Executive Summary

Introduction

This report provides a comprehensive view of heat demand and consumption in Northern Ireland, the renewable energy resources and technologies which can be used to provide renewable heat, and the potential for providing renewable heat with incentive mechanisms to meet a 2020 target, currently set at 10%.

The scope of this work requires a significant amount of data to be presented which is contained in the chapters and summaries throughout this work. Therefore this executive summary is used to present the high level conclusions and recommendations from the work and the reader should consult with the relevant chapters for more detail.

Northern Ireland's current heat demand and use of renewable heat.

Northern Ireland currently consumes 23.0 TWh of energy a year for producing heat to meet a heat demand of 17.4 TWh per year. This level of demand per person is comparable with other parts of the UK, and better than some other European countries surveyed. The majority of this energy comes from imported oil and imported gas, which poses future uncertainties around fuel security and cost for Northern Ireland.

The domestic sector is responsible for 61% of heat use in Northern Ireland and is therefore a key target for the development of renewable heat. The large industrial sector is responsible for 22% of the overall heat demand with a large fraction of this from two cement works. A small number of large scale installations in the industrial sector could therefore make a significant impact on renewable heat targets in Northern Ireland.

The heat demand has been mapped enabling locations of heat demand to be identified by sector and fuel type, and heat density analysis to be conducted for assessing the potential for district heating schemes. The maps below show the whole of Northern Ireland and then Belfast, with red areas showing high heat density, and green areas low heat density. The map clearly shows that most of the area of Northern Ireland, being rural, has very low heat demands, but that there are a significant number of urban areas with high density demands.

Overall, Northern Ireland's heat demand is predicted to drop from 17.4 TWh per year to 16.7 TWh per year with rises in demand from new development being outweighed by reductions in demand with efficiency improvements in the existing sector.

The level of renewable heat in Northern Ireland is currently relatively low at 1.7% of overall demand and this is mostly met by biomass, with a small amount from heat pumps and solar thermal systems.

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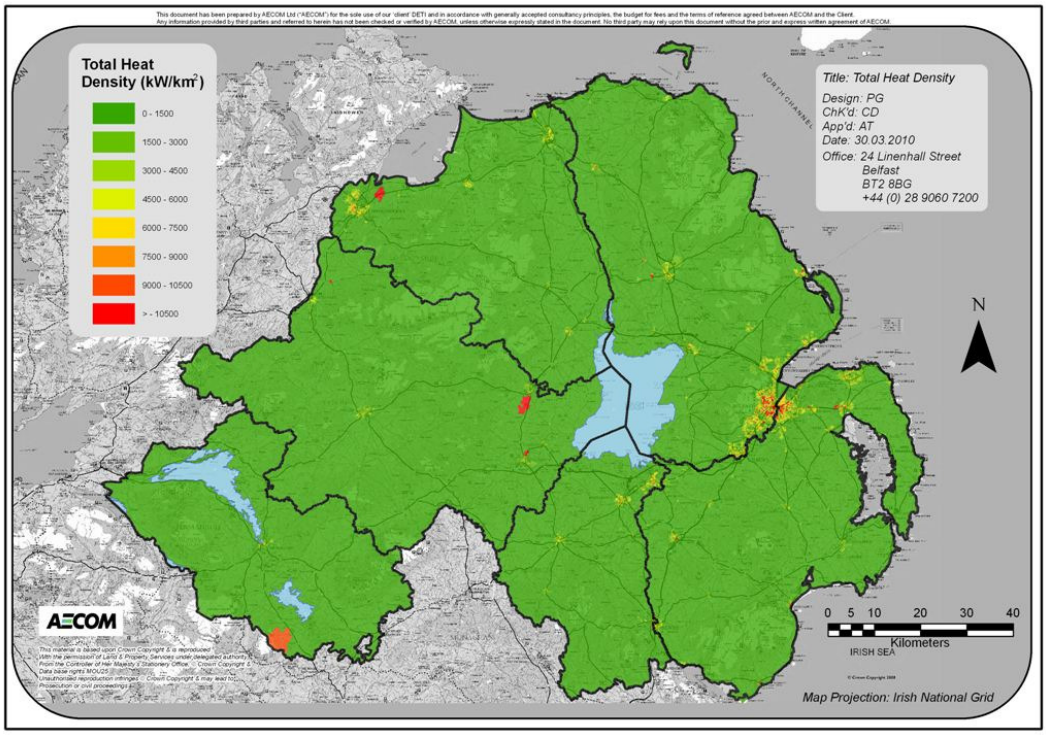

Figure 1: Heat density map of Northern Ireland.

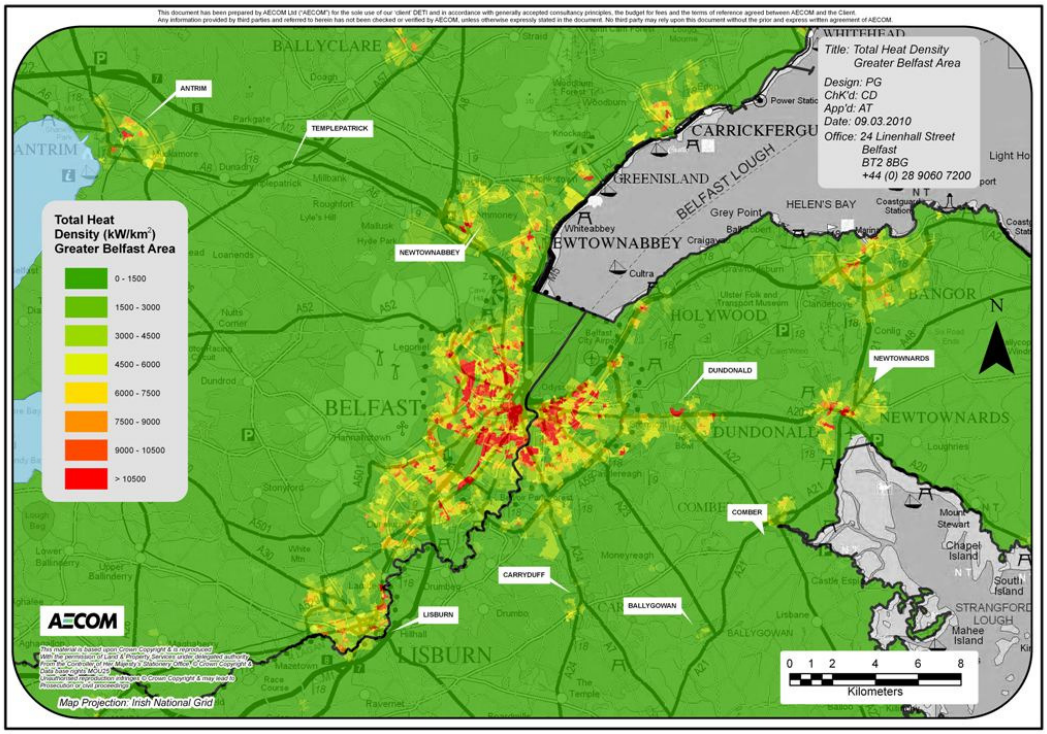

Figure 2: Close up showing heat density map of Belfast.

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Renewable resource potential

Northern Ireland is one of the least forested countries in Europe and the current availability of home-grown biomass is therefore limited to around 4 – 5% of overall heat demand. An increase in potential from biomass would therefore require extensive growth of energy crops which could provide another 5% of heat by 2020 (assuming 2.5% of the agricultural land is used) or the import of biomass from the Republic of Ireland or overseas.

The extensive farming industry in Northern Ireland could be used to help develop a biogas industry with farm and animal wastes, and grass being digested in anaerobic digestion systems. In total there is a potential for around 2.9 TWh of biogas per year corresponding to about 15 – 16% of the 2020 heat demand.

There are a number of geothermal opportunities in Northern Ireland where heat can be extracted from 2,500 – 3,000 metres below the earth's surface providing a source of "free" heat. The use of geothermal energy requires the extensive development of district heating in a number of towns and this report makes recommendations on how this can be achieved and supported.

Renewable heat can also be obtained from heat pumps driven by electricity. These need to be carefully optimised to provide good efficiencies and the CO_2 emissions associated with this method of delivering heat are closely linked to real efficiencies delivered and the grid electricity generation mix.

Overall, there is a significant potential for the generation of renewable heat in the short term, but in the longer term impacts in terms of renewable fuel import or indigenous expansion (in the case of biomass) and the support of heat infrastructure (district heating) is required to ensure these resources can be efficiently used.

Uptake and potential of renewable heat technologies and schemes

Building scale renewable heat generation

Analysis of the renewable heat supply curve for all domestic, commercial and public sector buildings (not large industrial users) shows that there are a number of potential applications which may be cost effective and which currently do not use renewable heat. These "low hanging fruit" should be targeted and mechanisms used to help overcome the non-financial barriers which may be preventing take-up of renewable heat.

The overall costs for providing renewable heat remain relatively low at around 5 p / kWh above the current heating costs up to a total of 6 TWh or about 40% of the 2020 demand. This suggests that this proportion could be met by renewable heat with a relatively low incentive. Beyond 6 TWh the costs become much greater due to a lack of suitable technologies and resource.

The net costs of providing renewable heat are predicted to be around £25 million per year for achieving the 10% target, and then about £8.8 million per year for each 1% above 10%.

Community scale district heating

The high level analysis in this report suggests that 30% of heat demand in Belfast and other towns could have potential for being met by district heating networks where heat is distributed via a system of insulated pipes from a central generator. This allows the use of much larger and more efficient renewable heat technologies such as biomass CHP and geothermal systems, and also enables the capture of waste heat from schemes that would otherwise just generate electricity.

The Belfast Urban Area represents the best technical opportunity for developing a heat network, with an overall demand of 2.4 TWh (or 13.6% of the current Northern Ireland heat demand). This could be met by the waste heat from a single large biomass power station if sufficient biomass can be obtained. A number of other smaller towns also show potential for district heating including those with geothermal resources.

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The overall costs of heat from district heating systems is generally higher than for existing fuels and technologies, but similar or lower than for smaller building-scale renewable options. In addition it provides a method for maximising the efficiency of renewable resources and a long term strategy for the widespread adoption of low and zero carbon heat in towns and cities.

District heating is used extensively in some European countries. Due to rising imported energy costs and energy security issues, Denmark developed widespread schemes in the 1970s by regulating connections in district heating zones resulting in over 60% of homes in Denmark now connected to a scheme.

If further analysis shows that district heating schemes are a preferred option, the barriers and costs associated with developing large scale energy infrastructure will require financial and political support in Northern Ireland. Due to the longer term cost benefits and resource efficiency opportunities it is recommended that further detailed analysis is conducted into the potential for district heating.

Biogas

There is a considerable theoretical potential for the development of biogas schemes in Northern Ireland which needs to be exploited. However biogas technologies in the UK are currently in their infancy and this report assumes that ten 1MWe equivalent schemes could be developed by 2020, with a theoretical potential for around 100 such schemes in total.

The generation of biogas for injection into the gas grid appears to be the most resource and cost efficient means to generate renewable heat, but there is also potential for anaerobic digestion CHP schemes to be developed where there is a local demand for the waste heat.

The location of biogas schemes is critical to their success to ensure that feedstock can be locally and cheaply sourced, the digestate can be distributed for fertiliser, and there are opportunities for the export of heat or injection of biogas. The best option could be a series of community scale schemes which are large enough to be relatively economic, but local enough to minimise feedstock and digestate transportation.

Large industrial sites

The 17 large industrial sites which fall under the EU-ETS account for 22% of Northern Ireland's heat demand, with the two cement works accounting for over half of this. Further detailed analysis is required for all these sites to assess the potential for renewable heat, but a few major installations in this sector could have a large effect on the overall renewable heat take up in Northern Ireland.

New development

Efficiency levels and CO_2 emissions from new development will be governed by future Building Regulations which are expected to be similar to those proposed for England, leading to 'zero carbon' homes and commercial buildings in the latter half of the 2010 – 2020 period.

The level of renewable heat in this sector will be largely driven by these Regulations, but could range from 0% (assuming high levels of energy efficiency and use of low carbon rather than renewable fuels) to 4.9% if all heat is met by renewable technologies. If all new dwellings were required to be fitted with solar water heating between now and 2020, then this would account for a 1% reduction in the 2020 demand.

Conclusions

A key aim of this report is to examine potential targets for renewable heat for 2020, and to identify methods of achieving these targets. However in the long term, a 2020 target will only ever form a stepping stone on to long term decarbonisation of heat and electricity in Northern Ireland. Therefore any target for 2020 should be compatible with longer term aspirations and solutions.

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Out of the three options in this report, the generation of biogas is the most flexible – it does not rely on suitable heat demands, uses a long term resource, and produces a fuel which is flexible for grid injection, distribution via containers, or transportation applications (although this clearly does not contribute to heat targets). Therefore targets set for biogas generation are compatible with longer term aspirations.

This work demonstrates that a 10% target can be met relatively cost efficiently using building scale technologies alone. However further work is required to examine the potential for district heating in more detail and whether this could provide more cost effective savings in the higher density urban areas and open up access to additional resources such as geothermal. The following table shows a summary of the potential through each of the delivery mechanisms and the impact on net costs of providing the renewable heat.

Table 1: Summary of the potential and costs of delivering renewable heat through the various delivery mechanisms.

Renewable heat delivery	Potential (% RH by 2020)	Impact on targets.	Annual incentive required (£million per 1% RH target)
Large industrial sector	Further analysis required but possible a significant potential.	The small number of applications and unknown viability means these applications should not be included in setting targets.	Unknown. Large scale energy consumers could mean that some of these applications are cost effective in the 2020 period.
Building scale	10% or more.	The analysis demonstrates that a 10% RH target is achievable using building scale technologies.	£2.5 million per % to achieve 10%. £8.8 million per 1% above 10%. No cost below 6%.
District heating	Further analysis required but preliminary assessment suggests circa 30%. Potential by 2020 extremely limited unless significant shift in policy and regulation.	Potential for district heating should not contribute to setting a 2020 target due to long term development and barriers.	Up to £9.4 - £11.5 million Some areas may be cost effective if sufficient uptake can be achieved.
Biogas	0.8% - 1.4% depending on biogas or CHP. Further potential in the longer term by approx 10 times.	Potential for circa 1% contribution to target setting depending on further analysis.	£8.2 million per 1% for biogas. £11.8 million per 1% for AD CHP.
New development	0 – 4.9%	Other drivers will be more important in this sector. It is important that building regulations are consistent with other renewable heat policies.	Zero cost in terms of incentives if driven through regulation.

There are a number of ways through which renewable heat targets can be achieved for Northern Ireland, some of which are additive and some of which are mutually exclusive. Most importantly, this report demonstrates that a 10% target should be achievable.

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There are three main ways in which a 10% target for renewable heat can be met:

1. **Large industrial / commercial sites.** There are 17 sites in Northern Ireland involved in the European ETS scheme which account for 22% of Northern Ireland's heat demand. Due to the individual nature of these sites, renewable heat opportunities are not included in the targets, but they could have a significant potential. Provision of renewable heat in this sector requires further analysis of each site, and of the technical and financial viability of delivering renewable heat. There are also risks around the use of a small number of target sites, which may or may not exist in 2020.
2. **Individual consumers market based.** The renewable heat curve analysis for this work demonstrates that renewable heat is currently cost effective for a number of consumers, and can be achieved in many other applications at a net additional cost. This approach is market based and may require the use of incentives and support mechanisms to increase level of uptake. Further analysis is required on refining incentive options if this route is selected. In general, biomass options are currently cost effective in the larger commercial and public sector buildings, and air source heat pumps appear to have the lowest net resource cost for dwellings.
3. **Community based schemes.** This report identifies that many areas could be suitable for district heating schemes at a community level. In addition there is potential for the generation of heat and electricity, or biogas, from community biogas schemes. Community based schemes may have financial barriers and require some form of incentivisation, but there are many other non-financial barriers which may require public sector support. Further detailed analysis of the community options is required to examine the viability of this in more detail. Biogas might make a relatively modest (14%) contribution to meeting the 2020 target. Again, there may be competing uses for biogas which may limit this further - such as for renewable electricity generation near the feedstock location, or transportation.

The following table provides recommendations on how a 10% renewable heat market share can be achieved and how a support scheme can be developed. It also aims to identify which Government Department or agency should take the lead for each recommendation.

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Table 2: Key recommendations.

Targets and incentives		
Conclusions	Recommendations	Lead Department(s)
Targets and incentives		
1. Achieving a 10% renewable heat share by 2020 is possible but will require Government intervention	Adopt a 10% target Develop a long term strategy for renewable and low carbon heat based on achieving a 10% renewable heat share by 2020, including options for incentivisation. This should include assessment of competition for resources and interaction with other energy sectors. Set up a cross departmental strategy group	DETI DETI DETI DOE DARD DSD DFP DRD OFMDFM
Developing a Northern Ireland Specific incentive scheme		
2. Develop a NI specific incentive scheme and Put in place interim measures.	Assess the potential for renewable heat provision, and develop options to most appropriately support large scale industrial schemes. Identify applications where renewable heat may currently be cost effective in the commercial sector, and assess current barriers and ways of overcoming these. Investigate in further detail and develop a renewable heat incentive (RHI) for small and medium scale projects in the domestic and commercial sectors where options currently are not cost effective. Conduct an Impact Assessment (IA) of potential options. Consider the appropriateness and the cost of allowing the retrospective payment of incentives to eligible installations .	DETI Invest NI DETI Invest NI DETI DSD DARD DETI DETI

Discussion and further work

Beyond the 2020 targets, we suggest that the path of de-carbonisation in NI should be guided by the most economic use of limited resources across all sectors - and most importantly heat and electricity. Such a path might well involve a greater use of district heating, to distribute CHP heat from low- and/or zero-carbon electricity generation for example. This is an area for further study, but its impact upon the position prior to 2020 will be limited given the timescales necessary for the roll-out of district heating in built-up areas.

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Potentially the most significant observation is that the renewable heat market requires long term support, both politically and financially. Options for incentivising the market and a methodology for reaching a 10% target are also included in this report. However, these will need to be carefully considered on a cross departmental basis to ensure a long term solution is agreed.

The key observations are as follows:

1. Renewable heat cannot be considered in isolation and other forms of low carbon heat, such as natural gas, and other energy sectors such as electricity generation and transportation all need to be considered to ensure that renewable heat plays the best part it can in the Northern Ireland energy mix. The draft SEF published in July 2009 gave an overview of energy policy in Northern Ireland and identified the need for a balanced energy portfolio going forward.
2. The SEF also recognised the potential benefits of further natural gas roll-out in both existing and potential licensed areas as a low carbon alternative to other fossil fuel sources. A strategy to increase the levels of renewable heat should be developed in tandem with a strategy to maximise natural gas uptake where appropriate.
3. Renewable resources (particularly biomass) are limited in Northern Ireland and the cost effectiveness of different resources and technology options varies. Northern Ireland therefore needs to consider how different resources and technologies are supported through **policy and regulation** to ensure maximum cost benefit and CO_2 savings. One outcome of this may be a form of **spatial energy planning**.

From these three observations, a number of next steps are proposed. The following table shows the suggested next steps alongside appropriate delivery partners.

Table 3: Suggested next steps

Conclusions	Next Steps	Lead Department(s)
Biogas		
Develop a biogas road-map for Northern Ireland. Incentivisation of biogas requires further analysis of options and support mechanisms including economic and non-economic barriers.	Conduct a detailed assessment of the biogas potential leading to the development of a biogas roadmap. This should provide an economic assessment of biogas options and the level of incentivisation required.	DETI DARD DOE
	Geographic supply – demand analysis of feedstock distribution, digestate distribution potential, and heat demands and gas network location.	DETI DARD DOE
	Technical and economic assessment of biogas system chains to identify the most appropriate biogas system options for Northern Ireland. This should include non-heat uses such as transportation and electricity generation	DETI DARD DOE
Biomass		
Develop a long term strategy for biomass to provide confidence to consumers, incentivise the uptake of renewable heat, maximise the resource availability and manage competition with other sectors.	Investigate the practical level to which home grown biomass could be developed. Examine the environmental impacts of increasing the use of energy crops including impact on other sectors such as food production.	DARD DOE
	Conduct a resource and demand assessment which considers all other potential biomass applications, for example, electricity generation and transport fuels.	DARD DETI
	Investigate the potential for a public sector Biomass Agency to help coordinate biomass activities and provide long term support to markets and confidence in price.	DARD
	Develop a strategy / policy for the import of biomass fuel to ensure there is a cost-effective security of supply	DARD

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Conclusions	Next Steps	Lead Department(s)
Technologies, resource, and strategy options		
Community heating schemes could have a large potential for the distribution of low and zero carbon heat.	Conduct more detailed analysis of district heating options, including the costs associated with retrofit of DH schemes in Northern Ireland. This work should compare the costs of DH options with stand alone solutions to identify the most appropriate strategy in each area.	DETI DSD
	Detailed assessment of district heating case study sites including Belfast Urban Area and geothermal areas	DETI DSD
Spatial energy planning could provide an economic way forward for incentivising and support the most appropriate solutions.	Assess the potential for developing a spatial energy planning approach in Northern Ireland Review the approach taken in GB with the PPS 1 supplement, and in other European countries such as Denmark	DOE DRD DOE
	Develop a strategy for implementing spatial energy planning in Northern Ireland if appropriate examining the planning framework and regional policy and regulation.	DOE DRD
Biomass technologies are the most cost effective option in the commercial sector but there are concerns over air quality, and biomass pellet quality.	Assess the impact of biomass technologies on air quality in urban areas of Northern Ireland Develop a set of criteria which can be used to determine the type and scale of biomass technologies which can be used in Urban areas	DOE DOE
	Examine current air quality standards to ensure these are appropriate and do not unnecessarily hinder the development of renewable heat in urban areas.	DOE
	Review standards from across Europe and adopt biomass pellet standards which will provide consumers with confidence in the quality of biomass pellet products.	DARD DETI

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