

Woodfuel Demand and Usage in Scotland

1st Jan 2017 – 31st Dec 2017

Report produced for Forestry Commission Scotland by Energy Saving Trust

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Executive Summary

1. This report on existing and potential woodfuel use covers 2017 and assesses the possible additional use of woodfuel for the next few years.
2. At the end of 2017, there were an estimated 7,002 boilers using woodfuel in Scotland. 99.5% of these installations have a thermal capacity of less than 1,000 kilowatts (kW).
3. Total woodfuel used in Scotland in 2017 was 1,520,368 oven dry tonnes (odt). In 2016, the total woodfuel used was estimated to be 1,353,329 odt. There was, therefore, a 12% increase in woodfuel usage in Scotland over this period.
4. In 2017, the number of large boilers with a capacity of 1,000 kilowatt thermal (kWth) or more represented 0.46% of all boilers using woodfuel in Scotland. Whilst a small proportion of boilers, they do however make up the vast majority of woodfuel consumption. From 2016 to 2017, the amount of woodfuel used by boilers in this category dropped as a percentage of total woodfuel used, from 75% to 71%.
5. The highest numbers of non-domestic woodfuel boiler installations were found in rural local authority areas, with Dumfries and Galloway, Highland, Aberdeenshire, Perth and Kinross and Scottish Borders accounting for 55% of all non-domestic installations.
6. The same rural local authorities were also responsible for the highest number of domestic woodfuel boiler installations, with Highland, Aberdeenshire, Scottish Borders, Dumfries and Galloway and Perth and Kinross (in order of highest to lowest) accounting for 52% of all domestic installations.
7. The majority of woodfuel used in Scotland continued to be virgin fibre, sawmill coproducts and process residues (67%). This is an increase of approximately 2% in its use compared with the 2016 figure of 65%. Within this category, the majority of fuel used is virgin fibre. Recycled wood remained the next most used woodfuel type, accounting for 22% of fuel used. This is a drop of 3% from the 2016 reported figure, and an overall drop of 17% from 2015, when it made up 39% of fuel used.
8. There were 3 additional large wood fuel boilers included in the woodfuel survey for 2017, one of which was newly operational. There are at least a further 2 large boilers in the process of development. The predicted increase in woodfuel demand from these 2 boilers is around 13,000 odt. As noted in the previous report, continued 'degression' of tariff rates offered through the government's Renewable Heat Incentive schemes has slowed the rate of new small heat installations (less than 200kWth). In previous years, this category has seen the highest increase in the number of boilers.
9. In 2017, woodfuel boilers in Scotland contributed 4,769,107 megawatt hours (MWh) to the Scottish Government's renewable heat targets.

10. Wood-fuelled boilers in Scotland are estimated to have saved 1,490,322 tonnes of CO₂e in 2017. This is an increase of 208,860 tonnes of CO₂e compared to the 2016 figure of 1,281,462¹.

1. Overview

This report is part of an annual series of Woodfuel Demand and Usage in Scotland reports. In this iteration of the report, we provide data for the 2017 calendar year (1st January 2017 to 31st December 2017). The use of woodfuel is presented using three heat capacity bands:

- Small installations: less than 200kWth
- Medium installations: between 200 and 999kWth
- Large installations: 1000kWth and above

The report has been produced by Energy Saving Trust on behalf of Forestry Commission Scotland and Scottish Government.

2. Methodology

2.1 Data collection

Data for this report was collected by email correspondence and telephone calls with woodfuel users, installers, suppliers and other stakeholders, as has been done for previous reports. Figures provided by woodfuel users were used on strict conditions of confidentiality and are therefore only reported on an aggregated basis. In addition, information was used from past Woodfuel Usage reports, in particular the reports covering the years 2014, 2015 and 2016.

This report has also been able to make extensive use of the data collected and published by the Department for Business, Energy and Industrial Strategy (BEIS – formerly DECC) on Renewable Heat Incentive (RHI) accredited boilers in the domestic and non-domestic schemes² plus earlier Scottish Biomass Heat Scheme (SBHS) survey data.

2.1.1 Non-domestic boilers

- The RHI scheme for non-domestic buildings was introduced in November 2011, although it is assumed in this study that no new boilers were commissioned until January 2012.

¹ This is a revised figure for 2016, down from 1,333,688 tonnes of CO₂e. This revision is discussed further under section 5.1 Methodological reflections.

² The source materials provided by BEIS for this report are not directly comparable with other publicly available RHI datasets for two reasons. The figures in this report are based on RHI accreditation dates, which are used as an estimate for when boilers have become operational, however, other BEIS publications utilise the RHI application date. The heat output figures are also derived from the heat used in each quarter, apportioned to the relevant months, whereas the official BEIS statistics assign the heat used to the month in which the RHI payment was received – which can be considerably later.

- Biomass boilers installed after July 2009 were eligible to be subsequently accredited onto the RHI scheme ('RHI backdating').
- Forestry Commission (FC) survey data covers non-domestic boilers installed between 2005 and 2012. However, the 2012 survey data is only used in the calculations of the average woodfuel use per installation. The aggregate number of boilers for that year has been replaced with the number of boilers obtained from the non-domestic RHI data.
- Boilers included in the FC's survey data, which were installed by the end of 2011, are referred to as '**antedated boilers**' for the purpose of this report. BEIS refers to boilers installed between July 2009 and November 2011 and subsequently accredited onto the RHI scheme as '**legacy**' boilers.
- For this year's report, the number, capacity and heat output of both small and medium sized non-domestic boilers were grouped together in the source RHI data provided by BEIS. To be able to follow the same methodology as last year, these boilers were divided into the small and medium size categories, that are used in this report, by multiplying the total number of RHI accreditations for 2017, by the proportion of RHI applications received in 2017 for each of the respective size categories. It has therefore been assumed that the proportion of installs by size category would follow a similar breakdown in the number and estimated output of RHI applications.

The key features of the 2017 RHI application data, used to calculate this report's small and medium sized non-domestic boiler figures, are as follows:

- 7% of the total applications were for small sized boilers and the remaining 93% were for the medium size category.
 - Small sized boilers comprised 1% of the RHI heat output applied for in 2017, and the remaining 99% came from medium sized applications.
- Based on the FC survey data (2005-2012) for boilers using less than 1,000 odt per year the average boiler size was 164.52kW and the average woodfuel consumption per boiler was 98.334 odt/year. This is the equivalent of **0.5977 odt per year, per 1kW of boiler heat capacity**. In the absence of this information in the RHI data, this conversion number has been applied to calculate woodfuel consumption from small and medium biomass systems in this report, following the same methodology as the past Woodfuel Demand and Usage in Scotland reports. We are therefore assuming that the woodfuel consumption for small and medium sized installations has remained broadly consistent over the time period since the last survey was conducted.
 - Boilers installed for generating heat in the larger wood processing plants will normally be fuelled with as much on-site process residue as possible such as bark, offcuts and sander dust. Where necessary companies can supplement their on-site supplies by diverting some of their existing roundwood or sawmill co-product purchases to make up quantities rather than separately buying-in virgin material such as logs, wood chips or recycled timber to fuel their biomass boilers. Therefore, any change in the woodfuel use figures for co-products and residue and recycled fibre can be attributed to just the large user sites; whereas the totals for virgin fibre, pellets and other materials is split between the different size categories.

2.1.2 Domestic boilers

- The RHI scheme for biomass boilers installed in domestic buildings was launched on 9th April 2014 but boilers installed after 15th July 2009 were eligible to be subsequently accredited to the scheme.
- No information is available on wood-fuelled boilers installed in domestic buildings prior to 15th July 2009.
- According to UK Housing Energy Fact file (BEIS, 2013)³, **the average woodfuel consumption per domestic installation has been estimated to be approximately 4 odt of woodfuel per annum⁴.**
- This research excludes firewood used in open fires or wood burning stoves in domestic homes.

2.1.3 Data for domestic and non-domestic boilers

- This study assumes that since the inception of the RHI schemes, all newly installed biomass boilers will be registered to receive the RHI, or, where they are electricity or combined heat and power (CHP) plants, they will be participating in the government's Renewables Obligation (RO) incentive scheme and data available from BEIS will therefore include them.

2.1.4 Data Assumptions

The following assumptions and assumption-based formula have been applied throughout:

- 1 oven dry tonne (odt) of wood has a realizable energy value of 5,000 kWh⁵.
- The green to oven dry timber ratio can be calculated using the following formula:

$$R = (100 - \text{oven dried mc\%}) / (100 - \text{green mc\%})$$

Where *R* = the ratio to apply
mc = moisture content

e.g. $R = (100 - 0) / (100 - 50)$

$$R = 2$$

So for every 1 odt (0% mc) wood produced, 2 tonnes at 50% mc will need to be harvested.

³ UK Housing Energy Fact File (BEIS, 2013)

⁴ This assumes an average sized home using an average amount of energy for heating and hot water purposes as set out in the UK Housing Fact File. In all likelihood, homes with biomass boilers are likely to be larger and will therefore use more energy, possibly as high as 6 odt per year. For the purposes of consistency with past reports, the figure of 4 odt has been applied.

⁵ This is the figure that has been used in past reports and has been used in this report for consistency. Typical figures quoted for oven dry calorific values of wood (net CV) are closer to 19 MJ/kg or 5,200 kWh per tonne (rounded down).

2.2 Scope and structure of report

The results are presented in this report in the same way as they were in the last report (Demand and Usage in Scotland Report: 1st Jan 2016 – 31st Dec 2016):

- The estimated quantity of woodfuel used by boilers installed for domestic use under the RHI scheme has been included.
- The results are presented using the following three heat banding categories, which correspond to the three tariff bands used by BEIS in the non-domestic RHI scheme:
 - Plants with an installed capacity of 1,000kWth and above
 - Plants with an installed capacity of 200kWth and above, but less than 1000kWth
 - Plants with an installed capacity of less than 200kWth

Information on the types and quantities of woodfuel used in boilers with a heat generating capacity of 1,000kWth and above was collected as part of this research through a woodfuel survey. For non-domestic boilers with a capacity of less than 1,000kWth, the estimate of the type of wood fuel and consumption is based on previously collected data and for domestic boilers on analysis by the Wood Heat Association (WHA).

3. Results

3.1 Woodfuel used by operational boilers

The total number of boilers using woodfuel at the end of 2016 was estimated to have been 6,666. In 2017, it is estimated that an additional 336 boilers were commissioned and accredited into RHI schemes⁶, bringing the total to 7,002. Of the additional 336 boilers in 2017, 105 (31%) were domestic installations and 231 (69%) were in the non-domestic sector. Overall, the increase in installation numbers between 2016 and 2017 was lower than the increase seen between 2015 and 2016, when an additional 681 boilers were commissioned onto RHI schemes. The latest figures maintain the downward trend of reducing numbers of new biomass boilers being installed; seen occurring since 2014.

In total, there were 7,002 antedated and RHI accredited boilers commissioned by the end of 2017 and the total wood fuel used is calculated to have been 1,520,368 odt.

3.1.1 Woodfuel used by boilers providing $\geq 1,000\text{kWth}$

At the end of 2017, there were 32 boilers (an increase of three from 2016) operating in this heat category, of which 8 were CHP plants⁷. **During 2017 these 32 boilers used a total of 1,082,828 odt of woodfuel. The 8 CHP plants used a total of 824,287 odt and the remaining heat only boilers over 1,000kWth used 258,541 odt of woodfuel.**

3.1.2 Woodfuel used by boilers providing $\geq 200\text{kWth}$ but $< 1000\text{kWth}$

At the end of 2016, there were 504 boilers operating in this heat category. Based on survey data and BEIS non-domestic RHI data, it is estimated that a further 213 boilers were commissioned in this size category in 2017, giving a total number of 717; a 42% increase on 2016 figures. Using the estimated average woodfuel consumption of 351.7 odt /year per installation⁸, **the amount of woodfuel used in 2017 by the 717 installations is calculated to be 252,168 odt.** This is a significant increase on the 149,249 odt estimated to be used by this size category in 2016.

3.1.3 Woodfuel used by boilers providing $< 200\text{kWth}$ in the non-domestic scheme

The number of antedated and RHI accredited boilers in the non-domestic RHI scheme was calculated to be 2,547 boilers at the end of 2016. In 2017, the total number of accredited boilers in this size category was estimated to have risen to 2,562, an increase of 15. Although this figure is an estimate based on the RHI application data, this increase is still the smallest on record for this size category since the first

⁶ BEIS RHI data indicates that 471 new boilers were commissioned in 2017 (excluding installations $\geq 1000\text{kW}$); which is larger than the figure of 336 presented in this report. The difference between the two growth figures is due to a reduction of 108 to the total number of boilers accredited prior to 2017, as provided by BEIS, compared to what was provided for the 2016 report.

⁷ BEIS RHI data indicates there are 30 RHI-registered large installations in Scotland, however, as some of the woodfuel survey participants do not state whether they receive RHI or RO we cannot presume that all 30 of these sites are included within the 32 survey participants.

⁸ This is an increase from the previous year, in which the odt per install was estimated as 296.13. The revised figure reflects a larger average boiler size, as calculated from RHI data on the number and capacity of installations in Scotland.

woodfuel report was published. The trend in the number of installs for <200kWth non-domestic boilers has continued to decrease sharply since 2014.

The average capacity for non-domestic RHI boilers in this size band was 111kW per install in 2017, around 4kW per install less than in 2016. Using the previously calculated relationship of 0.5977 odt of woodfuel per year per 1kW of boiler heat, this gives an average woodfuel consumption per installation of 66.6 odt per year. **As there were 2,562 antedated and RHI accredited boilers in the non-domestic scheme in 2017, their total estimated wood fuel consumption was 170,608 odt.**

3.1.4 Woodfuel used by boilers in the Domestic scheme

BEIS data made available in June 2018, shows that the median capacity of boilers accredited in the domestic scheme was 25kW. According to UK Housing Energy Fact file (BEIS, 2013), average woodfuel consumption per domestic installation is approximately 4 odt of woodfuel per year. **As there were 3,691 boilers accredited to the domestic RHI scheme in this category, their total woodfuel consumption was estimated to be 14,764 odt in 2017.**

3.1.5 Total woodfuel use

Over the 2017 calendar year, the total aggregated amount of woodfuel used by boilers in the three heat categories was 1,082,828 odt (Table 1). This is an increase of 167,039 odt (12%) compared with the previous calendar year. An estimated 71% of the total woodfuel used was consumed by boilers with a capacity of 1,000kWth or more, with the next highest consuming category being boilers with capacities between 200kWth and 999kWth. Compared to previous years, the biggest increase in woodfuel consumption occurred in the medium sized boiler category (200-999kWth), where there was an increase of 102,919 odt (69%) used in 2017 compared to 2016. This increase in woodfuel consumption is not only due to the increase in the total number of medium sized boilers, but also the increase in average boiler size for this category. This indicates that there are more medium sized boilers being installed which are towards the upper limit of the ≥ 200 kWth and <1000kWth range than found in previous years.

For the large boiler size category, a combination of some participants reporting an increase in woodfuel consumption, as well as the addition of 3 new surveyed sites, resulted in an increase of 67,957 odt for the category as a whole. The non-domestic small boiler size category showed a slight reduction in the woodfuel used due to a drop in known heat output and corresponding average boiler size, despite the very modest increase of 15 new installations for this category.

Table 1: Total woodfuel used by heat capacity of boilers 2017⁹

Boiler heat category	Number of boilers		Proportion of boilers (%)	Woodfuel consumption (odt)		Proportion of woodfuel consumption (%)
	Domestic	Non-domestic		Domestic	Non-domestic	
<200 kWth	3,691	2,562	89%	14,764	170,608	12%
	Total			Total		
	6,253			185,372		
200 - 999 kWth	717		10%	252,168		17%
≥ 1000 kWth	32		<1%	1,082,828		71%
Total	7,002		100%	1,520,368		100%

The total number of non-domestic boilers accredited to the RHI scheme up to the end of 2017 is shown by local authority in Map 1. The local authority with the greatest number of non-domestic installations is Dumfries and Galloway with a count of 525 boilers. This is followed by the Highland (446), Aberdeenshire (435) and Perth and Kinross (228) local authority areas. The local authorities with the fewest non-domestic installations are Dundee City and the Orkney Islands, both of which have 5 or fewer installs¹⁰.

The total number of domestic boilers accredited to the RHI scheme up to the end of 2017 is shown by local authority in Map 2. The local authority with the greatest number of domestic installations is Highland at 863, an increase of 16 compared to 2016. This is followed by Aberdeenshire, with 330 installations, and Scottish Borders with 315. The local authorities with the fewest domestic installations are Aberdeen City and Glasgow City, both of which have 5 or fewer installs¹¹.

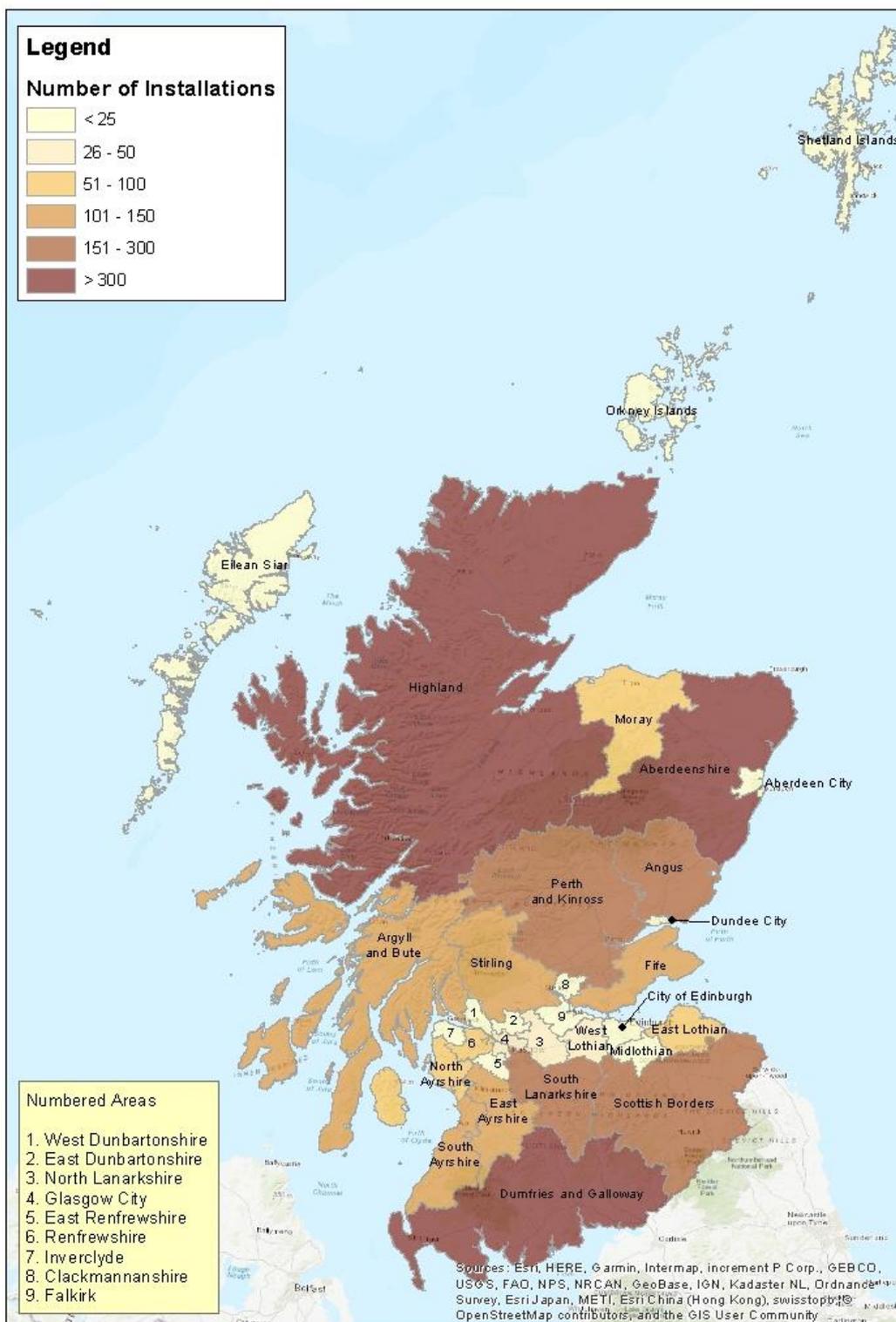
The distributions of non-domestic and domestic boilers by local authority are generally very consistent when comparing the two datasets together. The same 5 rural local authorities: Dumfries and Galloway, Highland, Aberdeenshire, Perth and Kinross and Scottish Borders, are responsible for the majority of both non-domestic and domestic systems. Comparing the two local authorities with the most installs, Dumfries and Galloway has 260 more non-domestic than domestic biomass boilers; and the Highland local authority area has 417 more domestic systems than non-domestic.

⁹ All percentages are rounded to 0 decimal places

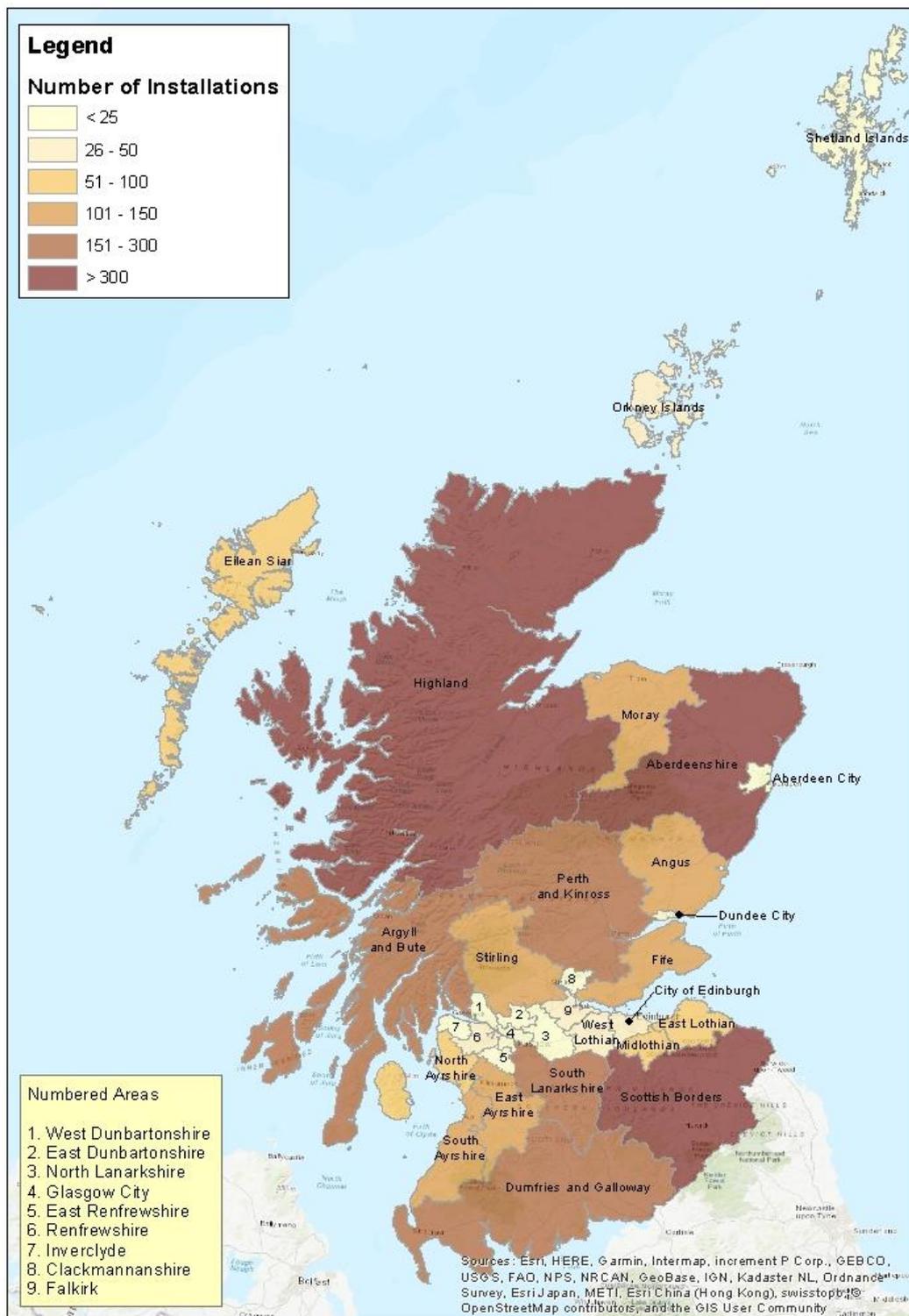
¹⁰ The exact figures could not be shared due to the risk of identifying individual sites.

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Map 1: Geographical distribution of non-domestic RHI accredited woodfuel boilers commissioned by the end of 2017 by local authority area



Map 2: Geographical distribution of domestic RHI accredited woodfuel boilers commissioned by the end of 2017 by local authority area



3.2 Woodfuel use by fuel category

Confidential information on the types and quantities of woodfuel used in boilers with a heat capacity of 1,000kWth or more has been collected as part of the research for this report.

To estimate the quantities of different types of fuel used for the other two heat categories, a similar set of assumptions have been made to those made in the previous report, namely, that the woodfuel used by boilers with a heat capacity of less than 1,000kWth in commercial situations or accredited to the non-domestic RHI scheme comprised 73% wood chips and sawmill co-products, 25% pellets and 2% other material.

As set out in the previous report, for the period up to September 2015, WHA analysis of GB non-domestic RHI data on biomass fuel and capacity indicated that 50% of woodfuel used was pellets, 33% wood chips and the rest logs. The percentage of pellets used in Scotland is therefore lower, but the conclusion in previous reports was that there is a more readily available supply of coniferous wood chips in Scotland than most other parts of GB. The WHA analysis also covered fuel type in domestic installations and this showed a split of 90% pellets and 10% logs. In the absence of any other data, this report has assumed the same split for Scotland.

Based on survey information and the above assumptions, the total woodfuel used in 2017 by category is given in Figure 1 below. Compared with 2016 (Figure 2), there has been an increase in the percentage of virgin fibre, co-products and residue, which made up 67% of woodfuel use in 2017 compared to 65% in 2016. There has been minimal change in the use of pellets and a decrease of 3% in the use of recycled fibre.

Figure 3 below shows total woodfuel use since 2004/2005 by major fuel category.

Figure 1: Woodfuel usage by fuel category in 2017

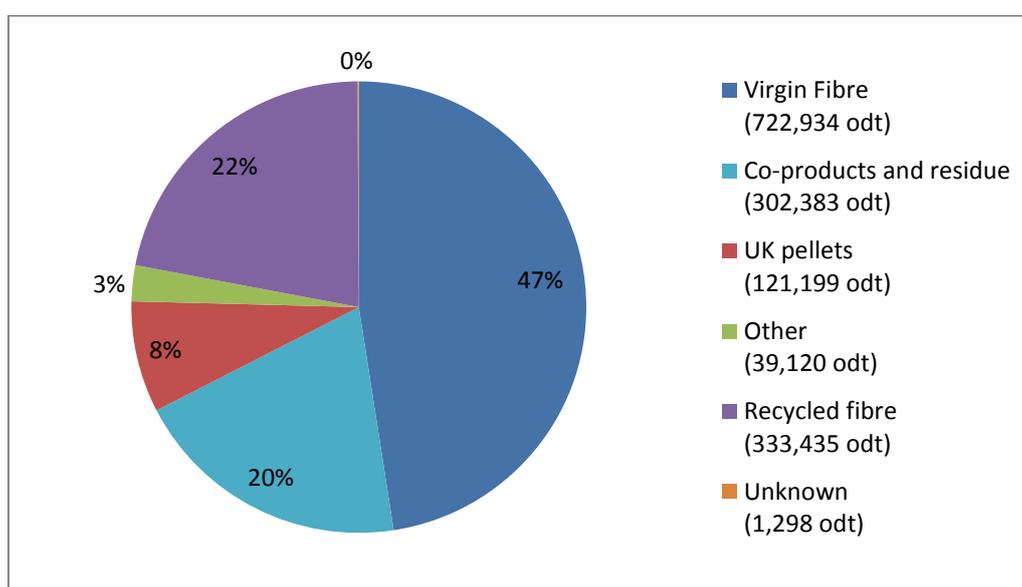


Figure 2: Woodfuel usage by fuel category in 2016

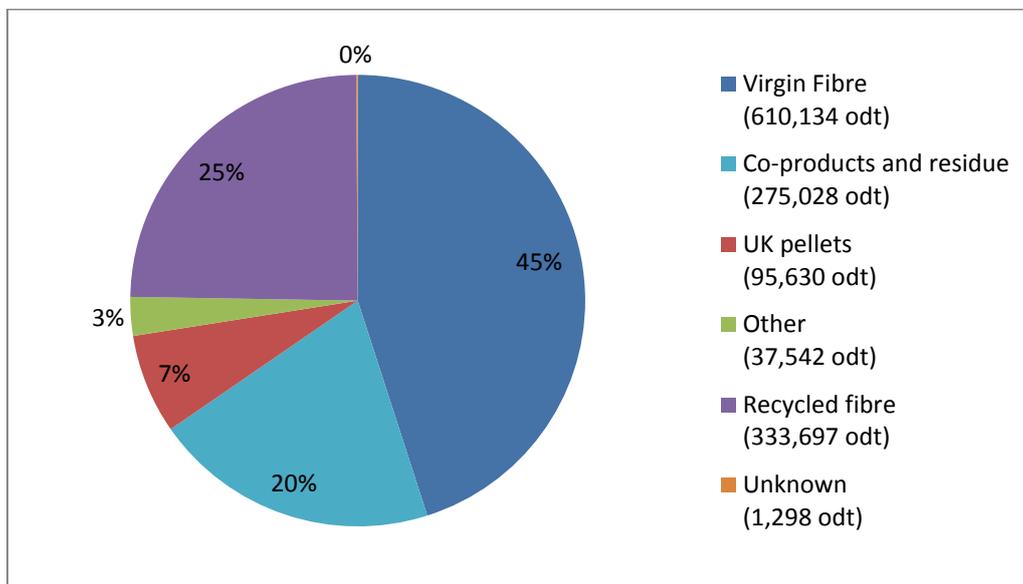
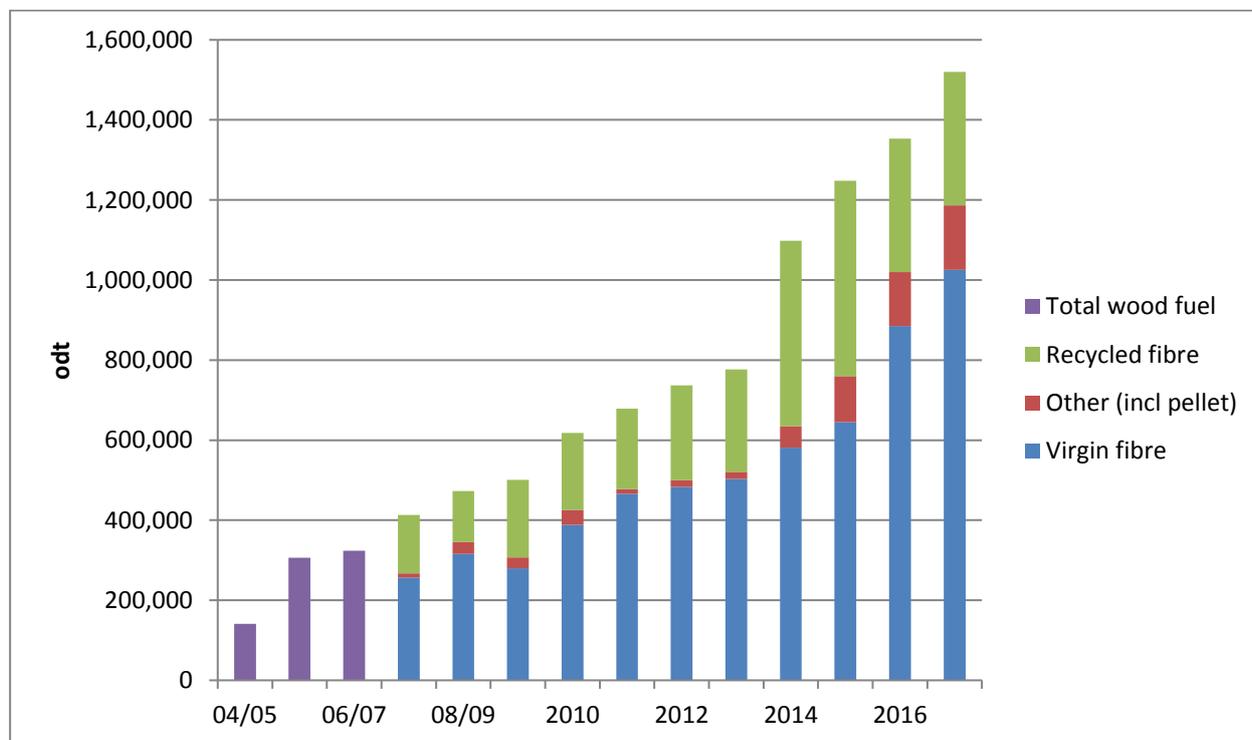


Figure 3: Total woodfuel use between 2005/6 and 2017 split by major fuel category



3.3 Contributions towards the Scottish Government’s renewable heat targets

Operational data on the contribution that wood-fuelled boilers made to the Scottish Government’s renewable heat targets in 2017 is not available for all heat categories of boiler. For boilers with a capacity of $\geq 1,000\text{kWth}$, where possible data was collected on total heat output from the sites through the woodfuel survey. Where this data was not available, the heat output was calculated from the woodfuel consumption, based on a calorific value of wood of $5,000\text{kWh}$ per oven dried tonne. For CHP plants, only the heat output has been included.

As was the situation in previous years, the total heat output obtained operationally from boilers with a heat capacity of $<1000\text{kWth}$ was not available. However, the numbers of boilers in each heat category and estimates of the average thermal capacity of the boilers was obtained, as described in previous sections. As the number of operational hours was not known, these have again been estimated. For both domestic and non-domestic boilers of $<200\text{kWth}$, we have assumed that that the boilers were only used for 6 months of the year (182.5 days) and they were then only operating 10 hours a day. Using these estimates, annual operating hours totalled 1,825. This represents an assumed load capacity of 20.8%, which is almost identical to the BEIS load factor of 20%. For boilers sized $200\text{kWth} - 999\text{kWth}$, we have assumed an annual operation of 5,000 hours. This is different to the assumptions used in reports prior to 2016 (where 1,800 hours was also assumed for this size category). However, the assumption of 5000 hours is in line with that used (for this size of biomass boiler) in the Renewable Heat in Scotland 2017 report¹². This report is produced on behalf of Scottish Government to assess progress towards their renewable heat target. In order to assess the contribution of biomass towards Scottish Government’s targets, we have therefore used the same assumption for this report.

Using the data and assumptions described above, the contribution that woodfuel made towards the Scottish Government’s renewable heat targets in 2017 has been estimated as $4,769,107\text{MWh}$ (see table 2 below). This is an increase of $1,164,825\text{MWh}$ (33%) over the 2016 estimate of $3,604,282\text{MWh}$.

Table 2: Estimated contribution of woodfuel to Scottish Government renewable heat target in 2017

Boiler heat category	Number of boilers	Annual hours of operation	Average boiler capacity (kWth)	Estimated heat output (MWh)
< 200kWth domestic	3,691	1825	25	168,402
< 200kWth non-domestic	2,562	1825	111	520,926
200 - 999kWth	717	5000	588	2,109,480
$\geq 1000\text{kWth}$	32	Survey data	Survey data	1,970,299
Total	7,002			4,769,107

¹² Renewable heat in Scotland, 2017:

<http://www.energysavingtrust.org.uk/sites/default/files/Renewable%20Heat%20Report%20%202018.pdf>

3.4 Carbon savings

The carbon savings achieved as a result of using woodfuel rather than other energy sources can be calculated using conversion factors for different fuel types published annually by BEIS¹³. The conversion factors for 2017 are given in Table 3 below.

For boilers with a capacity of 1,000kWth or more, it was feasible for most of the plants to record the substituted fuel to which the appropriate conversion factor was applied. By contrast, for boilers with a thermal capacity less than 1,000kWth it was not possible to identify what type of fuel was being replaced; it has therefore been assumed that these boilers replace oil systems (burning oil – kerosene). The carbon savings have been calculated using the estimated heat output figures as per Table 2.

Table 3: Conversion factors for greenhouse gas emissions for 2017

Substituted fuel	kgCO ₂ e per kWh (net calorific value)
Electricity	0.3516
Compressed natural gas	0.2046
Burning oil (kerosene)	0.2596
Coal (industrial)	0.3415

Table 4: Carbon savings from woodfuel projects in Scotland in 2017 – net CV¹⁴

Boiler heat category	Woodfuel use (odt/annum)	Energy output (MWh/annum)	Annual CO ₂ e savings (tonnes/annum)
< 200kWth	185,372	689,328	178,928
200 - 999kWth	252,168	2,109,480	547,556
≥ 1000kWth	1,082,828	3,026,611	763,837
Total	1,520,368	5,825,419	1,490,322

Note: Energy output for ≥ 1000kWth boilers is higher than that displayed in Table 2 as this figure includes electrical output generated by CHP plants (Table 2 is heat output only)

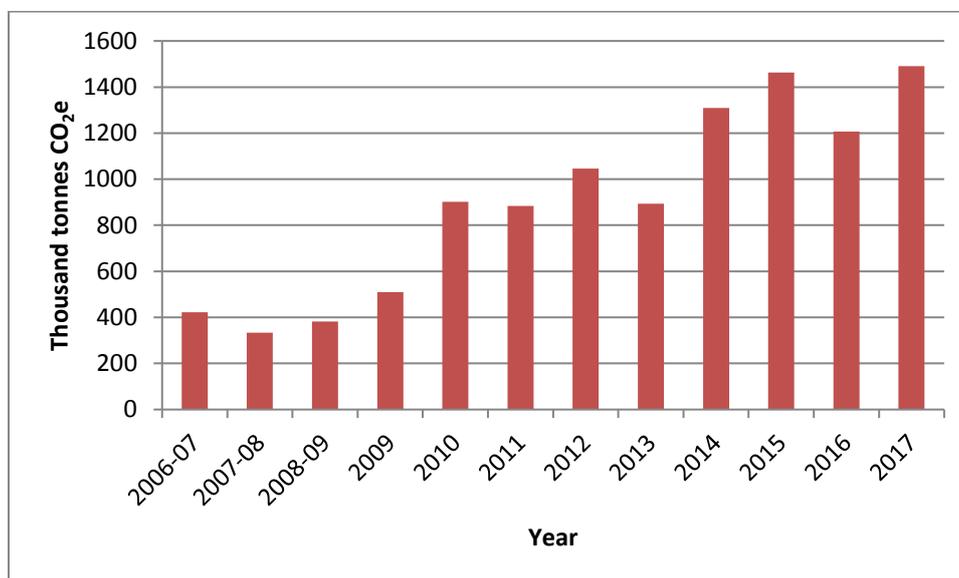
¹³ BEIS, Greenhouse gas reporting – conversion factors 2017:

<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017>

¹⁴ Net CV is the useful calorific value of one unit of fuel found in typical real world conditions, rather than that obtained in laboratory conditions.

Woodfuel boilers operating across Scotland are estimated to have saved 1,490,322 tonnes of CO₂ over the course of 2017. This is a significant increase of 208,860 tonnes compared with 2016. This carbon saving gain comes from the large increase in woodfuel consumption for medium sized boilers and the modest increase in woodfuel consumption for the large sized boiler categories. A better net CV kgCO₂e/kWh conversion factor for industrial coal use also contributed to <1% of the carbon savings for some of the larger biomass using plants. Figure 4 (below) shows annual CO₂e savings from 2006/07 to the current reporting year.

Figure 4: Annual CO₂e savings (thousand tonnes/annum)



4. Projects in progress

In order to manage the budget for the RHI, BEIS uses a 'degression' mechanism to alter tariff rates for technologies which are using more or less budget than anticipated. Alterations to these tariffs tend to be reflected in the install numbers, with a drop in installs when tariffs are low. Prior to 2017, BEIS steadily reduced the tariffs for small scale <200kWth non-domestic biomass and this was reflected in uptake rates, with a slower growth in the small scale biomass sector in 2017 and 2016 than in previous years (only 15 new installs in 2017, compared with 144 in 2016 and 508 in 2015).

In September 2017 all of the differentiated tariffs by installation size were removed, meaning all biomass systems, regardless of size, now receive the same tariff. This has led to a significant drop in tariff rate for medium sized biomass systems, but an increase for large (>1000kWth) and small (<200kWth) systems. This alteration has not yet had a clear impact upon the trends seen here, as the number of new small sized biomass systems was at its lowest in 2017 and the number of medium sized systems being installed remained broadly consistent with what occurred in 2016. It may have been that there was a hurry to install the medium sized systems before the tariff change occurred. In addition to this, a change to the tiering system for biomass was also introduced in September 2017. This increased the proportion of hours for which the higher Tier 1 rate can be claimed from 15% to 35%; which reduced the overall impact of the reduced subsidy rate for medium sized systems. As a result, the trends identified in this report, and previous iterations, will need to be monitored throughout 2018 in order to thoroughly evaluate how the RHI tariff changes have affected the overall installation rate, as well as installations by the different size categories.

One new large scale project (>1000kW) became operational in 2017 and there are at least 2 other large scale sites that could become operational in 2018 (or later). These installs are likely to lead to around 13,000 odt additional woodfuel consumption. This does not take into account any increase in the number of RHI accredited large boilers which may, or may not be favoured by the RHI reforms.

5. Discussion

5.1 Methodological reflections

The methodology used in this report differs from earlier ones in a number of respects:

1. This year the source data for non-domestic RHI accreditations provided by BEIS was different from previous years in one key way; the small and medium sized boilers were grouped together as one category (<1000kWth). This meant that the number of installs, capacity and heat output could not be accurately ascribed to the small and medium size categories. In order to use the same methodology as last year, we have calibrated the BEIS RHI accreditation data with their RHI application data (which BEIS also provided for 2017). We have assumed that the proportion of applications, in terms of total count, capacity and heat output, for small and medium boilers would broadly match the accreditations taking place. Therefore, if 7% of the total small and medium RHI applications were for small sized boilers, it was assumed that 7% of the small and medium accreditations would also be for the small sized category (see the methodology section for all of the percentage breakdowns used in this manner).

It could be argued that small and medium boilers would experience difference rates of installation or cancellation between the time of application and accreditation, but without any sufficient evidence to calculate this, we have taken the above assumption at face value. Therefore, whilst we cannot guarantee the figures for small and medium boilers reported here are 100% accurate; they will sufficiently represent the genuine trends occurring in woodfuel consumption. There is no risk of any double counting occurring due to this issue in the 2018 report because the source RHI data provided by BEIS is cumulative.

2. Although there is now much better information about the number of small woodfuelled boilers than there has been previously, available capacity and woodfuel use data for commissioned boilers accepted into the domestic RHI scheme is not considered very reliable. Operational information in this report for small boilers has been derived from past survey data and BEIS data and therefore it is thought to be reasonably reliable, but changes could be taking place that have not been picked up. However, any errors are thought to be small and be masked by the impact of the amount of woodfuel used in the larger boilers.
3. Some of the large biomass user sites ($\geq 1,000$ kWth) are actually comprised of numerous smaller sized boiler installations totalling greater than the large user threshold. As a result, it is possible that some of the sites currently treated as large biomass users may be double counted within the medium or small sized boiler categories. Amending the woodfuel survey to gather more detailed information on the site may help reduce the chance of this occurring, however, it may also reduce the current survey participation rate. The Energy Saving Trust will consider alterations to the methodology which may help take into account this issue for future reporting.
4. Revised carbon saving figures for the 2016 woodfuel report were quoted earlier in this publication, namely, a drop in the amount of carbon saved from 1,333,688 to 1,281,462 tonnes of CO₂ over the 2016 year. This revision was necessitated by an exceptionally large increase in

output, and thereby carbon saving, for one particular site than was found in previous years, despite only minor differences to the site's woodfuel consumption. This was caused by an erroneous assumption in the estimation of the site's characteristics. For this year's report, and to generate the 2016 revised figure, we have assumed the electrical output of this particular site to be the woodfuel consumption (odt) multiplied by the calorific value of one odt (5000kWh), multiplied by 25% - which is the assumed electrical efficiency of the system based on our experiences with other large steam turbine sites. Useful heat output has been calculated pro rata from electrical output based on the electricity to heat ratio from the 2015 woodfuel survey. As per the above point, we will consider any relevant and possible alterations to the report methodology which may help take into account such site particularities for future reporting.

5. It should be noted that there is a time lag affecting the heat output figures provided by BEIS because for any particular reporting year, some of the most recent heat meter data will not yet have been included within the BEIS RHI dataset. Whilst the output figures will then be slight underestimates, this missing output is not lost entirely as it will be included within the subsequent reporting year totals.

5.2 Key findings

The total amount of woodfuel used in Scotland in 2017 rose by 167,039 odt to 1,520,368 odt, a 12% increase on the amount used in 2016 (1,353,329 odt). This is broadly in line with woodfuel estimates for the previous two years, 13% in 2014-15 and 9% in 2015-16, which shows a relatively steady pace of increase in Scottish biomass use throughout the period.

The total number of boilers that use woodfuel in Scotland in 2017 was 7,002, an increase of 336 boilers from 2016. The majority of this increase (213) was in the 200 – 999kWth category. Around 31% (105) of the total 2017 installs occurred in the domestic sector with the remainder (231) in non-domestic settings.

The category using the most woodfuel was large scale boilers with a capacity of $\geq 1000\text{kWth}$. In 2017, they used 1,082,828 odt or 71% of all woodfuel. This is a slight reduction in the percentage of woodfuel consumption found for the large size category in 2016 (75%), when the absolute wood consumption was estimated to be 1,014,871 odt.

The number of boilers in the 200kWth-999kWth category grew significantly in 2017, from 504 to 717. For the first time in this report series, the woodfuel consumption reported for the medium boiler size category was larger than that for the combined small sized installations (domestic and non-domestic), with 252,168 compared to 185,372 odt respectively. The percentage growth in woodfuel for medium sized installations was 69%.

The sub 200kWth non-domestic category showed the least growth, with only 15 boilers estimated to have been installed during 2017, raising the total to number of boilers in this category to 2,562. This is considerably less than the 144 boilers installed in 2016, and continues the downward trend seen in the number of small size non-domestic installations occurring since 2014. This year the reported woodfuel

consumption for small non-domestic boilers actually fell by 4,256 odt from 174,864 odt in 2016 to 170,608 odt in 2017. The primary reason for this was a reduction in the average boiler size for this category, as evidenced by a drop in the heat output reported by BEIS in their RHI dataset.

The domestic category saw an increase of 105 boilers, from 3,586 in 2016 to 3,691 in 2017. The domestic sector's year on year growth has also been trending downwards since 2014, when an additional 1,124 boilers were installed.

The most widely used type of woodfuel in Scotland in 2017 was virgin wood fibre at 722,934 odt or 47% of the total fuel used. Co-products and residue made up an additional 302,383 of fuel used, meaning combined virgin fibre, co-products and residue made up 67% of fuel use. Recycled fibres made up 333,435 odt, or 22%, of fuel used; Pellets made up 8% of fuel used, whilst other fuels made up only 3%.

The rural local authority areas in Scotland account for the majority of all non-domestic and domestic woodfuel installations. The highest numbers of non-domestic and domestic installs can be found in the Dumfries and Galloway and Highland local authority areas respectively.

The contribution of woodfuel boilers to the Scottish Government's renewable heat target in 2017 has been estimated as 4,769,107MWh, a 33% increase over the 2016 contribution. This significant increase in heat output can be largely contributed to an increase of woodfuel consumption at most large user sites, as well as the increase in the number and average capacity of installed medium sized boilers

Carbon savings from woodfuel boilers in 2017 were estimated as 1,490,322 tonnes of CO₂, which is an increase of 208,860 tonnes compared to 2016. Again, the majority of this gain was from the increase in woodfuel consumption from large biomass users as well as from larger medium sized installations.