Renewable heat in Scotland, 2017

A report by the Energy Saving Trust for the Scottish Government

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Prepared by Energy Saving Trust

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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 the Energy Saving Trust Insight and Analytics team.

The Energy Saving Trust would like to thank all individuals and organisations who provided data, with particular thanks to the Department for Business, Energy and Industrial Strategy, Gemserv and the Forestry Commission Scotland.

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 Purpose of report

The Scottish Government has set a target for 11% of non-electrical heat demand in Scotland to be met from renewable sources by 2020[1].

In order to help measure progress towards this target the Energy Saving Trust (EST) maintains a database of renewable heat installations (referred to as the renewable heat database or dataset throughout this report) on behalf of the Scottish Government. The database records installations known to be operating and those currently in various stages of development. It contains data on the capacity and yearly heat output of those installations and is updated annually. The database also includes information on district or 'communal' heating schemes throughout Scotland[2]. However, only the proportion of renewable heat produced from these schemes is included in progress towards the renewable heat target.

The database has now been updated with new information on heat generated from renewable sources during the 2017 calendar year.

As well as tracking progress towards the Scottish Government's renewable heat target this report also provides commentary on accreditations under the domestic and non-domestic Renewable Heat Incentive (RHI) schemes between December 2017 and August 2018.

[1] Renewable Heat Action Plan for Scotland, the Scottish Government, November 2009: http://www.scotland.gov.uk/Publications/2009/11/04154534/0. Replaced by The Heat Policy Statement in June 2015: http://www.gov.scot/Publications/2015/06/6679

[2] Every reasonable effort has been made to identify operational district heating schemes in Scotland, however there may be some district heating schemes that are not included in the underlying database at this time. See section 3.6 for further details.

2 Summary of key findings

We estimate that:

- **2.0 GW of renewable heat capacity** was operational in Scotland by the end of 2017, **up 17%** (0.3 GW) from 2016, producing an estimated **4,800 GWh of actual heat** from renewable sources, which is an **increase of 28%** (1,050 GWh) from 2016.

- This increase in renewable heat output appears particularly large due to a drop in output in 2016. The reduction in output seen in 2016, compared to 2015, was primarily due to changes at a small number of large sites[3]. We have therefore also compared 2017 heat output with 2015 and this shows an increase from 2015 of 14% (600 GWh).

- **In 2017, Scotland generated an estimated 5.9 – 6.1% of its non-electrical heat demand from renewable sources**, an increase from 4.7% in 2016.

Figures 1, 2 and 3 show the change over time for both renewable heat capacity and output in Scotland. Data for 2008/09 is taken from the Renewable Heat in Scotland report, produced by the Sustainable Development Commission Scotland in June 2009[4]. EST has collected data for calendar years 2010 onwards[5].

In this report, the latest data available on the non-domestic renewable heat incentive (RHI) is from 2016. Instead of relying on 2016 levels of capacity and generation, the contribution from non-domestic RHI installations in 2017 to overall capacity and generation have been imputed based on recent trends in RHI data. This provides more realistic estimates that take some account of generation from new installations. More details can be found in section 3.1 and Appendix 4. Any figures broken down by technology type and size, for example in the paragraph below, do not include the imputed 2017 RHI data and therefore use lower estimates of total capacity and output figures which include the 2016 RHI data[6].

As in 2016, the majority of both capacity and output in 2017 came from biomass primary combustion and biomass combined heat and power (CHP). Combined, these technologies account for 81% (1.478 GW) of renewable heat capacity and 82% (3,757 GWh) of output. Whilst biomass continues to dominate in renewable heat generation, there has nonetheless been a considerable growth in other technologies. The total energy from waste output

[3] Renewable Heat in Scotland, 2016 report: http://www.energysavingtrust.org.uk/sites/default/files/reports/Renewable%20Heat%20in%20Scotland%202016%20report%20FINAL%20EST%2031Oct17.pdf

[4] Renewable Heat in Scotland, the Sustainable Development Commission Scotland, June 2009: http://www.sd-commission.org.uk/data/files/publications/SDC%20Renewable%20Heat%20Report.pdf

[5] Figures for 2010 to 2013 were amended for the 2014 report (published in October 2015) to account for methodology changes to heat output calculation due to newly available information, so will differ from figures in pre-2014 reports. For methodology change, see the Renewable Heat in Scotland, 2014 report: http://www.energysavingtrust.org.uk/sites/default/files/reports/EST%20RH%20Report%202014_final%20OCT.pdf

[6] The lower capacity and output estimates based on 2016 RHI data are 1.819 GW and 4,598 GWh, respectively.

increased by 31% to 449 GWh whilst the total heat pump output increased by 30% between 2016 and 2017 to 374 GWh.

The majority of renewable heat output and capacity is accounted for by installations in the 'large' size category (>1MW). Most biomass CHP and energy from waste facilities fall into this category.

Figure 1. Estimated renewable heat capacity in Scotland, 2008/09 – 2017

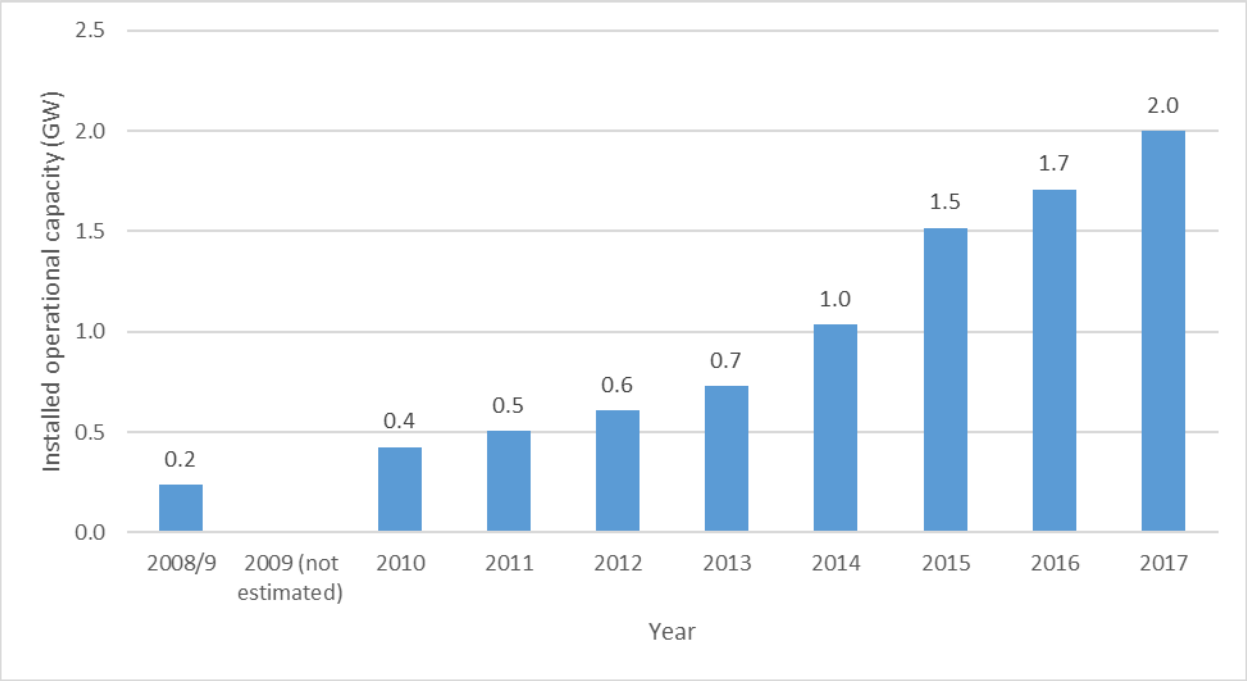


Figure 2. Estimated renewable heat output in Scotland, 2008/09 – 2017

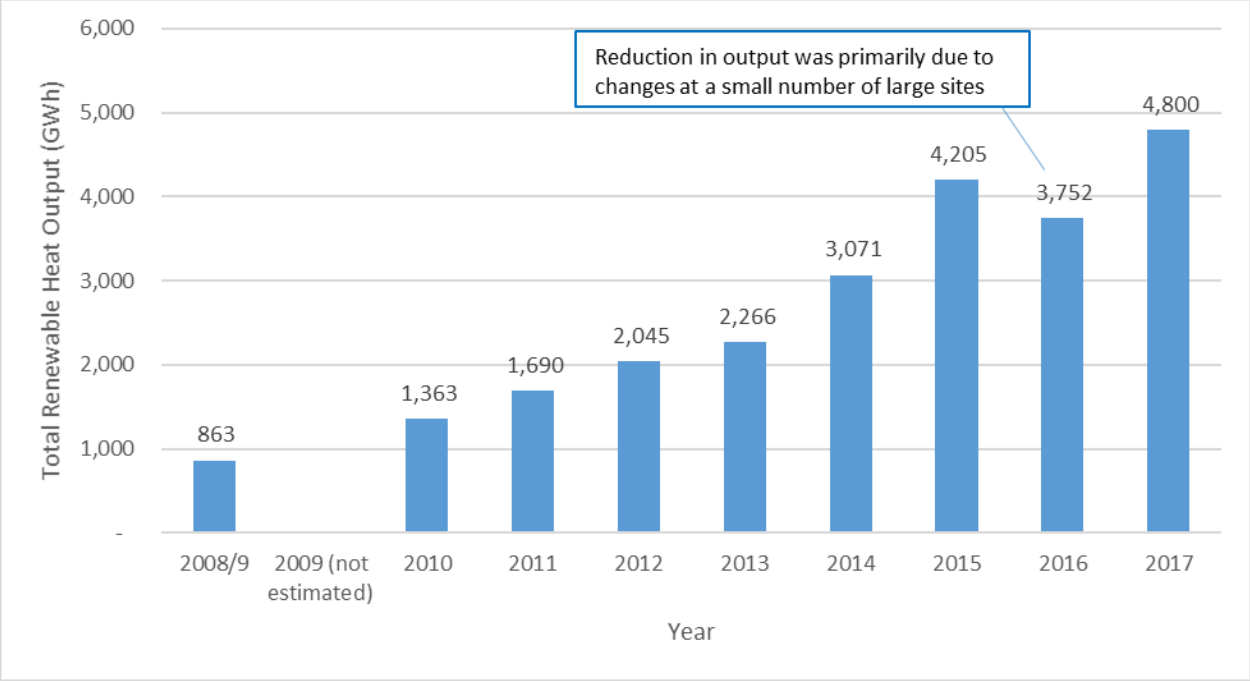
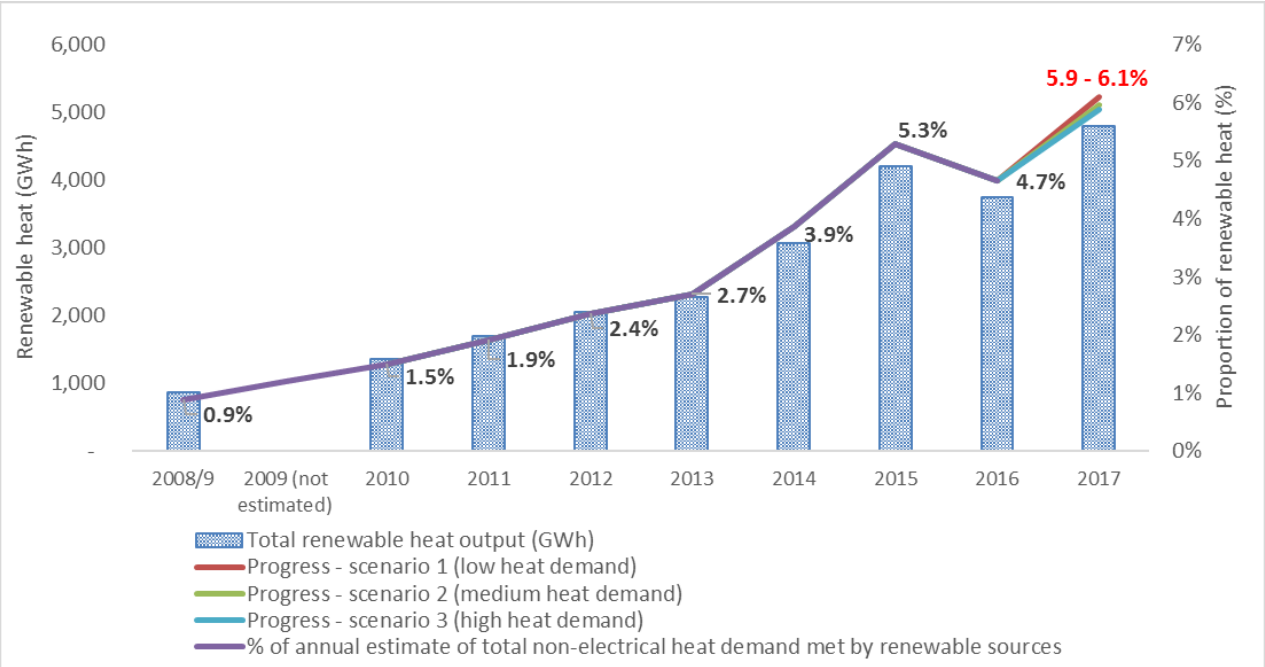


Figure 3. Estimated renewable heat output and % non-electrical heat demand met by renewables in Scotland, 2008/09 – 2017



Progress towards the 2020 target of 11% of non-electrical heat to come from renewable sources is monitored against an estimate of non-electrical heat demand, using the sub-national final energy consumption data published by the Department for Business, Energy

and Industrial Strategy (BEIS) on an annual basis. Due to a time lag in the publication of sub-national energy consumption data, the most recent year we have non-electrical heat demand figures for is 2016. For 2017, progress is shown against estimated non-electrical heat demand based on three scenarios that have been inferred from historic trends[7].

While renewable heat output has increased since 2008/09, heat demand has fallen over this period due to a combination of factors including improved energy efficiency and increases in average annual temperatures. This means that renewably generated heat now meets a greater proportion of overall heat demand than would have otherwise been the case. Had heat demand not reduced since 2008/09 then the renewable heat output recorded for 2017 would make up only 4.9% of non-electrical heat demand instead of the 5.9% - 6.1% that is currently estimated. It should be noted that, whilst heat demand has generally been falling over the last 10 years, it rose slightly in 2015 (by 0.2%) and again in 2016 (by 1.4%).

Based on the three scenarios of heat demand from 2017 to 2020, renewable heat output would need to increase by between 68% and 84% (depending on the heat demand scenario), in order to reach the Scottish Government's target. As large scale schemes can result in significant step changes in capacity and output any such increase is unlikely to be a smooth curve year on year. However, if this increase were spread evenly across the remaining 3 years this would be equivalent to an annual increase in output of between 19% and 25%. The average annual increase in output since 2010 is 21%.

Breakdown of 2017 data [8]:

As mentioned, figures that are broken down by size and technology type use lower estimates of 2017 renewable capacity and output figures which include 2016 non-domestic RHI data.[9] The majority of renewable heat output in Scotland continues to come from large (1 MW+) installations. **In 2017 61% of renewable heat came from large installations**, despite contributing only 43% of the total renewable capacity. This is because large installations often provide process heat all year round, compared to smaller installations which generally have more seasonal demands such as providing space and water heating. The capacity of large installations increased by 8% between 2016 and 2017. The heat output from large installations also increased by 35%.

The total capacities of small to medium (>45 kW and <1 MW) and micro (<45 kW) installations have also increased, by 5% and 9% respectively whilst the total outputs from these installations increased by 8% for small to medium and by 14% for micro installations.

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[7] The three scenarios for heat demand are:

i. Average annual change (2008-2016) – i.e. low projected heat demand scenario
ii. Stays constant (from 2016) – i.e. medium projected heat demand scenario
iii. Same change as most recent year (2015-16) – i.e. high projected heat demand scenario

[8] Unlike the previous report, CHPQA data was provided broken down by installation size and technology. This means that when 2017 and 2016 figures are being compared (by size and technology), there may be a small one-off increase in figures for 2017 as new data has been provided. However, the CHPQA data makes up a small proportion of the capacity and output figures of the whole database (2% of capacity and 1% of output).

[9] The lower capacity and output estimates based on 2016 RHI data are 1.819 GW and 4,598 GWh, respectively. Further explanation can be found in section 4.2 and Appendix 4.

The majority of Scotland's renewable heat output comes from biomass combustion (including biomass combined heat and power). **In 2017 biomass combustion supplied 82% of renewable heat in Scotland.** Heat pump and solar thermal installations, which are mostly used to provide water and space heating on small scales accounted for around 9%, with the remaining 10% generated from waste sources.

By the end of December 2017 11,945 domestic Scottish installations had been accredited under the RHI scheme since it started in 2014, with 86% of these installed in off-gas areas. **Systems in Scotland accounted for approximately 20% of the total number of RHI-accredited systems under both the domestic (19%) and non-domestic (20%) RHI schemes as of December 2017**[10]. **This is considerably above the proportion of installations to be expected on a pro-rata basis**.

[10] More up to date RHI data is published regularly by BEIS. A summary of the latest RHI data is included in this report (Section 5.2) as an indication of further capacity in development which has come on line in 2018. This data shows that as of the end of August 2018, 12,522 installations in Scotland had been accredited under the domestic RHI and 3,794 full applications for systems in Scotland had been made under the non-domestic RHI.

3 Methodology

3.1 Approach taken

Variables required

Two main variables are required from the renewable heat database:

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-thermal (kWth) or megawatt-thermal (MWth), depending on the size of the installation. Total heat capacity is presented in this report as gigawatts (GW)[11] or megawatts (MW), rather than as GWth or MWth, to avoid confusion with the units of heat output (GWh or MWh). Individual installations are classified in three capacity categories:

- Large (1 MW+)
- Small to Medium (45 kW – 1 MW)
- Micro (≤ 45 kW)

The second variable required from the database is an estimate of **useful renewable heat energy** produced over the reported year (1 January 2017 to 31 December 2017). Useful heat is the heat delivered to the end user or process, taking into account the technology efficiency and losses. 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)[12].

Useful heat output - Heat delivered to an end user or process, taking into account losses and system efficiency.

Actual heat output - The total amount of heat produced by a site, accounting for losses and system efficiency. Actual heat output includes heat that is not delivered to an end user or process.

Potential heat output - The total amount of heat that could potentially be generated by the site if it operated at peak capacity for the total number of 'peak running hours' or at the installation's assumed capacity.

Please note that this brief summary is included here because the terms above are used repeatedly within the main body of the report. For a fuller explanation of terminology used please refer to Appendix 1: Technical terms used.

[11] 1 GW = 1,000 MW = 1,000,000 kW.
[12] 1 GWh = 1,000 MWh = 1,000,000 kWh.

Available data

Useful heat output is hard to measure without access to site-level metered data (provided metering is in place). Sites accredited under either the non-domestic Renewable Heat Incentive (RHI) or Combined Heat and Power Quality Assurance (CHPQA) will monitor the amount of heat they generate and the amount of heat consumed by an end user, either on site or connected via a heat network, as part of their obligations under these schemes.

This report relies on several sources of unpublished data, including unpublished analysis of BEIS non-domestic RHI data. In previous years, BEIS carried out analysis on the RHI dataset and the EST dataset in order to provide a summary of the renewable heat capacity and useful heat output not already captured by the EST dataset. At the time of writing, analysis of 2017 RHI scheme data was not available. Instead of relying on 2016 levels of capacity and generation, the contribution from non-domestic RHI installations in 2017 to overall capacity and generation have been imputed based on recent trends in RHI data. This provides more realistic estimates that take some account of generation from new installations.

This approach to estimating heat values for non-domestic RHI installations can only be applied at a national (Scotland) level. The more detailed breakdowns of capacity and output by technology type and installation size use unchanged 2016 RHI data along with 2017 data from other sources. This results in two different estimates. The imputed 2017 figures contribute to the headline results (see Summary section), where generation is estimated at 4,800 GWh. This method also estimates an overall renewable heat capacity of 2.0 GW. More details on how these estimates were calculated can be found in Appendix 4. The non-domestic RHI data to 2016 (assuming no change in values) is used for more detailed breakdowns (see sections 4.3 to 4.6) and leads to an overall generation figure of 4,598 GWh and a capacity of 1.819 GW.

BEIS does not collect data on useful heat output directly in the RHI dataset; rather, they collect data on the ‘heat paid for’ per site under the scheme. We used this ‘heat paid for’ figure as a proxy for useful heat output, as the RHI can only support heat that is used for an ‘eligible purpose’. Aggregated data for the domestic RHI scheme from BEIS was not required because the majority of these installations should be captured within the Microgeneration Certification Scheme (MCS) Installation Database (MID) extract provided by Gemserv.

The data held by the CHPQA is confidential and is therefore not available at site level unless provided by the sites themselves. As in the previous iteration of the report, Ricardo-AEA carried out analysis on the CHPQA dataset and the EST dataset in order to provide an aggregated summary of the renewable heat capacity and useful renewable heat output which is not already captured by the EST dataset. In this report, the aggregated figures for heat capacity and output were provided, broken down by installation size and technology. This analysis has ensured that the output and capacity of any CHP installations which are

not captured within the EST database are nonetheless incorporated in the total figures. These figures include the overall renewable heat output and capacity figures, and figures associated with size and technology. Further details of the process undertaken to carry out this analysis are available in Appendix 5.

Together the capacity and 'heat paid for' summaries provided by BEIS, the heat capacity and output summaries provided by Ricardo-AEA and those calculated from the EST dataset provide the most accurate measure of renewable heat capacity and useful heat output in Scotland available to date. Further details of the process undertaken to carry out this analysis are available in sections 6.1 and 6.2 and Appendices 3 and 5.

In previous years the Forestry Commission Scotland (FCS) has conducted a woodfuel usage survey to determine the amount of woodfuel being used for heat generation purposes in Scotland. For the 2017 woodfuel usage survey, EST completed the data collection on behalf of FCS. As in previous years the updated capacity and heat output data for large biomass sites (both combined heat and power and heat only) with a capacity greater than or equal to 1 MW collected through the woodfuel survey was used to update the 2017 iteration of the renewable heat database. Metered data was provided by most of the largest sites. For the sites that could not provide metered heat data, the amount of woodfuel consumed for heat generation purposes has been used to derive an estimate of actual (or 'total') heat output, based on the assumed energy content of the woodfuel and site efficiencies.

With some exceptions[13], the remaining data has been collated from sources where heat output (either 'actual' or 'useful') for the site is not necessarily known. In these situations, heat output needs to be estimated. Where possible, heat output estimates are based on the quantity, type and energy content of fuels used in the relevant year at the site along with assumed (or known) operating efficiencies. This information is used to estimate *actual* heat output during 2017 but will be greater than the *useful* heat output. This figure may also be different to estimates of *potential* heat output, which are usually based on the heat capacity of an installation and an assumed number of peak operating hours. *Potential* heat output may therefore be higher than *useful* or *actual* heat output.

The information available about each installation varies, depending upon the data sources used. Where supplied, 'useful heat output' is used for the figures in this report; alternatively, 'actual heat output' is used and finally 'potential heat output' where neither of the previous values are available.

Where information on capacity is not available, this is estimated based on known heat output variables which have been reported (either the actual heat output or useful heat output) and assumptions about typical running hours, based on installation size and the type of application the heat is used for (i.e. 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. In the 2017 database, 85% of the total capacity is from

[13] For example, where we have a known contact at the site who can provide the correct information.

reported/measured data, 11% is estimated, and 4% is from records which do not identify if it is reported/measured or estimated. 88% of the total renewable heat output is reported/measured, 10% is estimated, and 2% is from records which do not identify if it is reported/measured or estimated. Further information about the assumptions used is provided in section 3.4. In all cases only the renewable portion of the heat output has been included in the figures reported.

3.2 Technologies included

The following technologies produce heat from renewable sources and are included in our estimate of progress towards the target (more detailed descriptions of these technologies can be found in Appendix 1):

- 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)[14].
  - Landfill gas capture.
  - Biomass primary combustion of biodegradable material (other than wood).
  - Advanced thermal treatment (ATT), using pyrolysis and/or gasification.
  - Biomethane gas to grid injection after anaerobic digestion and processing.

Had examples been found, fuel cell biomass and deep geothermal[15] (as opposed to ground source heat pumps, which are shallow geothermal) could also have been included.

Technologies which are not included in our estimate of progress towards the target, 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[16].

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

[14] Excluding the parasitic heat used to maintain the anaerobic digestion process.
[15] There are currently no known deep geothermal technologies in operation in Scotland; however, feasibility studies for 4 projects have been submitted to the Geothermal Energy Challenge Fund. These have been recorded as 'in scoping' in the database.
[16] In line with assumptions used in BEIS RESTATS methodology, clinical waste is considered non-biodegradable and therefore non-renewable. Renewable Energy Statistics: Data Sources and Methodologies, Department for Business, Energy & Industrial Strategy: https://www.gov.uk/government/collections/renewables-statistics

- 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.

3.3 Data sources used

EST has maintained and updated the renewable heat database for the Scottish Government on an annual basis since 2011. The heat output estimate for 2017 contained in this report has been generated by a further update of the information held in the database.

Multiple sources of data have been used to update the renewable heat database for 2017. Listed in Table 1 are the main sources used and the organisations which supplied them. In addition, other organisations and individuals connected with specific installations were contacted and provided useful information. For the 2017 renewable heat database, Scottish Government provided a new extract of Scottish Heat Network data for networks fuelled by biogas and biomass.

Table 1. Main datasets used for 2017 figures and estimates of future output

Organisation	Dataset
Department for Business, Energy and Industrial Strategy (BEIS)	Aggregated non-domestic RHI data covering installations in Scotland – summaries of capacity and heat output for the year, merged with EST data to generate a dataset of entries not already covered by the renewable heat database. The 2016 figures were used again for the 2017 database due to the latest data not being available for inclusion. Domestic RHI data is not included to avoid double counting with the data provided by Gemserv from the Microgeneration Certification Scheme (see below).
Ricardo-AEA, on behalf of BEIS	Aggregated CHP data covering renewable installations in Scotland – summaries of capacity and heat output from sites not currently covered by the renewable heat database.
Forestry Commission Scotland (based on survey carried out by EST)	Woodfuel demand and usage and estimated heat output in Scotland, 2017 (surveyed but with some assumed values). The data sets from the Forestry Commission Scotland's (FCS) woodfuel usage survey contain estimates of all woodfuel usage for the year 2017, for large sites only. FCS estimates woodfuel usage for smaller sites based on RHI data, but collects detailed site-level data for larger installations since they have such a large impact on overall wood usage figures.

Eunomia, on behalf of BEIS	The Renewable Energy Planning Database (REPD)[17].
Resource Efficient Scotland, on behalf of the Scottish Government	Resource Efficient Scotland SME Loans Scheme
Energy Saving Trust, on behalf of the Scottish Government	Applications to the District Heating Loan Fund, and the community and locally owned renewable energy database[18].
Local Energy Scotland, on behalf of the Scottish Government	Local Energy Challenge Fund (LECF), Geothermal Energy Challenge Fund
Scottish Heat Network Data, on behalf of the Scottish Government	Scottish Heat Network Data for networks fuelled by biogas and biomass.
Scottish Environment Protection Agency (SEPA)	Information on installations covered by Pollution Prevention and Control licences in Scotland.
Gemserv	Microgeneration Certification Scheme (MCS) data.

In addition, further information on renewable installations known to be in development was sourced from local authority planning departments through their online planning databases.

3.4 Assumptions used

Converting biomass woodfuel use to heat output

For the majority of large installations burning biomass wood for primary combustion or CHP, the main woodfuel usage estimates available were the Forestry Commission Scotland's annual survey. Where metered data was not available, woodfuel usage figures were converted into estimates of heat output, based on the assumptions about combustion efficiency given in Table 2. One oven-dried tonne (ODT) of wood is assumed to contain 4.92 MWh of energy[19]. The assumed boiler efficiencies used to convert oven-dried tonnes of wood burnt to heat output are given in Table 2 below. These efficiencies were updated

[17] https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
[18] http://www.energysavingtrust.org.uk/sites/default/files/reports/Community%20and%20locally%20owned%20report%202016_final.pdf
[19] Mitchell, Hudson, Gardner, Storry and Gray, 1990. Wood Fuel Supply Strategies Vol 1. The Report: ETSU B 1176-P1.

during the 2014 database update (report published October 2015) following the publication of Steve Luker Associates' analysis of *in situ* performance of biomass boilers[20].

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

Installation size	Assumed boiler efficiency	MWh heat output per ODT burnt
Large installations (>1 MW, or >10,000 ODT)	80%	3.94
Small to medium installations (45 kW – 1 MW, or <10,000 ODT) providing process heat	80%	3.94
Small to medium installations (45 kW – 1 MW, or <10,000 ODT) providing space heating	75%	3.69
Micro installations (≤45 kW) (not MCS)	70%	3.44

Combined heat and power (CHP)

Calculating useful heat output for combined heat and power (CHP) is difficult without detailed metered data for each specific site. Even with data on fuel input, energy content of the fuel, heat efficiency and running hours the realised useful heat output might vary considerably from the estimated heat output depending on whether or not the process (or customer) the useful heat goes to requires a regular amount of heat on a regular basis. Where known, useful heat output has been recorded for CHP sites, based on information from the sites themselves, either via the FCS and their woodfuel survey, or via direct contact with operations managers at the sites.
Where the verified useful heat output of the fuel is not known the following formula was used:

Estimated heat output (MWh) = Total fuel input (ODT) x Energy content of fuel (MWh/ODT) x Thermal efficiency of CHP plant (%)

Where the thermal efficiency of the CHP plant was unknown, a thermal efficiency of 48% was used. This is the average thermal efficiency in 2016 taken from chapter 7 of the Digest of UK Energy Statistics (DUKES) 2018[21].

[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376805/Review_of_biomass_performance_standards.pdf
[21] https://www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes. Since completing the data collection process for this report, the thermal efficiency has been updated to 47% in 2017.

Annual running hours

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 peak running hours per year by size of installation or sector (or verified running hours where known). These hours are given in Table 3. The same running hours were used to derive an estimate of heat output for those installations where information on capacity was provided but an estimate of heat output 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 (1 MW+) biomass providing process heat	8,000
Energy from waste installations providing process heat.	8,000
Commercial small to medium (45 kW-1 MW) biomass.	5,000
Combined heat and power, all sizes	3,603
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

Using known information to determine missing values

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.

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: 0.7 kW, from the Solar Trade Association.
- Useful heat output per m^2: 0.441 MWh, derived from SAP 2012 calculations for all regions in Scotland[22].

[22] This assumption was changed during the 2014 database update due to revisions to SAP. Previously 0.34 MWh per m^2 was used.

Energy from waste

In line with assumptions used in BEIS's RESTATS methodology[23], approximately 50% of the feedstock of municipal solid waste (MSW) is considered to be biodegradable. Therefore, an installation producing heat from burning MSW will have 50% of its heat capacity and output recorded as renewable in the database. This assumption was updated from 63.5% during the 2015 update of the database to account for increased recycling rates.

For anaerobic digestion (AD) facilities, 30% of the 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.

Operating status

In certain circumstances assumptions have been made about the operating status of projects. If no new information has been found for a project in the 2017 update where information was available about the project in 2016 then the following assumptions have been made:

Table 4. Status change map for 2016 to 2017

2016 status	New information available	2017 status
'In scoping'	None	'In scoping'
'In scoping' or 'In planning'	Planning permission granted	'Consented, not built'
'Under construction'	None	'Under construction'
'Unknown'	None	'Unknown'

3.5 Accounting for sites commissioned part-way through 2017

Most new additions to the renewable heat database were only operational for part of 2017. Where commissioning date is known, this has been used to determine the proportion of 2017 for which the site was operational. Where commissioning date is not known, an estimate has been used, based on when the data was collated and what information was given at the time. The estimated annual heat output for each site has been multiplied by the portion of 2017 for which it was operational.

3.6 Data collection for district and communal heating schemes

For district or 'communal' heating schemes, the number of non-domestic buildings or domestic dwellings connected to each scheme is recorded. Information on any extensions which are planned are also included in the database, where these are known. Information on

[23] Renewable Energy Statistics: Data Sources and Methodologies, BEIS: https://www.gov.uk/government/collections/renewables-statistics

whether or not an installation is providing district heating was not available from all sources used to update the database (e.g. from the RHI and REPD datasets). For the first time, an extract of Scottish Heat Network data was utilised and included in the 2017 Renewable Heat in Scotland database. However, the information is still not complete enough to use the dataset to estimate the extent of district heating in Scotland fuelled by renewable sources.

Data is collected on both renewable and non-renewable district heating schemes[24]; however only the proportion of renewable heat produced from these schemes is included in progress towards the renewable heat target.

[24] Every reasonable effort has been made to identify operational district heating schemes in Scotland, however there may be some district heating schemes that are not included in the underlying database at this time.

4 Renewable heat capacity and renewable heat output in 2017

4.1 Results for 2017

In 2017, 4,800 GWh of heat was produced from renewable sources, from an installed capacity of 2.0 GW[25].

In 2017 Scotland produced enough heat from renewable sources to meet **between an estimated 5.9% and 6.1% of non-electrical heat demand**. The final estimate will be reported in October 2019 when the 2017 heat demand data is available.

Progress towards the 2020 target of 11% of non-electrical heat to come from renewable sources is monitored against the non-electrical heat component of the final energy consumption data published by BEIS on an annual basis. This monitoring methodology was first used in the 2012 report (published June 2013). See Appendix 6 for more information on the methodology used prior to 2012, and how this differs from the current methodology.

In order to show progress towards the renewable heat target in this report, three non-electrical heat demand scenarios have been estimated for 2016 and 2017. These scenarios are based on published final sub-national energy consumption figures from BEIS[26] and have allowed us to present the progress towards the renewable heat target shown in Table 5. The three scenarios calculated were:

- Scenario 1 (low heat demand): Assuming heat demand between 2016 and 2017 reduces by the average annual change seen between 2008 and 2016.
- Scenario 2 (medium heat demand): Assuming heat demand does not change from 2016.
- Scenario 3 (high heat demand): Applying the 2015-16 heat demand percentage increase to 2016-17.

[25] These figures include aggregated data from the CHPQA database provided by Ricardo-AEA. This CHP data was not used in pre-2016 iterations of this report. These figures have been rounded (to the nearest 100 GWh and nearest 0.1 GW) to account for the fact that they incorporate estimated data for the non-domestic RHI, un-rounded figures may give a false impression of the degree of accuracy.
[26] See 2005-2016 figures here: https://www.gov.uk/government/statistical-data-sets/total-final-energy-consumption-at-regional-and-local-authority-level

Table 5: Renewable heat target - renewable heat as a percentage of heat demand[27]

	2008/09	2009*	2010	2011	2012	2013	2014	2015	2016	2017
Total renewable heat output (GWh)	863	Missing data	1,363	1,690	2,045	2,266	3,071	4,205	3,752	4,800
% of annual estimate of total non-electrical heat demand	**0.9%**	**1.2%**	**1.5%**	**1.9%**	**2.4%**	**2.7%**	**3.9%**	**5.3%[28]**	**4.7%[28]**	-
Progress - scenario 1										6.1%
Progress - scenario 2										6.0%
Progress - scenario 3										5.9%
Heat demand (GWh)	97,052	89,155	91,156	88,269	86,446	83,804	79,207	79,385	80,499	
Heat demand scenario 1 (average annual change 2008-2016)										78,684
Heat demand scenario 2 (same as 2016)										80,499
Heat demand scenario 3 (same change per year as 2015-16)										81,629

*Note: Renewable heat output was not estimated in 2009. EST has collected data for calendar years 2010 onwards.

Between 2016 and 2017, **renewable heat capacity** in Scotland has risen by **0.3 GW (from 1.7 GW to 2.0 GW)**, which is an **increase of 17%**.

The overall **renewable heat output** from operational sites in Scotland **increased by 1,050 GWh** from 3,750 GWh in 2016 to 4,800 GWh in 2017, **which is an increase of 28%**. The majority of this increase is due to increased generation from existing large commercial sites. The report on 2016 data showed a decrease in heat output compared to 2015 and this was primarily due to changes at a small number of large sites. We have therefore also compared 2017 heat output with 2015 and this shows an increase from 2015 of 14% (600 GWh).

For further breakdowns and discussion on both capacity and output by size and technology, see sections 4.3 to 4.6.

[27] See Appendix 6 for more information on the methodology for calculating non-electrical heat demand in Scotland.
[28] The 2015 heat demand estimate changed as BEIS revised their statistics, resulting in a change in the target % from 5.4% to 5.3%. The 2016 heat demand estimate has also changed and is slightly lower than the lowest estimate provided for 2016 in the Renewable Heat in Scotland 2016 report. This is because all scenarios in the previous report assumed heat demand would continue to decrease or, in the 'high demand' scenario, stay the same. However, heat demand increased slightly in 2016, meaning the proportion accounted for by renewable heat was slightly lower than estimated.

Annual figures for renewable heat capacity and useful renewable heat output since 2008/09 can be seen in Figures 4 and 5.

Figure 4. Estimated renewable heat capacity in Scotland, 2008/09 - 2017

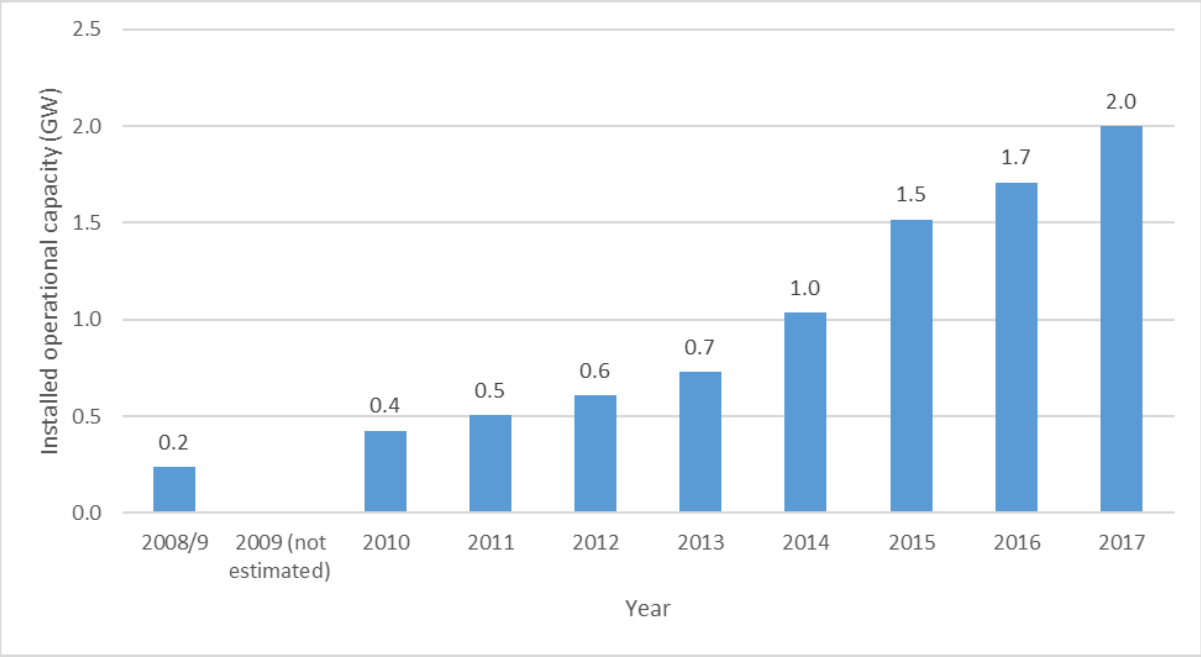


Figure 5. Estimated renewable heat output in Scotland, 2008/09 - 2017

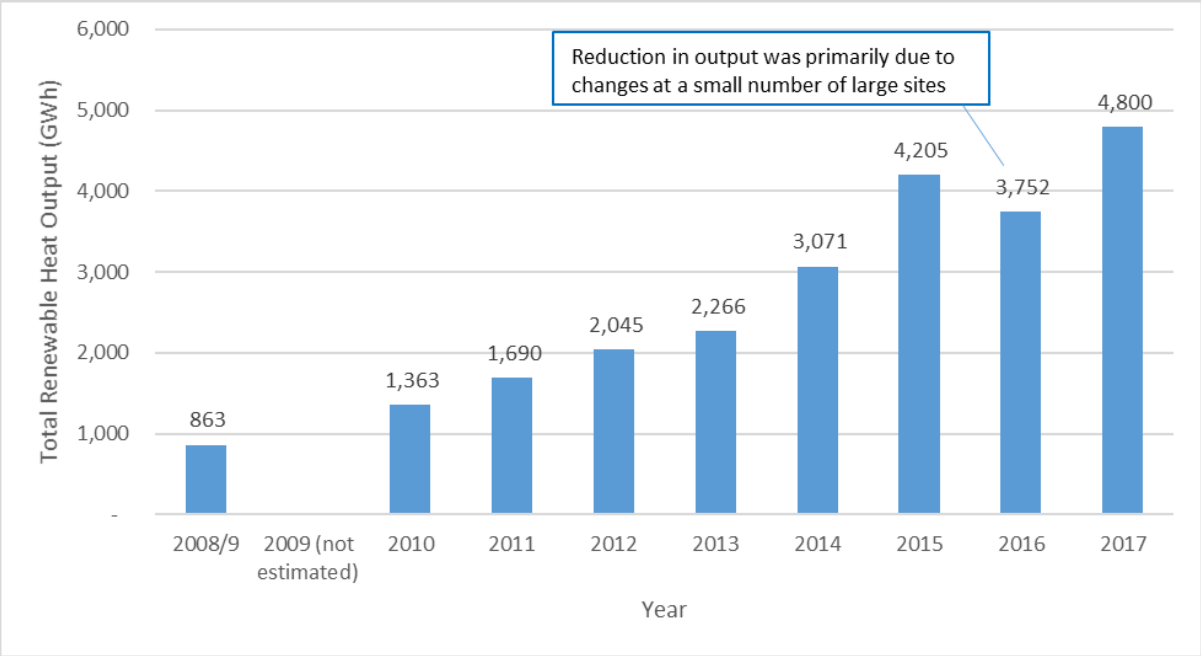
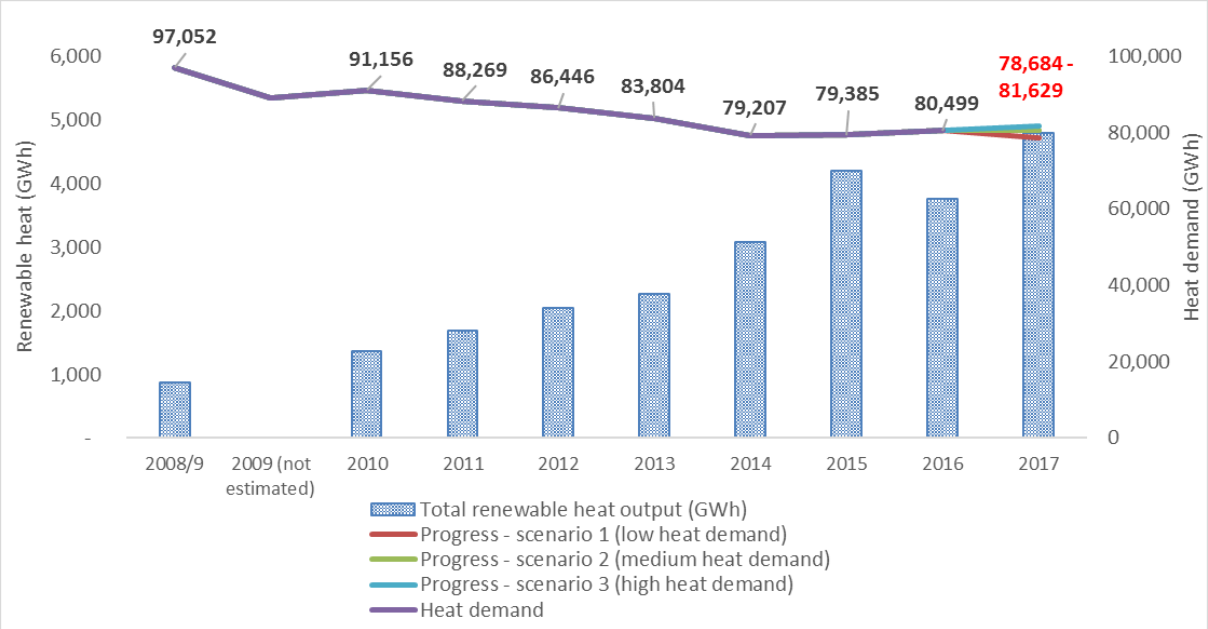


Figure 6. Estimated renewable heat output and non-electrical heat demand in Scotland, 2008/09 – 2017



While renewable heat output has gradually increased since 2008/09, heat demand has fallen over this period due to a combination of factors including improved energy efficiency and increases in average annual temperatures. This means that renewably generated heat now meets a greater proportion of overall heat demand than would have otherwise been the case. Had heat demand remained at 2008/09 levels then the renewable heat output recorded for 2017 would make up only 4.9% of non-electrical heat demand instead of the 5.9% - 6.1% that is currently estimated. It should be noted that, whilst heat demand has generally been falling over the last 10 years, it rose slightly in 2015 (by 0.2%) and again in 2016 (by 1.4%).

4.2 Note on analysis of technology and size

Estimates of overall capacity and generation have relied on imputed data, as noted in the methodology in section 3.1. This approach to estimating heat values for non-domestic RHI installations can only be applied at a national (Scotland) level. The more detailed breakdowns of capacity and output by technology type and installation size in sections 4.3 to 4.6 of the report rely on unchanged 2016 non-domestic RHI values (resulting in an estimated renewable heat output of 4,598 GWh and a capacity of 1.819 GW). It should be acknowledged that this is likely to underestimate renewable heat values in Scotland.

4.3 Results by installation size

In this report, unlike in the previous report, data provided from the CHPQA database has been **included** in these sections**.** This is because the data was provided on an aggregate basis but was also broken down by technology and installation size. This means that in instances when 2017 and 2016 figures are being compared (by size and technology), there may be a small one-off increase in these figures for 2017 as new data has been provided. However, the CHPQA data makes up a small proportion of the capacity and output figures of the whole database (2% of capacity and 1% of output).

The **majority of renewable heat output in 2017 continues to come from large (1 MW+) installations** (see Table 6). In total, large installations (all sites with capacity of 1 MW or more) contributed 43% of the renewable heat capacity and 61% of the annual output. Within this category there are **6 sites** that generate **more than 100 GWh heat per year**; together these sites provided 44% (2,022 GWh) of the total renewable heat output in Scotland in 2017 and 19% (0.343 GW) of the operational renewable heat capacity. Across all sizes, there are more than 28,000 installations in Scotland.

This large contribution from a small number of sites is inherent both from the scale of these sites and because 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 combustion of waste, which are year-round activities. Small to medium and micro installations are more likely to be used to provide space heating and/or hot water for buildings, whose demands are more seasonal and so their contribution to total renewable heat output is proportionately less.

The large contribution that the greater than 1 MW installations make to the overall output emphasises the importance of continuously improving the quality of data collected from these sites, as small changes in the information collected from these sites could result in potentially significant changes to the estimated total heat output.

Table 6. Renewable heat capacity and output in Scotland, 2017, by size of installation

Size category	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output	Number of installations (rounded to the nearest 10)	% Number of installations
Large (1MWth+)	0.776	43%	2,793	61%	80	<1%
Small to medium (>45kWth and <1MWth)	0.697	38%	1,055	23%	5,180	18%
Micro (≤45kWth)	0.341	19%	640	14%	23,350	82%
Biomethane (no stated capacity)	N/A	N/A	100	2%	10	<0.1%
Unknown	<0.01	<1%	10	<1%	10	<0.1%
Total	1.819	100%	4,598	100%	28,620	100%

Notes:

1) Biomethane gas to grid injection does not have a stated capacity, output from this technology is not included in any size category but has been added to the total heat output figure

2) The "unknown" category includes a bundle of installations where we have total capacity and total estimated output but no information on the size breakdown or number of installations

3) Data has been rounded for ease of reading, hence some totals may not precisely equal summed figures

Table 7. Renewable heat capacity and output in Scotland, 2016, by size of installation

Size category	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output	Number of installations (rounded to the nearest 10)	% Number of installations
Large (1MWth+)	0.717	42%	2,070	56%	70	<1%
Small to medium (>45kWth and <1MWth)	0.663	39%	972	26%	3,610	15%
Micro (≤45kWth)	0.314	19%	562	15%	20,510	85%
Biomethane (no stated capacity)	N/A	N/A	100	3%	10	<0.1%
Unknown	<0.001	<0.1%	<1	<0.1%	Missing data	Missing data
Total	1.695	100%	3,705	100%	24,200	100%

Notes:

1) This table displays data published in the previous report and does not include data updates discussed earlier

2) Biomethane gas to grid injection does not have a stated capacity, output from this technology is not included in any size category but has been added to the total heat output figure

3) The "unknown" category includes a bundle of installations where we have total capacity and total estimated output but no information on the size breakdown or number of installations, represented here by 'missing data'

4) Data has been rounded for ease of reading, hence some totals may not precisely equal summed figures

Key points from Tables 6 and 7 are:

- The **total capacity and output of large installations increased between 2016 and 2017 by 8% and 35% respectively.** This is in contrast to the reduction in output between 2015 and 2016 where a 30% decrease was seen. This reduction in output in 2016 was primarily due to changes at a small number of large sites. Between 2015 and 2016 there was only a 1% increase in capacity. Since 2008/09, the total capacity and total output of large installations has more than quadrupled (from 0.164 GW to 0.776 GW capacity and from 637 GWh to 2,793 GWh output).

- In 2017, **small to medium** (>45 kW and <1 MW) systems made up 18% of the renewable heat installations in Scotland (by number). The small to medium size category is mostly made up of biomass systems with other technologies (energy from waste, heat pumps and solar thermal) making up the remainder. **Capacity from these systems has increased by 5% (0.034 GW) between 2016 and 2017, while output has increased by 8% (82 GWh)**. In the absence of RHI data at the site specific level it is difficult to provide much analysis or draw conclusions from this change.

- **Micro heat capacity increased by 9% between 2016 and 2017, while output increased by 14%.** Similar to last year, this shows an ongoing increase in capacity and output year on year, however, the rate of this increase has declined. Between 2016 and 2017, capacity and output increased at a lower rate than between 2015 and 2016 (11% increase in capacity and 21% increase in output between 2015 and 2016). This may be a continuation of the effect of lower domestic RHI tariffs available for biomass in 2016 offering a less financially attractive deal for micro-installations.

  Since 2008/09 micro heat capacity has increased by more than 7 times (from 0.0454 GW to 0.341 GW) and output has increased by more than 4 times (from 139 GWh to 640 GWh). This indicates the impact of the domestic RHI (and Renewable Heat Premium Payment (RHPP) scheme) and other supporting Scottish Government programmes on this sector within Scotland. The increase in output between 2008/09 and 2017 seems small compared to the increase in capacity over the same time period, however, this is to be expected for micro heat installations as they have lower running hours than systems that are used for commercial or industrial purposes.

4.4 Results by technology

The **majority of both output (82%) and capacity (81%) in 2017 came from biomass primary combustion and biomass combined heat and power** (see Table 8, and Figures 7 and 8). This is a continuation of the trends seen in both the publically available domestic and non-domestic RHI reports[29], as well as from previous years' renewable heat in Scotland reports[30].

Tables 8 and 9 and Figures 7 and 8 show the breakdown of operational renewable heat capacity and renewable heat output in Scotland in 2017 by technology categories.

[29] See BEIS's website: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics for monthly updates on both schemes.
[30] http://www.energysavingtrust.org.uk/reports

Table 8. Renewable heat output and capacity in Scotland, 2017, by technology

Technology	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output
Biomass	1.112	61%	3,128	68%
Biomass CHP	0.366	20%	629	14%
Energy from waste	0.125	7%	449	10%
Heat pump	0.179	10%	374	8%
Solar thermal	0.037	2%	19	<1%
Total	1.819	100%	4,598	100%

Note: data has been rounded for ease of reading, hence some totals may not precisely equal summed figures.

As energy from waste includes a number of technologies such as incineration, advanced conversion technologies and landfill gas, a breakdown of this category is provided in Table 9 below.

Table 9. Renewable heat output and capacity in Scotland, 2017, energy from waste technologies

Energy from Waste Technology	Renewable heat capacity (MW)	% Renewable heat capacity	Annual output (GWh)	% Annual output
Energy from waste - advanced conversion technologies	109	6%	341	7%
Energy from waste – incineration	14	<1%	103	2%
Energy from waste - landfill gas	1	<0.1%	5	<0.2%
Total	125	7%	449	10%

Note: 'Energy from waste – advanced conversion technologies' incorporates biomethane to grid, anaerobic digestion CHP and anaerobic digestion heat production

Whilst biomass remains the largest contributor to both renewable heat output and capacity by some margin, other technologies have also seen growth between 2016 and 2017. In particular, energy from waste has seen an increase in capacity of 57% (from 0.079 GW to 0.125 GW) and increase in output of 31% (from 342 GWh to 449 GWh). Heat pumps have also seen considerable growth, with a 22% increase in capacity (from 0.147 GW to 0.179 GW) and 30% increase in output (from 287 GWh to 374 GWh).

Figure 7. Renewable heat capacity in Scotland, 2017, by technology

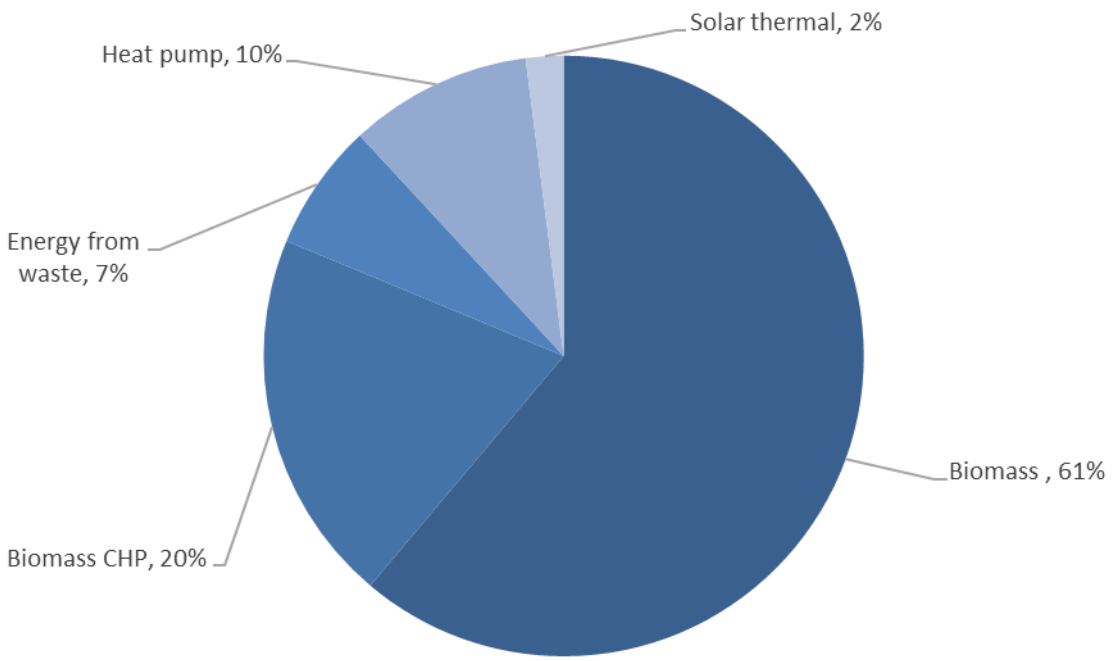
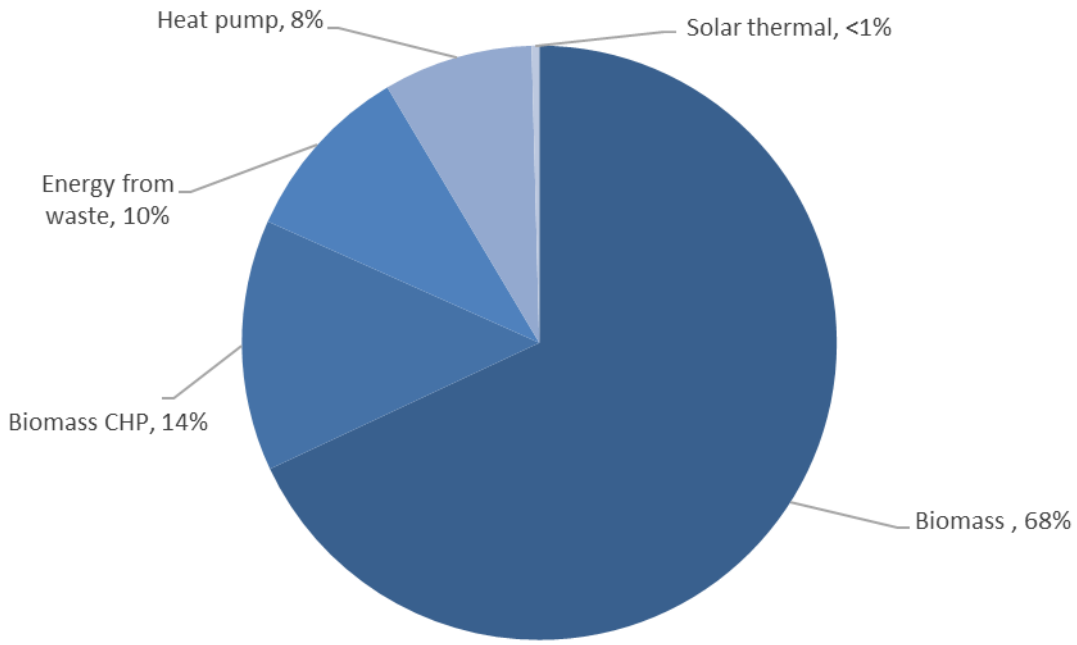


Figure 8. Renewable heat output in Scotland in 2017, by technology



4.5 Results by size and technology

In 2017, the biomass CHP and energy from waste sites follow the same pattern as in 2016, with the majority of them within the 'large' size bracket. As in 2016, solar thermal systems and heat pumps are almost entirely in the micro size bracket. They are in this size bracket because they are generally more suitable for space and/or water heating which currently in Scotland is usually generated on a smaller scale.

Large biomass sites account for around 29% of total biomass (heat) capacity, however their renewable heat output accounts for 59% of the total biomass renewable heat output in 2017. This is likely because larger sites often provide heat year round (e.g. for industrial use), whereas smaller sites generally have more seasonal demands such as providing space and water heating.

A breakdown of technology and size (as percent of the overall total for each technology) is shown in Figures 9 and 10 below.

Figure 9. Capacity by size and technology (% of total technology operational capacity), 2017

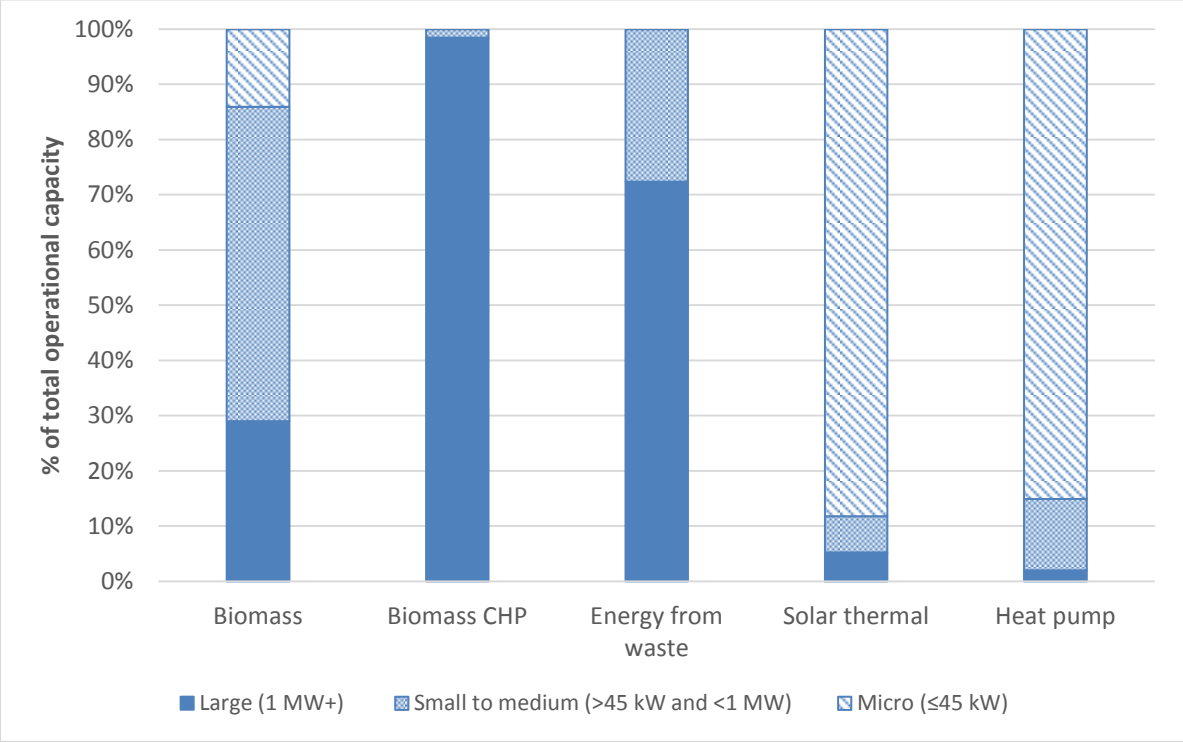
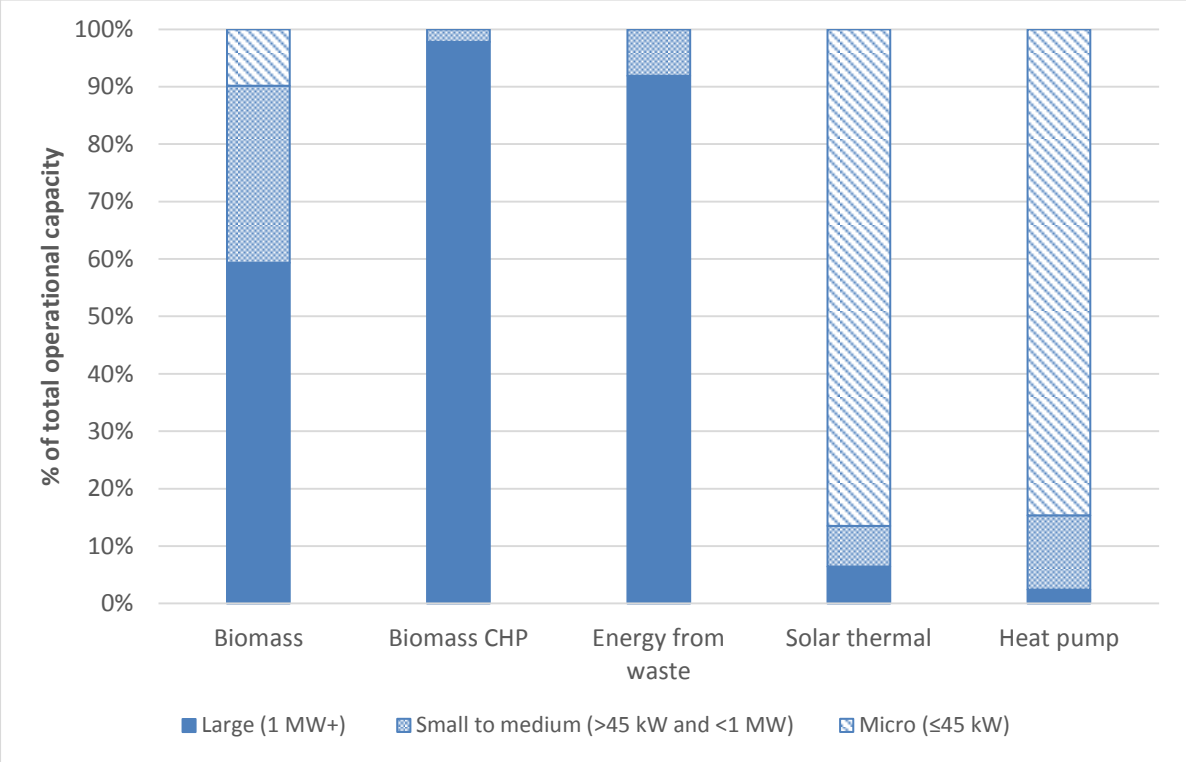


Figure 10. Output by size and technology (% of total technology heat output), 2017



4.6 Change in output and capacity by technology since 2016

The overall proportions of renewable heat capacity provided by different technology types have remained relatively stable between 2016 and 2017. Biomass primary combustion continues to be the largest contributor to renewable heat capacity in Scotland, followed by biomass CHP. Combined, these technologies accounted for 81% of renewable heat capacity in 2017, compared to 84% in 2016. Biomass primary combustion has seen an 8% increase in capacity in 2017, whilst biomass CHP has seen in a 9% decrease in capacity. This decrease is due to more accurate data being received about one large site in the database, resulting in a change in technology category away from biomass CHP to biomass primary combustion. It is important to note that the reported decrease does not reflect an absolute decrease in capacity but a shift of capacity from one technology category to another. Biomass still remains the dominant renewable heat technology in Scotland, and changes in this sector have the greatest impact on absolute capacity figures.

Biomass also continues to make up the vast majority of total renewable heat output (82%, compared to 83% in 2016). The increase in biomass combustion and biomass CHP output account for 78% of the total increase in renewable heat output in 2017.

Whilst biomass remains the dominant renewable heat technology in Scotland, there has also been considerable growth in the energy from waste and heat pump sectors. Energy from waste currently accounts for only 7% of renewable heat capacity and 10% of output. However, this was the fastest growing renewable heat technology in Scotland in 2017 (compared to 2016) in terms of proportional increase in both capacity and output. Energy from waste capacity has increased by 57% (0.045 GW) between 2016 and 2017, and output has increased by 31% (107 GWh). This follows an ongoing trend of increasing energy from waste year-on-year, with the output of energy from waste sites increasing by almost four times from 122 GWh in 2013 to 449 GWh in 2017. This is believed to be mainly due to RHI incentives.

Heat pumps, similarly, only contribute a relatively small proportion of total renewable heat capacity and output, but have seen reasonably large proportional increases in capacity and output between 2016 and 2017, with capacity increasing by 22% (0.032 GW) and output by 30% (87 GWh).

Table 10. Changes in renewable heat output and capacity in Scotland from 2016 to 2017, by technology

Technology category	2017 Total capacity (GW)	Change since 2016 (GW)	Percentage change	2017 Total annual output (GWh)	Change since 2016 (GWh)	Percentage change
Biomass	1.112	0.082	8%	3,128	624	25%
Biomass CHP	0.366	-0.036	-9%*	629	74	13%
Energy from waste	0.125	0.045	57%	449	107	31%
Heat pump	0.179	0.032	22%	374	87	30%
Solar thermal	0.037	0.001	2%	19	0	2%
Total	1.819	0.124	7%	4,598	893	24%

Notes: a) data has been rounded for ease of reading, hence some totals may not precisely equal summed figures.
b) 'Energy from waste – advanced conversion technologies' incorporates biomethane to grid, anaerobic digestion CHP and anaerobic digestion heat production
*c) *This decrease does not reflect an absolute decrease in capacity but is the result of a change in technology category for one large project after receiving updated data.*

4.7 Capacity and output by local authority area

The database captures information on the local authority area for most operational sites that are in the large (1 MW+) or small and medium (>45 kW and <1 MW) size categories. Information for each local authority is limited for micro (≤45 kW) installations as location information for these records has not been disclosed to EST from MCS between the years 2012 (first addition of MCS dataset) and 2016. This data is also unavailable for aggregated data from previous schemes (used for 2008/09 – 2011).

For the 2017 update of the renewable heat database, we received for the first time MCS data which included the local authority for each record dating back to 2012. This meant that it was possible to include installations that were new to the MCS in 2017 in the local authority breakdown in Table 11. However, we were not able to match the local authority data to individual sites in the database for installations that were part of the MCS prior to 2017, therefore these sites are included in the 'local authority unknown' figures in Table 11. With the addition of the 2017 MCS local authority data, installations where local authority is unknown account for a smaller percentage of both output and capacity than in previous years.

As in previous years a local authority breakdown of the aggregated non-domestic RHI data was not available for this report; aggregated RHI scheme data provided by BEIS to EST does not show local authority area as doing so would risk disclosing information about individual sites (combined with the other data provided). Similarly, a local authority breakdown of the aggregated CHPQA data was also not available for this report.

The percentages given below are based on a total heat output of 3.306 GWh and a total capacity of 0.984 GW – this is the heat output and capacity **excluding** those sites for which local authority data is not available (i.e. excluding aggregated RHI data, aggregated CHPQA data and micro-installation data from MCS for 2012 to 2016)

The key findings from analysis of the non-micro and non-RHI aggregated installations by local authority area, for those sites with available locational information are:

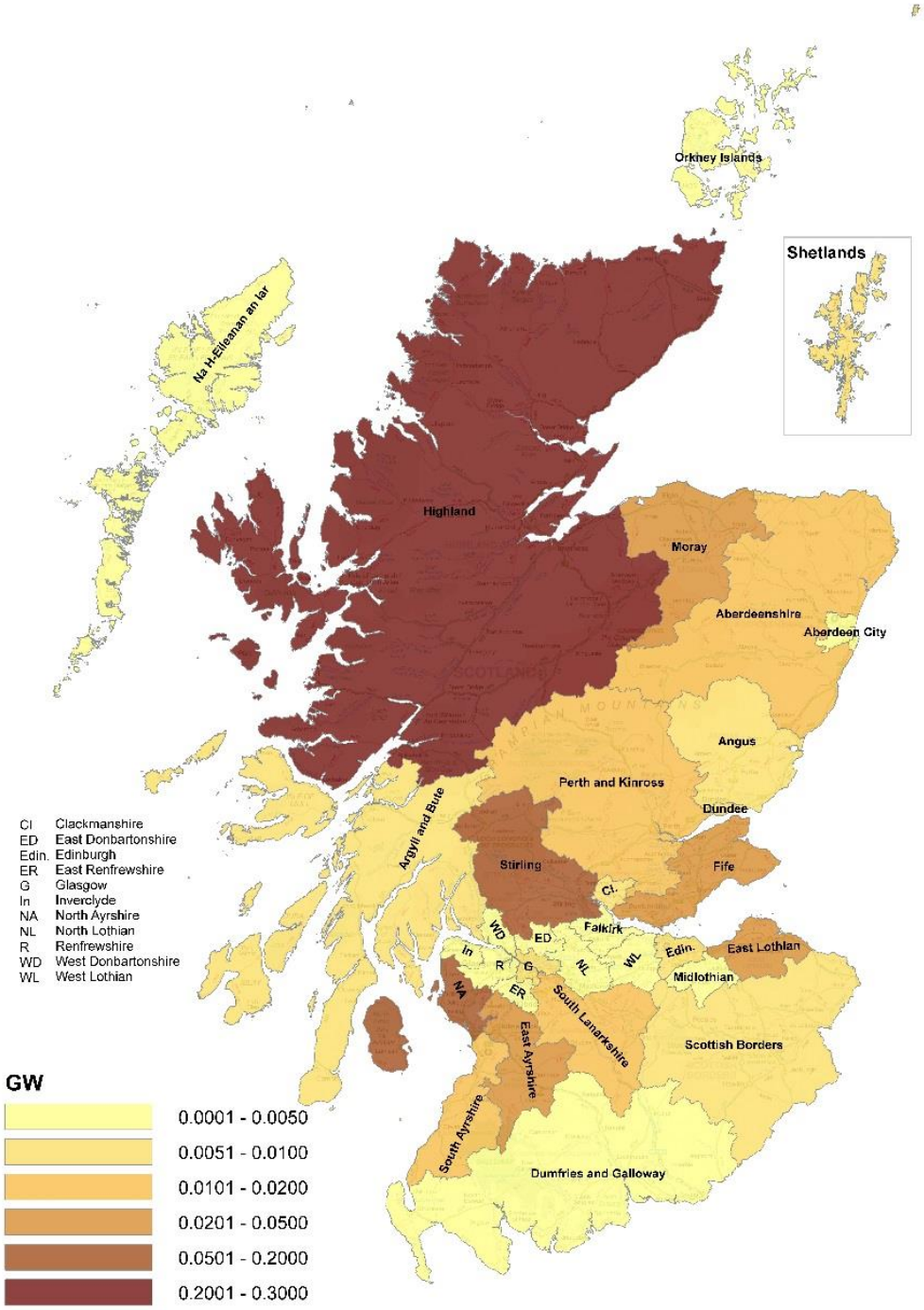
- Highlands accounted for 34% of Scotland's total renewable heat output for which the location is known in 2017 and had 23% of the overall operational capacity

- Almost 70% of the 2017 heat output came from just 4 areas (Highlands, Stirling, North Ayrshire and Moray), which collectively contributed over 2,285 GWh of renewable heat in 2017. These 4 areas had a combined capacity of 0.473 GW (48% of the renewable capacity in Scotland for which the location is known).

Table 11. Heat output and capacity by local authority area, Scotland, 2017

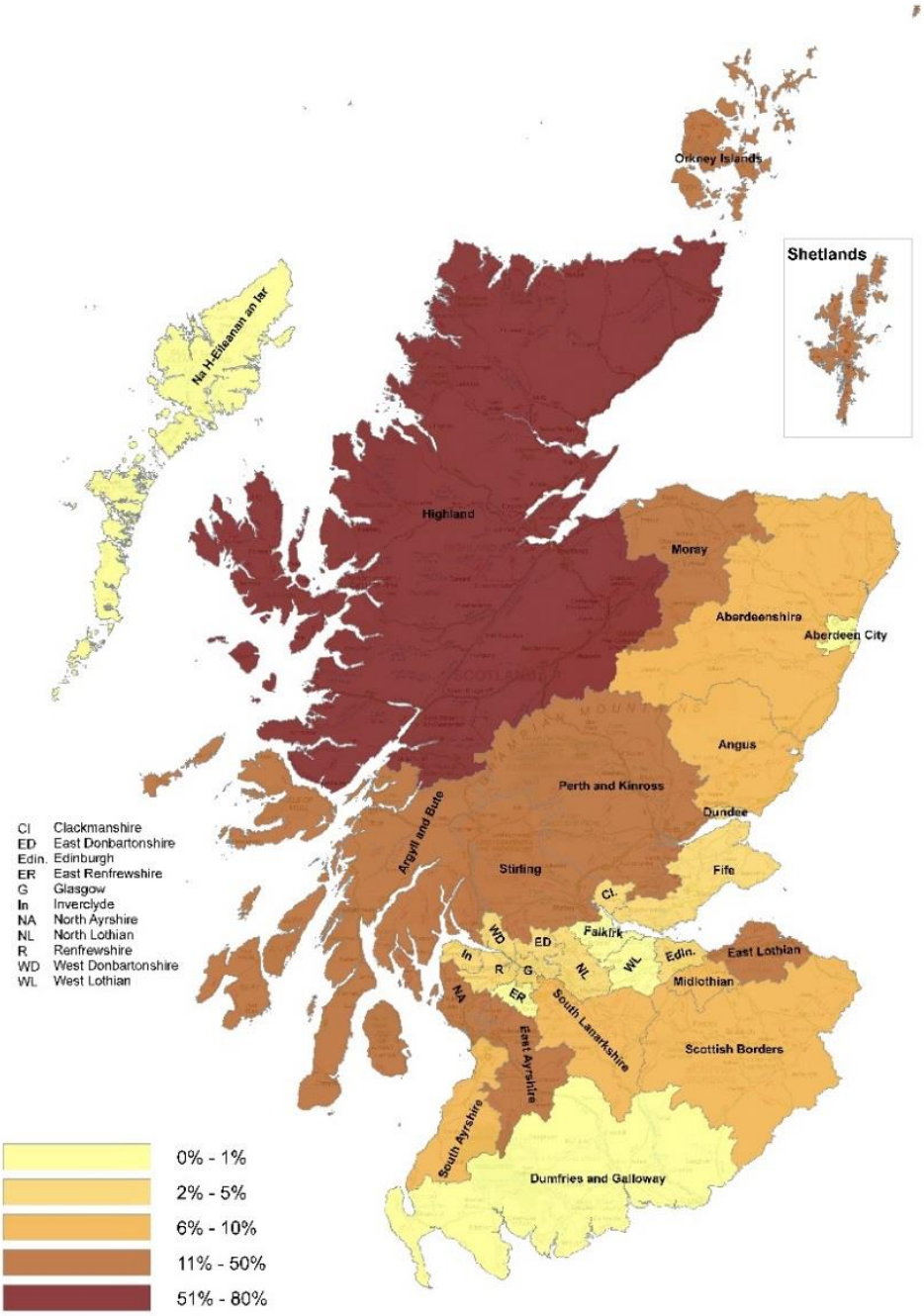
Local authority area	Renewable heat output, 2017 (GWh)	Renewable heat output, 2017 (%)	Operational renewable heat capacity, 2017 (GW)	Operational renewable heat capacity, 2017 (%)
Aberdeen City	15	0.3%	0.005	0.3%
Aberdeenshire	85	1.8%	0.033	1.8%
Angus	26	0.6%	0.011	0.6%
Argyll and Bute	46	1.0%	0.019	1%
City of Edinburgh	38	0.8%	0.014	0.7%
Clackmannanshire	0	0.0%	0.000	0.0%
Comhairle nan Eilean Siar	29	0.6%	0.014	0.8%
Dumfries & Galloway	98	2.1%	0.041	2.2%
Dundee City	5	0.1%	0.002	0.1%
East Ayrshire	108	2.3%	0.019	1%
East Dunbartonshire	0	0.0%	0.000	0.0%
East Lothian	37	0.8%	0.008	0.5%
East Renfrewshire	1	0.0%	0.001	0.0%
Falkirk	7	0.2%	0.005	0.3%
Fife	154	3.3%	0.213	11.7%
Glasgow City	36	0.8%	0.010	0.5%
Highland	1,137	24.7%	0.223	12.3%
Inverclyde	3	0.1%	0.001	0.1%
Midlothian	14	0.3%	0.006	0.3%
Moray	212	4.6%	0.067	3.7%
North Ayrshire	334	7.3%	0.104	5.7%
North Lanarkshire	12	0.3%	0.004	0.2%
Orkney Islands	14	0.3%	0.006	0.3%
Perth and Kinross	72	1.6%	0.016	0.9%
Renfrewshire	21	0.5%	0.015	0.9%
Scottish Borders	32	0.7%	0.013	0.7%
Shetland Islands	37	0.8%	0.008	0.5%
South Ayrshire	52	1.1%	0.015	0.8%
South Lanarkshire	62	1.3%	0.025	1.4%
Stirling	603	13.1%	0.080	4.4%
West Dunbartonshire	11	0.2%	0.005	0.3%
West Lothian	5	0.1%	0.002	0.1%
Local authority unknown	1292	28.1%	0.835	45.9%
TOTAL	**4,598**	**100.0%**	**1.819**	**100.0%**

Figure 11. Map showing operational renewable heat capacity by local authority area, 2017 for known locations[31]



[31] Local authority areas shown here to have a high proportion of renewable heat capacity do not mirror exactly those with the highest proportions of renewable heat capacity under RHI. To see which local authorities have the highest proportions of renewable heat capacity under RHI please refer to: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics.

Figure 12. Map showing the proportion of non-domestic heat demand met by renewable heat output, 2016 for known locations[32].



[32] Heat demand figures assume that heat demand does not change from 2016 (scenario 2). Heat output figures exclude pre-2017 micro installations and aggregated CHPQA and RHI data. To see which local authorities have the highest proportions of renewable heat capacity under RHI please refer to: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics.

Whilst the aggregated RHI data provided by BEIS to EST does not show local authority area, data is available separately from BEIS on the breakdown of the number and capacity of accreditations under the non-domestic RHI by local authority area[33]. We have chosen not to present these breakdowns in this report, as it contains only RHI data.

As mentioned above, the renewable heat database only records local authority area information for microgeneration technologies that were new to the MCS in 2017. It hasn't been possible to allocate installations from earlier years of the MCS to local authority areas. However, BEIS publish tables of domestic RHI accreditation numbers by local authority area and the data for Scotland from the December 2017 is given in Table 12.

[33] Please refer to: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics.

Table 12. Number of installations by local authority area accredited in Scotland under the domestic RHI scheme as of December 2017[34]

Local authority area	Number of installations	% installations
Aberdeen City	41	<1%
Aberdeenshire	993	8%
Angus	276	2%
Argyll and Bute	567	5%
City of Edinburgh	94	<1%
Clackmannanshire	32	<1%
Dumfries and Galloway	1,475	12%
Dundee City	30	<1%
East Ayrshire	182	2%
East Dunbartonshire	34	<1%
East Lothian	200	2%
East Renfrewshire	30	<1%
Falkirk	72	<1%
Fife	405	3%
Glasgow City	30	<1%
Highland	2,042	17%
Inverclyde	24	<1%
Midlothian	82	<1%
Moray	378	3%
Na h-Eileanan Siar	689	6%
North Ayrshire	127	1%
North Lanarkshire	69	<1%
Orkney Islands	267	2%
Perth and Kinross	643	5%
Renfrewshire	55	<1%
Scottish Borders	559	5%
Shetland Islands	174	1%
South Ayrshire	189	2%
South Lanarkshire	1,736	15%
Stirling	319	3%
West Dunbartonshire	19	<1%
West Lothian	112	<1%
TOTAL	**11,945**	**100%**

This breakdown shows that the Highland local authority area is leading in the deployment of domestic microgeneration systems, with 17% of the domestic RHI installations in Scotland

[34] Source: BEIS Non-Domestic RHI and domestic RHI monthly deployment data: December 2017. https://www.gov.uk/government/collections/renewable-heat-incentive-statistics#monthly-deployment-data

located in this area. Other areas with large numbers of microgeneration systems are South Lanarkshire and Dumfries and Galloway. Both areas had over 1,000 domestic RHI accredited systems as of December 2017, and held 15% and 12% of the total accredited domestic installations in Scotland respectively. As of December 2017, Scotland as a whole had 20% of the 60,093 accredited domestic RHI systems in Great Britain which is above the proportion of installations to be expected on a pro-rata basis.

The figures above do not provide a full picture of renewable heat being supplied to homes in each local authority area. For example, domestic RHI figures do not include homes supplied by renewable heat through district or communal heating or homes with microgeneration renewable technologies installed before 15 July 2009.

A number of factors influence uptake of RHI in each local authority area including the proportion of homes that do not have access to mains gas. The domestic RHI was designed to be targeted at, but not limited to, off-gas-grid households. The vast majority of microgeneration systems accredited under the domestic RHI are located off the gas grid, with 89% of heat pumps and 89% of biomass systems installed in off-grid areas[35]. A smaller proportion of solar thermal systems (63%) are located in off-grid areas. This is to be expected, as domestic solar thermal systems are most often used alongside a main heating system and work well with gas central heating systems.

Table 13. Number of installations on and off the gas grid accredited in Scotland under the domestic RHI scheme as of December 2017, by technology

Technology	Number of installations on gas grid	% installations on gas grid	Number of installations off gas grid	% installations off gas grid
Biomass	429	11%	3,333	89%
Heat pump	769	11%	6,303	89%
Solar thermal	416	37%	695	63%
TOTAL	**1,614**	**14%**	**10,331**	**86%**

Notes: a) This table was created using a list of off-gas postcodes generated by xoserve: http://www.xoserve.com/wp-content/uploads/Off-Gas-Postcodes.xlsx

Uptake of the domestic RHI has continued to increase across all eligible technologies since December 2017. Please refer to section 5.2 for further commentary on the trends seen in both the domestic and non-domestic RHI between December 2017 and August 2018.

[35] Based on RHI data from April 2014 to December 2017. Source: BEIS Non-Domestic RHI and domestic RHI monthly deployment data: December 2017. https://www.gov.uk/government/collections/renewable-heat-incentive-statistics#monthly-deployment-data

5 Further renewable heat capacity in development

5.1 Pipeline projects in the renewable heat database

In previous iterations of the renewable heat in Scotland report, an overview of projects currently in development has been presented alongside projections of both expected capacity and heat output over the coming years. There was an inherently large degree of uncertainty around these projections because the projects may not have come to fruition and the stated capacity and heat output for projects still in development are often subject to change. It is also likely that a large proportion of developing projects are not captured by the methodology used to update the database, particularly for smaller installations and installations that are not required to go through formal planning permission.

Commentary on the renewable heat capacity in development and potential output recorded in the renewable heat database has not been included in this report because of the continuing uncertainty associated with projected figures.

5.2 Trends seen in the RHI monthly statistics

While there is a large degree of uncertainty around the projects recorded as 'in development' in the renewable heat database, the RHI statistics published by BEIS on a monthly basis can give an indication of renewable heat capacity in the pipeline during 2018. During the first eight months of 2018, there was an increase in both the number of full applications[36] under the non-domestic RHI scheme and in accreditations under the domestic scheme.

Trends in the domestic RHI scheme:

- There was a **5% increase in accreditations** for systems in Scotland under the domestic RHI between December 2017 and August 2018. This is an increase of 577, from 11,945 as of 31 December 2017 to 12,522 as of 31 August 2018.

- The rate of growth in accreditations for systems in Scotland under the domestic RHI is slowing down. It has reduced from an increase of 201% in 2015, to 20% in 2016 and 10% in 2017.

- The technology with the largest increase in the number of accreditations under the domestic RHI was **air source heat pumps,** with an **increase of 470,** from 5,935 as of 31 December 2017 to 6,405 as of August 2018 (an increase of **8%**).

- The number of domestic **ground source heat pumps** accredited under the domestic RHI from December 2017 to August 2018 has **grown by 6%**, from 1,137 in December 2017 to 1,200 systems in August 2018.

[36] Under the non-domestic RHI 'Full application' refers to applications that are not preliminary. This means that the site will have been commissioned, but can be either accredited or currently going through the accreditation process.

- **Solar thermal** and **biomass installations** have seen lower rates of uptake, with solar thermal accreditations increasing by **3%** (from 1,111 to 1,148) and biomass accreditations increasing by <**1%** (from 3,762 to 3,769) between December 2017 and August 2018.

- As of August 2018, systems in **Scotland accounted for 20% of the total number of accredited systems under the domestic RHI scheme**.

Trends in the non-domestic RHI scheme:

- There was a 2% increase in the number of non-domestic RHI 'full applications' in Scotland between December 2017 and August 2018, with a 4% increase in capacity. This is an increase from 3,717 full applications in December 2017 to 3,794 in August 2018, and a capacity increase of 34 MW, from 971 MW to 1,005 MW.

- The rate of increase of full applications in Scotland under the non-domestic RHI has reduced from a 32% increase in 2015, to 16% in 2016 and 14% in 2017.

- The general trend across all countries (England, Wales and Scotland) was that the largest proportional growth in number of full applications between December 2017 and August 2018 was in large solid biomass boilers. GB wide, the number of full applications of large solid biomass boilers increased from 75 in December 2017 to 122 in August 2018 (an increase of 63%). CHP systems saw the largest proportional growth in capacity of full applications, increasing by 80% from December 2017 to August 2018.

- Medium solid biomass installations made up the largest number of new installations in Great Britain in the first 8 months of 2018, with 174 new installations from December 2017 to August 2018.

- As of August 2018, systems in **Scotland accounted for 19% of the total number of full applications and 20% of the total installed capacity under the non-domestic RHI** scheme.

These figures demonstrate the continued impact both the non-domestic and domestic RHI schemes, alongside supporting Scottish Government schemes, have on renewable heat in Scotland.

5.3 Emerging technologies and innovative projects in the pipeline

Sites converting from anaerobic digestion (AD) to biomethane to gas grid injection (BtG) are increasingly likely to become a prominent technology. These sites will not add to Scotland's overall heat capacity; as these sites start to inject gas, the contribution will only be noticeable in the figures for heat output. This is because there is no associated capacity with this kind of technology as you do not have a dedicated facility built to output a fixed capacity of biomethane; instead you have a varying volume of biomethane (generated from various amounts of agricultural or waste material) you inject into the gas grid to increase its overall heat output. Although there will be some low conversion losses, gas to grid injection should avoid higher heat losses from combusting gas on site (or flaring the excess gas and wasting the energy), and should make a contribution to decarbonisation of the gas grid.

There are a wide range of innovative projects being funded through various funding schemes. Together, these projects aim to show how different renewable technologies can be used and to reduce heat demand through the installation of energy efficiency measures and behavioural change. Many of the projects are not yet at a stage where heat capacity and estimated output can be included in the figures presented in this report. A summary of some of the relevant funding programmes is given below:

5.3.1 District Heating Loan Fund

The Scottish Government's District Heating Loan Fund has funded or co-funded a significant number of district heating schemes in Scotland and continues to provide a vital funding stream to help deliver both low carbon and renewable district heating projects. Information on projects awarded funding can be found at:
http://www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan

5.3.2 Local Energy Scotland funding

Local Energy Scotland delivers the Scottish Government's Community and Renewable Energy Scheme (CARES), which is a one stop shop offering free independent advice and funding options to support communities in taking forward renewable energy projects or getting the best deal from commercial schemes.

The current contract for CARES (awarded in March 2017) focuses on three key areas:

- promoting direct ownership of renewables by communities (and local businesses) bringing the highest financial return but greater risk
- shared ownership of (and community investment in) commercial schemes
- levering community benefit payments from commercial schemes.

Advice and funding has been adapted to meet these key objectives.

In addition, the Scottish Government has signalled its ambition with a new target of 1GW of community and locally owned energy by 2020. Progress as of June 2017 was an estimated 666 MW (66.6% of the target) of community and locally owned renewable energy capacity was operational in Scotland and the next annual update is due imminently.

5.3.3 Low Carbon Infrastructure Transition Programme

Launched in March 2015, the Low Carbon Infrastructure Transition Programme (LCITP) is a collaborative partnership led by the Scottish Government, working with Scottish Enterprise, Highlands and Islands Enterprise, Scottish Futures Trust and Resource Efficient Scotland. With a budget of £136 million split across two phases until 2020, this programme focuses on supporting the acceleration of low carbon infrastructure projects (including district heating) across the public, private and community sectors to develop investment grade business cases to help projects secure public and private capital finance.

Since early 2016, LCITP has awarded over £40 million of funding to 13 demonstrator projects supporting low carbon energy generation and supported the co-development of over 30 proof of concept and development proposals.

Details of LCITP funding calls and supported projects are available on the LCITP website: www.gov.scot/Topics/Business-Industry/Energy/Action/lowcarbon/LCITP

5.3.4 Energy Efficient Scotland

The Scottish Government's Infrastructure Investment Plan 2015 reaffirmed the designation of energy efficiency as a National Infrastructure Priority. The Route Map for Energy Efficient Scotland (formerly Scotland's Energy Efficiency Programme), launched in May 2018, set out the Scottish Government's vision for all buildings in Scotland, that by 2040 all our buildings are warmer, greener and more efficient.

Energy Efficient Scotland will help to remove poor energy efficiency as a driver of fuel poverty and will reduce greenhouse gas emissions by making buildings more energy efficient and helping to decarbonise the heat supply. It is an integrated programme of support for domestic and non-domestic buildings, aimed at improving energy efficiency and decarbonising heat supply.

The Route Map will guide decisions taken to support Scotland's homes to be improved so that by 2040 they achieve at least an Energy Performance Certificate (EPC) rating of band C, where technically feasible and cost-effective. This will be phased differently across tenures.

In the non-domestic sector, the Scottish Government proposal is that existing energy efficiency standards are continually extended so that by 2040 all buildings are improved to the extent that is technically feasible and cost-effective. The Scottish Government are also proposing moving towards a benchmarking system, which describes 'what good looks like' for a particular type of building.

Local authorities are a strategic partner for the programme, and the Scottish Government believes local authorities are well placed to expand delivery into the sectors and tenures necessary to achieve the standards proposed in the Route Map.

To support and organise local delivery, the Scottish Government has twice consulted on the introduction of a statutory duty on local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES). LHEES will be the link between the Scottish Government's long term targets and national policies and the delivery of energy efficiency and heat decarbonisation on the ground. They would allow local authorities to prioritise and target work.

Energy Efficient Scotland builds on the Scottish Government's existing programmes. In May 2018, a two-year Transition Programme was launched, which will continue to integrate and streamline existing support. In 2018/19, £5.5 million was made available to support the Transition Programme and the Scottish Government is currently supporting 25 local authorities to pilot integrated action across two phases.

5.4 Other developments from 2017 onwards

In general, operational renewable heat capacity in Scotland is growing faster than the annual heat renewable output from the operational sites. This implies that, although some systems will not be needed all year round, there is some underuse of the potential heat available which could potentially be exported to other heat users. Further strategic development of heat networks (where feasible) will allow authorities to identify and utilise excess heat, improve operational efficiencies, strengthen heat security and accelerate Scotland towards its renewable heat targets.

In January 2017 the Scottish Government worked with the Scottish Environment Protection Agency (SEPA) to repeat the surplus industrial heat data collection exercise. Data was requested on a voluntary basis via the Scottish Pollution Release Inventory (SPRI), from industries regulated by SEPA under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended). Responses were received from a small number of organisations and will be combined with information obtained in 2016 to inform future policy development.

The Heat Policy Statement published in 2015 stated that the Scottish Government recognise the need for regulation of district heating, commensurate with the scale of the market, and the 2016 Programme for Government committed the Scottish Government to consult on such regulations, as part of the development of the Route Map for Energy Efficient Scotland (formerly Scotland's Energy Efficiency Programme). In January 2017, the Scottish Government issued a high-level policy scoping consultation paper alongside the publication of the Energy Strategy, on regulation of district heating, and on Local Heat & Energy Efficiency Strategies (LHEES).

This consultation, which sought views and further evidence on a broad scenario for district heating regulation and Local Heat and Energy Efficiency Strategies, and considered how to deliver the recommendations of the Special Working Group of the Expert commission on District Heating (which submitted its report on potential regulatory frameworks for district heating in Scotland to Scottish Ministers in February 2016), closed in April 2017. The initial consultation was followed up in November 2017 with a second policy development

consultation which set out the Scottish Government's preferred approach to district heating regulation and LHEESs, for further comment and testing with stakeholders. The results of this are still being analysed and evidence from all rounds of consultation will be used to inform the Scottish Government's final decisions on whether any legislation (primary and / or secondary) would be needed for district heating regulation and LHEES.

6 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 the following 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.
- Realised heat output from installations may also not match the predictions of output based on installed capacity and peak running hours.
- It is worth noting that some heat projects, particularly CHP installations, 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. Use of the renewable heat will therefore depend firstly upon a suitable heat user being identified or established nearby; and secondly how much heat that user requires, either for process heat or space heating.

In the figures reported, 85% of renewable heat capacity is known,11% is estimated and 4% has unknown status. 88% of renewable heat output is known, 10% is estimated and 2% is unknown.

6.1 Estimating heat capacity and renewable heat output for non-domestic RHI accredited installations

The non-domestic Renewable Heat Incentive (RHI) launched in 2011, making its first payments for heat generated in 2012. The scheme is administered by Ofgem on behalf of BEIS. Previous reports have recommended that access to the RHI database be given to EST or the Scottish Government to ensure that all installations are captured in the renewable heat in Scotland database and that the respective output is included in the target monitoring figures. While some progress has been made on this action, legislative changes would be required to enable the non-domestic RHI database to be made available to the Scottish Government or EST for this purpose.

The RHI continues to incentivise the uptake of renewable heat technologies, a large number of which are small to medium biomass boilers. The renewable heat database is likely to capture most large-scale installations through the use of the Renewable Energy Planning Database (REPD) and a large proportion of micro installations through the receipt of anonymised data from the Microgeneration Installations Database (MID) (see section 6.2 below). The RHI data is likely to be the largest single source of site-level information on medium installations and this information is hard to find efficiently through other sources

without a high risk of double counting. Current site-level information in the renewable heat database on medium sized installations is therefore more likely to be uncertain (in terms of useful renewable heat output) and likely to be underreported. It has therefore become increasingly important to be able to cross-reference the renewable heat database with the RHI database as the RHI continues to see an increase in interest in this size category of biomass boilers[37].

In previous years, record level data on the RHI scheme in Scotland has not been available to EST. Instead, BEIS has carried out analysis on the EST and RHI databases. By doing so they have been able to provide EST with aggregated figures for the capacity, heat output and number of non-domestic RHI accredited installations that are not already accounted for in the renewable heat database.

At the time of writing, the necessary 2017 non-domestic RHI data was not available. Estimates of overall capacity and generation for 2017 have instead relied on imputed RHI data, as noted in the methodology section on page 11. More details on how these estimates were calculated are found in Appendix 4. This approach to estimating heat values for non-domestic RHI installations can only be applied at a national (Scotland) level. The more detailed breakdowns of capacity and output by technology type and installation size rely on unchanged 2016 RHI values.

Full details of the work carried out to produce the figures for the 2016 update (which were also used in this report), and the steps taken to avoid double counting are available in Appendix 3.

6.2 Estimating heat capacity and renewable heat output for CHPQA installations

The CHPQA programme is a government initiative which began in 2001. It aims to provide a practical, determinate method for assessing all types and sizes of combined heat and power schemes throughout the UK. The voluntary scheme, which is implemented by Ricardo-AEA, requires the submission of annual or monthly energy figures for electricity generated, fuel consumed and heat utilised. The scheme is voluntary, therefore may not capture every CHP installation in Scotland. However, various government tax breaks and incentives schemes require the installation to be a member of the CHPQA scheme in order to receive government support; this therefore incentivises membership of the scheme.

The inclusion of aggregated CHPQA data has allowed a more accurate estimate of total renewable heat capacity and output to be estimated and presented in this report. In the 2016 report, the small number of sites included in the aggregated CHPQA total meant that it was not possible to receive a breakdown of the figures by size or technology type. This was because it may have allowed individual sites to be identified and would therefore breach confidentiality. Without this, the aggregated CHPQA data was not included in the further analysis of the breakdown figures. However, in this report, it was possible to include the aggregated CHPQA data in the analysis of breakdown figures by size and technology.

[37] https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

6.3 Estimating micro installations: capacity and output

As in previous years, Gemserv have supplied an updated data extract from the MCS Installation Database (MID). Gemserv are the administrators of the Microgeneration Certification Scheme (MCS) which is a quality assurance scheme for microgeneration technologies and installers. Under this scheme MCS installers must register each installation on the MID otherwise it will not be recognised as an MCS installation. The MID therefore provides exact numbers of solar thermal, ground source heat pumps, air source heat pumps and biomass systems that are installed by MCS certified installers.

The current data in the renewable heat database for micro installations now includes MCS accreditation data from 2012-2017 (inclusive). For the 2011 report the number of micro installations was estimated as MCS data from the MID was not available to EST until 2012. The data used in the 2011 report 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 Hot Water Industry Council (HHIC) estimates and Stove Industry Alliance sales estimates for Scotland. Pre-2012 MCS data has not been included in the renewable heat database to avoid double counting.

Micro-renewable heat installations must be MCS certified (or equivalent) to be eligible for support under the RHI schemes (both domestic and non-domestic). It is therefore assumed that data for Scotland from the MID covers all micro heat systems accredited under the RHI. However, there are likely to be micro-renewable heat generating systems operational in Scotland that are not MCS accredited (either because they do not require scheme funding or would not be eligible for scheme funding). This means that the number, capacity and heat output for micro systems (smaller than 45 kW) are all likely to be underestimated. At the time of writing there was no data available that would provide the missing information without risking double counting.

6.4 Potential useful heat output that is not currently utilised

In previous reports the potential for unused heat from industrial sites currently using less heat than they produce has not been quantified. It is still beyond the current scope of this report to cover this subject, as the detailed data required and the agreed methodology are not yet available. (Data required would include: energy consumed on site; detailed heat and electrical output; unused ‘useful heat’ including the form of heat available, for example warm or hot water, steam, hot air. There is also a methodology required for quantifying the size and value of nearby potential heat loads in relation to the type and scale of heat available.)

6.5 Recommendations for future updates

6.5.1 Recommendation 1 – energy from waste data

Given the estimated current and potential contribution of energy from waste to renewable heat output, the database would benefit from greater information sharing between organisations involved in the development of energy from waste projects, as far as is possible within the limits of commercial confidentiality. On site data from operational projects regarding biodegradable content and quantity of the waste used for heat generation (or as feedstock for conversion to biofuels via AD, BtG, gasification or pyrolysis processes) as well as metered heat output data would help to ensure greater certainty in the calculations used to estimate the useful heat output figures included in this report. In addition, improved data about changes to the fraction of biodegradable material within the municipal waste stream over time would improve the evidence base of the contribution made by installations producing heat from burning municipal solid waste. Access to such data would also provide the information needed to more accurately estimate the potential contribution of projects in the pipeline to the Scottish Government's heat targets.

6.5.2 Recommendation 2 – CHP data

Considerable effort has been made to ensure accuracy of 'useful heat output' data from complex sites, both heat only and combined heat and power. The inclusion of aggregated CHPQA data has allowed a more accurate estimate of total renewable heat capacity and output to be presented in this report. However, it is recommended that future revisions of the database and report continue to improve the information that heat output figures are based on by using information on heat output directly from the operator where possible. This will allow the CHP installations to be included in the more in-depth analysis of the database and give a more accurate representation of renewable heat in Scotland.

6.5.3 Recommendation 3 – unused 'useful heat'

It is recommended that the Scottish Government continues to carry out work, with partners including SEPA, to quantify the amount of waste heat from industrial sites (see section 5.4). This could help inform future estimates of available unused but useful heat which, as mentioned in section 6.3 above, is currently beyond the scope of the database.

6.5.4 Recommendation 4 – Improving data quality of large sites

It is always important to seek ways of improving the data quality of all sites in the database, but it is particularly important to make sure that data is complete for large sites. This is because the greater than 1 MW installations make a significant contribution to the overall output and small changes in the information collected from these sites could result in potentially significant changes to the estimated heat output total. Stronger relationships with the owners of these sites could help to ensure that data is regularly updated and accurate.

Appendix 1. Technical terms used

7.1 References to 'heat output'

The following terms have been used in the report when talking about heat output from heat generating installations:

- **Heat output**

Where used in this report 'heat output' refers to the heat output from a site. This may be potential, actual or useful heat output.

- **Useful heat output**

Heat delivered to an end user or process, taking into account losses.

- **Actual heat output**

The total amount of heat produced by a site, accounting for losses and efficiency. Actual heat output includes heat that is *not* delivered to an end user or process.

- **Potential heat output**

The total amount of heat could potentially be generated by the site if it operated at peak capacity for the total number of 'peak running hours' stated in Table 3. Alternatively, the total heat output potentially generated by a site if it operated at the assumed capacity stated in Table 14.

- **Renewable heat output**

Refers to the renewable heat output from a site. This term is used for clarity where it may not be clear if the heat output being discussed is renewable, for example with energy from waste sites.

7.2 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, or to provide heat for an industrial process. The woodfuel may be chips, pellets or logs, or waste wood, sawdust or offcuts. In some installations the woodfuel 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 or water heating or both. 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 cases, it can be upgraded to biomethane gas and injected into a gas grid. 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.

  - **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 or gasification or both**

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.

- **Biomethane injection to the gas grid (BtG)**

This is the same technology as anaerobic digestion up to the point of having a biomethane (biogas) product. The resultant biomethane is not combusted on site but is 'upgraded'[38] to allow it to be injected into the gas grid, whilst ensuring it has similar properties to fossil natural gas. This technology will therefore allow the biomethane to displace fossil natural gas in the grid.

- **Deep geothermal**

Heat from deep underground is extracted by pumping water into a deep well, allowing it to heat up using the heat of the rocks, then abstracting the water via another well.

Had examples been found, fuel cell biomass could also have been included:

- **Fuel cell biomass**

Fuel cells running on biomass could be used to produce useful heat.

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**

DUKES[39] considers hospital waste as non-biodegradable, so installations burning only hospital waste are not counted as producing renewable heat. However, installations which

[38] 'Upgrading' consists of: removing carbon dioxide and other impurities and adding propane to ensure similar energy content to natural gas already in the gas network. The gas is then odorised and compressed before being injected into the gas grid.
[39] Renewable Energy Statistics: Data Sources and Methodologies, Department for Business, Energy and Industrial Strategy: https://www.gov.uk/government/collections/renewables-statistics

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 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

8.1 Capacity assumptions

Table 14 below shows the assumed capacities that were used in the renewable heat database where information on capacity was not available.

Table 14. Assumptions used for capacity where not known, 2017

Ownership category[40]	Building type	Technology	Estimate of likely installed capacity	Derived from
Community	Community buildings	Solar thermal	6 kWth	Average of other community solar thermal installations recorded in the database.
	Community buildings	Heat pumps (ASHP and GSHP)	7 kWth	Average of other heat pumps in public sector, LA non-domestic and community buildings, recorded in the database.
	All	Biomass	60 kWth	Average of other community biomass installations recorded in the database.
	All	Biomass district heating	175 kWth	Average of other community biomass district heating installations recorded in the database.
Other public sector and charity	All	Solar thermal	13 kWth	Average of other public sector and charity solar thermal installations recorded in the database.
	All	Heat pumps (ASHP and GSHP)	7 kWth	Average of other heat pumps in public sector, LA non-domestic and community buildings recorded in the database.
	All except hospitals	Biomass	110 kWth	Average of other public sector and charity biomass installations, excluding hospital installations, recorded in the database.

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

	Hospitals	Biomass	1.4 MWth (1,400 kWth)	Average of other hospital biomass installations recorded in the database.
Farms and Estates	All	Biomass	150 kWth	Average of other farm and estate biomass installations recorded in the database.
	All	Biomass district heating	150 kWth	Average of other farm and estate biomass district heating installations recorded in the database.
Local businesses	All	ASHP	12 kWth	Average of other local business ASHPs recorded in the database.
	All	GSHP	30 kWth	Average of other local business GSHPs recorded in the database.
	All	Biomass	140 kWth	Average of other local business biomass recorded in the database.
	All	Biomass district heating	140 kWth	Average of other local business biomass district heating recorded in the database.
Local authority	Domestic properties	Solar thermal – installed in 2011, 2012 or 2013	3.4 m^2	Analysis of Energy Saving Scotland home renewables loans.[41]
	Domestic properties	Solar thermal – installed in 2014, 2015, 2016 or 2017	4 m^2	Analysis of Energy Saving Scotland home renewables loans.[41]
	Domestic properties	Heat pumps (ASHP and GSHP)	7 kWth	Average of other LA- and HA-owned heat pumps in domestic properties recorded in the database.
	Schools	Solar thermal	7 kWth	Average of other school solar thermal installations recorded in the database.
	Schools	ASHP	6 kWth	Average of school ASHP installations recorded in the database.

[41] Energy Saving Scotland home renewables loans are loans for domestic renewables, administered by the Energy Saving Trust on behalf of the Scottish Government.

	Schools	Biomass	200 kWth	Average of other school biomass boiler installations recorded in the database.
	Other buildings	Heat pumps (ASHP and GSHP)	7 kWth	Average of other heat pumps in public sector, LA and community buildings, recorded in the database.
Housing Association	Domestic properties	Solar thermal – installed in 2011, 2012 or 2013	3.4 m^2	Analysis of Energy Saving Scotland home renewables loans.[41]
	Domestic properties	Solar thermal – installed in 2014, 2015 or 2016	4 m^2	Analysis of Energy Saving Scotland home renewables loans.[49]
	Domestic properties	Heat pumps (ASHP and GSHP)	7 kWth	Average of other LA- and HA-owned heat pumps in domestic properties, recorded in the database.
	Domestic properties	ASHP - EAHR[42]	7 kWth	Average of other LA- and HA-owned ASHP-EAHRs in domestic properties, recorded in the database.

[42] 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.

Appendix 3. Merging the renewable heat database with the non-domestic RHI database

9.1 Background

The non-domestic Renewable Heat Incentive (RHI) is a renewable heat incentive scheme that opened to applicants in November 2011 (with scope for legacy applicants to apply for accreditation). The non-domestic scheme is designed to incentivise uptake of renewable heat technologies in mainly non-domestic applications but does include district heating for residential schemes[43]. The RHI is administered by Ofgem on behalf of BEIS.

No site-level detail on the installations accredited (or awaiting accreditation) under the scheme has been shared with the Scottish Government or the Energy Saving Trust to date. Some of the systems accredited under the RHI will already be known about by the Energy Saving Trust from other data sources such as the FCS woodfuel surveys. However, it is likely that these data sources only capture a proportion of the uptake of renewable heat technologies, particularly in the small to medium technology size bracket (>45 kW and <1 MW). A substantial proportion of the micro (45 kW or less) installs in Scotland will be captured by the Microgeneration Installations Database (MID) data extract provided by Gemserv, and the larger installs are relatively easy to track through the REPD, publications of funding allocation to renewable heating projects, press releases and relevant organisation contacts. Small and medium sized projects are harder to track especially now as the REPD no longer monitors projects with a capacity of less than 1 MW. It has therefore become increasingly important to reconcile the renewable heat database and the non-domestic RHI database, to ensure the accuracy of the Scottish Government's target monitoring.

At the time of collating data for this report information for 2017 on non-domestic RHI installations not already captured in the EST database was not available, we have therefore used the data BEIS provided for the 2016 update of the database for analysis of size and technology type (headline renewable heat output and capacity figures use imputed RHI data as described in section 3.1 and Appendix 4). This means the methodology in Section 9.2 below has not been altered since the last report, as the same analysis was used this year. As in previous years, the analysis carried out on the two datasets estimated:

- The **number of full applications** under the RHI where no match exists in the renewable heat database.
- The **capacity** of renewable systems accredited under the RHI where no match exists in the renewable heat database.
- The **eligible heat** output of systems accredited under the RHI where no match exists in the renewable heat database.

[43] Communal and district heating include systems that link more than one property to the heat network. These may still be domestic applications but they are not eligible for support under the Domestic RHI scheme.

9.2 Methodology

The analysis undertaken by BEIS was done using an extract of the renewable heat database as of 21 June 2017[44]. For all sites with a capacity of 0.5 MW (500 kW) or higher, the data was manually cross-referenced to ensure accurate matching of sites with the largest capacity. The remaining data was then matched, with a positive result (match between both datasets) requiring an exact match between site names, or two of any of the other variables (postcode, address or organisation name).

For all systems on the RHI database where no match was found in the renewable heat database, the capacity and 'heat paid for' were aggregated and provided by for the calendar year 2016.

The variables provided by BEIS were:

- Number of full applications by technology and tariff band.
- Operational capacity by technology and tariff band.
- 'Heat paid for' under the RHI scheme, by technology and tariff band. It should be noted that this will not be an exact match for 'heat produced' but is the closest proxy available. As the RHI only pays for heat that is used for an eligible purpose[45], it can be directly translated into 'useful renewable heat output' for the purposes of this report.

Where the aggregated figures were based on 5 or fewer sites the respective information has been withheld to ensure information about particular sites was not disclosed.

9.3 Uncertainties and duplication

It is difficult to estimate the risk of double of counting or uncertainties for this report as the same aggregated figures provided by BEIS for the 2016 report were used in this report. Nevertheless, a description of the process undertaken last year for decreasing the risk of uncertainties and duplication is outlined below:

In order to ensure no duplication with the MID data provided by Gemserv, any micro (≤45 kW) systems in the RHI dataset were removed before the capacity and heat totals were aggregated.

[44] Any personal data was removed from the EST extract in compliance with the Data Protection Act 1998; any data provided to EST as otherwise confidential was also removed from the database before sharing with BEIS.
[45] Please see the RHI guidance for further details: https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi/eligibility-non-domestic-rhi

As not all data were manually matched, the aggregates provided by BEIS may still include output and capacity for sites that are already listed in the renewable heat database. This will be because either a match wasn't found or because the record was not sent to BEIS (due to being confidential or personal data). To avoid double counting, the records were assessed against the risk of double-counting by using the descriptors given in Table 15 below**.**

Table 15. Risk indicators assigned to renewable heat database records

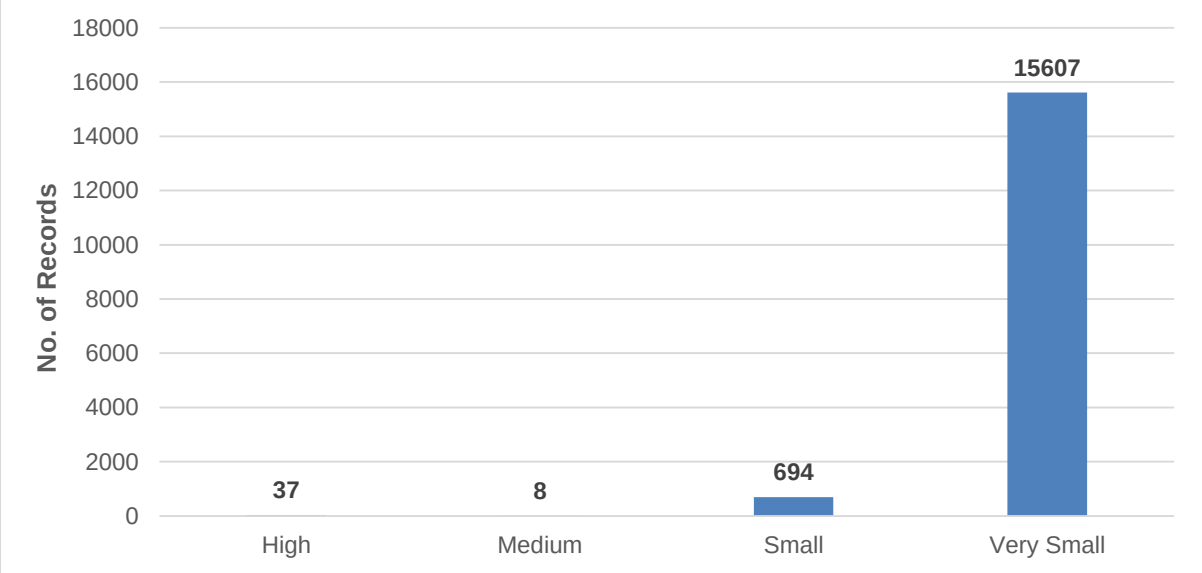
Risk	Descriptor
Very low	• The record is for a microgeneration system (capacity ≤45 kW). All microgeneration systems were removed from the RHI data after merging to avoid double counting. Or • The record has a capacity of 0.5 MW or more. These records were all checked manually for a match. Or • The site is accredited under the Renewables Obligation (RO) scheme and claims the Combined Heat and Power uplift under that scheme[46]. These sites cannot claim support under the RHI as well.
Low	• The record was sent to BEIS for merging with the renewable heat database and has good location information in the renewable heat database. Or • The renewable heat database records that the system was commissioned before November 2009, which would mean that the site is too old to claim RHI support. • The technology is unlikely to be supported by the RHI, as there are very few technologies in the RHI database (i.e. for CHP systems). • The system is not yet operational
Medium	• The record was sent to BEIS but has no, or poor, location information in the renewable heat database. Or • The record was not sent to BEIS, is not a micro technology and was commissioned between 2009 late 2011. These systems may be double counted as they will not have been included in the analysis carried out by BEIS. They are not, however 'High' risk as they may not have taken advantage of applying to the RHI as a legacy applicant.
High	• The record was not sent to BEIS, is not a micro technology and commissioned late 2011 and is an RHI-eligible technology. These systems will not have been included in BEIS analysis but are more likely to have applied for RHI support following the launch of the scheme.

The risk of each record being double-counted was labelled as 'High', 'Medium', 'Low' or' Very low'. Figure 13 shows the total number of records within the database in each risk category. The 'High' and 'Medium' records have been excluded from the overall figures used

[46] For details please see https://www.ofgem.gov.uk/sites/default/files/docs/2015/02/guidance_volume_one_-_july_2015_-.pdf

within this report[47]. The aggregated RHI figures were then added to the relevant renewable heat database summary figures to provide total capacity and heat figures for Scotland.

Figure 13. Proportion of records by double counting risk



[47] These sites are still recorded in the renewable heat database for reference.

Appendix 4. Calculating estimates for renewable heat capacity and output

10.1 Background

This report relies on several sources of unpublished data, including unpublished analysis of BEIS non-domestic RHI data (please see Appendix 3 for more details). At the time of writing, the necessary analysis of 2017 RHI scheme data was not available. The non-domestic RHI contribution accounted for more than a fifth of renewable heat output and around a third of capacity in 2016. Given the continued growth in the number of non-domestic RHI installations, use of 2016 data on the scheme would have resulted in underestimating both capacity and output. Instead of relying on 2016 levels of capacity and output, the contribution from non-domestic RHI installations in 2017 to overall capacity and output have been imputed based on recent trends in RHI data. This provides more realistic estimates that take some account of generation from new installations. From this analysis, renewable heat output and capacity are estimated at **4,800 GWh** and **2.0 GW** respectively for 2017**.**

These estimates are used as the headline figures.

10.2 Methodology

The methodology for calculating these estimates is outlined below:

- For recent years, the non-domestic RHI contribution to renewable heat output as a percentage of the total non-domestic RHI heat generated and paid for in Great Britain was calculated and averaged.
- This average percentage was applied to the 2017 heat generated and paid for figure for Great Britain. The same method was used to estimate the non-domestic RHI contribution to installed capacity
- The estimated contributions to renewable heat output and installed capacity calculated through the steps above were added to the totals for output and capacity taken from the 2017 renewable heat database, and CHPQA aggregated data. This gave the final estimates for total renewable heat capacity and output in 2017.

The figures for the non-domestic RHI contribution to total estimated renewable heat output and installed capacity in recent years came from previous aggregated RHI data provided by BEIS. This data is for installations that appear in the non-domestic RHI dataset but could not be matched to any records in an extract of the renewable heat database.

The non-domestic RHI heat generated and paid for figures and installed capacity figures for Great Britain were calculated using publicly available RHI Deployment data from BEIS[48].

10.3 Uncertainties

It is important to note that the final figures are estimates and may not accurately represent renewable heat capacity and output for 2017. However, we feel that these are reasonable estimates based on trends in the non-domestic RHI and previous BEIS data.

The data we receive from BEIS provides aggregate figures for the additional capacity and output not already captured in our database. The matching process carried out by BEIS involves matching sites in the size brackets ‘small to medium’ and ‘large’. Updates to large sites are particularly important as these have a significant impact on final figures. It is possible that all updates were not captured in our database and may have been captured by 2017 data received from BEIS. As the 2017 data was not available, it is possible that changes at one or more large sites (which were not captured in our database) could have resulted in an overall decrease in renewable heat capacity or output for 2017. This was seen in the previous report when changes at a small number of large sites brought down the renewable heat output figure for 2016. If this information had not been captured in our database, it is likely that it would have been picked up in the aggregate data received from BEIS for the 2016 update.

The calculated estimates are limited in that they could not be applied to figures broken down by technology and size. In this report, all figures broken down by technology or size use lower estimates of renewable heat capacity and output figures, which include 2016 RHI data. The lower estimates for renewable heat capacity and output are 1.819 GW and 4,598 GWh, respectively. Full details of the work carried out to produce the figures for the 2016 update (which were also used in this report), and the steps taken to avoid double counting are available in Appendix 3

[48] Non-domestic RHI heat generated and paid for figures and installed capacity figures for Great Britain were calculated using Tables 1.5 and 1.7 in BEIS 'RHI Deployment Data July 2018' found here: https://www.gov.uk/government/statistics/rhi-deployment-data-july-2018

Appendix 5. Combining renewable heat database with CHP dataset

11.1 Background

The CHPQA programme is a government initiative which aims to provide a practical, determinate method for assessing all types and sizes of combined heat and power schemes throughout the UK. The voluntary scheme, which is implemented by Ricardo-AEA, requires the submission of annual or monthly energy figures for electricity generated, fuel consumed and heat utilised.

As with the RHI data, no site-level detail on the installations which are CHP certified under the CHPQA scheme has been shared with the Scottish Government or the Energy Saving Trust to date. It is, however, likely that the majority of CHP systems certified under the scheme are already known to EST from other data sources, including the FCS woodfuel survey, and the REPD.

At the time of collating data for this report, Ricardo-AEA were unable to share full site-level information on CHPQA certified installations but did undertake some analysis on the two datasets in order to estimate:

- Operational renewable heat capacity
- Useful renewable heat output

11.2 Methodology

An extract of the CHP installations held in the renewable heat database as of 12th July 2018 was sent to Ricardo-AEA[49]. Sites were matched with the CHP database using key variables, including site names, organisation names and address data.

For all renewable energy generating systems in the CHP dataset where no match was found in the renewable heat database, the annual renewable capacity and useful heat output were aggregated and provided for the calendar year of 2017.

[49] Any personal data was removed from the EST extract in compliance with GDPR/DPA 2018; any data provided to EST as otherwise confidential was also removed from the database before sharing with BEIS.

11.3 Uncertainties and duplication

As there are only a small number of CHP installations recorded in the renewable heat database and all installations have good address level data, the risk of double counting or missing sites during the matching process has been deemed to be relatively low. However, if the matching process is repeated in future years, the risk of double counting would need to be reassessed.

There was no risk of double counting between the CHPQA aggregated figure and the RHI aggregated figure. This is because no additional capacity for CHP sites was provided by RHI (suggesting that all CHP sites currently receiving RHI funding were already included in the 2016 update of the EST dataset). It is recommended that, if both matching exercises are repeated in future years and CHP RHI aggregated figures are returned by BEIS, these figures should be discounted as they should already be included in the CHP aggregated figure[50].

As the CHPQA programme is a volunteer scheme, it is possible that there are operational CHP systems operational in Scotland that have not been captured by the renewable heat database, or by the CHP dataset.

[50] To be eligible for the RHI CHP systems must also be CHPQA certified, so installations not included by the renewable heat database should be included in both the RHI aggregated figure and the CHPQA aggregated figures

Appendix 6. Measurement of heat demand in Scotland

This Appendix sets out:

- How the Scottish Government derived the original 11% renewable heat target.
- How until the 2012 report (monitoring progress to 2011) the Scottish Government monitored progress on renewable heat as a percentage of projected 2020 heat demand.
- An explanation of how improved data and an updated methodology is being used to monitor renewable heat as a percentage of annual non-electrical heat demand in Scotland.

12.1 Background

Heat has been estimated to account for more than half of Scotland's total energy use[51]. Switching from fossil fuel to renewable heat sources 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[52] set a target of delivering 11% of Scotland's projected 2020 (non-electrical)[53] heat demand from renewable sources.

In 2006, the Scottish Energy Study[54] described Scotland's current energy supply, energy consumption and energy-related CO_2 emissions during 2002. This was the first major study of energy supply and demand to be conducted in Scotland for more than a decade. At that time, the discrete study provided the most robust data source available for estimates of energy consumption in Scotland. This study produced estimates for 2002 and subsequently a figure for 2020 heat demand was derived from these estimates. This heat demand figure was subsequently used to derive the 11% heat target (detailed in section 11.2). Due to improved availability of heat demand data for Scotland (detailed in section 11.3), the heat demand figure derived in 2006 is no longer used to monitor progress towards the 2020 target.

12.2 Derivation of the 11% heat target

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

[51] Energy in Scotland 2018, the Scottish Government, https://www.gov.scot/Topics/Statistics/Browse/Business/Energy/EIS2018
[52] Renewable Heat Action Plan (2009). http://www.scotland.gov.uk/Publications/2009/11/04154534/0
[53] 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 House Condition Survey (2016) estimates that around 11% of households in Scotland use electricity as their primary heating fuel.
[54] Scottish Energy Study, Vol 1 (2006). http://www.scotland.gov.uk/Publications/2006/01/19092748/0

estimated to be 60,089 GWh using data from the 2006 Scottish Energy Study. Therefore, the target was set at 11% (See Table 16).

Table 16: Description of the derivation of the renewable heat target (estimated 2020 figures)

Step	Step description	Output (GWh)
1	Total energy demand	160,307
2	Renewable energy target (20%)	32,061
3	Estimated renewable electricity contribution (50% target[55])	22,244
4	Estimated renewable transport contribution (10% target)	3,397
5	**Renewable heat output required (remainder)**	**6,420**
6	Total energy consumed within D/I/S sectors	95,276
7	Less: electricity consumption in these sectors	35,187
8	**Derived heat energy demand**	**60,089**
9	**Therefore renewable heat required**	**c. 11%**

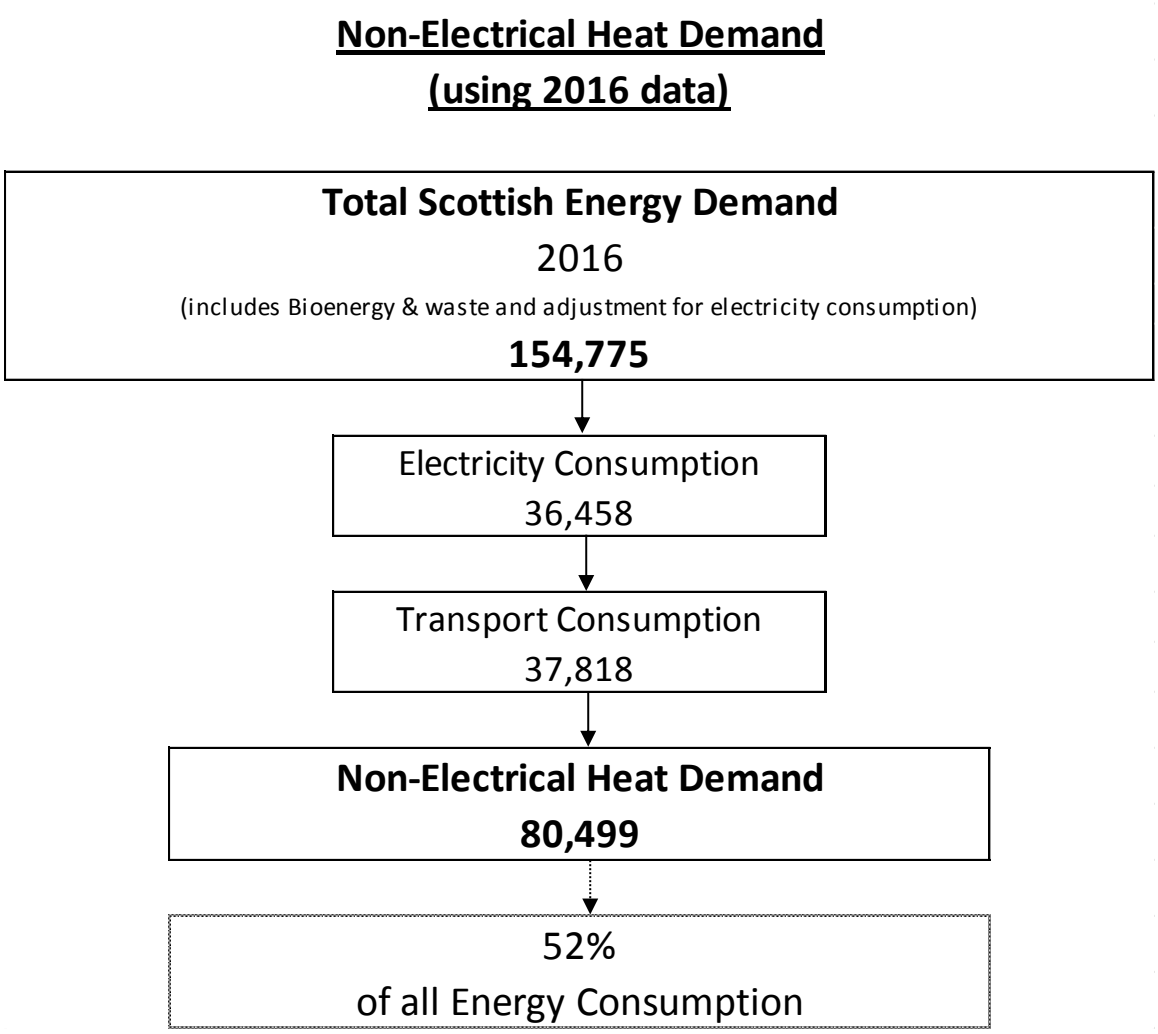
12.3 Improving data on heat demand in Scotland

In the years following the publication of the Scottish Energy Study, BEIS began publishing more detailed sub-UK estimates of energy consumption[56] which has enabled the development of a systematic and robust method of monitoring (non-electrical) heat demand in Scotland on an annual basis. The Scottish Government has worked with colleagues in BEIS to derive a heat demand methodology for Scotland which will allow more accurate annual measurement of progress towards the renewable heat target.

BEIS 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, this results in an estimate for non-electrical heat demand in Scotland (see the flow chart in Figure 14 below for more detail).

[55] 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
[56] Total final energy consumption at sub-national level, BEIS. https://www.gov.uk/government/collections/total-final-energy-consumption-at-sub-national-level

Figure 14: Heat demand methodology



The methodological differences between the 2006 Scottish Energy Study and BEIS's annual estimates of final energy consumption have implications for the monitoring of the renewable heat target. Table 17 presents a time series using both sources, demonstrating the impact this annual heat demand estimate has made on measuring progress towards the 11% renewable heat target.

It is important to note that BEIS's estimates of final energy consumption (from 2005 onwards) are subject to annual revision. This can impact on the Scottish Government's time series of non-electrical heat demand, and hence the renewable heat target progress figures.

Table 17: Renewable heat target - renewable heat as a % of heat demand 2008/09 to 2017

	2008/9	2009*	2010	2011	2012	2013	2014	2015	2016	2017
Total renewable heat output (GWh)	863	Missing data	1,363	1,690	2,045	2,266	3,071	4,205	3,752	4,800
New measure: % of annual estimate of total non-electrical heat demand	**0.9%**	Missing data	**1.5%**	**1.9%**	**2.4%**	**2.7%**	**3.9%**	**5.3%**[57]	**4.7%**[57]	-
Progress - scenario 1										6.1%
Progress - scenario 2										6.0%
Progress - scenario 3										5.9%
Heat demand (GWh)	97,052	89,155	91,156	88,269	86,446	83,804	79,207	79,385	80,499	
Heat demand scenario 1 (average annual change 2008-2016)										78,684
Heat demand scenario 2 (same as 2016)										80,499
Heat demand scenario 3 (same as change per year as 2015-16)										81,629
Previous measure: % of forecast 2020 non-electrical heat demand	1.4%	Missing data	2.3%	2.8%	3.4%	3.8%	5.1%	7.0%	6.2%	8.0%
Previous heat demand measure (GWh)	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*	*60,089*

*Note: Renewable heat output was not estimated in 2009. EST has collected data for calendar years 2010 onwards.

[57] The 2015 heat demand estimate changed as BEIS revised their statistics, resulting in a change in the target % from 5.4% to 5.3%. The 2016 heat demand estimate has also changed and is slightly lower than the lowest estimate provided for 2016 in the Renewable Heat in Scotland 2016 report. This is because all scenarios in the previous report assumed heat demand would continue to decrease or, in the 'high demand' scenario, stay the same. However, heat demand increased slightly in 2016, meaning the proportion accounted for by renewable heat was slightly lower than estimated.

12.4 Summary of the changes as a result of the new methodology

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 BEIS sub-UK consumption data – 2017 data will not be available until September 2019.
- All bioenergy & waste consumption is assumed to be non-electrical heat demand – which is likely to be an overestimate.
- An adjustment is made to the electricity consumption data to account for discrepancies within BEIS datasets.

To ensure transparency the Scottish Government has published both measures in parallel, for a transitional period, as the evidence base regarding heat use in Scotland is continuously being improved.

For any queries or feedback on the new measure, or on the measurement of heat demand in Scotland in general, please contact energystatistics@scotland.gsi.gov.uk