

# **Woodfuel Demand and Usage in Scotland**

## **1<sup>st</sup> Jan 2016 – 31<sup>st</sup> Dec 2016**

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 2016 and assesses the possible additional use of woodfuel for the next few years.
2. At the end of 2016, there were an estimated 6,666 boilers using woodfuel in Scotland. 99.6% of these installations have a thermal capacity of less than 1,000 kilowatts (kW).
3. Total woodfuel used in Scotland in 2016 was 1,353k oven dry tonnes (odt). In 2015, the total woodfuel used was estimated to be 1,243k odt. There was, therefore, a 9% increase in woodfuel usage in Scotland over this period. This is in contrast to the 2014-15 increase of 13%.<sup>1</sup>
4. In 2016, the number of large boilers with a capacity of 1,000 kilowatt thermal (kWth) or more represented 0.44% 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 2015 to 2016, the amount of woodfuel used by boilers in this category dropped as a percentage of total woodfuel used, from 82% to 75%.
5. The highest number of domestic woodfuel boiler installations was found in rural Local Authority areas, with Highland, Aberdeenshire, Borders, Dumfries and Galloway and Perth & Kinross accounting for 55% of all domestic installations.
6. The majority of woodfuel used in Scotland continued to be virgin fibre, sawmill coproducts and process residues (65%). This is an increase of nearly 14% in its use compared with the 2015 figure of almost 52%. Within this category, the majority of fuel used is virgin fibre. Recycled wood remained the next most used woodfuel type, accounting for 25% of fuel used. However, this is a significant drop compared to 2015, when it made up 39% of fuel used; the amount of recycled fibre used dropped by 154,267 odt between 2015 and 2016.
7. There will be at least one large new woodfuel boiler operational in 2017 with at least a further 2 large boilers in the process of development. The predicted increase in woodfuel demand from these 3 boilers is around 20,000 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 200 kWth). In previous years, this category has seen the highest increase in the number of boilers.
8. In 2016, woodfuel boilers in Scotland contributed 3,397k megawatt hours (MWh) to the Scottish Government's renewable heat targets.
9. Wood-fuelled boilers in Scotland are estimated to have saved 1,334k tonnes of CO<sub>2</sub>e in 2016. This is a decrease compared to 2015 (1,467k tonnes), however this decrease is due to a change in the calculation methodology.

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<sup>1</sup> The figures reported here for 2015 do not match those reported in the 2015 report. This is due to a change in the methodology used to calculate domestic fuel types.

## 1. Overview

This report is part of an annual series of Woodfuel Demand and Usage in Scotland reports. This iteration of the report provides data for the 2016 calendar year (1<sup>st</sup> January 2016 to 31<sup>st</sup> December 2016). The use of woodfuel is presented using three heat capacity bands:

- Small installations: less than 200kWth
- Medium installations: between 200 and 999 kWth
- 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 report covering the years 2014 and 2015.

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 schemes 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.
- 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 included 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.
- Based on the FC survey data (2005-2012) on 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.

- 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.

### **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)<sup>2</sup>, **the average woodfuel consumption per domestic installation has been estimated to be approximately 4 odt of woodfuel per annum<sup>3</sup>.**

- 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.

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<sup>2</sup> UK Housing Energy Fact File (BEIS, 2013)

<sup>3</sup> 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.

#### 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 kWh<sup>4</sup>.
- 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.

## 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: 1<sup>st</sup> Jan 2015 – 31<sup>st</sup> Dec 2015):

- 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).

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<sup>4</sup> 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).

## 3. Results

### 3.1 Woodfuel used by operational boilers

The total number of boilers using woodfuel at the end of 2015 was estimated to have been 5,985. In 2016, it is estimated that an additional 681 boilers were commissioned and accredited into RHI schemes<sup>5</sup>, bringing the total to 6,666. The increase in number of boilers was split relatively evenly between the domestic and non-domestic sectors, with 312 new installs in the domestic sector and 369 new installs in the non-domestic sector. Overall, the increase in installation numbers between 2015 and 2016 was lower than the increase seen between 2014 and 2015, when an additional 2,079 boilers were commissioned onto RHI schemes. This indicates a potential slowdown in growth of the sector.

**In total, there were 6,666 antedated and RHI accredited boilers commissioned by the end of 2016 and the total wood fuel used is calculated to have been 1,353,329 odt.**

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

At the end of 2016, there were 29 boilers (an increase of two from 2015) operating in this heat category, of which 7 were CHP plants<sup>6</sup>. **During 2016 these 29 boilers used a total of 1,014,871 odt of woodfuel. The 7 CHP plants used a total of 790,549 odt and the remaining heat only boilers over 1,000kWth used 224,322 odt of woodfuel.**

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

At the end of 2015, there were 281 boilers operating in this heat category. Based on survey data and BEIS non-domestic RHI data, it is calculated that a further 223 boilers were commissioned in this size category in 2016, giving a total number of 504; a 79% increase on 2015 figures. Using the estimated average woodfuel consumption of 296.13 odt /year per installation<sup>7</sup>, **the amount of woodfuel used in 2015 by the 281 installations is calculated to be 149,249.** This is a significant increase on the 61,303 odt estimated to be used by this size category in 2015.

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

The number of antedated and RHI accredited boilers into the non-domestic RHI scheme was calculated to be 2,403 boilers at the end of 2015. In 2016, the total number of accredited boilers in this size category rose to 2,547, an increase of 144.

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<sup>5</sup> BEIS RHI data indicate that 541 new boilers were commissioned in 2016 (excluding installations  $\geq 1000\text{kW}$ ); this is lower than the difference between figures reported in last year's woodfuel report and the total number of installs at the end of 2016. This difference is likely due to the time lag between application and commission, which means some 2015 installs may have been excluded from the figures in last year's report

<sup>6</sup> BEIS RHI data indicates there are 32 RHI-registered large installations in Scotland, however only 29 installations are known to us and included within the FCS woodfuel survey. The data in this report relates only to these 29 installations, as woodfuel usage of the missing plants is unknown.

<sup>7</sup> This is an increase from previous years, in which the odt per install was estimated as 218.16. The revised figure reflects a larger average boiler size, as calculated from RHI data on the number and capacity of installations in Scotland.

The average capacity for non-domestic RHI boilers in this size band was 115kW per installation 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 68.7 odt per year. **As there were 2,547 antedated and RHI accredited boilers in the non-domestic scheme in 2016, their total estimated wood fuel consumption was 174,864 odt.**

### 3.1.4 Woodfuel used by boilers in the Domestic scheme

BEIS data made available in September 2017, 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 3,586 boilers accredited to the domestic RHI scheme in this category, their total woodfuel consumption was estimated to be 14,344 odt in 2016.**

### 3.1.5 Total woodfuel use

Over the 2016 calendar year, the total aggregated amount of woodfuel used by boilers in the three heat categories was 1,353k odt (Table 1). This is an increase of 110k odt (9%) compared with the previous calendar year. An estimated 75% 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 capacity of less than 200kWth. Compared to previous years, the biggest increase in woodfuel consumption occurred in the medium sized boiler category ( $\geq 200$ kWth but  $< 1000$ kWth), where there was an increase of 88k odt used in 2016 compared to 2015.

**Table 1: Total woodfuel used by heat capacity of boilers 2016**

Boiler heat category	Number of boilers		Proportion of boilers (%) (rounded)	Woodfuel consumption (odt)		Proportion of woodfuel consumption (%) (rounded)
	Domestic	Non-domestic		Domestic	Non-domestic	
<200 kWth	3,586	2,547	92%	14,344	174,864	14%
	Total			Total		
	6,133			189,208		
200 - 999 kWth	504		8%	149,249		11%
$\geq 1000$ kWth	29		0%	1,014,871		75%
<b>Total</b>	<b>6,666</b>		<b>100%</b>	<b>1,353,329</b>		<b>100%</b>

The total number of domestic boilers accredited to the RHI scheme up to the end of 2016 is shown by local authority in Map 1. The local authority with the greatest number of domestic installations is Highland at 847, an increase of 75 compared to 2015. This is followed by Aberdeenshire, with 312



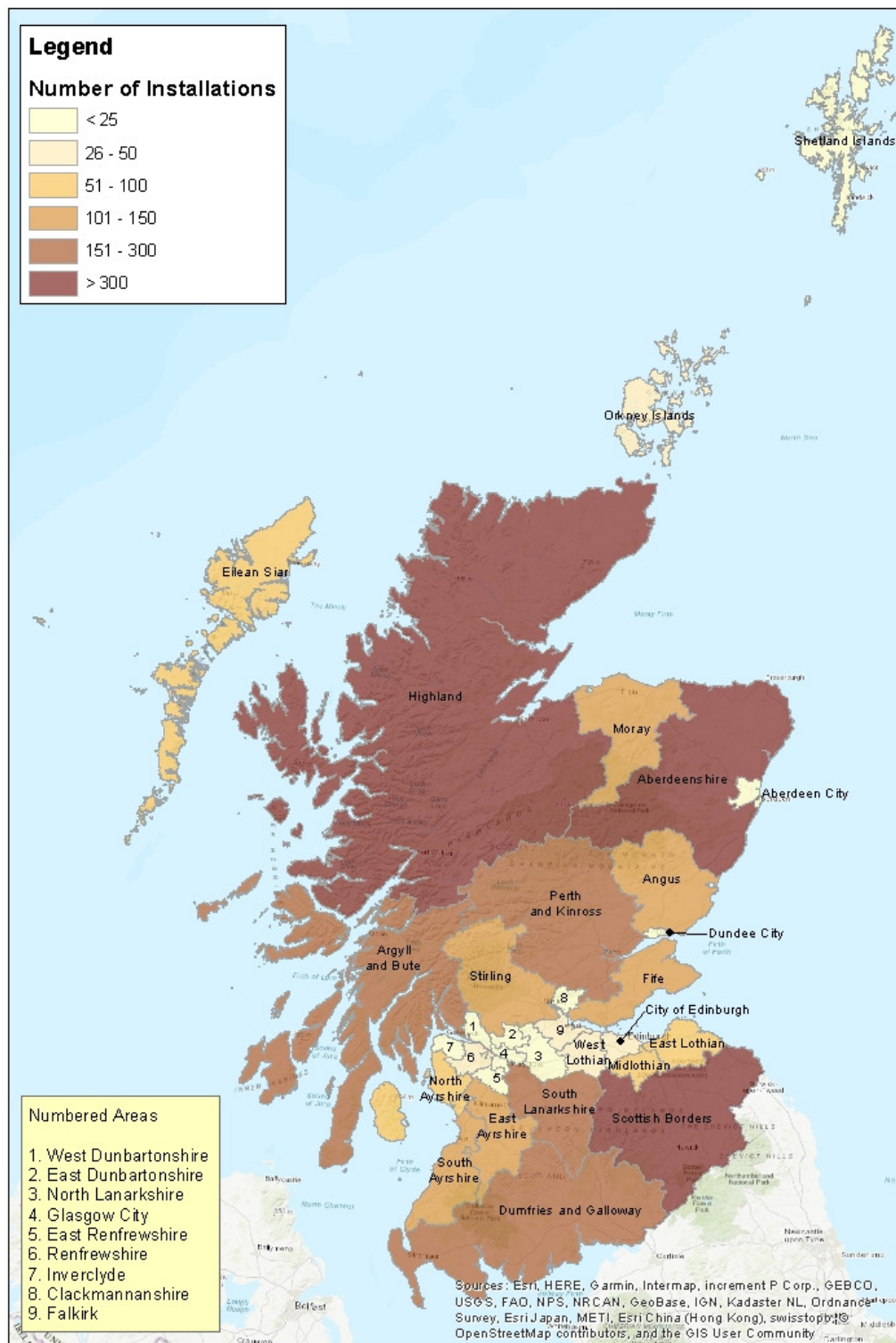
installations, and Scottish Borders with 307. The local authorities with the fewest domestic installations are Aberdeen City and Glasgow City, both of which have 5 or fewer installs<sup>8</sup>.

The figures reported here and in Map 1 show only domestic installations; this is in contrast to the figures reported in the 2015 Woodfuel Report, which showed the total number of domestic and non-domestic installations by local authority. This is because it was not possible to obtain an updated breakdown of non-domestic RHI installations by local authority for 2016. As such, the figures in this report should not be directly compared with those in the previous report.

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<sup>8</sup> The exact figures could not be shared due to the risk of identifying individual sites.

**Map 1: Geographical distribution of domestic RHI accredited woodfuel boilers commissioned by the end of 2016 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.

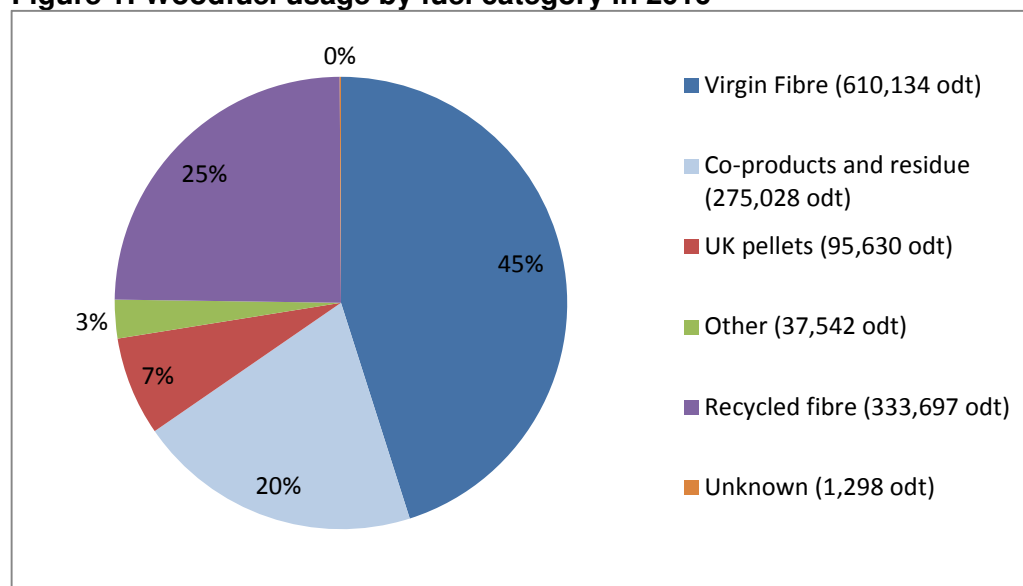
To estimate the quantities of different types of fuel used for the other two heat categories, a similar set of assumptions has been made to those made in the previous report, namely, that the woodfuel used by boilers with a heat capacity of less than 1,000kWth in commercial situations or accredited to 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 the previous report 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.

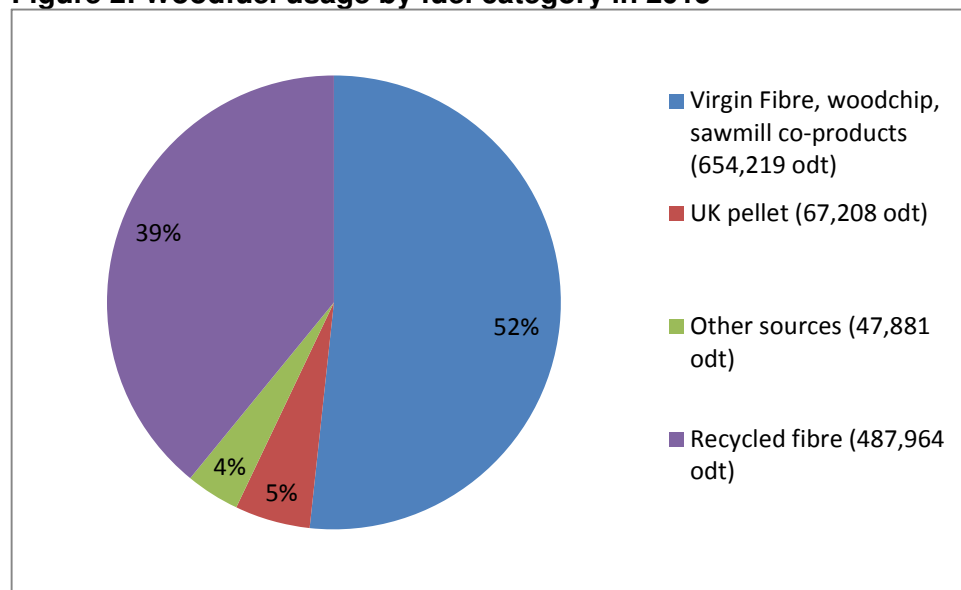
Based on survey information and the above assumptions, the total woodfuel used in 2016 by woodfuel category is given in Figure 1 below. In 2016, it was possible to separate virgin fibre from co-products and residue; in 2015 these were all recorded as one category. Compared with 2015 (Figure 2 below), there has been a significant increase in the percentage of virgin fibre, co-products and residue, which made up 65% of woodfuel use in 2016 compared to 52% in 2015. There has been minimal change in the use of pellets and a decrease in use of recycled fibre.

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

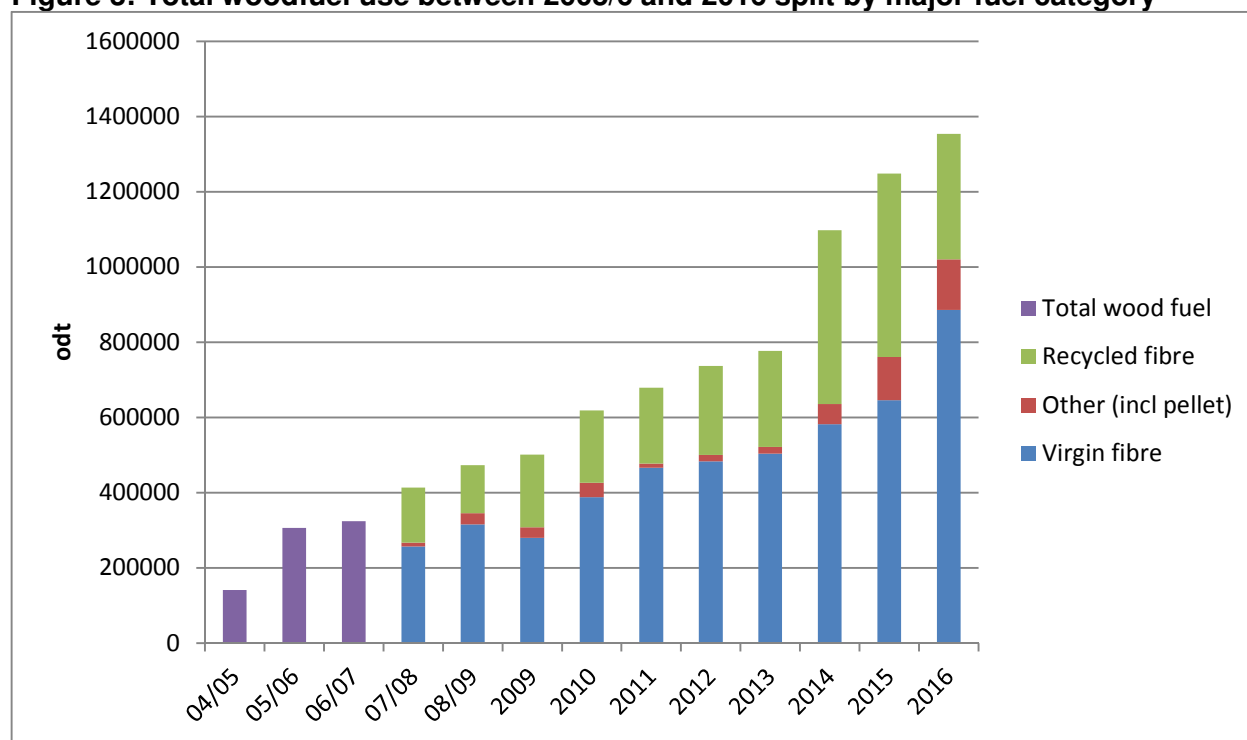
**Figure 1: Woodfuel usage by fuel category in 2016**



**Figure 2: Woodfuel usage by fuel category in 2015**



**Figure 3: Total woodfuel use between 2005/6 and 2016 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 2016 is not available for all heat categories of boiler. For boilers with a capacity of  $\geq 1,000$  kWth, where possible Energy Saving Trust collected data on total heat output from the sites through the woodfuel survey. Where this data was not available, Energy Saving Trust calculated heat output from the woodfuel consumption, based on a calorific value of wood of 5,000 kWh per oven dried tonne. For CHP plants, only the heat output has been included.

As was the situation in 2015, the total heat output obtained operationally from boilers with a heat capacity of  $< 1000$  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  $< 200$  kWth, it has been assumed 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 200kWth – 999kWth, an assumption of 5,000 hours annual operational has been used. This is different to the assumptions used in previous reports (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 2016 report<sup>9</sup>. 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, the same assumption has been used for this report.

Using the data and assumptions described above, the contribution that woodfuel made towards the Scottish Government's renewable heat targets in 2016 has been estimated as 3,604,282MWh (see table 2 below). This is an increase of 328,088MWh (10%) over the 2015 estimate of 3,276,195MWh<sup>10</sup>. The increase in heat output from 2014 to 2015 was 532,149MWh.

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<sup>9</sup> Renewable heat in Scotland, 2016:

<http://www.energysavingtrust.org.uk/sites/default/files/reports/Renewable%20Heat%20in%20Scotland%202016%20report%20FINAL%20EST%2031Oct17.pdf>

<sup>10</sup> This increase is in a large part due to the change in assumption for operating hours of medium sized (200-999kWth) boilers outlined above, rather than due to an actual increase in heat output. Using the previous assumption of 1800 operational hours, the 2016 estimated heat output would be 2,805,226MWh, a 14% drop compared to 2015. This is in line with the Renewable Heat Report, 2016, which found a total drop in renewable heat output in Scotland (from all technologies) of 11%.

**Table 2: Estimated contribution of woodfuel to Scottish Government renewable heat target in 2016**

Boiler heat category	Number of boilers	Annual hours of operation	Average boiler capacity (kWth)	Estimated heat output (MWh)
< 200 kWth domestic	3,586	1825	25	163,611
< 200 kWth non-domestic	2,547	1825	115	533,924
200 - 999 kWth	504	5000	495	1,248,525
≥ 1000 kWth	29	Survey data	Survey data	1,658,222
Total	6,666			3,604,282

### 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 BEIS<sup>11</sup>. The conversion factors for 2016 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 2016**

Substituted fuel	kgCO <sub>2</sub> e per kWh (net calorific value)
Electricity	0.4121
Compressed natural gas	0.2044
Burning oil (kerosene)	0.2596

<sup>11</sup> BEIS, Greenhouse gas reporting – conversion factors 2016:  
<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016>

Coal (industrial)	0.3393
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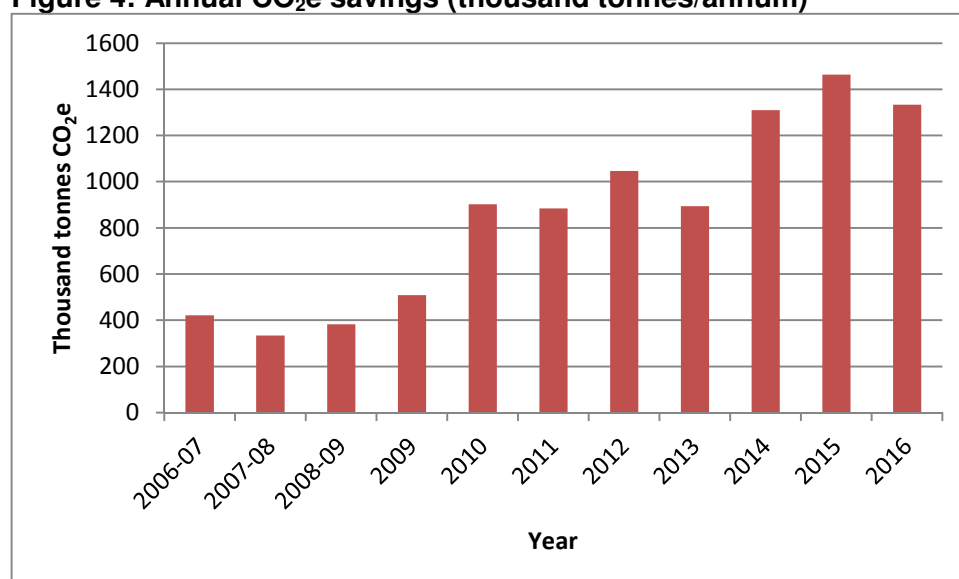
**Table 4: Carbon savings from woodfuel projects in Scotland in 2016 – net CV**

Boiler heat category	Woodfuel use (odt/annum)	Energy output (MWh/annum)	Annual CO <sub>2</sub> e savings (tonnes/annum)
< 200 kWth	189,208	697,535	181,112
200 - 999 kWth	149,249	1,248,525	324,174
≥ 1000 kWth	1,014,871	3,396,048	828,402
<b>Total</b>	<b>1,353,329</b>	<b>5,342,108</b>	<b>1,333,688</b>

*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)*

Woodfuel boilers operating across Scotland are estimated to have saved 1,333,688 tonnes of CO<sub>2</sub> over the course of 2016. This is a decrease of 133,456 tonnes compared with 2015. However, this decrease is primarily due to a change in the calculation method (see Section 5.1 for details). Using the same methodology as used in 2015, the estimated carbon saving in 2016 would be 1,756,929 tonnes CO<sub>2</sub>e, an increase of 289,785 tonnes compared to 2015. Figure 4 (below) shows annual CO<sub>2</sub>e savings from 2006/07 to the current reporting year (using the revised methodology for 2016).

**Figure 4: Annual CO<sub>2</sub>e 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. Throughout 2016, BEIS steadily reduced the tariffs for small scale (<200kWth) non-domestic biomass. This has been reflected in uptake rates, with a slower growth in the small scale biomass sector in 2016 than 2015 (only 144 new installs in 2016, compared to 508 in 2015 and 1,124 in 2014). By contrast, the tariffs for medium sized biomass (200kWth-999kWth) remained constant throughout 2016, with no degressions after April 2016. In this size category, there was an increase in installations in 2016, with 223 installs compared to only 117 in 2015 and only 27 in 2014.

Looking into 2017, up to September 2017 tariff rates continued to drop for small scale biomass, indicating the drop in install rate is likely to continue. In 2017, tariff rates were also degressed for medium sized installations. In March 2016, government held a consultation on its proposals for reform of the RHI. The response to this consultation was published in December 2016, and implemented in 2017. The changes included removal of differentiated tariffs by installation size, meaning all biomass systems, regardless of size, receive the same tariff. This has led to a significant drop in tariff rate for medium sized biomass systems, but an increase for large (>1MWth) and small (<200kWth) systems. The impact this will have on installations is uncertain; whilst tariff degressions and uncertainty often lead to lower installation rates, it may be that there is a 'rush' of installations of medium sized systems before the tariff change on 20<sup>th</sup> September. In addition to this, a change to the tiering system for biomass was also introduced in September 2017. This increases the proportion of hours for which the higher Tier 1 rate can be claimed from 15% to 35%; this should reduce the overall impact of the reduced subsidy rate for medium sized systems.

There are at least 3 large scale projects (>1MW) that could become operational in 2017 and 2018. These installs are likely to lead to at least 20,000 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. In general, consistent conversion factors have been applied throughout this report in line with previous reports, notably the figure of 5,000 kWh per odt and the figure of 0.5977 odt/year/kW. However, two factors have been changed in this report, as outlined in points (i) and (ii) below: the odt/install for medium sized boilers, and the annual hours of operation for medium sized boilers:
  - i. The estimated average woodfuel consumption per install for medium sized boilers (200kWth – 999kWth) was increased from 218.16 in 2015 to 296.13 odt/install in this report. This is due to an increased average boiler size; previously, the average boiler size had been estimated as 365kWth, for this report we have calculated the average boiler size to be 495kWth, using data provided by BEIS.
  - ii. When estimating the contribution of biomass to the Scottish Government’s renewable heat targets, we have changed our assumptions with regards to operational hours of 200kWth-999kWth sized boilers. Previously, it has been assumed that these boilers operate for 1,800 hours a year (10 hours a day, 180 days a year), and this figure has subsequently been used to estimate heat output. In this report, we have assumed boilers of this size are operational for 5,000 hours a year. This is in line with the assumptions used by Scottish Government in their Renewable Heat in Scotland, 2016 report, and is therefore in line with their assumptions regarding the 2020 renewable heat target.
  - iii. For larger boilers, where data on output was not available from the woodfuel survey, we have assumed consumption of 5,000kWh/odt, as has been used in previous reports.
2. To calculate carbon savings in this report, we have altered the methodology so that carbon savings relate directly to our estimate of energy output (both heat and electrical). In previous reports, carbon savings were calculated based on an assumption of 5,000kWh/odt; in this report we have utilised the energy outputs calculated to estimate carbon emissions.
3. As in previous reports, when estimating types of woodfuel used by sub-1,000kWth boilers (for which this data is unavailable) we have assumed consumption to be 73% woodchips and sawmill co-products, 25% pellets and 2% other material. For domestic installations, we have assumed a split of 90% pellets and 10% logs; in previous reports the same split was assumed for domestic and non-domestic sub-1,000kWth installations.
4. 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.

5. When analysing woodfuel boiler distribution by local authority area, in this report we were only able to look at domestic RHI installations. This is due to restrictions on the data BEIS were able to supply, due to low numbers of installations in some local authorities.

## 5.2 Key findings

The total amount of woodfuel used in Scotland in 2016 rose by 110k odt to 1,353k odt, a 9% increase on the amount used in 2015 (1,243k odt). Whilst still increasing, the rate of increase in woodfuel consumption has been declining in recent years: from 2013-14, woodfuel consumption rose by 42%, from 2014-15 consumption rose by only 13%, and from 2015-16 consumption rose by 9%.

The total number of boilers that use woodfuel in Scotland in 2016 was 6,666, an increase of 681 boilers from 2015. The majority of this increase was in the sub 200kWth category and in particular domestic boilers; domestic boilers accounted for 312 installations, 46% of the total increase.

The category using the most woodfuel was large scale boilers with a capacity of  $\geq 1000$  kWth. In 2016, they used 1,015k odt or 75% of all woodfuel. This is very similar to the woodfuel consumption of this category in 2015, which was 1,013k odt.

The number of boilers in the 200kWth-999kWth category grew significantly in 2016, from 281 to 504. Whilst this category continues to use a smaller amount of woodfuel than the two other size categories, it has grown considerably, from 61k odt in 2015 to 149k odt in 2016. This is an increase of 143%, i.e. more than double the woodfuel use. This follows an increasing trend for this category; between 2014 and 2015 there was a 71% increase in woodfuel use.

The sub 200kWth non-domestic category showed a growth of 144 boilers to 2,547 in 2016 and a corresponding increase of 14k odt in the amount of fuel used, with a total usage of 175k odt, a 9% increase over 2015.

The domestic category saw an increase of 312 boilers, from 3,274 in 2015 to 3,586 in 2016. Whilst the domestic sector therefore remains the largest growth area in terms of number of boilers, its growth is considerably slower than between 2014 and 2015, when 1543 new domestic boilers were installed.

The most widely used type of woodfuel in Scotland in 2016 was virgin wood fibre at 610k odt or 45% of the total fuel used. Co-products and residue made up an additional 275k of fuel used, meaning combined virgin fibre, co-products and residue made up 65% of fuel use. Recycled fibres made up 334k odt, or 25%, of fuel used; this is a significant drop in usage compared to 2015 for this fuel category. Pellets made up 7% of fuel used, whilst other fuels made up 3%.

The rural Local Authority areas in Scotland account for the majority of all domestic woodfuel installations, with the highest number of installations in Highland.

The contribution of woodfuel boilers to the Scottish Government's renewable heat target in 2016 has been estimated as 3,604,282MWh, a 10% increase over the 2015 contribution. However, this increase is in large part due to a change in calculation methodology; using the same methodology as in the 2015 report would give a reduction in estimated heat output of 14%. This drop is due to a reduction in operations from a small number of large sites.

Carbon savings from woodfuel boilers in 2016 were estimated as 1,334k tonnes of CO<sub>2</sub>, which is a reduction of 133k tonnes compared to 2015. However, this year-on-year decrease is to a large extent due to a change in the calculation methodology.

The predicted rate of growth of woodfuel usage in the market place is now more difficult to predict than previously due to the policy and economic factors highlighted in section 4 of this report. It is likely that growth in 2017 and 2018 will continue to slow.