid fuel heating. These technologies have different cost characteristics. A focus on cost-effectiveness may suggest only incentivising replacement of the most expensive counterfactual heating options; however, a focus on meeting the 2020 RES-H target may suggest that replacement of all counterfactual technologies should be promoted. In order to incentivise replacement of all counterfactual technologies, the tariffs need to be high enough to allow the renewable heating technologies to compete with the lowest cost counterfactual technology.
Design options considered:

- Target replacement of all counterfactual technologies
- Target replacement only certain counterfactual technologies

5.12 Inclusion of the ETS sector

Inclusion of the EU Emissions Trading Scheme (ETS) sector (comprising largely energy-intensive industry) would increase the addressable market and help towards achieving the 2020 Renewable heat target. In addition, the administrative burden per unit of renewable heat is likely to be lower for the ETS sector, since each installation in the ETS sector would be expected to be large. However, as described in the following section, the second of the two main objectives of the RHI (the first being to meet the 2020 RES-H target) is to meet Ireland’s 2020 non-ETS CO₂ emissions reduction target. Clearly, deployment of renewable heat in the ETS sector does not advance this second objective.

Design options considered:

- Exclude the ETS sector from the RHI scheme
- Include the ETS sector in the RHI scheme
6 Design Options for RHI

6.1 RHI Eligibility

The RHI is a policy mechanism aimed at achieving Ireland’s 12% renewable heat target. However, this policy mechanism does not sit in isolation to other energy and environmental aims. If broader public policy benefits can be gained from the design of the RHI, the Department is minded to pursue this objective. To this end, it is envisioned that a range of eligibility criteria will apply to the RHI in order to maximise, where possible, the benefit of the RHI to the Irish taxpayer.

6.2 Inclusion of ETS sector

The RHI scheme is aimed at supporting larger industrial and commercial installations outside of the EU Emissions Trading System (ETS) to switch from using fossil fuel heating systems to renewable heating systems. The focus on the non-ETS sector is likely to accrue a double benefit for the Irish taxpayer, helping to meet our renewable energy target and reduce emissions in the non-ETS sector, simultaneously.

However, given the short timeline for meeting the 2020 RES-H target, there may be merit in considering support for a smaller number of large ETS renewable heat installations. This could be a simple and effective way to meet the target, and reduce the overall complexity of administrating the scheme. In addition, a number of industry representations to the Department have suggested that the exclusion of the ETS sector could reduce competitiveness of Irish industry since ETS users are eligible for support for renewable heating in other European Union countries, and Northern Ireland. Thus, while the scope of the RHI excludes the ETS at the moment, the RHI could be expanded to include the ETS sector.

On the other hand, as one of the key objectives of the RHI - along with meeting the 2020 RES-H target - is to contribute to the 2020 non-ETS sector CO2 emissions reduction target; the inclusion of the ETS sector would reduce the contribution that the RHI could make to this objective. Furthermore, as the RHI is designed to close a gap to target (circa. 1,200 GWh), there will only be a finite amount of renewable energy that will ultimately receive some support under this scheme. Thus, the inclusion of a smaller number of larger ETS renewable heat installations could also have the effect of reducing the market potential for the number of medium size and small installations that could avail of support.
While the preferred option of the DCCAE is that the focus of the RHI would remain on the non-ETS sector to ensure a double benefit to the taxpayer, and ensure a larger number of participants can avail of support. On the other hand, it is important that there is sufficient heat demand to meet the renewable heat target and that the administration of the scheme is not overly complex.

What are respondents’ views on the inclusion or exclusion of the ETS sector?

6.3 Grandfathering

The Government announcement on the RHI was made on 8 July 2014. A number of representations have been made to the Department indicating that the announcement of the RHI has delayed some investment decisions as prospective investors contemplate the potential benefits of the RHI and await the design of the scheme.

In order to support ongoing investment in the renewable heating sector, the Department will seek clearance from the European Commission that RHI support can apply to RHI applicants, who meet the criteria of the scheme, and were completed and first commissioned\(^9\) between the Government announcement on the RHI on the 8 July 2014 and the start date of the RHI.

The DCCAE are also mindful of the need to ensure that existing renewable heat installations are not scrapped in order to apply for the RHI. If applicants do not meet the RHI criteria, they will not be eligible. RHI support will be from the date of accreditation under the scheme and payments will not be backdated to any previous date.

If permission is granted for grandfathering by the European Commission the successful applicants will be eligible to apply for support, but will have to meet all the terms and conditions of the new scheme. Ultimately any Grandfathering decision is subject to budgetary approval and State Aid compliance. A final decision on grandfathering will form part of the final State Aid clearance notification for the RHI scheme, as was the case in the U.K. scheme.

6.4 Minimum Energy Efficiency Eligibility Criteria

The Department is keen to ensure that the RHI be used not only to incentivise the uptake of renewable heating technologies but also to encourage improvements in energy efficiency, where possible. By including minimum participant energy efficiency eligibility obligations, this would contribute towards the Government’s obligations under the EU Energy Efficiency

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\(^9\) The definition of ‘commissioned’ will be determined as part of the administration of the scheme,
Directive Ireland’s energy efficiency targets for 2020 and 2030, and the RES-H target.

The RHI in Ireland must avoid the undesirable outcomes seen elsewhere, where renewable heating systems were installed in highly inefficient buildings, leading to high costs for taxpayers, and uncertainty over the net impact on carbon emissions.

The Building Energy Rating (BER) scheme assigns an energy rating to individual buildings based on a site survey by a qualified assessor using a standardised method and software. A minimum BER rating may be used as the basis of a minimum energy efficiency criterion for buildings in the commercial and public sectors where space and water heating predominate. There are multiple advantages to adopting the BER scheme as a minimum standard:

1. it is a national scheme and so provides a standardised approach.
2. it is a cost-effective straightforward process and mandatory for buildings for sale or for rent;
3. it may encourage inefficient buildings to take cost effective steps to upgrade building fabric before applying for an RHI.

It is noted that the inclusion of any minimum BER rating for RHI eligibility should take into consideration the BER rating of the building after installation of the renewable heating technology since the installation itself will (through the change in heating efficiency and fuel, and the associated impact on primary energy consumption) affect the BER rating of the building. The minimum BER criteria may be subject to review on an ongoing basis.

However, the BER would not be suitable as a basis for a minimum efficiency criterion in industry or agriculture, where the heating demands include significant process heating and are hence much more varied, and cannot be captured using standardised models of building energy use. In such cases, a more bespoke assessment is required. One possible approach could be to link the RHI, for large industrial users, to SEAI’s Excellence in Energy Efficiency Design (EXEED) scheme. EXEED is a new scheme developed by SEAI and is currently in the pilot stage.10

For smaller users, and those with no significant process heating, a minimum efficiency criterion based on an individual performance scheme may be more cost-effective and efficient.

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10 It involves ongoing support and management to ensure best practice and, given the bespoke assessment involved, is most cost-effective for large and/or energy-intensive installations. EXEED certifications last 3 to 5 years with annual reviews of the management and best practices.
The preferred option of the DCCAE is that the Building Energy Rating (BER) scheme will apply to buildings in the commercial and public sector participating in the RHI.

For smaller industrial and agriculture heat users, and those with no significant process heating, a minimum efficiency criterion based on the individual energy performance scheme will likely be needed.

For industrial and agricultural heat users with significant process heat loads the EXEED programme may be used. Are there any other options to consider for this group?

### 6.5 Minimum Technology Requirements

The RHI must incentivise high quality installations that provide renewable heat in the most effective and efficient way. This means ensuring minimum technology standards are met and adhered to by applicants.

The minimum requirements will be technology specific. For example, biomass boilers should be designed appropriately in order to minimise particulate matter and nitrogen oxide emissions, whereas heat pumps should be designed and installed in such a way that they demonstrate an adequate Seasonal Performance Factor (SPF) to ensure they are producing renewable heat. It is also important that heat pumps are sized appropriately, and installed in buildings with suitable heat demand requirements and profiles. This could be achieved by including a list of eligible products and installers for the RHI. Including a list of eligible installers will help to manage the availability of skilled installers for each technology as the market grows in Ireland.

The proposals described above will be critical to the success of the RHI; however, it is also clear that they will require administrative resources to undertake the required provision of information, monitoring and evaluation across the supply chain from producer to end-user. This will be an important consideration on the final requirements to be implemented.

Do respondents agree with the requirement to ensure minimum technology standards for each technology should form part of the RHI?
6.6 Eligibility of Heat Use for the RHI

It is possible that renewable heat supported through the RHI will not always be used in the most efficient way, but will still receive payments. It is important to discourage bad practice and inefficient use of heat, where possible.

Minimum energy efficiency criteria, as described in section 6.4, will prevent some instances of poor heat use, but additional criteria may be required to prevent misuse of the scheme. In some circumstances, for example, the heat produced from a CHP unit is greater than the on-site heat demand, and there is a risk that the heat will not usefully meet any existing demand. The application of deemed heat use (rather than metered heat use) could help mitigate this issue (see section 6.13 on metering).

It will also be important to consider which heat uses should be eligible for the RHI. For example, an AD CHP plant typically uses a proportion of the heat produced in the AD process itself. Renewable heat might also be used for drying biomass to improve the biomass fuel quality or for drying digestate before it can be used as a fertiliser. These uses of the heat are not replacing any counterfactual (since the heat demand is associated with the renewable heating installation itself), and as such may be deemed ineligible. The U.K. RHI has some important ‘exemptions’ which relate to the drying of biomass carried out on a commercial basis (which may assessed for eligibility on a case by case basis) and for and AD digestate pre-treatment. For anaerobic digestion plants, the pasteurisation of feedstock before they enter the digester, and the digestate, is regarded as eligible processes. These different uses will be considered as part of the RHI in Ireland.

It is proposed that the RHI beneficiaries in Ireland will be required to show that heat is supplied to meet an economically justifiable heating requirement that would otherwise be met by an alternative form of heating such as a gas boiler. In addition, heat load should be an existing or new heating requirement, and not created artificially purely to claim the RHI.
6.7 The Impact of Biomass Combustion Air Quality and CO₂ Emissions

Minimising any negative health and environmental impacts from air pollution, while maximising the potential associated CO₂ savings, must form an important component of the RHI scheme in Ireland.

In addition to meeting the 2020 RES-H target, Ireland is committed to reducing CO₂ emissions and has mandatory emission ceilings for air pollutants under the air National Emission Ceilings Directive (NECD). Ireland has adopted a target of a 20% reduction in GHG emissions in the non-ETS sector compared to 2005 levels by 2020. Whilst renewable heating technologies typically result in lower carbon emissions than the counterfactual technologies, the exact saving depends on many factors such as the technology type, the efficiency and the carbon intensity\(^\text{11}\) of the renewable heating fuel.

The carbon savings that will be derived from the RHI are strongly dependent on the overall level of uptake of RH technologies; beyond this, the mix of technologies has an impact on the overall CO₂ saving since certain technologies lead to greater savings on a per kWh basis than others. This also applies to air pollution emission as certain renewable technologies have zero atmospheric emissions while for others air pollution emissions can be considerable.

Renewable heating technologies are typically considered low carbon in comparison with fossil fuel heating. However, all the renewable heating technologies lead to some level of carbon emissions on a life cycle basis. It will therefore be important to ensure the RHI scheme is designed to achieve the greatest reduction in carbon emissions as possible, whilst at the same time ensuring that any negative impact on air quality is minimised.

The impact of biomass combustion: the role of technology standards and fuel quality on air quality emissions

The emissions associated with biomass technologies are influenced by a number of factors, including, but not limited to:

- Fuel type and quality;
- Appliance design, type, operation and abatement technology;
- Appliance installation and maintenance;
- Appropriate sizing of the RHT and upgrading of building performance to optimise heat requirements and reduce the number of cold starts;
- The flue design;
- The existing background air quality.

\(^\text{11}\) In the case of Biomass Fuels, carbon intensity relates to the lifecycle Greenhouse Gas emission associated with the cultivation transport and processing of biomass.
Fuel type and quality

To ensure the quality of biomass fuel (typically relating to the moisture content) a list of eligible suppliers of biomass could be maintained and applied to the RHI. The use of the Wood Fuel Quality Assurance scheme (WFQA) could apply. The Wood Fuel Quality Assurance scheme (WFQA) in Ireland ensures that certified suppliers source their fuel in compliance with the EU Timber Regulation, in addition to guaranteeing the quality and reliability of the fuel. The scheme is focused on ensuring fuel quality standards by adhering to ISO EN standards. This scheme is currently optional for suppliers of biomass but consideration could be given to making this a mandatory requirement of the RHI for all biomass used. This was an important recommendation in a recent Industry report on biomass emissions12

Biomass Technology: appliance design, type, operation and abatement technology

The burning of biomass results in emissions of particulate matter (PM), including black carbon, oxides of nitrogen (NOx), oxides of carbon (e.g. CO), oxides of sulphur (SOx) and dioxins/furans13. PM and NOx are the most significant for health and environmental impacts and have direct impacts on both human health and the ecosystem.

Through the National Emissions Ceiling Directive (NECD), Ireland has binding reduction targets for a range of pollutants, including PM and NOx, for 2020 and 2030. At present, and despite significant progress in recent years, the ceiling for NOx is being exceeded in Ireland, such that emissions must fall between now and 2020 (and 2030) for Ireland to avoid legal action and fines. Any emissions from new biomass plant installed through the RHI will be additional to the current levels, and will thus make it more challenging for Ireland to comply with the NECD, requiring alternative emission reductions to be identified elsewhere.

The appliance design and operation, along with any abatement technologies included in the installation, influence the emissions associated with the biomass installation. It is important that the best available technologies

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12 IrBEA (2016) Study on Biomass Combustion Emissions The WFQA scheme complies with current international standards for wood fuel EN ISO 17225 (2014), and EUTR compliance. Members are subject to inspection and testing. The WFQA also requires compliance with plant health requirements under EU and national legislation as administered by Department of Agriculture, which issues clearance for importation.

leading to the lowest emissions levels are incentivised. Abatement technology to reduce, though not eliminate emissions is available for biomass systems; however, it can be costly, raising both the capital cost and the operational costs. In order to ensure the use of abatement technologies, therefore, appropriate standards should be applied.

Appropriate standards for PM and NOx emissions could be implemented using an approved appliance list or ‘type approval’ system. The U.K. RHI requires all biomass installations must meet emission limits of less than <30g of particulate matter and less than <150g of NOx per GJ of net thermal input.\(^\text{14}\) This is implemented through an Emissions Certificate for biomass appliances, or on site emission testing.

**Appliance installation and maintenance**

The correct installation and maintenance of biomass appliances is vital to ensure high efficiencies are achieved and to minimise PM and NOx emissions. This could be managed in a number of ways:

1. Via a list of approved installers;
2. Via the introduction of a mentoring, advice, monitoring process;
3. The inclusion of an inspection and verification process that ensures standards and requirements are adhered to;
4. The introduction of a certified installer scheme for biomass combustion appliances in Ireland; and
5. Through the introduction of an emissions certificate system, along the lines of the U.K. RHI.

The DCCAE is minded to adopt minimum standards for PM and NO\(_x\) emissions in line with the U.K., which is implemented through an Emissions Certificate and on-site emission testing where necessary for biomass appliances. What are the views of respondents to this proposal?

### 6.8 Biomass Sustainability Criteria

In designing the RHI, biomass sustainability is a key concern given the limited domestic biomass resource in Ireland. In the context of using biomass for heat production there are two key metrics of sustainability – 1) life cycle GHG balance and 2) the wider environmental impacts (e.g. biodiversity, land use impacts etc.)

\(^{14}\) Ofgem, *Domestic Renewable Heat Incentive Reference Document Version 4.0* (October 2016)
Forestry in Ireland has existing checks and balances to promote environmental sustainability (e.g. felling licences). Imported biomass has to comply with the requirements of the EU Timber Regulation whereby it must be shown to be legally sourced. Forestry in Ireland must adhere to environmental guidelines through all stages of activity from afforestation to thinning and harvesting. These guidelines address environmental and biodiversity issues outside of lifecycle GHG emissions. Through these mechanisms biodiversity and environmental concerns are addressed along the forest biomass supply chain. New integrated sustainability guidance and GHG savings thresholds are now proposed in the European Commission’s proposed for a revised renewable energy Directive.

Biomass imported into Ireland must meet the EU Timber Requirements which ensure that the timber was legally harvested in the country of origin, but does not currently have to comply with environmental sustainability criteria and, if used for energy production, does not have to demonstrate minimum GHG savings. Solid and gaseous biomass (energy crops, domestic forestry, biomass wastes and residues, imported wood fuel etc.) used in the heat and power sectors in Ireland are currently not subject to mandatory requirements for lifecycle GHG reduction.

Whilst the long-term goal is to establish a sustainable national biomass market, the domestic resource of biomass is limited (with around 4,200 GWh expected to be available in 2020)\(^{15}\) and it is likely that imported biomass will be required to play a role in reaching the RES-H 2020 target. Both the availability and the cost of imported biomass will depend strongly on the sustainability criteria included in the eligibility requirement for the RHI, as well as on the demand for bioenergy in other countries worldwide.

It is likely that Europe will be a net importer of biomass and Ireland will compete with other European countries for imported biomass. Therefore, Ireland’s access to international imports is likely to be based on its willingness to pay along with any sustainability criteria imposed by Ireland. Whatever sustainability criteria are ultimately adopted, the criteria should not discriminate against European imports under European competition law.

The EU Renewable Energy Directive (RED) provides criteria for sustainability which cover all biofuels used in transport and all liquid biofuels used in all sectors, and requires that they are used as part of a national scheme. The RED does not include equivalent sustainability criteria for solid and gaseous biomass used in the heat and electricity sectors. The European Commission has published recommended sustainability requirements for solid and gaseous biomass set out in Communication SEC(2010)65-66 which includes a methodology for calculating the life-cycle GHG emissions of biomass. It is up to each Member State to determine whether or not to include such sustainability criteria when introducing subsidies for biomass. A few Member

\(^{15}\)SEAI Bioenergy Supply in Ireland 2015 – 2035.
States have adopted some or all of the recommendations set out in the Communication, including the U.K., Denmark, Belgium and the Netherlands. The following form the basis of the EU sustainability criteria:

**EU Renewable Energy Directive (EC 2009)**

The EU Renewable Energy Directive has two key aspects:

1. **Biodiversity protection** – avoiding land use changes of certain types of land:
   a. **High biodiversity value** – primary forests, protected areas, highly biodiverse grasslands
   b. **Lands with high carbon stock** – wetlands, continuously forested areas, other forested areas
   c. **Peatlands**

2. **GHG emission savings** – At least 35% savings, increasing to 50% in 2017 (60% for new installations from 2017) compared to the EU’s fossil energy mix (83.8 gCO₂/MJ).

Ireland could enforce these EU recommendations, or choose to go further and apply the same criteria as those in the U.K. RHI. The U.K. standards are set out below:

**U.K. biomass sustainability criteria – 2015**

The U.K. biofuels sustainability criteria expand on those in the EU Renewable Energy Directive:

1. **Biodiversity protection** – specific land criteria, in order to ensure biodiversity and minimise negative environmental impacts
   a. The fuel must be **100% from legal sources** (legally harvested as defined in the EU Timber Regulation (EUTR))
   b. At least 70% of the fuel must come **from sustainable or deemed sustainable sources** (as defined in the Timber Standard for Heat & Electricity)
   c. For a forest to be labelled a ‘sustainable source’, its management has to fulfil a number of standards, such as: minimising the harm for the ecosystem; maintaining the forests’ productivity; maintaining the ecosystems’ health and vitality; maintaining biodiversity; complying with local and national requirements regarding labour and welfare as well as health and safety; and developing a regard for a variety of local factors related to the forest such as customs, dispute settlement and land tenure rights.

2. **GHG emission savings** – lifecycle greenhouse gas emissions threshold of 34.8 gCO₂/MJ of biomass heat produced or biomethane injected (125 gCO₂/kWh). Furthermore, there are plans to introduce a minimum greenhouse gas threshold of 60% relative to the EU-wide fossil fuel comparator (83.8gCO₂/MJ), and to apply the criteria to all biomass heat receiving RHI subsidies.

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16 DECC (2013), *Impact Assessment - RHI Tariff Review, Scheme Extensions and Budget Management*
The complex administrative processes involved in adopting the U.K. approach would need to be considered in detail.

There may be alternative approaches to requiring full biomass fuel chain GHG reporting (as in the U.K. RHI) that could be adopted. This could involve identifying the steps in individual supply chains which typically contribute the highest greenhouse gas emissions, and could potentially tip the life cycle GHG emissions to a point where the fuel is not delivering sufficient savings over a fossil fuel alternative. For example, for biogas and biomethane fuel chains where domestic crops are used as a feedstock it is typically the nitrogen fertiliser use which contributes the most to the fuel chain GHG emissions (both direct emissions of Nitrous Oxide from fertiliser application and indirect emissions from fertiliser manufacture). For woody and grassy biomass fuel chains it can often be the amount and type of fuel used in drying and processing steps which contribute the most.

This alternative approach could involve identifying the ‘high risk’ supply chains and the ‘high risk steps’ within them, and setting some indicative thresholds for fuel /material use, or, a GHG threshold. Applicants would be required to report on these steps and demonstrate that their practices are resulting in GHG emissions below the indicative thresholds. This approach would likely require a lower administrative burden on reporters and the administrator but give sufficient assurances that GHG savings were being delivered by biomass fuels supported under the RHI.

**Greenhouse Gas Emissions from Biogas and Biomethane**

GHG emissions associated with production of biogas and biomethane include emissions associated with transport of the feedstock to the plant, operation of the plant (e.g. fugitive emissions from the anaerobic digestion plant) and for the biomethane plant, energy used to operate upgrading systems and methane slippage from that equipment.

Where crops such as grass silage are used as a feedstock, there are also the emissions associated with their cultivation and management – principally emissions associated with the production of fertilisers, nitrous oxide emissions from the soil caused by application of nitrogen in fertilisers or digestate, and CO₂ emissions from the application of urea fertiliser and certain types of limiting products. The emissions per unit of heat produced from biogas depend on whether the biogas is combusted in a boiler or CHP plant, and in the case of CHP plant how much of the heat is used. The more heat that is produced by the CHP plant and that serves a useful purpose, the lower emissions per unit of heat and electricity.
Emissions from AD plant using waste feedstocks are expected to have about the same emissions as plants using slurries.

How the plant is operated can significantly affect emissions e.g. open storage of digestate could significantly increase emissions, and combustion of the off gases from the process of upgrading biogas to biomethane of biogas can reduce emissions (as the off gases contain small amounts of methane). Use of slurries and manures in AD can also lead to additional emissions reductions in the agricultural sector, as emissions from storing digestate are less than emissions from storing slurries and manures\(^{17}\). AD can also have an added benefit of reducing potential odour issues associated with slurry storage and spreading activities. Use of wastes, can similarly deliver additional GHG savings in the waste sector, if the wastes would have otherwise been disposed of to landfills.

In considering what approach/criteria to adopt an important factor will be the administration requirements needed to implement any of the options outlined would need to be considered in detail. For example, implementing the U.K. standards could pose a particularly high requirement on the appointed RHI administrator and the applicant.

- Should the same criteria apply for domestic and imported biomass?
- Should the same standards apply to both forestry and energy crop based biomass?
- The preferred position of the DCCAE is to ensure a robust set of environmental sustainability standards for imported biomass. Should the E.U., U.K. or other sustainability criteria apply?
- What type of supply chain for GHG certification is appropriate (U.K. or other)?
- The DCCAE could include a maximum biomass lifecycle emissions eligibility criterion as part of the sustainability criteria for the RHI. What are respondents’ views on this?
- What is the most appropriate method for demonstrating compliance with the environmental sustainability criteria?
- Should the certification of GHG and wider sustainability issues be mandatory?
- Should the RHI scheme differentiate tariffs by CO\(_2\) intensity of the biomass? If not, why not?
- What is the most appropriate method for demonstrating minimum GHG reductions are being achieved in specific supply chains?

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\(^{17}\) JRC, 2015. Solid and gaseous bioenergy pathways: input values and GHG emissions
6.9 Differentiation of Tariff by Renewable Heat Technology

The differentiation of RHI tariffs by renewable heat technology allows the distribution of costs for the different technologies to be accounted for. Given the range in both upfront and ongoing costs of the renewable heating technologies, differentiation by technology will be required to ensure a diverse mix of technologies are taken up as a result of the RHI.

With no differentiation, it is likely that only the lowest cost technologies will be taken up and/or the lower cost technologies will be over-incentivised in order to ensure the higher cost technologies can be incentivised.

The inclusion of different tariffs for different technology types would reflect the different costs associated with each. The inclusion of different tariffs would likely diversify the number of technologies in the RHI scheme; however, may impact on the overall costs of the scheme.

The preferred option of the DCCAE is to introduce an RHI scheme with tariff differentiation by renewable technology.

What are the views of respondents on the question of tariff differentiation by technology type?

6.10 Differentiation of Tariff by Installation Size or by Output

The cost of generating renewable heat typically depends on the size of the installation, as well as by technology. In order to reduce the risk of over- or under-incentivisation of installations, it is an option to differentiate by installation size to reflect the change in both upfront and ongoing costs with size.

In the U.K. RHI, the tariffs are banded by installation size (in terms of capacity, i.e. MW) with lower tariffs for larger installations. However, this banding structure has led many participants to opt for multiple smaller installations, with a capacity just below a tariff band threshold in order to receive a higher tariff. It is expected that this has resulted in additional (i.e. avoidable) costs to the Exchequer. The U.K. Government has recently proposed a removal of the tariff bands for new biomass boilers in order to incentivise more appropriate sizing of installations.

An alternative approach is to ‘tier’ the tariffs based on the annual heat output (on a per kWh basis). The participant would receive a marginal payment such
that all participants receive payment according to the tariff for Tier 1 up to the first threshold value; those with a heat output greater than that threshold receive additional payment according to the tariff for Tier 2, and so on for all higher Tiers. Since the cost of generating renewable heat typically falls with increasing installation size, the tariff would fall from one Tier to the next.

Since the tiering approach is based on heat output rather than installation capacity (i.e. on MWh not MW), tiering is more likely than banding to encourage appropriate system sizing whilst accounting for the tariff variation required with installation size.

The preferred option of the DCCAE is to introduce a tiering approach based on metered heat output (c/kWh). What are the views of respondents on this proposal?

6.11 Age of Existing Fossil Fuel Heating technologies being targeted for replacement

Targeting only counterfactual technologies that are at the end of their useful life will strongly limit the potential uptake of RH technologies. Given the short timescale available to meet the 2020 RES-H target, some degree of early replacement of counterfactual technologies is likely to be required. In this case, the RHI tariffs need to be high enough to incentivise replacement of counterfactual technologies that still have useful lifetime remaining.

RHI should not be limited to end-of-life replacement of the incumbent system as this would likely restrict the scheme and its effectiveness too much. In many cases, the counterfactual heating system is typically kept in place to provide backup for the renewable heating technology. Under these circumstances, the age of the incumbent technology is likely to have less impact on the users’ decision to install a renewable heating technology.

What are the views of respondents on this matter?

6.12 Duration of support and profile of payments to scheme participants

The duration of support and the IRR have a significant impact on the uptake of the technologies whose uptake is limited by the payback periods (i.e. not biomass technologies, which are limited by biomass fuel availability). A decision to shorten the duration of RHI support and/or increase the IRR results in a higher tariff, and correspondingly a lower payback period and hence higher uptake.
In deciding on the optimal duration of support and payback period, the impact on the Exchequer is a crucial determinant.

**Duration of Support**

The non-domestic U.K. RHI scheme provides support over 20 years, reflecting the expected lifetime of the majority of the renewable technologies. Providing support over the full lifetime of the renewable technologies has the key advantage of incentivising on-going, efficient use of the technologies. However, the long duration of support leads to long payback periods and is likely to significantly limit the uptake.

The tariffs (in cents/kWh) are set such that all the additional costs of the RH technology relative to the counterfactual technology over the lifetime of the RH technology are reimbursed over the duration of support of the RHI scheme. This means that when the duration of support is shorter the tariffs will be significantly higher. As a result, the payback period is shorter and the uptake is expected to be higher. However, the annual cost to the Exchequer will be significantly higher, albeit for a shorter period of time.

An additional risk associated with a shorter duration of support is of the participant reverting back to the counterfactual technology once the support ends, if the ongoing costs of the renewable heating technology are larger than for an alternative, fossil-fuel option. In addition, there is a risk that a shorter duration of support may mean that required maintenance of the relevant technology may be put off or delayed in order to maximise tariff revenue at the expense of technology life. Figure 1 presents an illustrative example of how the payback period varies with the duration of support, under the approach taken in this analysis.

**Figure 1: Illustration of the impact on payback period of the duration of support**

![Bar chart showing the relationship between support duration and payback period](chart.png)
While the 5 to 10 years duration of support may be preferable from a commercial perspective, as a longer payback time than this may not appeal to investors, the cost to the Exchequer will be significantly higher in the immediate term. A shorter period of support may also be deemed to be overcompensation by the European Commission.

It can be argued that a longer support period of 15 to 20 years, while placing less pressure on the Exchequer, would also help to ensure ongoing use of the renewable heat technologies, and would help to provide certainty in the supply chain for biomass suppliers. In addition, a longer duration for support time would likely incentivise more optimal operating and maintenance practices with the RHTs.

The preferred option is that the RHI will be paid for a 15 year period. What are the views of respondents on a shorter or longer tariff payment period?

Profile of Payments

The RHI payments could be uniformly distributed over the duration of support, paid as a combination of an upfront and ongoing payments, or ‘front loaded’ such that the level of support is higher for an initial period and then falling to a lower level for the remaining duration of support. For example, for a 15 year duration of support, the payments could be paid through a higher tariff for the first 5 years followed by a lower tariff for the last 10 years. The U.K. RHI offers only ongoing payments.

In calculating all payment profiles the tariffs will be calculated such that the net present value (NPV) of the payments over the full support period remains constant. The inclusion of an upfront payment, or the use of front-loading, has the advantage of reducing the payback period and therefore likely increasing the uptake. However, both options also increase the annual cost to the Exchequer over the early years of the RHI. There is also a risk that the inclusion of upfront payments will result in poor quality installations in a ‘race to the bottom’.

Furthermore, in some cases where front loading is applied, the higher tariff offered in the first period may be higher than the marginal cost of producing a unit of heat. In such case, this may incentivise over-production of heat, and present a challenge in terms of State Aid rules. While a mix of upfront and ongoing payments may be preferable to incentivise uptake along with promoting efficient lifetime operation, the analysis has shown that the pressure on the Exchequer is too great.
The preferred option is that the RHI will comprise of ongoing payments over a period of years with no front loading. On balance, this decision would minimise the impact on the Exchequer while ensuring the RHI remains attractive for investment. What are the views of respondents on this approach?

6.13 Payment based on Metered Heat or Deemed Heat Use

As in the U.K., ongoing RHI payments in Ireland will be paid on a per kWh basis. Therefore, in order to determine the payment required for each installation, the heat output needs to be either metered or deemed (that is, predicted or modelled according to the type and size of building or process using the heat).

Payment based on metered heat has the advantage that it particularly incentivises uptake where heat consumption is likely to be large. In addition, a requirement for metering would offer additional certainty over the quantity of renewable heat generated. However, payment based on metered heat has the disadvantage that it may in some cases incentivise the over-production of heat. This issue can be significantly reduced by tiering the tariffs by heat output and by appropriate administrative standards and checks.

The advantages of a payment based on deemed heat use are that energy efficiency is incentivised, and that the consumer knows in advance the level of RHI revenue they will receive each year. However, there is a risk that payments based on deemed heat use may result in payments being made despite the RH technology not being used. It is possible that RHI recipients would seek to keep the counterfactual heating system in place to provide back-up to the RHT. This presents a risk that the consumer will revert to using the counterfactual.

The preferred approach is that the metered option is allowed for all installations, but that the deemed option is allowed as an alternative for small installations. However, when a secondary heating source or backup heat supply is required, payment will be made based on metered readings only. This is to verify how much heat was produced by the renewable heat system rather than the counterfactual. A determination as to what constitutes a small user heat will need to be decided as part of the administration of the scheme.

What are views of respondents on the proposals for metering and deemed heat use as outlined?
6.14 Systematic Adjustment to Tariffs

Over the lifetime of the scheme the renewable heat technology costs are likely to vary. This is due to changes in fuel prices as well as component prices (due in part to the market growth which may be stimulated by the RHI). It will be important to have a mechanism through which the tariffs can be adjusted to take account of these changes.

An important question is to which index the tariffs should be linked. In the U.K. RHI, tariffs are linked to the Consumer Price Index (CPI). Alternative indices include industry-specific/technology-specific prices and/or fuel prices.

The DCCAE preferred option is to index the RHI tariff to the Consumer Price Index. This is the case in the existing Renewable Energy Feed-in Tariff and has worked well. What are the views of respondents on this proposal?

6.15 Budget Management Mechanism/Cost Controls

Ensuring an effective budget management mechanism is an important part of maintaining value for money for the taxpayer and controlling overall costs. It is also essential for the long-term success of the RHI scheme in Ireland.

It is proposed that the DCCAE introduce one or more ‘budget management mechanisms’ to manage overall costs of the scheme. Two ‘budget management mechanisms’ have been identified and could apply:

1. A Tariff degression and;
2. A Budget Cap (annual or overall)

The inclusion of a tariff degression, whereby the tariffs (for new applicants only) decrease when the uptake crosses a certain threshold (either overall or on a technology basis) could be used to control the uptake and associated costs to the Exchequer. Tariff degression has the advantage of reducing the risk to the Exchequer of over-payment.

Tariff degression could be applied when uptake of any RH technology is higher than that expected/desired. This could occur when fuel or technology prices change in a way that the CPI indexation has not reflected and which makes the RH technology more cost-effective than the tariffs account for, and uptake is accordingly larger than expected. This is applied in the U.K. RHI scheme. If certain uptake ‘triggers’ are exceeded, the tariffs are reduced by a fixed percentage. In the U.K. case, there are a range of ‘triggers’ which lead to degression of the tariffs by a fixed amount between 5% and 20%, to dampen
demand. The degression thresholds, and the percentage decrease of the tariffs, should be pre-determined to ensure clarity.

The inclusion of a budget cap could also an important instrument to control costs. In this case, when the projected RHI payments reach the budget cap (either annually or overall) the scheme would close to all new applicants either temporarily or permanently.

A budget cap would be a separate mechanism from tariff degression. The Department is minded to set an overall budget cap and/or an annual budget cap. The budget caps could be applied across all technologies as a whole. If uptake in any given year means that the total payment in that year will exceed the annual budget cap, the scheme could be closed temporarily to new participants. If an annual budget cap is exceeded, the scheme could be opened again for new participants the following year, once the budget has been ‘reset’.

If uptake as a whole means that the total payment for the scheme will exceed the overall budget cap, the scheme could be closed to new participants. If an overall budget cap is exceeded, the scheme might be closed permanently.

The preferred approach of the DCCAE is to introduce a tariff degression and budget cap mechanism along the lines of the U.K. scheme. What are the views of respondents on this proposal?

### 6.16 Allowed rate of return

The internal rate of return (IRR) that participants can expect to gain from the RHI payments is likely to affect the uptake of RH technologies. The higher the IRR, the higher the RHI tariff and hence the lower the payback period for the renewable heat installation. The IRR required by investors depends on both the cost of capital and the risks associated with the renewable heat technologies. These factors in turn depend on the sector, size of installation (and hence the investment size and payback period) and technology type.

The RH market is still relatively small and immature in Ireland and as such there is a higher level of risk associated with RH technologies than the counterfactual technologies. The IRR needs to reflect these risks in order to incentivise the uptake of renewable heating technologies, develop the market and help build consumer confidence.

The tariffs for the U.K. non-domestic RHI scheme are based on a 12% IRR for all renewable heating technologies except solar thermal. This is not differentiated by consumer sector. A value of 12% was chosen in the U.K. case to reflect the risks associated with the renewable heating technologies. Since the introduction of the RHI, investor confidence in biomass boilers in the U.K.
has increased and as a result investors are more willing to lend\(^\text{18}\). In addition, the cost of capital in Ireland is expected to be lower than it was in the U.K. when the RHI was launched.

As such, a somewhat lower IRR could be considered acceptable to project developers.

### 6.17 Implementation options

The administrative burden and associated costs of implementing an RHI scheme in Ireland will be significant. An effective governance structure will need to cover information provision, monitoring and evaluation of the scheme as well as processing scheme applications and payment.

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**The Minister for Communications, Climate Action and Environment has appointed the Sustainable Energy Authority of Ireland as the designated RHI administrator.**

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### 6.18 Pre-accreditation

As part of the industry stakeholder engagement process, the issue of a ‘pre-accreditation’ option was raised. A ‘pre-accreditation’ is an approach whereby developers planning a renewable heat project can submit the proposed project plan and effectively obtain in-principle confirmation of eligibility for the RHI. It was argued that this would in order to provide more certainty for project developers.

Industry stakeholders reported a wide range of timescales for procurement of renewable heating technologies, from just 1 week for smaller, ‘off-the-shelf’ installations, to up to 5 years for the largest and most complex installations. For most large projects the project development timescale is likely to be longer than one year. Under these circumstances, uncertainty over the eligibility for the RHI, or over the continuation of the support scheme, may lead the project to be deemed unviable.

In the U.K. RHI, pre-accreditation is available only for large and complex installations, including geothermal installations, biogas installations and solid biomass installations above 200 kWth in size.

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**What are the views of respondents on the question of pre-accreditation for larger more complex installations?**

\(^{18}\) DECC - Evaluation of the Renewable Heat Incentive, 2014
7  Annex 1

The following annex provides interested parties an overview of the overall modelling approach to the design of tariffs for the RHI in Ireland. It does not include information on the specific (c/kWh) to be paid per technology, but provides a broad overview of the approach to modelling the RHI and how the potential cost of each technology was treated. **No submissions/comments to this annex will be considered as part of the consultation feedback.**

7.1  Overview of tariff design process

The tariff design process follows a bottom-up approach based on the detailed stock model of commercial, public and industrial building archetypes\(^\text{19}\) in Ireland developed through Element Energy and Frontier Economics 2014 work for SEAI, as well as the Ireland-specific cost and performance data gathered through the industry stakeholder engagement process. The approach is summarised in Figure 2, and described in detail below.

Figure 2: High-level summary of tariff calculation process

| Stock and energy demand model of buildings in Ireland: Building types, Energy end-uses |
| Technology cost and performance data by size and type |
| Technology suitability and load factor by archetype |
| Fuel costs by fuel and consumption band to 2050 |
| Other economic parameters (e.g. discount rate) |
| NPV of renewable heating technology |
| NPV of counterfactual (fossil-fuel) heating technology |
| Supply curve for all archetypes in the stock model for all RH technologies |
| Divide into segments (e.g. by technology and installation size) |
| Identification of reference installation for each segment |
| Detailed tariff design based on the set of reference installations |
| Full set of shortlisted policy design options |

\(^{19}\) An archetype is a standard building type defined, in this case, by ‘activity’ type (such as hotel or hospital in the non-residential case), main heating fuel and thermal efficiency level.
7.2 Net Present Value Calculations

For each of the renewable heating technologies under examination - with the exception of AD CHP/Biomethane and Energy-from-Waste - the tariff calculation is based on an assessment of the Net Present Value (NPV) of ownership for each of the building archetypes in the stock model. In the case of AD CHP/Biomethane, the information used was developed as part of a related study by Ricardo Energy & Environment. The approach taken for Energy-from-Waste is described in section 7.8 below.

A number of data sets were used in order to determine the NPV for each renewable heating technology in each suitable archetype in the stock:

- **Technology costs and performance**
  - Capital cost
  - Operating cost
  - Additional and hidden costs
  - Thermal and electrical efficiency
  - Economic lifetime

- **Technology suitability**
  - Suitability for different heat uses (including space heating and hot water, low temperature process heating, high temperature process heating)
  - Suitable size range

- **Fuel costs** (to 2050)

- **Commercial, public and industrial demand archetypes**
  - Annual heating demand (by space heating and hot water, low temperature process heating, high temperature process heating)
  - Heating system load factor by technology
  - Annual electricity demand

- **Other economic parameters**
  - Discount rate (rate of return)

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20 Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyse the profitability of a projected investment or project.
7.3 Existing Fossil Fuel heating systems targeted for replacement

The RHI must be designed in a way as to incentivise a switch from fossil fuel heating system to renewable alternatives. The counterfactual heating systems (i.e. gas, oil, solid, or electric resistive heating) vary in cost, and need to be considered in the design of the tariff.

For the purpose of designing the renewable heat incentive, the counterfactual in all cases (with the exception of Biomass CHP and Biomethane grid injection) was taken as Gas boiler heating. For Biomass CHP, the counterfactual was taken as Gas CHP, and for Biomethane grid injection it was taken as the wholesale gas price. For AD CHP the counterfactual was taken as Gas boiler (rather than Gas CHP) since this was deemed the most likely alternative (i.e. the same users would not be likely to install a Gas CHP if they were not installing AD CHP).

**Technology Costs and Performance**

The capital and operating costs for each renewable heat technology are based on data gathered as part of the industry engagement process. The data received was used to derive values for the capital and operating costs of each technology as a function of installation size, where relevant. Technology costs for AD CHP and Biomethane were developed as part of a separate study by Ricardo Energy & Environment. The typical economic lifetime of each technology is also based on data from the industry.

**Additional and Hidden Costs:**

The calculation of total NPV used to derive the tariffs included an assessment of the additional and hidden costs summarised in Table 1. These were derived from a range of sources as described in the table.

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21 This view was given by Ricardo Energy and Environment who are undertaking a biogas and biomethane analysis for SEAI.
Table 1: Summary of additional and hidden costs applied

<table>
<thead>
<tr>
<th>Additional or hidden cost</th>
<th>Notes</th>
<th>Cost assumption</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metering</td>
<td>The additional capital cost of the heat meter</td>
<td>Cost varies with size (€4–6/kWth)</td>
<td>Industry stakeholder engagement</td>
</tr>
<tr>
<td>Biomass storage unit</td>
<td>The additional capital cost of the biomass fuel storage unit (for biomass only)</td>
<td>Cost varies with size</td>
<td>Industry stakeholder engagement</td>
</tr>
<tr>
<td>Space for biomass fuel storage unit</td>
<td>Compensation for loss of space used for the fuel storage unit (for biomass only)</td>
<td>Cost varies with sector; Public/Commercial: €488/kWth (€975/m²) Industry: €163/kWth (€325/m²)</td>
<td>Element Energy/NERA, Achieving deployment of renewable heat (2011)</td>
</tr>
<tr>
<td>Administration costs</td>
<td>Compensation for the additional administration time required for the renewable technology</td>
<td>Costs vary with sector and technology type</td>
<td>Element Energy/NERA, Achieving deployment of renewable heat (2011); Element Energy, Energy efficiency investment pathways in Ireland, for SEAI (2015)</td>
</tr>
<tr>
<td>Energy audit</td>
<td>Cost for having an energy audit carried out</td>
<td>Cost varies with building size: €0.67/m²</td>
<td>Industry stakeholder engagement</td>
</tr>
<tr>
<td>Grid connection</td>
<td>Fee for grid connection (for CHPs only)</td>
<td>Cost varies with size: €200k–€1m</td>
<td>Ricardo Energy &amp; Environment study on cost of biogas and biomethane, for SEAI (2016)</td>
</tr>
<tr>
<td>Retrofit of large area emitters</td>
<td>Additional capex and installation costs for replacing existing radiators with large area radiators or underfloor heating (for HPs only)</td>
<td>€625/kWth (not required for new buildings)</td>
<td>Industry stakeholder engagement; Frontier Economics/Element Energy, Pathways to high penetration of heat pumps, Report for CCC (2013)</td>
</tr>
<tr>
<td>Decommissioning the counterfactual</td>
<td>The cost of removing the counterfactual technology</td>
<td>Marginal cost: €12/kWth if applicable: most stakeholders suggested that the counterfactual would be left in place as a back-up so this cost is not included in the tariff calculation</td>
<td>Industry stakeholder engagement</td>
</tr>
</tbody>
</table>
Technology Suitability

In the tariff calculation and uptake modelling, a number of assumptions on the suitability of each of the renewable heating technologies for certain circumstances and/or end-uses were included. For example, biomass CHP is not typically suitable for application in a building with a small annual energy demand of, say, 5 MWh, since biomass CHP systems are typically large (hundreds of kW or larger), and the system would be very greatly over-sized. Unrealistic cases such as these are excluded from the analysis in order to ensure they do not skew the resulting tariff calculation. The suitability assumptions on which the tariff calculation and uptake modelling is based are described further below.

It is important to note, however, that the suitability assumptions are distinct from the eligibility criteria described in the consultation document and ‘unsuitable’ cases are not necessarily ineligible for the RHI. To continue the example above, we do not propose to explicitly exclude the use of biomass CHP in buildings with small annual energy demand – it is simply that we do not expect such installations to be typical.

Technology size

In the tariff calculation, it is assumed that each heating technology is available in a number of distinct unit sizes, and that each has an assumed minimum and/or a maximum size. This limits the suitability of certain technologies for particular building archetypes with very high or very low heating demands. For example, deep geothermal installations are not suitable for small energy users due to the assumed minimum size of a deep geothermal installation of ≈200 kW, where the minimum size is a result of the high cost of drilling the borehole.

Heat uses

The stock model of buildings and industry in Ireland underpinning the tariff calculation includes the heat demand for each archetype for three end-uses:

- Space heating and hot water
- Low temperature process heat
- High temperature process heat

Not all RH technologies are suitable to provide heat for all end-uses. All the RH technologies are able to contribute fully or partially towards the space heating and hot water demand. Feedback from the industry stakeholder engagement process suggests only a fraction of the space heating and hot water demand is typically met by solar thermal installations, typically in the range 40-80%. In addition, stakeholders indicated that some of the technologies can also contribute towards low temperature process heating. Biomass boilers are deemed suitable provide up to 100% of the low temperature process heating demand, whereas heat pumps are deemed suitable to provide up to ≈35% (an estimate based on an assumption of low temperature process heat at 200°C
and a heat pump flow temperature of 70°C). Biomass direct air heating\(^{22}\) can provide up to 100% of space heating and low temperature process heating for some industry demands. However, given that this is a niche technology that will not be suitable for most buildings in the industry sector.

### 7.4 Fuel Price assumptions used in tariff design

Retail fuel prices in 2016 are based on the values in SEAI’s *Fuel Cost Comparison*\(^{23}\) from July 2016. The fuel prices are applied in terms of the annual fuel consumption ‘bands’ as provided in the *Fuel Cost Comparison*, to reflect the lower average price paid by larger consumers. An allowance was made for night rate electricity for heat pumps, assumed for the purposes of this analysis to be 20%\(^{24}\).

The biomass purchase prices assumed in the tariff design were chosen to represent different price points on the biomass resource supply curve for Ireland, based on the most up-to-date supply curves developed by SEAI in the recent study *Bioenergy Supply in Ireland 2015 – 2035*\(^{25}\). In addition, an annual fuel consumption banding for biomass analogous to that for gas and electricity in the *Fuel Cost Comparison* was used to reflect the lower average price expected to be paid by larger consumers.

Fuel prices have been projected forward to 2050. In order to do this, fuel prices were disaggregated into a component exclusive of the carbon price/tax, and a component representing the carbon price/tax. The component exclusive of the carbon price/tax was projected forward according to the U.K. Department of Energy and Climate Change’s *Fossil fuel price projections*\(^{26}\) (using the gas wholesale price to project both gas and electricity prices). The carbon price/tax component was projected forward according to the EU ETS price forecasts for the case of electricity, and according to the larger of the current level of the carbon tax in Ireland (€20 per tonne) and the EU ETS price for the case of gas, oil and solid fuel.

Electricity export prices, relevant for gas-fired CHP counterfactual technologies, were based on the average System Marginal Price over the full two-year period from 1\(^{st}\) January 2014 to 1\(^{st}\) January 2016, taken from *Single Electricity Market Operator* (SEMO) data. Electricity export prices for AD CHP and biomass CHP are defined separately, to cater for the fact that they may eligible for the upcoming Renewable Electricity Support Scheme (RESS).

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\(^{22}\) Biomass direct air heating refers to the case where biomass is combusted to heat air which is circulated directly around a room or building or into an industrial process, rather than being used to heat water to be circulated for space heating or hot water provision.

\(^{23}\) SEAI, *Fuel Cost Comparison* (July 2016)

\(^{24}\) This value is based on Element Energy data from heat pump field trials in the U.K.


support levels for the RESS are currently under development. For the purposes of this analysis, a fixed support level of 14 c/kWh in 2016 for both AD CHP and biomass CHP technologies, approximately in line with the support levels in REFIT 3, is used. The electricity export prices are projected forward according to the same procedure as for the electricity retail prices; however, we assume that the Renewable Electricity Support Scheme support level received by any given AD CHP or biomass CHP installation remains fixed in real terms over the installation lifetime, even if the support level offered to new installations changes over time.

7.5 Commercial, public and industrial demand archetypes

Element Energy has previously developed with SEAI\textsuperscript{27} a detailed stock and energy model of commercial and public buildings and industry in Ireland. This consists of more than 300 archetypes described by:

- Sub-sector (commercial, public, industry)
- Size
- HVAC type
- Heating system
- Thermal condition

The stock model includes a breakdown of the heating demand into space heating and hot water, low temperature industrial processes and high temperature industrial processes. This stock and energy model forms a key part of the NPV calculation and tariff design.

\textit{Counterfactual heating system and difference in NPV}

The NPV was also determined for a counterfactual technology for each archetype. For the purpose of designing the renewable heat incentive, the counterfactual in all cases (with the exception of Biomass CHP and Biomethane grid injection) was taken as Gas boiler heating. For Biomass CHP, the counterfactual was taken as gas CHP, and for Biomethane grid injection it was taken as the wholesale gas price.\textsuperscript{28} For AD CHP the counterfactual was taken as gas boiler (rather than Gas CHP) since this was deemed the most likely alternative (i.e. the same users would not be likely to install a Gas CHP if they were not installing AD CHP).

Given the short time to 2020, it is likely that the RHI will need to target not only replacement of counterfactual heating systems at the end of life but also some early replacement. In the absence of an RHI, the typical time period between decisions to replace a heating system, the ‘decision frequency’, is of the order of 15 years. However, in the presence of an RHI, the decision frequency is likely to be substantially increased; particularly if the RHI is only


\textsuperscript{28}This view was given by Ricardo Energy and Environment who are undertaking a biogas and biomethane analysis for SEAI.
offered for a short, fixed period. For example, it may be expected that consumers who have just installed a new (non-renewable) heating system (e.g. in 2016) would be unlikely to install another by 2020. The modelling presented in this report makes the assumption of a decision frequency of 5 years\textsuperscript{29}. This implies that over the period 2018-2020 (the RHI is expected to be implemented in late 2017) those consumers who have installed a new heating system since 2012 would not consider installing a new RH system, but consumers who last installed a heating system before that date would consider this option. In line with this assumption, the remaining value of the counterfactual technology is included as appropriate.

The difference in the NPV for the renewable heating technology and the counterfactual technology defines the present value which must be represented by the total RHI payment. Accounting for the other relevant tariff design options, including the duration of support, profile of payment and the allowed rate of return, the required tariff is then determined for each individual building archetype-technology combination.

### 7.6 Reference archetypes and tariff calculation

The required tariffs calculated for each building archetype-technology combination are allocated to ‘segments’ based on technology type and tier (based on the eligible annual heat demand) as specified by the design options. The final design options that will be included in the RHI will be determined by the findings of this consultation.

For each technology and tier segment, the reference archetype is then identified. The reference archetype is that in which the median unit of heat demand (based on the heat demand across the stock) falls when the archetypes within the segment are ordered from highest tariff to lowest tariff. The reference archetypes then ‘represent’ their respective segment. This is illustrated in Figure 3:

\textsuperscript{29} As part of the project, a number of sensitivities were run. In agreement with the steering committee, a 5 year decision frequency was selected.
The tariffs required for the reference archetypes will then be used to determine the tariffs for each technology and tier. In the tiering approach, all participants receive payment according to the tariff for Tier 1 up to the first threshold value; those with a heat output greater than that threshold receive additional payment according to the tariff for Tier 2, and so on for all higher tiers. The effective overall tariff for each archetype (expressed as a single value in c/kWh) will therefore be equal to the sum of marginal payments for each tier divided by the total eligible heat output.

**Figure 3: Example of tiered tariffs and tariffs for reference archetypes**
7.7 AD CHP, AD Boiler and Biomethane Grid Injection

The tariffs for AD CHP, AD boiler and biomethane grid injection were determined using archetypes developed by Ricardo Energy & Environment. In this case, the archetypes relate to AD and biomethane installation types, differentiated by size, type of feedstock and heat load, as summarised in the Table below. The detailed cost and performance data for AD CHP, AD boiler and biomethane grid injection, and the data collection method, was provided by the Ricardo Energy & Environment study. The same methodology for the tariff design and uptake modelling for these technologies was then applied, while taking account of the specific characteristics of each.

**Table 2: AD CHP, boiler and biomethane archetype parameters**

<table>
<thead>
<tr>
<th>Technology type</th>
<th>Size</th>
<th>Feedstock type</th>
<th>Heat load</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD CHP</td>
<td>Small (&lt;500 kW biogas)</td>
<td>Farm fed (dairy slurry, grass silage, livestock manure)</td>
<td>Low (0-20%)</td>
</tr>
<tr>
<td></td>
<td>Medium (500-3,000 kW biogas)</td>
<td>Waste fed (source-separated food waste, contaminated food waste, sludges from industry waste)</td>
<td>Medium (40-60%)</td>
</tr>
<tr>
<td></td>
<td>Large (≥3,000 kW biogas)</td>
<td></td>
<td>High (60-80%)</td>
</tr>
<tr>
<td>AD boiler</td>
<td>Small (&lt;500 kW biogas)</td>
<td>Animal slurry and whey</td>
<td>Low (60%)</td>
</tr>
<tr>
<td></td>
<td>Medium (≥500 kW biogas)</td>
<td>Mixture of waste materials</td>
<td>Medium (80%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>High (85%)</td>
</tr>
<tr>
<td>Biomethane grid injection</td>
<td>Medium (&lt;3,000 kW biogas)</td>
<td>Farm fed (cattle slurry, grass silage, maize)</td>
<td>Constant (100%)</td>
</tr>
<tr>
<td></td>
<td>Large (≥3,000 kW biogas)</td>
<td>Waste fed (all food waste, mixture of waste materials)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sewage sludge (waste water treatment primary sludge)</td>
<td></td>
</tr>
</tbody>
</table>

7.8 Energy-from-waste

Several energy-from-waste plants are in operation in Ireland; however, these currently produce electricity only, and the ‘waste’ heat is not typically captured. The heat generated by these plants could – with some efficiency

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30 Ricardo Energy & Environment, *Report on AD CHP and biomethane* (Not yet published)
penalty on electricity generation – be recovered and used on nearby industrial sites or to serve district heating systems. Consideration was given to whether the RHI could incentivise the useful extraction of heat from existing energy from waste plants that currently produce electricity only.

The effective cost of producing heat energy in this way is based on the electrical efficiency penalty of extracting the waste heat. The ‘Z-factor’ is defined as the ratio of the heat usefully extracted to the electricity foregone. A Z-factor of 6-10 is typical for energy-from-waste plants. Here a Z-factor of 7.131 is assumed.

The effective cost of extracting heat can then be estimated from the value of the electricity foregone to the EfW plant operator. In Ireland, the biodegradable fraction of industrial and municipal waste was eligible for the REFIT 3 tariff (12 c/kWh for units larger than 1,500 kWₑ). Assuming, as an illustrative example, that the electricity could be exported at 12 c/kWh, the effective cost of heat is taken as:

\[
\text{Cost of heat energy} = \frac{\text{Wholesale price of electricity}}{Z \text{ factor}}
\]

The effective cost of heat energy is therefore 1.7 c/kWh. It is noted that this is less than the typical marginal cost of producing heat from a gas boiler (the cost of a unit of gas is in the range 3-6 c/kWh32). However, despite the low marginal cost of producing heat in this way, the use of heat from energy-from-waste typically requires a large capital investment, as there is not usually sufficient on-site or local heat demand. As such, use of the heat from an energy-from-waste plant is likely to require the development of a district heating network.

The business case for a heat network rests on the potential heat network developer (whether a private sector or public sector body, or a joint venture) having sufficient confidence in long term heat sale revenues to justify the large upfront cost of the network infrastructure. The economic viability of a heat network is highly location-specific, and requires a high local heat density (among other factors) to generate sufficient revenue from the capital investment. Given the highly location-specific economics of district heating, an RHI-type incentive is not an appropriate mechanism to address the barrier to the capture of waste heat from energy-from-waste plants. An alternative form of incentive would be more appropriate such as, for example, site-specific capital grants or low-cost financing. A recent and relevant example of such a scheme was announced in 2015 by the U.K. Government’s Heat Networks Delivery Unit. The Heat Network Investment Project33 aims to provide £320m of capital support specifically to incentivise the delivery of low carbon heat networks in the U.K. Support will be granted following a competitive case-by-

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31 Lincoln City Council, Lincoln Energy from Waste & District Heating Study (2011)
32 SEAI, Fuel Cost Comparison: Commercial/Industrial fuels (October 2016)
33 https://hnip.salixfinance.co.uk/ (Accessed November 2016)
case assessment of applications, which must describe in detail the proposed heat network project, the reason support is required and the economic, environmental and social benefits the project would bring.