The Carbon Footprint of Scotland's Waste

Carbon Metric Technical Report (2017 & 2018)

European Union
The Scottish Government
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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.

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

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Research date: April – June 2020

Publication date: September 2020

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Executive Summary

The Carbon Metric uses Scottish Environment Protection Agency (SEPA) waste data, and life cycle thinking, to estimate the whole life carbon impacts of Scotland's waste. This report presents the seventh annual Carbon Metric, covering 2017 and 2018[1], and details on the Carbon Metric technical update.

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 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 and 2018 respectively. Of the 4.6 Mt CO2 eq reduction in carbon impacts between 2011 and 2018, 3.8 Mt CO2 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, despite constituting only 5% of Scotland's waste by weight. A similar trend was also observed in Scotland's waste data for 2017.

[1] we were not been able to publish 2017 CM report last year due to unforeseen circumstances and hence this publication covers both 2017 and 2018 as reporting years.

[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.

1 Introduction

The Scottish Carbon Metric measures the whole-life carbon impacts of Scotland's managed waste, from resource extraction and manufacturing emissions, right through to waste management emissions, regardless of where in the world these impacts occur, as shown in Figure 1-1.

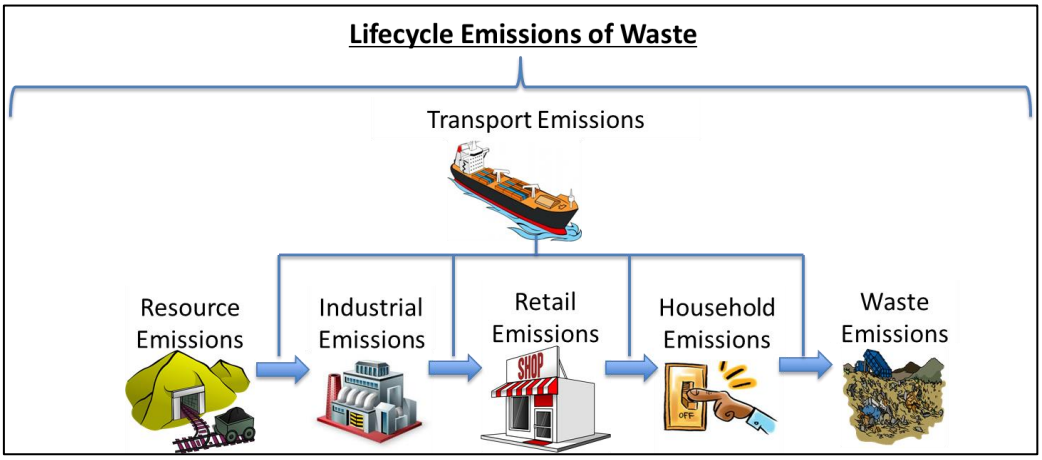


Figure 1-1 Representation of the lifecycle emissions of waste.

The Carbon Metric quantifies the complete lifecycle impacts of more than 30 different common waste categories, providing policy makers and business leaders with an alternative to weight-based waste measurement. This allows 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. A full list of policy drivers is provided in Section 4 (see page 22).

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.

The Scottish Carbon Metric is updated annually to take into consideration the latest waste data published by the Scottish Environment Protection Agency (SEPA)[4]. Carbon factors are also reviewed and updated (when possible) on the basis of the best available knowledge. The first edition of the Carbon Metric covering 2011 waste data was published in 2013. This report summarises the results of the 2017 and 2018 Carbon Metric analysis.

2 Data revisions and updates

2.1 Updates to waste data

2.1.1 Revisions to SEPA's waste dataset

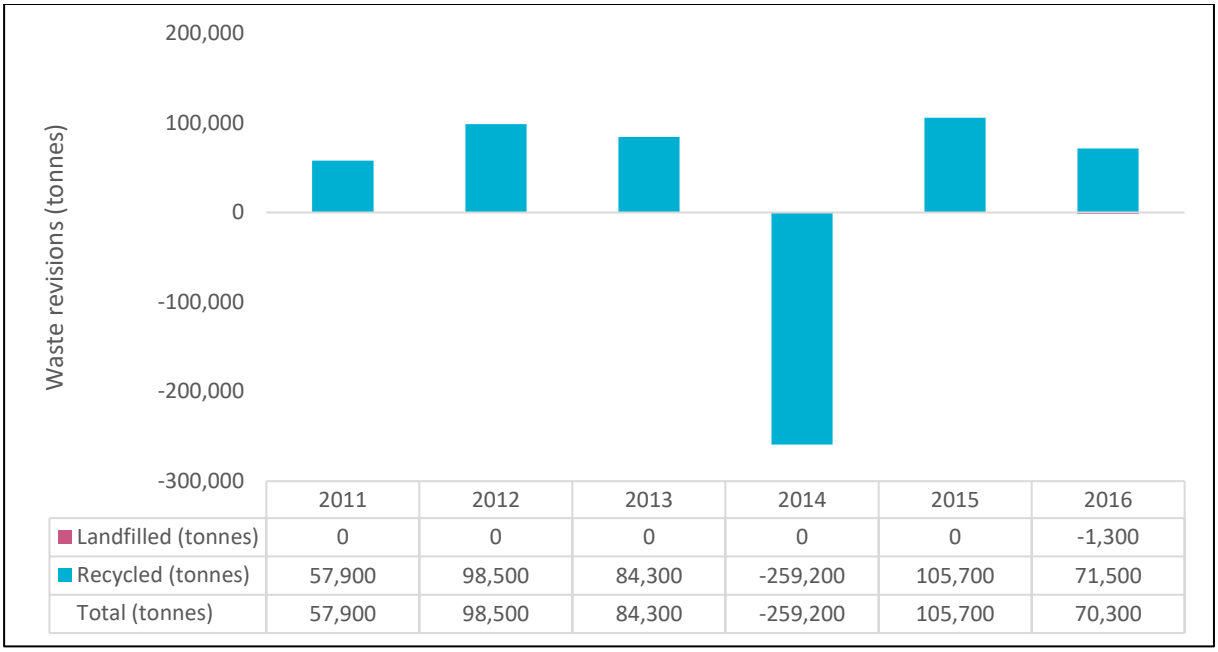
Latest revisions to SEPA's waste dataset[5], undertaken since the 2016 CM publication, have reported significant changes to tonnages. Revisions cover all waste sources, but most changes occur in the Commercial and Industrial (C&I) and Construction and Demolition (C&D) sectors. For the C&I dataset, revised data takes into account the following:

- account site returns amended since the previous publication; and

[4] https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/
[5] https://www.sepa.org.uk/media/500273/waste-from-all-sources-summary-document-and-commentary-text-2018.pdf

- a refinement to the C&I methodology has been used for sector allocations.

Figure 2-1 shows changes to tonnages of waste recycled and landfilled since the last reporting period (i.e., 2016), as reported by SEPA[6]. Of note is the change in waste recycling for 2014. Recycling data for mineral waste from C&D activities has been revised downwards from 831,800 tonnes to 691,044, a reduction of 2.9%. Similarly, the recycling of waste soils has been revised downwards from 1.96 million tonnes to 1.75 million tonnes, a reduction of 4.3%. This has resulted in an overall reduction in recycling in 2014 from 5.39 million tonnes to 5.13 million tonnes (4.9%) (see Section 3.6 for further details).



	2011	2012	2013	2014	2015	2016
Landfilled (tonnes)	0	0	0	0	0	-1,300
Recycled (tonnes)	57,900	98,500	84,300	-259,200	105,700	71,500
Total (tonnes)	57,900	98,500	84,300	-259,200	105,700	70,300

Figure 2-1 Changes to Scottish waste from all sources managed 2011-2016.

[6] https://www.sepa.org.uk/media/500273/waste-from-all-sources-summary-document-and-commentary-text-2018.pdf

2.2 Updates to the Carbon Metric tool

2.2.1 *Electricity and transport carbon factors 2017 and 2018*

Two key updates were made to greenhouse gas emissions (GHGs) factors as part of the 2017 and 2018 Carbon Metric update. These changes, presented in Table 2-1, take into account the 2017 and 2018 carbon factors of energy production and transport activities in the UK and reflect the ongoing decarbonisation of the UK national electricity grid. Although these changes have a minor impact on most waste categories, carbon factors of materials with high caloric value such as plastic waste and rubber waste will be affected, particularly for energy recovery technologies. As the UK national grid is decarbonising, the relative benefits of incinerating non-biodegradable wastes to produce electricity will decline and, consequently, the overall carbon impacts will increase. Table 2-2 lists the UK electricity and transport GHG factors used between 2011 and 2018 and the level of decarbonisaiton taking place in both energy and transport sectors.

Table 2-1 Updates made to the 2017 and 2018 versions of the Carbon Metric tool.

Update	Reference
Electricity grid factors were updated using the 2017/18 values.	UK Government GHG Conversion Factors for Company Reporting - DEFRA/DECC (2017/18)
Transport factors were updated using the 2017/18 values.	UK Government GHG Conversion Factors for Company Reporting - DEFRA/DECC (2017/18)

Table 2-2 UK electricity and transport GHGs factors used in the carbon metric[7].

	2011	2012	2013	2014	2015	2016	2017	2018
Electricity (kg CO_2eq. per kWh)	0.45	0.46	0.45	0.49	0.46	0.41	0.35	0.28
Change (%) (baseline – 2011)		2%	-3%	11%	-6%	-11%	-15%	-37%
Transport (kg CO_2eq. per t.km) (x 100)	162	162	162	161	134	145	140	141
Change (%) (baseline – 2011)		0	0	-1%	-17%	-10%	-13%	-13%

2.2.2 *Considerations for future updates*

Zero Waste Scotland's Environmental Analysis team is currently undertaking a complete overhaul of the Carbon Metric tool. The ultimate objective of this project is to increase our understanding of the overall environmental impacts of Scotland's waste by adding a number of new environmental indicators. Delivered in partnership with Edinburgh Napier University and Cambridge Architectural Research Ltd, the upgraded tool, which will replace the existing Carbon Metric tool, will be designed using the ecoinvent v3.5 life cycle inventory (LCI) database, the world's leading LCI database that is widely used by academics and LCA practitioners.

2.3 Outstanding data gaps and limitations

2.3.1 *Food waste fraction in mixed residual waste*

Tonnages of food waste separately collected have increased rapidly in recent years. However, the original methodology used in the Carbon Metric assumed that food waste content of residual waste

[7] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

was constant. Therefore, it was unaffected by an increase in separately collected food waste, resulting in an implied increase in total household food waste over time.

In order to address this issue, estimates of food waste are based on a revised methodology for estimating the waste composition of residual waste (i.e. household and similar wastes). 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. Whilst the total food waste per capita is assumed constant, it worth mentioning that the new methodology takes into consideration the increase in total food waste due to population growth in the case of household waste and Gross Value Added in the case of non-household waste.

SEPA, Zero Waste Scotland and the Scottish Government are reviewing the frequency of waste composition studies to better understand these changes in future.

Table 2-3 shows the revised composition analysis of the 'Household and Similar Waste' category for (a) household and (b) non-household waste. This table shows how the materials found in this waste category are disaggregated into the other waste categories included in the Carbon Metric. Thus, in 2018, 26% and 2% of household and similar wastes are assigned to the household and non-household animal and mixed food waste category, respectively, on top of the tonnages that are separately collected.

Table 2-3 **Composition analysis of 'Household and Similar Waste' category for (a) household and (b) non-household waste.**

(a)

Waste category	2011	2012	2013	2014	2015	2016	2017	2018
Animal and mixed food waste	21%	24%	26%	25%	25%	24%	25%	26%
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	2%	2%	2%	2%	2%	2%	2%	2%
Glass wastes	7%	6%	6%	6%	6%	6%	6%	6%
Health care and biological wastes	10%	10%	9%	9%	9%	9%	9%	9%
Household and similar wastes	7%	7%	6%	6%	6%	7%	7%	6%
Metallic wastes, mixed ferrous and non-ferrous	4%	4%	4%	4%	4%	4%	4%	4%
Mineral waste from construction and demolition	3%	3%	3%	3%	3%	3%	3%	3%
Paper and cardboard wastes	15%	15%	14%	14%	15%	15%	15%	14%
Plastic wastes	16%	15%	15%	15%	15%	15%	15%	15%
Rubber wastes	0%	0%	0%	0%	0%	0%	0%	0%
Textile wastes	6%	6%	6%	6%	6%	6%	6%	6%
Vegetal wastes	6%	5%	5%	5%	5%	5%	5%	5%
Wood wastes	3%	3%	3%	3%	3%	3%	3%	3%
Total	100%	100%	100%	100%	100%	100%	100%	100%

(b)

Waste category	2011	2012	2013	2014	2015	2016	2017	2018
Animal and mixed food waste	30%	34%	30%	39%	14%	14%	5%	2%
Paper and cardboard waste	32%	30%	32%	28%	39%	39%	44%	45%
Plastic wastes	16%	15%	16%	14%	20%	20%	22%	23%
Vegetal wastes	3%	3%	3%	3%	4%	4%	4%	4%
Metallic wastes, ferrous	3%	3%	3%	2%	3%	3%	4%	4%
Glass wastes	2%	2%	2%	2%	3%	3%	3%	3%
Household and similar waste	11%	10%	11%	10%	14%	14%	15%	16%
Textile wastes	1%	1%	1%	1%	1%	1%	2%	2%
Metal waste, non-ferrous	1%	1%	1%	1%	1%	1%	1%	1%
Discarded equipment (excluding batteries and cars)	1%	1%	1%	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%

2.3.2 Waste data gaps

The carbon impacts of the C&I waste management routes are poorly understood for many waste types because they are extremely heterogeneous (examples include chemical wastes and healthcare and biological wastes). Issues such as a lack of properly reported data, differences in the classification of waste, and changes in waste classification through the waste management process create further inaccuracies in the C&I dataset. In the short-term, this issue is likely to persist. However, ongoing work by DEFRA and SEPA to develop a UK electronic waste tracking system is expected to help close this data gap in the future[8].

2.3.3 Carbon factor limitations

Some waste categories have poorly understood carbon impacts, meaning the carbon factors in the Carbon Metric are subject to a high degree of uncertainty. The most common issues leading to a lack of understanding of the carbon impacts of waste types are:

- Heterogeneous and poorly defined waste categories; and
- A lack of carbon data with appropriate temporal, geographical or technical boundaries, particularly regarding the origins of imported material which becomes waste.

In addition, a portion of Scotland's waste (4% in 2017 and 2.5% in 2018) has no carbon factor, meaning the carbon impact of Scotland's waste is underestimated. Waste materials without a complete set of carbon factors include: 'Acid, alkaline or saline wastes', 'Dredging spoils', 'Healthcare and biological wastes', 'Industrial effluent sludges', and 'Wastes containing PCB'.

These limitations are expected be addressed in the ongoing Carbon Metric upgrade project (see Section 2.2.2).

3 Results: the carbon impacts of Scotland's waste

The carbon impacts of Scotland's waste in 2017 and 2018 are presented in this section, alongside a trend analysis of 2011-2018 waste and carbon data. Results include the impact from all waste produced and managed in Scotland during a given year. Management impacts include the carbon benefits from recycling (avoided production of virgin materials) and energy from waste (avoided fossil fuel generation) as well as the impacts from all waste management routes. Carbon impacts and savings attributed to the consumption of materials in Scotland are counted wherever they occur in the world. Reuse and repair activities that prevent waste are largely uncaptured in the Carbon Metric dataset.

3.1 Carbon impact of waste, 2017 and 2018

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. from the previous year as shown in Figure 3-1. Higher waste carbon impacts in 2017 were primarily due to an increase in carbon intensive waste materials in the non-household waste stream (see Figure 3-2 [a] and [b]). Figure 3-3 shows that total waste arisings across seven carbon intensive waste materials increased by 27% in 2017 compared to the previous year, hence the increase reported in our results.

[8] https://www.environment.gov.scot/data/waste-data-strategy/

In 2018, the overall carbon impact of Scottish Waste 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 impact of Scotland's waste continues on a downward trajectory when compared to 2011 baseline levels. Our analysis shows that the reduction in whole-life carbon impacts between 2011 and 2018 is approximately 4.6 Mt CO_2 eq.; 30% lower than 2011 carbon impacts. 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.

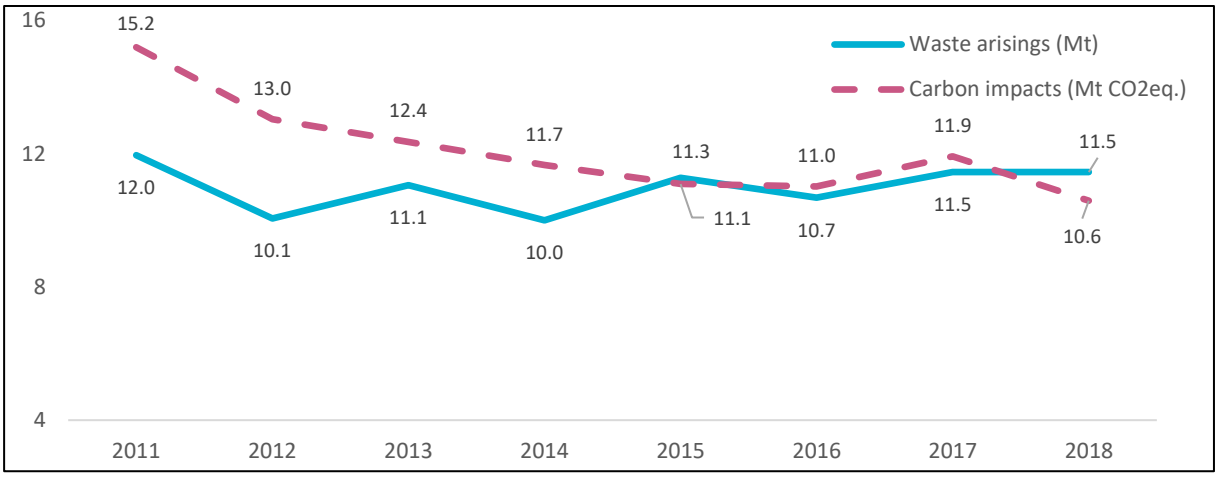


Figure 3-1 Weight versus carbon impacts of resource loss and waste management in Scotland.

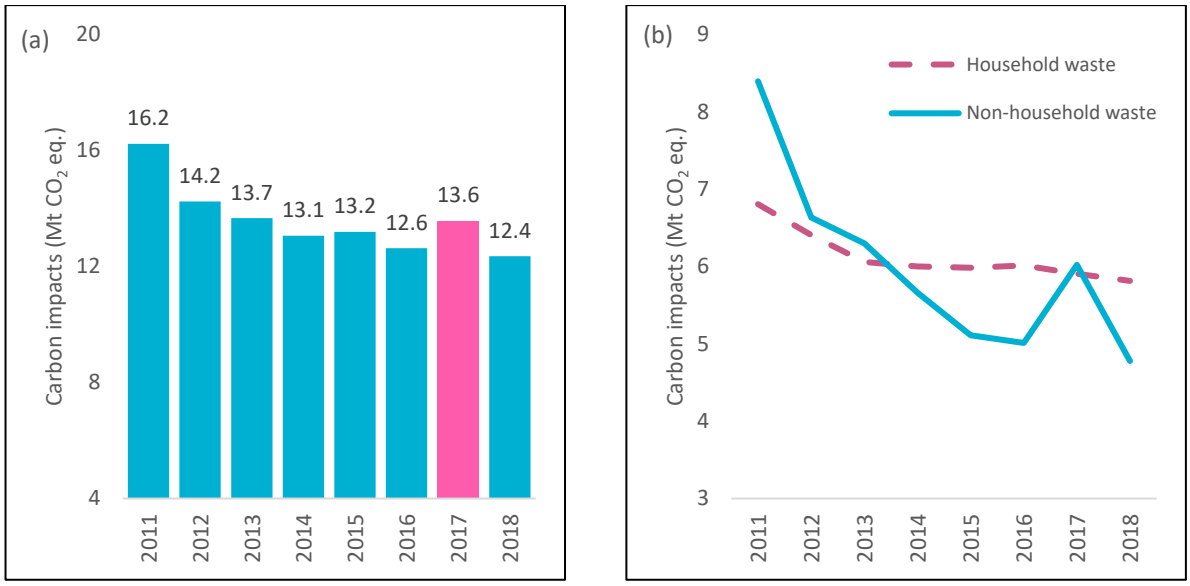
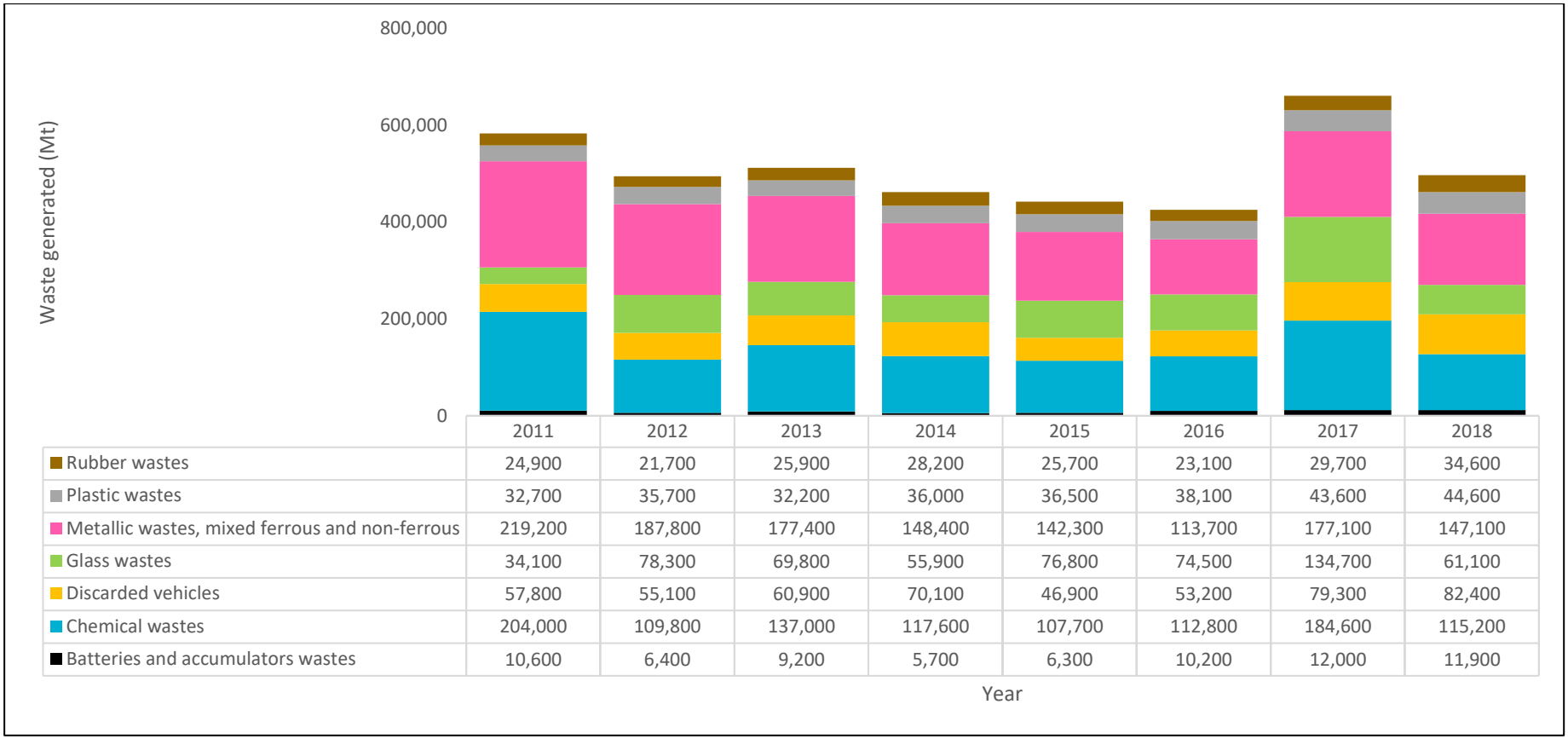


Figure 3-2 Embodied (resource extraction and manufacturing) carbon impacts of (a) waste from all source and (b) by source.



	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 3-3 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.

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

In 2017, Scottish households contributed to 48% of total carbon impacts but their contribution jumped to 55% in 2018 (Table 3-1). This increase in the contribution of household waste is not due to any changes to household waste arisings or management scenarios. It is because the carbon impacts of non-household waste decreased in 2018, after the spike in 2017, as shown in Figure 3-2.

Table 3-1 The Carbon Impact of Scottish waste in 2017(a) and 2018(b).

(a)

Sector	Carbon impact of waste (t CO_2 eq.)	Carbon impact of waste (%)
Households	5,867,000	48%
Commercial and Industrial	6,481,000	52%
Total	**12,348,000**	**100%**

(b)

Sector	Carbon impact of waste (t CO_2 eq.)	Carbon impact of waste (%)
Households	5,814,000	55%
Commercial and Industrial	4,778,000	45%
Total	**10,592,000**	**100%**

Figure 3-4 shows the proportion of the impacts – both (a) weight, and (b) carbon – of waste by source, i.e. household versus non-household. Between 2011 and 2018, 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.

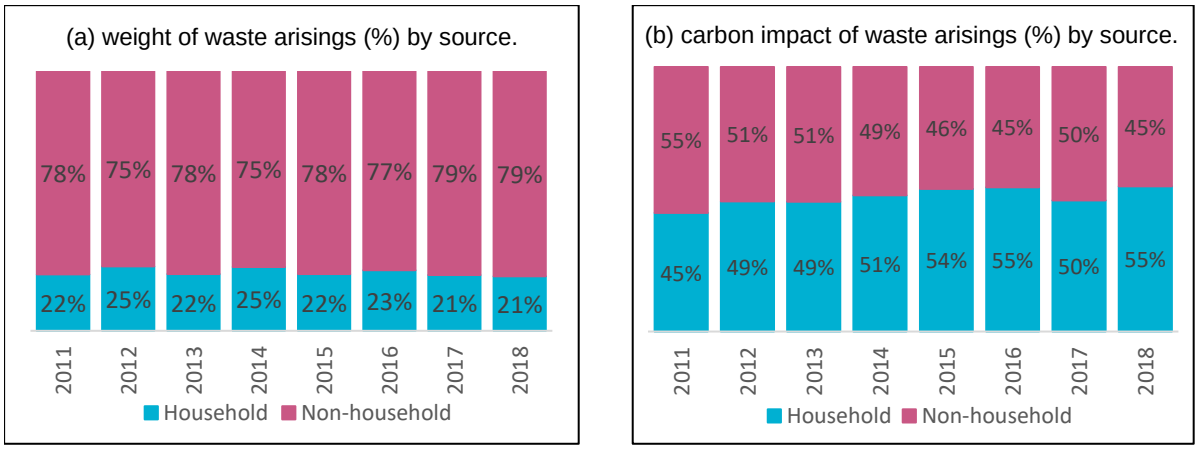


Figure 3-4 Contribution analysis of household vs non-household (a) waste tonnages and (b) carbon impacts.

The whole-life carbon impacts carbon impacts from material production remain the greatest contributor to the whole-life carbon impacts of Scotland's waste by far, as shown in Table 3-2 (and Figure 3-6 on page 15 for all years). 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 for the third consecutive year. 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.

Table 3-2 Carbon impact of waste generated and managed in 2017(a) and 2018(b)

(a)

Life cycle phase	Carbon impact of waste in 2017 (t CO_2 eq.)	Percentage (%)
Waste generated	13,574,000	114%
Recycled	-2,662,000	-22%
Incinerated	161,000	1%
Landfilled	862,000	7%
Other diversion	-7,000	0%
Overall carbon impact	**11,928,000**	**100%**

(b)

Life cycle phase	Carbon impact of waste in 2018 (t CO_2 eq.)	Percentage (%)
Waste generated	12,355,000	117%
Recycled	-2,878,000	-27%
Incinerated	157,000	1%
Landfilled	965,000	9%
Other diversion	-6,000	0%
Overall carbon impact	**10,593,000**	**100%**

3.3 Carbon impacts of waste management activities

Figure 3-5 shows that waste incinerated in 2018 decreased by approximately 56,200 tonnes in comparison to the previous year while waste landfilled increased by nearly 332,900 tonnes, out of which 158,800 tonnes (47%) were soil landfilled. Carbon impacts associated with waste incinerated in 2018 are nearly 167,100 t CO_2 eq., 6200 t CO_2 eq. (4%) higher than the carbon impacts of incineration in 2017.

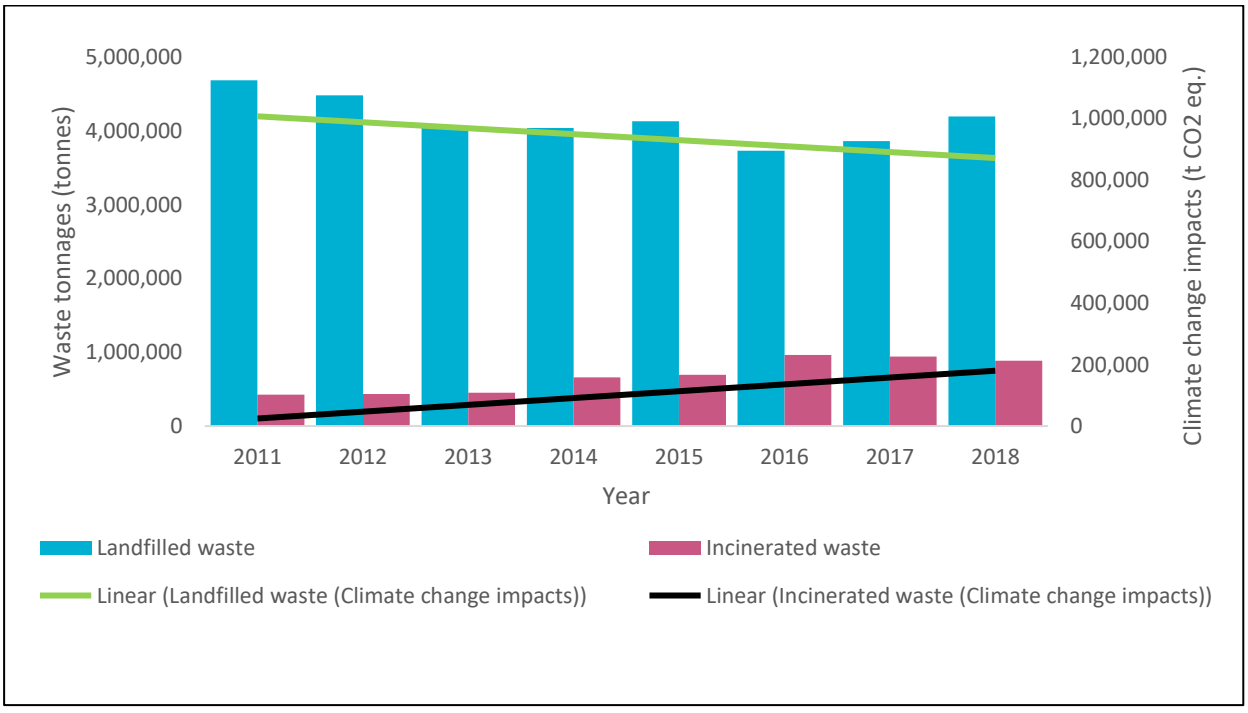


Figure 3-5 Waste tonnages incinerated and landfilled versus their net carbon impacts.

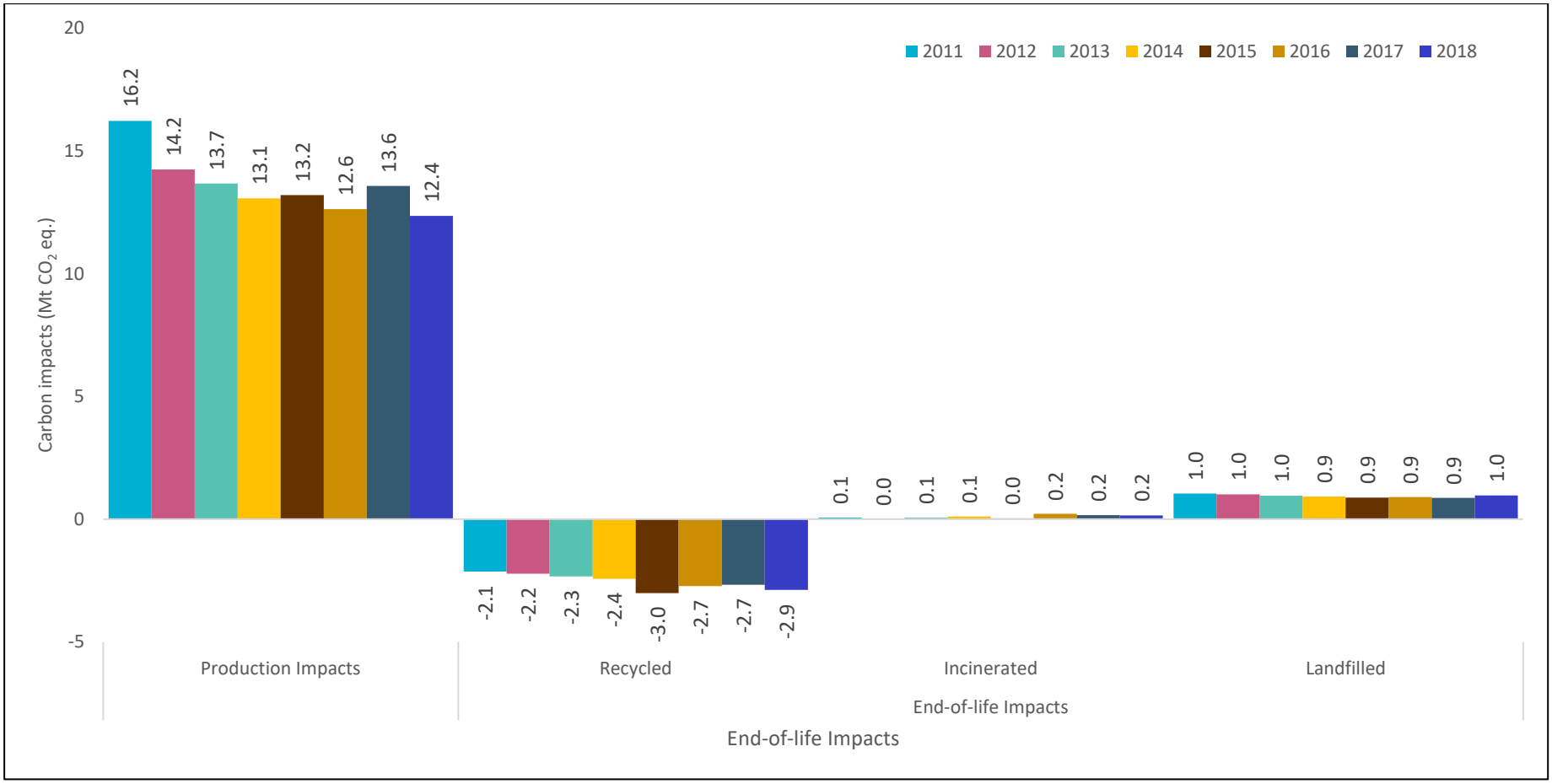


Figure 3-6 **Carbon life cycle impacts of waste (both household and non-household) by end-of-life treatment options, including material production.**

The amount of food waste landfilled in Scotland continues to decline as the amount of separately collected food waste increases, as shown in Figure 3-7. 2017 was the first year in which tonnages of recycled food waste exceeded that of food waste landfilled. An estimated 249,500 tonnes of food waste were landfilled in 2018, 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 by 37% from 390,400 t CO_2 eq. to 245,800 t CO_2 eq. in 2018.

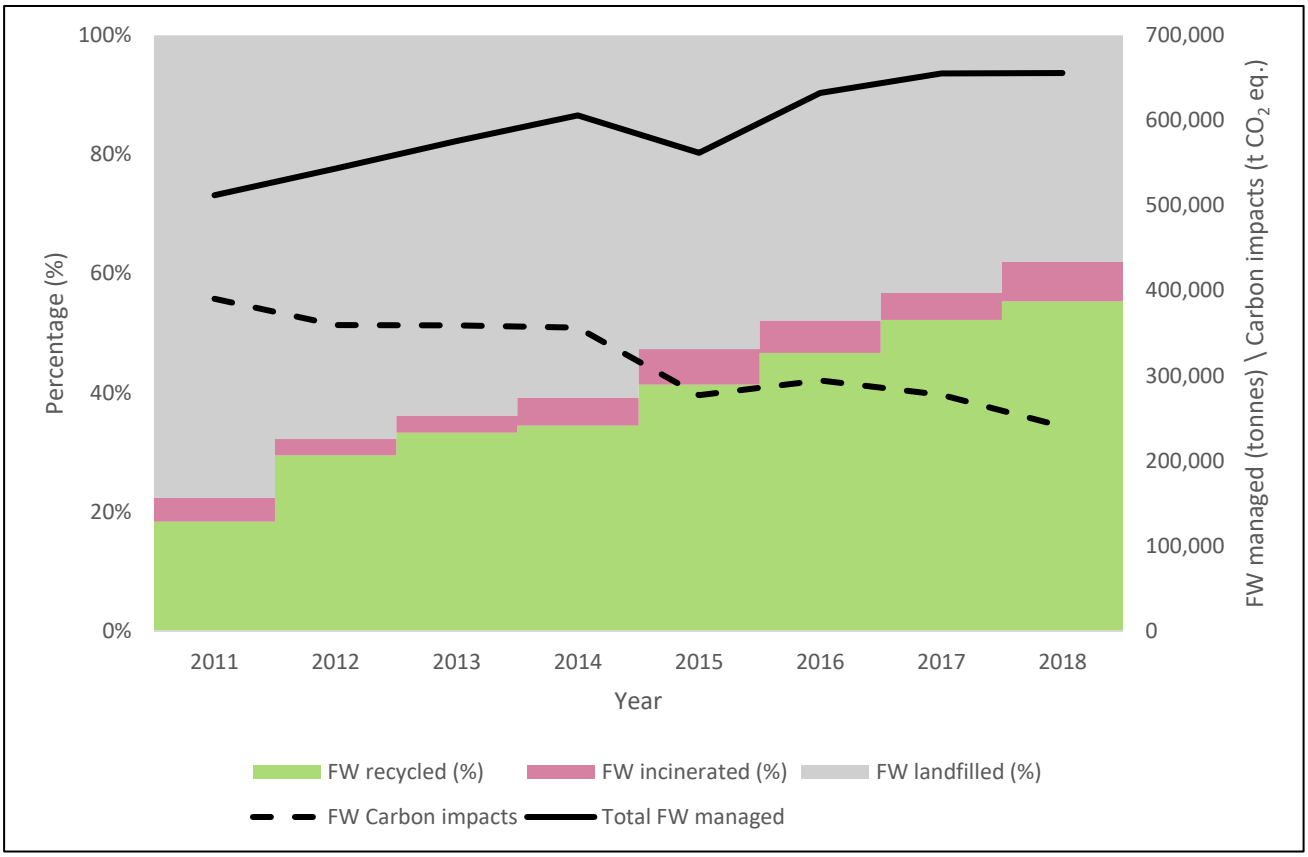


Figure 3-7 End-of-life route (%) for food waste (FW) in Scotland from 2011 to 2018, including a trend analysis of total FW tonnages managed and carbon impacts.

3.4 Carbon intensity, 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 a higher proportion of materials that have a high 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 3-8. This is largely due to a greater improvement in non-household recycling rates over the period (Figure 3-9 &Figure 3-10).

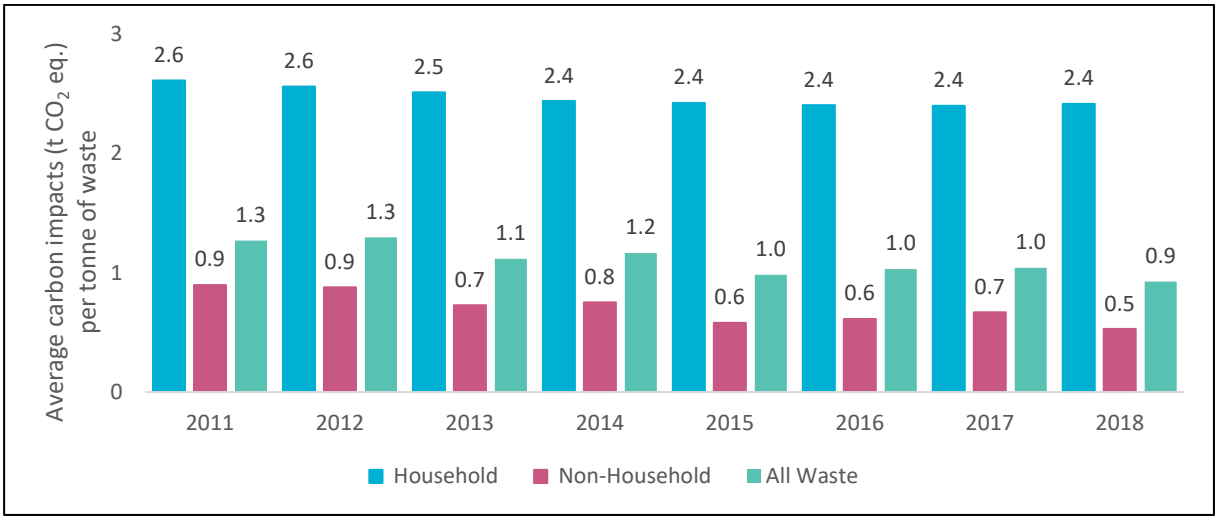


Figure 3-8 **Carbon intensity of Scottish waste, 2011-2018.**

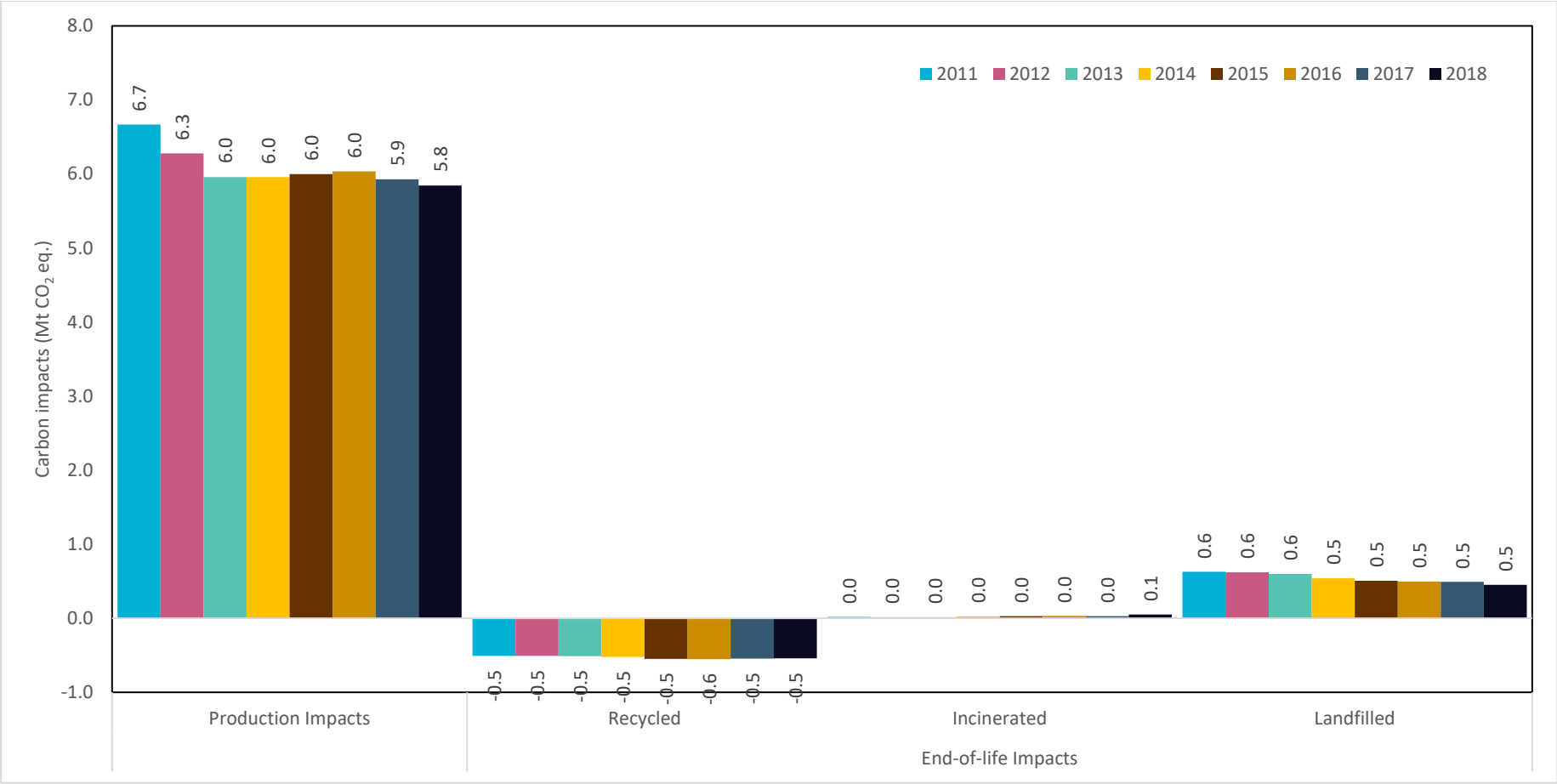


Figure 3-9 **Carbon life cycle impacts of household waste by end-of-life treatment options, including material production.**

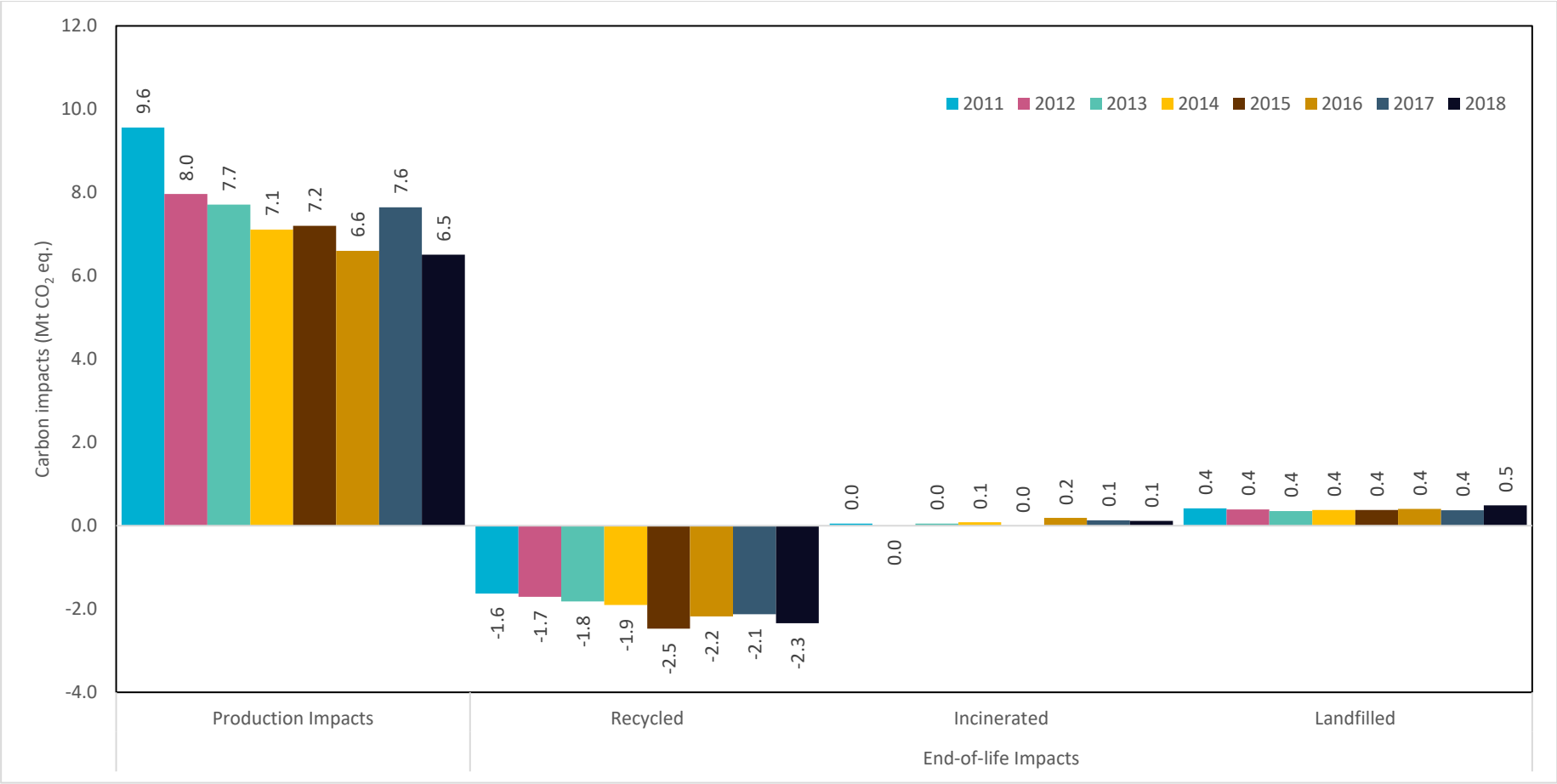


Figure 3-10 **Carbon life cycle impacts of non-household waste by end-of-life treatment options, including material production.**

3.5 Material analysis

The carbon impacts of all waste material in the 2017 and 2018 Carbon Metric are shown in Annex 3.

Most of Scotland's waste carbon impacts are concentrated in a few materials which either have a high carbon intensity or occur in large volumes (or both).

The top five waste materials by weight in 2018 (excluding unassigned household and similar waste) accounted for 71% of Scotland's waste, but only 34% of its waste carbon impacts. The top five most carbon intensive waste materials in 2018 accounted for just 20% of the total weight, but 71% of waste carbon impacts (i.e. 81% for household waste and 69% for non-household waste) (Figure 3-11 and Figure 3-12). 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, again making it a promising target for waste prevention efforts (see Table 3-3).

The top five waste materials by weight in 2017 (excluding unassigned household and similar waste[9]) accounted for 68% of Scotland's waste, but only 36% of its waste carbon impacts. In contrast, the top five most carbon intensive waste materials accounted for just 10% of the total weight, but 72% of the waste carbon impacts, as shown in Table 3-4 (i.e. 80% for household waste and 66% for non-household waste). The waste category with the single greatest carbon impact was animal and mixed food waste, accounting for 5% of waste by weight but 32% of waste carbon impacts. Similarly, textile waste, which accounted for just 1% of 2017 waste by weight, was responsible for 18% of waste carbon impacts, making it a promising target for waste prevention efforts.

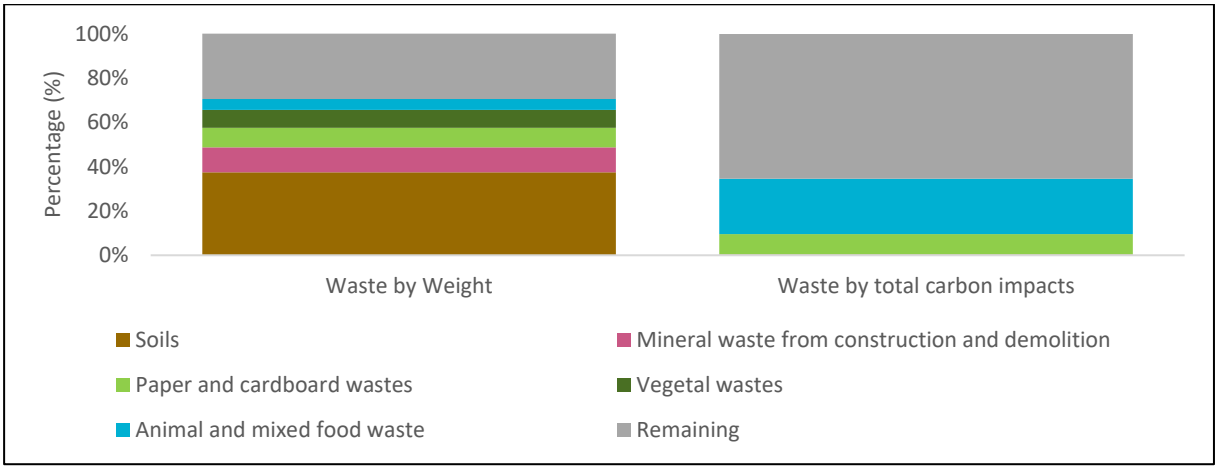


Figure 3-11 Top five waste materials by weight and their associated carbon impacts, 2018.

[9] 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' waste category still appears in the top five materials by weight as many materials could not be re-assigned. Therefore, it was excluded in this analysis as the focus is on identifying materials with the highest carbon impacts.

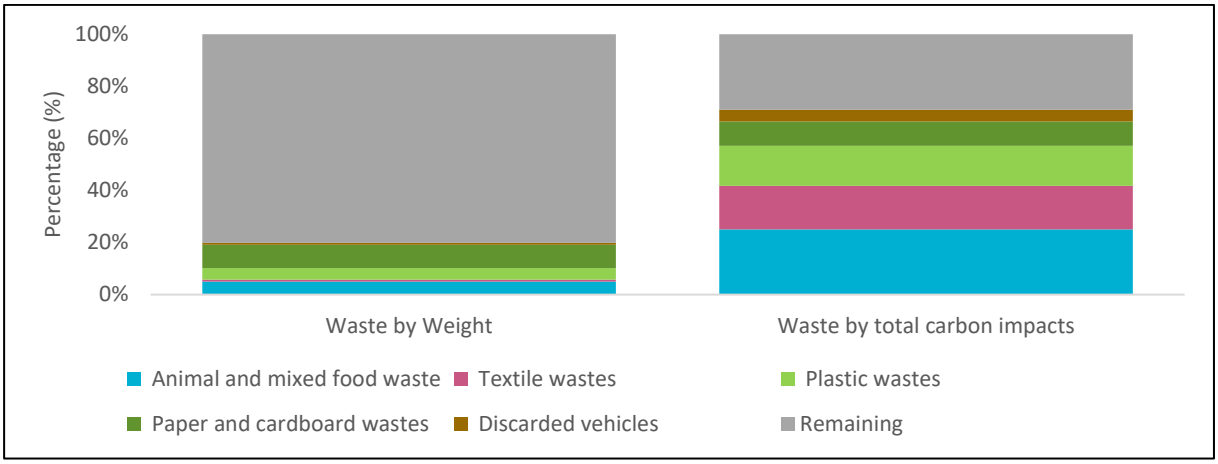


Figure 3-12 **Top five waste materials by carbon impacts and their associated weight, 2018.**

Table 3-3 **Top five materials by carbon impact in 2018 (tonnes CO_2 eq.).**

Position	Household wastes	Non-household wastes	All Scottish waste
1	*Animal and mixed food waste*	*Plastic wastes*	*Animal and mixed food waste*
	1,886,600	964,800	2,648,300
2	*Textile wastes*	*Paper and cardboard wastes*	*Textile wastes*
	1,770,200	805,000	1,770,200
3	*Plastic wastes*	*Animal and mixed food waste*	*Plastic wastes*
	666,300	761,700	1,631,100
4	*Metallic wastes, mixed ferrous and non-ferrous*	*Discarded vehicles*	*Paper and cardboard wastes*
	202,200	486,000	992,600
5	*Paper and cardboard wastes*	*Metallic wastes, mixed ferrous and non-ferrous*	*Discarded vehicles*
	187,600	253,900	487,900
Share of Total Impacts	**81%**	**69%**	**71%**

Table 3-4 **Top five materials by carbon impact in 2017 (tonnes CO_2 eq.).**

Position	Household wastes	Non-household wastes	All Scottish waste
1	*Animal and mixed food waste*	*Animal and mixed food waste*	*Animal and mixed food waste*
	1,890,200	1,946,000	3,836,200
2	*Textile wastes*	*Plastic wastes*	*Textile wastes*
	1,807,500	636,700	2,148,400
3	*Plastic wastes*	*Metallic wastes, mixed ferrous and non-ferrous*	*Plastic wastes*
	673,600	558,500	1,310,300
4	*Metallic wastes, mixed ferrous and non-ferrous*	*Discarded vehicles*	*Metallic wastes, mixed ferrous and non-ferrous*

	199,000	491,200	757,500
5	*Paper and cardboard wastes*	*Textile wastes*	*Discarded vehicles*
	179,900	340,900	493,300
Share of Total Impacts	**80%**	**66%**	**72%**

3.6 The impact of data revisions on the carbon impacts

Changes to reported tonnages between 2011 and 2016, published in the latest SEPA waste report (see Section 2.1.1), have led to higher carbon impacts reported for previous years, in particular 2014. Overall, revised carbon impacts are 2% higher than original impacts, as shown in Figure 3-13. The highest increase (4%) is reported for 2014 as overall recycling tonnages have been revised downwards from 5.39 million tonnes to 5.13 million tonnes, a reduction of 4.8% (~259,200 tonnes).

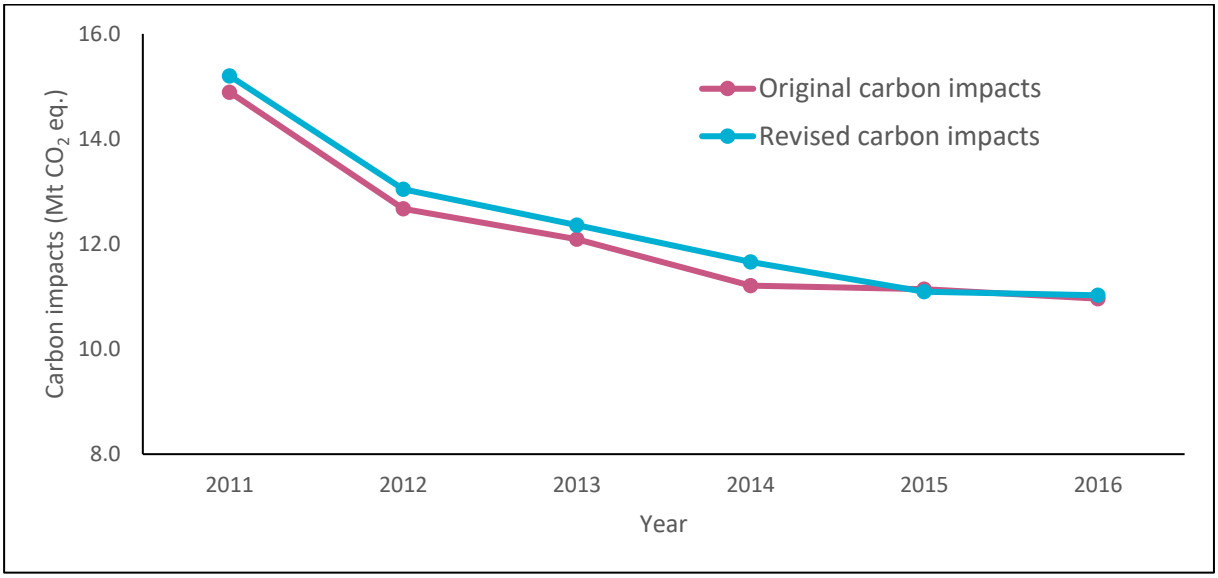


Figure 3-13 Revisions to carbon impacts between 2011 and 2016.

4 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[10];
2. Ban on all biodegradable municipal waste to landfill by 2025[11];
3. 15% waste reduction below 2011 levels by 2025[12];
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].

[10] 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.
[11] https://www.circularonline.co.uk/news/scotlands-landfill-ban-delayed-until-2025/
[12] Scottish Government (2016) Making Things Last

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[13]. 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%[14].

5 Further information

There are several other outputs from the Carbon Metric which can be accessed on the Zero Waste Scotland website. These include:

- Zero Waste Scotland Carbon Metric Factors – Spreadsheet - (2011 – 2018)
- Zero Waste Scotland Total Carbon Impacts - Spreadsheet - (2011-2018)
- The Carbon Footprint of Scotland's Waste - Summary Report - (2017 and 2018)

6 Conclusion

This report quantifies the carbon impact of Scotland's waste from 2011 to 2018, and provides updates to Scotland's waste and carbon data, which are used to make this assessment.

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, largely due to a significant tonnage increase in carbon intensive waste materials (e.g. glass and chemical wastes). Impacts then fell 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. This trend continued in 2018 as food waste recycled was higher than the amount of food waste landfilled by 113,200 tonnes.

[13] https://www.zerowastescotland.org.uk/sites/default/files/2011%20Carbon%20Metric%20Technical%20Report%20-%20published%202013.pdf

[14] https://www.sepa.org.uk/media/500273/waste-from-all-sources-summary-document-and-commentary-text-2018.pdf

Annex 1a: Tonnages of household and non-household waste for 2017[15][16][17].

Material type [18]	Household (tonnes)				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes	0	0	0	0	0
Animal and mixed food waste	435,400	100,800	29,500	261,000	11,000
Animal faeces, urine and manure	0	0	0	0	0
Batteries & accumulators wastes	500	500	0	0	0
Chemical wastes	1,100	1,100	100	0	0
Combustion wastes	0	0	2,800	31,900	14,000
Common sludges	0	0	0	0	0
Discarded equipment	64,400	33,700	2,500	22,500	900
Discarded vehicles	400	400	0	0	0
Dredging spoils	0	0	0	0	0
Glass wastes	157,000	104,900	7,500	66,100	2,700
Health care & biological wastes	127,000	400	11,200	98,700	4,100
Household and similar wastes[19]	87,800	300	7,800	68,300	2,800
Industrial effluent sludges	0	0	0	0	0
Metallic wastes, ferrous	600	10,100	0	0	0
Metallic wastes, mixed	85,700	50,400	4,900	42,800	2,800
Metallic wastes, non-ferrous	100	4,700	0	0	0
Mineral waste from C&D	122,700	94,200	3,900	34,200	1,400
Mineral wastes from waste treatment & stabilised wastes	0	0	0	0	0
Mixed & undifferentiated materials	303,000	1,500	34,000	14,800	1,100
Other mineral wastes	0	0	0	0	0
Paper and cardboard wastes	259,000	226,100	17,400	154,200	6,300
Plastic wastes	210,200	52,500	18,100	159,700	6,600

[15] https://www.environment.gov.scot/data/data-analysis/waste-from-all-sources/

[16] Waste data for years 2011 to 2016 are available on the SEPA Waste Portal. Please note that specific materials in the 'Household and similar wastes' category have been assigned to their original waste categories.

[17] Due to rounding, numbers presented throughout this report might not add up precisely to the totals indicated and percentages may not precisely reflect the absolute figures for the same reason.

[18] Where waste is subject to intermediate waste treatment, the waste type may change. For example, an intermediary waste sorting facility may take mixed household waste and produce specific waste types as outputs, such as paper, plastic or sorting residues. For this reason, the quantity of waste types generated may differ from the quantity of waste managed for those waste types. For further info, see the SEPA waste data quality report.

[19] Tonnages of 'Household and similar wastes' incinerated and landfilled have been extracted out into their material specific categories where possible using compositional analysis, so their tonnage and carbon impacts can be assessed separately. Planned future updates for the Carbon Metric will also enable us to disaggregate tonnages of 'Household and similar wastes' generated.

Rubber wastes	1,000	900	0	0	0
Sludges and liquid wastes from waste treatment	0	0	0	0	0
Soils	13,700	21,300	0	0	0
Sorting residues	0	0	0	0	0
Spent solvents	0	0	0	0	0
Textile wastes	89,600	10,900	7,100	62,200	2,600
Used oils	600	600	0	0	0
Vegetal wastes	391,200	311,200	7,100	63,300	14,900
Waste containing PCB	0	0	0	0	0
Wood wastes	109,800	94,000	6,600	27,400	1,100
Total	**2,460,800**	**1,120,500**	**160,500**	**1,107,100**	**72,300**

Material type	Non-Household (tonnes)[20]			
	Generated[21]	Recycled/ Composted	Incinerated	Landfilled
Acid, alkaline or saline wastes	5,100	0	0	0
Animal and mixed food waste	336,100	230,300	300	22,200
Animal faeces, urine and manure	78,600	5,600	71,800	100
Batteries & accumulators wastes	12,000	8,900	0	0
Chemical wastes	184,600	0	900	2,600
Combustion wastes	21,300	1,600	0	0
Common sludges	173,500	222,000	29,300	2,800
Discarded equipment	25,000	0	100	1,700
Discarded vehicles	79,300	32,300	0	0
Dredging spoils	5,400	4,600	0	100
Glass wastes	157,400	124,700	0	24,500
Health care & biological wastes	32,400	0	1,600	8,000
Household and similar wastes	106,300	500	0	26,100
Industrial effluent sludges	57,100	1,600	10,000	17,300
Metallic wastes, ferrous	276,200	575,200	0	6,600
Metallic wastes, mixed	214,800	86,400	0	0

[20] In 2017, the total amount of Scottish waste recorded as recycled, recovered, disposed, or managed by other management was 11.76 million tonnes which was 0.06 million tonnes (0.5%) less than the amount of waste generated (11.82 million tonnes). SEPA produced a more robust methodology for estimating C&I data generated (introduced with the 2011 publication) and for C&D waste aggregates recycled (introduced with 2014 publication and applied to historical data). With these new methodologies the difference between waste generated and waste managed is less variable, ranging from 12.0% more waste generated than managed in 2011 to 2.5% less in 2016. For further information, please refer to the quality report on SEPA's website.

[21] The estimates for non-household waste are obtained by subtracting estimates of household waste, obtained from waste tonnages submitted by 32 Scottish local authorities using the web-based reporting tool WasteDataFlow, from estimates of waste from all sources compiled by Data taken from licenced and permitted waste site returns and exempt activity returns submitted to SEPA.

Metallic wastes, non-ferrous	42,800	65,500	0	1,900
Mineral waste from C&D	1,254,100	917,600	0	97,600
Mineral wastes from waste treatment & stabilised wastes	12,100	71,600	0	278,900
Mixed & undifferentiated materials	188,100	5,600	0	16,800
Other mineral wastes	144,300	37,100	800	54,700
Paper and cardboard wastes	345,500	99,700	300	75,900
Plastic wastes	202,600	8,800	0	40,400
Rubber wastes	29,700	0	8,400	400
Sludges and liquid wastes from waste treatment	0	29,800	0	700
Soils	4,116,300	3,000,800	0	1,255,200
Sorting residues	6,400	11,000	392,400	811,500
Spent solvents	52,900	0	1,700	0
Textile wastes	16,500	100	0	5,700
Used oils	44,900	0	0	0
Vegetal wastes	624,500	394,900	0	1,800
Waste containing PCB	200	100	0	0
Wood wastes	146,500	19,800	265,400	300
Total	**8,992,500**	**5,956,100**	**783,000**	**2,753,800**

Annex 1b: Tonnages of household and non-household waste for 2018[22].

Material type [23]	Household (tonnes)				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes	0	0	0	0	0
Animal and mixed food waste	437,000	92,100	43,500	249,500	10,400
Animal faeces, urine and manure	0	0	0	0	0
Batteries & accumulators wastes	500	500	0	0	0
Chemical wastes	900	900	100	0	0
Combustion wastes	0	0	100	43,900	18,900
Common sludges	0	0	0	0	0
Discarded equipment	60,500	31,000	3,500	20,500	800
Discarded vehicles	400	400	0	0	0
Dredging spoils	0	0	0	0	0
Glass wastes	152,500	107,600	10,500	60,100	2,400
Health care & biological wastes	124,400	300	15,800	89,700	3,700
Household and similar wastes[24]	86,900	200	11,000	62,600	2,600
Industrial effluent sludges	0	0	0	0	0
Metallic wastes, ferrous	0	11,400	0	0	0
Metallic wastes, mixed	83,600	45,900	6,800	39,000	2,800
Metallic wastes, non-ferrous	0	6,000	0	0	0
Mineral waste from C&D	116,300	87,100	5,500	31,200	1,300
Mineral wastes from waste treatment & stabilised wastes	0	0	0	0	0
Mixed & undifferentiated materials	298,600	4,500	44,000	8,000	0
Other mineral wastes	0	0	0	0	0
Paper and cardboard wastes	263,100	209,600	24,400	144,200	5,700
Plastic wastes	204,300	57,100	25,500	145,300	5,900
Rubber wastes	800	800	0	0	0
Sludges and liquid wastes from waste treatment	0	0	0	0	0
Soils	12,600	25,900	0	0	0

[22] Waste data for years 2011 to 2016 are available on the SEPA Waste Portal. Please note that specific materials in the 'Household and similar wastes' category have been assigned to their original waste categories.

[23] Where waste is subject to intermediate waste treatment, the waste type may change. For example, an intermediary waste sorting facility may take mixed household waste and produce specific waste types as outputs, such as paper, plastic or sorting residues. For this reason, the quantity of waste types generated may differ from the quantity of waste managed for those waste types. For further info, see the SEPA waste data quality report.

[24] Tonnages of 'Household and similar wastes' incinerated and landfilled have been extracted out into their material specific categories where possible using compositional analysis, so their tonnage and carbon impacts can be assessed separately. Planned future updates for the Carbon Metric will also enable us to disaggregate tonnages of 'Household and similar wastes' generated.

Sorting residues	0	0	0	0	0
Spent solvents	0	0	0	0	0
Textile wastes	87,700	10,200	9,900	56,600	2,300
Used oils	700	700	0	0	0
Vegetal wastes	368,600	287,500	9,600	55,800	19,400
Waste containing PCB	0	0	0	0	0
Wood wastes	105,800	95,000	10,400	25,100	1,400
Total	**2,405,200**	**1,074,700**	**220,600**	**1,031,500**	**77,600**

Material type	Non-Household (tonnes)			
	Generated[25]	Recycled/ Composted	Incinerated	Landfilled
Acid, alkaline or saline wastes	4,700	0	0	0
Animal and mixed food waste	133,600	260,200	0	0
Animal faeces, urine and manure	103,400	29,800	71,600	0
Batteries & accumulators wastes	11,900	9,400	0	0
Chemical wastes	115,200	0	1,900	2,100
Combustion wastes	10,600	1,300	0	0
Common sludges	197,200	215,200	26,800	3,200
Discarded equipment	17,900	12,200	0	0
Discarded vehicles	82,400	48,200	0	0
Dredging spoils	94,900	83,800	0	2,300
Glass wastes	40,900	131,100	0	0
Health care & biological wastes	0	0	0	0
Household and similar wastes	87,100	500	10,700	118,700
Industrial effluent sludges	59,000	200	14,700	18,700
Metallic wastes, ferrous	304,000	612,400	5,600	46,200
Metallic wastes, mixed	131,100	92,200	0	0
Metallic wastes, non-ferrous	62,900	76,700	1,600	13,200
Mineral waste from C&D	1,160,400	930,300	0	5,600
Mineral wastes from waste treatment & stabilised wastes	0	16,800	0	231,300

[25] The estimates for non-household waste are obtained by subtracting estimates of household waste, obtained from waste tonnages submitted by 32 Scottish local authorities using the web-based reporting tool WasteDataFlow, from estimates of waste from all sources compiled by Data taken from licenced and permitted waste site returns and exempt activity returns submitted to SEPA.

Mixed & undifferentiated materials	165,200	0	0	38,400
Other mineral wastes	155,400	51,600	700	38,400
Paper and cardboard wastes	761,300	102,900	38,700	383,400
Plastic wastes	305,400	19,300	6,100	119,300
Rubber wastes	34,600	0	18,100	1,300
Sludges and liquid wastes from waste treatment	0	34,200	0	3,700
Soils	4,278,800	2,878,100	0	1,414,000
Sorting residues	2,300	0	236,600	722,000
Spent solvents	47,500	0	700	0
Textile wastes	0	0	0	0
Used oils	46,600	0	700	100
Vegetal wastes	545,800	384,600	0	0
Waste containing PCB	200	100	0	0
Wood wastes	85,100	18,000	231,700	0
Total	**9,045,400**	**6,009,100**	**666,200**	**3,161,900**

Annex 2a: 2017 Carbon factors for waste[26].

Material type	Household (kg CO_2 eq. per tonne of material)[27]				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes					
Animal and mixed food waste	3,744	-20	-7	1,003	19
Animal faeces, urine and manure					
Batteries & accumulators wastes	12,107	-579			
Chemical wastes	1,321	4,039	396		
Combustion wastes				8	-4
Common sludges					
Discarded equipment	1,754	-181	55	4	
Discarded vehicles	6,850	-1,622	328		
Dredging spoils					
Glass wastes	1,210	-755	62	4	
Health care & biological wastes			136	420	
Household and similar wastes	3,202	-667	396	453	19
Industrial effluent sludges					
Metallic wastes, ferrous	2,922	-1,771			
Metallic wastes, mixed	3,893	-2,540	55	4	-2,485
Metallic wastes, non-ferrous	12,946	-9,963			
Mineral waste from C&D	21	2	55	3	
Mineral wastes from waste treatment & stabilised wastes					
Mixed & undifferentiated materials	1,895	-1,212	-120	107	
Other mineral wastes					
Paper and cardboard wastes	882	-547	-151	504	
Plastic wastes	3,185	-537	1,739	4	
Rubber wastes	3,100	-514	1,621		
Sludges and liquid wastes from waste treatment					
Soils		1		1	
Sorting residues					
Spent solvents					
Textile wastes	20,444	-5,828	216	599	
Used oils	1,401	-725			
Vegetal wastes		-52	-31	214	19

[26] Historic carbon factors used in previous publications are available on the Zero Waste Scotland website.
[27] Grey cell: Not an applicable waste management route for this waste stream; red cell: No data available to create a carbon factor.

Waste containing PCB					
Wood wastes	516	-288	-228	925	

Material type	Non-Household (kg CO_2 eq. per tonne of material)				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes	1,364				
Animal and mixed food waste	5,736	-20	-7	1,003	19
Animal faeces, urine and manure	0	147	-90	142	19
Batteries & accumulators wastes	12,107	-1,419	402	91	
Chemical wastes	1,321	4,039	396	7	
Combustion wastes		-4		8	
Common sludges	0	326	236	117	
Discarded equipment	1,754	-181	55	4	
Discarded vehicles	6,850	-1,622	328		
Dredging spoils					
Glass wastes	1,210	-755	62	4	
Health care & biological wastes			136	420	
Household and similar wastes	3,134	-606	396	311	19
Industrial effluent sludges		159	396	328	
Metallic wastes, ferrous	2,922	-1,771	15	4	
Metallic wastes, mixed	3,485	-2,201	55	4	
Metallic wastes, non-ferrous	12,946	-9,963	55	4	
Mineral waste from C&D	80	-76	55	2	
Mineral wastes from waste treatment & stabilised wastes		14	49	15	
Mixed & undifferentiated materials	1,895	-1,212	-120	107	19
Other mineral wastes	44	31	636	12	
Paper and cardboard wastes	882	-547	-151	504	19
Plastic wastes	3,185	-997	1,739	4	
Rubber wastes	3,100	-514	1,621	4	
Sludges and liquid wastes from waste treatment			368	9	19
Soils	0	1		1	
Sorting residues	3,524	-928	432	345	19
Spent solvents	1,604	-1,286	1,521	6,284	
Textile wastes	20,444	-5,828	216	599	
Used oils	1,401	-725	-1,195		

Vegetal wastes		-50	-31	214	19
Waste containing PCB					
Wood wastes	591	-337	-228	925	19

Annex 2b: 2018 Carbon factors for waste[28].

Material type	Household (kg CO_2 eq. per tonne of material)[29]				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes					
Animal and mixed food waste	3744	-18	-4	1011	20
Animal faeces, urine and manure					
Batteries & accumulators wastes	12107	-579			
Chemical wastes	1321	4039	391		
Combustion wastes				8	-4
Common sludges					
Discarded equipment	1754	-181	50	4	
Discarded vehicles	6850	-1622	328		
Dredging spoils					
Glass wastes	1210	-755	57	4	
Health care & biological wastes			164	420	
Household and similar wastes	3208	-655	391	462	20
Industrial effluent sludges					
Metallic wastes, ferrous	2922	-1771			
Metallic wastes, mixed	3893	-2540	50	4	-2490
Metallic wastes, non-ferrous	12946	-9963			
Mineral waste from C&D	21	2	50	3	
Mineral wastes from waste treatment & stabilised wastes					
Mixed & undifferentiated materials	1895	-1212	-60	107	
Other mineral wastes					
Paper and cardboard wastes	882	-547	-130	508	
Plastic wastes	3185	-537	1794	4	
Rubber wastes	3100	-514	1691		
Sludges and liquid wastes from waste treatment					
Soils		1		1	
Sorting residues					
Spent solvents					
Textile wastes	20444	-5828	216	599	
Used oils	1401	-725			
Vegetal wastes		-51	-25	214	20
Waste containing PCB					

[28] Historic carbon factors used in previous publications are available on the Zero Waste Scotland website.
[29] Grey cell: Not an applicable waste management route for this waste stream; red cell: No data available to create a carbon factor.

Wood wastes	516	-288	-197	925	

Material type	Non-Household (kg CO_2 eq. per tonne of material)				
	Generated	Recycled/ Composted	Incinerated	Landfilled	Other diversion
Acid, alkaline or saline wastes	1364				
Animal and mixed food waste	5736	-18	-4	1011	20
Animal faeces, urine and manure	0	145	-76	142	20
Batteries & accumulators wastes	12107	-1430	402	91	
Chemical wastes	1321	4039	391	7	
Combustion wastes		-4		8	
Common sludges	0	326	236	117	
Discarded equipment	1754	-181	50	4	
Discarded vehicles	6850	-1622	328		
Dredging spoils					
Glass wastes	1210	-755	57	4	
Health care & biological wastes			164	420	
Household and similar wastes	3135	-601	391	314	20
Industrial effluent sludges		159	391	328	
Metallic wastes, ferrous	2922	-1771	15	4	
Metallic wastes, mixed	3485	-2201	50	4	
Metallic wastes, non-ferrous	12946	-9963	50	4	
Mineral waste from C&D	80	-76	50	2	
Mineral wastes from waste treatment & stabilised wastes		14	49	15	
Mixed & undifferentiated materials	1895	-1212	-60	107	20
Other mineral wastes	44	31	673	12	
Paper and cardboard wastes	882	-547	-130	508	20
Plastic wastes	3185	-997	1794	4	
Rubber wastes	3100	-514	1691	4	
Sludges and liquid wastes from waste treatment			366	9	20
Soils	0	1		1	
Sorting residues	3526	-925	446	349	20
Spent solvents	1604	-1286	1521	6284	
Textile wastes	20444	-5828	216	599	
Used oils	1401	-725	-1195		
Vegetal wastes		-50	-25	214	20

Waste containing PCB					
Wood wastes	591	-337	-197	925	20

Annex 3a: Carbon impacts of waste in Scotland in 2017.

The table below shows the carbon impact of waste for each material in the Carbon Metric. Red cells indicate materials where there are tonnages of waste produced but no carbon factors exist. Grey cells indicate material streams and management options which are not applicable to that sector.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,630,300	-2,000	-200	261,900	200
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	6,100	-300	-	-	-
Chemical wastes	1,500	4,500	-	-	-
Combustion wastes	-	-	-	300	-100
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	113,000	-6,100	100	100	-
Discarded vehicles	2,800	-700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	189,900	-79,200	500	300	-
Health care and biological wastes	-	-	1,500	41,500	-
Household and similar wastes	281,300	-200	3,100	31,000	100
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	1,600	-17,900	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	333,700	-128,100	300	200	-7,000
Metallic wastes, non-ferrous	1,600	-46,700	-	-	-
Mineral waste from construction and demolition	2,500	200	200	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	574,300	-1,800	-4,100	1,600	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	228,400	-123,600	-2,600	77,700	-
Plastic wastes	669,500	-28,200	31,500	700	-
Rubber wastes	2,900	-500	-	-	-

Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-
Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	1,832,500	-63,700	1,500	37,200	-
Used oils	900	-500	-	-	-
Vegetal wastes	-	-16,200	-200	13,500	300
Waste containing PCB	-	-	-	-	-
Wood wastes	56,700	-27,100	-1,500	25,400	-
Total	**5,929,500**	**-538,100**	**30,100**	**491,500**	**-6,500**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	7,000	-	-	-	-
Animal and mixed food waste	1,928,200	-4,500	-	22,300	-
Animal faeces, urine and manure	-	800	-6,400	-	-
Batteries and accumulators wastes	145,000	-12,600	-	-	-
Chemical wastes	243,900	-	300	-	-
Combustion wastes	-	-	-	-	-
Common sludges	-	72,400	6,900	300	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	43,900	-	-	-	-
Discarded vehicles	543,500	-52,300	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	190,500	-94,200	-	100	-
Health care and biological wastes	-	-	200	3,400	-
Household and similar wastes	333,300	-300	-	8,100	-
Industrial effluent sludges	-	300	3,900	5,700	-
Metallic wastes, ferrous	807,300	-1,018,800	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	748,700	-190,200	-	-	-
Metallic wastes, non-ferrous	553,600	-652,800	-	-	-
Mineral waste from construction and demolition	100,200	-70,200	-	200	-

Mineral wastes from waste treatment and stabilised wastes	-	1,000	-	4,200	-
Mixed and undifferentiated materials	356,600	-6,800	-	1,800	-
Other mineral wastes	6,300	1,200	500	700	-
Paper and cardboard wastes	304,700	-54,500	-	38,200	-
Plastic wastes	645,300	-8,800	-	200	-
Rubber wastes	92,000	-	13,600	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	3,100	-	1,600	-
Sorting residues	22,400	-10,200	169,600	280,000	-
Spent solvents	84,800	-	2,600	-	-
Textile wastes	337,800	-300	-	3,400	-
Used oils	62,800	-	-	-	-
Vegetal wastes	-	-19,600	-	400	-
Waste containing PCB	-	-	-	-	-
Wood wastes	86,500	-6,700	-60,600	300	-
Total	**7,644,300**	**-2,124,000**	**130,600**	**370,900**	**0**

Annex 3b: Carbon impacts of waste in Scotland in 2018.

The table below shows the carbon impact of waste for each material in the Carbon Metric. Red cells indicate materials where there are tonnages of waste produced but no carbon factors exist. Grey cells indicate material streams and management options which are not applicable to that sector.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	0	0	0	0	0
Animal and mixed food waste	1,636,100	-1,700	-100	246,600	200
Animal faeces, urine and manure	0	0	0	0	0
Batteries and accumulators wastes	6,300	-300	0	0	0
Chemical wastes	1,100	3,500	0	0	0
Combustion wastes	0	0	0	400	-100
Common sludges	0	0	0	0	0
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	106,200	-5,600	200	100	0
Discarded vehicles	2,500	-600	0	0	0
Dredging spoils	0	0	0	0	0
Glass wastes	184,600	-81,200	600	300	0
Health care and biological wastes	0	0	2,800	37,700	0
Household and similar wastes	278,700	-100	4,300	28,300	100
Industrial effluent sludges	0	0	0	0	0
Metallic wastes, ferrous	100	-20,100	0	0	0
Metallic wastes, mixed ferrous and non-ferrous	325,400	-116,700	300	200	-7,000
Metallic wastes, non-ferrous	600	-59,900	0	0	0
Mineral waste from construction and demolition	2,400	200	300	100	0
Mineral wastes from waste treatment and stabilised wastes	0	0	0	0	0
Mixed and undifferentiated materials	566,000	-5,400	-1,200	900	0
Other mineral wastes	0	0	0	0	0
Paper and cardboard wastes	232,000	-114,600	-2,900	72,000	0
Plastic wastes	650,600	-30,700	46,500	600	0
Rubber wastes	2,600	-400	0	0	0
Sludges and liquid wastes from waste treatment	0	0	0	0	0

Soils	0	0	0	0	0
Sorting residues	0	0	0	0	0
Spent solvents	0	0	0	0	0
Textile wastes	1,793,700	-59,500	2,100	32,300	0
Used oils	900	-500	0	0	0
Vegetal wastes	0	-14,600	-200	11,900	400
Waste containing PCB	0	0	0	0	0
Wood wastes	54,600	-27,300	-1,900	21,600	0
Total	**5,844,400**	**-535,500**	**50,800**	**453,000**	**-6,400**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	6,400	0	0	0	0
Animal and mixed food waste	766,500	-4,700	0	0	0
Animal faeces, urine and manure	0	4,300	-4,900	0	0
Batteries and accumulators wastes	144,400	-13,400	0	0	0
Chemical wastes	152,200	0	700	0	0
Combustion wastes	0	0	0	0	0
Common sludges	0	70,200	6,300	400	0
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	31,500	-2,200	0	0	0
Discarded vehicles	564,200	-78,300	0	0	0
Dredging spoils	0	0	0	0	0
Glass wastes	49,500	-99,000	0	0	0
Health care and biological wastes	0	0	0	0	0
Household and similar wastes	273,100	-300	4,200	36,700	0
Industrial effluent sludges	0	0	5,700	6,100	0
Metallic wastes, ferrous	888,400	-1,084,700	100	200	0
Metallic wastes, mixed ferrous and non-ferrous	457,000	-203,000	0	0	0
Metallic wastes, non-ferrous	813,900	-764,300	100	100	0
Mineral waste from construction and demolition	92,700	-71,100	0	0	0

Mineral wastes from waste treatment and stabilised wastes	0	200	0	3,500	0
Mixed and undifferentiated materials	313,100	0	0	4,100	0
Other mineral wastes	6,800	1,600	500	500	0
Paper and cardboard wastes	671,300	-56,200	-4,600	191,400	0
Plastic wastes	972,600	-19,300	11,100	500	0
Rubber wastes	107,100	0	31,200	0	0
Sludges and liquid wastes from waste treatment	0	0	0	0	0
Soils	0	2,900	0	1,800	0
Sorting residues	8,100	0	107,400	246,100	0
Spent solvents	76,100	0	1,100	0	0
Textile wastes	0	0	0	0	0
Used oils	65,200	0	-900	0	0
Vegetal wastes	0	-19,100	0	0	0
Waste containing PCB	0	0	0	0	0
Wood wastes	50,300	-6,000	-41,800	0	0
Total	**6,510,400**	**-2,342,400**	**116,200**	**491,400**	**0**

Annex 4: Revised 2011 – 2016 carbon assessments of waste in Scotland.

In accordance with standard accounting methodology, as data is updated, historic data is revised to account for more accurate information. This allows fair comparison between the current year and past years. This means the historical tonnage data in the Carbon Metric is revised annually and the latest carbon factors applied to it before any trend analysis between years is conducted. This annex shows the carbon impact of Scottish waste for 2011-2016 using the most up to date tonnage data from SEPA and the latest carbon factors.

Table A4.1 Carbon impacts of Scottish waste by sector and material type, 2011.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,602,700	-400	-200	301,800	100
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	4,800	-300	-	-	-
Chemical wastes	300	1,000	-	-	-
Combustion wastes	-	-	-	100	-
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	130,900	-6,600	100	100	-
Discarded vehicles	2,700	-600	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	255,900	-72,000	300	500	-
Health care and biological wastes	-	-	500	60,200	-
Household and similar wastes	379,300	-300	1,900	45,900	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	4,300	-10,800	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	395,500	-90,800	200	300	-8,900
Metallic wastes, non-ferrous	7,000	-19,400	-	-	-
Mineral waste from construction and demolition	3,400	200	200	100	-

Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	21,200	-18,500	-	-	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	345,100	-132,000	-2,100	109,300	-
Plastic wastes	941,600	-16,600	18,100	1,100	-
Rubber wastes	3,800	-700	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-
Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	2,510,500	-87,500	900	53,600	-
Used oils	800	-400	-	-	-
Vegetal wastes	-	-17,600	-200	17,600	-
Waste containing PCB	-	-	-	-	-
Wood wastes	58,900	-26,300	-600	35,800	-
Total	**6,668,700**	**-499,600**	**19,100**	**626,400**	**-8,800**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	8,400	-	-	-	-
Animal and mixed food waste	3,038,600	-1,400	-100	90,700	-
Animal faeces, urine and manure	-	-	-14,400	-	-
Batteries and accumulators wastes	127,800	-9,000	-	-	-
Chemical wastes	269,800	203,800	10,500	-	-
Combustion wastes	-	-	-	4,200	-
Common sludges	-	42,600	8,800	3,300	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	62,000	-100	-	-	-
Discarded vehicles	396,200	-2,800	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	84,500	-140,200	-	-	-
Health care and biological wastes	-	-	200	2,300	-

Household and similar wastes	469,400	-3,600	800	9,900	-
Industrial effluent sludges	-	200	1,500	5,100	-
Metallic wastes, ferrous	806,100	-936,800	-	100	-
Metallic wastes, mixed ferrous and non-ferrous	819,700	-83,500	-	-	-
Metallic wastes, non-ferrous	753,600	-457,600	-	-	-
Mineral waste from construction and demolition	113,600	-68,600	-	400	-
Mineral wastes from waste treatment and stabilised wastes	-	400	-	2,700	-
Mixed and undifferentiated materials	303,200	-41,500	-900	8,100	-
Other mineral wastes	6,800	1,900	-	600	-
Paper and cardboard wastes	455,000	-56,700	-1,100	45,900	-
Plastic wastes	801,900	-46,200	4,400	400	-
Rubber wastes	77,300	-	22,300	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	2,500	-	1,700	-
Sorting residues	2,200	-17,900	14,000	232,500	-
Spent solvents	92,900	-	300	-	-
Textile wastes	707,300	-3,800	1,500	5,800	-
Used oils	93,900	-	-	-	-
Vegetal wastes	-	-9,100	-	2,200	-
Waste containing PCB	-	-	-	-	-
Wood wastes	67,700	-	-	-	-
Total	**9,557,900**	**-1,627,400**	**47,800**	**415,900**	**0**

Table A4.2 Carbon impacts of Scottish waste by sector and material type, 2012.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,596,100	-600	-200	322,600	100
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	4,900	-200	-	-	-
Chemical wastes	400	1,200	-	-	-
Combustion wastes	-	-	-	100	-
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	118,700	-6,100	100	100	-
Discarded vehicles	2,400	-600	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	230,900	-73,300	200	400	-
Health care and biological wastes	-	-	300	54,900	-
Household and similar wastes	337,200	-300	1,300	42,900	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	4,500	-10,800	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	359,900	-100,400	100	300	-3,700
Metallic wastes, non-ferrous	6,300	-25,800	-	-	-
Mineral waste from construction and demolition	3,100	200	100	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	202,800	-8,700	-100	-	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	303,500	-127,200	-1,500	100,000	-
Plastic wastes	819,400	-19,300	12,500	1,000	-
Rubber wastes	3,800	-600	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-

Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	2,226,600	-86,500	700	49,200	-
Used oils	700	-400	-	-	-
Vegetal wastes	-	-16,900	-100	16,400	-
Waste containing PCB	-	-	-	-	-
Wood wastes	58,000	-27,600	-400	33,300	-
Total	**6,279,200**	**-503,900**	**13,000**	**621,300**	**-3,600**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	8,000	-	-	-	-
Animal and mixed food waste	2,701,000	-2,700	-	40,200	-
Animal faeces, urine and manure	-	1,900	-14,800	-	-
Batteries and accumulators wastes	77,100	-6,200	-	-	-
Chemical wastes	145,300	-	1,000	-	-
Combustion wastes	-	-	-	3,800	-
Common sludges	-	131,500	7,900	3,300	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	33,400	-	-	-	-
Discarded vehicles	377,100	-14,900	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	124,500	-121,000	-	-	-
Health care and biological wastes	-	-	100	2,500	-
Household and similar wastes	320,800	-1,900	300	3,100	-
Industrial effluent sludges	-	500	3,800	4,500	-
Metallic wastes, ferrous	622,100	-816,300	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	735,100	-140,900	-	-	-
Metallic wastes, non-ferrous	606,400	-507,200	-	-	-
Mineral waste from construction and demolition	87,100	-56,500	-	200	-

Mineral wastes from waste treatment and stabilised wastes	-	1,300	-	3,300	-
Mixed and undifferentiated materials	228,800	-16,000	-	5,100	-
Other mineral wastes	9,200	3,600	-	700	-
Paper and cardboard wastes	321,500	-74,000	-400	14,500	-
Plastic wastes	599,400	-4,700	1,700	100	-
Rubber wastes	67,300	-	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	100	-
Soils	-	1,500	-	1,700	-
Sorting residues	12,800	-6,600	26,900	301,800	-
Spent solvents	87,700	-	2,600	-	-
Textile wastes	548,600	-2,000	2,100	1,600	-
Used oils	143,000	-	-	-	-
Vegetal wastes	-	-13,100	-	1,100	-
Waste containing PCB	-	-	-	-	-
Wood wastes	105,700	-66,500	-38,800	3,000	-
Total	**7,961,900**	**-1,710,200**	**-7,600**	**390,600**	**0**

Table A4.3 Carbon impacts of Scottish waste by sector and material type, 2013.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,592,300	-1,000	-200	327,400	100
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	4,400	-200	-	-	-
Chemical wastes	600	1,700	-	-	-
Combustion wastes	-	-	-	100	-100
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	106,400	-5,700	100	100	-
Discarded vehicles	2,200	-500	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	210,000	-75,700	300	400	-
Health care and biological wastes	-	-	400	48,700	-
Household and similar wastes	297,000	-200	1,600	39,100	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	4,100	-11,900	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	322,700	-98,300	200	200	-4,100
Metallic wastes, non-ferrous	7,400	-30,500	-	-	-
Mineral waste from construction and demolition	2,700	200	100	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	402,800	-3,000	-1,100	1,600	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	263,700	-125,000	-1,700	89,200	-
Plastic wastes	703,700	-21,200	15,000	900	-
Rubber wastes	2,700	-500	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-

Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	1,976,900	-89,200	800	43,900	-
Used oils	800	-400	-	-	-
Vegetal wastes	-	-16,000	-200	14,800	-
Waste containing PCB	-	-	-	-	-
Wood wastes	58,900	-29,000	-700	30,200	-
Total	**5,959,300**	**-506,400**	**14,600**	**596,700**	**-4,100**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	10,900	-	-	-	-
Animal and mixed food waste	2,335,600	-2,900	-	35,800	-
Animal faeces, urine and manure	-	2,300	-14,600	-	-
Batteries and accumulators wastes	111,900	-6,000	-	-	-
Chemical wastes	181,300	13,500	1,100	-	-
Combustion wastes	-	-	-	2,600	-
Common sludges	-	121,900	8,500	3,200	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	37,900	-	-	-	-
Discarded vehicles	417,200	-2,100	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	109,700	-130,900	-	-	-
Health care and biological wastes	-	-	100	2,300	-
Household and similar wastes	286,200	-1,400	-	3,000	-
Industrial effluent sludges	-	200	3,200	5,100	-
Metallic wastes, ferrous	769,400	-905,000	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	708,000	-156,300	-	-	-
Metallic wastes, non-ferrous	541,000	-572,100	-	-	-
Mineral waste from construction and demolition	78,900	-53,300	-	100	-
Mineral wastes from waste treatment and stabilised wastes	-	800	-	2,300	-

Mixed and undifferentiated materials	290,900	-31,900	-	2,700	-
Other mineral wastes	9,300	3,600	-	900	-
Paper and cardboard wastes	285,700	-68,000	-	14,300	-
Plastic wastes	533,000	-3,400	-	100	-
Rubber wastes	80,400	-	22,100	-	-
Sludges and liquid wastes from waste treatment	-	-	100	100	-
Soils	-	2,700	-	1,700	-
Sorting residues	22,200	-12,800	24,700	276,800	-
Spent solvents	89,900	-	1,200	-	-
Textile wastes	573,800	-1,500	2,500	1,600	-
Used oils	112,800	-	-	-	-
Vegetal wastes	-	-15,200	-	1,300	-
Waste containing PCB	-	-	-	-	-
Wood wastes	127,200	-	-	-	-
Total	**7,713,200**	**-1,817,800**	**48,900**	**353,900**	**0**

Table A4.4 Carbon impacts of Scottish waste by sector and material type, 2014.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,603,000	-1,300	-500	290,100	300
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	4,900	-200	-	-	-
Chemical wastes	500	1,400	-	-	-
Combustion wastes	-	-	-	200	-100
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	107,100	-5,800	200	100	-
Discarded vehicles	2,800	-700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	206,900	-76,200	500	400	-
Health care and biological wastes	-	-	500	45,700	-
Household and similar wastes	296,300	-300	3,000	34,300	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	3,800	-14,800	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	325,600	-101,000	300	200	-6,500
Metallic wastes, non-ferrous	5,600	-35,200	-	-	-
Mineral waste from construction and demolition	2,800	200	300	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	424,200	-11,000	-1,300	2,000	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	271,500	-124,300	-3,500	82,900	-
Plastic wastes	709,500	-22,000	26,300	800	-
Rubber wastes	2,600	-400	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-

Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	1,931,400	-81,300	1,400	41,100	-
Used oils	800	-400	-	-	-
Vegetal wastes	-	-16,800	-300	14,200	200
Waste containing PCB	-	-	-	-	-
Wood wastes	57,400	-27,800	-1,100	28,200	-
Total	**5,956,700**	**-517,900**	**25,800**	**540,300**	**-6,100**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	16,600	-	-	-	-
Animal and mixed food waste	2,640,700	-2,900	-	70,800	-
Animal faeces, urine and manure	-	1,500	-15,700	-	-
Batteries and accumulators wastes	69,000	-6,900	-	-	-
Chemical wastes	155,600	-	900	-	-
Combustion wastes	-	-	-	2,900	-
Common sludges	-	77,500	5,300	2,500	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	35,500	-	-	-	-
Discarded vehicles	480,300	-2,500	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	85,800	-159,900	-	-	-
Health care and biological wastes	-	-	100	1,500	-
Household and similar wastes	192,900	-100	-	4,100	-
Industrial effluent sludges	-	200	2,800	4,100	-
Metallic wastes, ferrous	781,100	-981,600	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	605,500	-144,300	-	-	-
Metallic wastes, non-ferrous	352,900	-564,400	-	-	-
Mineral waste from construction and demolition	88,300	-46,500	100	400	-

Mineral wastes from waste treatment and stabilised wastes	-	800	-	2,500	-
Mixed and undifferentiated materials	195,000	-12,100	-	2,400	-
Other mineral wastes	5,900	1,200	-	600	-
Paper and cardboard wastes	201,600	-49,700	-	19,600	-
Plastic wastes	405,000	-200	-	100	-
Rubber wastes	87,500	-	22,600	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	2,000	-	1,600	-
Sorting residues	1,100	-5,300	62,300	258,700	-
Spent solvents	92,200	-	1,400	-	-
Textile wastes	375,600	-100	600	4,900	-
Used oils	93,600	-	-100	-	-
Vegetal wastes	-	-13,000	-	1,800	-
Waste containing PCB	-	-	-	-	-
Wood wastes	147,100	-	-	-	-
Total	**7,108,800**	**-1,906,300**	**80,300**	**378,500**	**0**

Table A4.5 Carbon impacts of Scottish waste by sector and material type, 2015.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,613,400	-1,800	-500	268,600	200
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	7,200	-400	-	-	-
Chemical wastes	300	1,000	-	-	-
Combustion wastes	-	-	-	200	-
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	110,200	-5,800	200	100	-
Discarded vehicles	3,100	-700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	203,300	-77,400	600	300	-
Health care and biological wastes	-	-	800	43,300	-
Household and similar wastes	293,200	-400	3,500	32,500	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	2,800	-15,700	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	330,900	-115,100	400	200	-6,300
Metallic wastes, non-ferrous	9,300	-41,900	-	-	-
Mineral waste from construction and demolition	2,500	200	300	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	485,500	-21,300	-4,800	1,900	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	250,200	-122,200	-4,000	79,100	-
Plastic wastes	702,700	-22,800	32,500	800	-
Rubber wastes	2,500	-400	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-

Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	1,924,100	-74,100	1,700	38,900	-
Used oils	800	-400	-	-	-
Vegetal wastes	-	-16,400	-400	13,700	300
Waste containing PCB	-	-	-	-	-
Wood wastes	55,000	-26,700	-2,400	26,600	-
Total	**5,997,000**	**-542,300**	**27,900**	**506,300**	**-5,800**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	7,600	-	-	-	-
Animal and mixed food waste	1,908,700	-3,100	-	22,800	-
Animal faeces, urine and manure	-	3,200	-12,100	-	-
Batteries and accumulators wastes	76,600	-9,200	-	-	-
Chemical wastes	142,200	-	900	-	-
Combustion wastes	-	-	-	2,600	-
Common sludges	-	107,200	6,700	1,100	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	83,100	-7,400	-	-	-
Discarded vehicles	321,500	-5,700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	118,200	-170,600	-	100	-
Health care and biological wastes	-	-	100	2,900	-
Household and similar wastes	281,400	-100	-	3,000	-
Industrial effluent sludges	-	2,100	5,300	3,100	-
Metallic wastes, ferrous	943,900	-966,100	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	602,500	-14,400	-	-	-
Metallic wastes, non-ferrous	503,900	-1,295,000	-	-	-
Mineral waste from construction and demolition	88,400	-59,100	-	100	-

Mineral wastes from waste treatment and stabilised wastes	-	1,100	-	3,400	-
Mixed and undifferentiated materials	365,500	-	-	3,900	-
Other mineral wastes	6,700	2,500	-	600	-
Paper and cardboard wastes	266,600	-17,800	-	14,000	-
Plastic wastes	536,000	-200	-	100	-
Rubber wastes	79,600	-	12,400	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	2,600	-	1,700	-
Sorting residues	2,000	-5,800	56,300	310,100	-
Spent solvents	97,400	-	1,000	-	-
Textile wastes	576,400	-100	2,100	5,600	-
Used oils	68,100	-	-	-	-
Vegetal wastes	-	-21,000	-200	300	-
Waste containing PCB	-	-	-	-	-
Wood wastes	124,600	-13,900	-70,100	800	-
Total	**7,200,900**	**-2,470,800**	**2,400**	**376,200**	**0**

Table A4.6 Carbon impacts of Scottish waste by sector and material type, 2016.

Material type	Household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	-	-	-	-	-
Animal and mixed food waste	1,625,500	-2,000	-400	260,800	200
Animal faeces, urine and manure	-	-	-	-	-
Batteries and accumulators wastes	8,000	-400	-	-	-
Chemical wastes	700	2,100	-	-	-
Combustion wastes	-	-	-	300	-100
Common sludges	-	-	-	-	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	116,600	-6,200	200	100	-
Discarded vehicles	2,800	-700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	200,800	-80,900	600	300	-
Health care and biological wastes	-	-	1,300	42,800	-
Household and similar wastes	290,800	-400	3,700	32,100	-
Industrial effluent sludges	-	-	-	-	-
Metallic wastes, ferrous	800	-16,900	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	347,100	-130,400	400	200	-6,500
Metallic wastes, non-ferrous	1,500	-41,400	-	-	-
Mineral waste from construction and demolition	2,800	200	300	100	-
Mineral wastes from waste treatment and stabilised wastes	-	-	-	-	-
Mixed and undifferentiated materials	542,900	-1,900	-5,100	1,600	-
Other mineral wastes	-	-	-	-	-
Paper and cardboard wastes	237,100	-125,300	-3,700	79,000	-
Plastic wastes	694,000	-26,800	35,900	800	-
Rubber wastes	3,300	-500	-	-	-
Sludges and liquid wastes from waste treatment	-	-	-	-	-
Soils	-	-	-	-	-

Sorting residues	-	-	-	-	-
Spent solvents	-	-	-	-	-
Textile wastes	1,899,700	-69,200	1,800	38,400	-
Used oils	800	-400	-	-	-
Vegetal wastes	-	-16,300	-300	13,700	200
Waste containing PCB	-	-	-	-	-
Wood wastes	59,700	-28,300	-2,100	26,100	-
Total	**6,034,900**	**-545,700**	**32,600**	**496,300**	**-6,200**

Material type	Non-household sources (t CO_2 eq.)				
	Generated	Recycled	Incinerated	Landfilled	Other Diversion
Acid, alkaline or saline wastes	7,400	-	-	-	-
Animal and mixed food waste	1,917,400	-3,900	-	39,700	-
Animal faeces, urine and manure	-	700	-8,200	-	-
Batteries and accumulators wastes	123,000	-9,300	-	-	-
Chemical wastes	149,000	-	400	-	-
Combustion wastes	-	-	-	400	-
Common sludges	-	114,800	7,600	800	-
Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)	39,700	-	-	-	-
Discarded vehicles	364,300	-15,700	-	-	-
Dredging spoils	-	-	-	-	-
Glass wastes	115,400	-122,200	-	100	-
Health care and biological wastes	-	-	100	2,100	-
Household and similar wastes	267,800	-	-	7,300	-
Industrial effluent sludges	-	500	5,300	4,900	-
Metallic wastes, ferrous	772,900	-1,030,200	-	-	-
Metallic wastes, mixed ferrous and non-ferrous	460,700	-126,000	-	-	-
Metallic wastes, non-ferrous	515,500	-856,600	-	-	-
Mineral waste from construction and demolition	101,800	-61,100	-	200	-
Mineral wastes from waste treatment and stabilised wastes	-	2,000	-	3,900	-
Mixed and undifferentiated materials	334,500	-2,400	-	2,300	-
Other mineral wastes	5,200	1,000	-	600	-

Paper and cardboard wastes	252,400	-31,400	-	34,000	-
Plastic wastes	523,100	-	-	200	-
Rubber wastes	71,700	-	4,500	-	-
Sludges and liquid wastes from waste treatment	-	-	-	100	-
Soils	-	3,000	-	1,400	-
Sorting residues	22,400	-18,600	174,700	298,700	-
Spent solvents	81,700	-	900	-	-
Textile wastes	342,200	-	-	5,500	-
Used oils	53,000	-	-	-	-
Vegetal wastes	-	-19,800	-	1,100	-
Waste containing PCB	-	-	-	-	-
Wood wastes	77,900	-	-	-	-
Total	**6,599,000**	**-2,175,200**	**185,300**	**403,300**	**0**

Annex 5: References.

The tables below list all references used to estimate the Carbon Metric. Detailed calculations and assumptions are not published due to confidentiality reasons.

Tonnage data

Author	Year	Title	Publisher
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA
ZWS Waste Composition Analysis study[30]	2015	Internal ZWS calculations based on LA composition studies carried out in 2013 and 2015	Zero Waste Scotland

General assumptions data

Author	Year	Title	Publisher
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
McKinnon, A	2007	Synchronised Auditing of Truck Utilisation and Energy Efficiency: A Review of the British Government's Transport KPI Programme	British Government's Transport KPI Programme
IGD	2008	UK Food & Grocery Retail Logistics Overview Date	IGD
ERM	2008	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency
Intergovernmental Panel on Climate Change	2006	Guidelines for National Greenhouse Gas	IPCC

[30] 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 the future.

		Inventories. Emissions Factor Database	
WRAP	2006	Sustainable use of resources for the production of aggregates in England	WRAP
Aggregain	2010	CO_2 calculator, based on hot mixed asphalt	WRAP
Intergovernmental Panel on Climate Change	2014	5th Assessment Report, Working Group One	IPCC

Acids, alkaline or saline waste

Author	Year	Title	Publisher
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.1	Swiss Centre for Life Cycle Inventories

Animal and mixed food wastes

Author	Year	Title	Publisher
AEA Technology	2005	Food transport: The Validity of Food Miles as an Indicator of Sustainable Development	DEFRA
AIC	2009	Fertiliser Statistics 2009 Report	Agricultural Industries Confederation
Bingemer, H and Crutzen, P	1987	The Production of Methane from Solid Waste	Journal of Geophysical Research 92 (D2) 2182-2187
Cranfield University	Unpublished	Greenhouse Gas Impacts of Biowaste Management	DEFRA (Defra Research Project IS0205)
Davis, J. and Haglund, C.	1999	Life Cycle Inventory (LCI) of Fertiliser Production	Agricultural Industries Confederation
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
DEFRA and ONS	2012	Family food and expenditure survey	DEFRA
Environment Agency	2005	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency

Enviros Consulting	2006	Production of Guidelines for Using Compost in Crop Production - A Brief Literature Review	WRAP
Schmidt, J and Weidema, B	2008	Shift in the marginal supply of vegetable oil	International Journal of LCA, 13 LCA (3) 235-239
Kranert, M. & Gottschall, R. Entsorgergemeinschaft der Deutschen Entsorgungswirtschaft e.V.	2007	Grünabfälle – besser kompostieren oder energetisch verwerten? EdDE-Dokumentation Nr. 11	EdDE
Mitaftsi, O and Smith, S R	2006	Quantifying Household Waste Diversion from Landfill Disposal by Home Composting and Kerbside Collection	Imperial College, London
Prasad, M	2009	EPA STRIVE Programme 2007-2013 A Literature Review on the Availability of Nitrogen from Compost in Relation to the Nitrate Regulations SI 378 of 2006 Small Scale Study Report	Environmental Protection Agency, Ireland
Schmidt, J	2010	Comparative life cycle assessment of rapeseed oil and palm oil	International Journal of LCA, 15, 183197
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA
Tassou, S., Hadawey, A., Ge, Y. and Marriot, D.	2008	FO405 Greenhouse Gas Impacts of Food Retailing	DEFRA
US EPA	2005	Landfill Gas Emissions Model (LandGEM) V3.02	US EPA
Webb N, Broomfield M, Buys G, Cardenas L, Murrells T, Pang Y, Passant N, Thistlethwaite G, Watterson J	2014	UK Greenhouse Gas Inventory, 1990 to 2012: Annual Report for submission under the Framework Convention on Climate Change	DEFRA
Williams AG, Audsley E and Sandars DL	2006	Determining the Environmental Burdens and Resource Uses in the Production of Agricultural and Horticultural Commodities. Main Report. Defra Research Project IS0205	DEFRA
Wood, S and Cowie, A	2004	"A Review of Greenhouse Gas Emission Factors for Fertiliser Production."	IEA BioEnergy
Zaher U, Khachatryan H, Ewing T, Johnson R, Chen S, Stockle C	2010	Biomass assessment for potential bio-fuels production: Simple methodology and case study	The Journal of solid waste technology and management vol:36 iss:3 pg:182 -192
ZWS	2016	Survey of the organics reprocessing industry in Scotland in 2014	ZWS

Animal faeces, urine and manure

Author	Year	Title	Publisher
NNFCC	2011	Anaerobic digestion_UK Renewable fuels and energy factsheet, Nov 2011, p.2	NNFCC
Arcadis	2010	Annex F to Assessment of the options to improve the management of bio-waste in the european union	Eunomia
WRAP	2007	Using quality compost to benefit crops	WRAP
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
Amon	2006	GHG and NH3 emission abatement by slurry treatment	
Brennan	2010	Chemical amendment of dairy cattle slurry to reduce P loss from grasslands	
Caslin	2009	Potential of farm scale AD in Ireland	
Frost and Gilkinson	2011	Performance summary for AD of dairy cow slurry at afbi hillsborough	
DEFRA	2010	Fertiliser manual (RB209), 8th edition	DEFRA
ERM	2007	Carbon balances and Energy impacts of the Management of UK wastes, Table A1.10, p. A15	
Ralevic and Layzel	2006	An inventory of the bioenergy potential of british columbia, Table 3, p. 4	
Webb and Hawkes	1985	The anaerobic digestion of poultry manure: variations in gas yield with influent concentration and ammonium nitrogen levels	

Batteries and accumulators waste

Author	Year	Title	Publisher

BIOIS	N/A	Reconstructed Factors Calculation Tool	N/A
ERM	2006	Battery Waste Management - A life cycle Assessment	DEFRA
Oaken Hollins	2011	Study into the feasibility of protecting and recovering critical raw materials	
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.1	Swiss Centre for Life Cycle Inventories

Chemical wastes

Author	Year	Title	Publisher
Munoz	2010	LCA Chlor alkali waste	
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.1	Swiss Centre for Life Cycle Inventories

Combustion wastes

Author	Year	Title	Publisher
Chen et al.	2010	LCA allocation procedure used as an incentive method for waste recycling, An application to mineral additions in concrete	
Lee	2004	Estimation of the environmental credit for the recycling of granulated blast furnace slag based on LCA	
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.-	Swiss Centre for Life Cycle Inventories

Common sludges

Author	Year	Title	Publisher
Akwo	2008	A LCA of sewage sludge treatment options	Akwo
Beecher	2008	A greenhouse gas emissions analysis of biosolids management options for Merrimack	Beecher
Brown	2010	Calculator Tool for determining Greenhouse gas emissions for biosolids processing and end-use	Brown
EUC	2010	Environmental, economic and social impacts of the use of sewage sludge on land	EUC
European Commision	2001	Disposal and recycling routes for sewage sludge	European Commission

Ghazy	2011	Economic and environmental assessment of sewage sludge treatment in Egypt	Ghazy
Hong	2009	LCA sewage sludge	Hong
Hospido	2005	Environmental Evaluation of Different Treatment Processes for Sludge from Urban Wastewater Treatments	Hospido
Hospido-Carbella	2010	Environmental assessment of anaerobically digested sludge reuse in agriculture	Hospido-Carbella
Jolliet H	2005	Life cycle assessment of processes for the treatment of wastewater urban sludge	Jolliet H
Murray	2008	Hybrid life-cycle environmental and cost inventory of sewage sludge treatment and end-use scenarios	Murray
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.-	Swiss Centre for Life Cycle Inventories

Discarded equipment (excluding discarded vehicles, batteries and accumulators wastes)

Author	Year	Title	Publisher
Environment Agency	2005	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	Environment Agency
Huisman, J et al	2008	Review of Directive 2002/96 on Waste Electrical and Electronic Equipment	Study No. 07010401/2006/442493/ETU/G4, United Nations University, Bonn Germany
ISIS	2008	Preparatory Studies for Eco-design Requirements of EuPs (Tender TREN/D1/40-2005) LOT 13: Domestic Refrigerators & Freezers	
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA

Discarded vehicles

Author	Year	Title	Publisher
JRC	2008	Environmental impacts of passenger cars (IMPRO-car)	
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.-	Swiss Centre for Life Cycle Inventories

Glass wastes

Author	Year	Title	Publisher
Enviros	2003 (a)	Glass Recycling - Life Cycle Carbon Dioxide Emissions	British Glass, Sheffield
Enviros	2003 (b)	Glass Recycling - Life Cycle Carbon Dioxide Emissions	British Glass, Sheffield
WRAP	2011	LCA of Aggregates	
Valpak	2011	Split of open and closed loop recycling	Personal communication
Swiss Centre for Life Cycle Inventories	2016	Ecoinvent v3.-	Swiss Centre for Life Cycle Inventories

Health care and biological wastes

Author	Year	Title	Publisher
Zhoa	2009	LCA medical waste	

Household and similar wastes

Author	Year	Title	Publisher
Wastes Work and AEA	2010	The composition of municipal solid waste in Scotland	Zero Waste Scotland
WRAP	2014	The Benefits of Reuse Two	WRAP
Exodus Research	2012	The Composition of Mixed Waste from Scottish Health and Social Care, Education, Motor, Wholesale and Retail Sectors in 2011	Zero Waste Scotland

Industrial effluent sludges

Author	Year	Title	Publisher
Drozdowski	2008	Quantification protocol for mechanical sludge utilization	Drozdowski

		projects related to agricultural land application	
ICFPA	2005	Calculation Tools for estimating GHG emissions from pulp and paper mills	ICFPA
Likon		Recent advances in Paper mill sludge management	Likon
Scott	1995	Sludge characteristics and disposal alternatives for the pulp and paper industry	Scott
Tarnwski	2004	Emission factors for combustion of biomass fuels in the pulp and paper indsutry (p.92)	Tarnwski
US EPA	2010	Available and emerging technologies for reducing GHG emissions from the pulp and paper manufacturing industry	US EPA

Metallic wastes, ferrous

Author	Year	Title	Publisher
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
ERM	2008	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent Report No 14	Swiss Centre for Life Cycle Inventories
Swiss Packaging Institute	1997	BUWAL	Swiss Packaging Institute
World Steel Association	2009	World Steel Life Cycle Inventory	World Steel Association

Metallic wastes, mixed ferrous and non-ferrous

Author	Year	Title	Publisher
British Metals Recycling Association	2005	About Metal Recycling	British Metals Recycling Association

Swiss Centre for Life Cycle Inventories	2010	Ecoinvent Report No 14	Swiss Centre for Life Cycle Inventories
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA

Metallic wastes, non-ferrous

Author	Year	Title	Publisher
CE Delft	2007	Environmental Indices for the Dutch Packaging Tax	CE Delft
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
Environment Agency	2008	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency
European Aluminium Association	2013	Environmental Profile Report for the European Aluminium Industry	European Aluminium Association
PE Americas	2010	Life Cycle Impact Assessment of Aluminium Beverage Cans	PE Americas
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories
Wilmshurst, N. Anderson, P. and Wright, D.	2006	WRT142 Final Report Evaluating The Costs Of 'Waste To Value' Management	DEFRA

Mineral waste from construction and demolition

Author	Year	Title	Publisher
Aggregain	2010	CO2 calculator, based on hot mixed asphalt	WRAP
Bovis	2000	DETR Partners in Innovation Project: Construction - The Price of Waste	DETR
ERM	2008	LCA of plasterboard	WRAP
Goodall	2003	Actions not words: taking real responsibility for the environment	BAM Construct UK Ltd
Imperial College London	2008	LCA of Aggregates	WRAP
Mineral Products Association	2011	Accelerating progress. . . meeting the challenges	MPA

		Summary Sustainable Development Report	
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA

Mineral wastes from waste treatment and stabilised wastes

Author	Year	Title	Publisher
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories

Mixed and undifferentiated materials – see Paper and Cardboard wastes

Other mineral wastes

Author	Year	Title	Publisher
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
ELCD III	2006	Various	JRC
MPA	2011	Accelerating progress. . . meeting the challenges Summary Sustainable Development Report 2011	
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories
Viridis	2005	The environmental sustainability of recycled and secondary aggregates (ESRSA) tool	WRAP
WRAP	2006	Sustainable use of resources for the production of aggregates in England	WRAP

Paper and cardboard wastes

Author	Year	Title	Publisher
CEPI	2008	Key Statistics 2007 European Pulp and Paper Industry	CEPI
Chen C, Gan J, Qui R,	pending	Energy Use and CO2 Emissions in China's Pulp and Paper Industry: Supply Chain	Resources Conservation and Recycling

Chen S, Ren L, Liu Z, Zhou C Yue W and Zhang J	2011	Life cycle assessment and type III environmental declarations for newsprint in China.	Acta Scientiae Circumstantiae, 31, (6) 1331–1337.
DEFRA	2012	Streamlined LCA of Paper Supply Systems	Unpublished, DEFRA
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
ERM	2008	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency
ERM	2010	LCA of Example Milk Packaging Containers	WRAP
European Commission	2010	European Life Cycle Database	Joint Research Council
FEFCO	2012	European database for Corrugated Board Life Cycle Studies	FEFCO
National Life Cycle Inventory Database	2003	Ecoinvent 2000 - Part III - Paper and Board	Swiss Centre for Life Cycle Inventories
Oakdene Hollins	2008	CO2 impacts of transporting the UK's recovered paper and plastic bottles to China	WRAP
Procarton	2013	Carbon footprint for cartons	Procarton
Swiss Centre for Life Cycle Inventories	2007	Ecoinvent v2	Swiss Centre for Life Cycle Inventories
Wang & Mao	2012	"Risk Analysis and Carbon Footprint	
ZWS	2016	DMR Reprocessing	ZWS

Plastic wastes

Author	Year	Title	Publisher
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
Plastics Europe	2010	Plastics Europe Ecoprofiles	Plastics Europe

PriceWaterhouseCoopers & Ecobilan	2002	Life Cycle Assessment of Expanded Polystyrene Packaging. Case Study: Packaging system for TV sets	PriceWaterhouseCoopers & Ecobilan
SEPA	2020	Waste from all sources: waste data tables 2018	SEPA
WRAP	2008	LCA of Mixed Waste Plastic Recovery Options	WRAP
WRAP	2006	A review of supplies for recycling, global market demand, future trends and associated risks	WRAP
ZWS	2012	Developing the Evidence Base for Plastics Recycling in Scotland	

Rubber wastes

Author	Year	Title	Publisher
AEAT and ERM	2004	Life Cycle Assessment of the Management Options for Waste Tyres, R&D Technical Report P1-437/TR	Environment Agency
Optimat	2013	Tyre arisings study for ZWS	Optimat
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories
Curry R, Powell J, Gribble N, Waite S	2011	A streamlined life-cycle assessment and decision tool for used tyres recycling Volume 164 Issue 4, November 2011, pp. 227-237	Proceedings of the Institution of Civil Engineers - Waste and Resource Management

Sludges and liquid wastes from waste treatment

Author	Year	Title	Publisher
Exodus Research	2012	The Composition of Mixed Waste from Scottish Health and Social Care, Education,	ZWS

		Motor, Wholesale and Retail Sectors in 2011	
Williams G, Audsley E and Sandars D	2006	Determining the Environmental Burdens and Resource Uses in the Production of Agricultural and Horticultural Commodities. Main Report. Defra Research Project IS0205	DEFRA

Soils

Author	Year	Title	Publisher
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
WRAP	2006	Sustainable use of resources for the production of aggregates in England	WRAP

Sorting residues

Author	Year	Title	Publisher
ACT NOWaste	2009	MRF Residual Waste Audit	ACT NOWaste
Cascadia Consulting Group, Inc	2006	Waste Monitoring Programme (MRF Assessment)	Cascadia Consulting Group, Inc
Demetrious	2018	Life cycle assessment of the management of residual waste from material recovery facilities by landfill, incineration and gasification-pyrolysis in Victoria	RMIT University
WRAP	2009	MRF Quality Assessment Study	WRAP

Spent solvents

Author	Year	Title	Publisher
Capello	2008	Environmental Assessment of Waste-Solvent Treatment Options (Part II)	

Hofstetter	2003	Environmentally preferable treatment options - toluene	
Johnson et al.	1994	Anaerobic degradation of hazardous organics down gradient of sanitary landfill	
Palmer et al.	2011	From life cycle assessment to life cycle management_A case study on industrial waste management policy making	
Raymond	2010	LCA of solvent waste in pharmaceutical industry	
Seyler et al.	2005	Life Cycle Inventory for Use of Waste Solvent as Fuel Substitute in the Cement Industry	
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories

Textile wastes

Author	Year	Title	Publisher
Albers K, Canepa P, Miller J	2008	Analyzing the Environmental Impacts of Simple Shoes Life Cycle Assessment (Volume 15, Number 7, 726-736	University of Santa Barbara, California, The International Journal of
Balsen	2013	Environmental Product Declaration of Tufted cut pile carpet with recycled pile material	Institut Bauen und Umwelt
BIO IS	2009	Environmental Improvement Potentials of Textiles (IMPRO-Textiles)	European Commission (Joint Research Centre – Institute for Prospective Technological Studies)
Cheah L, Ciceri N, Olivetti E, Matsumura S, Forterre D, Roth R, Kirchain R	2013	Manufacturing-focused emissions reductions in footwear production	Journal of Cleaner Production, 44, 18-29
E&SP with research by RMG:Clarity	2012	Study into consumer second hand shopping behaviour to identify the reuse displacement effect	WRAP
ELCD III	2006	Landfill of textiles factor	JRC
ERM	2008	Waste and Resources Assessment Tool for the	The Environment Agency

		Environment (WRATE) Version 1	
Farrent	2008	Environmental benefits from Reusing Clothes	The International Journal of Life Cycle Assessment (Volume 15, Number 7, 726-736, DOI: 10.1007/s11367-010-0197-y)
Golder Associates	2004	Textiles recycling, published as part of WRATE	Environment Agency
Oxfam Waste Savers	2009	Maximising Reuse and Recycling of UK Clothing and Textiles	DEFRA
WastesWork and AEA	2010	The composition of municipal solid waste in Scotland	Zero Waste Scotland
WRAP	2013a	Study into consumer second-hand shopping behaviour to identify the re-use displacement effect	WRAP
WRAP	2013b	Clothing longevity and active use	WRAP
WRAP	2012	Textiles flow and market development opportunities in the UK	WRAP
WRAP	2014	Benefits of Re-use 2 (BORT)	WRAP

Used oils

Author	Year	Title	Publisher
IFEU	2005	Ecological and energetic assessment of re-refining used oils to base oils: Substitution of primarily produced base oils including semi-synthetic and synthetic compounds	GEIR

Vegetal wastes – see Animal and Mixed Food wastes

Wood wastes

Author	Year	Title	Publisher
CeCOP		Wood LCA revision C	

CORRIM	2008	Particleboard: A Life-Cycle Inventory of Manufacturing Panels from Resource through Product	CORRIM: Phase II Final Report Module F
Corrim	2013	Cradle to Gate Life Cycle Assessment Reports for US Wood Products by Region	
UK Government GHG Conversion Factors for Company Reporting - DEFRA/BEIS (2018)	2018	Transport and energy carbon factors	BEIS
ELCD III	2006	Untreated wood factor	JRC
ELCD III	2006	Treated wood factor	JRC
ELDC	2006	European reference Life-Cycle Database	JRC
ERM	2008	Single trip pallet no biogenic CO2	Intelligent Global Pooling Systems
ERM	2008	Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	The Environment Agency
Gnosys	2009	Life Cycle Assessment of Closed Loop MDF Recycling	WRAP
Merrild H and Christensen T	2009	Recycling of wood for particle board production: accounting of greenhouse gases and global warming contributions	Waste Management Research 27(8):781-8
Pöyry Forest Industry Consulting Ltd and Oxford Economics Ltd	2009	Wood Waste Market in UK	WRAP
Swiss Centre for Life Cycle Inventories	2010	Ecoinvent v2.2	Swiss Centre for Life Cycle Inventories

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