MORE CIRCULARITY
LESS CARBON
-25% BY 2025

THE CARBON FOOTPRINT OF WASTE

CROSS ANALYSIS OF THE FIRST COHORT

PAYS DE LA LOIRE ▪ GENOA ▪ BRUSSELS CAPITAL REGION

ACR+

ZERO WASTE SCOTLAND

ACR+ is an international network of cities and regions sharing the aim of promoting a sustainable resource management and accelerating the transition towards a circular economy on their territories and beyond.

Circular economy calling for cooperation between all actors, ACR+ is open to other key players in the field of material resource management such as NGOs, academic institutions, consultancy or private organisations.

Find out more at www.acrplus.org

Zero Waste Scotland exists to lead Scotland to use products and resources responsibly, focusing on where we can have the greatest impact on climate change. Using evidence and insight, our goal is to inform policy, and motivate individuals and businesses to embrace the environmental, economic, and social benefits of a circular economy. We are a not-for-profit environmental organisation, funded by the Scottish Government and European Regional Development Fund.

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

Project name: More Circularity, Less Carbon– ZWS & ACR+ partnership

Written by: Jean-Benoit Bel (ACR+)

Reviewed by: Ramy Salemdeeb (Zero Waste Scotland), Françoise Bonnet (ACR+), Gaëlle Colas (ACR+)

Research date: June – February 2020

Publication date: July 2021

Disclaimer:

While ACR+ and Zero Waste Scotland have taken reasonable steps to ensure the content of this document was correct in all material respects when originally drafted, it employs a methodology appropriate to the original purpose of the report. Accordingly, reliance should not be placed on this document if used for a purpose other than that for which it was expressly intended, and you should seek your own independent advice in connection with any use of the report or any information or data contained within it. ACR+ and Zero Waste Scotland do not accept liability for any loss, damage, cost or expense incurred or arising from reliance on this report.

References in the report to any specific information, methods, models, data, databases, or tools do not imply endorsement by either ACR+ or Zero Waste Scotland.

CONTENTS

EXECUTIVE SUMMARY

The 'More Circularity, Less Carbon' (MCLC) campaign was launched by ACR+ in November 2019 to help its member in addressing the carbon footprint of their waste. ACR+ has partnered with its member Zero Waste Scotland to assess how individual territories can reduce the carbon impact of municipal waste by 25 per cent by 2025.

To do so, Zero Waste Scotland adapted its own carbon assessment tool to develop the Carbon Metric International. It allows the assessment of the carbon footprint linked with material resources by using local waste data: generation, composition, and treatment. The tool assesses the impact linked with waste management, but also the impacts linked with the production and the consumption of the product that became waste. To summarise, the CMI allows the assessment of both direct and indirect emissions of the consumption of material resources and products at local level thanks to local waste data.

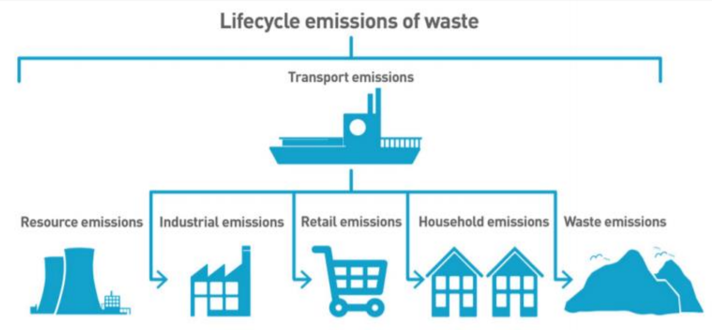

Figure 1: Schematic diagram presenting the lifecycle emissions of waste.

The MCLC campaign consists in different "cohorts", in which three territories collect data and assess their carbon footprint with the assistance of Zero Waste Scotland and ACR+. A first cohort was launched in early 2020, with the participation of the Brussels-Capital Region (a capital region taking the form of a metropolitan area), the French region Pays de la Loire (a region encompassing various different types of territories), and the Italian city of Genoa (a coastal city)

These three territories present quite different data when it comes to waste generation, composition, and treatment. These differences are linked with local specificities, but also the fact that the scope of municipal waste data is slightly different: in the Brussels Region, it is mostly composed of household waste, while in the two other territories a share of commercial waste is also included.

Waste treatment is also organised differently. The recycling rates range from 35% for Genoa and 37% for Brussels, to 51% for Pays de la Loire. Besides, Brussels does not use landfilling and all residual waste is incinerated, while Genoa and Pays de la Loire both resort to landfilling, incineration, and mechanical-biological treatment.

These discrepancies lead to different carbon footprints, with a lower footprint per capita in Brussels linked with a comparably narrower scope for municipal waste, but also with less carbon-intensive materials generated. However, the carbon footprints still present similar trends: most impacts are linked with the production and consumption of products, while their end-of-life allows the saving of carbon emissions thanks to recycling, even if these savings are limited compared to the total footprint.

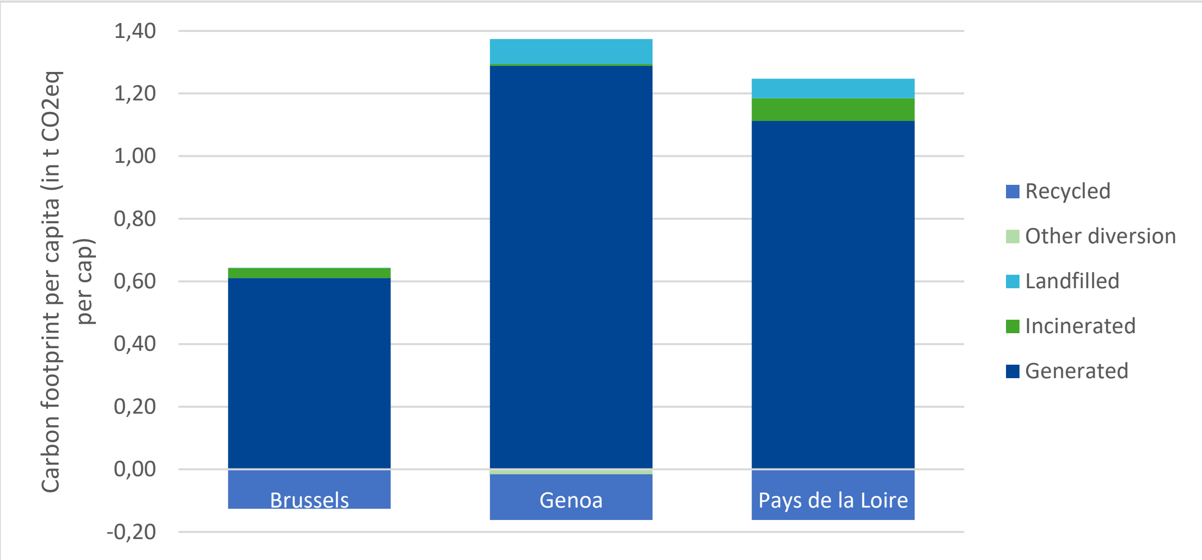

Figure 2: carbon footprint per capita linked with waste generated and managed in the three territories (in t CO2eq per cap.)

Other common observations can be made for the three territories:

- The three territories share the **same most carbon-intensive fractions: textile, food, and plastic**. If recycling has a potential to improve their carbon footprint, especially for plastic, it seems that the main potential for improvement lies in prevention and re-use.
- For **food waste**, reduction of food wastage is a key action to be promoted. It is very important to take into account the quantities of avoidable food waste generated when designing biowaste treatment units. Indeed, organic recovery entails limited carbon savings compared to the impact of food production.
- For **textile**, it seems that reuse and recycling hold a certain potential for reducing the carbon footprint, yet it might not be sufficient, and textile recycling is still technically limited. More "upstream" actions focusing on production, durability of clothing, use (including washing), and re-use (donation, repair, remanufacturing) need to be promoted.
- For **plastic**, recycling seems to have a true potential for reducing the whole carbon footprint, yet more details on the different types of plastic generated, the loss rates, and their actual recycling routes, would help to identify potential improvements.

It is important to note that there is little correlation between the tonnages of waste and their carbon footprint, as the most carbon-intensive fractions generally represent a very small share of municipal waste in weight. This calls for an on-going monitoring of the carbon footprint of waste, a better understanding of waste generation and composition, and more efforts put on prevention and re-use monitoring.

Despite having several limitations due to the paucity of local data, which prevents from better analysing how local specificities can play a role, these assessments are a first step toward a better understanding of the carbon footprint of material resources at local level, as well as of the key actions to reduce this footprint.

ACR+ 'MORE CIRCULARITY LESS CARBON' CAMPAIGN

The 'More Circularity, Less Carbon' campaign was launched by ACR+ in November 2019, with the objective to help its members to better understand the carbon footprint of material resources (i.e. linked with the production, consumption, and end-of-life of products that became waste), and to identify key circular economy actions and policies to mitigate these carbon emissions.

ACR+ has partnered with its member Zero Waste Scotland to assess how individual territories can reduce the carbon impact of municipal waste among by 25 per cent by 2025.

Zero Waste Scotland's Carbon Metric International (CMI) tool, developed from Scotland's ground-breaking Carbon Metric, enables ACR+ members to measure the carbon impact of their municipal waste, take effective actions to reduce it, and track their progress towards the 2025 target. The first version of the CMI only covers municipal waste, for which most territories have reliable data, but future version will also include commercial and industrial waste.

A first cohort of three territories has been launched in early 2020. These three territories have collected waste and carbon-related data, which was then processed by Zero Waste Scotland to assess the current carbon footprint linked with municipal waste. For each territory, a specific report has been published, presenting the main findings from the collected data. These reports are available on the ACR+ website.

This first cohort will be followed by other cohorts of territories, which will progressively expand the number of datasets and lead to further cross-analyses.

This report aims at cross-analysing the results of the three first assessments to better understand the similarities and differences and identify how these local assessments could be improved to better reflect the different contexts.

ZERO WASTE SCOTLAND'S CARBON METRIC INTERNATIONAL

Zero Waste Scotland has developed a ground-breaking tool in the fight against global climate change. The Carbon Metric (CM) measures the whole-life carbon impacts of Scotland's waste, from resource extraction and manufacturing emissions right through to waste management emissions, regardless of where in the world these impacts occur (Figure 1). The CMI only takes into consideration the non-biogenic emissions, meaning that the emissions related to the natural carbon cycle (e.g. CO_2 emissions linked with the incineration or composting of biomass) are not included.

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

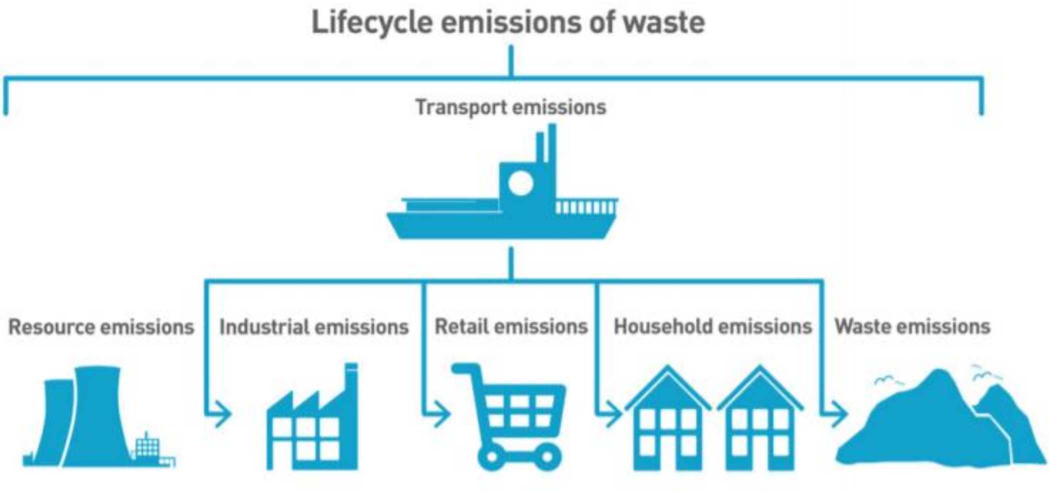

Figure 3 Schematic diagram presenting the lifecycle emissions of waste.

The Carbon Metric provides policymakers and business leaders with an alternative to weight-based waste measurement, allowing them to identify and focus specifically on those waste materials with the highest carbon impacts and greatest potential carbon savings. Scotland's 33% per capita food waste reduction target is an example of a policy informed by the Carbon Metric[1].

Further details on the Carbon Metric methodology can be found on Zero Waste Scotland's website[2].

USING ZERO WASTE SCOTLAND CMI

In the framework of the More Circularity, Less Carbon campaign, an expansion of the Carbon Metric has been developed by Zero Waste Scotland, the Carbon Metric International (CMI). The CMI is built based on the bottom-up life cycle assessment approach which enables any region to use the model to estimate its bespoke carbon factors of waste. To use the CMI, territories must undergo two steps:

- Identify the quantities of waste generated and break these quantities down into 33 different waste categories defined in accordance with the European Waste Categories[3], as well as detail how these different waste fractions are treated (recycled, incinerated, landfilled, or other);
- For each waste fraction, provide details on the composition, the distances associated with the transport of products before becoming waste, and of the waste, and how the waste is recovered (what recycling processes, or what energy production).

The main difficulty is to identify data on the composition of mixed fractions such as residual waste or mixed bulky waste, as well as the output of sorting centres (such as materials recovery facilities) where mixed fractions are sorted into single-material streams. For instance, the following example explains how food waste is reported in the different

[1] Scottish Government (2016) Making Things Last
[2] Zero Waste Scotland (2020) Carbon Metric Publications.
[3] Eurostat, 2013, Manual on waste statistics (available here)

categories. In this example, food waste is collected separately and sent to composting, where residues are sent to landfill. Besides, residual waste encompasses a share of food waste and is sent partly to incineration, and partly to a mechanical-biological treatment plant (MBT). The MBT process extracts the food waste within residual waste, which is then sent to anaerobic digestion and the digestate produced is recovered.

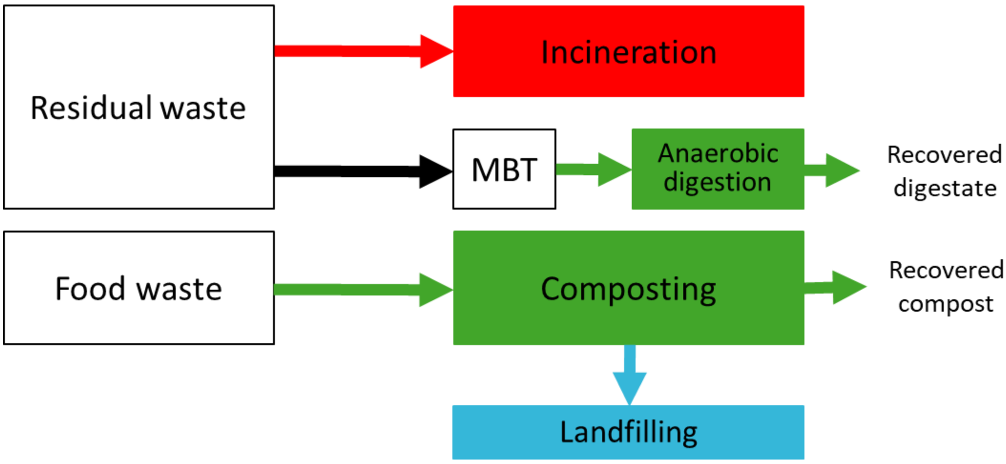

Figure 4: a theoretical food waste management system used to illustrate the reporting of food waste quantities in the CMI

In this case, the reporting of food waste has to be done in the following way:

- Incinerated quantities: it is assessed by the share of food waste in the quantities of residual waste sent to incineration. To do so, the composition analysis of residual waste is used to assess the share of food waste in residual waste.
- Recycled quantities: it is assessed as the sum of the quantities of organic matter sorted in the MBT and sent to anaerobic digestion and the quantities of source-separated food waste sent to composting, minus the impurities sent to landfilling. If the digestate produced by the anaerobic digestion plant is not recovered (e.g., due to quality issues), then the associated quantities of organic matter should not be reported as being recycled.
- Landfilled quantities: it is assessed as the quantities discarded from composting unit and sent to landfilling.

LIMITS OF THE APPROACH

As the CMI is based on life cycle assessment methods, it inherits the limitation of environmental tools build using the same principle, in particular the impact of data availability on the model output. The results provided by the CMI is very dependent on the quality of the data reported by different regions. For instance, for quantities reported as “mixed, undifferentiated” streams, average figures have to be used that might not be representative of the actual carbon footprint.

Besides, only waste that was “captured” by the “documented” waste services (e.g., the municipal waste service, or the quantities reported by EPR organisations) is included. Any other quantities (e.g., illegally managed, composted at home, or managed by other players such as charity organisations) is not reported, meaning that the impact associated with their management is not included, but more importantly, the footprint of the associated products is not taken into consideration. In the case of a territory where significant quantities of food waste are managed at home and not reported, it will result in underestimated quantities of food, which might bear a significant footprint and could include a significant potential for carbon mitigation (e.g., with the reduction of food wastage). For WEEE, illegal management is believed to concern about 60% of the generated quantities in Europe[4], which means that local quantities can also be underestimated. It is therefore advisable to lead complementary researches on possible unreported quantities for the most carbon-intensive fractions.

FIRST COHORT

The first cohort was launched in early 2020, and is composed of three territories where ACR+' members are located:

- **Pays de la Loire** is one of the 13 metropolitan French regions, located in the western part of the country. It encompasses about 3.76 million inhabitants, in 1,238 communes, and has a density of 117 in./km². There are several medium to big cities, such as Nantes, Angers, or Le Mans.
- **Genoa** is a port city and the capital of northwest Italy's Liguria region with a population of 583,600 inhabitants. Household waste for the region is managed by ACR+ member AMIU Genova S.p.A., that collected data for the CMI.
- **The Brussels-Capital Region** is one of the three Belgian regions comprising 19 municipalities, including the City of Brussels, with a total population of 1.2 million inhabitants. Data were collected by Brussels Environment, the environment and energy administration of the Brussels-Capital Region

These territories are quite different when it comes to their typology and status (a region encompassing various different types of territories, a city, and a capital region taking the form of a metropolitan area).

Figure 5 Geographical location of the three territories. From left to right: Pays de la Loire, Genoa, Brussels-Capital Region

WASTE GENERATION IN THE THREE TERRITORIES

Although the scope of this first cohort was household waste, the three participants all focused on municipal waste. Yet, the exact scope covered by their data differ from one to the other. Municipal waste generally includes household waste and commercial waste similar to household waste in quantities and composition.

[4] CWIT project: https://www.cwitproject.eu/

- **Pays de la Loire**: the data encompass municipal waste, i.e. waste generated by household and assimilated waste (commercial waste similar to household waste). In France, assimilated waste represents about 20% of municipal waste when it comes to residual waste, food waste, and paper and packaging waste. Data include waste managed by or on behalf of local authorities (door-to-door, bring banks, and civic amenity sites), as well as household and similar waste under EPR systems (WEEE, batteries, furniture, etc.) that can also be managed outside of the public service (for instance collected by retailers). The reported data are on the year 2015.
- **Genoa**: the data also include household waste and assimilated waste collected in 2018.
- **Brussels-Capital Region**: the data only encompass waste generated by households in 2018. In the Brussels-Capital Region, commercial activities have to appoint a waste collector, so differentiated data are available for household waste and commercial waste, even if it is believed that some commercial activities wrongly use the household waste service.

The composition of generated waste is quite different among the three territories, as presented in the following graph:

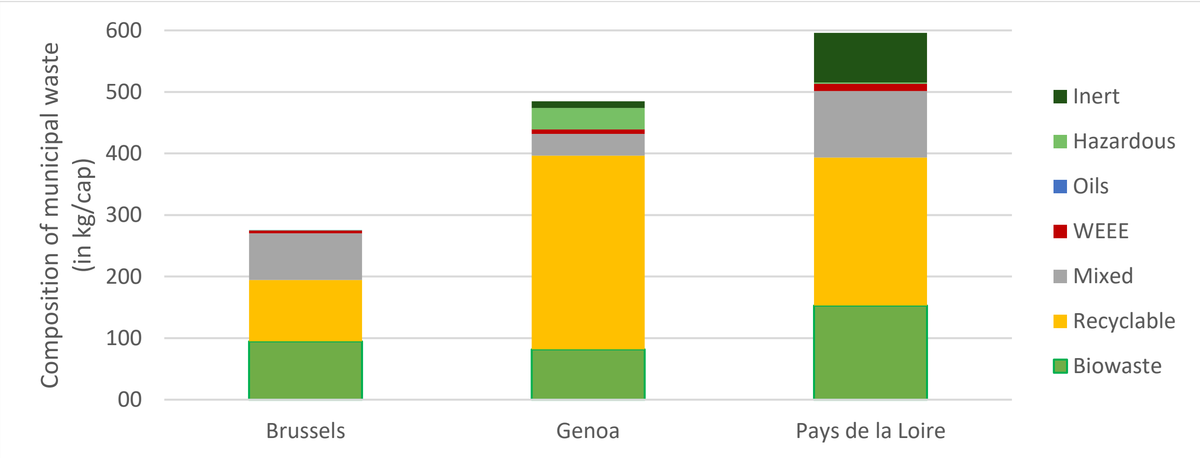

Figure 6: Composition of waste generated in the three territories (in kg/cap)

The differences between the quantities of waste generated can be explained by various reasons:

- **Commercial waste** is not included in the data for the Brussels Regions, as mentioned above, while it is likely to represent about 20 to 30% of the reported quantities in the other territories;
- **Inert waste** quantities are quite different from one territory to another, which might reflect the different management systems for construction and demolition waste (which can be partly or fully managed by private companies). In Pays de la Loire, comparatively large quantities are collected in civic amenity sites;
- **Food waste** quantities per capita are more significant in Brussels and Genoa, while **garden waste** quantities are very significant in Pays de la Loire, which might be explained by the different typologies: Brussels and Genoa are very urbanised, while Pays de la Loire encompasses much more rural areas. Besides, part of it might be composted at home or in decentralised units, and the associated quantities are unreported.

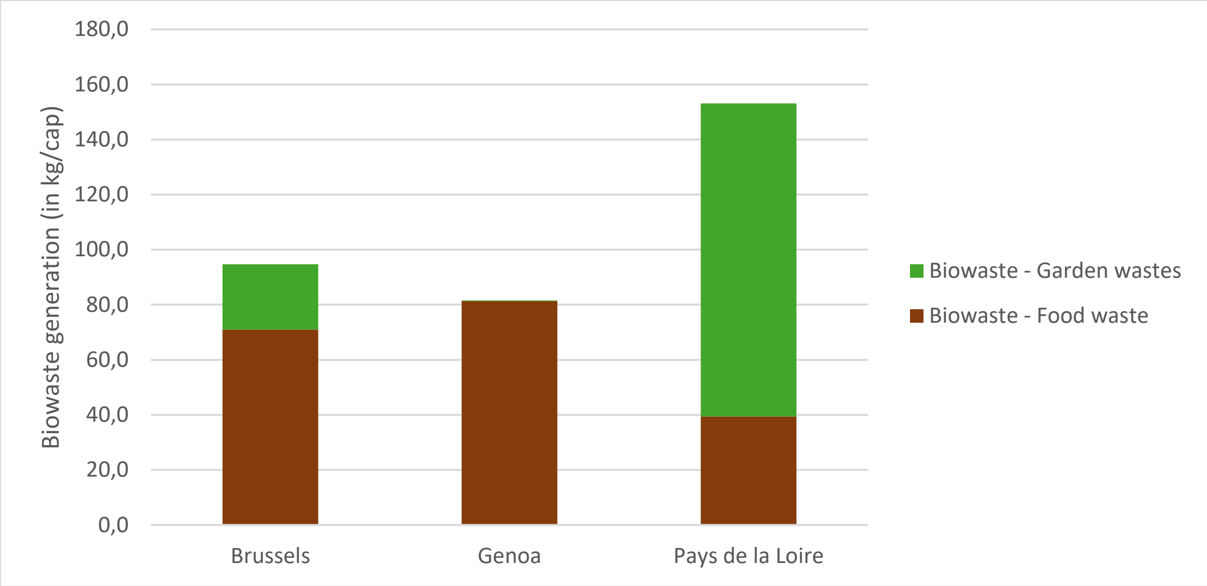

Figure 7: biowaste generation per capita in the three territories (in kg/cap)

- Significant differences can also be observed for **dry recyclable** waste fractions, as highlighted by the following graph:

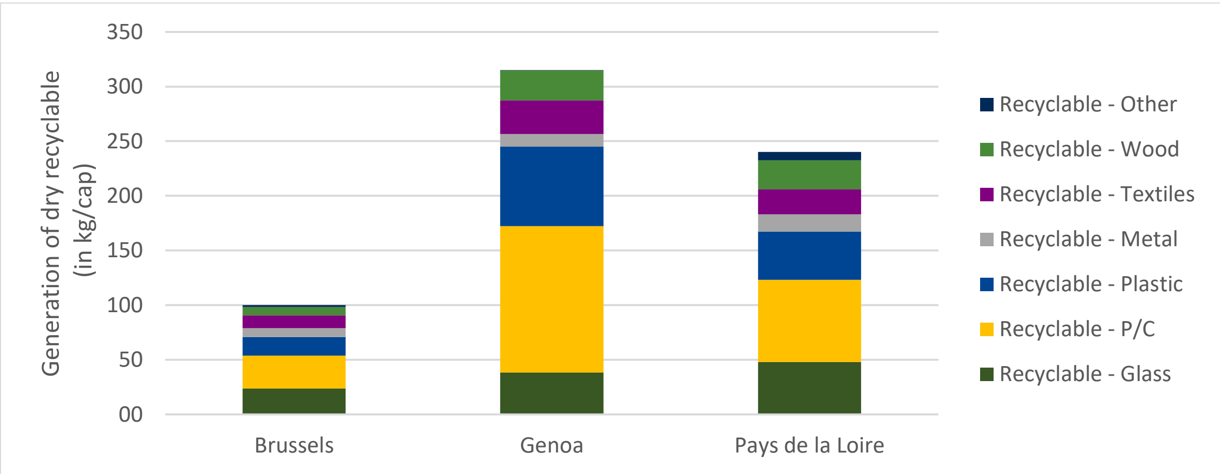

Figure 8: generated quantities of dry recyclable materials in the three territories (in kg/cap)

Important differences can be observed for paper and cardboard, plastic, and wood, which might also reflect different shares of commercial waste in the municipal waste. As stated above, both Genoa and Pays de la Loire's data include a share of non-household waste, that is collected together with household waste. This might explain why paper and cardboard generation is higher. Unfortunately, no data is available to assess the share of commercial waste in the reported quantities.

There might also be different consumption patterns. Yet, it is difficult to assess how much these differences play a role in the composition of municipal waste. Besides, it is unknown whether other collection schemes exist in parallel of the municipal service, and whether these quantities are included in the reported data.

WASTE MANAGEMENT IN THE THREE TERRITORIES

The three territories have implemented different waste management strategies, and the different performances can be seen on the following graph:

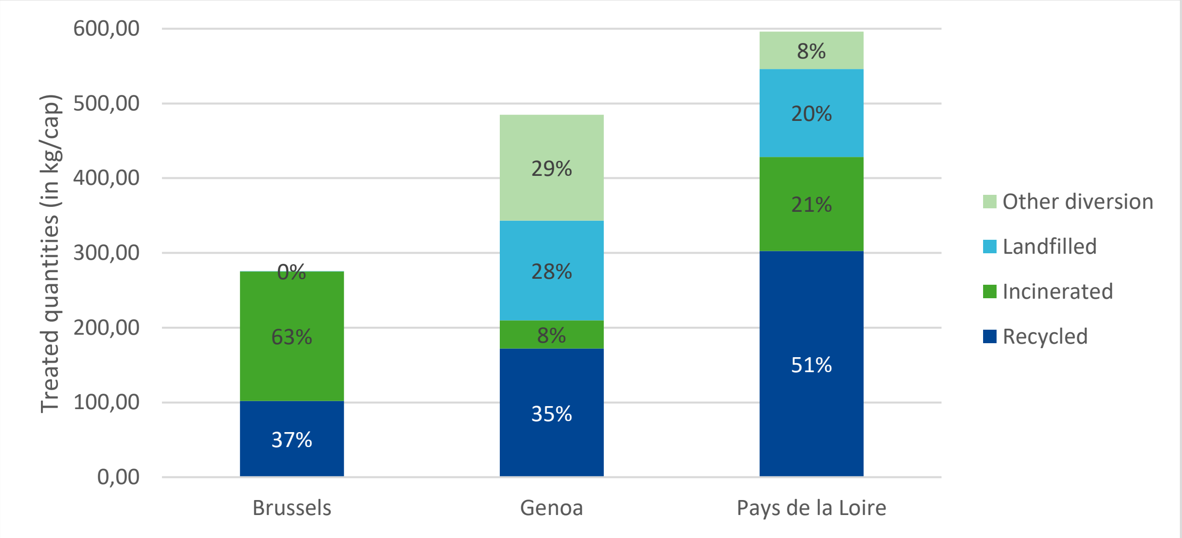

Figure 9: municipal waste by treatment method in the three territories (in kg/cap)

Recycling rates range from 35% to 51%. Recycling might include a small share of "reuse" (for instance for textile). Another difference is the use of landfilling, which is more widespread in Genoa and Pays de la Loire, and not used in the Brussels-Capital Region. Part of the municipal waste is reported as sent to "other diversion" destination: in Genoa, part of the residual waste is sent to MBT plants located in other provinces, and the details on the outputs are not available. In Pays de la Loire, the actual treatment of construction and demolition waste is unknown, so it is labelled as "other".

Differences can also be observed for the different waste fraction. The destination of biowaste is presented below:

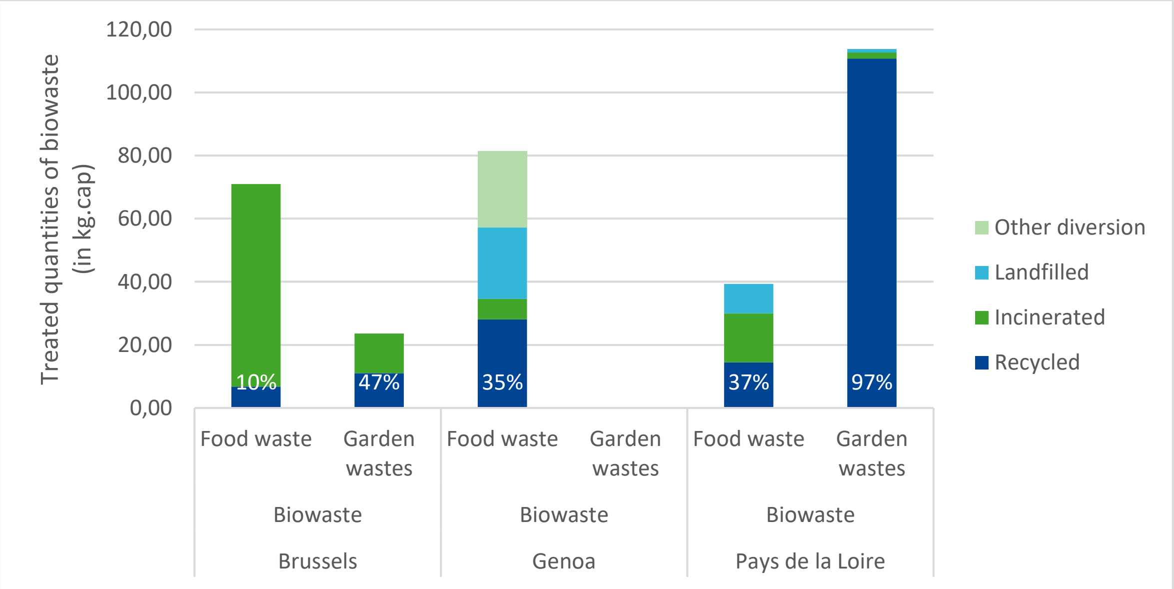

Figure 10: destination of food waste and garden waste in the three territories (in kg/cap). The capture rate is indicated at the bottom of each bar.

Food waste recycling is still underdeveloped in the three territories. In Genoa and Pays de la Loire, the use of MBT allows to reach higher quantities sent to recycling. In Brussels, food waste collection has been implemented recently and is still on voluntary basis, which can explain the low performance. In Pays de la Loire, garden waste is almost entirely recycled. Most of it is collected in civic amenity sites, and mostly sent to composting plants.

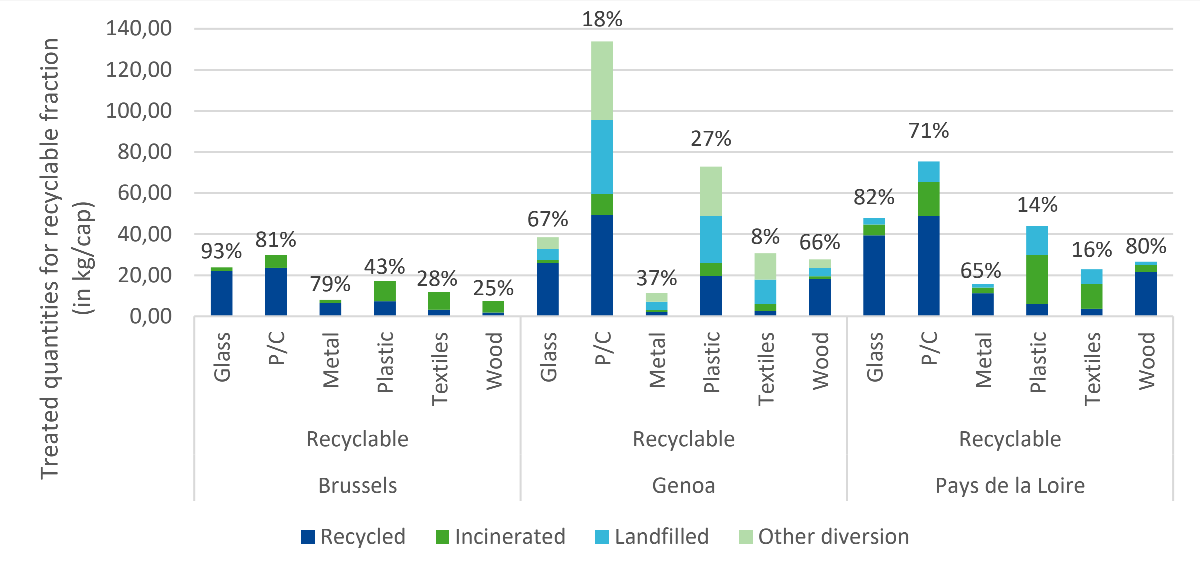

Figure 11: destination of the main material fractions collected in the three territories (in kg/cap). Capture rates are indicated above each bar

Recycling rates are quite high for glass, metal, and paper and cardboard in Brussels and Pays de la Loire. Genoa's recycling performances are overall lower, but for wood and glass. Regarding plastic, recycling rates are low in Genoa and Pays de la Loire, and average in Brussels. Textile recycling and reuse is quite low in all three territories.

OVERALL CARBON IMPACT

The assessment of the carbon footprint for the different waste fractions is done using "carbon factors". These carbon factors enable to assess the carbon emission associated with the generation, recycling, incineration, or landfilling of one tonne of waste for each waste fraction. To assess these waste fractions, specific data are collected from the participating territories, focusing on the actual composition of each fraction, the transport distances of the associated products and waste, the recycling routes followed by the different types of waste, and the performances of the treatment units where they are treated.

These types of data might be quite challenging to identify at sub-national level. For cohort 1, extensive data could only be collected for Pays de la Loire, taking into consideration both regional and national data. For the other two participants, Pays de la Loire's carbon factors were used as well, which brings some uncertainties; indeed, the actual composition of the different waste fractions, and the actual recycling routes followed by the different waste fractions can be quite different from one place to another.

The associated carbon impact per inhabitant is presented on the following graph:

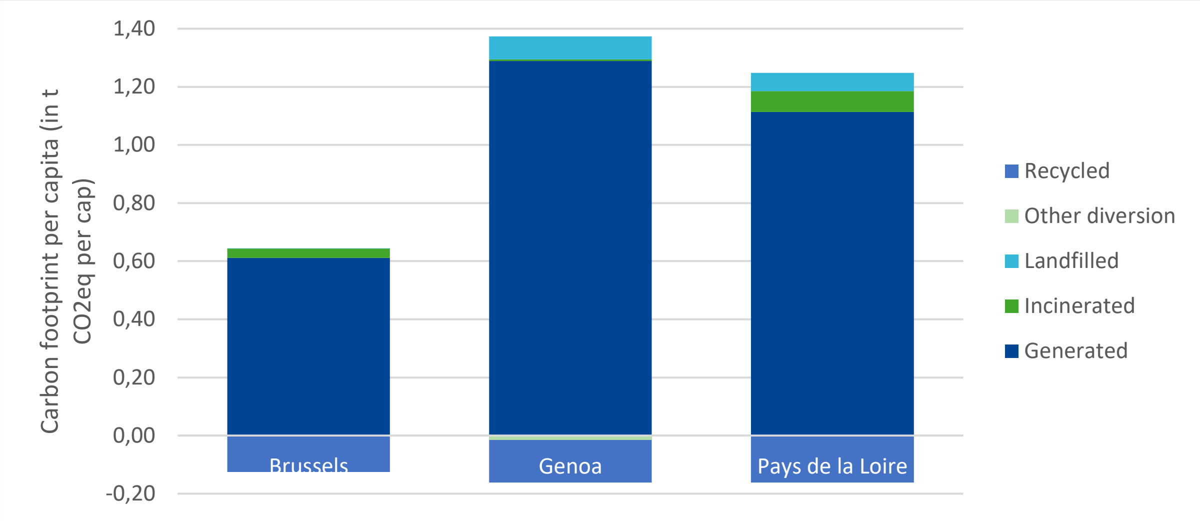

Figure 12: carbon footprint per capita linked with waste generated and managed in the three territories (in t CO_2eq per cap.)

In the figure above, the "generated" category refers to the impact linked with the production and consumption of products that became the waste reported by the three territories. For instance, the "generated" impact for food waste represent the carbon impact associated with the farming, transformation, transport, and consumption of food and food products that then became food waste.

The impact associated with recycled quantities is negative, which reflects the fact that the recycling of waste leads to the saving of carbon emissions, e.g., by generating secondary raw materials substituted to raw materials that are more carbon-intensive. It is interesting to note that the relative contribution of recycling in Brussels is higher than in the other two regions, reflecting higher recycling performances for carbon-intensive materials.

Incineration in Genoa has a limited impact, yet it is because the incinerated quantities are quite low. The emissions generated by incineration also include savings linked with the production of energy that replace energy produced by other processes, but overall, these savings do not compensate the emission linked with the combustion of waste materials. The savings depend on different parameters that might change from one territory to another: different types of energy produced by the incinerators (electricity, heat, co-generation), their energy efficiency, the different energy mixes in the different countries which are more or less carbon-intensive, etc. Carbon emissions from incineration also depends on the composition of the incinerated waste (biogenic content, energy content, etc.).

There are some similarities between the three territories. Firstly, the impact of "generation" is significantly higher in all three territories, while the impact associated with waste management is comparatively very limited. In all three territories, waste management allows the saving of carbon emissions, thanks to recycling. However, the emissions saved thanks to waste management are relatively limited compared to the emissions linked with the production and consumption of products.

CARBON IMPACT PER WASTE FRACTION

For all three territories, the waste fractions that are the main contributors to the carbon footprints are quite similar: textile, biowaste, mixed/undifferentiated fractions, plastic, and paper/cardboard, as shown on the following graph:

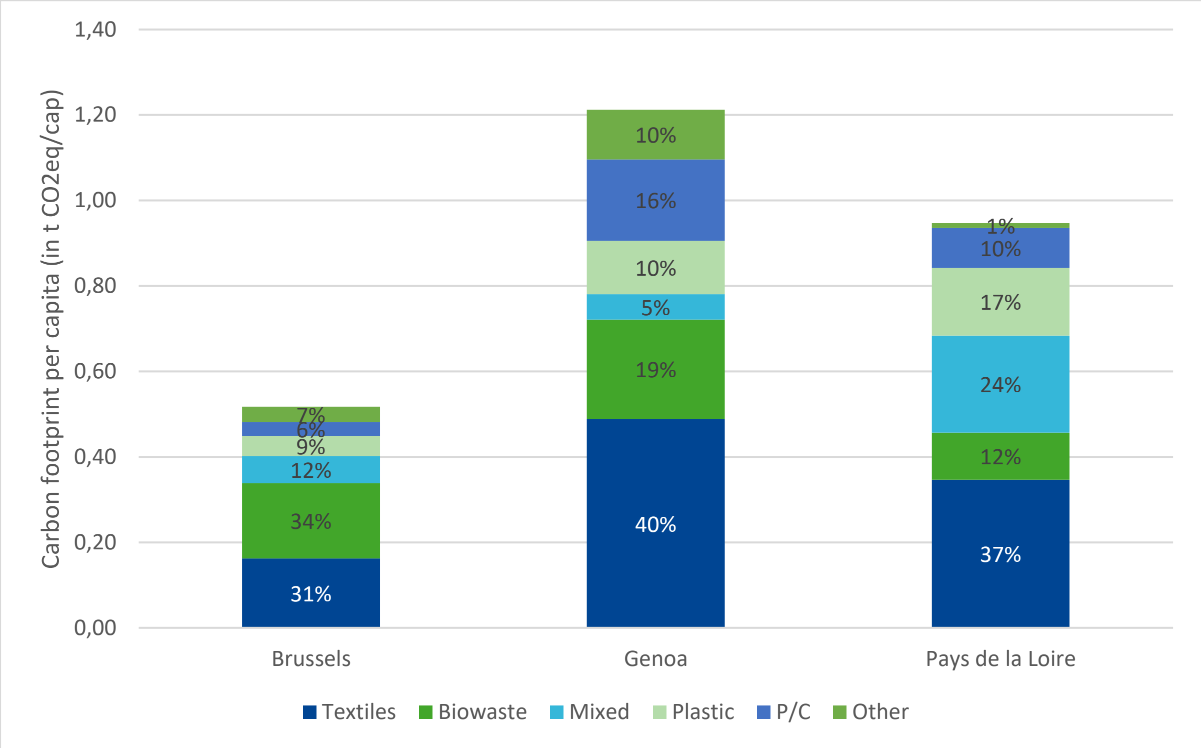

Figure 13: carbon footprint per capita for the different waste fractions in the three territories

Textile waste represents between 30 and 40% of the regional carbon footprints, while food waste's contribution ranges from 12 to 34% (reflecting the share of food waste in municipal waste). The relative contribution differs from one territory to another. These key waste fractions will be analysed in more detail in the following parts.

CARBON FOOTPRINT PER TONNE OF WASTE

Comparing the carbon footprint per tonne of waste generated can also give interesting insight on the impact of waste management as well as on how local specificities can play a role. The overall carbon footprint per tonne of municipal waste generated for the three territories is presented below:

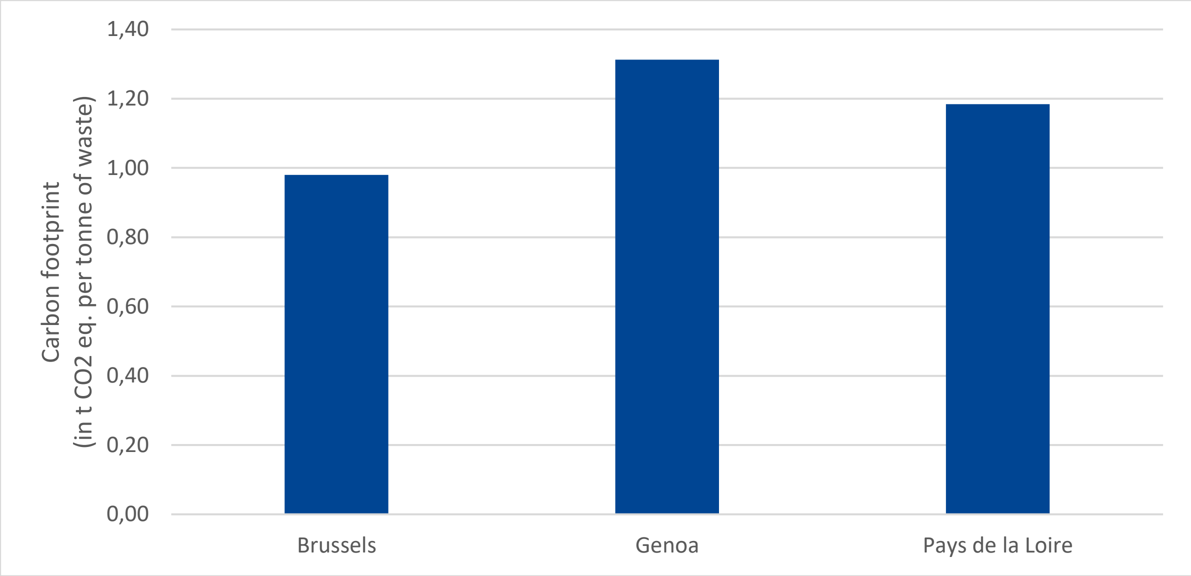

Figure 14: carbon footprint per tonne of waste in t CO2 eq.CO2 eq. per tonne

The footprint per tonne is quite lower in Brussels, and higher in Genoa. Considering that the impact of product generation represents the major part of the carbon footprint, it is likely that these differences are due to different composition of municipal waste and the share of carbon-intensive waste fractions. The Brussels-Capital Region also presents lower emissions linked with landfilling, as well as higher savings linked with recycling, linked with higher recycling performances. There is no correlation between the overall recycling rate presented above and the carbon footprint per tonne.

There are also differences regarding the carbon footprint per tonne for the key waste fractions, as presented in the following graph:

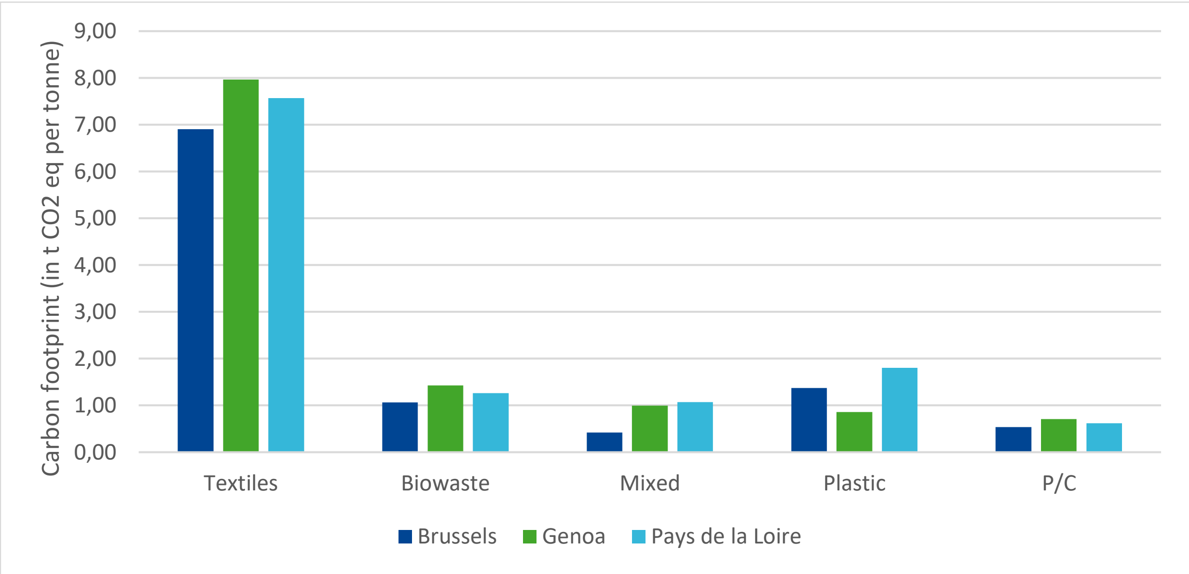

Figure 15: carbon footprint per tonne of waste for key fractions (in t CO2 eq. per tonne of waste)

These differences are likely to be connected the way they are managed. Quite significant differences can be observed for textiles, mixed fractions, and plastic waste, reflecting for instance higher reuse and recycling rates in Brussels, and lower incineration rates for plastic in Genoa.

FOCUS ON PRIORITY FRACTIONS

Textiles

The reported quantities of textile waste are quite different from one territory to another, as presented on the graph below:

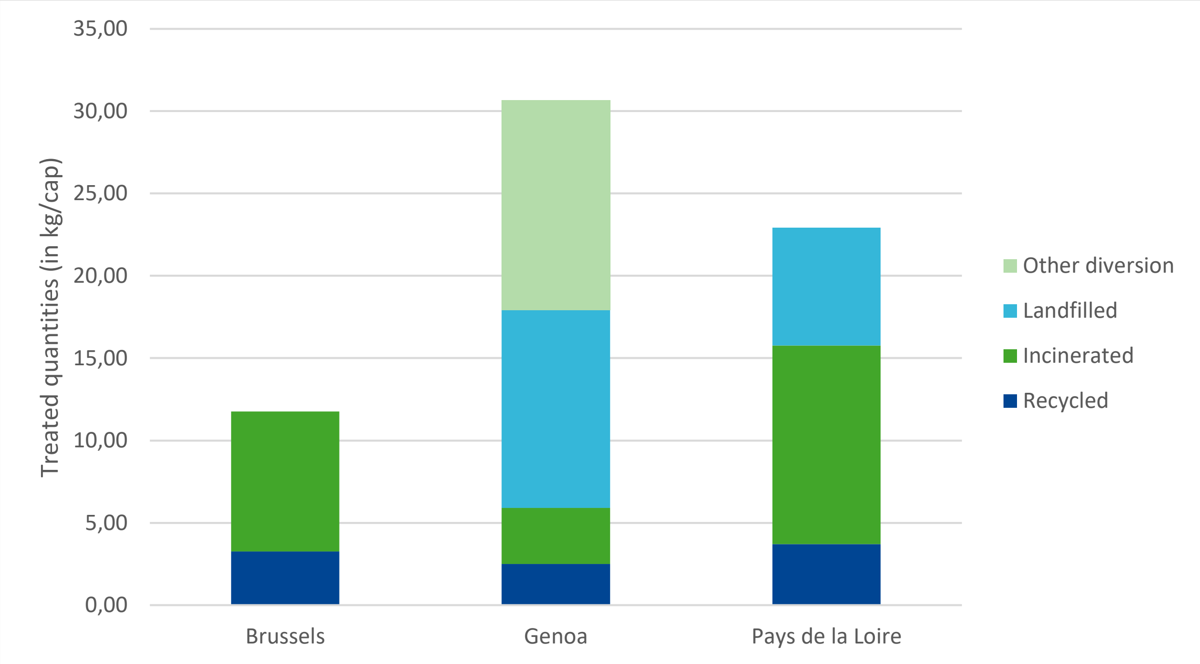

Figure 16: treated quantities of textile waste in kg/cap

This might be due to the exact scope of textile waste (e.g., Pays de la Loire's data also include textiles from furniture and upholstery in addition to clothes, Genoa and Brussels both include clothes collected in bring banks and within residual waste), or due to unreported fractions (e.g. part of the textiles might be collected by local players that do not report data, such as charity organisations). As observed above, capture and recycling rates are pretty low in all three territories, and most textile waste is currently either incinerated or landfilled.

According the ECAP project[5], clothing and household textiles waste generation can vary from one country to another, the available figures showing quantities ranging from 9 to about 27 kg/cap/yr, even though there are uncertainties about the comparability of the presented data. The data reported above seem high compared to these figures, yet the exact scope might be different.

The carbon footprint per capita for textile waste is presented below:

[5] ECAP, 2018, Used Textile Collection in European Cities

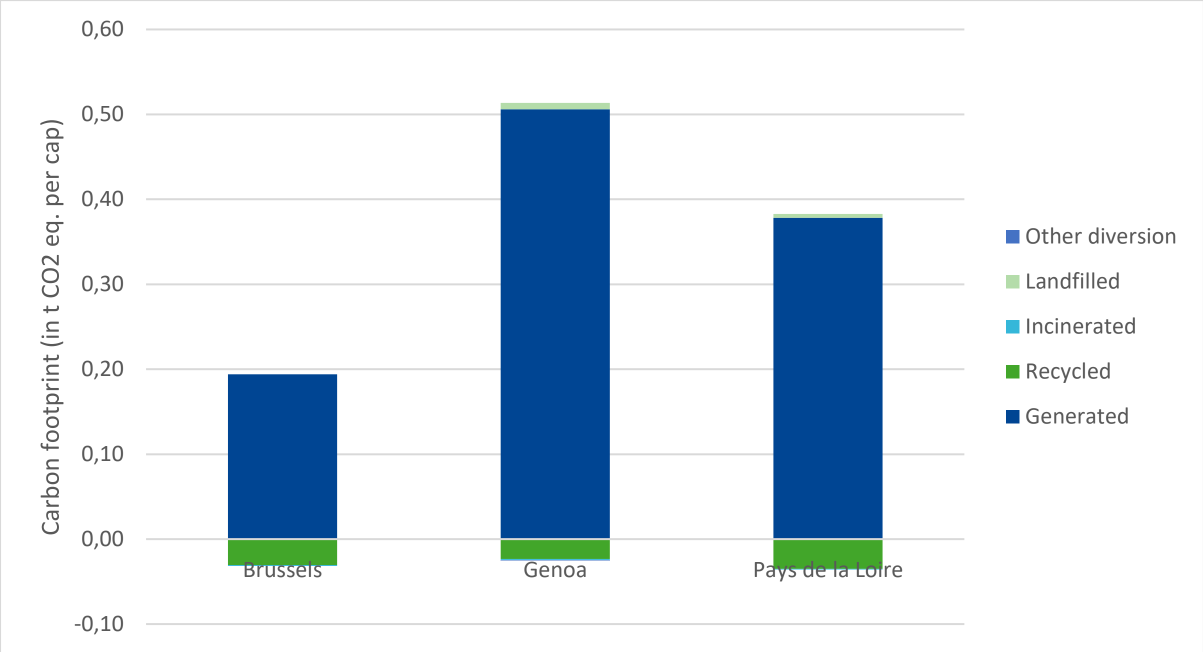

Figure 17: carbon footprint per inhabitant for textile waste (in t CO2 eq. per cap)

The main impact comes from the generation and consumption of textile and textile products, while its incineration and landfilling have little to no impact. Recycling enables some saving, yet it is very limited compared to the total footprint. Due to a lack of data, the same carbon factors were used for the generation of products, which explains why the carbon impacts reflect the generated and treated quantities. It is possible that different consumption patterns could lead to different footprints, but more data on local consumption would be needed to better understand this.

When setting the recycling rate to 100% for the three territories, the following figure is obtained:

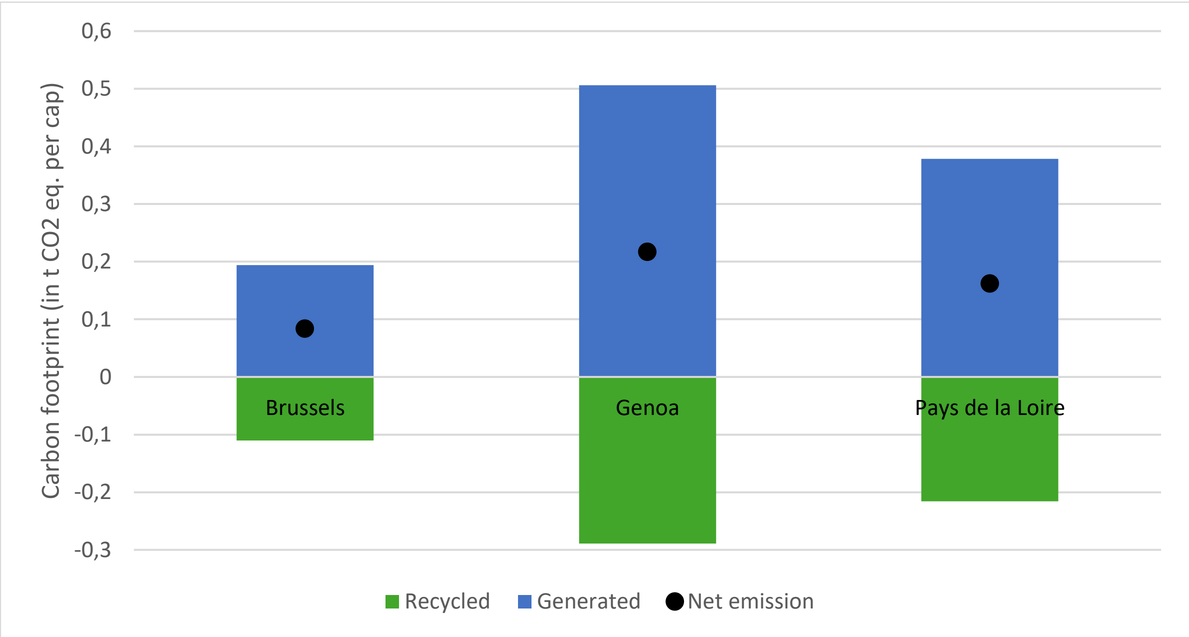

Figure 18: carbon footprint of textile with 100% recycling (in t CO2 eq. per cap)

The potential of recycling is significant, as recycling 100% of the textile waste would reduce the net footprint of textile by 50% for all three territories, and the overall footprint by 15 to 20% depending on the territory. However, the textile carbon footprint would still represent a very significant share of the total footprint in this theoretical situation.

The carbon footprint of clothing is quite different from one product to another[6]. It seems that the extraction of resource (e.g. cotton cultivation), the manufacture and clothing, and the use phase (especially the washing of clothes) are the most impactful steps of the life cycle of clothing[7].

Several actions can be undertaken at local level to mitigate the carbon footprint of the production and use phases: facilitate the creation of short-term clothing rental, promote more durable clothes, promote repair, and increase collection for re-use and re-use shops[8].

Food waste

As presented previously, food waste generation is quite different for the three territories, with Pays de la Loire presenting quite lower generated quantities:

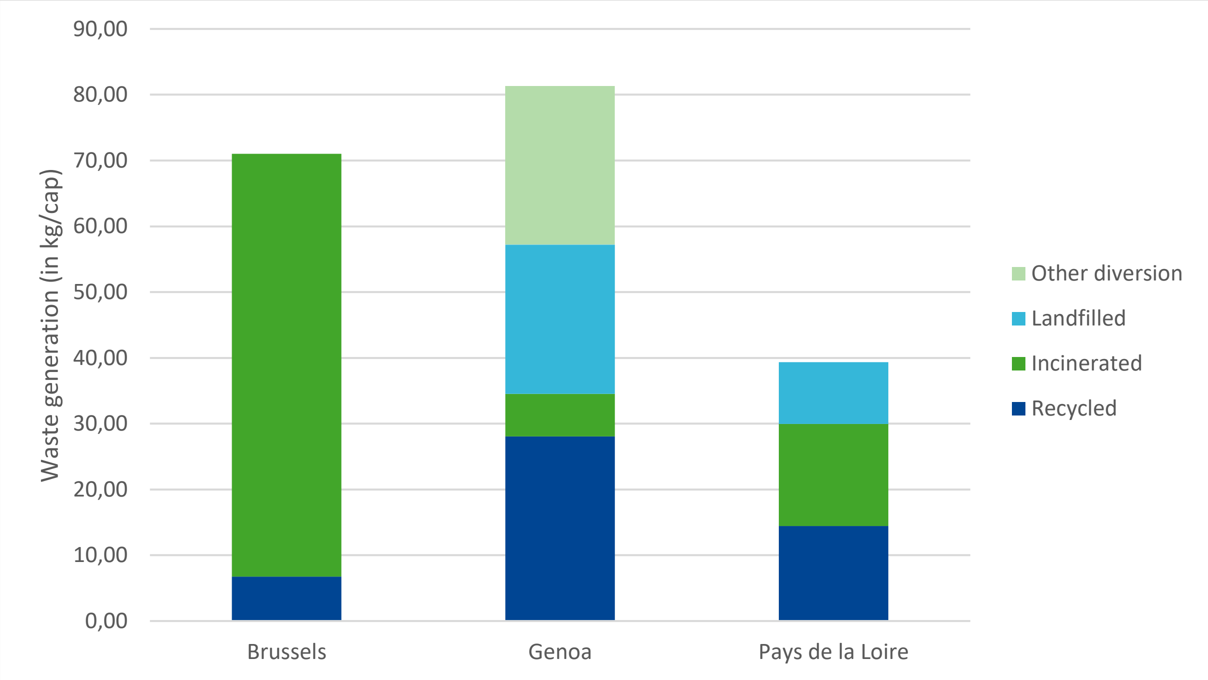

Figure 19: food waste generation in the three territories (in kg/cap/yr)

Food waste recycling is quite limited in all three territories. Food waste source separation is extremely limited, and most quantities sent to recycling in Genoa and Pays de la Loire are sorted in MBT plants. Incineration is the main treatment method in the Brussels-Capital Region, while landfilling is also used in Genoa and Pays de la Loire. Food waste collected in Brussels-Capital Region and Genoa is mainly sent to anaerobic digestion, while it is mostly sent to composting in Pays de la Loire.

---

6 https://www.bilans-ges.ademe.fr/documentation/UPLOAD_DOC_FR/index.htm?coton_-synthetique_-autre.htm
7 Rana et al., 2015, *Carbon Footprint of Textile and Clothing Products*
8 Ellen MacArthur Foundation, 2017, *A new textiles economy: Redesigning fashion's future*

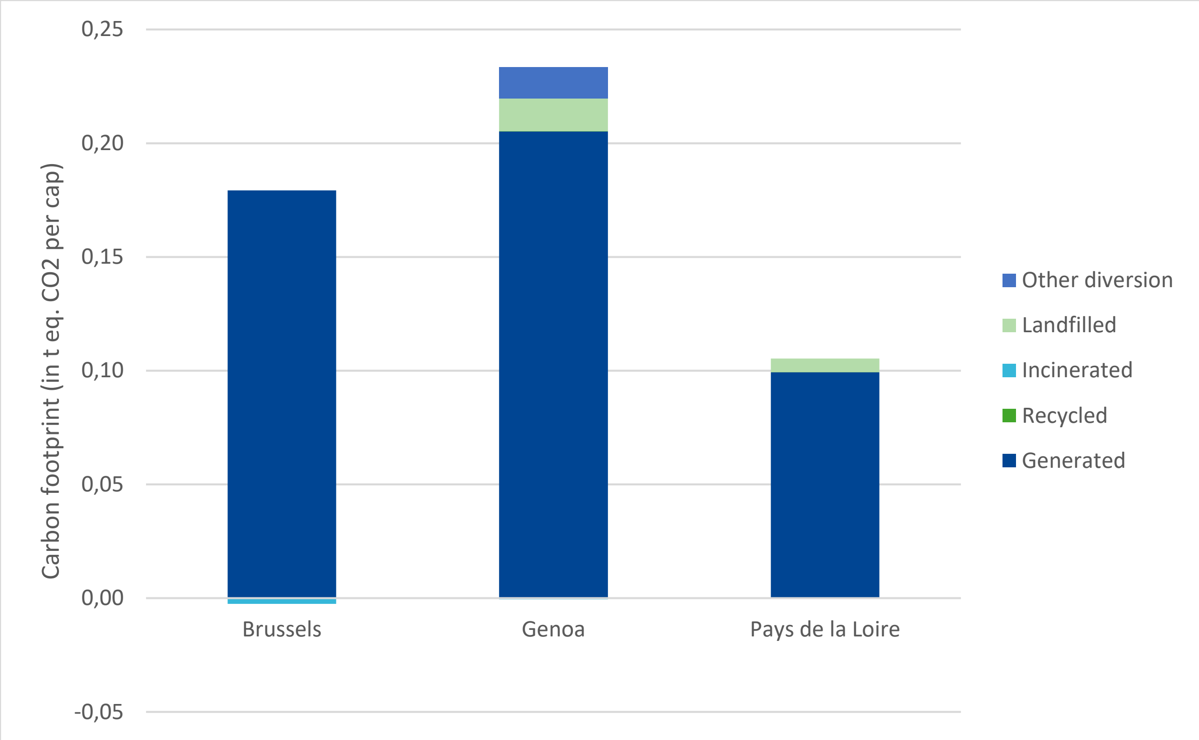

Figure 20: carbon footprint of food waste (in t CO2 eq. per cap)

The carbon footprints are dominated by the impact of the generation/use phase of food, and the current waste management strategies implemented in the three territories have limited impact on it. Again, due to little availability of local data, the same carbon factors were used to assess these footprints, when local consumption patterns could be different from one territory to another. Likewise, a better assessment of the current local recycling schemes could contribute to assess more accurately how increasing source separation could mitigate the carbon emissions.

However, it seems that the main potential for the reduction of the food footprint lies in food waste prevention. Agriculture is the most contributing phase when it comes to the carbon footprint of food[9], so reducing the losses (at every step of the value-chain, from production, to transformation, distribution, and consumption) is a priority action to improve the carbon footprint. Several actions can be promoted as local level, such as the promotion of low-carbon diets (e.g. with less meat and processed food, and more legumes[10]), and the reduction of losses (e.g. through awareness raising or the promotion of food donation).

Plastic

The reported quantities of plastic waste are very different from one territory to another, which might be linked to different scopes and data quality. The quantities and treatment methods are presented in the following graph:

[9] Notarnicola et al., 2015, *Environmental impacts of food consumption in Europe*
[10] WWF, 2018, *Vers une alimentation bas carbone, saine et abordable*

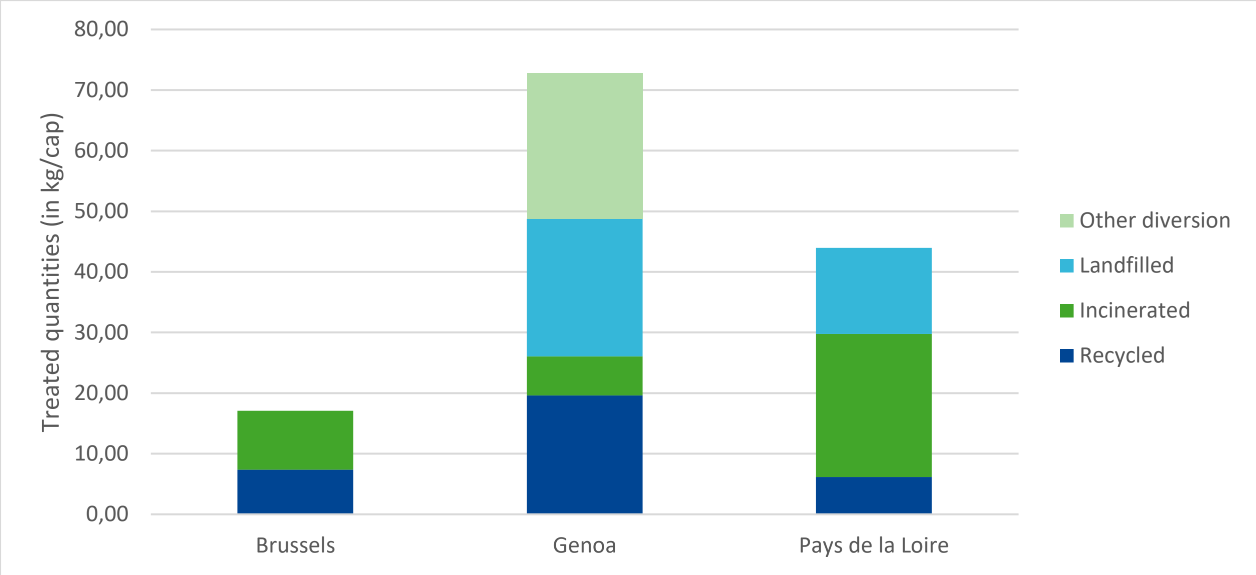

Figure 21: plastic waste treatment in the three territories (in kg/cap/yr)

Plastic waste includes various types of products. For all three territories, the same composition was used, due to a lack of data. The data used are the ones identified for Pays de la Loire: plastic waste is mostly composed of plastic packaging, and a share of hard plastic collected in civic amenity sites. Plastic is also included in different fractions: sanitary textiles, mattresses, and furniture waste, for instance. Most of the sorted plastic are plastic packaging (mainly bottles), and a small quantity of plastic waste is collected in civic amenity sites. Overall, plastic bottles (in PET, HDPE, and PO) represent about 25% of the total plastic waste generated, while films represent about 32%. The rest is composed of other types of packaging, and other hard plastic.

The carbon impact per capita is presented on the graph below:

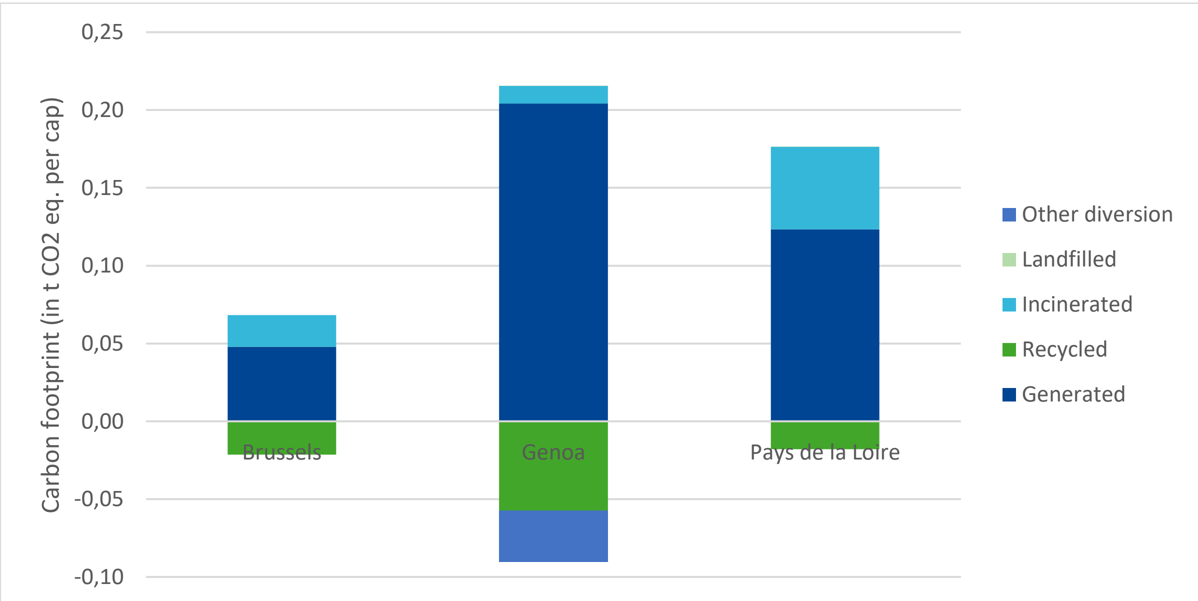

Figure 22: carbon impact of plastic waste generation and treatment for plastic waste (in t CO2 eq. per cap)

The carbon footprint is mostly impacted by the quantities generated, yet it is important to note that incineration can play an important role as well. The relatively higher recycling performances in Brussels and Genoa also lead to relatively large carbon saving. Considering the important savings allowed by recycling, there is a great potential in boosting the sorted quantities and the quality of sorted plastic to reduce the overall impact of plastic.

The carbon impact per tonne of waste is presented below:

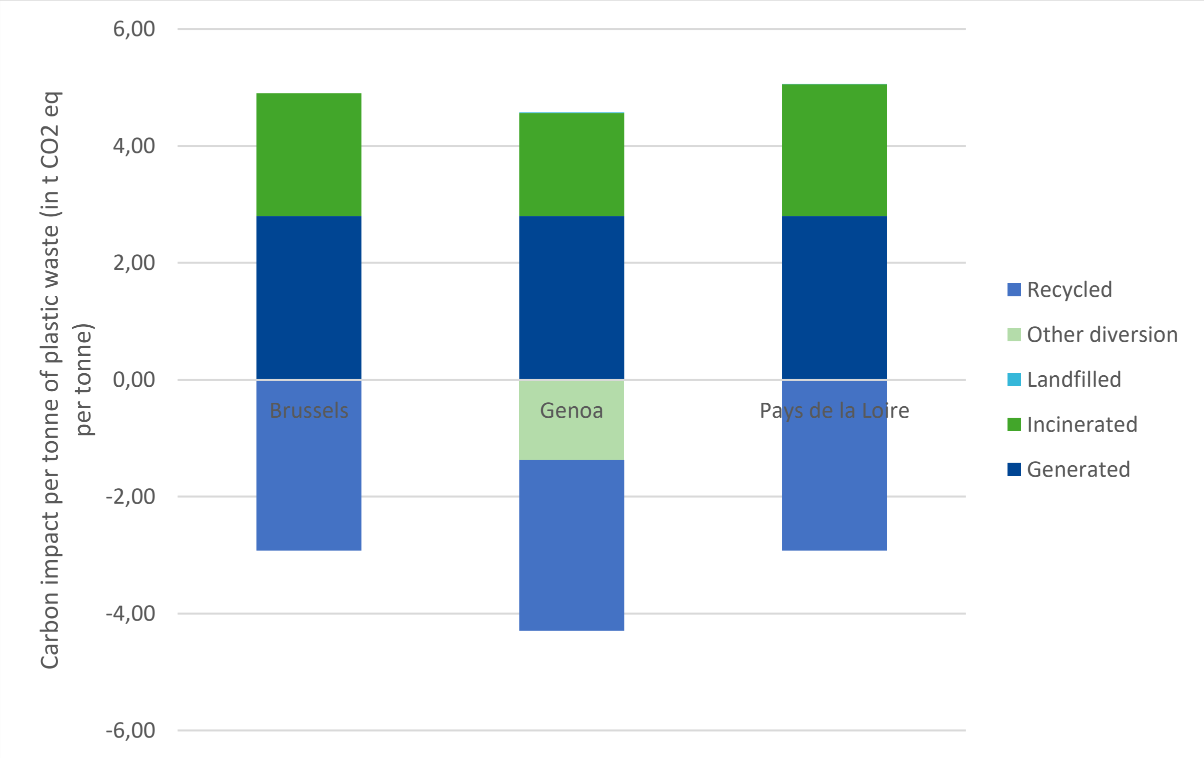

Figure 23: carbon impact of plastic waste per tonne of waste (in t CO2 eq. per tonne)

Due to unavailability of local data for two territories, the same carbon factors were used for the generation and recycling of plastic waste, which is probably not accurate. It is likely that the local collection, sorting, and recycling systems are different (including the quality, the EPR schemes, the recycling routes, etc.), which would lead to different carbon factors for recycled quantities. Incineration leads to different impacts; this is due to the fact that the energy mix are different from one country to another, leading to different carbon savings linked with energy recovery. Besides, the energy efficiency of incinerators might also play a role. For instance, incinerators producing electricity only are single-cycle stream-power plants, limited to efficiencies from 35 to 42%, while Combined heat and power units (producing both heat and electricity) offers efficiencies of up to 70%. More information on the energy efficiency of local incineration plants could give further insight on the actual impact of plastic incineration.

The lack of detailed local data prevented from better understanding how local specificities play a role in the carbon footprint for plastic. A better knowledge of local composition, as well as on the outcomes of sorted fractions (including impurities, recycling routes, etc.) would help to better understand how the current local schemes are effectively reducing the local carbon footprint.

GENERAL CONCLUSIONS

Even though the three territories present different waste compositions and waste management systems, several similarities can be listed:

- The impact of products (production and consumption) is extremely high compared with the impact of their end-of-life;
- Waste management allows to save carbon emissions, mostly thanks to recycling. Increasing recycling is likely to improve the overall carbon footprint, even if room for improvement is different from one fraction to another, and might also depend on the quality of the sorted materials and the actual recycling route that they follow. It is important to note that the focus should not only be put on the quantities sorted for recycling, but also the quality of the sorted waste (directly impacting the final recycled quantities), and the recycling routes (e.g. close-loop recycling vs. downcycling);
- The three territories share the same priority fractions when it comes to the potential for reduction, namely textile, food (garden waste has a rather limited impact), and plastic. If recycling has a potential to improve the carbon footprint, especially for plastic, it seems that the main potential for improvement lies in prevention and re-use.
- For these three fractions, more granular data would be relevant to better understand where the potential for reduction lies:
    - For food waste, reduction of food wastage is a key action to be promoted. It is very important to take into account this element and the quantities of avoidable food waste when designing biowaste treatment units. Indeed, organic recovery entails limited carbon savings compared to the impact of production of food wastage. Another important element that is not captured by the carbon metric is the relevance of closing the loop of nutriments through organic recovery. A better knowledge of the share of avoidable food waste could help setting more relevant targets in terms of prevention and recycling.
    - For textile, it seems that recycling holds a certain potential for reducing the carbon footprint, yet it might not be sufficient. Besides, textile recycling is still technically limited. More "upstream" actions focusing on production, durability of clothing, use (including washing), and re-use (donation, repair, remanufacturing) need to be promoted.
    - For plastic, recycling seems to have a true potential for reducing the whole carbon footprint, yet more details on the different types of plastic generated, the loss rates, and their actual recycling routes, would help to identify potential improvements.

It is important to note that there is little correlation between the tonnages of waste and their carbon footprint, as the most carbon-intensive fractions generally represent a very small share of municipal waste in weight. This calls for an on-going monitoring of the carbon footprint of waste, a better understanding of waste generation and composition, and more efforts put on prevention and re-use monitoring.

FOLLOW-UP

These assessments are a first step toward a better understanding of the carbon footprint of material resources at local level, as well as of the key actions to reduce this footprint. They have several limitations due to the paucity of local data, which prevents from better analysing how local specificities can play a role. However, they allow the identification of key fractions to focus on, especially textiles, food, and plastics. They also show how the impact of the end-of-life is generally limited, and how prevention and re-use measure as well as actions tackling production and consumption should be given more importance to make circular economy more effective in tackling climate change.

Comparisons are challenging, considering that these are the first datasets collected within the More Circularity, Less Carbon campaign. Besides, the scope of waste data reported by the different territories are not entirely comparable, some of them including commercial waste, while there might also be unreported quantities. The quality of local waste data is a key parameter to obtain comprehensive figures on the carbon footprint.

The current carbon impacts mostly reflect the composition of local waste, since the “generation” phase is the main contributor, and considering that common carbon factors were used for most waste fractions for all three territories. More data on the composition and recycling routes for key fractions could help to fine-tune the assessment and better understand how local specificities impact local carbon footprints.

Following this first assessment, follow-up activities can be proposed:

- Investigate the possibility to collect more information on the key fractions in the different territories, including on the undifferentiated fractions;
- Identify and assess the key actions that could be promoted at local level to effectively mitigate the local carbon footprint linked with material resources;
- Pursue the cross-analyses when the figures from the upcoming cohorts are available;
- Update the figures when new waste data are available, to monitor the evolutions.

Besides, this first assessment allowed the identifications of data gaps as well as of key factors that influence the local footprints. These findings will be useful to adapt the Carbon Metric International to make it more user-friendly, and more adapted to local waste data.

New cohorts will be organised, leading to the collection and analysis of more local and regional waste data, along with their carbon footprint. Further cross-analyses will be proposed, possibly leading to a better understanding on how local factors can influence the carbon footprint, and how priorities might change from one place to another.

Another important aspect to bear in mind is that the carbon footprint is only one of the environmental issues addressed by the circular economy. When defining strategies, it can be relevant to take other aspects (such as resource scarcity, air or water pollution, etc.) into consideration.

More information on the campaign, as well as the individual reports presenting the data for each of the three territories are available on the MCLC webpage.

-25%
BY 2025

MORE CIRCULARITY
LESS CARBON

ACR+

ZERO WASTE SCOTLAND

www.acrplus.org/morecircularitylesscarbon

#morecircularitylesscarbon

@ACRplus | @ZeroWasteScot