Renewable Heat in Scotland, 2018

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, MCS and Scottish Forestry.

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 2018 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 2018 and July 2019.

A separate appendix file has been prepared to accompany this report which can be accessed from the Energy Saving Trust website. Only the 2018 appendices are applicable to this report because many of the calculations, sources and assumptions used in the analysis are reviewed and updated on an annual basis.

For any questions or comments relating to the Renewable Heat Database or accompanying analysis and report please contact RenewableReporting@est.org.uk.

[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 3.5 for further details.

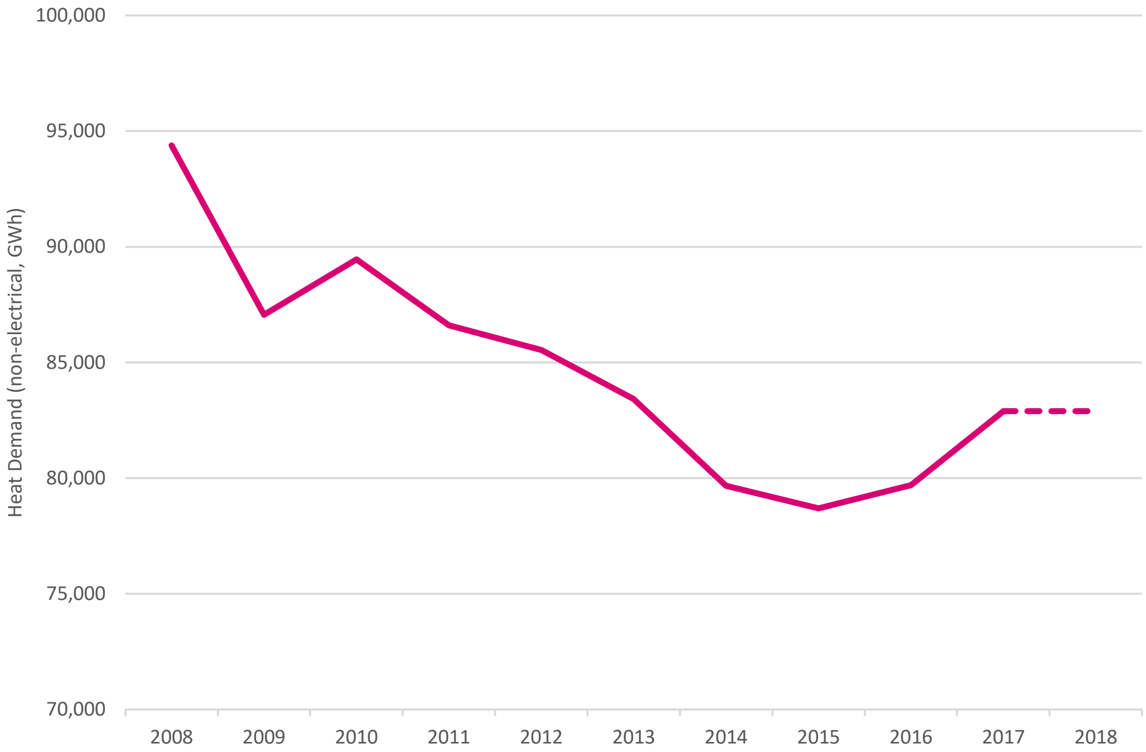
2 Summary of key findings

We estimate that:

- **In 2018, Scotland generated an estimated 6.3% of its non-electrical heat demand from renewable sources**, an increase from 5.5% in 2017[3].
- **2.01 GW of renewable heat capacity** was operational in Scotland by the end of 2018, **up 4%** (0.07 GW) from 2017, producing an estimated **5,230 GWh of useful heat output** from renewable sources, which is an **increase of 14%** (661 GWh) from 2017[4].
- The increase in output seen in 2018, compared to 2017, is largely due to newly operational biomass and energy from waste sites as well as an increased heat output from over half of the existing biomass sites.

Figures 1 and 2 show the change over time for both non-electrical heat demand and the proportion of which is met by renewables in Scotland.

Figure 1. Estimated non-electrical heat demand in Scotland, 2008 – 2018

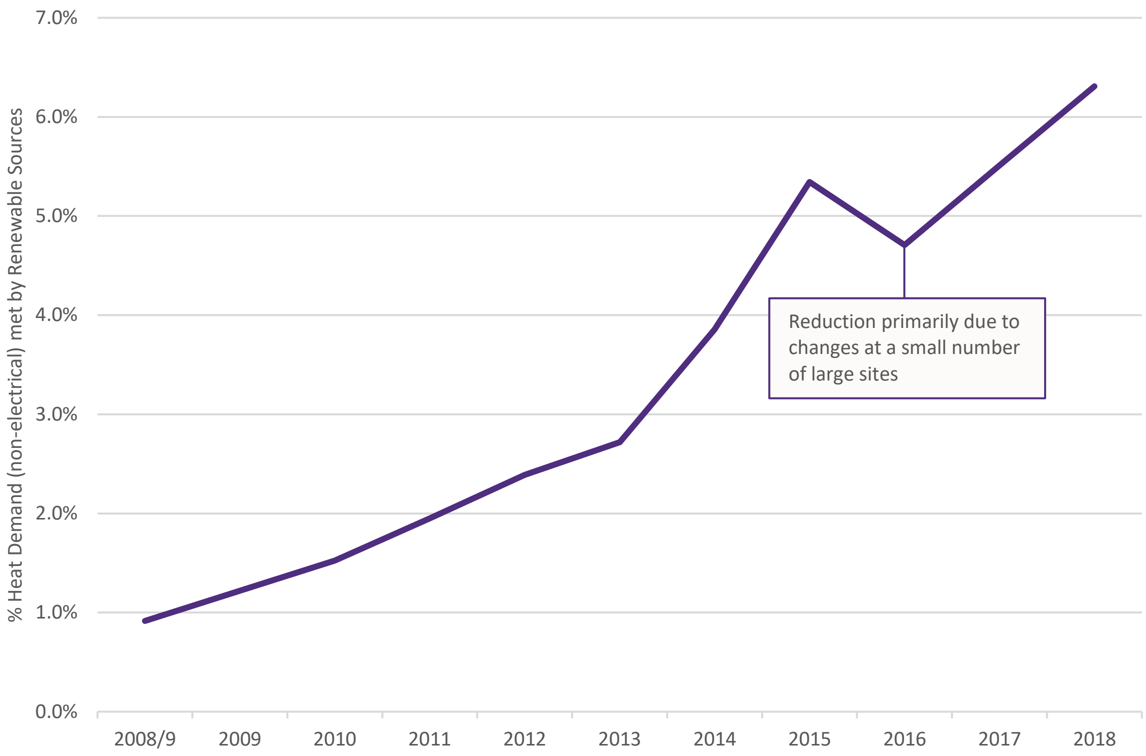


Note: the non-electrical heat demand for 2018 has been estimated by holding the 2017 value constant. See the update to the Renewable Heat in Scotland, 2018 report to be published in early 2020 for a revised estimate.

[3] 5.5% is the revised figure, down from an estimate of 5.9 - 6.1% as was published in the 2017 report. A new methodology for estimating the % of heat demand met by renewables has been adopted for this report, replacing the three scenario estimates of heat demand in Scotland with a single estimate based on the preceding year's heat demand. This methodological change is explained in more detail in section 3.7 and Appendix 7.

[4] These absolute values and percentage differences are based upon operational figures for 2017 which have been updated during the preparation of this report. The updated 2017 values are 1.94 GW of capacity and 4,569 GWh of output. All revised figures for 2017 are discussed in section 3.6 and can be found in full within Appendix 1. All figures and percentage changes presented throughout this report compare the 2018 results with the revised figures for 2017.

Figure 2. Percentage of non-electrical heat demand met by renewables in Scotland, 2008/9 – 2018



Note: The percentage of non-electrical heat demand met by renewable sources for 2008/9 uses the heat demand value for the 2008 calendar year and the resulting percentage is therefore an approximate indication.

As renewable heat output was not estimated for 2009, the percentage of non-electrical heat demand to be met by renewables for that year has been interpolated from the 2008/9 and 2010 values.

2.1 Non-electrical heat demand and the renewable target

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.

In previous years, the renewable heat output was compared against three estimated heat demand scenarios based on predicted low, medium or high heat demands. For ease of comparison and greater consistency with other Scottish Government publications, we have compared the renewable heat output against last year's estimated heat demand. An update to the 2018 Renewable Heat Report will be published in early 2020 which will utilise sub-national gas demand figures for 2018, after publication by BEIS, to create a revised estimate for the percentage of non-electrical heat demand to be met by renewable sources; the definitive percentage will then be published in September 2020 as part of the Scottish Government's quarterly energy statistics once sub-national non-gas demand figures for 2018 have also been made available[5].

[5] See https://www2.gov.scot/Topics/Statistics/Browse/Business/Energy for the latest Scottish Government energy statistics.

While renewable heat output has increased since 2008/9, 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 heat generated from renewables now meets a greater proportion of overall heat demand than would have otherwise been the case. Had heat demand remained constant since 2008, then the renewable heat output recorded for 2018 would make up only 5.5% of non-electrical heat demand instead of the 6.3% that is currently estimated. It should be noted that, whilst heat demand has generally been falling over the last 10 years, it rose in 2016 (by 1.3%) and again in 2017 (by 4%). The recent increases in heat demand has slowed the rate of growth for the proportion of non-electrical heat demand being met by renewables. If heat demand had remained constant with that of 2015, the percentage of non-electrical heat demand met by renewable sources would have been 6.6%, or 0.3 percentage points higher than it is now.

Holding the heat demand figures from 2018 constant to 2020, renewable heat output would need to increase by around 74% 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 2 years, this would be equivalent to an annual increase in output of around 32%. The average annual increase in output since 2010 is 19%.

2.2 Breakdown of 2018 data

As in 2017, the majority of both capacity and output in 2018 came from **biomass primary combustion and biomass combined heat and power (CHP).** Together, these technologies **account for 74% (3,845 GWh) of output and 83% (1.66 GW) of renewable heat capacity**, an increase of 14% and 2% respectively from 2017, despite only contributing 33% (8,440) of the total recorded installs. **The increase in biomass combustion and biomass CHP output accounts for 73% of the total increase** in renewable heat output in 2018.

Whilst biomass continues to dominate in renewable heat generation there has nonetheless been growth in other technologies. **Heat pump output has increased by 20% (56 GWh) to account for 6% (350 GWh)** of the total renewable heat output on record. Solar thermal installations contribute less than 1% (18 GWh) to the total output with the remaining **20% (1,027 GWh) generated from energy from waste sources.**

The largest contribution of renewable heat output in Scotland continues to come from large (>1 MW) installations. **In 2018, 47% of renewable heat came from large size installations**, despite contributing only 40% of the total renewable capacity and less than 1% of the total number of installs. 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. A large proportion of the output from biomass CHP (97%), biomass primary combustion (46%) and energy from waste (26%) facilities fall into the large size category. The majority of output from energy from waste technologies comes from biomethane installations, at 566 GWh (61%), which do not have a capacity and are thereby not classed by size.

The ‘small to medium’ (>45 kW – <1 MW) group contributes the largest share of the capacity at 42% although only 29% of the output. The total capacity of small to medium (>45 kW – <1 MW) sized installations has increased by 3% and output by 24% since 2017. The capacity of micro (≤45 kW) installations has increased by 8% and output by 9% compared to their respective 2017 figures.

By the end of December 2018, 12,976 domestic Scottish installations had been accredited under the RHI scheme since it started in 2014. As of January 2019[6], 87% of these were installed in off-gas areas compared to an off-gas grid installation rate of 68% in England and Wales. **Systems in Scotland accounted for approximately 20% of the total number of RHI-accredited systems under both the domestic (20%) and non-domestic (21%) RHI schemes as of December 2018**[7]**. This is considerably above the proportion of installations to be expected on a pro-rata basis**.

[6] Data from January 2019 is used as the closest proxy to December 2018 publicly available from BEIS at the time of publication to contain a breakdown of RHI installations by off and on-gas grid areas. https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2019

[7] 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 2019. This data shows that as of the end of July 2019, 13,883 installations in Scotland had been accredited under the domestic RHI and 3,860 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)[8] 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 2018 to 31 December 2018). 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)[9]. In some cases, the useful heat production of an installation is not known. Where this occurs, actual heat output is used instead which is the known or estimated total heat production of an installation of which useful heat makes up an unknown proportion[10].

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 and the EST datasets in order to provide a summary of the renewable heat capacity and useful heat output not already captured by EST's Renewable Heat Database. However, the full unpublished non-domestic RHI data for 2018 was provided by BEIS and analysis of this data

[8] 1 GW = 1,000 MW = 1,000,000 kW.
[9] 1 GWh = 1,000 MWh = 1,000,000 kWh.
[10] The full definitions for useful, actual and potential heat output are described in appendix 2.

was carried out by EST. The matching methodology used was different as a result and this is discussed in full in Appendix 4.

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'. Due to a lag in collecting the data, the amount of heat paid for is not always available for every installation within the RHI dataset. In these cases, the 'imputed heat' for 2018 was used instead, which is an estimate of the heat likely to be generated based on details of the site and the amount of heat generated in preceding periods.

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 MCS (provided by Gemserv in previous years).

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 and EST datasets in order to provide an aggregated summary of the renewable heat capacity and useful renewable heat output which is not already captured by the Renewable Heat Database. 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 6.

Taken together, the capacity and 'heat paid for' data provided by BEIS, the installation data from MCS, 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 to 6.3, and Appendices 4, 5 and 6.

Scottish Forestry (previously Forestry Commission Scotland) previously conducted an annual woodfuel usage survey to determine the amount of woodfuel being used for heat generation purposes in Scotland by large biomass users (defined as those with one or more biomass systems of greater than 1 MW capacity). Since 2017, EST has been carrying out the data collection and related analysis on behalf of Scottish Forestry and the Scottish Government. As in previous years, the updated capacity and heat output data for large biomass sites (both combined heat and power and heat only) collected through the survey was used to update the 2018 iteration of the Renewable Heat Database. For the sites that could not provide a heat output figure themselves, 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[11].

With some exceptions[12], 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 2018 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 multiplied by the number of hours within a year (8,760). *Potential* heat output is therefore very likely to be higher than *useful* or *actual* heat output.

Where information on capacity is not available, this is estimated based on known heat output (either the actual heat output or useful heat output) divided by the operational running hours. Where actual running hours of the system is not reported by the source, assumptions about typical running hours, based on installation size and the type of heat application (i.e. space heating or process heat), are used to calculate the output figure.

Where capacity and running hours is known, but not output, annual heat output is estimated based on the known values. Output can also be calculated by multiplying a known capacity by assumed typical running hours per year, where the latter has not been provided by the source.

In the 2018 Renewable Heat Database, 92% of the total capacity is from reported or measured data, 7% is estimated, and 1% is from records which do not identify if it is reported, measured or estimated. 71% of the total renewable heat output is reported or measured, 27% is estimated, and 2% is from records which do not identify if it is reported, measured or estimated. The MCS and CHP accreditation data received were counted as known values, although in reality, these datasets are likely to include some modelled rather than actual figures. Only the metered RHI values were treated as known and the ‘imputed’ heat values used from the RHI dataset have been counted as estimates. 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 2):

- Biomass (wood) primary combustion.
- Biomass (wood) combined heat and power (CHP).

[11] Further information on the assumptions used can be found within Appendix 3.
[12] For example, where we have a known contact at the site who can provide the correct information.

- Solar thermal panels.
- Heat pumps: water source, air source and ground source.
- Energy from waste (EfW), including:
  - Anaerobic digestion (AD)[13].
  - 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[14] (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[15].

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

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

[13] Excluding the parasitic heat used to maintain the anaerobic digestion process.
[14] 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.
[15] 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

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 2018 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 2018. 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 both the 2017 and 2018 versions of the Renewable Heat Database, Scottish Government provided an extract of Scottish Heat Network data for networks fuelled by biogas and biomass.

Table 1. Main datasets used for 2018 figures and estimates of future output

Organisation	Dataset
Department for Business, Energy and Industrial Strategy (BEIS)	Non-domestic RHI data covering a list of installations with capacity and heat output for the year 2018, merged with EST data to generate a dataset of entries not already covered by the Renewable Heat Database. Domestic RHI data is not included to avoid double counting with the data provided by MCS 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.
Scottish Forestry (based on survey carried out by EST)	Woodfuel demand and usage and estimated heat output in Scotland, 2018 (surveyed but with some assumed values). The datasets from the Scottish Forestry woodfuel usage survey contain estimates of all woodfuel usage for the year 2018 for large sites (>1 MWth) only. Scottish Forestry 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)[16].
Resource Efficient Scotland, on behalf of the Scottish Government	Renewable heat installations funded by Resource Efficient Scotland's SME Loans Scheme
Energy Saving Trust, on behalf of the Scottish Government	Applications to the District Heating Loan Fund, and data from the community and locally owned renewable energy database[17]

[16] https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
[17] https://www.energysavingtrust.org.uk/scotland/communities/community-renewables/community-energy-reports

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.
MCS	Microgeneration Certification Scheme (MCS) data, provided by MCS in 2018 (and provided by Gemserv prior to 2018)
Other sources[18]	Including Ofgem accreditation register, publicly available planning documents and information from site operators/owners and other technical organisations

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 from the Scottish Forestry'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. 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 Appendix 3. These efficiencies were updated 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].

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. One of the reasons for this is because CHP produces both electricity and heat and estimating the breakdown of output for each energy type depends on which is more sought by the end user. Where known, useful heat output has been recorded for CHP sites, based on information from the sites themselves provided via woodfuel surveys, or via direct contact with operations managers at the sites.

[18] Analysis contains data on installations covered by Pollution Prevention and Control licenses in Scotland provided by Scottish Environment Protection Agency (SEPA) in previous years but not for this year.
[19] Mitchell, Hudson, Gardner, Storry and Gray, 1990. Wood Fuel Supply Strategies Vol 1. The Report: ETSU B 1176-P1.
[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376805/Review_of_biomass_performance_standards.pdf

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

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 assumed running hours can be found within Appendix 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.

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 3.

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

- Capacity per m^2: 0.7 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].

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. This estimate of the parasitic heat requirement of the AD process was provided by Zero Waste Scotland.

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[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 46% in 2018.
[22] This assumption was changed during the 2014 database update due to revisions to SAP. Previously 0.34 MWh per m^2 was used.
[23] Renewable Energy Statistics: Data Sources and Methodologies, BEIS: https://www.gov.uk/government/collections/renewables-statistics

3.5 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 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 last year, an extract of Scottish Heat Network data was included in the 2017 Renewable Heat in Scotland database. This source was used to update the database again this year, however, the information is not complete enough to use the dataset to estimate the extent of district heating in Scotland fuelled by renewable sources.

3.6 Revised figures for 2017

Some of the figures provided in last year's report for 2017 have been revised due to improvements in the quality of the data collected and as part of the annual data cleansing process.

The most significant changes made arose from introducing a risk factor to account for potential duplication between small scale (≤45 kW) reported installs and the anonymised domestic extract provided by MCS. Further alterations occurred due to changes in the RHI database matching procedure carried out by EST for the first time this year as well as from some considerable changes reported from a few of the large sites (>1 MW) surveyed.

The headline changes to the 2017 report are as follows:

- The known total of operational capacity was reduced from 2.0 GW to 1.94 GW.
- The total yearly output for 2017 fell from 4,800 GWh to 4,569 GWh.

The full list of changes made to the 2017 results are set out in more detail in Appendix 1.

3.7 Revised heat demand estimates

In 2019, BEIS adjusted their methodology to calculate sub-national energy consumption; it now includes petroleum use in the public sector and agriculture which it didn't before. In September 2019, BEIS published a revised time series back to 2005. Previously heat demand was assumed to be all gas and residual fuels not used for transport but end use of these fuels is not definitively known from the sub-national statistics. BEIS's Energy Consumption in the UK (ECUK) publication breaks down end use for heat by sector and fuel, but this data applies to Great Britain as a whole. To estimate use for heat in Scotland, the proportion used for heat for each fuel and sector was applied to the Scottish consumption figures to calculate a more realistic representation of Scottish heat demand. The ECUK data shows that approximately 96% of non-transport consumption from coal, petroleum, manufactured fuels and bioenergy and wastes is used for heat. The whole series of heat demand estimates used in this report has been revised to reflect these changes.

4 Renewable heat capacity and renewable heat output in 2018

In 2018, 5,230 GWh of heat was produced from renewable sources from an installed capacity of 2.01 GW[24].

In 2018, Scotland produced enough heat from renewable sources to meet **an estimated 6.3% of non-electrical heat demand**.

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).

In previous iterations of this report, progress towards the renewable heat target was shown through the use of three non-electrical heat demand scenarios that had been estimated for each reporting year[25].

For ease of reporting and for now greater consistency with other Scottish Government publications[26], only one scenario is used to estimate the percentage of heat demand met by renewables: the unchanged heat demand scenario (scenario 2). The renewable heat generated as a percentage of Scottish heat demand from 2008/9 to 2018 is presented in Table 2 and Figures 5 and 6. A revised estimate of the percentage of non-electrical heat demand met by renewable sources will be published in early 2020 once sub-national gas demand figures for 2018 have been made available by BEIS; the definitive percentage will then be published in September 2020 as part of the Scottish Government's quarterly energy statistics[27] once sub-national non-gas demand figures for 2018 have also been published.

As discussed in section 3.7, all previously reported non-electrical heat demand figures, and the percentage thereof fuelled by renewable sources, have been revised. This is due to a change in the methodology used by BEIS to calculate sub-national energy consumption as well as a change in the methodology for estimating the contribution of non-transport related fuel use towards non-electrical heat demand.

See Appendix 7 for more information on the methodology used to estimate the percentage of non-electrical head demand prior to this publication and how this differs from the current methodology.

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[24] 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.
[25] The three scenarios include; scenario 1 (low heat demand) which assumes a reduction in heat demand by the average annual change seen between 2008 and 2017; scenario 2 (medium heat demand) which assumes no change in demand from the previous year and scenario 3 (high heat demand) which applies the largest percentage increase in heat demand since reporting began to the previous year's heat demand figure.
[26] See the Annual Compendium of Scottish Energy Statistics (ACSES) for further information on Scottish energy trends. https://www2.gov.scot/Topics/Statistics/Browse/Business/Energy/ACSES
[27] See https://www2.gov.scot/Topics/Statistics/Browse/Business/Energy for the latest Scottish Government energy statistics.

Table 2: Renewable heat and renewable heat as a percentage of heat demand[28]

	2008/9	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total renewable heat output (GWh)	863	Not estimated	1,363	1,690	2,045	2,266	3,071	4,205	3,752	4,569	5,230
% of total non-electrical heat demand	**0.9%**	**1.2%**	**1.5%**	**2.0%**	**2.4%**	**2.7%**	**3.9%**	**5.3%**	**4.7%**	**5.5%**	**6.3%**
Heat demand (GWh)	94,380	87,058	89,461	86,609	85,540	83,422	79,670	78,694	79,695	82,895	82,895

Note: The percentage of non-electrical heat demand met by renewable sources for 2008/9 uses the heat demand value for the 2008 calendar year and the resulting percentage is therefore an approximate indication.

As renewable heat output was not estimated for 2009, the percentage of non-electrical heat demand to be met by renewables for that year has been interpolated from the 2008/9 and 2010 values.

Between 2017 and 2018, **renewable heat capacity** in Scotland has risen by **0.07 GW (from 1.94 GW to 2.01 GW)**, which is an **increase of 4%**.

The overall useful **renewable heat output** from operational sites in Scotland **increased by 661 GWh** from 4,569 GWh in 2017 to 5,230 GWh in 2018, **which is an increase of 14%**. Approximately 44% (291 GWh) of this increase is from small to medium sized installations; this size bracket had 30 new installations become operational within 2018 and many of the pre-existing installs recorded an increase in output. The larger sites also show an increase in output of around 12% (262 GWh), and this accounts for 40% of the total increase in output from 2017 to 2018.

For further breakdowns and discussion on both capacity and output by size and technology, see sections 4.1 to 4.5.

Annual figures for renewable heat capacity and useful renewable heat output since 2008/9 can be seen in Figures 3 and 4.

[28] The non-electrical heat demand figures presented here, and the related % of which is met by renewables, have been revised from what was published previously. This is discussed in section 3.7 and for further information see Appendix 7.

Figure 3. Estimated renewable heat capacity in Scotland, 2008/9 - 2018

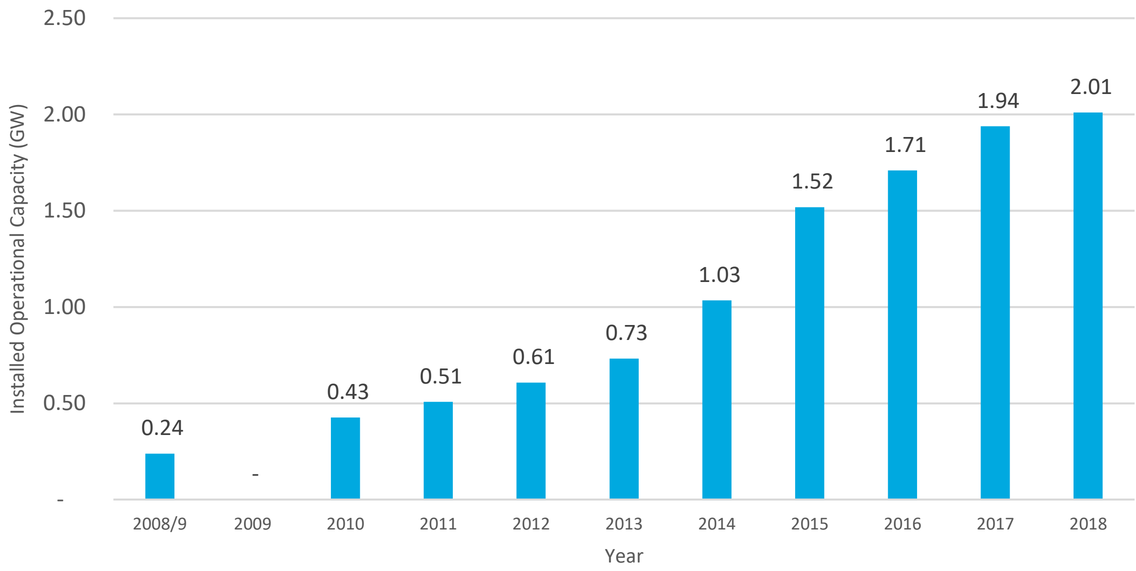
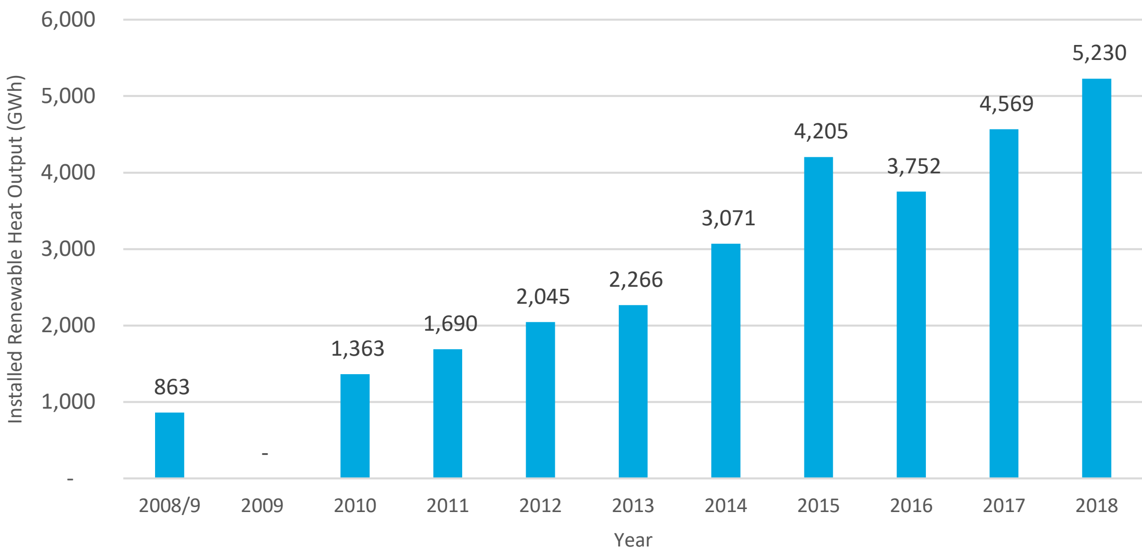


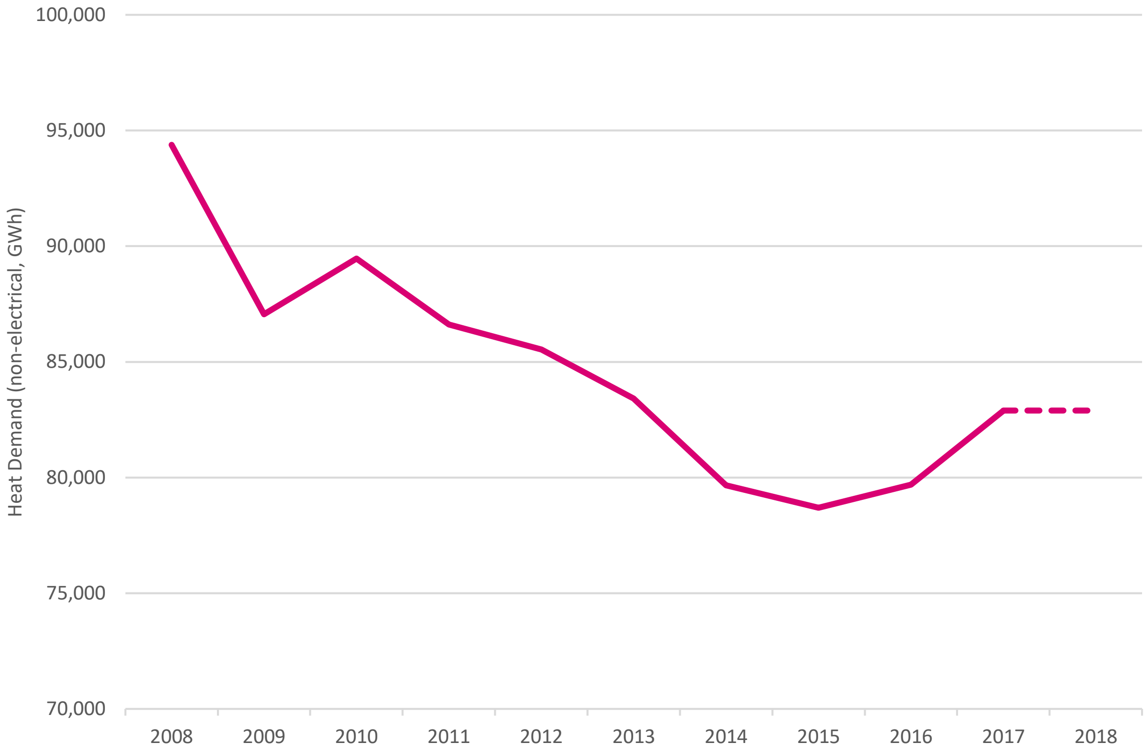
Figure 4. Estimated renewable heat output in Scotland, 2008/9 - 2018



Note: The output drop from 2015 to 2016 was primarily due to changes at a small number of larger sites.

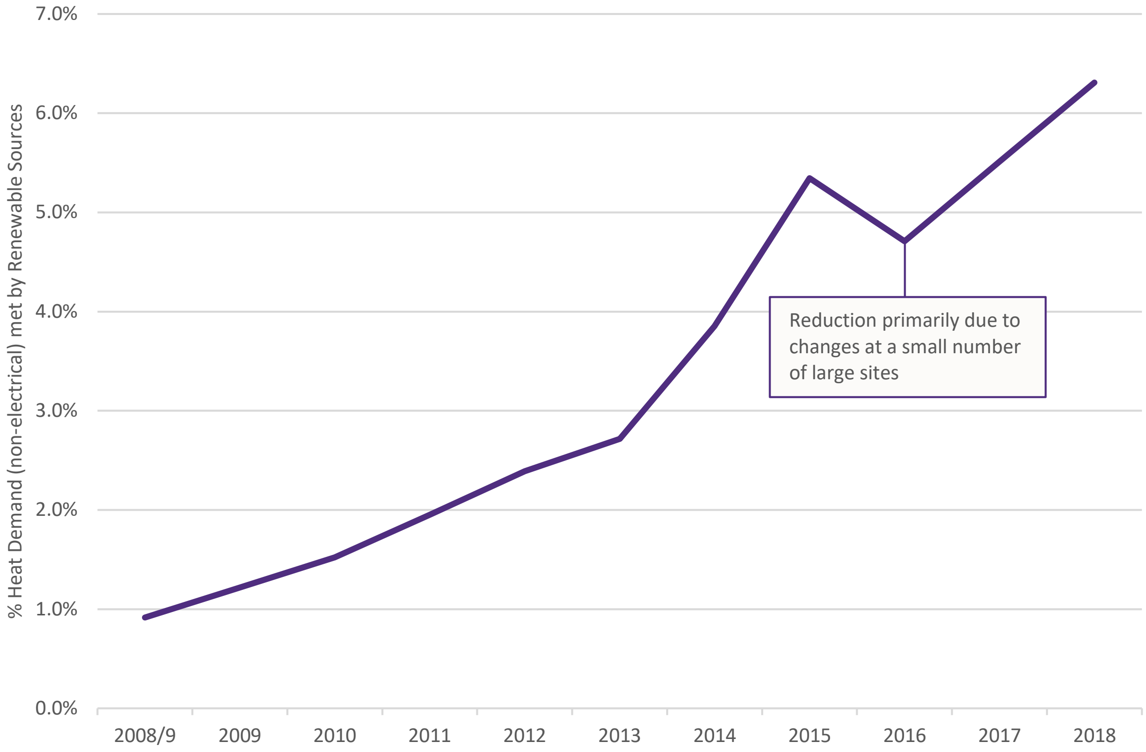
While renewable heat output has gradually increased since 2008/9, heat demand has fallen over this period due to a combination of factors including improved energy efficiency and increases in average annual temperatures (see Figure 5 below). This means that renewably generated heat now meets a greater proportion of overall heat demand than would have otherwise been the case. Had heat demand remained at 2008/9 levels then the renewable heat output recorded for 2018 would make up only 5.5% of non-electrical heat demand instead of the 6.3% 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 2016 (by 1.3%) and again in 2017 (by 4.0%).

Figure 5. Estimated non-electrical heat demand in Scotland, 2008 – 2018



Note: the non-electrical heat demand for 2018 has been estimated by holding the 2017 value constant. See the update to the Renewable Heat in Scotland, 2018 report to be published in early 2020 for a revised estimate.

Figure 6. Percentage of non-electrical heat demand met by renewables in Scotland, 2008/9 – 2018



Note: The percentage of non-electrical heat demand met by renewable sources for 2008/9 uses the heat demand value for the 2008 calendar year and the resulting percentage is therefore an approximate indication.

As renewable heat output was not estimated for 2009, the percentage of non-electrical heat demand to be met by renewables for that year has been interpolated from the 2008/9 and 2010 values.

4.1 Results by installation size

The **largest share of renewable heat output in 2018 continues to come from large (>1 MW) installations** (see Table 3). In total, large installations contributed 40% of the renewable heat capacity and 47% of the total annual output. This is broadly consistent with the revised figures for 2017 (see Table 4), when large sized systems made up 48% of the total reported heat output. Small and medium sized systems have shown the greatest proportional increase, 24%, compared with 2017. As discussed earlier, this is due to a combination of new sites becoming operational and greater outputs reported from installations already in operation prior to 2018.

This large contribution from a small number of very large 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.

Within the large size category there are **7 installations** that generate **more than 100 GWh heat per year in 2018**; together these sites provided 30% (1,571 GWh) of the total renewable heat output in Scotland in 2018 and 15% (0.303 GW) of the operational renewable heat capacity.

The large contribution made by installations with capacities greater than 1 MW to the overall output emphasises the importance of continuously improving the quality of data collected from these sites. Small changes in the information collected from these sites could result in potentially significant changes to the estimated total heat output. One such example is the drop in output seen between the 2015 and 2016 reporting years (see Figure 6), largely as a result of a small number of changes for large sized project entries.

Table 3. Renewable heat capacity and output in Scotland, 2018, by size of installation

Size category	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output	Number of installations	% Number of installations
Large (>1 MW)	0.798	40%	2,450	47%	100	<1%
Small to medium (>45 kW – <1 MW)	0.864	42%	1,511	29%	3,650	14%
Micro (≤45 kW)	0.347	18%	634	12%	21,780	85%
Biomethane	N/A	N/A	624	12%	10	<0.1%
Unknown	<0.1	<1%	10	1%	20	<0.1%
Total	2.010	100%	5,230	100%	25,550	100%

Table 4. 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	% Number of installations
Large (>1 MW)	0.778	40%	2,188	48%	90	<1%
Small to medium (>45 kW – <1 MW)	0.835	43%	1,221	27%	3,620	16%
Micro (≤45 kW)	0.322	17%	584	13%	19,290	84%
Biomethane	N/A	N/A	566	12%	10	<0.1%
Unknown	<0.1	<1%	10	1%	10	<0.1%
Total	1.938	100%	4,569	100%	23,020	100%

Notes for Tables 3 and 4:

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

3) The "unknown" category includes groups of installations where the total capacity and output are known but not the number of, and thereby size per, install. It also includes some anonymised CHPQA data which is not broken down by size category for reasons of non-disclosure.

4) Data has been rounded for ease of reading, and all installation counts have been rounded to the nearest 10, hence some totals may not precisely equal summed figures

Key points from Tables 3 and 4 are:

- The **total capacity and output of large installations increased between 2017 and 2018 by 3% and 12% respectively.** The number of installs for the large size category increased by 10 from 2017. Since 2008/9, the total capacity and total output of large installations has more than tripled (from 0.164 GW to 0.798 GW capacity and from 637 GWh to 2,450 GWh output).

- In 2018, **small to medium** (>45 kW – <1 MW) systems made up 14% of the renewable heat installations in Scotland (by number). The small to medium size category is mostly made up of biomass systems (92% by number of installs) with other technologies (energy from waste, heat pumps and solar thermal) making up the remainder (8%). **Capacity from these systems has increased by 3% (0.028 GW) between 2017 and 2018, while output has increased by 24% (291 GWh)**. The high ratio of output to capacity gained in this size category for 2018 highlights the contribution made from increasing the running hours, and thereby output, from installations known to be operating prior to 2018. All of the capacity gain comes from newly operational installations.

- **Micro heat capacity increased by 8% between 2017 and 2018, while output increased by 9%.** This continues the ongoing trend for the contribution of the micro size category increasing year on year however, the rate of increase has declined across that same period. Between 2017 and 2018, capacity and output increased at a lower rate than between 2015 and 2016 when capacity rose by 11% and output rose by 21%. This may be a continuation of the effect of lower domestic RHI tariffs available for biomass in 2018 offering a lower financial return for micro-installations.

  Since 2008/9 micro heat capacity has increased by more than seven times (from 0.0454 GW to 0.347 GW) and output has increased by more than four times (from 139 GWh to 634 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 2008/9 and 2018 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.

4.2 Results by technology

The **majority of both output (74%) and capacity (83%) in 2018 came from biomass primary combustion and biomass combined heat and power** (see Table 5, and Figures 7 and 8). This is a continuation of the trends seen in both the publicly available domestic and non-domestic RHI reports[29] as well as from previous years' Renewable Heat in Scotland reports.

Tables 5 and 7 and Figures 7 and 8 show the breakdown of operational renewable heat capacity and renewable heat output in Scotland in 2018 by technology category.

Table 6 shows the breakdown of operational renewable heat capacity and renewable output in Scotland for 2017 by technology category for comparison.

Table 5. Renewable heat output and capacity in Scotland, 2018, by technology

Technology	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output	Number of installations	% Number of installations
Biomass	1.261	63%	3,088	59%	8,400	33%
Biomass CHP	0.403	20%	757	14%	40	<1%
Energy from waste	0.123	6%	1,027	20%	180	1%
Heat pump	0.186	9%	340	6%	13,250	52%
Solar thermal	0.037	2%	18	<1%	3,690	14%
Total	2.010	100%	5,230	100%	25,550	100%

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

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

Table 6. Renewable heat output and capacity in Scotland, 2017, by technology

Technology	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output	Number of installations	% Number of installations
Biomass	1.232	64%	2,677	59%	8,180	36%
Biomass CHP	0.395	20%	685	15%	30	<1%
Energy from waste	0.115	6%	904	20%	150	1%
Heat pump	0.159	8%	284	6%	11,310	49%
Solar thermal	0.036	2%	17	<1%	3,340	15%
Total	1.938	100%	4,569	100%	23,010	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 6 below.

Table 7. Renewable heat output and capacity in Scotland, 2018, energy from waste technologies

Energy from Waste Technology	Renewable heat capacity (GW)	% Renewable heat capacity	Annual output (GWh)	% Annual output
Energy from waste - advanced conversion technologies	0.105	5%	935	18%
Energy from waste – incineration	0.014	1%	77	1%
Energy from waste - landfill gas	0.004	<1%	15	<1%
Total	0.123	6%	1,027	20%

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 2017 and 2018. In particular, energy from waste has seen an increase in capacity of 6% (from 0.115 GW to 0.123 GW) but with an increase in output of 14% (from 904 GWh to 1,027 GWh). Heat pumps have also seen considerable growth, with a 17% increase in capacity (from 0.159 GW to 0.186 GW) and 20% increase in output (from 284 GWh to 340 GWh).

Figure 7. Renewable heat capacity in Scotland, 2018, by technology

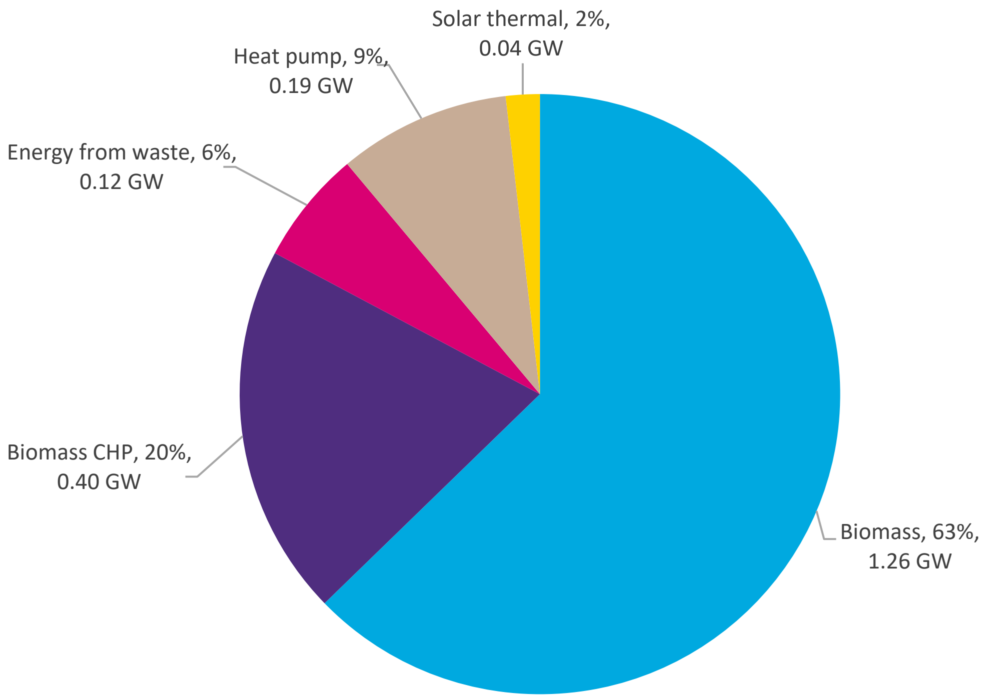
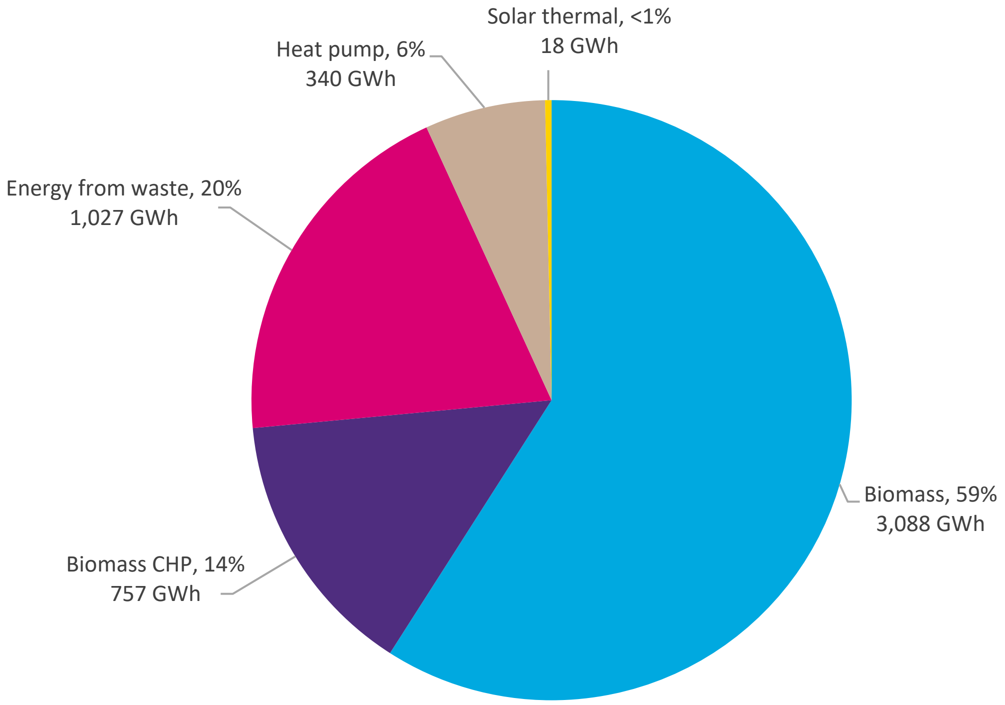


Figure 8. Renewable heat output in Scotland in 2018, by technology



4.3 Results by size and technology

In 2018, the size of biomass CHP and energy from waste sites follow the same patterns seen in 2017 and 2016, with the majority of the installations being found within the 'large' size bracket. However, 61% of energy from waste heat output comes from biomethane installations which, as no energy is generated on site, do not have a capacity and are therefore not able to be classed by installation size. However, biomethane installations contribute a considerably lower proportion of the total number of energy from waste installations at 7%.

Large biomass sites account for around 24% of total biomass (not including biomass CHP) capacity, however their renewable heat output accounts for 46% of the total renewable heat output from biomass technologies in 2018. 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. The share of biomass output from large size installs has decreased relative to previous years with larger sites having an almost even share of the total biomass output with small and medium sized installations (43%). To some extent, this reflects the increase in uptake of small and medium sized biomass boilers to take advantage of preferential changes to the non-domestic RHI tariffs for this size bracket relative to the larger and micro installation size tariffs.

As in previous reporting years, 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. The majority of heat pump and solar thermal installs in Scotland are for domestic properties.

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), 2018

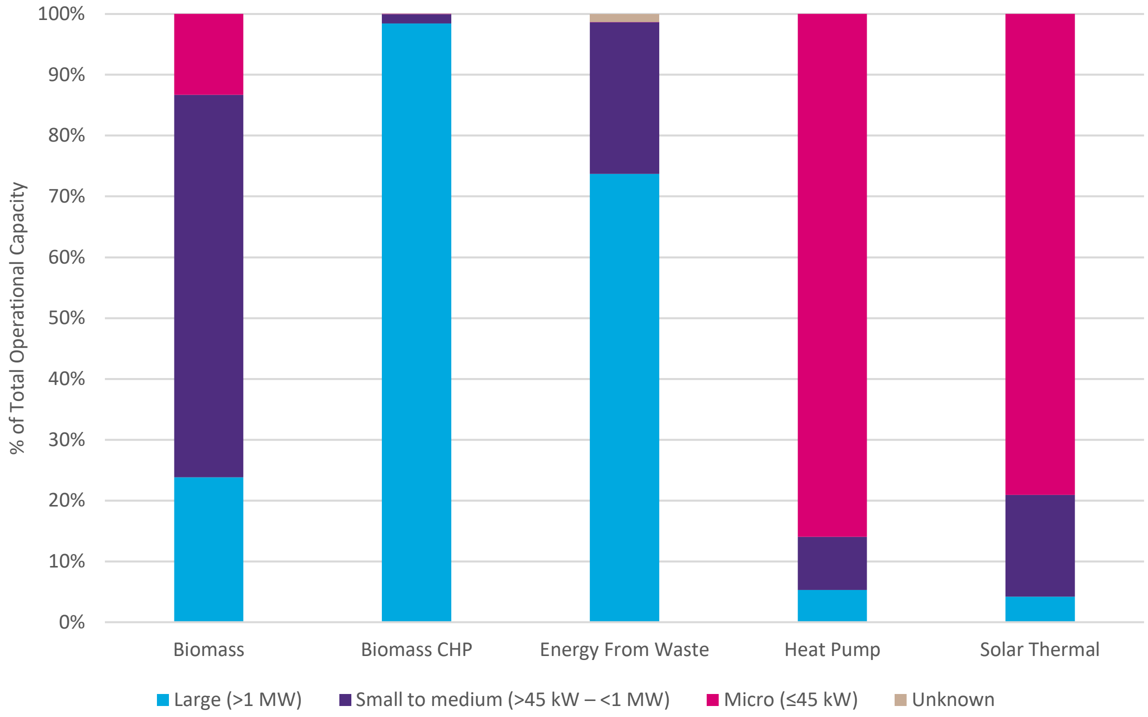
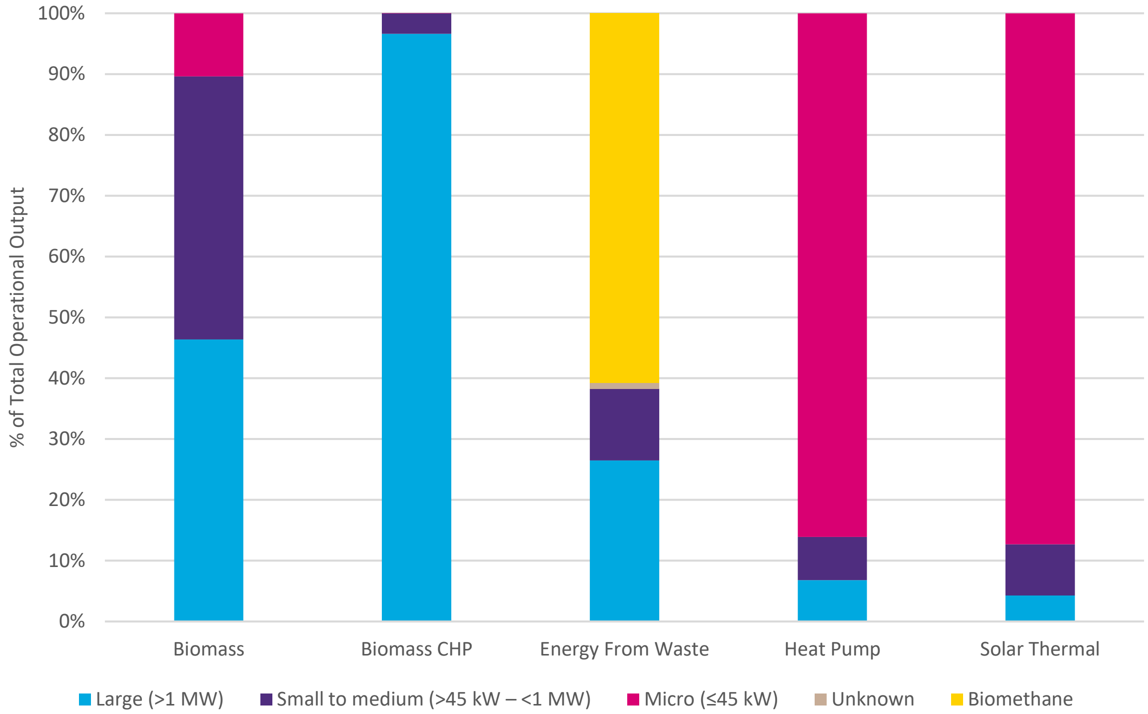


Figure 10. Output by size and technology (% of total technology operational heat output), 2018



4.4 Change in output and capacity by technology since 2017

The overall proportions of renewable heat capacity provided by different technology types have remained relatively stable between 2017 and 2018 (see Table 8). Biomass primary combustion continues to be the largest contributor to renewable heat capacity in Scotland followed by biomass CHP. Biomass primary combustion and biomass CHP have each seen a 2% increase in capacity in 2018. Combined, these technologies accounted for 83% of renewable heat capacity in 2018 compared to 84% in both 2017 and 2016.

Biomass also continues to make up the vast majority of total renewable heat output (74% in 2017 and 2018, see Table 9). The increase in biomass combustion and biomass CHP output accounts for 74% of the total increase in renewable heat output in 2018.

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.

The growth in output and capacity from energy from waste in 2018 follows an ongoing trend of increasing year-on-year, with the number of energy from waste sites increasing by 20 installs from 2017 and output increasing by over eight times from 122 GWh in 2013 to 1,027 GWh in 2018.

Energy from waste currently accounts for 6% of renewable heat capacity and 17% of output. The total capacity of energy from waste sites has remained broadly consistent with the last two reporting years because the vast majority of the output gain for this technology group comes from biomethane installs which do not have a capacity as the renewable fuel is injected into the grid rather than burned on site. Some reduction in energy from waste capacity also occurred as part of data cleansing when four large sites, which only recently started operating within the last two years, were removed as they do not currently have any end users for the heat generated. These sites total a combined 24 MW of additional capacity and will continue to be monitored throughout the next reporting cycle.

Heat pumps similarly contribute a relatively small proportion of total renewable heat capacity and output but have seen reasonably large proportional increases between 2017 and 2018; an increase of 17% to both capacity and output. The majority of this gain occurred within the micro-size category, a large proportion of which is known to be in domestic settings.

Table 8. Changes in renewable heat capacity (GW) in Scotland from 2017 to 2018, by technology

Technology category	2018 Total capacity	2017 Total capacity	Absolute change	Percentage change
Biomass	1.261	1.232	0.029	2%
Biomass CHP	0.403	0.395	0.008	2%
Energy from waste	0.123	0.115	0.007	6%
Heat pump	0.186	0.159	0.027	17%
Solar thermal	0.037	0.036	0.001	3%
Total	**2.010**	**1.938**	**0.072**	**4%**

Table 9. Changes in renewable heat output (GWh) in Scotland from 2017 to 2018, by technology

Technology category	2018 Total annual output	2017 Total annual output	Absolute change	Percentage change
Biomass	3,088	2,677	410	15%
Biomass CHP	757	685	72	10%
Energy from waste	1,027	904	123	14%
Heat pump	340	284	56	20%
Solar thermal	18	17	1	4%
Total	**5,230**	**4,569**	**661**	**14%**

Notes for Tables 8 and 9:

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

4.5 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 – <1 MW) size categories. Information for each local authority is limited for micro (≤45 kW) installations as location information for these records had 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 2008/9 – 2011).

Since 2017, EST has been receiving MCS data which includes the local authority for each record dating back to 2012. Due to the data cleansing occurring on both datasets and anonymisation of MCS records initially obtained, it was not possible to match old MCS records with the correct local authority identifiers. Therefore, all MCS installations commissioned before 2017 are included within the 'local authority unknown' figures in Table 10. EST and MCS are cooperating with the goal of replacing all of the historical MCS installs currently held within the Renewable Heat Database with the more up to date records.

CHPQA data received from Ricardo-AEA is also not available at a local authority level due to the risk of disclosing anonymised data.

The distribution of renewable heat output is shown in Table 10 and renewable heat capacity in Table 10 and Figure 11. The percentage of each local authority's heat demand met by the renewable heat output from those same council areas is shown in Figure 12[30].

The key findings from the local authority analysis are:

- The Highland local authority area accounted for 17% of Scotland's total renewable heat output and 14% of the overall operational capacity for in 2018.

- Four local authority areas (Highland, Stirling, North Ayrshire and South Ayrshire) accounted for 46% of the heat output for which the local authority area is known and collectively contributed over 2,414 GWh of renewable heat in 2018. These 4 areas had a combined capacity of 0.55 GW (27% of the renewable capacity in Scotland).

- 10% of the reported output and 13% of the reported capacity cannot currently be attributed to a local authority.

Local authorities with less than 10 MW of operational renewable heat capacity or 10 GWh of operational heat output have had data anonymised to prevent the potential disclosure of confidential or commercially sensitive information.

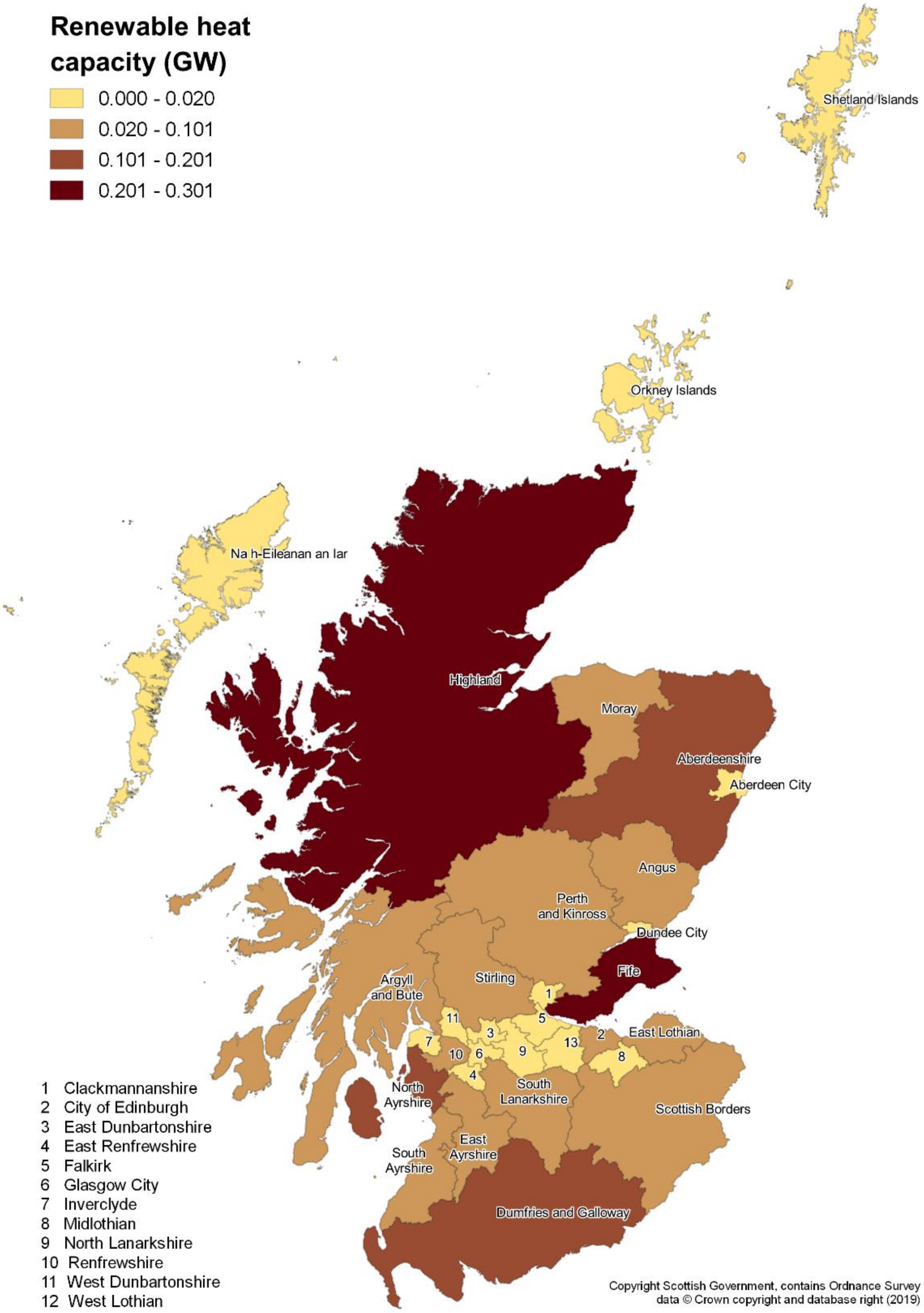
[30] This illustration utilises heat demand values which are not published publicly by BEIS and have there not been published in this report.

Table 10. Heat output and capacity by local authority area, Scotland, 2018

Local authority area	Renewable heat output, 2018 (GWh)	Renewable heat output, 2018 (%)	Operational renewable heat capacity, 2018 (GW)	Operational renewable heat capacity, 2018 (%)
Aberdeen City	15	0.28%	0.01	0.40%
Aberdeenshire	345	6.60%	0.19	9.43%
Angus	129	2.47%	0.06	3.00%
Argyll and Bute	52	1.01%	0.03	1.52%
City of Edinburgh	45	0.87%	0.02	1.03%
Clackmannanshire	##	##	##	##
Dumfries and Galloway	276	5.28%	0.14	6.90%
Dundee City	##	##	##	##
East Ayrshire	150	2.86%	0.08	3.79%
East Dunbartonshire	55	1.05%	0.01	0.41%
East Lothian	54	1.04%	0.02	1.14%
East Renfrewshire	##	##	##	##
Falkirk	##	##	##	##
Fife	190	3.63%	0.24	12.02%
Glasgow City	21	0.40%	0.01	0.61%
Highland	904	17.29%	0.28	13.83%
Inverclyde	13	0.25%	0.01	0.54%
Midlothian	21	0.40%	0.01	0.49%
Moray	278	5.31%	0.09	4.50%
Na h-Eileanan Siar	21	0.40%	0.01	0.59%
North Ayrshire	376	7.19%	0.12	5.79%
North Lanarkshire	63	1.21%	0.01	0.63%
Orkney Islands	10	0.19%	0.01	0.26%
Perth and Kinross	216	4.13%	0.07	3.66%
Renfrewshire	31	0.59%	0.03	1.49%
Scottish Borders	150	2.86%	0.06	2.75%
Shetland Islands	34	0.66%	0.01	0.42%%
South Ayrshire	470	8.98%	0.06	2.77%
South Lanarkshire	76	1.45%	0.06	2.83%
Stirling	664	12.69%	0.10	4.74%
West Dunbartonshire	##	##	##	##
West Lothian	33	0.64%	0.01	0.66%
Local authority unknown	502	9.60%	0.26	13.06%
TOTAL	**5230**	**100%**	**2.01**	**100%**

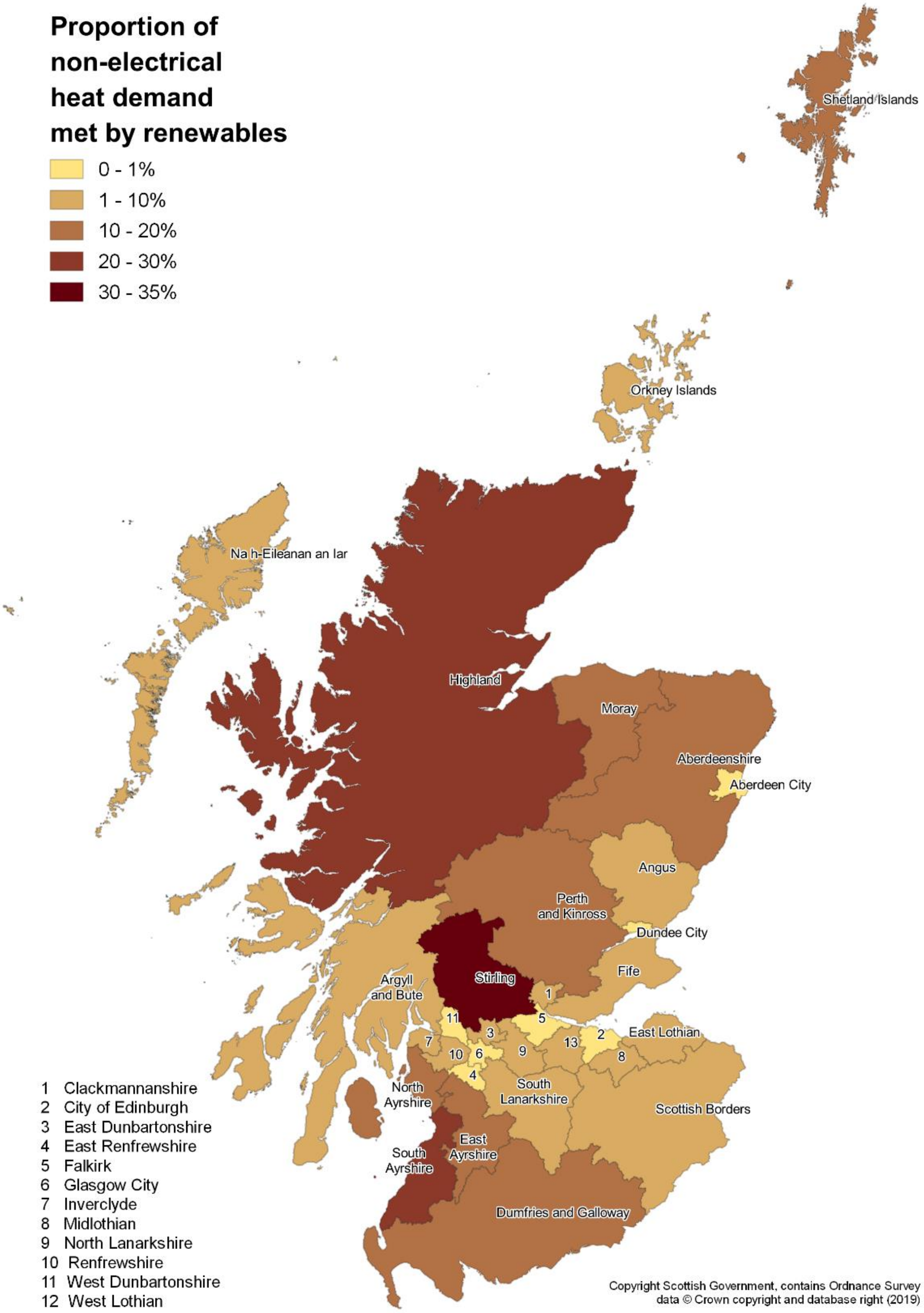
Note: ## denotes anonymised data

Figure 11. Map showing operational renewable heat capacity by local authority area, 2018[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 percentage of local authority heat demand met by local renewable sources, 2018



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 (see Table 11). As of January 2019, the last date for which this data was published by BEIS, 90% of heat pumps and 89% of biomass systems were installed in off-grid areas[32]. 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 can work well with certain gas central heating systems.

Table 11. Number of installations on and off the gas grid accredited in Scotland under the domestic RHI scheme as of January 2019, by technology

Technology	Number of installations on gas grid	% installations on gas grid	Number of installations off gas grid	% installations off gas grid
Biomass	414	11%	3,386	89%
Heat pump	826	10%	7,280	90%
Solar thermal	420	36%	736	63%
TOTAL	**1,660**	**13%**	**11,402**	**87%**

Note: 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 2018. Please refer to section 5.2 for further commentary on the trends seen in both the domestic and non-domestic RHI between December 2018 and July 2019.

5 Further renewable heat capacity in development

5.1 Pipeline projects in the Renewable Heat Database

Commentary on the predicted 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. However, EST is aware of several large sites (>1 MW capacity) which have recently begun operating but as yet have no end heat users to supply. The majority of these are energy from waste sites but some biomass users are also included. EST will continue to monitor the progress of potential heat use at these sites and any other installations we become aware of during 2019, largely through the use of available heat network data, planning decisions and other local authority or Scottish Government heat plan related documents.

[32] Based on RHI data from April 2014 to January 2019. https://www.gov.uk/government/collections/renewable-heat-incentive-statistics#monthly-deployment-data

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 2019. During the first seven months of 2019 there was an increase in both the number of full applications[33] under the non-domestic RHI scheme and in accreditations under the domestic scheme.

Trends in the domestic RHI scheme:

- There was a **7% increase in accreditations** for systems in Scotland under the domestic RHI between December 2018 and July 2019. This is an increase of 905, from 12,976 as of 31 December 2018 to 13,881 as of 31 July 2019.

- The rate of growth in accreditations for systems in Scotland under the domestic RHI continues the trend of slowing down. It has reduced from an increase of 201% in 2015 (trebling since 2014), to 20% in 2016, to 10% in 2017 and now sits at 7% for 2018.

- The technology with the largest increase in the number of accreditations under the domestic RHI was **air source heat pumps,** with an **increase of 729,** from 6,780 as of December 2018 to 7,509 as of July 2019 (an increase of **11%**).

- The number of domestic **ground source heat pumps** accredited under the domestic RHI from December 2018 to July 2019 has **grown by 8%**, from 1,240 in December 2018 to 1,343 systems in July 2019.

- **Solar thermal** and **biomass installations** have seen lower rates of uptake, with solar thermal accreditations increasing by **4%** (from 1,157 to 1,200) and biomass accreditations increasing by **1%** (from 3,799 to 3,829) between December 2018 and July 2019.

- As of July 2019, systems in **Scotland accounted for 19% of the total number of accredited systems under the domestic RHI scheme**, a slight drop of 1% as to the 20% share held in December 2018.

[33] 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.

Trends in the non-domestic RHI scheme:

- There was a 1% increase in the number of non-domestic RHI 'full applications' in Scotland between December 2018 and July 2019, with a corresponding 1% increase in capacity. This is an increase from 3,824 full applications in December 2018 to 3,860 in July 2019 and a capacity increase of 8 MW, from 1,029 MW to 1,037 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, 14% in 2017 and 3% in 2018.

- The general trend across all countries (England, Wales and Scotland) was that the largest proportional growth in number of full applications between December 2018 and July 2019 was in large water or ground source heat pumps. GB wide, the number of full applications of large water or ground source heat pumps increased from 256 in December 2018 to 302 in July 2019 (an increase of 18%). The same technology size category saw the largest proportional growth in capacity of full applications, increasing by 20% from December 2018 to July 2019.

- Small water or ground source heat pump installations made up the largest number of new installations in Great Britain in the first 7 months of 2019, with 65 new installations, or a 7% increase, from December 2018 to July 2019.

- As of July 2019, systems in **Scotland accounted for 29% of the total number of full applications and 21% of the total installed capacity under the non-domestic RHI** scheme.

Overall, the non-domestic RHI trends highlighted by currently available data for 2019 suggests the continuation of the downward trend in the number of new biomass applications being made with an inverse rise in the number of heat pump applications. The non-domestic RHI applications mirror, to some extent, the growing rate in uptake of heat pumps in domestic settings.

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 biogas from anaerobic digestion (AD) to biomethane for 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) that you inject into the gas grid for use. 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 has already been a considerable increase in the amount of heat generated by biomethane to grid sites in Scotland during 2017 and 2018. The majority of the biomethane technology derived output presented in this report was sourced from the BEIS RHI dataset because it is not always clear whether sites export all or some of the biogas captured from anaerobic digestion, or other processes, for conversion to biomethane or whether all consumption takes place on the site alone.

In May 2019 the Scottish Government published a review of domestically available bioenergy resources[34]. This report suggested that there could be up to 2,700 GWh of feedstock available for processes such as AD by 2030. The Scottish Government has commissioned further research to better understand the scale of AD opportunity and the barriers to deployment. The results of this research will help to inform the development of a Bioenergy Action Plan to be published by May 2020.

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[35].

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 community groups and organisations and rural businesses to take forward renewable energy projects.

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

- Promoting direct ownership of renewables by communities and rural SME's.
- Shared ownership of (and community investment in) commercial schemes.
- Levering community benefits from commercial schemes.

[34] https://www.climatexchange.org.uk/media/3609/the-potential-contribution-of-bioenergy-to-scotland-s-energy-system.pdf
[35] Information on projects awarded funding through the District Heating Loan Fund can be found at: http://www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan

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

CARES supports the delivery of Scottish Governments' targets for 1 GW of community and locally owned energy by 2020 and 2 GW by 2030. Progress as of June 2018 was an estimated 697 MW (69.7% of the target) of operational community and locally owned renewable energy capacity 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 17 demonstrator projects supporting low carbon energy generation and supported the co-development of over 30 proof of concept and development proposals.

As part of the Programme for Government the First Minister announced that to support Scotland's response to the Climate Emergency, a Low Carbon Heat Fund would be launched providing a minimum of £30m support for local and industrial renewable heat projects. Applications for capital support closed on 25th October 2019 and projects must be completed by 31st March 2022[36].

5.3.4 Energy Efficient Scotland

The Scottish Government's Infrastructure Investment Plan 2015 designated 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; 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.

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

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 set the strategy for reducing energy demand and decarbonising the heat supply to buildings. These set out long-term approaches to reducing emissions from buildings and tackling fuel poverty by identifying a solution tailored to the local area as well as identifying zones suitable for the development of heat networks

The Scottish Government will work with local government to put the strategies on a statutory footing and bring forward the timescale for implementation. A pilot programme was initiated to shape and test the development of LHEES. This allows all 32 local authorities to trial different aspects and to support the building of capacity and capability.

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. Two pilot phases have run so far with 23 local authorities receiving funding. In September 2019 the remaining 9 local authorities were invited to participate in the third round of pilots.

5.4 Other developments from 2018 onwards

In the 2017 Renewable Heat in Scotland report it was noted that operational renewable heat capacity in Scotland is growing faster than the annual heat renewable output from the operational sites. However, the results from 2018 suggests the opposite with output increasing by approximately 14% and capacity by around 4%.

In addition to the capacity and output on record, there are several large sites currently in operation, or close to being so, which were removed from this year's analysis because there are currently no end users ready to receive the heat generated. 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.

EST will endeavour to monitor the development of such sites because the integration of these existing energy centres into local or new heat networks could boost the percentage of non-electrical heat demand met by renewables in Scotland closer towards the 2020 target. However, in a number of cases it is not clear how long it will be until currently available but unused heat could be utilised and therefore the likelihood of these sites contributing towards the 2020 target deadline remains unknown.

The Scottish Government recognises that there is a clear role for heat networks both now and in the future in reducing the emissions associated with heating homes and buildings.

As discussed above, support for the deployment of new heat networks is currently supplied through the District Heating Loan Fund (DHLF), the Low Carbon Infrastructure Transition Programme (LCITP) and the Heat Network Partnership.

In addition, it was announced in the Programme for Government 2019 – 2020 that the Scottish Government will now move to introduce a Heat Networks Bill in the coming year. The Bill aims to substantially grow the number of heat networks in Scotland by attracting greater private investment in the sector and by regulating developers and suppliers to support public awareness and acceptance.

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 not match the predictions of output based on installed capacity and peak running hours.

- 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, 92% of renewable heat capacity is known, 7% is estimated and 1% has an unknown status. 71% of renewable heat output is known, 27% 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 and made its first payments 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 monitoring reports. In 2019 a full extract of all active, not cancelled or terminated, non-domestic RHI accreditations was made available to EST for comparison with the Renewable Heat Database under the condition that only the final aggregated and anonymised “missing” capacity and output totals be added to the final results.

The RHI continues to incentivise the uptake of renewable heat technologies of which 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 6.3 below). Installations of varying size and in ownership of local authorities or housing associations are also likely to be captured through the work on the Community Energy in Scotland database which is also collated by EST.

Analysis of the RHI data for the Renewable Heat in Scotland report indicated that a considerable amount of small and medium sized installations are currently unknown to EST. This is especially important for biomass installations in commercial settings which are capable of contributing a greater proportion of heat output than smaller scaled installs for domestic properties or for other space heating uses.

Being able to conduct the matching exercise ourselves also reduced the risk of double counting as time could be spent undertaking a thorough manual matching process. As a result, the RHI aggregates included within this report are considered likely to be the most accurate done to date. A full breakdown of the matching method and possible limitations thereof can be found in Appendix 4.

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 and therefore may not capture every CHP installation in Scotland. However, various government tax breaks and incentive schemes require the installation to be accredited under the CHPQA scheme in order to receive government support and this increases participation 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. An extract of the Renewable Heat Database was sent to Ricardo-AEA for cross-matching with the CHPQA data set and the total number of unmatched installs, capacity and output was returned. Due to the small number of sites found to be unmatched, some results were anonymised and aggregated in a manner which made it difficult to compare with previously reported results or other datasets, there is therefore a risk of double counting some projects. One change made to this years' methodology to reduce this risk was to exclude the CHP data returned for biomass CHP sites as these were also likely to be included within the RHI CHP tariff data because a CHPQA accreditation is a requirement in order to be accredited under this tariff.

6.3 Estimating heat capacity and renewable output for micro installations

As in previous years, an up to date extract of the installs from the MCS Installation Database (MID) was obtained. Prior to 2018, this was provided by Gemserv but the database is now managed by MCS who continued to supply EST and the Scottish Government with the data requested. The Microgeneration Certification Scheme (MCS) 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 2012-2018 (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 (≤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.

For the first time this year, additional checks were applied to the Renewable Heat Database to reduce the risk of double counting projects sourced from a variety of sources with records from the MID. These additional checks had the effect of removing around 45 MW of capacity and 100 GWh of output from the Renewable Heat Database; largely from known domestic or likely domestic installs reported from local authorities and housing associations of Scotland. The full logic used to reduce the risk of duplicating domestic installs can be found in Appendix 5.

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.

As discussed in sections 4.4 and 5.1, the only changes to the treatment of sites producing heat but not necessarily using it was to remove around 24 MW of operational renewable capacity from the analysis because the available evidence, from various planning and heat mapping sources, suggested that the heat was not currently being used.

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 and as far as is possible within the limits of commercial confidentiality. While some new energy from waste sites were sourced using Ofgem accreditation data and information from other online resources and technical organisations, 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 to the Scottish Government's heat targets of pipeline projects.

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 versions 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 CHP installations to be included in the in-depth analysis of the database and give a more accurate representation of renewable heat in Scotland as well as to reduce the risk of double counting projects with other sources.

6.5.3 Recommendation 3 – unused 'useful heat'

It is recommended that the Scottish Government continues to carry out work with partners to quantify the amount of waste heat from industrial sites (see section 5.4) and/or other sources. This could help inform future estimates of available unused but useful heat which, as mentioned in section 6 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 and it is particularly important to make sure that data is complete for large sites. This is because large installations (>1 MW) 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.

6.5.5 Recommendation 5 – Increased use of MCS data

As discussed in section 6.3 above, the MCS data covering the years before 2017 does not have local authority identifiers and this limits the extent to which the analysis can explore domestic trends. Work was started in partnership with MCS to provide updated records from the MID which could be used to replace the ones currently held by EST. Work will continue to achieve greater integration of the MCS data throughout the next reporting year.

7 Further Information

For further information, please see the corresponding appendix file which accompanies this report and has been referenced throughout. The contents of the appendix file covers:

- Appendix 1. Full revised figures for December 2017 report
- Appendix 2. Technical terms used
- Appendix 3. Renewable Heat Database assumptions
- Appendix 4. Merging the Renewable Heat Database with the non-domestic RHI database
- Appendix 5. Reducing the risk of duplicate projects between Renewable Heat Database and MCS installs
- Appendix 6. Combining Renewable Heat Database with CHP dataset
- Appendix 7. Measurement of heat demand in Scotland