Renewable Heat in Scotland, 2019

A report by Energy Saving Trust for the Scottish Government

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Prepared by Energy Saving Trust

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About Energy Saving Trust

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 Energy Saving Trust on behalf of the Scottish Government. The report draws on various sources of data from Energy Saving Trust and other organisations working in Scotland and was written by Energy Saving Trust's Insight and Analytics team.

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 (BEIS), MCS, Scottish Forestry and SGN.

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 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 has now been updated with new information on heat generated from renewable sources during the 2019 calendar year.

Other sources of information are used alongside the Renewable Heat Database to complete the understanding of renewable heat in Scotland, including:

- Data provided by the Department for Business, Energy and Industrial Strategy (BEIS) covering accreditations under the non-domestic Renewable Heat Incentive (RHI) scheme and Combined Heat and Power Quality Assurance (CHPQA) programme.
- A data extract of accreditations under the microgeneration certification scheme provided by MCS.

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 RHI schemes between December 2019 and June 2020, as an indicator of the growth in renewable heat into the next reporting year.

A separate appendix file has been prepared to accompany this report which can be accessed from the Energy Saving Trust website. Only the 2020 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. Where any reference is made in this report to an appendix, please see the separate Renewable Heat Report 2020 appendices file.

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 Summary of key findings

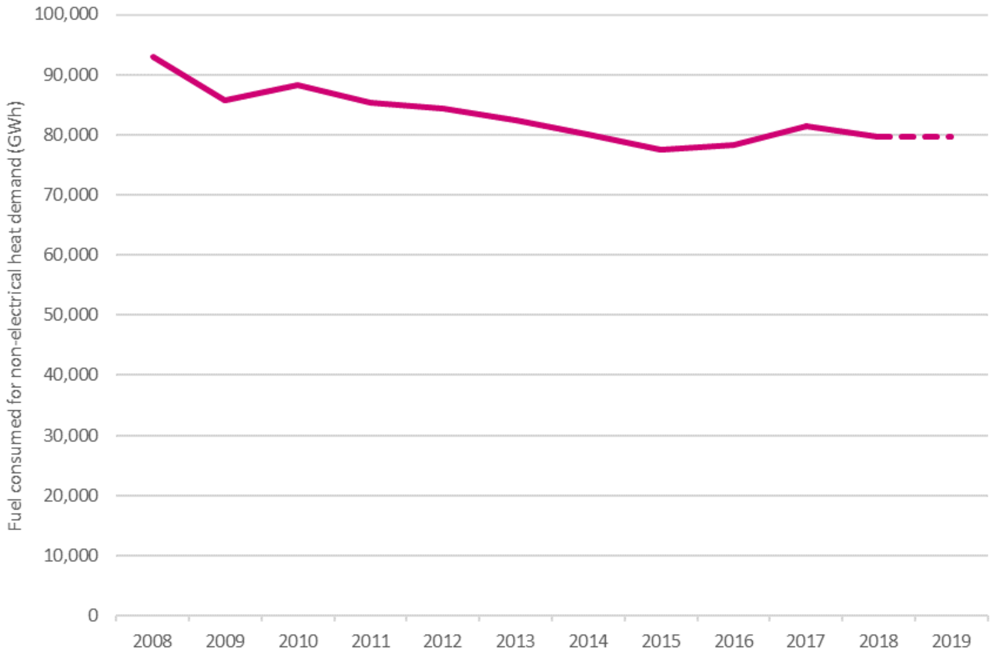
We estimate that:[2]

- **In 2019, useful renewable heat generated in Scotland was equivalent to 6.5% of the fuel consumed for non-electrical heat demand**,[3] an increase from 6.2% in 2018 and from 0.9% in 2008.
- **An estimated 5,205 GWh of useful heat output was generated by renewable technologies in 2019,** an increase from 4,966 GWh in 2018[4] and from 864 GWh in 2008-09.
- **2.03 GW of renewable heat capacity** was operational in Scotland by the end of 2019, up from 2.00 GW in 2018 and from 0.24 GW in 2008-09.
- **The reported heat output and capacity comes from 30,450 operational renewable energy installations,** up from 27,720 in 2018.
- **The energy content of the fuels consumed to meet Scotland's non-electrical heat demand was 79,658 GWh in 2018,** down from the 81,421 GWh consumed in 2017 and from the 92,986 GWh consumed in 2008.[5]
- **Approximately 56% of the total reported heat output is accredited under the domestic and non-domestic RHI schemes.**

Figure 1 shows the change over time for the fuel consumed to meet Scotland's non-electrical heat demand and Figure 2 shows the percentage of this which is met by renewables sources.

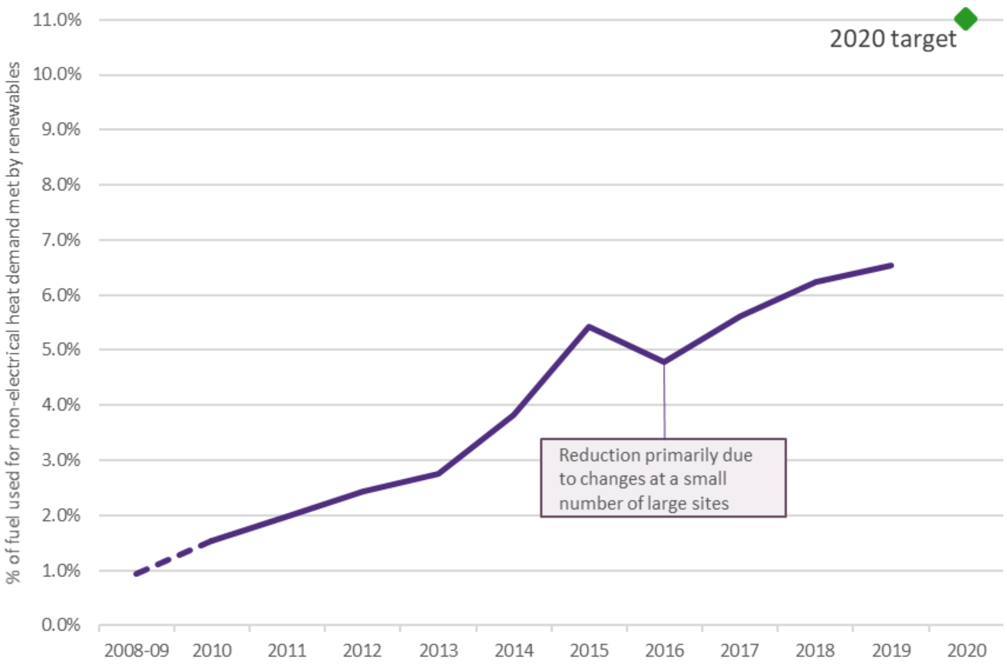
[2] All output values have been rounded to the nearest whole number, capacity values to the nearest 2 decimal places and number of installations to the nearest 10 for ease of reading, hence some figures may not be precisely consistent with summed totals or percentage changes due to rounding.
[3] The terminology has changed from previous reports to better represent the values being reported on with the data available. See Section 2.1 and the 'Methodology' section for more detail.
[4] All figures presented throughout this report compare the 2019 results with revised figures for 2018. The revised 2018 figures are discussed in more detail in the results section and Appendix 1.
[5] The 2018 value has been rolled over to 2019 because the final sub-national fuel estimates for a given calendar year are not available until the publication of the subsequent Renewable Heat in Scotland report.

Figure 1. Estimated fuel consumed for non-electrical heat demand (GWh) in Scotland, 2008 to 2019



Note: the fuel consumed for non-electrical heat demand for 2019 has been estimated by holding the 2018 value constant. See the Scottish Government's Scottish Energy Statistics Hub later in 2020 for an updated figure for 2019.[6]

Figure 2. Percentage of fuel consumed for non-electrical heat demand met by renewables in Scotland, 2008-09 to 2019



Note: The percentage of fuel consumed for non-electrical heat demand met by renewable sources for 2008-09 uses the heat demand value for the 2008 calendar year and the resulting percentage is therefore an approximate indication.

[6] https://scotland.shinyapps.io/Energy/

2.1 Fuel consumed for non-electrical heat demand and the renewable target

Progress towards the 2020 target of 11% of non-electrical heat demand to come from renewable sources is monitored against an estimate of the energy content of fuels consumed for non-electrical heat demand in Scotland, using the sub-national final energy consumption data published by BEIS on an annual basis.

The terminology used in the Renewable Heat in Scotland reports has changed. The terminology now refers to the energy value of the fuels used to meet the non-electrical heat demand rather than non-electrical heat demand itself. This is because the heat output of renewable technologies, taking into account system efficiencies and other losses, is being compared against an estimate of the energy value of fuels consumed to meet the non-electrical heat demand which does not take into account system efficiencies or losses. The impact of this is that we are knowingly underestimating the percentage of non-electrical heat demand being met by renewables, however, this is the best possible estimate of the progress towards the 2020 target with the datasets and information currently available.

While renewable heat output has increased since 2008-09 by 4,328 GWh (502%), the energy value of fuels consumed for non-electrical heat demand has fallen over this period by 13,328 GWh (14%) due to a combination of factors including improved energy efficiency, improved efficiency of heating technologies and increases in average annual temperatures.

Holding the fuel consumed for non-electrical heat demand figure from 2018 constant to 2020, renewable heat output would need to increase by around 68% in the next year in order to reach the Scottish Government's 2020 target. Although the commissioning of large schemes can result in significant step changes in capacity and output, it is very unlikely that the Scottish Government target will be met. This is evidenced by the average annual increase in output since 2010 of 17%, with the last two reporting years, 2018 and 2019, both showing below average growth.

2.2 Breakdown of 2019 data

Figures 3, 4 and 5 show the breakdown of heat output, capacity and number of installations in Scotland by the technology and size category of the installation. Figure 6 shows the contribution of each technology and installation size category to the growth in renewable heat output seen in 2019.

As in 2018, **biomass heat-only and biomass CHP installations provided the majority of both heat output (71%) and capacity (81%) in 2019,** although the two technologies show little change in the reported totals between the two years. The lack of change can be attributed to a reduction in output at a small number of large sites, as well as methodological improvements which led to revising down the capacity and output of other large sites. This has masked the output growth from the 120 new small to medium and micro sized biomass heat-only installations as seen in Figure 6.

Figure 3. Heat output by technology and installation size, 2018 and 2019

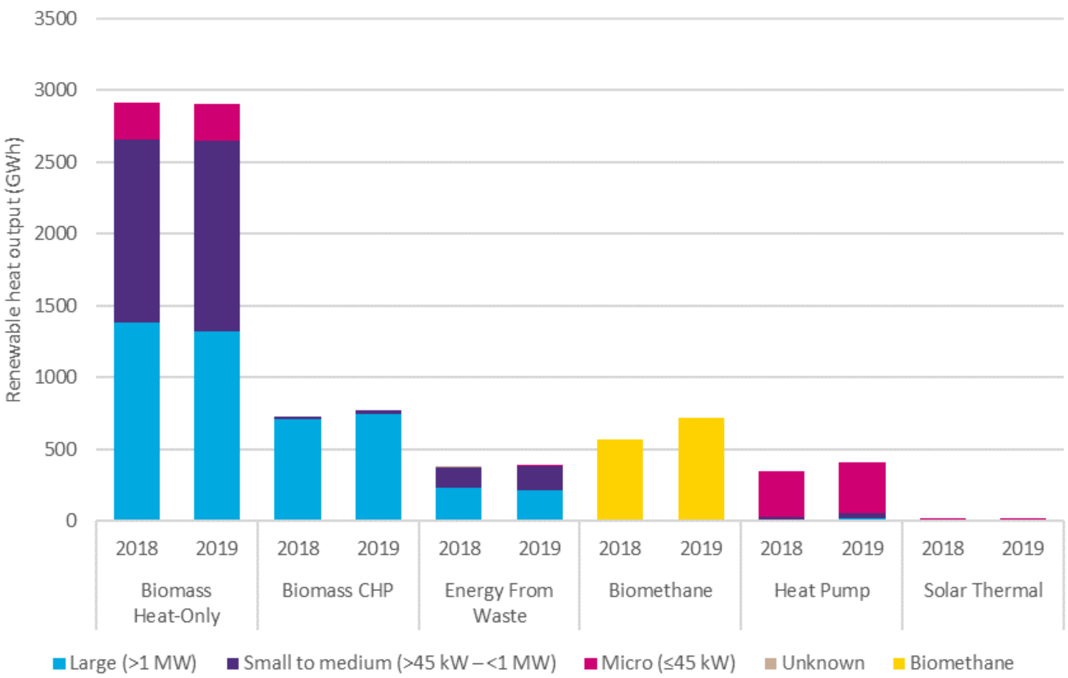


Figure 4. Heat capacity by technology and installation size, 2018 and 2019

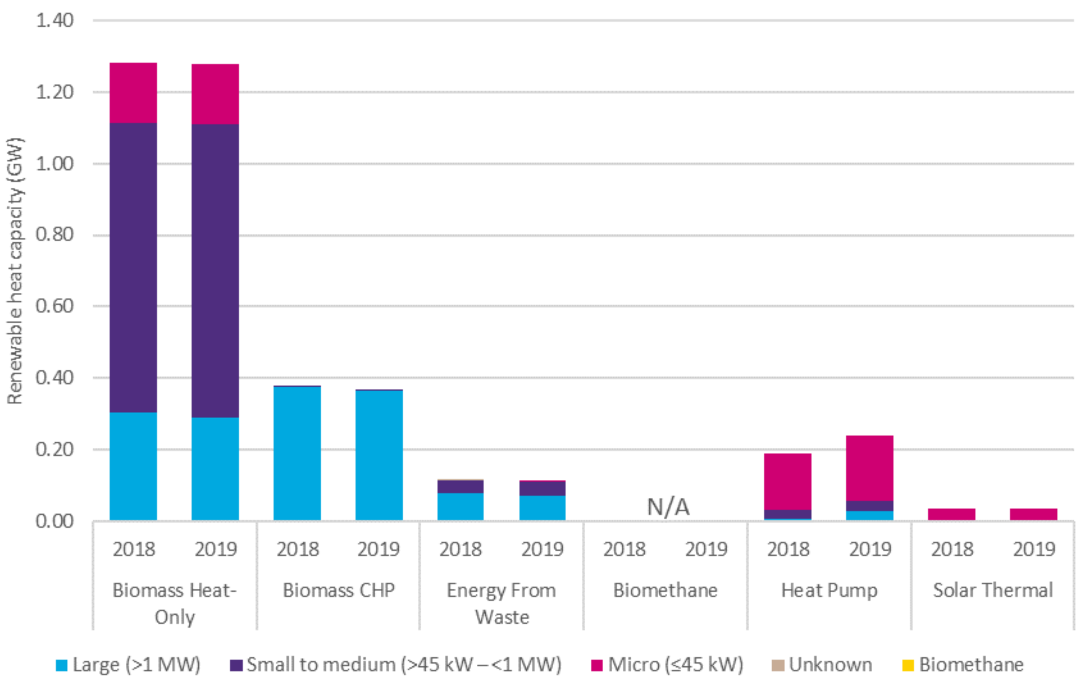
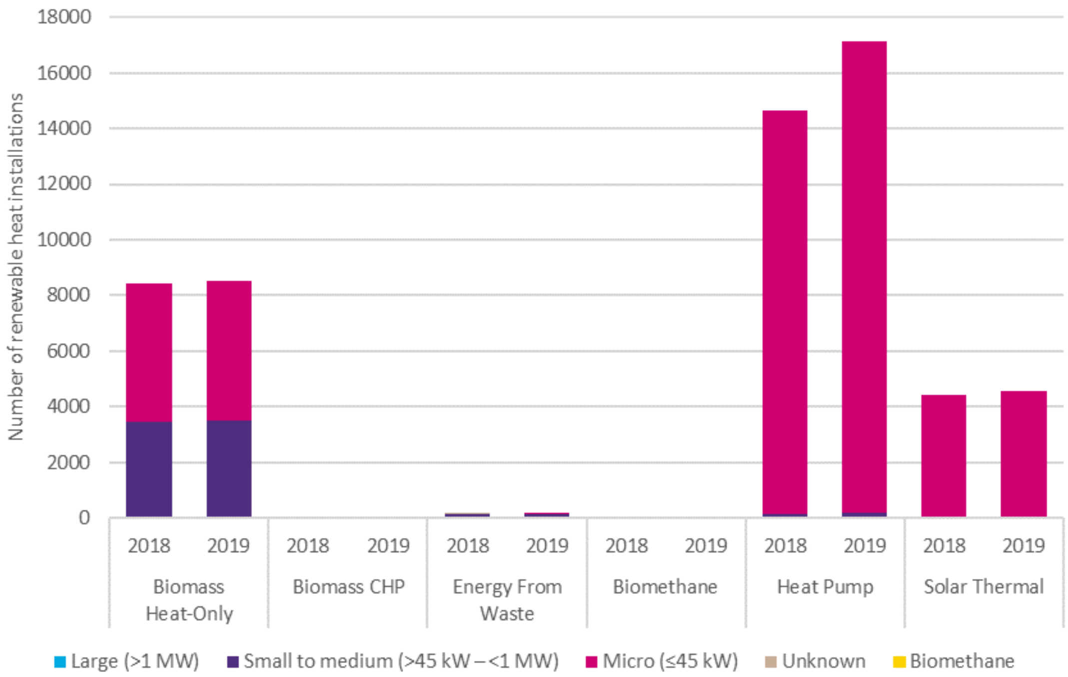


Figure 5. Number of installations by technology and installation size, 2018 and 2019



The largest contribution to the growth in renewable heat output reported in 2019 (61%) was from the biomethane technology[7] but this has had no impact on the reported capacity totals because biomethane sites do not have a stated capacity. This is because no biomethane is considered to be consumed on site for heating and it is instead injected into the gas grid. The increase in biomethane output can be attributed to an increase in the amount of biomethane produced and injected into the gas grid for heating purposes at almost every known Scottish biomethane producing site between 2018 and 2019.

The second largest contributor to the growth in renewable heat output seen in 2019 (26%) was the heat pump technology group, largely due to a significant increase in the number of installations, 98% (2,260) of which were in the micro size category. This continues the trend of seeing greater uptake of smaller sized heat pumps to provide space and hot water heating, particularly in domestic settings.

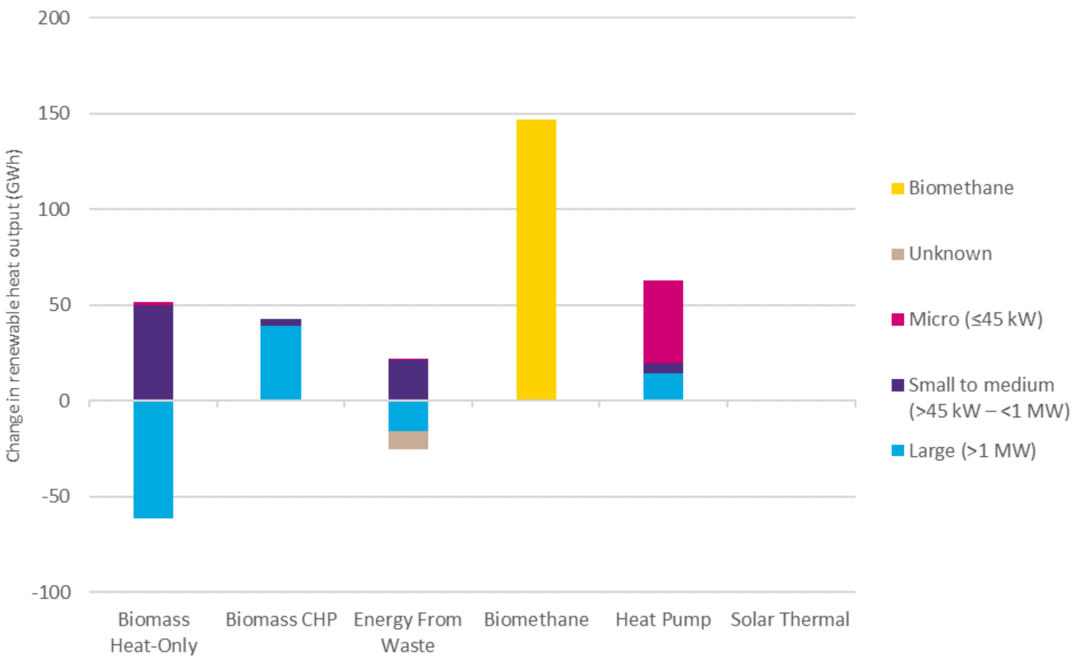
Both the energy from waste and solar thermal technology categories showed little change in output, capacity and number of installations between 2018 and 2019.

In 2019, **a significant proportion of renewable heat output (44%) and capacity (37%) in Scotland continues to come from large (>1 MW) installations** despite them contributing less than 1% of the total number of installations. This is because, aside from the scale of the installations themselves, larger installations often provide process heat all year round

[7] The biomethane technology has been split out from energy from waste category to better report on the impact of biomethane producing sites and because biomethane can be produced from feedstocks which may not be classified as waste, such as energy crops. Although, no information is currently available to us which would detail the feedstocks used for biomethane production in Scotland.

compared to smaller installations which generally have more seasonal demands such as providing space and water heating.

Figure 6. Change in renewable heat output by technology and installation size, 2018 to 2019



The large installation size category saw a slight reduction in output since 2018 due to changes in operation at a small number of large sites and revisions to some site figures due to improved datasets becoming available. **A significant proportion of the output from biomass CHP (97%), biomass heat-only (46%) and energy from waste (57%) facilities fall into the large size category.**

Both the small to medium and micro installation size categories reported a modest growth in output owing largely to new heat pump installations, as well as smaller numbers of new biomass and solar thermal installations. In addition, there was increased output from some existing small to medium biomass and energy from waste installations since 2018.

By the end of December 2019, 14,735 Scottish installations had been accredited under the domestic RHI scheme and 3,978 had been accredited under the non-domestic RHI scheme. **Systems in Scotland accounted for approximately 19% of the RHI-accredited systems under both RHI schemes as of December 2019**. **This is above the proportion of installations to be expected on a pro-rata basis** as only 9% of GB households are located in Scotland, in part reflecting the higher proportion of properties in off-gas grid areas in Scotland (14%) compared to England (9%).[8] 87% of domestic RHI accreditations and 78% of non-domestic RHI accreditations are in off-gas grid areas in Scotland compared to a 69% and 70% for England and Wales combined.

[8] Off-gas grid property estimates based on analysis of the list of off-gas postcodes generated by xoserve: http://www.xoserve.com/wp-content/uploads/Off-Gas-Postcodes.xlsx

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3 Methodology

EST has maintained and updated the Renewable Heat Database for the Scottish Government on an annual basis since 2011. The heat output estimate for 2019 contained in this report has been generated by a further update of the information held in the database alongside cross-analysis with other externally provided datasets.

3.1 Data sources used

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.

Table 1. Main datasets used for 2019 figures and estimates of future output

Organisation	Dataset
Department for Business, Energy and Industrial Strategy (BEIS)	Extract of Scottish installations accredited under the non-domestic Renewable Heat Incentive (RHI)
MCS	Extract of Scottish installations accredited under the microgeneration certification scheme (MCS)
Department for Business, Energy and Industrial Strategy (BEIS)	Extract of Scottish installations accredited under the Combined Heat and Power Quality Assurance (CHPQA) programme
Scottish Forestry (based on survey carried out by EST)	Annual woodfuel survey of large capacity (>1 MW) wood fuelled biomass installations in Scotland
Eunomia, on behalf of BEIS	The Renewable Energy Planning Database (REPD)[9]
Resource Efficient Scotland, on behalf of the Scottish Government	Renewable heat installations funded by Resource Efficient Scotland's Small and Medium Enterprise (SME) Loan Scheme
Energy Saving Trust, on behalf of the Scottish Government	Data from the District Heating Loan Fund and the community and locally owned renewable energy database[10]
SGN	Anonymised data on the energy content of biomethane injections to the gas grid in Scotland

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

3.2 Approach taken

Variables required

The Renewable Heat 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.

Two main variables are required from the Renewable Heat Database to monitor progress towards the Scottish Government's target of 11% of non-electrical heat demand being met by renewable sources.

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 upon the size of the installation. Total heat capacity is presented in this report as gigawatts (GW)[11] rather than as GWth, to avoid confusion with the units of heat output (GWh). 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 (1st January 2019 to 31st December 2019). 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 heat output, or useful heat output, and is recorded in megawatt hours (MWh) for each installation in the database, with the totals in this report given in gigawatt hours (GWh).[12] 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.[13]

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) programme 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. Since 2018, a full and unpublished extract of Scottish non-

[11] 1 GW = 1,000 MW = 1,000,000 kW.
[12] 1 GWh = 1,000 MWh = 1,000,000 kWh.
[13] The full definitions for useful, actual and potential heat output are described in Appendix 2.

domestic RHI accreditations has been provided by BEIS and analysis of this is carried out by EST. The methodology used to match accreditations in the non-domestic RHI dataset against records in the Renewable Heat Database, so as to avoid double counting, is discussed 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 an estimate 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 2019 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 these installations should be captured within the Microgeneration Certification Scheme (MCS) Installation Database (MID) extract provided by MCS; an MCS certificate is required to be accredited under the domestic RHI scheme. The MCS dataset is also likely to hold information on installations that are not or are unable to be accredited under the RHI schemes. To be accredited under MCS, the renewable heat installation typically needs to have a capacity of less than 45 kW and therefore the MCS dataset is the most comprehensive source of information on micro-sized installations in Scotland.

For the first time this reporting year, MCS provided a full extract of their database including address level information so that EST could cross reference the data with the Renewable Heat Database and the non-domestic RHI data extract to minimise the risk of double counting. The full methodology used to analyse the MCS data is discussed in Appendix 5.

An extract of combined heat and power (CHP) installations in Scotland which are accredited under the CHPQA programme was also provided by BEIS for the first time this year to assist with refining renewable heat output and capacity estimates. The CHPQA programme was established to monitor, report on and improve the output from CHP installations. The CHPQA dataset is likely to capture many of the CHP installations in operation, particularly those larger in scale which will contribute more greatly towards the renewable heat targets, because, although participation in the scheme is voluntary, CHPQA certification grants eligibility to a range of financial incentives including the non-domestic RHI scheme.

The CHP heat outputs are reported directly by the site operators and only heat used for eligible purposes under the CHPQA scheme is included (i.e. useful heat). The CHPQA extract was cross referenced with the Renewable Heat Database and the non-domestic RHI extract as to reduce the risk of double counting individual sites. Further details of the process undertaken to carry out this analysis are available in Appendix 6.

Scottish Forestry conduct 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). This is used to help estimate the amount of woodfuel being consumed for energy purposes in Scotland.[14] 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 2019 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 heat output based on the assumed energy content of the woodfuel and site efficiencies.[15]

With some exceptions,[16] the remaining data has been collated from sources where heat output (either 'actual' or 'useful') for the site is not necessarily known and, 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 known or assumed operating efficiencies. This information is used to estimate *actual* heat output during 2019 but may be greater than the *useful* heat output.

Where information on capacity is not available, this is estimated by dividing a known heat output by the operational running hours. Where the actual running hours of the system are not reported by the source, assumptions about typical running hours are made instead, based on installation size and technology.

Where capacity and running hours are both known, but not output, annual heat output is estimated by multiplying the capacity by the running hours. 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.

Further information about the assumptions used is provided in Section 3.4.

In the 2019 Renewable Heat in Scotland report, 83% of the total renewable heat output is reported or measured, 17% is estimated and less than 1% is from records which do not identify if the output values are known or estimated. 90% of the total renewable capacity is from reported or measured data, 10% is estimated and less than 1% is not designated whether it is known or estimated.

Only the metered non-domestic RHI values were treated as known and the 'imputed' heat values have been counted as estimates.

For some records in the CHPQA dataset, the capacity may have been estimated but as the dataset does not denote which records, if any, have estimated values, all CHQPA capacity values were treated as estimates.

Although the MCS values are modelled at or before the time of installation, they have been treated as known values because they are derived from on-site measurements of the property using accredited MCS methodologies and are therefore both robust and tailored to the specific

[14] https://forestry.gov.scot/publications/744-woodfuel-demand-and-useage-in-scotland-2018-report
[15] Further information on the assumptions used can be found within Appendix 3.
[16] For example, where we have a known contact at the site who can provide the precise information.

installation. MCS data was treated as estimates where values were missing or were statistically atypical of the dataset and in these cases, EST used the average values for that technology instead. The full MCS data handling methodology is discussed in more detail in Appendix 5.

Similarly, we have treated estimated values given by sites themselves as known rather than estimated because these values would be based upon knowledge specific to that installation and are likely to be very precise; estimated values in the Renewable Heat Database only apply when EST has attempted to estimate an installation's capacity and output with limited information available.

In all cases, only the renewable portion of the heat output has been included in the figures reported.

Taken together, the capacity and 'heat paid for' data from the non-domestic RHI scheme, the installation data from MCS, the heat capacity and output values from the CHPQA programme 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.

3.3 Technologies included

The following technologies produce heat from renewable sources and are included in the estimate of progress towards the target (more detailed descriptions of these technologies can be found in Appendix 2):

- Biomass (wood) heat-only combustion.
- Biomass (wood) combined heat and power (CHP).
- Solar thermal panels.
- Heat pumps: water source, air source and ground source.
- Energy from waste (EfW), including:
  - Anaerobic digestion (AD).[17]
  - Landfill and sewage gas capture.
  - Biomass primary combustion of biodegradable material (other than wood).
  - Advanced thermal treatment (ATT), using pyrolysis and/or gasification.
- Biomethane – sites producing biomethane for injection into the gas grid.

Technologies which are not included in the estimate of progress towards the target, as they produce heat which is not renewable, are:

- Non-biomass CHP running on mains gas or another 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.[18]

[17] Excluding the parasitic heat used to maintain the anaerobic digestion process.
[18] 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

The following technologies could be considered sources of renewable heat but it has been decided that currently they are not to be included 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, solar PV or hydro-produced electricity which is used to provide heat. These technologies are excluded to avoid double counting of progress towards renewables targets, as the energy produced counts towards the Scottish Government's target for renewable electricity generation.

3.4 Assumptions used

Converting biomass woodfuel use to heat output

For the majority of large installations burning biomass wood for heat or CHP, the main woodfuel usage estimates available were from the Scottish Forestry's annual woodfuel survey. Where metered data was not available, woodfuel usage figures were converted into estimates of heat output, based on assumptions about combustion efficiency. One oven-dried tonne (ODT) of wood is assumed to have a gross calorific value of 5.639 MWh.[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 this year to coincide with methodological changes to the latest Woodfuel Demand and Usage in Scotland 2018 report published by Scottish Forestry.[20]

Combined heat and power (CHP)

Calculating useful heat output for CHP is difficult without detailed metered data for each specific site. Even with data on fuel input, energy content of the fuel, system efficiency and running hours, the realised useful heat output might vary considerably. One of the main reasons for this is that CHP produces both electricity and heat and estimating the output for each energy type depends on how the CHP is operated by the end user. This then poses a problem for sites where the main purpose is generating electricity as it is unknown how much of the heat generated goes unused.

Where known, useful heat output has been recorded for CHP sites based on information from the sites themselves provided via woodfuel surveys, the CHPQA data extract or other direct contact.

Where the output of a CHP plant was unknown, the assumptions detailed in Appendix 3 were used to estimate the plant's efficiency, capacity, running hours and woodfuel calorific values, where applicable, in line with the CHP statistics found in chapter 7 of the Digest of UK Energy Statistics (DUKES) 2018.[21]

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[19] Calorific value calculated by converting to MWh per odt the GJ per tonne value for 'Industrial wood' from section A.1 'Estimated average calorific values of fuels 2018' of the Digest of UK Energy Statistics (DUKES). https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

[20] https://forestry.gov.scot/publications/744-woodfuel-demand-and-useage-in-scotland-2018-report

[21] The 2018 values have been used because at the time of analysis for the report the DUKES 2019 figures were unavailable.

Annual running hours

Assumed annual running hours are used to estimate capacity from a known output, or an output from a known capacity, where those values are unknown. This year, we have used the non-domestic RHI analysis to provide average running hours for biomass and heat pumps to be used for systems where the running hours are unknown in the Renewable Heat Database. The result was a reduction to the assumed annual running hours and thereby a reduction in renewable heat output. This methodological change has been applied to the 2019 and revised 2018 figures as to allow a direct comparison between the two but comparisons with 2017 or earlier reported totals are thereby limited to an extent.

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 in the Renewable Heat Database. 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:

- 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.

A methodology specific to the MCS dataset was used to estimate the capacity and output of MCS accreditations where that information was missing, see Appendix 5 for more information.

Energy from waste

In line with assumptions used in BEIS's RESTATS methodology,[22] 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.

[22] 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 where known. Information on any known extensions which are planned are also included in the database. Information on whether or not an installation is providing district heating was not available from all sources used to update the database (e.g. REPD dataset). The Renewable Heat Database heat network information is supplemented by extracts of Scottish Heat Network data provided by the Scottish Government. The collated information is not yet regarded as complete enough to use the dataset to estimate the extent of district heating in Scotland fuelled by renewable sources.

3.6 Revised figures for 2018

All of the figures provided in the report for 2018 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 arose from applying the typical running hours found in the non-domestic RHI extract for biomass and heat pump installations because these were typically lower than the running hours assumed previously. The change resulted in a reduction of approximately 145 GWh to the total reported output of the original 2018 report.

The headline changes to the 2018 report are as follows:

- The known total operational capacity decreased from 2.01 GW to 2.00 GW.
- The total yearly heat output for 2018 fell from 5,230 GWh to 4,966 GWh.

The full list of changes to the 2018 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. 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.

The terminology used in the Renewable Heat in Scotland reports to describe non-electrical heat demand has changed to better reflect that the sub-national fuel estimates, used as the comparator against the reported renewable heat output, do not take into account the efficiencies or losses of the systems consuming said fuels. The report now refers to fuel consumed for non-electrical heat demand instead. As the renewable heat output figures do take into account system efficiencies and other losses, either via using metered datasets or by applying adjustments through the Renewable Heat Database assumptions and calculations, we are knowingly underestimating the percentage of non-electrical heat demand being met by renewables. However, this is the best possible estimate of the progress towards the 2020 target with the datasets and information currently available for reporting purposes.

3.8 Local authority identifiers

Work was carried out throughout 2018 and 2019 to affix local authority identifiers to as many known renewable heat installations as possible, however, for a small proportion this is not currently possible because some of the Renewable Heat Database records are aggregated and anonymised installation counts for schemes which ran across Scotland and the breakdown of installations by local authority is unknown.

Since 2018, BEIS have provided a non-domestic RHI dataset including address level information which allows the identification of local authority and for the first time this year, BEIS have also provided the local authority of accreditations under the CHPQA programme as well. In addition, MCS have also provided a full extract of the MCS installation database with address level information for the first time this reporting year from which the local authority of each installation could be identified.

As a result of the above, 97% of renewable heat output and 95% of renewable heat capacity has now been identified to local authority level, up from 90% of output and 87% of capacity in the 2018 report.

4 Renewable heat capacity and output in 2019

In 2019, 5,205 GWh of heat was produced from renewable sources from an installed capacity of 2.03 GW. This was enough renewable heat output to meet an estimated 6.5% of the fuel consumed for non-electrical heat demand in 2019.

Progress towards the 2020 target of 11% of non-electrical heat demand 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).

The renewable heat generated as a percentage of Scottish heat demand from 2008-09 to 2019 is presented in Table 2 and Figures 7 and 8. As the Renewable Heat in Scotland Report is published for any given calendar year before the corresponding BEIS heat demand estimates are available, the fuel consumed for non-electrical heat demand is estimated by rolling over the preceding year's figure. A revised estimate of fuel consumed for Scottish non-electrical heat demand, and the percentage of it met by renewables, will be available later in 2020, and the final figures in September 2021, on the Scottish Government's Scottish Energy Statistics Hub.[23]

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.

Table 2: Renewable heat and renewable heat as a percentage of fuel consumed for non-electrical heat demand in Scotland

	2008-09	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total renewable heat output (GWh)	863	Not estimated	1,363	1,690	2,045	2,266	3,071	4,205	3,752	4,569	4,966	5,205
% of total non-electrical heat demand	**0.9%**	**1.2%**	**1.5%**	**2.0%**	**2.4%**	**2.8%**	**3.8%**	**5.4%**	**4.8%**	**5.6%**	**6.2%**	**6.5%**
Fuel consumed for heat demand (GWh)	92,986	85,738	88,229	85,281	84,321	82,336	80,147	77,597	78,384	81,421	79,658	79,658

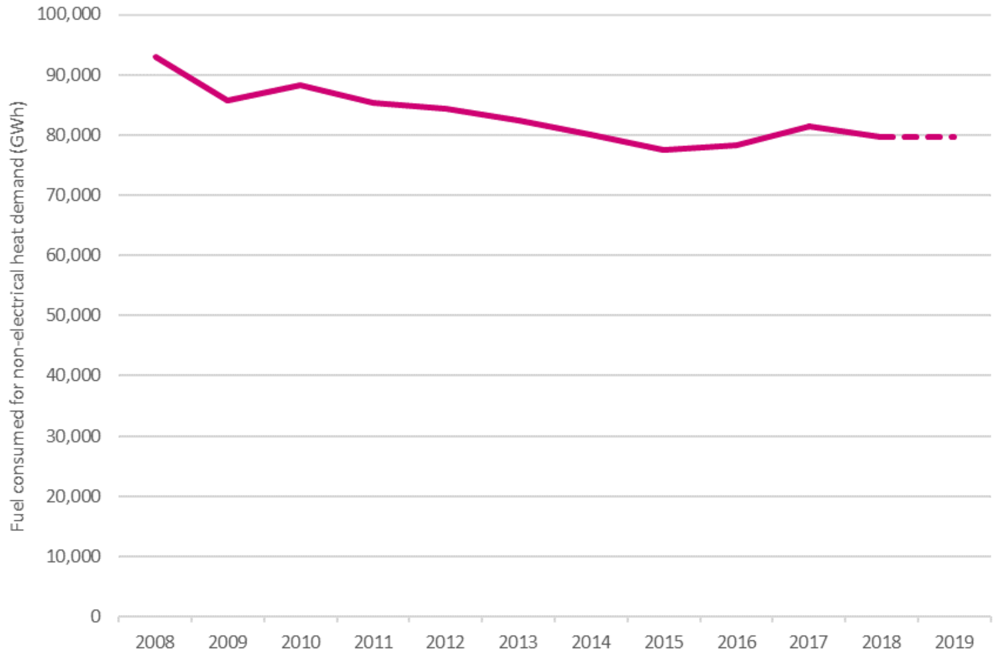
Note: The figures presented here differ from previously published Renewable Heat in Scotland reports because the heat demand time series is reviewed, and revised if necessary, each reporting year.

The percentage of fuel consumed for non-electrical heat demand met by renewable sources for 2008-09 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 fuel consumed for non-electrical heat demand to be met by renewables for that year has been interpolated from the 2008-09 and 2010 values.

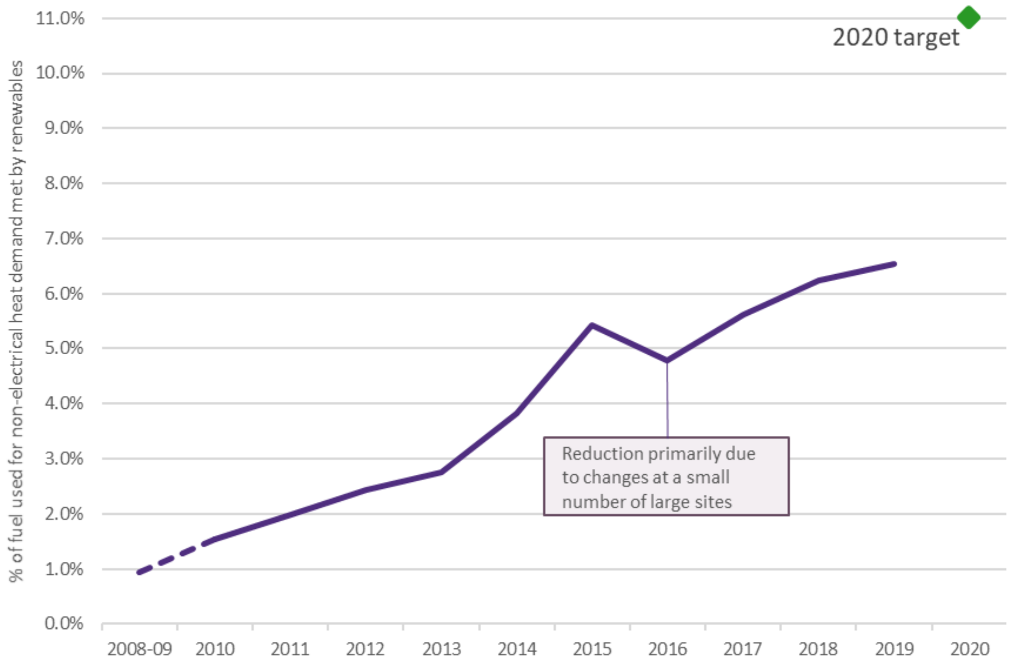
[23] https://scotland.shinyapps.io/Energy/

Figure 7. Estimated fuel consumed for non-electrical heat demand (GWh) in Scotland, 2008 to 2019



Note: the non-electrical heat demand for 2019 has been estimated by holding the 2018 value constant. See the Scottish Government's Scottish Energy Statistics Hub later in 2020 for an updated 2019 non-electrical heat demand figure.[24]

Figure 8. Percentage of fuel consumed for non-electrical heat demand met by renewables in Scotland, 2008-09 to 2019



Note: The percentage of fuel consumed for non-electrical heat demand met by renewable sources for 2008-09 uses the heat demand value for the 2008 calendar year and the resulting percentage is therefore an approximate indication.

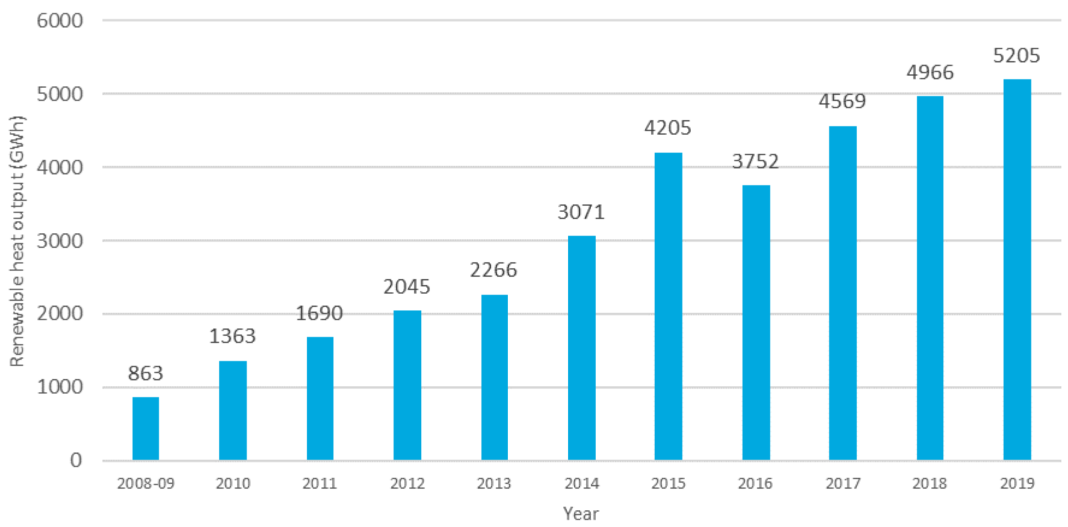
[24] https://scotland.shinyapps.io/Energy/

While renewable heat output has increased since 2008-09 by 4,328 GWh (502%), the fuel consumed for non-electrical heat demand has fallen over this period by 13,328 GWh (14%) due to a combination of factors including improved energy efficiency, improved heating system efficiencies and increases in average annual temperatures. The result is that in 2019 an estimated 6.5% of the fuel consumed for non-electrical heat demand was met by renewables. It should be noted that, whilst the fuel consumed for non-electrical heat demand has generally been falling over the last 10 years, it rose in 2016 (by 1.0%) and again in 2017 (by 3.9%).

The overall useful **renewable heat output** from operational sites in Scotland **increased by 239 GWh** from 4,966 GWh in 2018 to 5,205 GWh in 2019, **which is an increase of 5%**.

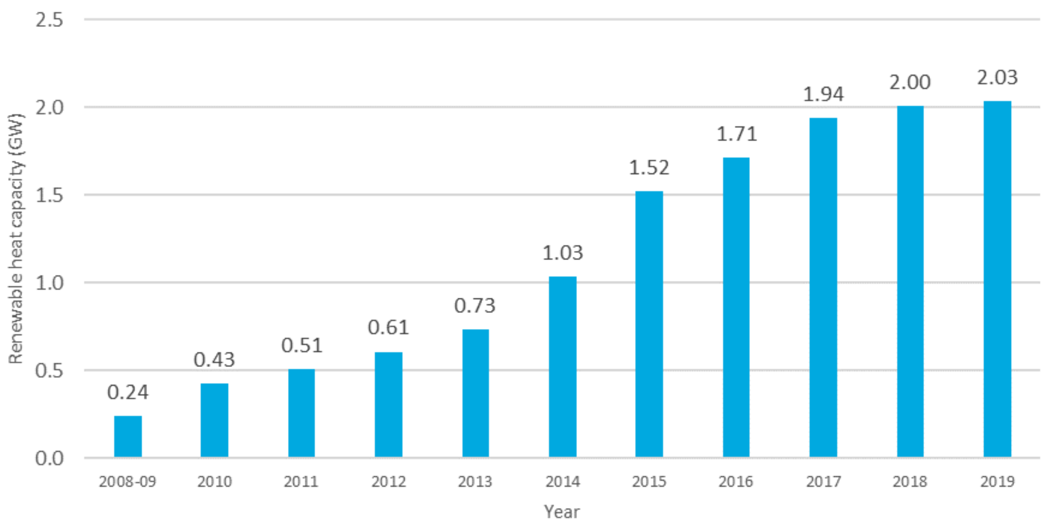
Between 2018 and 2019, **renewable heat capacity** in Scotland has risen by **0.03 GW** (from 2.00 GW to 2.03 GW), **which is an increase of 1%.**

Figure 9. Estimated renewable heat output in Scotland, 2008-09 to 2019



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

Figure 10. Estimated renewable heat capacity in Scotland, 2008-09 to 2019



4.1 Results by installation size

Tables 3, 4 and 5 report the changes in renewable heat output, capacity and number of installations by size category between 2018 and 2019.

Table 3. Changes in renewable heat output (GWh) in Scotland from 2018 to 2019, by installation size

Size category	2019 output	2019 percentage	2018 output	2018 percentage	Absolute change	Percentage change
Large (>1 MW)	2,313	44%	2,337	47%	-24	-1%
Small to medium (>45 kW – <1 MW)	1,544	30%	1,463	29%	81	6%
Micro (≤45 kW)	632	12%	587	12%	45	8%
Biomethane	716	14%	569	11%	147	26%
Unknown	0	0%	10	<1%	-10	-100%
Total	5,205	100%	4,966	100%	239	5%

Table 4. Changes in renewable heat capacity (GW) in Scotland from 2018 to 2019, by installation size

Size category	2019 capacity	2019 percentage	2018 capacity	2018 percentage	Absolute change	Percentage change
Large (>1 MW)	0.76	37%	0.77	38%	0.01	-2%
Small to medium (>45 kW – <1 MW)	0.89	44%	0.87	44%	0.02	2%
Micro (≤45 kW)	0.38	19%	0.36	18%	0.03	7%
Biomethane	N/A	N/A	N/A	N/A	N/A	N/A
Unknown	0	0%	<0.01	<1%	>-0.01	-100%
Total	2.03	100%	2.00	100%	0.03	1%

Table 5. Changes in number of renewable heat installations in Scotland from 2018 to 2019, by installation size

Size category	2019 number of installations	2019 percentage	2018 number of installations	2018 percentage	Absolute change	Percentage change
Large (>1 MW)	90	<1%	80	<1%	10	12%
Small to medium (>45 kW – <1 MW)	3,840	13%	3,780	14%	60	1%
Micro (≤45 kW)	26,510	87%	23,830	86%	2,680	11%
Biomethane	20	<1%	20	<1%	<10	7%
Unknown	0	0%	10	<1%	-10	-100%
Total	30,450	100%	27,720	100%	2,740	10%

Notes for Tables 3, 4 and 5:

1) Biomethane gas to grid injection does not have a stated capacity and has been included within the size category tables as its own entry.

2) Due to improved data sources becoming available, there are no longer any figures included within the analysis for systems of an unknown installation size.

3) These tables include some capacity reductions to specific sites owing to better data becoming available as well as data cleansing rather than genuine changes in the growth of renewable heat.

4) Data has been rounded for ease of reading; output to the nearest whole number, capacity to 2 decimal places and installation counts to the nearest 10, hence some totals may not precisely equal summed figures.

The largest share of renewable heat output, 44% (2,313 GWh) in 2019 continues to come from large (>1 MW) sized installations. The large size category also contributed 37% (0.76 GW) of the total reported capacity despite making up less than 1% of the total number of installations.

Between 2018 and 2019, the reported output from large size installations has reduced by 24 GWh and capacity by 0.01 GW. This is due to the growth in output from the 10 new installations in this size category being masked by a combination of, a genuine reduction in output at some of the large sites, plus improved heat capacity and output estimates becoming available for other large sites.

There are less than 10 installations within this size category generating more than 100 GWh of heat in 2019 and together these sites provided 25% (1,297 GWh) of the total renewable heat output in Scotland.

The continuing significant contribution from a small number of large sites is inherent both from the scale of these installations and because this size 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 sized installations are more likely to be used to provide space heating and/or hot water for buildings, whose demands are more seasonal and so their contribution to total renewable heat output is proportionately less.

The large contribution 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. This is because small changes in the information from these sites could result in potentially significant changes to the estimated total heat output. Another such example is the drop in output seen between the 2015 and 2016 reporting years (see Figures 8 and 9), largely as a result of a small number of changes to the operation of large sized installations.

In 2019, small to medium (>45 kW to <1 MW) sized systems made up 13% of the renewable heat installations in Scotland (by number). Capacity from small to medium sized systems has increased by 2% (0.02 GW) between 2018 and 2019, while output has increased by 6% (81 GWh). Small to medium sized systems accounted for approximately 34% of the increase in heat output seen since 2018.

The micro size category has grown the most in terms of the number of installations, with 2,680 additional installations recorded in the 2019 calendar year. This corresponds to an 8% (45 GWh) increase in output and a 7% (0.03 GW) increase in capacity. Micro sized installations provided 19% of the growth in renewable heat output seen since 2018. The vast majority of the new micro sized installations are accredited under MCS, in domestic properties and will have lower running hours compared to the larger installation sizes as they will predominantly be providing hot water and seasonal space heating.

Biomethane installations have shown the largest proportional increase in output which was 26% (147 GWh) greater than in 2018. This corresponds to 61% of the total growth in renewable heat output seen in 2019. Biomethane makes up a significant proportion of the renewable heat output on record (14%, 716 GWh) despite there being less 20 installations of this technology in Scotland.

4.2 Results by technology

Biomass heat-only and biomass CHP provided the majority of both output (71%, 3678 GWh) and capacity (81%, 1.65 GW) in 2019. This is a continuation of the trends seen in both the publicly available domestic and non-domestic RHI statistics[25] as well as from previous years' Renewable Heat in Scotland reports.

Tables 6, 7 and 8 show a breakdown of operational renewable heat output, capacity and number of installations for 2018 and 2019 by technology category.

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

Table 6. Changes in renewable heat output (GWh) in Scotland from 2018 to 2019, by technology

Technology	2019 output	2019 percentage	2018 output	2018 percentage	Absolute change	Percentage change
Biomass heat-only	2,906	55%	2,915	59%	-10	0%
Biomass CHP	772	15%	730	15%	43	6%
Energy from waste	383	7%	387	8%	-4	-1%
Biomethane	716	14%	569	11%	147	26%
Heat pump	408	8%	345	7%	63	18%
Solar thermal	20	<1%	19	<1%	<1	1%
Total	5,205	100%	4,966	100%	239	5%

Table 7. Changes in renewable heat capacity (GW) in Scotland from 2018 to 2019, by technology

Technology	2019 capacity	2019 percentage	2018 capacity	2018 percentage	Absolute change	Percentage change
Biomass heat-only	1.28	63%	1.28	64%	<0.01	>-1%
Biomass CHP	0.37	18%	0.38	19%	-0.01	-3%
Energy from waste	0.11	5%	0.12	6%	-0.01	-6%
Biomethane	N/A	N/A	N/A	N/A	N/A	N/A
Heat pump	0.24	12%	0.19	9%	0.05	27%
Solar thermal	0.04	2%	0.04	2%	<0.01	1%
Total	2.03	100%	2.00	100%	0.03	1%

Table 8. Changes in number of renewable heat installations in Scotland from 2018 to 2019, by technology

Technology	2019 number of installations	2019 percentage	2018 number of installations	2018 percentage	Absolute change	Percentage change
Biomass heat-only	8,550	28%	8,430	30%	120	1%
Biomass CHP	20	<1%	20	<1%	0	0%
Energy from waste	170	1%	170	1%	0	0%
Biomethane	20	<1%	20	<1%	<10	7%
Heat pump	17,140	56%	14,670	53%	2,480	17%
Solar thermal	4,560	15%	4,430	16%	140	3%
Total	30,450	100%	27,720	100%	2,740	10%

Whilst biomass remains the largest contributor to both renewable heat output and capacity by some margin, other technologies have seen greater proportional growth between 2018 and 2019.

Heat pump output grew by 18% (63 GWh) to make up 8% of the total heat output reported for all technologies, up from a 7% share in 2018. Heat pump capacity grew by 27% (0.05 GW) to form 12% of the total capacity, up from a 9% share in 2018. There were 2,480 new heat pump installations in Scotland in 2019, bringing the total number of heat pump installations to 17,140. 99% (2,260) of heat pump installations are in the micro-size category reflecting their wide uptake for space heating and hot water demand in the domestic sector.

Biomethane installations were the largest contributor (61%) to the growth in renewable heat output in 2019. An additional 147 GWh of heat was produced by biomethane sites over the 2018 reported biomethane totals, which is an increase of 26%. However, this has had no impact on the reported capacity totals because biomethane sites do not have a stated capacity as no biomethane is considered to be consumed on site for heating and is instead injected into the gas grid. The increase in biomethane output can be attributed to an increase in the amount of biomethane produced and injected into the gas grid for heating purposes at almost every known Scottish biomethane producing site between 2018 and 2019.

There was little change to the reported energy from waste and solar thermal totals. Energy from waste capacity was reduced by 6% (0.01 GW) and output was reduced by 1% (4 GWh) which can be more attributed to revisions to site level data rather than genuine change.

Solar thermal capacity increased by 1% (<0.01 GW) and output also grew by 1% (<1 GWh). Solar thermal installations contribute less than 1% (20 GWh) of the total heat output recorded. There were 140 new solar thermal installations reported in 2019.

4.3 Results by size and technology

A breakdown of the heat output, capacity and number of installations by technology and size category is shown in figures 11, 12 and 13 below.

In 2019, and as per the preceding annual Renewable Heat in Scotland reports, the majority of output from biomass CHP (97%) is produced by installations in the large size bracket. Large sized installations also produce a significant amount of the heat output from the biomass heat-only (46%) and energy from waste (57%) technologies. This is likely because larger sites often provide heat all year-round (e.g. for industrial use), whereas smaller sites generally have more seasonal demands such as providing space and water heating.

The split of biomass output provided by large sized installations, small to medium sized installations (46%) and micro sized installations (9%) has broadly remained consistent between 2018 and 2019.

As in previous reporting years, the vast majority of output and capacity from solar thermal systems (88% and 89%) and heat pumps (87% and 76%) are from the micro sized category. These technologies are most often found within in this size bracket because they are generally more widely used for space and/or water heating which, currently in Scotland, is usually generated on a smaller scale and can be seasonal in demand. The majority of heat pump and solar thermal installations in Scotland can be found in domestic properties and are accredited under MCS.

Figure 11. Heat output by technology and installation size, 2019

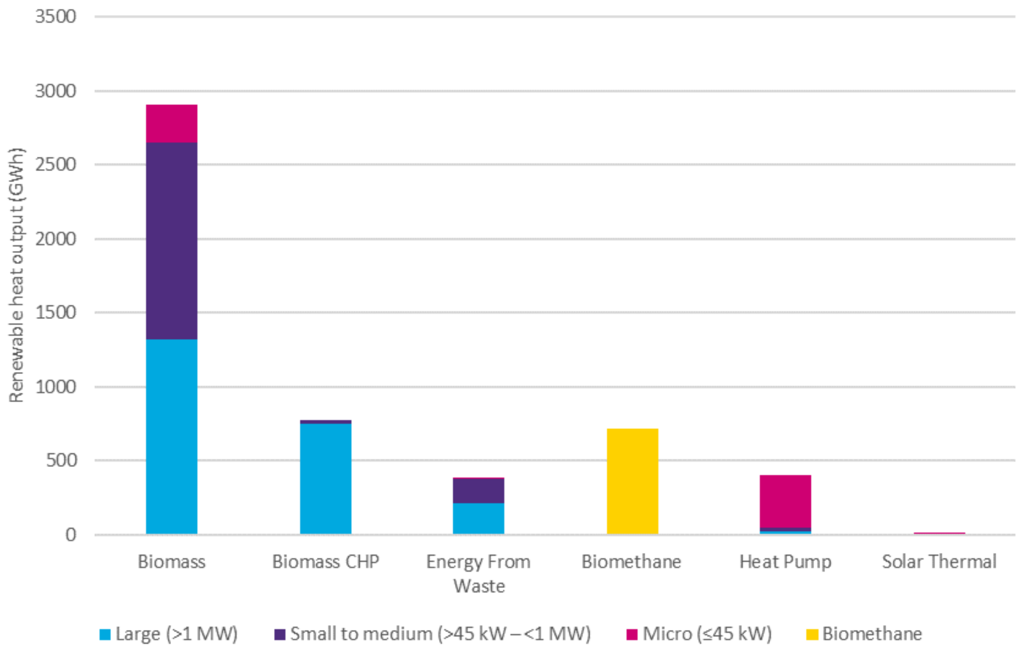


Figure 12. Heat capacity by technology and installation size, 2019

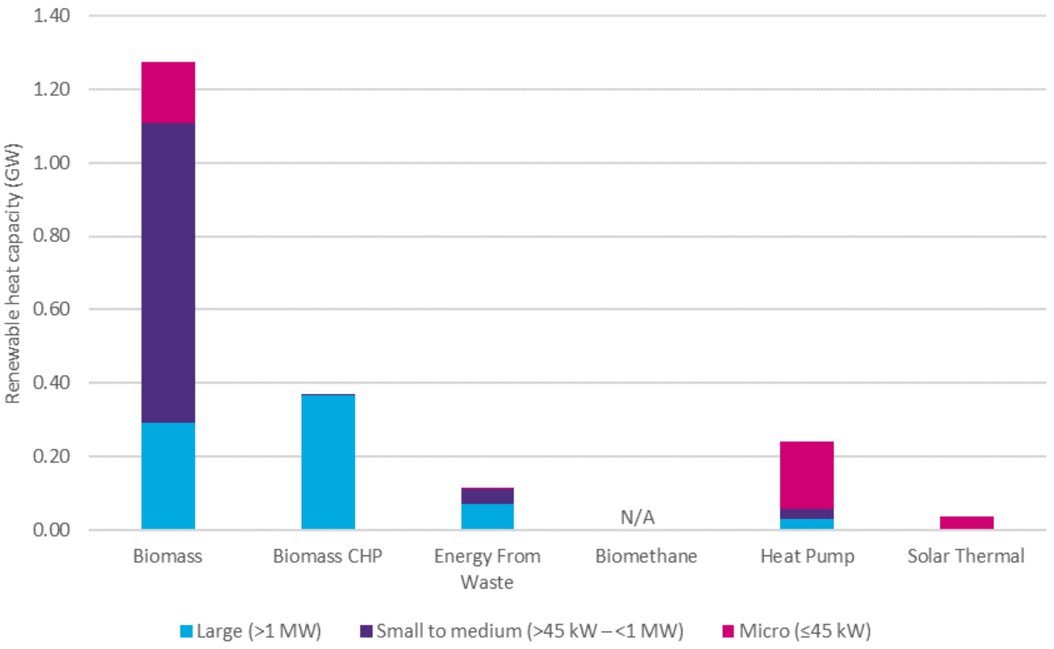
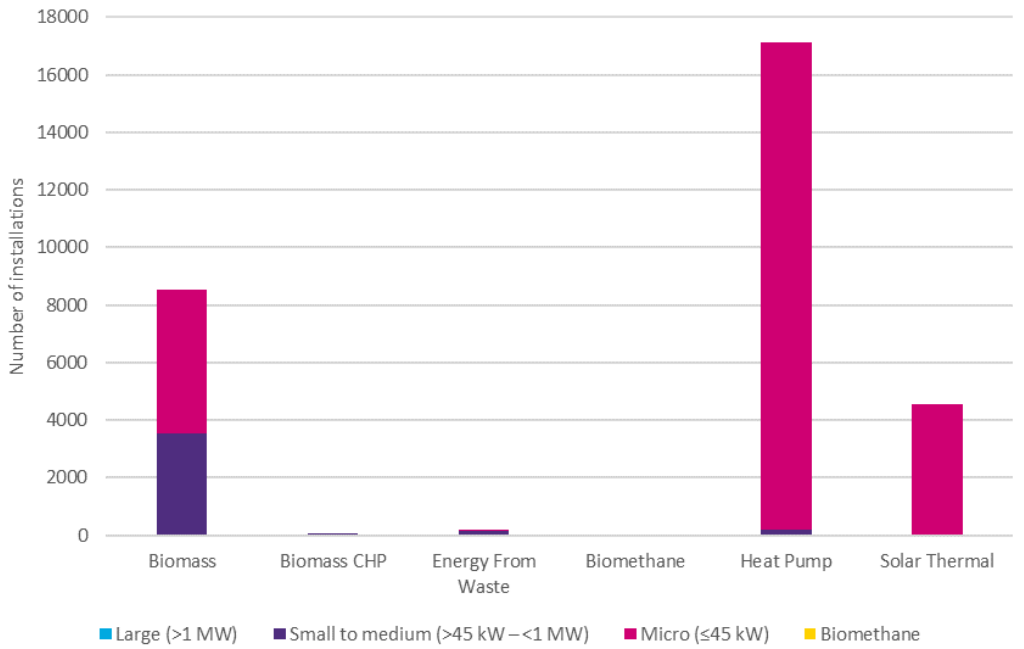


Figure 13. Number of renewable heat installations by technology and installation size, 2019



4.4 Capacity and output by local authority area

The distribution of renewable heat output by local authority area is shown in Table 9 and Figure 14 and renewable heat capacity in Table 9 and Figure 15.

The key findings from the local authority analysis are:

- The Highland local authority area accounted for 19% of Scotland's total renewable heat output and 15% of the overall operational capacity in 2019.
- Four local authority areas (Highland, Stirling, South Ayrshire and North Ayrshire) accounted for around 47% of the total heat output and collectively contributed 2,441 GWh of renewable heat in 2019. These 4 areas had a combined capacity of 0.59 GW, or 29% of the renewable capacity in Scotland.

Any local authority area with a reported total operational heat capacity of less than 0.01 GW or with an operational renewable heat output of less than 10 GWh have had their percentage values in the following table anonymised (with '##') so as to prevent the potential disclosure of confidential or commercially sensitive information.

Table 9. Heat output and capacity by local authority area in Scotland, 2019

Local authority area	Renewable heat output, 2019 (GWh)	Renewable heat output, 2019 (%)	Operational renewable heat capacity, 2019 (GW)	Operational renewable heat capacity, 2019 (%)
Aberdeen City	18	0.35%	0.01	0.47%
Aberdeenshire	361	6.94%	0.20	10.02%
Angus	168	3.23%	0.06	3.17%
Argyll & Bute	62	1.19%	0.04	1.93%
Clackmannanshire	<10	##	<0.01	##
Dumfries & Galloway	293	5.62%	0.16	7.89%
Dundee City	<10	##	0.01	0.27%
East Ayrshire	163	3.13%	0.08	3.96%
East Dunbartonshire	65	1.26%	0.01	0.45%
East Lothian	64	1.22%	0.03	1.49%
East Renfrewshire	<10	0.14%	<0.01	##
Edinburgh, City of	55	1.07%	0.03	1.30%
Eilean Siar	31	0.60%	0.02	0.79%
Falkirk	<10	##	<0.01	##
Fife	217	4.17%	0.25	12.06%
Glasgow City	32	0.62%	0.02	0.89%
Highland	996	19.14%	0.30	14.69%
Inverclyde	15	0.29%	0.01	0.56%
Midlothian	26	0.50%	0.01	0.68%
Moray	358	6.88%	0.09	4.49%
North Ayrshire	368	7.07%	0.12	5.97%
North Lanarkshire	70	1.34%	0.01	0.66%
Orkney Islands	17	0.32%	0.01	0.48%
Perth & Kinross	215	4.12%	0.09	4.40%
Renfrewshire	29	0.55%	0.02	1.12%
Scottish Borders	142	2.74%	0.07	3.49%
Shetland Islands	37	0.72%	0.01	0.67%
South Ayrshire	503	9.66%	0.06	3.14%
South Lanarkshire	106	2.04%	0.07	3.33%
Stirling	574	11.03%	0.10	5.06%
West Dunbartonshire	<10	##	<0.01	##
West Lothian	42	0.81%	0.02	0.89%
Unknown	138	2.64%	0.10	4.78%
TOTAL	**5205**	**100%**	**2.03**	**100%**

Note: ## denotes an anonymised percentage

Figure 14. Map showing operational renewable heat output by local authority area in Scotland, 2019

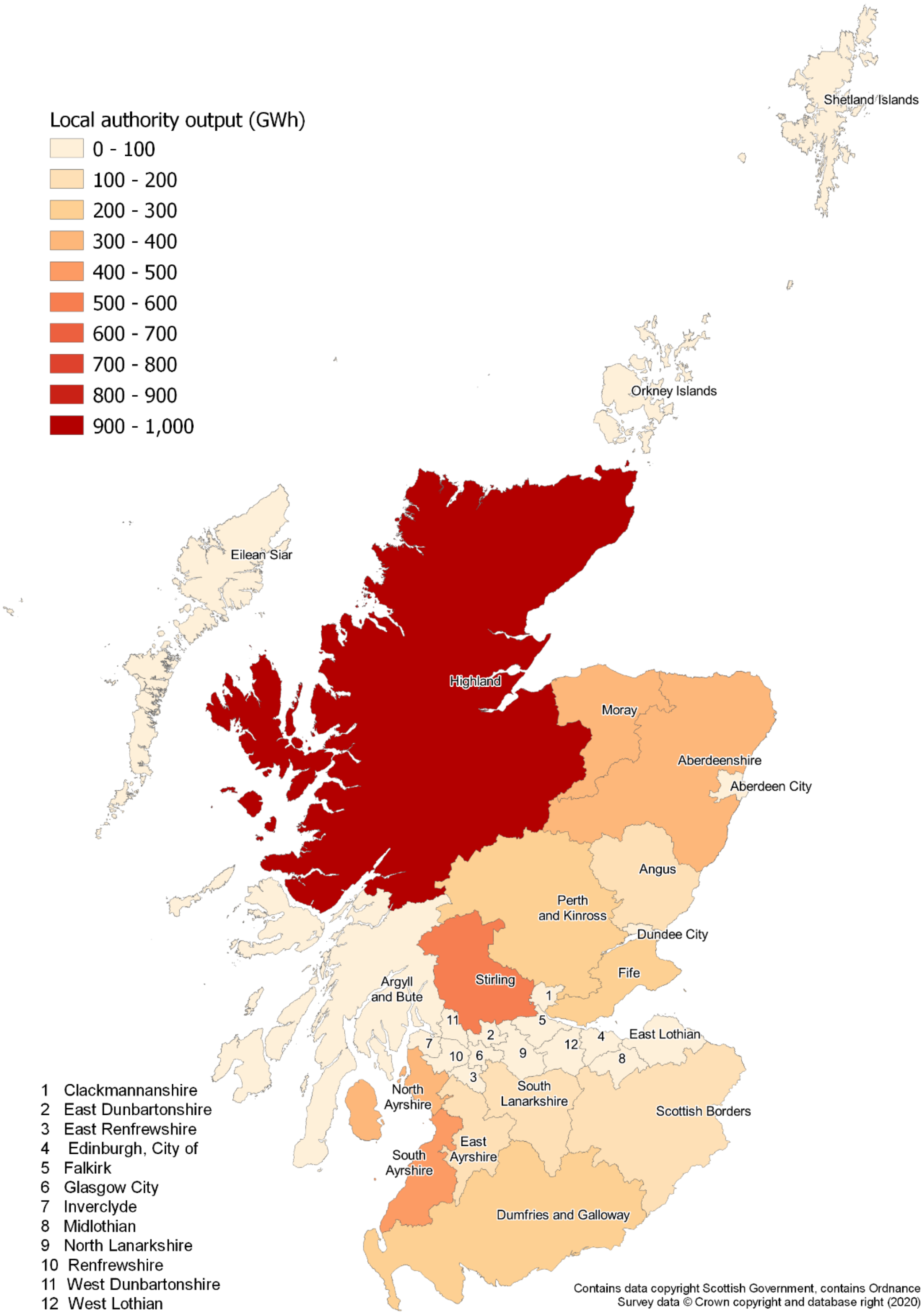
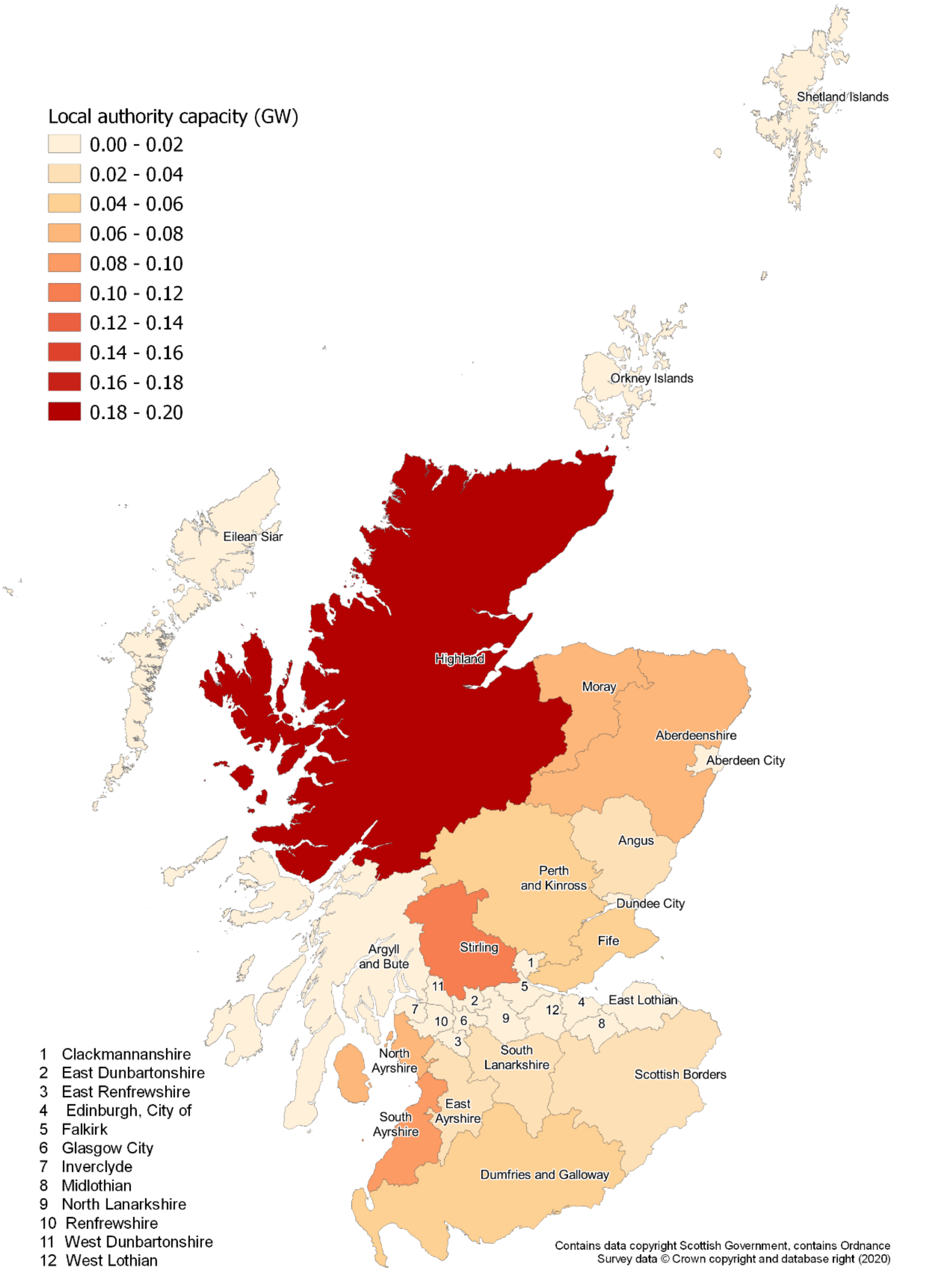


Figure 15. Map showing operational renewable heat capacity by local authority area in Scotland, 2019[26]



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[26] 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.

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 micro-sized systems accredited under the domestic RHI are located off the gas grid (see Table 10). As of December 2019, 89% of heat pumps and 89% of biomass systems were installed in off-gas grid areas,[27] compared with approximately 14% of Scottish properties located in off-gas grid postcodes. A smaller proportion of solar thermal systems (65%) are located in off-gas 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 10. Number of installations on and off the gas grid accredited in Scotland under the domestic RHI scheme as of December 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	422	11%	3,401	89%
Heat pump	1,029	11%	8,663	89%
Solar thermal	432	35%	788	65%
TOTAL	**1,883**	**13%**	**12,852**	**87%**

Note: 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 2019. Please refer to section 5.2 for further commentary on the trends seen in both the domestic and non-domestic RHI schemes between December 2019 and July 2020.

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

5 Further renewable heat capacity in development

5.1 Pipeline projects in the Renewable Heat Database

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 begun operating in the last two years 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 as well as any other installations we become aware of during 2020, largely through the use of available heat network data, planning decisions and other local authority or Scottish Government heat plan related documents.

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 2020. During the first six months of 2020 there was an increase in both the number of accreditations under the domestic and non-domestic[28] RHI schemes.

Trends in the domestic RHI scheme:

- There was a **5% increase in accreditations** for systems in Scotland under the domestic RHI between December 2019 and June 2020. This is an increase of 791, from 14,735 as of 31st December 2019 to 15,526 as of 31st June 2020.

- There was a 14% increase in annual accreditations under the domestic RHI scheme in 2019. This stopped the trend of decreasing growth in annual accreditations seen since 2015 when the annual increase in accreditations was 201%. In the following years, this fell to 20% in 2016, to 10% in 2017 and to 7% in 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 787,** from 8,296 as of December 2019 to 9,083 as of June 2020 (an increase of **9%**).

- The number of domestic **ground source heat pumps** accredited under the domestic RHI from December 2019 to June 2020 has **grown by 4%**, from 1,396 to 1,453 systems.

- **Solar thermal** installations have seen lower rates of uptake, with solar thermal accreditations increasing by **1%** (from 1,220 to 1,232) from December 2019 to June 2020.

[28] Accreditations under the non-domestic RHI scheme are referred to as ‘Accredited full applications’ in the RHI monthly deployment data.

- **Biomass** accreditations have decreased by **2%** (from 3,823 to 3,758) between December 2019 and June 2020.

- As of June 2020, systems in **Scotland accounted for 19% (15,526 installations) of the total number of accredited systems under the domestic RHI scheme (79,654 installations)**, consistent with the 19% share held in December 2019.

Trends in the non-domestic RHI scheme:

- There was a 2% increase in the number of non-domestic RHI accreditations in Scotland between December 2019 and June 2020, from 3,798 accreditations as of December 2019 to 3,855 as of June 2020. This corresponds to a 3% (0.03 GW) increase in capacity from 1.00 GW to 1.04 GW.

- The rate of annual increase of accreditations in Scotland under the non-domestic RHI has continued to decline from a 32% increase in 2015, to 16% in 2016, to 14% in 2017, to 4% in 2018 and to a rate of 2% in 2019.

- The general trend across all countries included in the RHI (England, Wales and Scotland) was that the largest proportional growth in number of accreditations between December 2019 and June 2020 was in small water or ground source heat pumps. GB wide, the number of accreditations for small water or ground source heat pumps increased from 951 in December 2019 to 1,128 in June 2020 (an increase of 19%). Large water or ground source heat pumps saw the largest absolute growth in capacity of accreditations, increasing by 0.05 GW (20%) from December 2019 to June 2020.

- As of June 2020, systems in **Scotland accounted for 19% of the total number of accredited full applications (3,855 out of 20,334) and 20% of the total installed capacity (1.04 GW out of 5.2 GW) under the non-domestic RHI scheme**.

Overall, the non-domestic RHI data currently available for 2020 suggests the continuation of a downward trend for new biomass applications being made under the scheme, with an inverse rise in the number of applications for heat pumps. This mirrors, to some extent, the growing rate of uptake of heat pumps seen under the domestic RHI scheme.

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

5.3 Emerging technologies and innovative projects in the pipeline

Sites converting biogas from anaerobic digestion (AD) to biomethane for gas grid injection (BtG) are increasingly becoming a more prominent technology in Scotland. 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, 2018 and now 2019. The majority of the biomethane technology derived output presented in this report was sourced from the BEIS RHI dataset, supplemented by data from SGN, because it is not always clear whether sites export some or all of the biogas captured from AD, or other processes, for conversion to biomethane, or whether all consumption takes place on the site alone. There are similar issues in identifying whether an AD fed biogas site is burning biogas solely to generate electricity or if they are using some or all of the resulting heat output as well.

In May 2019, the Scottish Government published a review of domestically available bioenergy resources.[29] 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..

5.4 Renewable energy funding streams

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:

5.4.1 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 an important funding stream to help deliver both low carbon and renewable district heating projects.[30] Since 2011, the Scottish Government has offered over £15 million to 50 different projects across Scotland.

5.4.2 Local Energy Scotland funding

Local Energy Scotland delivers the Scottish Government's Community and Renewable Energy Scheme (CARES), which offers free independent advice and funding options to support community groups, public sector organisations and rural businesses to take forward and be involved in renewable energy projects.

[29] https://www.climatexchange.org.uk/media/3609/the-potential-contribution-of-bioenergy-to-scotland-s-energy-system.pdf
[30] 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

The current contract for CARES (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.

However, it is important to note that CARES support is flexible and will adapt to meet the changing environment, which we have seen in terms of the reduction/removal of renewable subsidies, with a focus now on decarbonisation for community activity.

CARES supports the delivery of the Scottish Governments' targets for 1 GW of community and locally owned energy by 2020 and 2 GW by 2030. Progress as of June 2019 was an estimated 732 MW (73.2% of the target) of operational community and locally owned renewable energy capacity in Scotland.

5.4.3 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 £52 million of funding to 25 demonstrator projects supporting low carbon energy generation and supported the co-development of over 30 proof of concept and development proposals.

On the 17th of June 2020, the Scottish Government launched the £1 million Green Recovery: Low Carbon Energy Project Development Funding invitation, designed to stimulate and accelerate the development of a pipeline of low carbon energy opportunities across Scotland. Applications for development support closed on the 14th of August 2020.

As part of the Programme for Government the Scottish Government announced the opening of a new funding call for the £50 million Green Recovery Low Carbon Infrastructure Transition Programme in September to support low carbon and renewable heat projects. This is a capital funding call seeking projects with a broad low carbon infrastructure focus on heat decarbonisation, smart energy systems, local energy systems and demonstrator projects. This funding is available to business, community projects and local authorities.

5.4.4 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; for all buildings to be warmer, greener and more efficient by 2040.

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

The Route Map will guide decisions taken to support Scotland's homes, aiming to maximise the number of homes achieving an Energy Performance Certificate (EPC) band C by 2030, through targeted support and enabling action, so that by 2040 all homes achieve at least an Energy Performance Certificate (EPC) rating of band C where technically feasible and cost-effective. This will be phased differently across tenures.

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

Local authorities are a strategic partner for the programme as they 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 as well as identifying zones suitable for heat decarbonisation.

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 allowed all 32 local authorities to trial different aspects and to support the building of capacity and capability, and is due to be completed in March 2021.

Energy Efficient Scotland builds on the Scottish Government's existing programmes and these have been restarted following the COVID-19 public health emergency. The projects delivered as part of the Transition Programme have been completed and evaluated and the lessons learned have been incorporated into existing and planned delivery mechanisms. An update to the Energy Efficient Scotland Route Map and the Heat Decarbonisation Policy Statement will be published alongside the Climate Change Plan update from the end of this year.

5.5 Other developments from 2020 onwards

As part of the Programme for Government 2020/21, the Scottish Government announced an investment of £1.6 billion over the next Parliament to expand and accelerate heat and energy efficiency programmes as part of a Green Recovery. This investment is intended to create a sustainable market for renewable and zero emissions heat in Scotland and demonstrate a long-term commitment to tackling emissions from heating. This will more than double annual capital investment in heat and energy efficiency by the end of the next Parliament, from £112 million in 2019/20 to £398 million in 2025/26.

The Scottish Government is committed to ensuring that, from 2024, new buildings must use zero emissions heat. This involves working with the construction, property and commercial development sectors to inform the development of new regulations to achieve this. A consultation on the New Build Heat Standard will be launched in Autumn 2020.

In the public sector, the Scottish Government are committed to engaging with partners to further develop and implement the Net Zero Carbon Standard for new public buildings.

At the end of 2020, the Scottish Government will publish a draft Heat in Buildings Strategy, encompassing a refresh of the Energy Efficient Scotland route map and setting out a strategic vision for decarbonising heat across all buildings in Scotland.

The Scottish Government commissioned a study on waste heat potential, in order to support emerging regional and national policies associated with the development and deployment of low carbon heat networks in Scotland. The study will be examining a variety of potential waste heat sources in Scotland, quantifying their potential and mapping their spatial distribution via GIS. The results of the study will support policymakers and industry in identifying waste heat opportunities, as well as support energy master planning that considers the use of local waste heat sources thereby enabling environmental and economic benefits. This will also feed into update of the national comprehensive assessment of the potential for combined heat and power and district heating and cooling in the UK, last completed in 2015, which is due to be completed by end of 2020.

The Scottish Government, recognising 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, introduced the Heat Networks (Scotland) Bill to the Scottish Parliament on the 2nd of March 2020. The Bill aims to contribute to Scotland’s climate change targets by regulating heat networks (i.e. district and/or communal heating), in a way which increases investor, supply chain and consumer awareness and acceptance, thereby encouraging their deployment. Heat networks will have a key role to play in supplying Scotland’s heat in the future, which is why the Bill introduced the regulatory elements of heat network zones, a heat network licensing system as well as heat network consents and permits. These will help bring greater certainty to the market and ensure that heat networks are developed in strategic places that deliver best outcomes in terms of greenhouse gas emissions reduction and addressing fuel poverty.

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.

Of the figures reported, 83% of renewable heat output is known, 17% is estimated and less than 1% has an unknown status; 90% of renewable heat capacity is known, 10% is estimated and less than 1% 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. 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. An updated extract was provided for this year’s analysis covering RHI payments made for heat output in 2017 to 2019.

The RHI continues to incentivise the uptake of renewable heat technologies of which a large number would have otherwise been unknown to EST. Continued access to the latest RHI data is therefore key in ensuring that a wide cross section of these installations are included within this and future reporting on renewable heat in Scotland.

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 data from the Microgeneration Installations Database (MID). 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 and Locally Owned Energy in Scotland database, which is also collated by EST.

Some improvements were made to the matching process between the Renewable Heat Database and the RHI, CHPQA and MCS datasets which further reduced the risk of double counting projects and overestimating heat output within our totals. A full breakdown of the matching methods and possible limitations thereof can be found in Appendices 4, 5 and 6.

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.

For the first time this year, BEIS have provided an extract of CHPQA accreditations in Scotland which has helped refine the estimate of the total renewable heat capacity and output in operation.

6.3 Estimating heat capacity and renewable output for micro installations

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 MCS Installation Database (MID) otherwise it will not be recognised as an MCS installation. The MID therefore provides exact numbers of solar thermal, heat pumps and biomass systems that are installed by MCS certified installers.

For the first time this year MCS provided a full extract of the MID with address affixed which allowed a much greater level of detail of analysis to take place. Micro installation counts, capacities and outputs could be attributed to local authority areas to improve the local authority reporting and the addresses also allowed cross reference with the non-domestic RHI dataset as to remove potential double counting. MCS informed EST that a small percentage of their certified installations were in non-domestic settings but the exact quantity was unknown and it was through cross reference with the non-domestic RHI dataset and Renewable Heat Database that approximately 20 GWh of renewable heat output was identified as at risk of double counting and removed from the analysis. The full logic used to reduce the risk of duplicating MCS installations across other datasets can be found in Appendix 5.

Although MCS has been accrediting installations since 2008, only the MCS data covering 2012 to 2019 (inclusive) has been used within the analysis because for micro and domestic installations prior to 2012 other existing datasets have been used instead, such as: EPC data, Building Services Research and Information Association (BSRIA), data from Energy Saving Trust grant and loan schemes, Heating and Hot Water Industry Council (HHIC) estimates and Stove Industry Alliance sales estimates for Scotland where the overlap between these datasets and the MCS extracts are unknown. Pre-2012 MCS data has therefore not been included in the Renewable Heat Database as 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) may be underestimated. At the time of writing there was no data available that would provide the missing information without increasing the risk of double counting.

6.4 Potential useful heat output that is not currently utilised

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

6.5 Recommendations for future updates

6.5.1 Recommendation 1 – energy from waste data

Given the estimated current and potential contribution of energy from waste to renewable heat output, the database would benefit from greater information sharing between organisations involved in the development of energy from waste projects and, as far as is possible, within the limits of commercial confidentiality. Any on site information from operational projects regarding biodegradable content and the quantity of 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 – Increased use of MCS data

As discussed in section 6.3, continuing to work on and refine the MCS matching methodology as to reduce the risk and rate of project duplication between the MCS, RHI and Renewable Heat datasets will be key to refining a more precise estimate of the renewable heat output divide between domestic and non-domestic properties. In addition, access to the domestic RHI dataset at address level would allow a further degree of analysis perhaps considering elements not yet touched on in this report such as the percentage of unsubsidised renewables being installed and an idea of decommissioning rates for domestic renewable heating systems.

7 Further Information

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

- Appendix 1. Full revised figures for December 2018 report
- Appendix 2. Technical terms used
- Appendix 3. Renewable Heat Database assumptions
- Appendix 4. Merging Renewable Heat Database with non-domestic RHI dataset
- Appendix 5. Including the MCS dataset within the analysis
- Appendix 6. Combining Renewable Heat Database with CHP dataset
- Appendix 7. Measurement of heat demand in Scotland