Renewable Heat in Scotland, 2019 Appendices

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Prepared by the Energy Saving Trust

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These appendices were created for use with the Renewable heat in Scotland 2019 report published by the Energy Saving Trust (EST) on behalf of Scottish Government.

All information contained within this document relates only to the 2019 iteration of the Renewable Heat Report, published in 2020, because many of the calculations, sources and assumptions used in the analysis are reviewed and updated on an annual basis.

Prior to the 2018 report, the appendices had been included within the main body of the report but for ease of use we have now separated them.

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

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Appendix 1. Full revised figures for December 2018 report

A1.1 Summary of revisions

Due to improvements in the quality of the data captured and as part of the annual data cleansing process, the figures for December 2018 have been revised.

The most impactful revisions made were to the assumed running hours of biomass and heat pump installations in the Renewable Heat Database where the amount of heat produced is estimated rather than known through metered datasets such as the non-domestic RHI extract.

The revised 2018 running hours were calculating from the metered installations accredited under the non-domestic RHI scheme and applied to unaccredited systems in the Renewable Heat Database to recalculate 2018's final output figures.

There were additional revisions due to more up to date extracts of the MCS and non-domestic RHI datasets being received.

The headline changes to the 2018 report are as follows:

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

Revisions to 2018 capacity and output broken down by installation size and technology can be found in Tables A1 and A2 of Section A1.2**.**

A1.2 Revised 2018 results by size of installation and technology

Table A1. Previously reported and revised figures for December 2018, by size of installation[1]

Size category	Previously reported figures for December 2018			Revised figures for December 2018		
	Renewable heat capacity (GW)	Annual output (GWh)	Number of installations	Renewable heat capacity (GW)	Annual output (GWh)	Number of installations
Large (>1 MW)	0.80	2,450	90	0.77	2,337	80
Small to medium (>45 kW – <1 MW)	0.86	1,511	3,650	0.87	1,463	3,780
Micro (≤45 kW)	0.35	634	21,780	0.36	587	23,830
Biomethane (no stated capacity)	N/A	624	10	N/A	569	20
Unknown	<0.01	10	20	<0.01	10	10
Total	2.01	5,230	25,550	2.00	4,966	27,720

Table A2. Previously reported and revised figures for December 2018, by technology

Technology	Previously reported figures for December 2018			Revised figures for December 2018		
	Renewable heat capacity (GW)	Annual output (GWh)	Number of installations	Renewable heat capacity (GW)	Annual output (GWh)	Number of installations
Biomass heat-only	1.26	3,088	Not published	1.28	2,915	8,430
Biomass CHP	0.40	757	Not published	0.38	730	20
Energy from waste	0.12	1027	Not published	0.12	387	170
Biomethane	N/A	Included under energy from waste	Not published	N/A	569	20
Heat pump	0.19	340	Not published	0.19	345	14,660
Solar thermal	0.04	18	Not published	0.04	19	4,430
Total	2.01	5,230	Not published	2.00	4,966	27,720

[1] Output values are rounded to nearest whole number, capacity values rounded to two decimal places and number of installations rounded to the nearest 10 in all cases.

Appendix 2. Technical terms used

A2.1 References to 'heat output'

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

- **Heat output**

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

- **Useful heat output**

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

- **Actual heat output**

The predicted amount of heat produced by a site, accounting for losses and efficiency. Actual heat output includes heat that is *not* delivered to an end user or process and is often estimated using assumed values for running hours and capacity.

- **Potential heat output**

The total amount of heat that could potentially be generated by the site if it operated all year round.

- **Renewable heat output**

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

A2.2 Renewable energy technologies

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

- **Biomass (wood) heat-only primary combustion**

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

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

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

- **Solar thermal panels**

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

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

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

- **Energy from waste (EfW)**

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

- **Anaerobic digestion (AD):**

Organic matter is broken down in the absence of oxygen to produce methane gas. The methane is then burnt to produce heat, or burnt in a combined heat and power unit to generate both heat and electricity. In some cases, it can be upgraded to biomethane gas and injected into a gas grid. In some applications, the heat produced is used solely to maintain the anaerobic digestion process, which requires some heat input. Useful renewable heat has been classed as heat produced (and used) beyond that fed back into the anaerobic digestion process to maintain it, which is called parasitic heat load in the Renewable Heat report.

- **Landfill gas capture:**

Landfill gas (methane from rotting organic matter in landfill) is captured and burnt to produce heat or used in a combined heat and power unit.

- **Biomass primary combustion:**

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

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

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

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

This is the same technology as anaerobic digestion up to the point of having a biomethane (biogas) product. The resultant biomethane is not combusted on site but is 'upgraded'[2] to allow it to be injected into the gas grid, whilst ensuring it has similar properties to fossil natural gas. This technology will therefore allow the biomethane to displace fossil natural gas in the grid.

In previous editions of the Renewable Heat Report, biomethane installations were counted under the energy from waste technology category but is now reported on separately to improve the commentary on the growth on renewable heat in Scotland.

- **Deep geothermal**

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

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

- **Fuel cell biomass**

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

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

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

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

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

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

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

DUKES[3] considers hospital waste as non-biodegradable, so installations burning only hospital waste are not counted as producing renewable heat. However, installations which burn other wastes that are considered biodegradable such as municipal waste, in addition to hospital

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

waste, have been included in the database but only the heat output proportioned to the percentage of the waste that is biodegradable has been counted.

The following renewable heat technologies are not included in the Renewable Heat Database:

- **Passive renewable heating**

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

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

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

Appendix 3. Renewable Heat Database assumptions

A3.1 Biomass efficiency assumptions

Table A3 below lists the gross efficiencies used for calculating heat output of biomass boilers from known amounts of woodfuel combusted.

The biomass CHP efficiency reflects the efficiency of converting the wood fuel into usable energy and not the efficiency by which the CHP system generates electricity will be considerably lower. Heat is often a waste by-product of CHP electricity production, so to account for this a heat wastage factor has been applied to estimate the proportion of heat which is released by the CHP system when there is no demand for it. This heat wastage factor is based on analysis of the ratio of heat to electricity output of CHP sites in the UK relative to their stated capacities as found in the CHP chapter of the Digest of UK Energy Statistics (DUKES) publication.[4]

Table A3. Boiler efficiencies assumed for converting oven-dried tonnes (ODT) of wood burnt to heat output

Biomass technology	Assumed gross system efficiency	MWh heat output per ODT burnt	MWh useful heat output per ODT burnt
Biomass heat-only	70.0%	3.95	3.95
Biomass CHP	70.6%	3.98	1.78

A3.2 Running hour assumptions

Running hours are used throughout the database to calculate renewable heat output when the output is not known by multiplying the capacity by the assumed running hours. For the first time this year, output has been calculated using running hours derived from RHI database to further improve their accuracy.

In previous years we have published the running hours assumptions used but as bespoke running hours calculated from unpublished site level RHI information are now being used, the running hours will no longer be published alongside the report. Note that it is only a small proportion of the output that is being estimated using assumed running hours with the rest of the output values coming from metered data or other site-specific information.

A3.3 Capacity assumptions

Table A4 below shows the assumed capacities that are used in the Renewable Heat Database where information on capacity was not available. Only 10% of the reported total renewable

[4] https://www.gov.uk/government/statistics/combined-heat-and-power-chapter-7-digest-of-united-kingdom-energy-statistics-dukes

heat capacity is estimated either using the capacity assumptions below or the running hours assumptions discussed above.

Table A4. Assumptions used for capacity where not known, 2019

Technology	Build type	Estimate of likely installed capacity (kWth)	Derived from
ASHP	Schools	6	Average of other school ASHP installations recorded within the database
ASHP	Domestic properties	7	Average of other ASHP in domestic properties recorded in the database
ASHP	Commercial properties	12	Average of other local business ASHP installations recorded in the database
ASHP/GSHP	Community Buildings	7	Average of other community heat pump installations recorded in the database
ASHP/GSHP	Other non-domestic buildings	7	Average of other local authority and housing association heat pumps in non-domestic properties recorded in the database
ASHP/GSHP	Public sector properties	7	Average of other public sector heat pump installations recorded in the database
Biomass	Community buildings	60	Average of other community biomass installations recorded in the database
Biomass	Public sector properties	110	Average of other public sector biomass installations recorded in the database
Biomass	Commercial properties	140	Average of other biomass installations recorded in the database
Biomass	NHS hospitals (small)	200	Average of other small to medium hospital biomass installations recorded in the database
Biomass	Schools	200	Average of other school biomass installations recorded in the database
Biomass	NHS hospitals (large)	1400	Average of other large hospital biomass installations recorded in the database
Biomass district heating	Other district heating	140	Average of other biomass district heating installations recorded in the database
Biomass district heating	Community district heating	175	Average of other community biomass district heating installations recorded in the database

Exhaust ASHP	Domestic properties	7	Average of other ASHP - EAHR in domestic properties in the database
GSHP	Domestic properties	7	Average of other GSHP in domestic properties recorded in the database
GSHP	Commercial properties	30	Average of other local business GSHP installations recorded in the database
Solar Thermal	Community Buildings	6	Average of other community solar thermal installations recorded in the database
Solar Thermal	Schools	7	Average of other school solar thermal installations recorded in the database
Solar Thermal	Public sector properties	13	Average of other public sector solar thermal installations recorded in the database
Solar Thermal (installed 2011-14)	Domestic properties	2.38	Analysis of Home Energy Scotland domestic renewables loans data[5]
Solar Thermal (installed 2014-18)	Domestic properties	2.8	Analysis of Home Energy Scotland domestic renewables loans data[5]

[5] Home Energy Scotland home renewable loans are loans for domestic renewables, administered by the Energy Saving Trust on behalf of the Scottish Government, and have been used to estimate average capacities for domestic solar thermal installs.

Appendix 4. Merging Renewable Heat Database with non-domestic RHI dataset

A4.1 Background

The non-domestic Renewable Heat Incentive (RHI) is a scheme that opened to applicants in November 2011 (with scope for legacy applicants to apply for accreditation). The non-domestic scheme is designed to incentivise uptake of renewable heat technologies in mainly non-domestic applications but does include district heating for residential schemes.[6] The RHI is administered by Ofgem on behalf of BEIS.

In the reporting years prior to 2018, no site-level detail on the installations accredited (or awaiting accreditation) under the scheme had been shared with the Scottish Government or the Energy Saving Trust. Since 2018, and under strict conditions of access to the site level RHI dataset, Energy Saving Trust has conducted analysis on the non-domestic RHI scheme, comparing accreditations under it with Energy Saving Trust's Renewable Heat Database.

All installations in the Renewable Heat Database that were matched with a non-domestic RHI accreditation using the process set out in Section A4.2 were excluded from the analysis and the RHI capacity and output values were used instead because the metered RHI data will be more accurate and up to date than Energy Saving Trust's estimates.

The variables provided by BEIS were:

- A record of each application to the non-domestic RHI scheme including the accreditation status, commissioning date, address, technology and tariff band.
- The operational renewable heat capacity of the installation.
- 'Heat paid for' under the RHI scheme, which is used as an estimate of useful heat output because the RHI scheme only pays for heat that is used for an eligible purpose.[7]

Since many of the systems accredited under the non-domestic RHI were already known about by Energy Saving Trust from other data sources such as Scottish Forestry's woodfuel surveys, checks were required to ensure, as much as possible, that the risk of double counting projects be kept to a minimum. The methodology to do so, and any limitations thereof, is described in detail in the following section.

[6] Communal and district heating include systems that link more than one property to the heat network. These may still be domestic applications but they are not eligible for support under the Domestic RHI scheme.
[7] Please see the RHI guidance for further details: https://www.ofgem.gov.uk/environmental-programmes/non-domestic-renewable-heat-incentive-rhi/eligibility-non-domestic-rhi

A4.2 **RHI matching methodology**

The analysis undertaken by Energy Saving Trust was done using an extract of the Renewable Heat Database as of 31st July 2020. As per the work carried out by BEIS in previous years, all sites with a capacity of 0.5 MW (500 kW) or greater were manually cross-referenced with the Renewable Heat Database to ensure accurate matching of the sites with the largest output and capacities as to minimise the impact of double counting should any duplicate project entries between the two datasets remain.

All non-domestic RHI accreditations with a capacity of less than 0.5 MW were then cross referenced with the Renewable Heat Database using excel formulae to compare concatenations of key pieces of information shared between the two datasets.

The key variables used to identify matches between the datasets were:

- Project name
- Owner name
- Address
- Postcode
- Technology
- Capacity
- Commissioning date

The matching process was most successful when using concatenations of all or the majority of the variables above and where it was least successful, this could often be attributed to the postcode or capacity not exactly matching between the two datasets. Best efforts were made to manually check as many of the automated matches as possible, but it was not possible to manually check all within the publication timeframe. As such, the automated matching process was treated conservatively and all automated matches, including those not manually checked, were omitted from the analysis.

Appendix 5. Including the MCS dataset within the analysis

The MCS dataset is an extract of installations accredited under the Microgeneration Certification Scheme through the MCS Installation Database (MID). The database is installer facing who lodge the accreditations through an online portal.

Only a proportion of the MID fields are provided for the purposes of the Renewable Heat in Scotland analysis and include:

- Installation address and postcode
- Commissioning date
- Technology
- Capacity
- Generation (output)

The extract covers all installations accredited under MCS in Scotland going back until 2008 when the MCS standards were launched and is the best source of information on micro-sized installations in Scotland.

With a dataset as large as this which covers a long period of time and is collated directly from the installers, it is almost inevitable that some data issues will occur, particularly in subsets of the data such as amongst historical (pre-2015) records. The most common issues pertaining to the analysis of renewable heat in Scotland were missing capacity and generation values or values which were deemed atypical enough to not be included within the analysis. As an example of the latter, installations with outputs corresponding to an annual usage of a single hour in a year were considered unsuitable for the analysis.

Rather than omitting records entirely, Energy Saving Trust cleaned the MCS data using the following methodology:

Capacity and generation values were categorised into *'suitable and 'unsuitable'* datapoints. The following conditions were used to determine an *'unsuitable'* capacity or generation value:

- Capacity
    - Missing, NULL or zero value
    - Greater than the max capacity limit for the technology set out in Table A5
- Generation
    - Missing, NULL or zero value
    - Have a capacity factor greater than the maximum capacity factor and lower than the minimum capacity factor for the technology in Table A5

Table A5. Capacity and capacity factor parameters by technology used to cleanse MCS dataset

Technology	Max capacity (kW)	Min capacity factor	Max capacity factor
Air source heat pump	100	1%	90%
Biomass	150	1%	90%
Ground/Water source heat pump[8]	100	1%	90%
Solar thermal	75	1%	30%

The *'unsuitable'* values were replaced using the logic set out in Table A6. Average capacity values were determined from all *'suitable'* capacity values.

Table A6. Logic for cleansing unsuitable MCS capacity and generation values

Capacity Flag	Generation Flag	New Value Capacity	New Value Generation
Suitable	Suitable	Unchanged	Unchanged
Suitable	Unsuitable	Unchanged	Capacity*8760*Capacity Factor
Unsuitable	Suitable	Generation/(8760*Capacity Factor)	Unchanged
Unsuitable	Unsuitable	Av. capacity	Av. Capacity*8760*Capacity Factor

As part of the data cleansing, it was realised that some of the MCS installations could be duplicated across the non-domestic RHI dataset and the Renewable Heat Database. The methodologies described in sections A5.1 and A5.2 were applied in order to reduce this risk as much as possible.

A5.1 MCS and the RHI matching methodology

An automated approach using Excel formulae, akin to the method used to identify duplicate projects between the Renewable heat Database and non-domestic RHI datasets set out in Appendix 4, was used to look for duplicate entries between the MCS and non-domestic RHI datasets. Concatenations of commissioning date, technology, capacity and postcode proved to be the most successful.

Overall, the MCS matching process did not have a considerable impact on the analysis because only a small proportion of the MCS records were found to be in non-domestic

[8] The MCS dataset does not distinguish between installations of ground source and water source heat pumps.

settings. Approximately 20 GWh of output was removed from the analysis due to duplicate projects between the two datasets.

Cross checking the MCS dataset against the domestic RHI scheme was not necessary because the MCS dataset includes additional installations which were either ineligible for accreditation or were never accredited under the domestic RHI scheme. The MCS dataset should therefore be a more complete representation of renewable heat produced by micro-sized installations in Scotland and is used in place of data from the domestic RHI scheme.

A5.2 MCS and the Renewable Heat Database matching methodology

Cross checking between the MCS dataset and the Renewable Heat Database was required because the Renewable Heat Database contains a large number of domestic installations reported to us by local authorities and housing associations which would be at high risk of duplicating records in the MCS dataset.

It was not possible to cross check each individual installation between the MCS dataset and the Renewable Heat Database. Instead the following logic rules, detailed in Table A7, were applied to the Renewable Heat Database in order to identify the level of risk of duplication for each record. Records classed as ‘high’ or ‘very high’ risk had their Renewable Heat Database capacity and output values excluded from the analysis and the corresponding MCS values were used instead.

Table A7. MCS Risk indicators assigned to Renewable Heat Database records

Risk	Descriptor
Very low	• The installation is not micro sized (capacity ≤45 kW) because the vast majority of installs reported by MCS are less than 45 kW in size. Or • The record is for a microgeneration system (capacity ≤45 kW) but the install was commissioned prior to 2010 which is before the start of the MCS.
Low	• The record is for a microgeneration system (capacity ≤45 kW) AND The installation build type is known to be non-domestic. MCS, and the cross analysis between the MCS and non-domestic RHI datasets, have confirmed that the MCS MID database contains very few non-domestic installations and those should have been identified as part of the non-domestic RHI cross checking.
Medium	• The record is for a microgeneration system (capacity ≤45 kW) AND The installation build type is unknown, but the owner is not a local authority or housing association. The vast majority of domestic records within the Renewable Heat Database are sourced from local authorities or housing associations. Other organisation types are therefore deemed less risky.
High	• The record is for a microgeneration system (capacity ≤45 kW) AND the installation build type is likely to include some domestic installations. For example, 'accommodation' or 'guest house' build types are more likely to be considered domestic than other non-mixed build types. These records are therefore deemed riskier, regardless of which organisation owns the installation.
Very High	• The record is for a microgeneration system (capacity ≤45 kW) AND The installation build type is known to be domestic OR • The record is for a microgeneration system (capacity ≤45 kW) AND The owner is a local authority or housing association AND The build type is unknown. Records provided by local authorities or housing associations are deemed high risk as the vast majority of installations owned by such organisations are in domestic settings.

Appendix 6. Combining Renewable Heat Database with CHP dataset

A6.1 Background

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

For the first time this reporting year, site level detail on the installations which are CHP certified under the CHPQA scheme had been shared with the Scottish Government and the Energy Saving Trust to help refine renewable heat estimates in Scotland.

The CHPQA data extract included fields on:

- The site owner
- Installation address
- Technology
- Capacity
- Thermal and electrical output
- Amount of fuel consumed by fuel type

A6.2 Uncertainties and duplication

The majority of CHP installations in Scotland were already known to us through handling other data sources including the Renewable Energy Planning Database (REPD), non-domestic RHI data extract and the annual woodfuel surveys. To avoid double counting, each CHPQA installation was manually cross checked with the non-domestic RHI data extract and the Renewable Heat Database.

When a site was found to be a duplicate, there were often slight discrepancies in the capacity and output values across the datasets examined. As a result, the following logic was used to conduct the analysis:

- Where a CHPQA installation was also found within the non-domestic RHI data extract, the non-domestic RHI values were used except in cases where a site was known to only be partially RHI accredited (i.e. only a portion of the renewable heat capacity and output was accredited under the non-domestic RHI scheme).

- Where a CHPQA installation was not found within the non-domestic RHI data extract but within the Renewable Heat Database, if the Renewable Heat Database information was up to date, such as from a recent survey of the site, the Renewable Heat Database values were used. If the Renewable Heat Database values had not been updated in this reporting year, or included some degree of estimation, the CHPQA values were used instead.

It is assumed that most, if not all, of the CHPQA installations would have had their thermal capacity values reported by the site. However, as the CHPQA dataset did not identify which records, if any, had estimated capacity values, it was decided to treat all CHPQA capacity values as “estimated” in order to be as conservative as possible.

As the CHPQA programme is a volunteer scheme, it is possible that there are operational CHP systems in Scotland that have not been captured by the Renewable Heat Database, non-domestic RHI dataset or the CHPQA data extract. However, the risk of a large site being omitted from all three datasets is considered unlikely especially because accreditation under the CHPQA programme allows access to some financial incentives which would otherwise not be available to the operator.

Appendix 7. Measurement of heat demand in Scotland

This Appendix sets out:

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

A7.1 Background

Heat has been estimated to account for more than half of Scotland's total energy use.[9] Switching from fossil fuel to renewable heat sources has the potential to reduce greenhouse gas emissions and make a significant contribution to Scotland's overall renewable energy target. The 2009 Renewable Heat Action Plan[10] sets a target of delivering 11% of Scotland's projected 2020 (non-electrical)[11] heat demand from renewable sources.

In 2006, the Scottish Energy Study[12] described Scotland's current energy supply, energy consumption and energy-related CO_2 emissions during 2002. This was the first major study of energy supply and demand to be conducted in Scotland for more than a decade. At that time, the discrete study provided the most robust data source available for estimates of energy consumption in Scotland. This study produced estimates for 2002 and subsequently a figure for 2020 heat demand was derived from these estimates. This heat demand figure was subsequently used to derive the 11% heat target (detailed in section A7.2). Due to improved availability of heat demand data for Scotland (detailed in section 11.3), the heat demand figure derived in 2006 is no longer used to monitor progress towards the 2020 target.

A7.2 Derivation of the 11% heat target

The target figure of 11% for renewable heat by 2020 was derived using the estimated contributions that renewable electricity and renewable transport would make to the overall 2020 renewable energy target. Based on the requirements of total non-electrical heat demand in Scotland at the time, it was estimated that renewable heat must contribute 6,420 GWh of output in order for Scotland to meet its 2020 Renewable Energy Target. Total heat energy demand in Scotland in 2020 was estimated to be 60,089 GWh using data from the 2006 Scottish Energy Study. Therefore, the target was set at 11% (See Table A8).

[9] Energy Statistics Database, September 2019, Scottish Government, https://www2.gov.scot/Topics/Statistics/Browse/Business/Energy/Database
[10] Renewable Heat Action Plan (2009). http://www.scotland.gov.uk/Publications/2009/11/04154534/0
[11] To avoid double counting we measure the non-electrical heat component against the heat target, acknowledging that the demand for heating delivered by electricity will be included as part of the renewable electricity target. The Scottish House Condition Survey (2016) estimates that around 11% of households in Scotland use electricity as their primary heating fuel.
[12] Scottish Energy Study, Vol 1 (2006). http://www.scotland.gov.uk/Publications/2006/01/19092748/0

Table A8. Description of the derivation of the renewable heat target (estimated 2020 figures)

Step	Step description	Output (GWh)
1	Total energy demand	160,307
2	Renewable energy target (20%)	32,061
3	Estimated renewable electricity contribution (50% target[13])	22,244
4	Estimated renewable transport contribution (10% target)	3,397
5	**Renewable heat output required (remainder)**	**6,420**
6	Total energy consumed within domestic, industrial and service sectors	95,276
7	Less: electricity consumption in these sectors	35,187
8	**Derived heat energy demand**	**60,089**
9	**Therefore, renewable heat required**	**c. 11%**

A7.3 Improving data on heat demand in Scotland

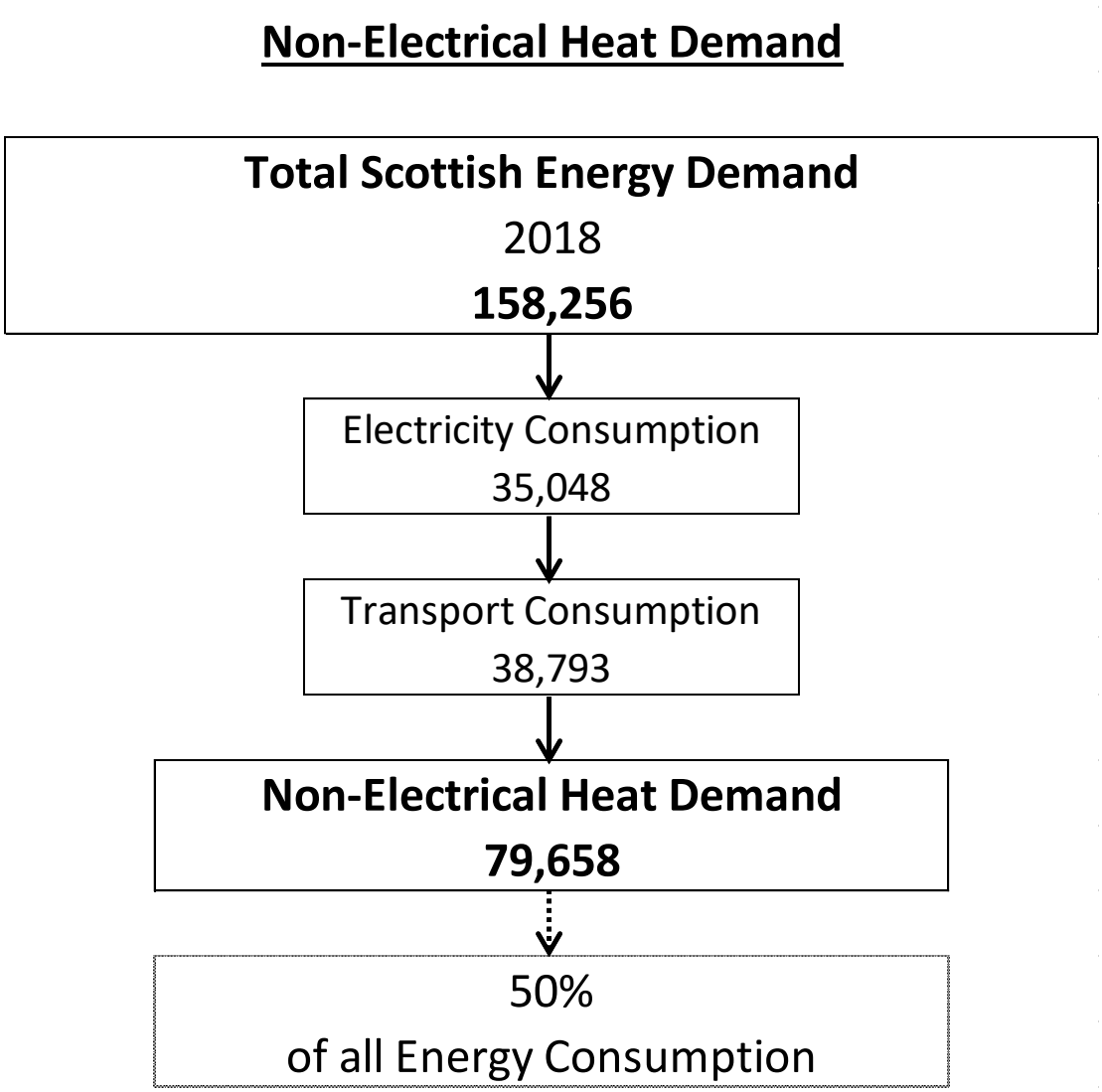
In the years following the publication of the Scottish Energy Study, BEIS began publishing more detailed sub-UK estimates of energy consumption[14] which has enabled the development of a systematic and robust method of monitoring (non-electrical) heat demand in Scotland on an annual basis. The Scottish Government has worked with colleagues in BEIS to derive a heat demand methodology for Scotland which will allow more accurate annual measurement of progress towards the renewable heat target.

BEIS data shows a breakdown of final energy consumption by end use for Scotland down to local authority level. By subtracting electricity and transport consumption from the final energy consumption figure, this results in an estimate for non-electrical heat demand in Scotland (see the flow chart in Figure A1 below for more detail).

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

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

Figure A1. Heat demand methodology



The methodological differences between the 2006 Scottish Energy Study and BEIS's annual estimates of final energy consumption have implications for the monitoring of the renewable heat target. Table A9 presents a time series using both sources, demonstrating the impact this annual heat demand estimate has made on measuring progress towards the 11% renewable heat target.

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

In 2019 BEIS adjusted their methodology to calculate sub-national energy consumption; now including 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 are 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.

In this edition of the Renewable Heat Report, the non-electrical heat demand terminology has changed, now relating to the energy value of the fuels used to meet the non-electrical heat demand rather than the 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 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.

Table A9. Renewable heat and renewable heat as a percentage of heat demand

	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%**
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 numbers 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 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 non-electrical heat demand to be met by renewables for that year has been interpolated from the 2008-09 and 2010 values.

A7.4 Summary of the changes as a result of the new methodology

Advantages

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

Issues

- There is a lag in the availability of BEIS sub-UK consumption data – 2018 data will not be available until September 2020.
- An adjustment is made to the electricity consumption data to account for discrepancies within BEIS datasets.
- The adjustment of figures for heat end use is based on the proportion used for heat in GB as a whole. There may be reasons to believe that Scotland's proportion used for heat may be different. A greater proportion of buildings being off the gas grid and higher heating demand may be reasons why Scotland may differ to the rest of GB.

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

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