Renewable Heat in Scotland, 2012

A report by the Energy Saving Trust for the Scottish Government

June 2013

Prepared by Rachel Carss, Energy Saving Trust

About the Energy Saving Trust

The Energy Saving Trust is Scotland and the UK's leading impartial organisation helping people save energy and reduce carbon emissions. We do this by directly supporting consumers to take action, helping local authorities and communities to save energy, using our expert insight and knowledge and providing quality assurance for goods and services.

This work was carried out by the Energy Saving Trust on behalf of the Scottish Government. The report draws on various sources of data from the Energy Saving Trust and other organisations working in Scotland, and was written by Rachel Carss with input from Elaine Waterson.

With thanks to all individuals and organisations who provided data, and with particular thanks to Gemserv, the Forestry Commission Scotland and Hudson Consulting.

Please note that the methodology used in this report to calculate renewable heat capacity and output for Scotland may not necessarily be in line with that required by the EU Renewable Energy Directive and as such the figures should not be used for any reporting purposes associated with this Directive.

Contents

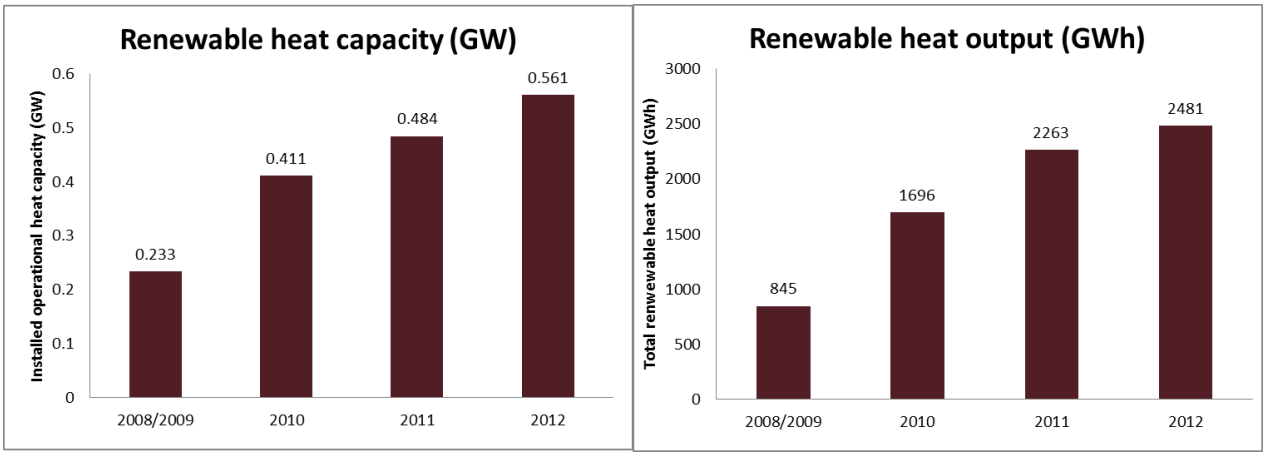
1. Summary of key findings

The Scottish Government has set a target for 11% of non-electrical heat demand in Scotland to come from renewable sources by 20201.

In order to help measure progress towards this target, the Energy Saving Trust maintains a database of renewable heat installations on behalf of the Scottish Government. The database records installations known to be operating and those currently in various stages of development, and contains data on the capacity and yearly heat output of those installations. In March 2012, we estimated that during calendar year 2011 Scotland had 0.484GW of renewable heat capacity in operation, producing an estimated 2,263GWh of useful renewable heat energy, equating to 3.8% of Scotland's forecast non-electrical heat demand in 20202.

The database has now been updated with new information on heat generated from renewable sources during 2012, and new installations which are in development. As a result, we estimate that in calendar year 2012, around 0.561GW of renewable heat capacity was operational in Scotland, producing an estimated 2,481GWh of useful renewable heat. This equates to 4.1% of Scotland's total forecast non-electrical heat demand in 2020.This represents an increase of 0.077GW of capacity from 2011, and an increase of 218GWh of heat generated from renewable sources compared to that in 2011.

Figure 1. Estimated renewable heat capacity and output, in 2008/09, 2010 , 2011 and 2012 (note: data were not gathered for calendar year 2009).



[1] Renewable Heat Action Plan for Scotland, Scottish Government, November 2009. http://www.scotland.gov.uk/Publications/2009/11/04154534/0

[2] Renewable Heat in Scotland, 2010. A report by the Energy Saving Trust for the Scottish Government, March 2011. http://www.scotland.gov.uk/Resource/Doc/917/0115248.pdf

2. Methodology

2.1 Approach taken

Two main outputs are required from the renewable heat database which the Energy Saving Trust maintains on behalf of the Scottish Government. The first is an estimate of operational renewable heat capacity. Capacity refers to the maximum instantaneous power output of a renewable heating system such as a biomass boiler, and is usually measured in kilowatt therms (kWth) or megawatt therms (MWth), depending on the size of the installation. Total heat capacity is presented in this report as gigawatts (GW)[3] or megawatts (MW), rather than as GWth or MWth, to avoid confusion with the units of heat output (GWh). Installations are classified by their capacity, into large (1MW and above), medium (between 1MW and 45kW) and micro (less than or equal to 45kW).

The second main output required from the database is an estimate of useful[4] renewable heat energy produced over a year. This is referred to throughout the report as useful heat output and is recorded in megawatt hours (MWh) for each installation in the database, with the totals in this report given in gigawatt hours (GWh)[5].

Useful heat output is hard to measure, and few renewable heat installations monitor the heat generated from their systems[6]. Therefore the results presented in this report are mainly estimates of heat output, based on what data are available for each installation. Where possible, results are based on data received about fuel inputs to particular installations and assumptions about their efficiency, which are used to estimate *actual* heat output during 2012. This figure may be different to estimates of *potential* output, which are usually based on the heat capacity of an installation and an assumed number of operating hours, and which might therefore be higher. However where data on fuel inputs were not available, the figure for potential output has been used.

The information available about each installation varies, depending on the data sources used. Where they are supplied, estimates of fuel input are used as the preferred basis for estimating annual heat output. Where information on capacity is not available, this is estimated based on information about heat output and assumptions about typical running hours, based on installation size and the heat use (space heating or process heat). Where capacity is known, but not output, annual heat output is estimated based on assumptions about typical running hours per year. Further information about the assumptions used is provided in section 2.4, *Assumptions used*.

---

[3] 1GW = 1,000MW = 1,000,000kW
[4] Useful heat is the heat delivered to the end user or process, taking into account the technology efficiency.
[5] 1GWh = 1,000MWh = 1,000,000kWh
[6] Although non-domestic installations claiming the renewable heat incentive (RHI) are required to submit regular heat meter readings to Ofgem, data from individual Scottish installations registered for the RHI were not available from Ofgem for this update of the renewable heat database.

Where possible, data have been checked against estimates provided by industry figures and/or trade bodies for the different sectors and technologies.

Results are reported here for calendar year 2012, rather than financial year 2012/13. This is because the Forestry Commission Scotland data set on wood fuel use, which provides a large portion of the data on which total output has been estimated, is currently updated on a calendar year basis.

2.2 Technologies included

The following technologies produce heat from renewable sources, and are included in the database:

- Biomass (wood) primary combustion
- Biomass (wood) combined heat and power (CHP)
- Solar thermal panels
- Heat pumps: water source, air source and ground source
- Energy from waste (EfW), including:
- Anaerobic digestion (AD)[7]
- Landfill gas capture
- Biomass primary combustion of biodegradable material (other than wood)
- Advanced thermal treatment (ATT), using pyrolysis and/or gasification

Had an example been found, the following technology could also have been included:

- Fuel cell biomass

Technologies which are not included in the database, as they produce heat which is not renewable, are:

- Non-biomass combined heat and power (CHP) running on mains gas or other fossil fuel
- Exhaust air heat recovery (EAHR) where the initial heat is not provided from a renewable source
- Energy from waste: installations where the only fuel is clinical (hospital) waste[8]

The following technologies can be considered sources of renewable heat, but are not currently captured in the renewable heat database:

- Passive renewable heating, for example solar gain. This is excluded due to the difficulty of assessing its contribution to heating demand.
- Wind- or hydro-produced electricity which is used to provide heat. These technologies are excluded to avoid double counting of progress towards renewables targets, as the energy produced counts towards the Scottish Government's target for renewable electricity generation.

Descriptions of all these technologies are provided in Appendix 1

[7] Excluding the parasitic heat used to maintain the anaerobic digestion process.
[8] In line with assumptions used in the Department of Energy and Climate Change (DECC) RESTATS methodology, clinical waste is considered non-biodegradable and therefore non-renewable. Renewable Energy Statistics: Data Sources and Methodologies, Department of Energy and Climate Change.
http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

2.3 Data sources used

The Energy Saving Trust updated the renewable heat database for the Scottish Government in March 2011 and again in March 2012 to give an estimate of renewable heat capacity and output in 2010 and 2011 respectively. The new estimate for renewable heat output in 2012 has been generated by updating the information held in the database. Effort has focussed on updating information from the installations with the largest capacities, which also produce the largest amounts of heat.

Multiple sources of data were used to update the renewable heat database. The main sources used, and the organisations which supplied them, are listed in table 1. In addition, other organisations such as the Carbon Trust, and individuals connected with specific installations, were also contacted and provided useful information.

The data sets from the Forestry Commission Scotland and Hudson Consulting contain estimates of wood fuel usage for the year 2012 for large biomass plants. Data from the Forestry Commission Scotland report 'Annual woodfuel demand and usage in Scotland 2011' has been used for smaller systems as predictions for these were not available.

Table 1. Main datasets used

Organisation	Dataset
Forestry Commission Scotland / Hudson Consulting	Annual woodfuel demand and usage in Scotland (*estimate for 2012*)
AEA, on behalf of the Department of Energy and Climate Change (DECC)	The Renewable Energy Planning Database (REPD)[9]
Energy Saving Trust, on behalf of the Scottish Government	• Energy Saving Scotland small business loans; • Energy Saving Scotland home loans and home renewables loans; • Energy Saving Scotland home renewables grants[10]; • Applications to the district heating loan fund; • Community and locally owned renewable energy database[11]

[9] https://restats.decc.gov.uk/cms/welcome-to-the-restats-web-site/
[10] Energy Saving Scotland home renewables grants ended in June 2010.
[11] http://www.energysavingtrust.org.uk/scotland/Publications2/Communities/Community-and-locally-owned-renewable-energy-PDF

Energy Saving Trust, on behalf of the Department of Energy and Climate Change (DECC)	Renewable heat premium payment applications
Scottish Environment Protection Agency (SEPA)	Information on installations covered by the Pollution Prevention and Control license in Scotland
Gemserv	Microgeneration Certification Scheme (MCS) data

In addition, information on installations in development was sourced from local planning authority planning departments via online searches.

In addition to the data sources used in previous reports, this year has the addition of Microgeneration Certification Scheme (MCS) data provided by the administrators of the scheme, Gemserv, for microgeneration systems. This is the first time the report has included data of this kind.

2.4 Assumptions used

For the majority of large and medium sized installations burning biomass wood for primary combustion or CHP, the main source of information available was estimates of wood fuel use from Hudson Consulting's annual survey of wood fuel use in Scotland for the Forestry Commission Scotland. These data were then converted into estimates of heat output, based on the assumptions about combustion efficiency given in table 2. One oven-dried tonne (ODT) of wood at 30% moisture content is assumed to contain 4.92MWh of energy[12].

Table 2. Boiler efficiencies assumed for converting oven-dried tonnes of wood burnt to heat output

Installation size	Boiler efficiency assumed	MWh heat output per ODT burnt
Large installations (>1MW, or >10,000 ODT)	90%	4.43
Medium installations (45kW – 1MW, or <10,000 ODT)	85%	4.18
Small (≤45kW) non-domestic	80%	3.94
Domestic	35%	1.74

[12] Mitchell, Hudson, Gardner, Storry and Gray, 1990. Wood Fuel Supply Strategies Vol 1. The Report: ETSU B 1176-P1.

For biomass combined heat and power, a calculation was used to work out the estimate of heat energy produced from oven dried tonnes of wood, based on the values given for electrical power (MWe) and heat output (MWth). An example is given in figure 2 below.

Figure 2. Formula used to estimate efficiency of heat production from burning biomass, in a biomass CHP plant.

Example calculation: a 20MWe and 80MWth biomass CHP unit.
Total efficiency = 90% (as for large biomass combustion plant)
Total output (electricity + heat) = 10 + 80 = 100MW
Total thermal input = output / total efficiency = 100 / 0.9 = 111MW
Electrical efficiency = electrical output / thermal input = 20 / 111 = 18%
Thermal efficiency = heat output / thermal input = 80 / 111 = 72%

For installations where an estimate of annual heat output was provided (or derived from ODT of wood burnt) but information on capacity was not given, capacity has been estimated based on typical running hours per year by size of installation or sector. These hours are given in table 3. The same running hours were used to derive an estimate of output for those installations where information on capacity was provided but an estimate of heat per year was not.

Table 3. Peak running hours assumed by technology, size and heat use

Sector and size of installation	Peak running hours/year
Large (1MW+) biomass providing process heat, and large biomass CHP	8,000
Energy from waste installations providing process heat or running as CHP	8,000
Commercial small to medium (45kw-1MW) biomass[13]	5,000
Space heating biomass, all sizes (including district heating)	2,500
Heat pumps providing space heating	2,500
Heat pumps or biomass providing space heating for community buildings	250

[13] DECC uses an estimate of 1,314 peak load hours per year (equivalent to a 15% load factor) as the tier-break point between tier 1 and tier 2 prices paid for heat from small and medium sized non-domestic biomass under the Renewable Heat Incentive. However this is noted by DECC as being a reasonable estimate of a minimum level of usage that could be expected. Therefore 2,500 peak load hours has been used here, in keeping with estimates of renewable heat in Scotland, as an estimate of total peak load hours for space heating in Scotland. http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx

For installations where values for neither capacity nor output were provided, an estimate was made for likely installed capacity, based on technology type, ownership category and building type (where appropriate). This was derived from similar installations where capacity was known. The values assumed for capacity in those instances are given in Appendix 2. It is important to note that there are some additional capacity assumptions for this year's report for systems where the building type was unknown (see appendix 2). Yearly heat output was then estimated using the assumptions in table 3.

For solar thermal panels, information was sometimes only provided in m^2 of panel area. The following assumptions were used to derive capacity and/or output, where this was not provided:

- Capacity per m^2: 0.7kW, from the Solar Trade Association
- Useful heat output per m^2: 0.34MWh, derived from SAP 2009 calculations

In line with assumptions used in DECC's RESTATS methodology[14], municipal solid waste is considered to contain 63.5% biodegradable waste. Therefore an installation producing heat from burning municipal solid waste will have 63.5% of its capacity and output recorded as renewable heat in the database. For anaerobic digestion facilities, 4% of the renewable heat output has been removed from the total figure for useful renewable heat production, as this is estimated to be the parasitic heat requirement of the AD process[15].

In certain circumstances assumptions have been made about the operating status. If information for a project has been found in previous years but no further information has been found for the 2012 update the following assumptions have been made: If a project has been previously recorded as 'in scoping' and no further information has been found, then the assumption has been made that it is still at the same stage of development. Projects that have had planning permission granted but there is no further information the status is 'consented but not built'. Projects that were 'under construction' in June 2011 have remained in the same status if no evidence that the project is operation has been found. There are some projects recorded in the database that have no evidence of status, these are classed as unknown.

Scotland's total forecast non-electrical heat demand in 2020 is taken to be around 60,089GWh (60.1TWh)[16].

[14] Renewable Energy Statistics: Data Sources and Methodologies, Department of Energy and Climate Change. http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx
[15] Based on discussions with the Carbon Trust.
[16] Renewable Heat Action Plan for Scotland, Scottish Government, November 2009. http://www.scotland.gov.uk/Publications/2009/11/04154534/0

3. Renewable heat capacity and renewable heat output in 2012

3.1 Results for 2012

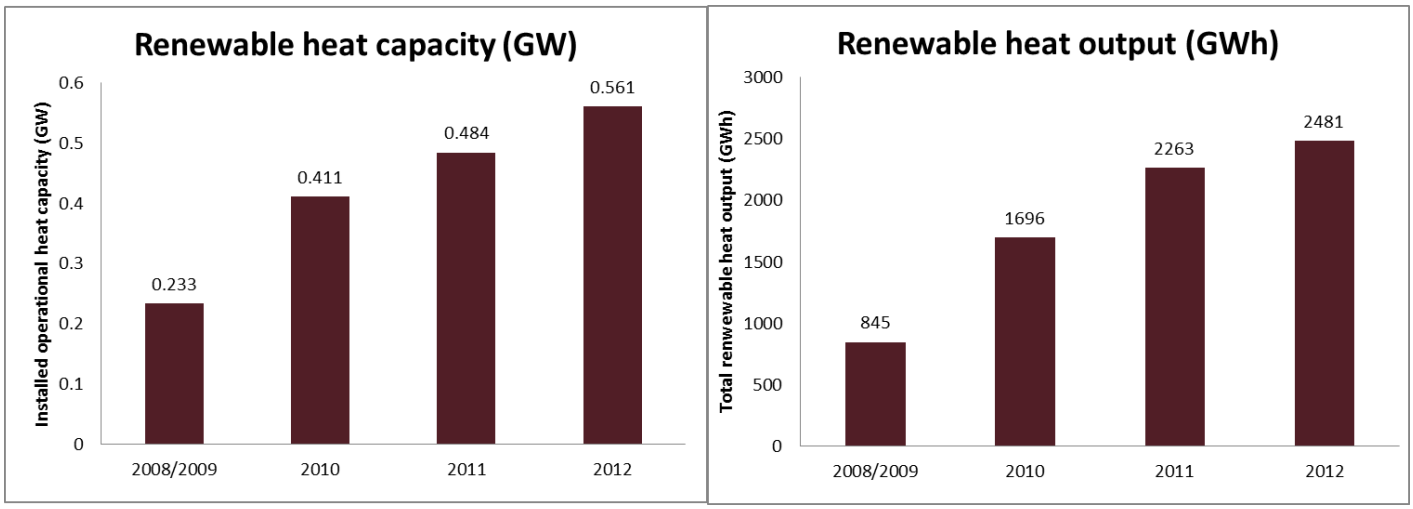
In 2012, **2,481GWh** of heat was produced from renewable sources, from an installed capacity of **0.561GW**. 2,481GWh is equivalent to **4.1%** of the non-electrical heat demand of 60.1TWh it is estimated that Scotland will require in 2020[17]. It is assumed that all the installations currently in operation will still be operating by 2020.

0.561GW of capacity and 2,481GWh of output represent an increase of 0.077GW in capacity compared to 2011, and an increase of 218GWh in output since 2011. Since the Sustainable Development Commission Scotland's[18] estimate of renewable heat output in Scotland during 2008/9, renewable heat capacity has increased by 0.33GW and output by 1,636GWh a year.

Table 4. Estimated renewable heat capacity and output, in 2008/09, 2010, 2011 and 2012 *(note: data were not gathered for calendar year 2009).*

	2008/2009	2009	2010	2011	2012
Capacity (GW)	0.233	-	0.411	0.484	0.561
Heat Output (GWh)	845	-	1,696	2,263	2,481
% Of Scotland's non-electrical heat demand	1.4%	-	2.8%	3.8%	4.1%

Figure 3. Estimated renewable heat capacity and output, in 2008/09, 2010, 2011 and 2012 *(note: data were not gathered for calendar year 2009).*



[17] Renewable Heat Action Plan for Scotland, Scottish Government, November 2009. http://www.scotland.gov.uk/Publications/2009/11/04154534/0

[18] Renewable Heat in Scotland. A report to the Scottish Government from the Sustainable Development Commission Scotland, June 2009. http://www.sd-commission.org.uk/publications.php?id=1015

The majority of renewable heat output in 2012 continues to come from large (1MW+) installations (table 5), as in previous years. The number of large (1MW+) installations contributed 67% of the renewable heat capacity and 83% of the annual output. However, they represent only 0.4% of the number of installations. Large installations contribute a larger percentage of heat output (83%) than of installed capacity (67%), compared with small to medium (45kW-1MW) and micro (≤45kW) installations. This reflects the longer running hours and (in some cases) higher efficiencies seen in large installations. In addition, the large installation category includes installations which are primarily using renewable heat to provide process heat, as a product of combined heat and power, or for waste disposal, which are activities which continue year round. Small to medium, and micro installations, are more likely to be used to provide space heating and/or building hot water, whose demands are more seasonal.

Table 5. Renewable heat output and capacity in Scotland, 2012, by size of installation

	Renewable heat capacity (MW)	% renewable heat capacity	Annual Output (MWh)	% annual output	Number of installs	% of installs
Large (1MWth+)	375	67%	2,069,619	83%	43	0.4%
Small to medium (>45kWth and <1MWth)	66	12%	170,462	7%	408	3.6%
Micro (≤45kWth)	119	21%	240,545	10%	10,800	96.0%
Total	**561**	**100%**	**2,480,626**	100%	**11,251**	**100.0%**

3.2 Results by technology

The majority of both output and capacity in 2012 came from biomass primary combustion and biomass combined heat and power (table 6, and figures 4 and 5). 79% of renewable heat capacity, and 82% of renewable heat output came from installations which used biomass primary combustion or biomass combined heat and power.

Table 6. Renewable heat output and capacity in Scotland, 2012, by technology

	Renewable heat capacity (MW)	% renewable heat capacity	Annual Output (MWh)	% annual output
Biomass	300	53%	1,149,959	46%
Biomass CHP	144	26%	892,420	36%
Energy from waste	41	7%	300,492	12%
Heat Pump	49	9%	122,211	5%
Solar Thermal	28	5%	15,544	1%
Total	**561**	**100%**	**2,480,626**	**100%**

Note: totals may not equal sums due to rounding

Figure 4. Renewable heat capacity in Scotland, 2012, by technology

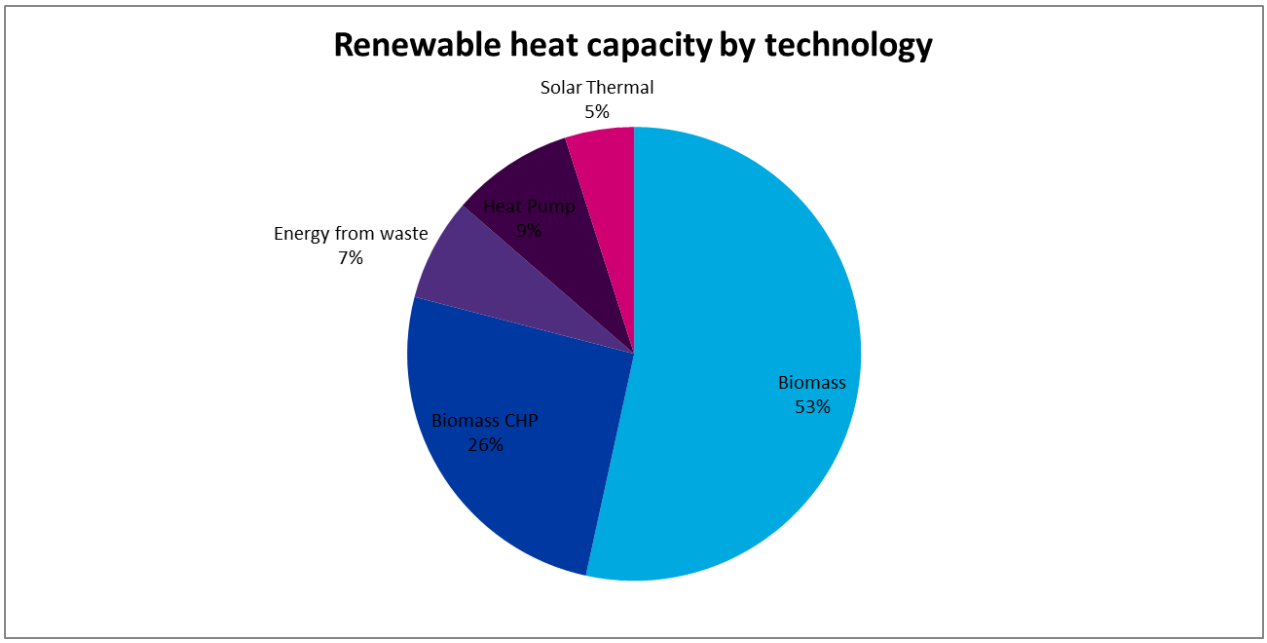
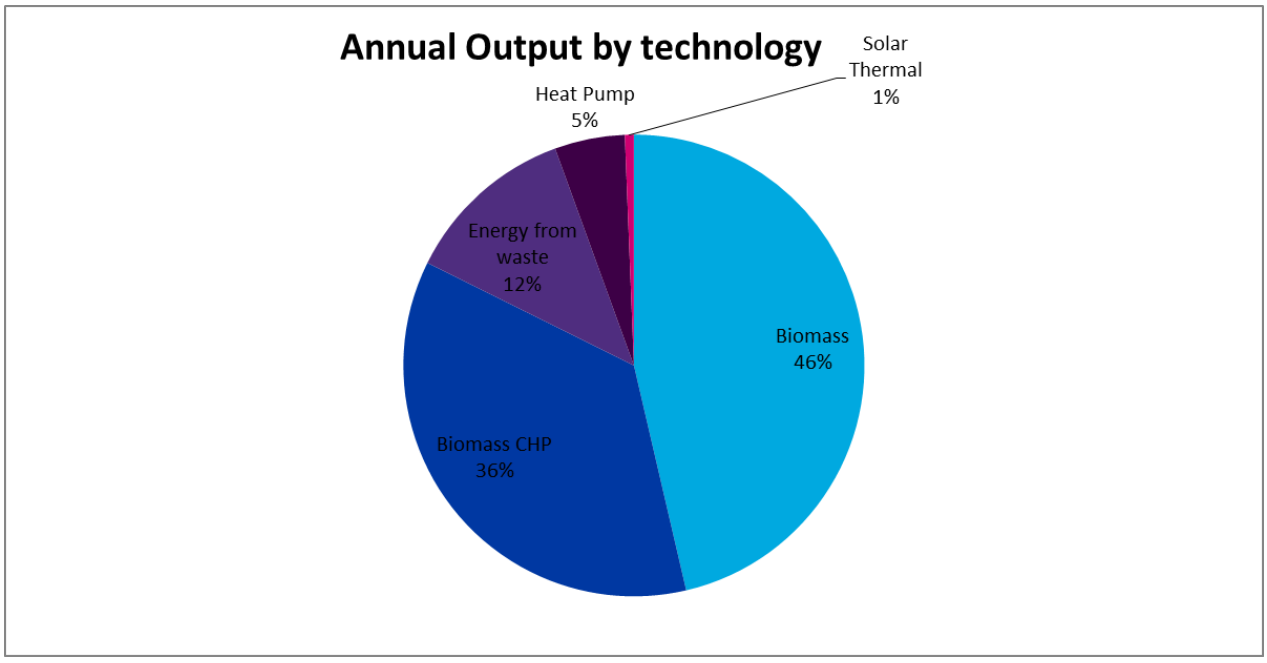


Figure 5. Renewable heat output in Scotland in 2012, by technology



3.3 Change in output and capacity by technology since 2011

Two notable developments since 2011 account for significant differences in output and capacity between 2011 and 2012. These are:

- The estimated capacity of renewable heat in energy from waste installations has increased by 21MW due to the introduction of some new plants to the database. The largest is an 8MW plant burning the waste from leather processing. Previously, 14,000 tonnes of leather was sent to land fill at the plant but now the heat produced from the thermal plant is used in the leather processing procedure.

- A reduction in the annual output of Biomass CHP systems. This is because one plant purchased around 24,500odt less wood fuel than the previous year. This could be due to over ordering in 2011.

Table 7.Changes in renewable heat output and capacity in Scotland from 2011 to 2012, by technology

	2012 Total Capacity	Change since 2011	2012 Total Annual Output	Change since 2011
Biomass	300 MW	45 MW	1,149,959 MWh	104,959 MWh
Biomass CHP	144 MW	0 MW	892,420 MWh	-85,580 MWh
Energy from waste	41 MW	21 MW	300,492MWh	172,492 MWh
Heat Pump	49 MW	7 MW	122,211 MWh	20,611 MWh
Solar Thermal	28 MW	6 MW	15,544 MWh	4,544 MWh
Total	**561 MW**	**79 MW**	**2,480,626 MWh**	**217,026 MWh**
	0.561 GW	**0.079GW**	**2,481 GWh**	**217 GWh**

Note: totals may not equal sums due to rounding

4. Further renewable heat capacity in development

4.1 Further capacity under construction and in planning

The renewable heat database has also been updated to include information (where available) on renewable heat installations which are in development: under construction, consented but not yet built, in planning or in scoping. These can be used to provide an estimate of future renewable heat output in Scotland, although there is necessarily a large degree of uncertainty around such figures.

An estimated **0.125GW** of installed capacity from (mostly large) projects is currently under construction in Scotland, which could provide a further **896GWh** of renewable heat. Adding these figures to current operational installations will provide a total of **0.686GW** of renewable heat capacity and **3,377GWh** of renewable heat output, equivalent to **5.6%** of non-electrical heat in 2020.

In addition, an estimated 0.423GW of capacity is either consented but not built, or submitted to local planning authorities for planning permission. These installations could provide around 2,364GWh of renewable heat. Assuming that 50% of these projects come to fruition before 2020 (providing a further 0.212GW and 1,182GWh of heat), and added to those installations currently under construction and operating, this would give a total capacity of **0.898W** and **4,558GWh** of renewable heat, equivalent to **7.6%** of non-electrical heat in 2020.

A further 0.088GW of heat capacity is estimated from projects which are still at the 'scoping' phase i.e. they have not yet submitted an application for planning permission. These could provide a further 651GWh of heat. However these numbers should be treated with caution as:

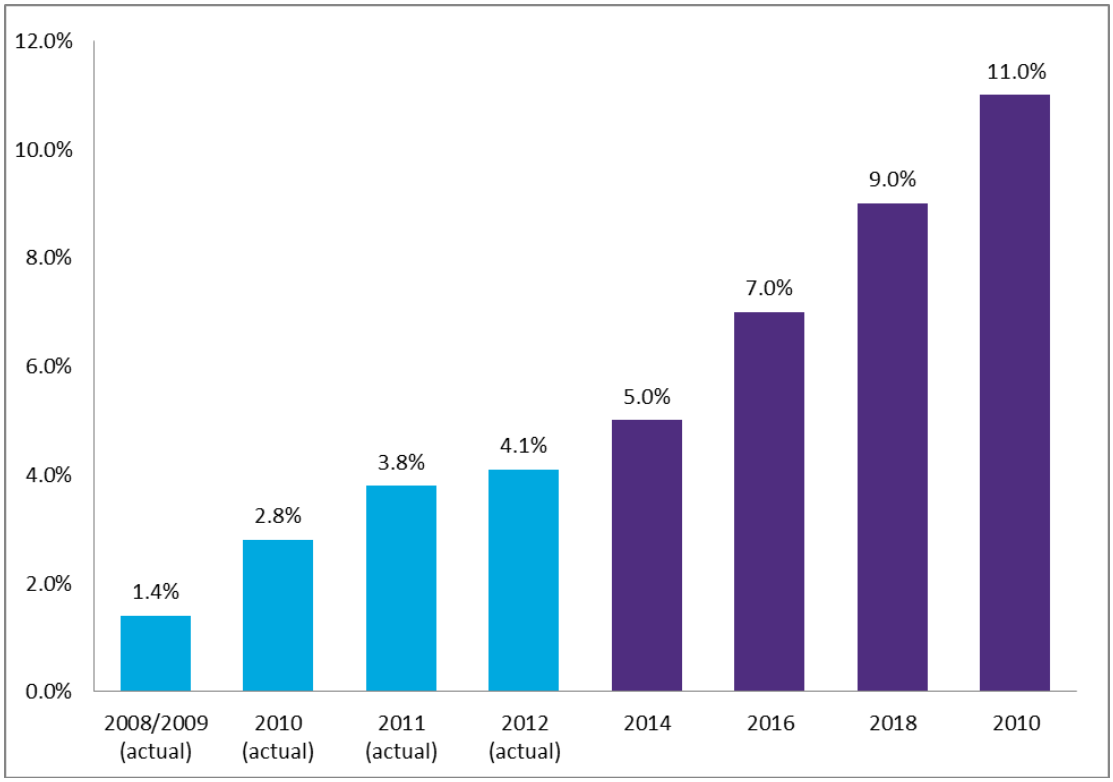
- It is not known how many of these projects will ultimately become operational;
- Numbers are likely to be an underestimate as not all projects in scoping will have been captured in the renewable heat database.

4.2 Comparing the findings with progress towards the 2020 target

Between 2011 and 2012, renewable heat capacity in Scotland has increased by 0.077GW, and output has increased by 218GWh, from 3.8% of 2020 forecast non-electrical heat demand to 4.1%. Projects under construction, consented but not yet built, or in planning, could potentially bring total heat output to around 4,558GWh a year, or 7.6% of 2020 heat demand (section 4.1).

Scotland is currently still ahead of the projections provided in the Renewable Heat Action Plan (2009) for meeting the 2020 target (figure 6). The target set out in 2009 for 2012 was 3.5% so the actual result of 4.1% means that Scotland is ahead of the target.

Figure 6. Indicative interim milestones towards the 2020 target for renewable heat[19], compared with actual heat output in 2008/9, 2010, 2011 and 2012 *(note data were not collected for calendar year 2009).*



5. Uncertainty levels associated with the methodology used, and recommendations for future updates

In any analysis of this kind where incomplete data are gathered from a variety of sources, certain assumptions have to be made to fill in gaps in the data. Assumptions made for particular technologies or sectors are discussed in this section, as well as general advice on the robustness of these figures.

As in previous years there is a chance that installations could have been either missed or double counted.

Estimates of future output and capacity from installations still in development should also be treated with caution, as these projects may not come to fruition for a variety of reasons, and the stated capacity and

[19] Renewable Heat Action Plan for Scotland, Scottish Government, November 2009. http://www.scotland.gov.uk/Publications/2009/11/04154534/0

heat output for projects still in development may be subject to change. Actual heat output from future installations may also not equal predictions of future output based on installed capacity and peak running hours. It is worth noting that many heat installations currently in development propose to export heat to nearby heat users; however the heat networks necessary to transport this heat have yet to be constructed, and in some cases there is not yet a heat user located nearby. Therefore use of the renewable heat will depend firstly on a suitable heat user being agreed or established nearby; and secondly how much heat that user requires, either for process heat or space heating.

5.1 Estimating micro installations: capacity and output

In previous years assumptions have been made on the number of micro size installations (smaller than 45kWp) but for the first time Germserv supplied data from the MSC database. Gemserv are the administrators of the Microgeneration Certification Scheme (MSC) which is a quality insurance scheme for microgeneration technologies and installers. This provided us with exact numbers of solar thermal, ground source heat pumps, air source heat pumps and biomass systems that were installed by MCS certified installers and with the some additional data from a housing association in 2012..

The current data for micro installations includes MCS data from 2012 but is not made up of MCS data exclusively. Just over 1,500 micro installations were added to the database for the 2012 report from MCS records. The remainder of the data is that used in the 2011 report and this came from a range of sources such as EPC data, Building Services Research and Information Association (BSRIA) Energy Saving Trust grant and loan schemes, Heating and Hotwater Industry Council (HHIC) estimates and Stove Industry Alliance sales estimates for Scotland. The same range of data has not been used this year to avoid double counting.

We are aware that there are a number of installations that could be operational that have not received Government grants or funding and will not be evident on the MSC database. This means that the numbers for systems that are smaller than 45kWp are likely to be an underestimate. There was no data available to use that would provide the missing information without risking double counting.

5.2 Energy from waste installations

Energy from waste technologies (primary combustion of non-wood biomass, anaerobic digestion, and combustion of landfill gas) now provide 7% of renewable heat capacity and 12% of renewable heat output (table 6). This represents a relatively large increase from the 2011 figures which were 4% and 6% respectively. This is due to the introduction of some large Energy from Waste plants to the database such as a thermal plant creating heat from waste leather that has a capacity of 8MW.

5.3 Recommendations for future updates

As noted in the report published in 2012, the Renewable Heat Incentive (RHI) is expected to be one of the main drivers of future increases of renewable heat production in Scotland and the rest of Great Britain. Non-domestic installations claiming payments under the RHI are required to submit regular meter readings on actual heat production to Ofgem, who are the administrators of the scheme. We recommend that the Scottish Government work closely with DECC and Ofgem to ensure this data can be used by the Scottish Government to help monitor progress towards its renewable heat target.

The Scottish Housing Condition Survey has recently started to collect data on domestic microgeneration installations. . This data potentially captures installations that have not received government grants or loans and as such could provide a more accurate picture than current data sources. This data should be considered for inclusion in the next update of the renewable heat database and associated report.

5.4 Measuring progress against Scotland's Renewable Heat target

To date Scotland's progress against its renewable heat target has been monitored using the latest annual renewable heat output estimate against a forecasted 2020 figure for heat demand. This heat demand figure was derived from data for 2002 in the 2006 Scottish Energy Study, which at the time provided the most robust data source available for estimates of energy consumption in Scotland.

However, since the original methodology for measuring Scotland's progress against its renewable heat target was developed, the Department of Energy and Climate Change (DECC) began publishing more detailed sub-UK estimates of energy consumption and this has enabled the Scottish Government to develop a more systematic and robust method of monitoring Scotland's (non-electrical) heat demand on an annual basis. For a transitional period this report details Scotland's progress against its renewable heat target using the existing methodology, with the proposals for and outputs of the new methodology included in Appendix 3.

Appendix 1. Individual technology descriptions

Renewable energy technologies:

The following technologies are considered to produce heat from renewable sources, and are included in the database:

- **Biomass (wood) primary combustion**

Wood is burnt to directly produce heat for space or water heating, and/or to provide heat for an industrial process. The wood burnt may be chips, pellets or logs, or waste wood, sawdust or offcuts. In some installations the wood fuel may be supplemented by, or be a supplement to, other non-renewable fuels such as coal. These cases are referred to as 'co-firing', and the renewable heat capacity and renewable heat output of installations when co-firing occurs are estimated to be a proportion of the total capacity and heat, based on the mix of different renewable and non-renewable fuels used.

- **Biomass (wood) combined heat and power (CHP)**

Biomass is burnt in order to generate electricity. Heat is produced as a by-product, which can then be used for process heat, or supplying space or water heating.

- **Solar thermal panels**

Panels which produce hot water using the sun's heat. The systems can be designed so that the hot water produced also contributes to space heating demand ('solar space heating') but it is more commonly used to provide only hot water.

- **Heat pumps: water source, air source and ground source**

Technologies to extract low-grade heat from the external environment (the ground, air or a water body) and through a compression system produce heat for space and/or water heating. Although heat pumps rely on electricity to operate, their high co-efficient of performance (COP) means they extract more heat energy from the environment than they use in electricity. 'Exhaust air heat pumps' (which in addition to extracting heat from the external air, also draw warmth from warm stale air leaving a building) have been included within the category air source heat pumps. However units which are purely exhaust air heat recovery, without also extracting heat from the air outside, have not. Cooling provided by heat pumps has not been included in the database.

- **Energy from waste (EfW)**

Heat energy produced from the treatment of organic biodegradable waste other than wood. This category includes the following technologies:

- **Anaerobic digestion (AD):**

Organic matter is broken down in the absence of oxygen to produce methane gas. The methane is then burnt to produce heat, or burnt in a combined heat and power unit to generate both heat and electricity. In some applications, the heat produced is used solely to maintain the anaerobic digestion process, which requires some heat input. Useful renewable heat has been classed as heat produced (and used)

beyond that fed back into the anaerobic digestion process to maintain it, which is sometimes called the parasitic heat load.

- **Landfill gas capture:**

Landfill gas (methane from rotting organic matter in landfill) is captured and burnt to produce heat or used in a combined heat and power unit. Only one example of this was found which is currently providing useful heat for buildings, and this is the Dunfermline landfill gas plant in Fife.

- **Biomass primary combustion:**

This category covers installations where materials other than wood, such as municipal solid waste and animal carcasses, are burnt directly to produce heat. For installations burning municipal solid waste, a proportion of the heat capacity and output is estimated to be renewable, based on the biodegradable proportion of the waste burnt.

- **Advanced thermal treatment (ATT), using pyrolysis and/or gasification**

Treatment of waste at high temperatures either in the complete absence of oxygen (pyrolysis) or a limited amount of oxygen (gasification) to produce gases which can be burnt to generate heat or heat and electricity.

Had an example been found, the following technology could also have been included:

- **Fuel cell biomass**

Fuel cells running on biomass could be used to produce useful heat. However none have yet been identified in Scotland.

Technologies which are not included in the database, as they do not produce renewable heat, are:

- **Non-biomass combined heat and power (CHP)**

Combined heat and power units running on gas (or other fossil fuels) to produce electricity and heat. Because the heat from such units comes from fossil fuel sources, it has not been counted towards 'renewable heat' targets in this report.

- **Exhaust air heat recovery (EAHR)**

Systems for recovering the heat from warm stale air leaving a building, which is used to warm incoming air. This can help to reduce space heating requirements. However because the heat being recovered for the building will normally have come from fossil fuels in the first instance, rather than being drawn from a renewable source, these systems have not been included as providing renewable heat.

- **Energy from waste: installations where the only fuel is hospital waste**

The Digest of UK Energy Statistics (DECC)[20] considers hospital waste as non-biodegradable, so installations burning only hospital waste are not counted as producing renewable heat. However

[20] Renewable Energy Statistics: Data Sources and Methodologies, Department of Energy and Climate Change. http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

installations which burn other wastes that are considered biodegradable such as municipal waste, in addition to hospital waste, have been included in the database**.**

The following renewable heat technologies are not included in the renewable heat database:

- **Passive renewable heating**

This is where building design is used to ensure buildings benefit from features such as solar gain through large areas of south-facing glazing. Such design features can successfully help a building meet its heat demand, however they have not been included in this report or database, as the heat resource provided is very hard to assess.

- **Wind or hydro to heat (electricity)**

Wind to heat installations (where wind turbines produce electricity which is used to directly charge electric storage heaters for space heating) can be an important source of low carbon heating in remote rural locations in Scotland. However the electricity produced by these systems is already counted towards renewable electricity targets for Scotland, so estimates of heat from these systems have not been included in the renewable heat figures reported here.

Appendix 2. Capacities assumed for individual installations where information was not available

The following assumed capacities were used in the renewable heat database where information on capacity was not available.

Ownership category[21]	Building type	Technology	Estimate of likely installed capacity	Derived from:
Community	Community buildings	Heat pumps (ASHP and GSHP)	16kWth	Average for other heat pumps in public sector, LA non-domestic and community buildings recorded in the database
	All	Biomass	45kWth	Average for other community biomass installations recorded in the database
	All	Biomass district heating	250kWth	Average for other community biomass district heating installations

[21] Ownership categories are those used in the community and locally owned renewable energy database, maintained by the Energy Saving Trust for the Scottish Government.

				recorded in the database
Other public sector and charity	All	Solar thermal	13kWth	Average for other public sector and charity solar thermal installations recorded in the database
	All	Heat pumps (ASHP and GSHP)	16kWth	Average for other heat pumps in public sector, LA non-domestic and community buildings recorded in the database
	All except hospitals	Biomass	150kWth	Average for other public sector and charity biomass installations, excluding hospital installations, recorded in the database
	Hospitals	Biomass	1.7MWth (1,700kWth)	Average for other hospital biomass installations recorded in the database**.**
Farms and Estates	All	Biomass	150kWth	Average for other farm and estate biomass installations recorded in the database
	All	Biomass district heating	150kWth	Average for other farm and estate biomass district heating installations recorded in the database
Local businesses	All	ASHP	16kWth	Average for other local business ASHP's recorded in the database
	All	GSHP	30kWth	Average for other local business GSHP's recorded in the database
	All	Biomass	200kWth	Average for other local business biomass recorded in the database
	All	Biomass district heating	150kWth	Average for other local business biomass district heating recorded in the database

Local authority	Domestic properties	Solar thermal	3.4m^2	Analysis of Energy Saving Scotland home renewables grants[22]
	Domestic properties	Heat pumps (ASHP and GSHP)	7kWth	Average for other LA- and HA-owned heat pumps in domestic properties recorded in the database
	Schools	Solar thermal	7kWth	Average for other school solar thermal installations recorded in the database
	Schools	ASHP	10kWth	Average for school ASHP installations recorded in the database
	Schools	Biomass	200kWth	Average for other school biomass boiler installations recorded in the database
	Other buildings	Heat pumps (ASHP and GSHP)	16kWth	Average for other heat pumps in public sector, LA and community buildings, recorded in the database
Housing Association	Domestic properties	Solar thermal	3.4m^2	Analysis of Energy Saving Scotland home renewables grants[23]
	Domestic properties	Heat pumps (ASHP and GSHP)	7kWth	Average for other LA- and HA-owned heat pumps in domestic properties, recorded in the database
	Domestic properties	ASHP - EAHR[24]	4kWth	Average for other LA- and HA-owned ASHP-EAHR's in domestic properties, recorded in the database
Industrial	Commercial	Energy from waste	1.6MW	Average for all Energy from waste plants in the database
Unknown	Unknown	Solar Thermal	4.14kWth	Average for all systems <45kWp in database

[22] Energy Saving Scotland home renewables grants (no longer available) were grants for domestic renewables, administered by the Energy Saving Trust on behalf of the Scottish Government.
[23] Energy Saving Scotland home renewables grants (no longer available) were grants for domestic renewables, administered by the Energy Saving Trust on behalf of the Scottish Government.
[24] ASHP - EAHR = air source heat pump with exhaust air heat recovery. Such heat pumps draw heat from both air outside a building, and heat from stale air leaving the building or extracted from rooms such as kitchens and bathrooms within the building, to provide space and water heating to the building.

Unknown	Unknown	Biomass	0.341MW	Average of all Biomass systems in database
Unknown	Unknown	ASHP	20kWp	Average for all systems <45kWp in database
Unknown	Unknown	GSHP	31kWp	Average for all systems <45kWp in database

Appendix 3. Measurement of Heat Demand in Scotland

Purpose

1. This annex sets out:
    - how Scottish Government derived the original 11% heat target
    - how we have monitored progress to date on renewable heat as a percentage of projected 2020 heat demand
    - a proposal explaining how improved data and a new methodology will allow us to monitor renewable heat in future as a percentage of annual non-electrical heat demand in Scotland.

Background

2. Heat has been estimated to account for approximately half of Scotland's total energy use[25]. Switching from fossil fuel to renewable sources of heat has the potential to reduce greenhouse gas emissions, and make a significant contribution to Scotland's overall renewable energy target. The 2009 Renewable Heat Action Plan[26] set a target of delivering 11% of Scotland's projected 2020 (non-electrical)[27] heat demand from renewable sources.

3. In 2006, the Scottish Energy Study[28] described Scotland's current energy supply, energy consumption and energy-related CO2 emissions during 2002 and was the first major study of energy supply and demand to be conducted in Scotland for over a decade. At that time, the discrete study provided the most robust data source available for estimates of energy consumption in Scotland. However, it was not feasible to monitor heat demand on an annual basis. This study produced estimates for 2002 and subsequently a figure for 2020 heat demand was derived from these estimates. Therefore, to date, the heat target has been monitored using the latest annual renewable heat output estimate against this forecasted 2020 figure for heat demand.

[25] Scotland's Renewable Heat Strategy: Recommendations to Scottish Ministers - Renewable Heat Group (RHG) Report 2008. http://www.scotland.gov.uk/Resource/Doc/211131/0055786.pdf
[26] Renewable Heat Action Plan (2009). http://www.scotland.gov.uk/Publications/2009/11/04154534/0
[27] To avoid double counting we measure the non-electrical heat component against the heat target, acknowledging that the demand for heating delivered by electricity will be included as part of the renewable electricity target. The Scottish Household Condition Survey (2011) estimates that around 15% of households in Scotland use electricity as their primary heating fuel.
[28] Scottish Energy Study, Vol 1 (2006). http://www.scotland.gov.uk/Publications/2006/01/19092748/0

Derivation of the 11% Heat Target

4. The target figure of 11% for renewable heat by 2020 was derived using the estimated contributions that renewable electricity and renewable transport would make to the overall 2020 renewable energy target. Based on the requirements of the other sectors it was estimated that renewable heat must contribute 6,420 GWh of output in order for Scotland to meet its 2020 Renewable Energy Target. Total heat energy demand in Scotland in 2020 was estimated to be 60,089 GWh using data from the Scottish Energy Study. Therefore, the target was set at 11% (See Table 1).

Table 1: Description of the derivation of the Renewable Heat Target (estimated 2020 figures)

Step	Step description	Output (GWh)
1	Total Energy Demand	160,307 GWh
2	Renewable Energy Target (20%)	32,061 GWh
3	Estimated Renewable Electricity Contribution (50% target[29])	22,244 GWh
4	Estimated Renewable Transport Contribution (10% target)	3,397 GWh
5	**Renewable Heat Output Required (Remainder)**	**6,420 GWh**
6	Total Energy Consumed within D/I/S sectors	95,276 GWh
7	Less: Electricity Consumption in these sectors	35,187 GWh
8	**Derived Heat Energy Demand**	**60,089 GWh**
9	**Therefore Renewable Heat Required**	**c. 11%**

Improving Data on Heat Demand in Scotland

5. In the years following the publication of the Scottish Energy Study, the Department of Energy and Climate Change (DECC) began publishing more detailed sub-UK estimates of energy consumption[30] which has enabled the development of a systematic and robust method of monitoring (non-electrical) heat demand in Scotland on an annual basis. We have worked with colleagues in DECC to derive a heat demand methodology for Scotland which will allow more accurate annual measurement of progress towards the renewable heat target.

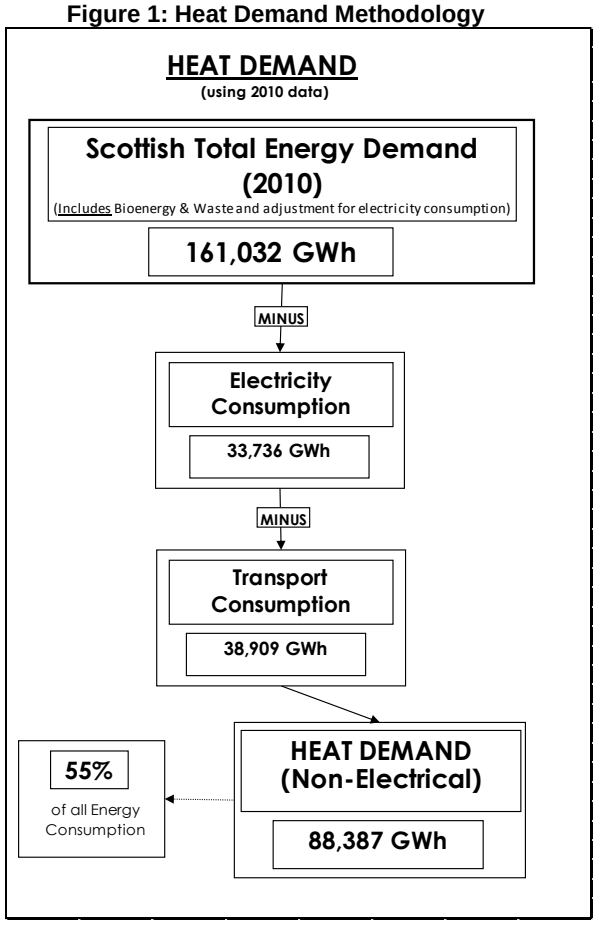
6. The DECC data shows a breakdown of final energy consumption by end use for Scotland down to local authority level. By subtracting electricity and transport consumption from the final energy consumption figure (as well as making adjustments for bioenergy & waste and electricity consumption[31]), this results in an estimate for non-electrical heat demand in Scotland (See the flow chart in Figure 1 below for more detail).

[29] The heat target was derived at a time when the renewable electricity target in Scotland was set at 50%. http://www.scotland.gov.uk/News/Releases/2007/11/27095600

[30] Total final energy consumption at sub-national level, DECC. https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/total-final-energy-consumption-at-sub-national-level

[31] The total energy demand figure is adjusted to account for an inconsistency with the electricity consumption figures presented within the energy tables published by DECC. In 2010, there was a difference of 6,345 GWh between the electricity consumption figure in the sub-national consumption table and that in the sub-national electricity supply table (27,391 GWh and 33,736 GWh respectively). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65842/7363-elec-gen-supply-figures-et-art-sheet.xls

Figure 1: Heat Demand Methodology



7. The methodological differences between the 2006 Scottish Energy Study and DECC's annual estimates of final energy consumption has implications for the monitoring of the renewable heat target. Table 2 presents a time series using both sources, demonstrating the impact this annual heat demand estimate will make on measuring progress towards the 11% renewable heat target.

Table 2: Renewable Heat Target - Renewable heat as a % of heat demand

	2009	2010	2011
Total Renewable Heat Output (GWh)[1]	845	1,696	2,263
Current measure: % of Renewable Heat Output (2020 demand) [2]	1.4%	2.8%	3.8%
Proposed measure: % of Renewable Heat Output (annually) [3]	1.0%	1.9%	-

Sources
1. Energy Saving Trust
2. Scottish Energy Study
3. DECC sub-national final energy consumption

8. A summary of the changes as a result of the new methodology are listed below:

   Advantages

   - The target can now be measured annually against the heat demand in a particular year, allowing more accurate monitoring of target progress.
   - Improves the comparability and consistency with other energy target measures.

   Issues

   - There is a lag in the availability of the DECC sub-UK consumption data – 2011 data will not be available until December 2013.
   - All bioenergy & waste consumption is assumed to be non-electrical heat demand – which is likely be an overestimate.
   - An adjustment is made to the electricity consumption data to account for discrepancies within the DECC datasets.

Next Steps

9. During the development of this new methodology, the Scottish Government have consulted with a wide range of stakeholders including the Institution of Mechanical Engineers (IMechE), the Energy Saving Trust (EST), the Committee for Climate Change (CCC), and Scotia Gas Networks (SGN), and Audit Scotland (as part of its ongoing performance audit on renewable energy), in order to ensure that a wide evidence base is being considered and the technical expertise available across the sector is being utilised. The new measure is considered an improvement to the previous 2020 heat demand estimate.

10. To ensure transparency the Scottish Government propose to publish both measures in parallel, for a transitional period, as the evidence base regarding heat use in Scotland is continuously being improved. This will include exploring different scenarios to project a range of estimates for heat demand in Scotland in 2020. Further detail on heat demand and how the Scottish Government intend to progress the de-carbonisation of the heat sector will be included in the Heat Generation Policy Statement, due for publication later in 2013.

11. If you have any queries or feedback on the proposed new measure, or on the measurement of heat demand in Scotland in general, then please use the contact details below:

    energystatistics@scotland.gsi.gov.uk

Energy Saving Trust, 2nd Floor, Ocean Point 1, 94 Ocean Drive, Edinburgh, EH6 6JH
energysavingtrust.org.uk