The Carbon Footprint of Scotland's Waste

Carbon Metric Summary Report (2017 & 2018)

European Union
The Scottish Government
Riaghaltas na h-Alba
EUROPE & SCOTLAND
European Regional Development Fund
Investing in a Smart, Sustainable and Inclusive Future

Zero Waste Scotland exists to lead Scotland to use products and resources responsibly, focusing on where we can have the greatest impact on climate change.

Using evidence and insight, our goal is to inform policy, and motivate individuals and businesses to embrace the environmental, economic, and social benefits of a circular economy.

We are a not-for-profit environmental organisation, funded by the Scottish Government and European Regional Development Fund.

Find out more at https://www.zerowastescotland.org.uk/

Project name: Carbon Metric – waste from all sources (2017 & 2018)

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Executive Summary

This report provides a summary of the 2017 & 2018 Scottish Carbon Metric which quantifies the complete lifecycle carbon[1] impacts of Scotland's waste. Key findings are:

- The whole-life carbon impact of Scotland's waste in 2017 was 11.9 Mt CO_2 eq., (million tonnes of carbon dioxide equivalent), an increase of 0.9 Mt CO_2 eq. or 8% from 2016. This spike is largely due to a significant tonnage increase in carbon intensive waste materials (e.g. Glass and chemical wastes). Compared to 2017, carbon impacts then fell by 11% in 2018 (1.3 Mt CO_2 eq) to 10.6 Mt CO_2 eq . Total reduction in the whole-life carbon impacts of Scotland's waste between 2011 and 2018 is approximately 4.6 Mt CO_2 eq., 30% below 2011 baseline levels.

- Scotland continues to reduce its carbon impacts associated with the management of residual waste. Between 2011 and 2018, landfilled waste reduced by 10% (491,000 tonnes) while the amount of waste incinerated increased by 108% (460,000 tonnes).

- 2017 was the first year in which tonnages of recycled food waste exceeded that of food waste landfilled[2]. This trend continued in 2018 as food waste recycled was higher than the amount of food waste landfilled by 113,200 tonnes.

- Increased use of separate food waste collection services between 2011 and 2018 reduced the impacts of managing food waste by approximately 144,000 t CO_2 eq[3].

- Carbon impact of materials production remains the highest contributor to the overall carbon impacts of Scotland's waste, accounting for 93% and 91% of the total carbon impacts in 2017 & 2018 respectively. Of the 4.6 Mt CO_2 eq reduction in carbon impacts between 2011 and 2018, 3.8 Mt CO_2 eq (84%) was accounted for by the reduction in the carbon impact of materials production.

- The five most carbon intensive waste materials made up just 20% of Scotland's waste by weight in 2018, but accounted for 71% of the overall carbon impacts. Food waste was the most carbon intensive waste material, responsible for 25% of Scotland's total waste carbon footprint. That's despite constituting only 5% of Scotland's waste by weight. A similar pattern was also observed in Scotland's waste data for 2017.

Further information on the Carbon Metric and archived documents relating to its development can be found on the Zero Waste Scotland website.

[1] Shorthand term for the emissions of any of the number of greenhouse gases that affect climate change. Carbon emissions are usually expressed as CO_2 eq. (equivalent), which is a unit of measurement based on the relative impact of a given gas on global warming.

[2] Inclusive of the food waste fraction in the 'household and similar wastes' category.

[3] Estimates of food waste are based on a revised methodology for estimating the waste composition of residual waste (household and similar wastes). Previously, the food waste content of residual waste was assumed constant and therefore unaffected by an increase in separately collected food waste, resulting in an implied increase in total household food waste over time. In the new method, total per capita food waste, both separately collected and what remains in the residual waste stream, is now assumed constant, so any change in separately collected food waste tonnage will result in an equal and opposite change in residual food waste. SEPA, Zero Waste Scotland and the Scottish Government are reviewing the frequency of waste composition studies to better understand these changes in future.

The Carbon Metric: a powerful tool to fight climate change

Scotland has developed a ground-breaking tool in the fight against global climate change. The Scottish Carbon Metric measures the whole-life carbon impacts of Scotland's waste, from resource extraction and manufacturing emissions right through to waste management emissions, regardless of where in the world these impacts occur (Figure 1).

The Carbon Metric shows how reducing our waste, and managing what waste remains in a more sustainable way, is critical to the global fight against climate change.

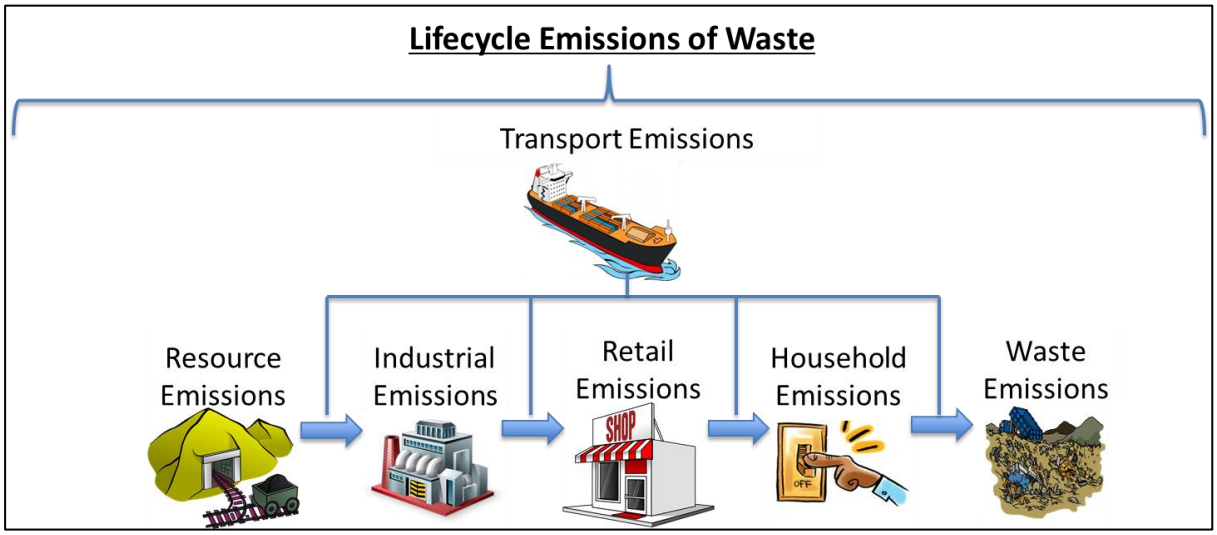


Figure 1 **Schematic diagram presenting the lifecycle emissions of waste.**

The Carbon Metric quantifies the whole-life carbon impacts of more than 30 different common waste materials, providing policy makers and business leaders with an alternative to weight-based waste measurement, and allowing them to identify and focus specifically on those waste materials with the highest carbon impacts and greatest potential carbon savings. Scotland's 33% per capita food waste reduction target is an example of a policy informed by the Carbon Metric[4].

As Scotland continues to transition towards a more circular economy the Carbon Metric is helping to measure our progress, proving that sustainable waste and resource policy can deliver major emissions savings across all economic sectors.

Key Findings from the 2017 & 2018 Carbon Metric

The Scottish Carbon Metric is updated on an annual basis using the Scottish Environment Protection Agency's (SEPA's) latest published waste data[5]. The first edition of the Carbon Metric covering 2011 waste data was published in 2013. This report summarises the key findings from the 2018 Carbon Metric.

Scotland's Waste and Waste Carbon Impacts (2011-2018)

The whole-life carbon impact of Scotland's waste in 2017 was 11.9 Mt CO2 eq., (million tonnes of carbon dioxide equivalent), an increase of 0.9 Mt CO2 eq. from the previous year (Figure 2). Higher

[4] Scottish Government (2016) Making Things Last
[5] https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/

waste carbon impacts in 2017 were primarily due to an increase in carbon intensive waste materials in the non-household waste stream (Figure 3a & 3b). Figure 4 shows total waste arisings across seven carbon intensive waste materials increased 27% in 2017 compared to the previous year.

In 2018, the overall carbon impact of Scottish Waste in 2018 was nearly 10.6 Mt CO_2 eq., 11% (i.e.,1.3 Mt CO_2 eq.) lower than carbon impacts reported in 2017. The total carbon impacts of Scotland's waste continues on a downward trajectory when compared to 2011 baseline levels. Our analysis shows that the reduction in carbon impacts between 2011 and 2018 is approximately 4.6 Mt CO_2 eq. – that's 30% lower than 2011 carbon impacts (Figure 2). Of the 4.6 Mt CO_2 eq reduction in carbon impacts between 2011 and 2018, 3.8 Mt CO_2 eq (84%) was accounted for by the reduction in the carbon impact of materials production.

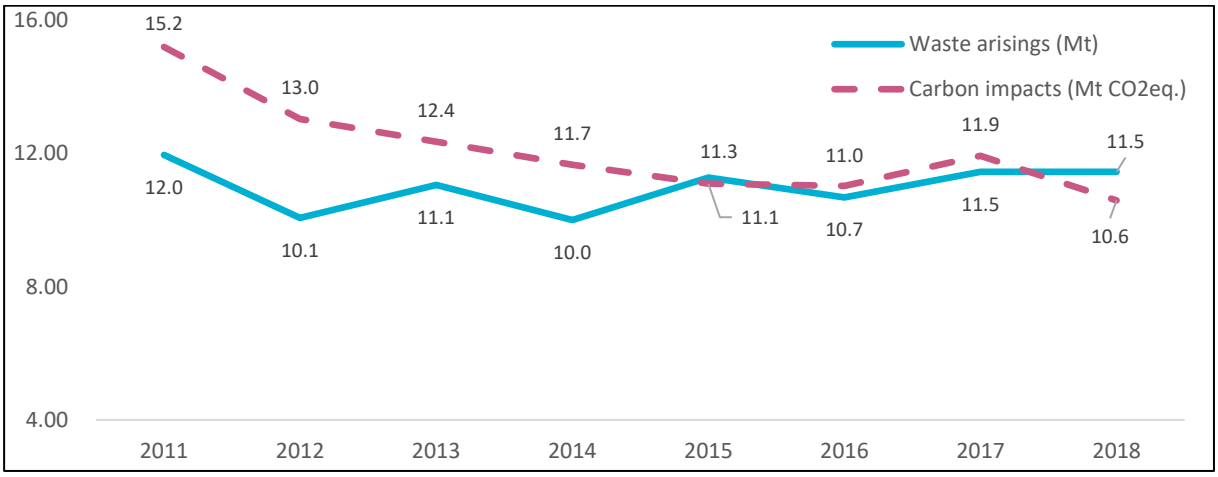


Figure 2 **Weight vs carbon impacts of resources loss and waste management in Scotland.**

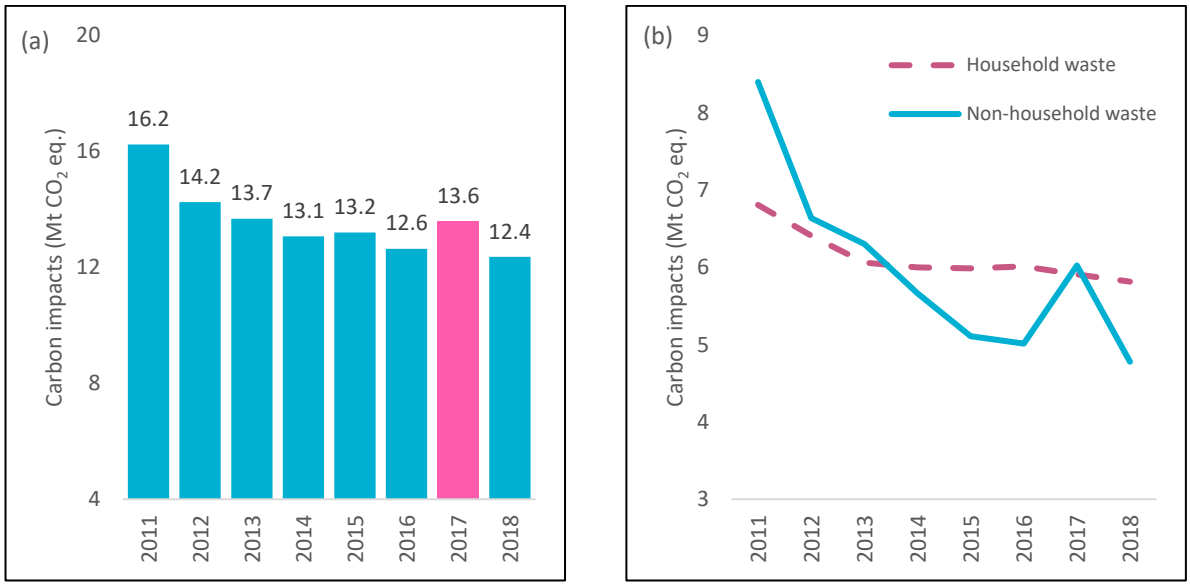
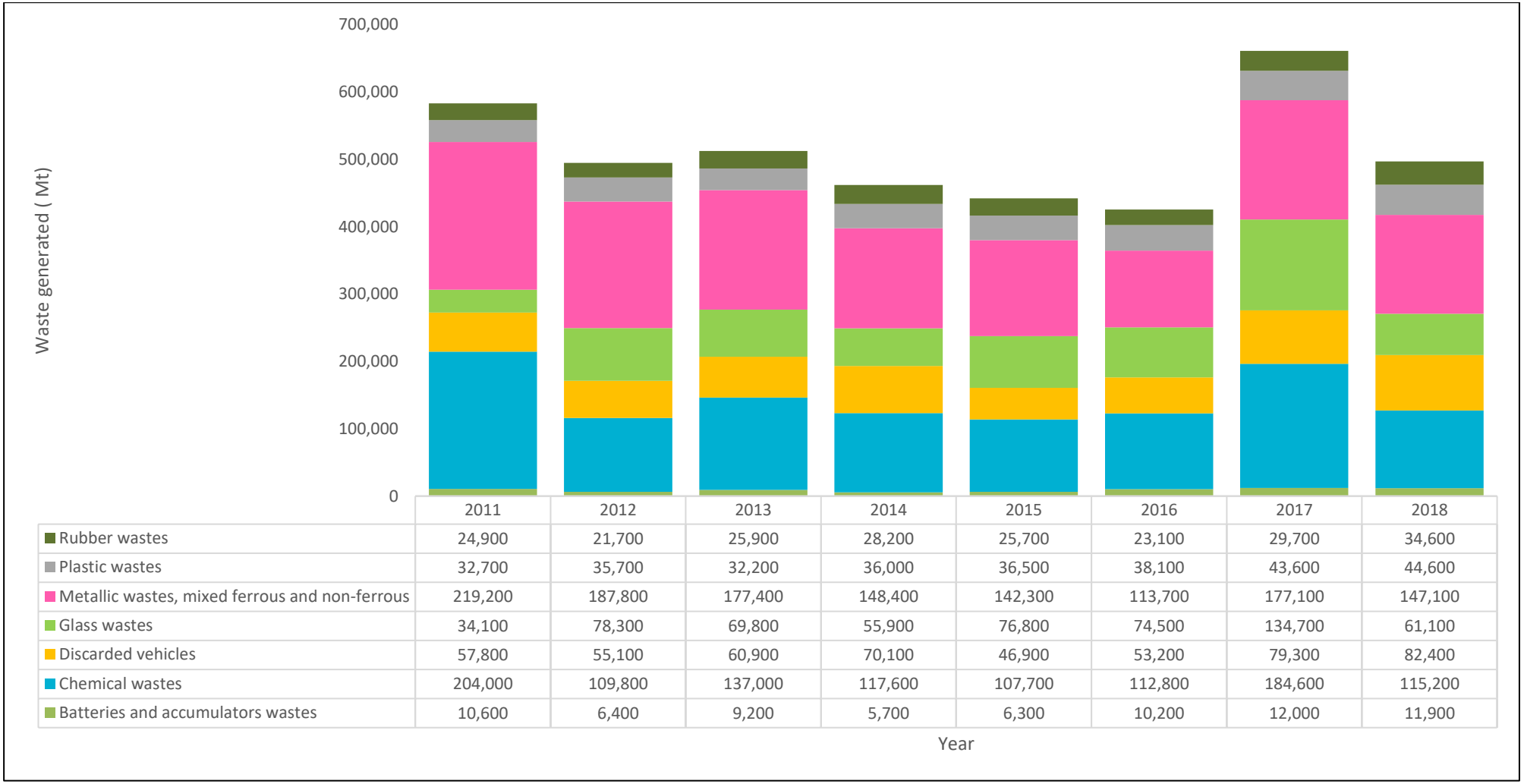


Figure 3 **Embodied (resource extraction and manufacturing) carbon impacts of (a) waste from all source and (b) by source.**



	2011	2012	2013	2014	2015	2016	2017	2018
Rubber wastes	24,900	21,700	25,900	28,200	25,700	23,100	29,700	34,600
Plastic wastes	32,700	35,700	32,200	36,000	36,500	38,100	43,600	44,600
Metallic wastes, mixed ferrous and non-ferrous	219,200	187,800	177,400	148,400	142,300	113,700	177,100	147,100
Glass wastes	34,100	78,300	69,800	55,900	76,800	74,500	134,700	61,100
Discarded vehicles	57,800	55,100	60,900	70,100	46,900	53,200	79,300	82,400
Chemical wastes	204,000	109,800	137,000	117,600	107,700	112,800	184,600	115,200
Batteries and accumulators wastes	10,600	6,400	9,200	5,700	6,300	10,200	12,000	11,900

Figure 4 Waste tonnages from all sources generated in Scotland and reported under carbon intensive material categories between 2011 and 2018. YoY refers to year-on-year changes reported.

The amount of food waste landfilled in Scotland continues to decline as the amount of separately collected food waste increases, as shown in Figure 5. The year 2017 was the first in which tonnages of recycled food waste exceeded that of food waste landfilled. An estimated 249,500 tonnes of food waste was landfilled in 2018, that's 148,300 tonnes (37%) less than in 2011, while food waste recycled between 2011 and 2018 increased by 268,700 tonnes (286%).

Since 2011, the carbon impacts of managing food waste in Scotland have fallen 37% from 390,400 t CO2 eq. to 245,800 t CO2 eq. in 2018.

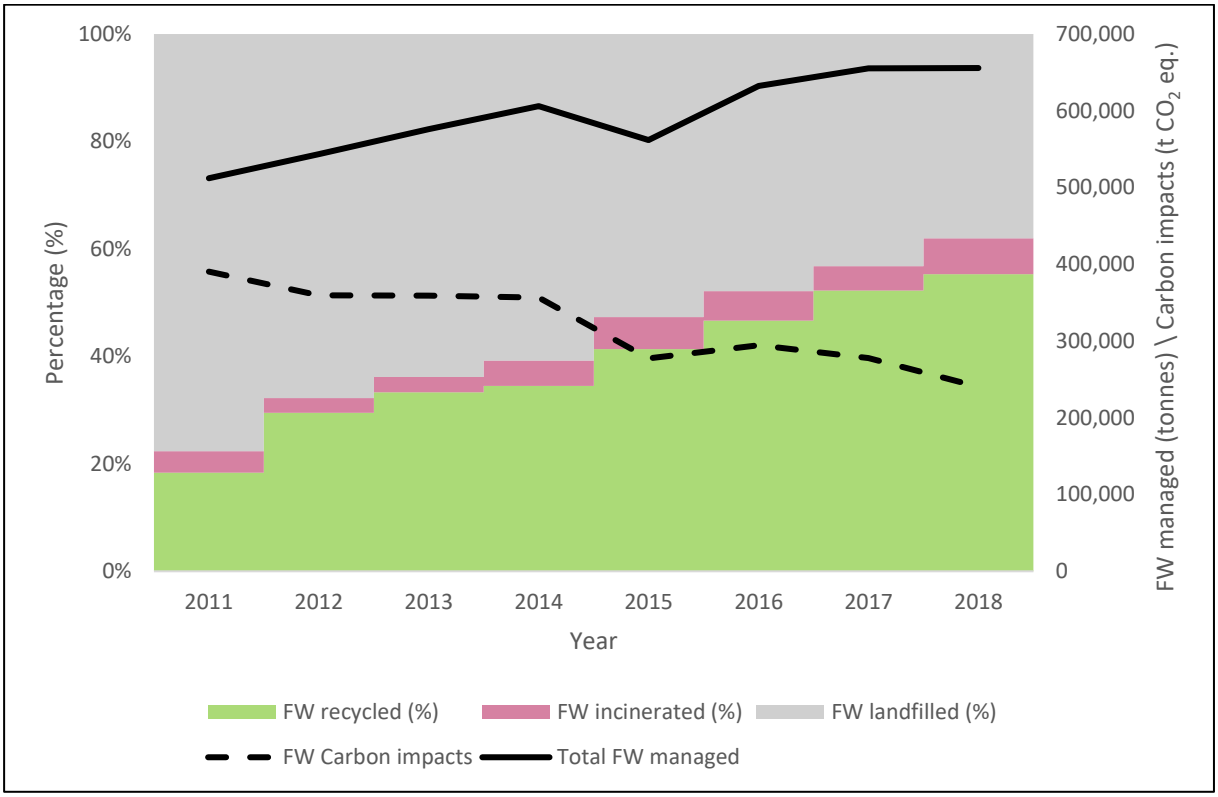


Figure 5 End-of-life route (%) for food waste (FW) in Scotland from 2011 to 2018, including a trend analysis of total FW tonnages managed and carbon impacts.

Embodied carbon impacts from material production are by far the greatest contributor to the whole-life carbon impacts of Scotland's waste, as shown in Figure 6. Carbon impacts from landfilling remain the second largest carbon contributor at 0.9 and 1 Mt CO_2 eq. in 2017 and 2018 respectively, followed by incineration which remained at around 0.2 Mt CO_2 eq in both 2017 and 2018. Recycling reduced Scotland's waste carbon impacts by 2.9 Mt CO_2 eq. in 2018, representing an 8% increase in carbon savings compared to 2017.

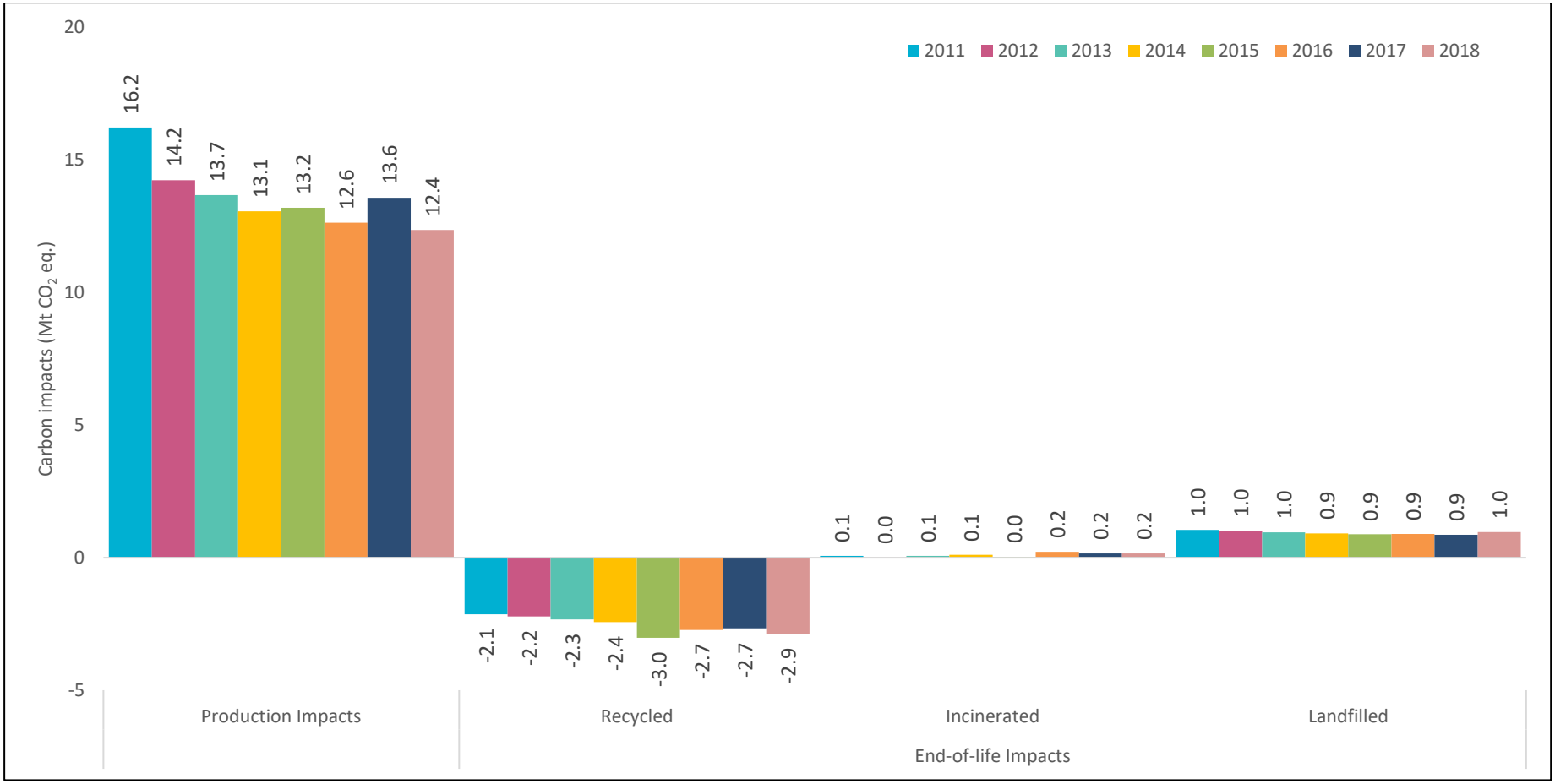


Figure 6 **Carbon life cycle impacts of waste by end-of-life treatment options.**

Lifecycle Impacts of Scotland's Waste (2011-2018)

The carbon intensity (i.e. the whole-life carbon impact per tonne of waste) of Scotland's waste declined by 27% between 2011 and 2018. The carbon intensity of household waste is much higher than non-household waste owing to its substantially higher embodied carbon content (household waste is made up of materials which have higher carbon content, such as food waste, paper and plastics, compared to non-household waste) and higher rates of landfill. Since 2011, the carbon intensity of non-household waste has fallen by 41% compared to just 7% for household waste, as shown in Figure 7. This is due to a greater improvement in non-household recycling rates over the period. Moreover, it worth mentioning that carbon intensity factors take into consideration embodied carbon impacts which were reduced by 12% and 32% for household and non-household waste between 2011 & 2018, respectively.

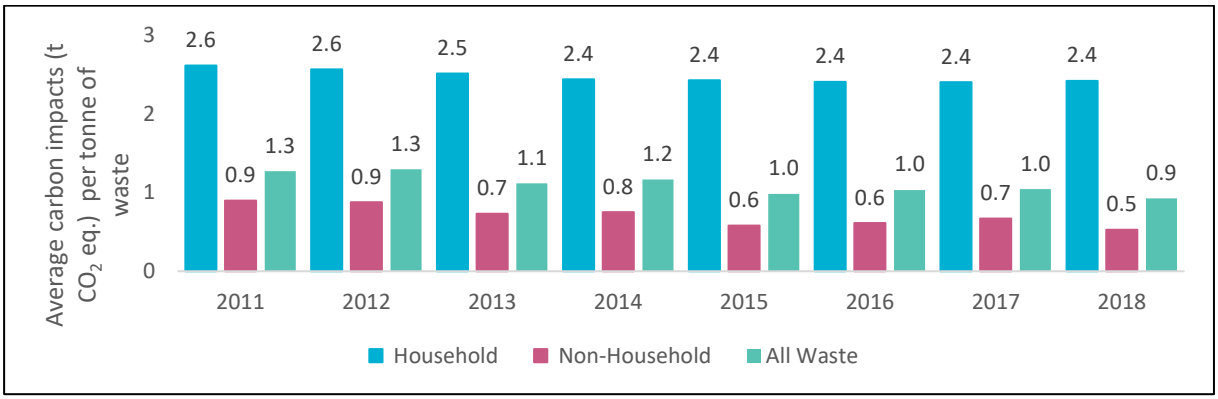


Figure 7 **Carbon intensity of Scottish waste, 2011-2018.**

Household vs. Non-Household Waste (2011-2018)

Figure 8 shows the proportion of the impacts – both (a) weight, and (b) carbon – of waste by source, i.e household vs non-household. Between 2011 and 201, no more than 25% of Scotland's waste originated from households, but the share of its carbon impact was substantially higher (55% in 2018) as household waste has a significantly higher carbon intensity than non-household waste, as discussed above.

The contribution of non-household waste returned to 45% in 2018 after a spike in 2017, as discussed previously.

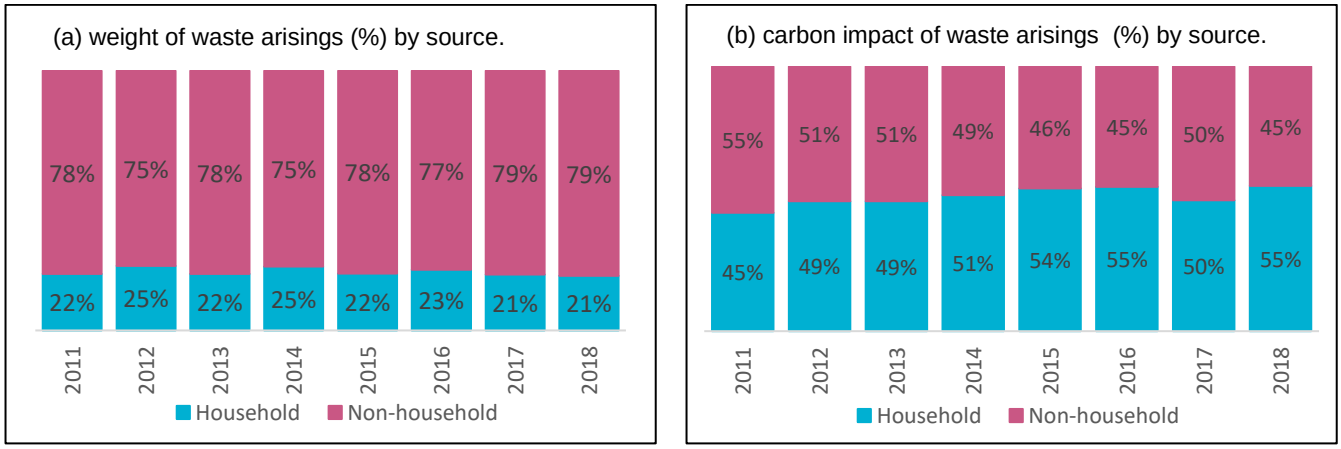


Figure 8 **Contribution analysis of household vs non-household (a) waste tonnages and (b) carbon impacts.**

The Top Five Waste Materials: Weight vs. Carbon Impacts (2018)

The Carbon Metric shows that many of the high tonnage waste materials which dominate the national waste stream have relatively low carbon impacts. To maximise the climate change benefits of waste and resource management focus should be placed on the most carbon intensive waste materials, such as food waste and textiles.

The top five waste materials by weight in 2018 (excluding unassigned household and similar waste[6]) accounted for 71% of Scotland's waste, but only 34% of its waste carbon impacts (Figure 9). On the other hand, the top five most carbon intensive waste materials accounted for just 20% of the total weight, but 71% of waste carbon impacts, as shown in Figure 10. The waste category with the single greatest carbon impact is animal and mixed food waste, which accounted for 5% of waste by weight but 25% of waste carbon impacts. Similarly, textile waste, which accounts for just 1% of waste by weight, is responsible for 17% of waste carbon impacts, making it a promising target for waste prevention efforts.

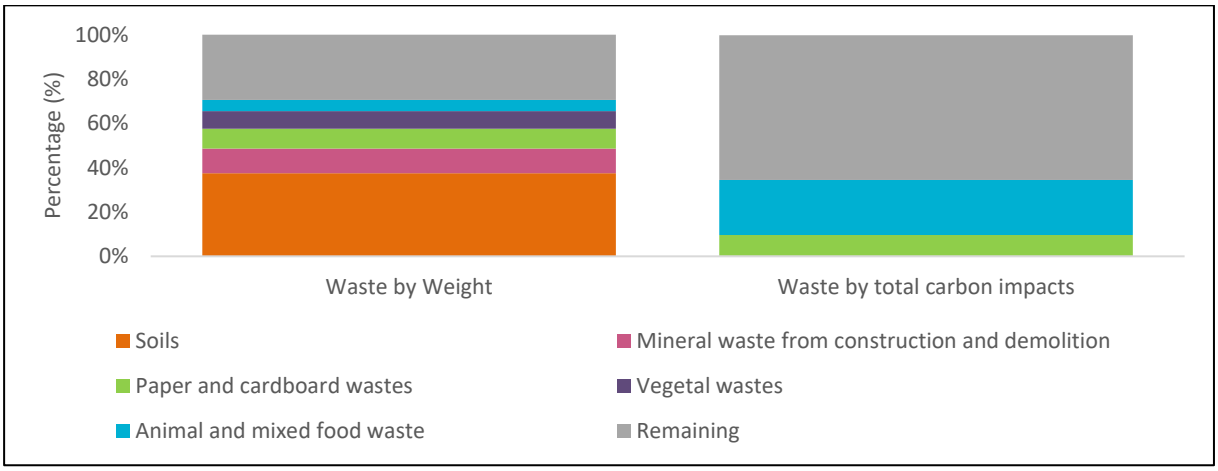


Figure 9 Top five waste materials by weight and their associated carbon impacts, 2018.

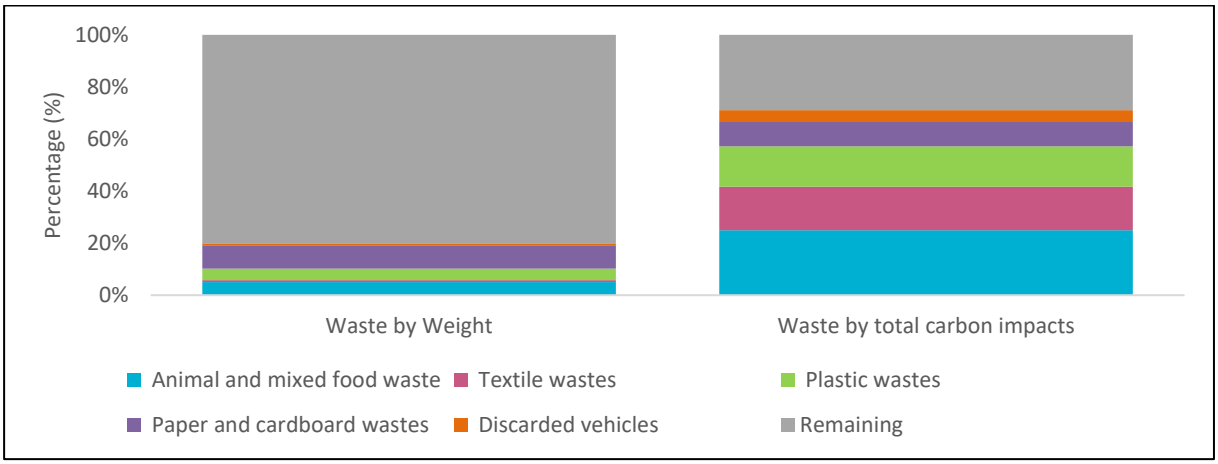


Figure 10 Top five waste materials by carbon impacts and their associated weight, 2018.

[6] Mixed waste categories, such as household and similar waste, are comprised of many different material types so their Carbon Metric carbon factors reflect their material composition. For the purpose of the top five weight vs. carbon comparison however, these materials have been extracted into their material specific categories where possible using compositional analysis. This means their tonnage and carbon impacts can be assessed separately. Despite this, the household and similar waste category still appears in the top five materials by weight as many materials could not be assigned. It was excluded in this analysis as the focus is on identifying materials with the highest carbon impacts.

Measuring Progress, 2011-2025

There are six main policy drivers to reduce waste generation and increase recycling rates in Scotland:

1. 70% of construction and demolition waste recycled or prepared for reuse by 2020[7];
2. Ban on all biodegradable municipal waste to landfill by 2025[8];
3. 15% waste reduction below 2011 levels by 2025[9];
4. 33% per capita food waste reduction below 2013 levels by 2025[9];
5. 70% recycle rate for all waste by 2025[9]; and
6. Maximum 5% landfill rate by 2025[9].

These policies were initially expected to reduce Scotland's annual waste carbon impact by 22% below 2011 levels, or 3.1 Mt CO_2 eq., by 2025[10]. As of 2018, our analysis suggests that Scotland has already achieved carbon savings of 4.6 Mt CO_2 eq., 30% below 2011 baseline levels. This substantial reduction can be attributed to a number of factors such as achieving a recycling rate of 60.7% for waste from all sources and a 286% increase in separately collected food waste, which has led to a drop in the amount of biodegradable municipal waste landfilled by 25%[11].

[7] C&D recycling rates are from data provided to Europe for reporting under the Waste Framework Directive. C&D recycling excludes hazardous waste and soil and stone recycled.
[8] https://www.circularonline.co.uk/news/scotlands-landfill-ban-delayed-until-2025/
[9] Scottish Government (2016) Making Things Last
[10] https://www.zerowastescotland.org.uk/sites/default/files/2011%20Carbon%20Metric%20Technical%20Report%20-%20published%202013.pdf
[11] https://www.sepa.org.uk/media/500273/waste-from-all-sources-summary-document-and-commentary-text-2018.pdf

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