CARBON CALCULATOR FOR ZERO WASTE PROJECTS.

USER GUIDE

Version 1 (July 2021)

MISSION ZERO ACADEMY
powered by ZERO WASTE EUROPE

CONTENTS

1. INTRODUCTION

Welcome!

This user guide aims to present and help users through this tool to calculate the impacts of a zero waste approach in regards to reducing GHG emissions.

The tool is a service offered by the Mission Zero Academy, powered by Zero Waste Europe.

1.1. Context

Reducing the amount of waste generated at source, and reducing the hazardous content of that waste, is regarded as the highest priority according to the Waste Hierarchy established in the European Union legislation.

To achieve the vision of a circular economy and a carbon-neutral society by 2050, as set out by the European Union, a new mind-set will need to be rapidly adopted and translated into meaningful action on the ground that results in materials being recognised as valuable resources rather than waste.

Therefore, we should not just look at how best to dispose of waste safely, but to create and maintain systems that do not generate waste in the first place. Figure 1 presents this vision by considering an approach that moves from waste management to resource management.

Figure 1. A Zero Waste hierarchy for Europe. Source: [Zero Waste Europe.]()

The Zero Waste hierarchy has 7 levels, two related to products and five related to waste, which are described below.

Refuse, rethink, redesign

The first level encapsulates any activity related to stopping waste from being produced. Be it by creating a system that is waste free by design or by stopping the commercialisation of single-use items that can be easily replaced with alternatives. This category includes new production and consumption models that reduce the use of resources and the generation of wastes.

Example: *Reusable packaging solutions in closed loop systems (e.g. in food delivery or e-commerce).*

Reduce and reuse

Continuing on the topic of waste prevention, reduce and reuse considers using products or components for the same purpose for which they were conceived, or to repurpose them for another use that does not reduce their value. This avoids having underutilised assets in our economy and prevents materials ending up as waste. The goal is to prevent them from being discarded and instead find ways for them to go back into a circular economy. The processes included in this strategy may include straight reuse (possibly by someone else, possibly in a different way), refurbishment (cleaning, lubricating or other improvement) and repair (rectifying a fault).

Example: *Preventing near-to-perish food in supermarkets from becoming waste by selling it with a discount.*

Preparation for reuse

Moving down the hierarchy, preparation for reuse reproduces the efforts to clean, repair and refurbish items that have become waste in order for them to become products again. The processes included in this strategy may include straight reuse (possibly by someone else, possibly in a different way), refurbishment (cleaning, lubricating or other improvement), repair (rectifying a fault), redeployment or reuse of less than 100% of the original (using working parts elsewhere) and remanufacturing (the only option that requires a full treatment process -like new manufacture- to guarantee the performance of the finished object).

Example: *The refurbishment of Waste Electrical and Electronic Equipment (such as a fridge or a washing machine) to make them suitable to be used again. Or some upcycling examples to lift materials out of waste, such as rugs made from old sheets or re-upholstering old furniture.*

Note: the distinction of reuse and preparation for reuse is merely of a legal nature. More info here: http://ec.europa.eu/environment/waste/prevention/pdf/report_waste.pdf

Recycling, composting, anaerobic digestion

The fourth level of the hierarchy deals with what, in an ideal scenario, should be the last option to retain materials in sustainable resource management, namely to turn materials that have been separately collected into high quality secondary ones.

Example: *Turning separately collected paper or cardboard into cellulose for new products or packaging. Turning source separated high quality organics into soil improvers by means of composting and/or anaerobic digestion so as to restore fertility of soils.*

Material and chemical recovery

As explained, the Zero Waste Hierarchy differs from but supplements the EU's one in the configuration of its lowest levels. The EU waste hierarchy places energy recovery as the next step after recycling, whilst the Zero Waste Hierarchy prioritises the extraction of valuable materials from the mixed waste and the discards from sorting processes. This is better aligned with the vision of the Circular Economy, which aims to retaining the value of materials and resources within a circular loop, whereas thermal treatment of waste today often results and can be described as a "leakage of resources". Material Recovery and Biological Treatment operations on mixed waste in systems with high separate collection rates (which are set by the EU until 2035 currently) provide a cost-effective way to preserve the value of resources whilst minimising the volume of waste sent for disposal. The new technologies related to chemical recycling also fit in this level, but only as long as they deal with the discards of sorting processes -and not with separately collected streams- and they transform used polymers into new ones.

Residuals management

The current EU waste legislation obliges Member States to source separate and separately collect several waste streams, allowing for most bio-waste to be diverted from the residual waste. For any bio-waste not separately collected, this can be safely landfilled by means of prior biological stabilisation, in full compliance with the EU Landfill Directive and related obligation on pre-treatment. Such systems may be designed to work on increasing amounts of source separated organics, and decreasing amounts of residual waste. The transition that Europe is going to see in the coming years, very much depending on the success in advancing towards waste-free systems by design –see levels 1 and 2-, should see the amounts of residual waste dwindle and will require flexibility to adapt to this new scenario.

Unacceptable

The new hierarchy defines anything 'unacceptable' that results in the creation of a lock-in effect that obstructs the transition towards zero waste, destroys resources and/or are environmentally unsustainable. Landfilling of non-stabilised waste, littering and any sort of combustion or co-combustion of mixed waste, with or without oxygen, are options that should become part of the past because they contradict the EU decarbonisation and circular economy agendas, absorbing investment that should have otherwise been directed to the highest levels of the hierarchy.

1.2. Aim of the tool

The tool has three aims:

- To provide an accessible but data-driven framework that is capable of accounting for and visualizing the contribution of waste management policies towards reducing harmful emissions responsible for climate change
- To use a lifecycle approach to calculate the benefits of zero waste measures in reducing greenhouse gas (GHG) emissions within the following areas: waste prevention, reuse, preparation for reuse, recycling and disposal.
- To align the climate and zero waste agendas at the local (city) level, guiding policy-making towards a zero-waste, decarbonized economy.

Therefore, the tool allows the user to assess the GHG emissions of the current waste management system (*baseline situation*). The next step for the user is to highlight a series of potential zero waste strategies that could or are being implemented and that would result in a new waste management scenario in the coming future (*future scenario*). Such strategies are then transformed into 'added and avoided emissions,' which are accounted for together with the GHG emissions of the future waste management system. Therefore, the tool allows to compare the GHG emissions of the baseline situation and that of a potential future scenario, in the way towards zero waste cities.

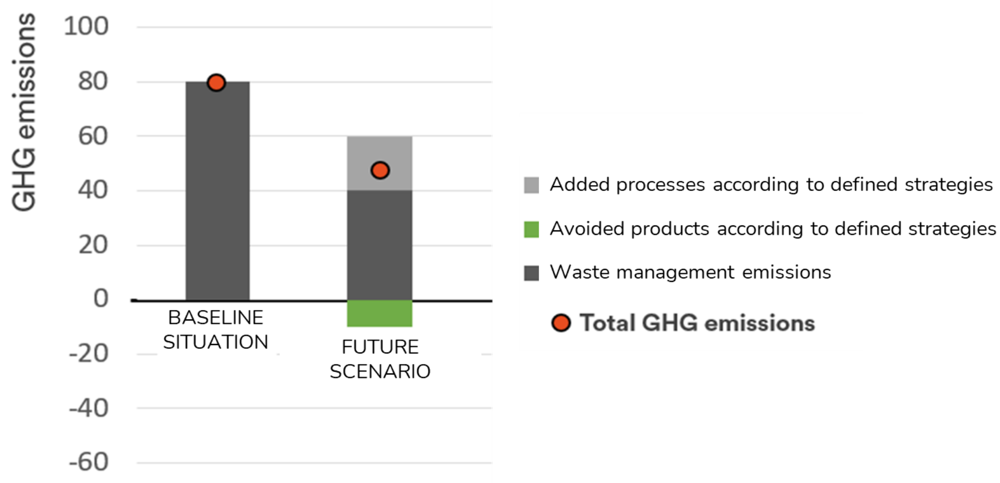


Figure 2. Comparison of GHG emissions from the baseline situation and the future scenario, after implementing zero waste strategies.

What are some potential uses of the tool?

Municipalities may use the tool for different potential uses, mainly:

- To compare the GHG emissions of two different years and track progress over time (by introducing waste management data in the 'baseline situation' and the 'future scenario' worksheets).
- To estimate the potential environmental effect of different 'What if…?' scenarios, by introducing information of the baseline situation and creating potential future scenarios.
- To feed the process of elaborating a zero waste city plan by enriching discussions and the planning process with information regarding the climate change contribution of the current situation and the effects of the plan.

Remember that:

Greenhouse Gas (GHG) emissions are only one way to measure the environmental impact of a policy (as well as the social and economic impacts that need to be factored in) and therefore this should inform a broader decision-making process which looks at the wider implications of waste prevention measures, supported by the Mission Zero Academy and the Zero Waste Cities Certification.

1.3. Before starting…

This user guide is organized according to the structure of the tool. Throughout the document, the reader will find guidance on how to use the tool, a definition of the key concepts and some tips on how to get the most out of the tool.

The calculator has been designed to function most effectively at the municipality level, though it can be used at any scale (including state, country, and region). Any municipality can use the tool if they have access to local waste management data. This also applies to municipalities outside of Europe, even though all default values built into the calculator are based on the European context.

Before starting with the tool, the following checklist provides an indication of the most important data required for input.

- The total amount of waste generated for the baseline year.
- The typical composition of municipal solid waste (MSW) generated within the study area.
- The amount of collected source-separated materials (e.g. glass, plastic, metals, paper and cardboard, organic material).
- The configuration of waste treatment plants (destinations and, if available, treatment efficiencies).
- Information regarding the zero waste strategies (added and avoided processes).
- As for the future scenario, the tool will provide guidance on how to estimate it, based on the current baseline situation and the defined zero waste strategies.

With these data, and following the step-by-step instructions, it is possible to obtain an estimation of the carbon footprint of any municipality's waste management and prevention operations, both for the current situation and the future scenario.

Where available, it is advisable to use location specific data in order to integrate its own characteristics and features to the calculation. Otherwise, default values based on European averages and estimations from the authors have been provided.

Reading the User Guide before using the tool is a must.

The quickest way to use the tool is by starting reading the User Guide, since it provides instructions and tips on how to take the most advantage of the tool. It is of extreme importance to understand how the tool works in order to avoid miscalculations misinterpretations.

1.4. Tool overview

The carbon calculator tool guides the user through a series of steps, each of them together within one specific Microsoft Excel worksheet[1].

Figure 3 presents the structure of the tool, which consists of a total of 6 steps (each of which is represented by a worksheet within the tool and numbered from 1 to 6).

WELCOME PAGE

1. READ ME!
Discover the basic aspects of this tool

2. ASSESS BASELINE SITUATION
Define the current waste management system in your city.

3. SET PRIORITIES
Set key performance indicators, targets and a timeline.

4. ZERO WASTE CITY ACTION PLAN
Define and describe the zero waste actions that will be implemented in your city.

5. FUTURE SCENARIO
Configure what will be the future waste management situation, once the actions have been implemented.

6. GHG EMISSIONS
Discover the climate change contribution of municipal waste in your city and the effect of the zero waste actions.

Figure 3. Overview of the tool structure.

Along the tool, the user will find instructions on how to proceed, moving from step 1 to 6. It is important to keep in mind that throughout the tool, **green cells** are highlighted and have been designed for local data to be included (Figure 4). Therefore, the user should introduce information into each green cell, when necessary and/or appropriate. On some occasions, the tool will show 'default data', based on national averages and estimates, but it will be the responsibility of the user to introduce data in the green cells (preferably introducing local primary data or, if not available, making use of the suggested default values). In addition to this, the user is asked to indicate, when possible, the references or sources of the data provided.

[1] The tool has been developed and should be used in Microsoft® Excel® for Microsoft 365 MSO (64 bits). If the software asks if you would like to activate macros, please select “Yes”.

Besides this, the user should be aware that the tool can be helpful in the process of becoming a certified Zero Waste City, under the framework of the Zero Waste Cities Certification (more details are available in Section 7 of this user guide). Under this certification scheme, a set of Key Performance Indicators is established, which can also be assessed within the tool, as shown in Figure 4.

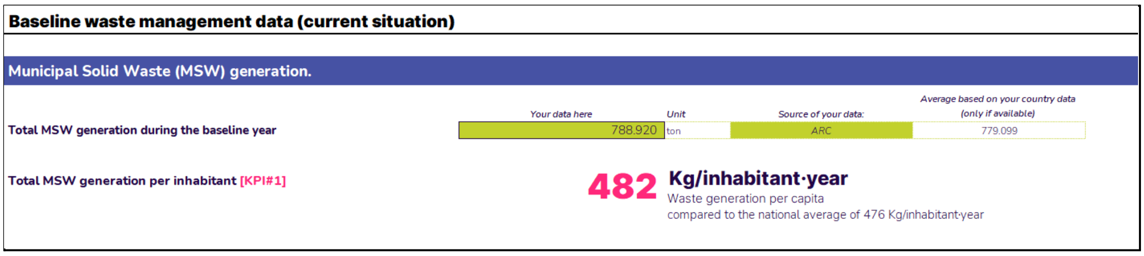


Figure 4. Tool screenshot.

Your feedback is very much appreciated

You are about to use the first version of the Carbon calculator for zero waste projects, a service offered by the Mission Zero Academy, powered by Zero Waste Europe. This implies that you may be among those early-adopters that use the tool to account for and visualize the contribution of waste management policies towards reducing harmful emissions responsible for climate change.

As it happens with any new tool or product, feedback is necessary to identify improvement opportunities and to refine it. It might also be possible that occasional bugs are encountered when using the tool. For all these reasons, all users are encouraged to share their experience and provide feedback. These inputs are very valuable to move on building more robust tools and methods towards a zero waste world.

2. ASSESS BASELINE SITUATION

2.1. General city parameters

This section establishes the general parameters for the city (or any other kind of unit of study) (Figure 5).

General city parameters

	Your data here	Unit	Source of your data:
Country	Spain		
Municipality	BARCELONA		
Baseline year	2019		
Population (inhabitants)	1.636.762	inhabitants	Idescat

Figure 5. Tool screenshot showing the general city parameters.

The baseline year should be chosen taking into account the availability of data.

The selection of the country allows the tool to provide background data for some parameters, if available.

Background data

The country selection establishes a set of default values (at the national level) that the user can choose to use for their study area, if specific values are not available. These are presented automatically and the user may decide at each point whether to introduce their own data, or keep the background data, which is often the national average of their country.

Selecting “Others” from the drop-down “Country” box provides a set of European-average default values obtained from different sources.

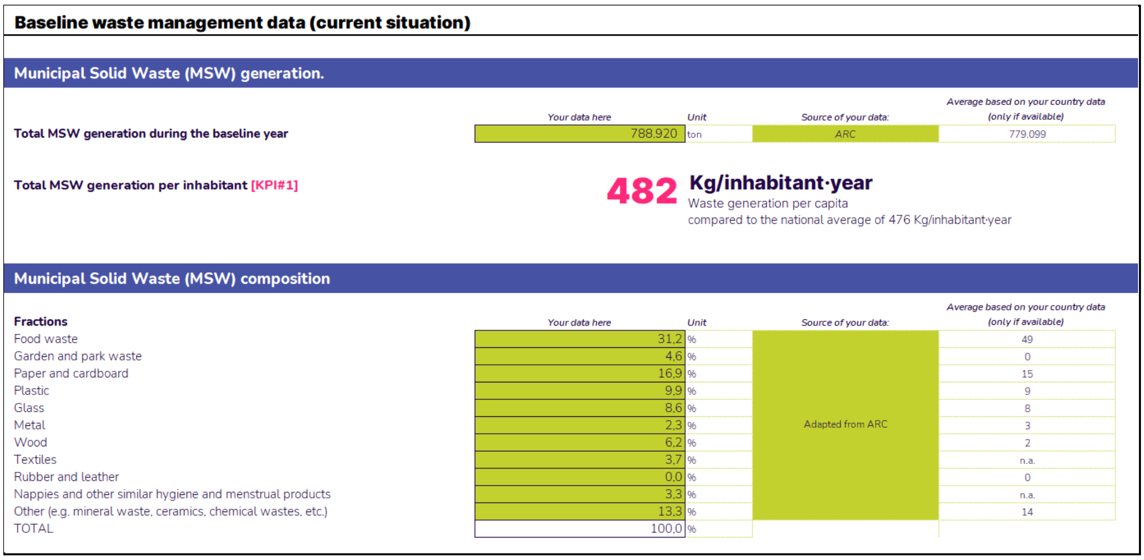
Background information available in the tool:

- Waste generation per capita
- Waste treatment options
- Waste composition
- Source-separation of waste (from the capital city of the selected country).
- Landfill biogas capture
- Electricity mix emission factor

More information about the background data can be found in ANNEX I: BACKGROUND DATA.

2.2. Baseline waste management data (current situation)

This section allows the user to insert their waste management data corresponding to the baseline year (Figure 6). It is important that the user provides the source of the data, which should be publicly available where possible.



Baseline waste management data (current situation)

Municipal Solid Waste (MSW) generation.

	Your data here	Unit	Source of your data:	Average based on your country data (only if available)
Total MSW generation during the baseline year	788.920	ton	ARC	779.099

Total MSW generation per inhabitant [KPI#1]

482 **Kg/inhabitant·year**
Waste generation per capita
compared to the national average of 476 Kg/inhabitant·year

Municipal Solid Waste (MSW) composition

Fractions	Your data here	Unit	Source of your data:	Average based on your country data (only if available)
Food waste	31,2	%	Adapted from ARC	49
Garden and park waste	4,6	%		0
Paper and cardboard	16,9	%		15
Plastic	9,9	%		9
Glass	8,6	%		8
Metal	2,3	%		3
Wood	6,2	%		2
Textiles	3,7	%		n.a.
Rubber and leather	0,0	%		0
Nappies and other similar hygiene and menstrual products	3,3	%		n.a.
Other (e.g. mineral waste, ceramics, chemical wastes, etc.)	13,3	%		14
TOTAL	100,0	%		

Figure 6. Tool screenshot showing the beginning of the 'Baseline waste management data' section.

Key Performance Indicators (KPIs)

The tool presents three KPIs by default:

- Total MSW generation per inhabitant [KPI#1]
- Overall separate collection rate [KPI#2]
- Diversion rate of MSW from harmful disposal methods and false solutions [KPI#3].

2.2.1. Municipal Solid Waste (MSW) generation

Municipal waste covers household waste and waste similar in nature and composition to household waste, as defined by the European Union.

In order to learn more about municipal waste, one can read the EU's guidance on municipal waste data collection. Figure 7 presents waste generation per capita throughout European countries.

Figure 7. Municipal waste generated per capita in EU countries in 2019. Source: [Eurostat.](#)

2.2.2. Municipal Solid Waste (MSW) composition

The MSW composition distinguishes several waste fractions, based on materials, namely:

- Food waste
- Garden and park waste
- Paper and cardboard
- Plastic
- Glass
- Metal
- Wood
- Textiles
- Rubber and leather
- Nappies and other similar hygiene and menstrual products
- Other (e.g. mineral waste, ceramics, chemical wastes, etc.)

> The tool works with waste streams and fractions based on materials (e.g. metal, plastic, wood) and not on product categories (e.g. WEEEs, packaging, furniture). This is important since the assessment of the environmental impact is based on the material (and not on the product or its function). In other words, if we prevent furniture waste, we may be preventing wooden, metal and plastic materials.

To use the tool effectively, the user should insert local data on the composition of MSW (prior to any sort of source-separation of waste).

In the case of the ‘Other’ fraction, the user should make sure that it does not include any of the previous waste fractions and, in particular, that it does not include biodegradable waste (e.g. food, green waste, paper and cardboard, nappies or wood). This is of relevance since the ‘other’ fraction is considered inert in case it ends up landfilled.

What should be done if data is compiled under different waste categories from those provided?

The composition options provided is consistent with typical MSW composition reporting across Europe. The user should always be able to allocate domestic waste streams to the categories provided, even if they come under different names. For example, bulky waste may be divided into wood (a table), metal and other (e.g. mattresses) It is up to the user to make their data fit into the composition options provided. Note that the “other” category is used to accommodate waste fractions not represented in this breakdown. Examples of wastes typically found within the “other” category include ceramics, porcelain, batteries and small electronic waste.

2.2.3. Collection of source-separated materials

In this section the user is required to input the amount (tonnes) of source-separated materials collected separately from the mixed general waste stream over the study period (baseline year). The tool will then automatically calculate the percentage (%) collected for each waste stream within the total generated amount.

The tool assumes a waste management system where the collection of source-separated materials is promoted using a series of different colour-coded collection containers (either communal or per household) or pneumatic systems that allow for the public to dispose of their glass, plastics, metals, paper and cardboard and organic materials separately. These categories of source-separated collected materials are reasonably common throughout Europe and most are compulsory for EU Member States, but finer details and further options (e.g. textile, Waste Electrical and Electronic Equipment or bulk waste collection systems) can vary from country to country, with some nations (and even different regions within one country) employing a variety of different collection systems. These sy

What should be done if the source-separated collection categories within the system of study do not match the ones provided?

There are three likely reasons for such an issue to arise:

- The waste collection system provides facilities for separating the recyclable materials into even further categories (e.g. in some countries, glass is separated according to colour);
- The local collection system does not provide facilities for separate collection of certain materials (e.g. separate collection of organic material is not practised everywhere) and
- The recyclable material may be collected in commingled recycling bins (e.g. paper, glass and plastic collected together) and separated down-stream in a specific facility.

Table 1 provides some suggestions to assist the user in manipulating his/her data to account for any such differences.

Table 1. Typical reasons for deviation from the source-separated material categories

Reason for deviation	*How to adjust the data*
(1) System has more source-separation categories	Generally, the excess categories will simply be one of the five accounted for in the Tool, but broken down into further sub-categories (e.g. clear, green and brown glass). If this is the case, simply add the percentages of these sub-categories to fit into the five categories of glass, plastic, metals, paper & cardboard and organic materials.
(2) Some materials are not source-separated	If any of the five categories of source-separated waste are not collected separately in the specific study area, simply adjust the relevant source-separation percentage for that category to 0%.
(3) Commingled recycling	Use downstream data or empirically-derived assumptions to break these quantities down into their individual components (e.g. in Ragusa, Italy, glass and metal (cans) are collected together in one container; however the percentage contribution of each is known). If it is not possible to obtain data or to use relevant assumptions for isolating these materials into the

	categories required by the tool, then simply revert to the default values provided.

How should Tetra Pak items be allocated?

According to Tetra Pak, their products are typically comprised of aluminium (5%), paper (74%) and plastic (21%). If the user has specific data for the amount of tetra-pak items recovered through the source-separation process (by weight), then it is recommended that he/she calculates the different waste categories using the percentage calculation above and then allocate these the results to the relevant categories in the tool. For example, if source-separation results in 100 tonnes of tetra-pak each year. Therefore, 5 tonnes (5%) is allocated to the source-separated metals category, 74 tonnes (74%) is allocated paper and 21 tonnes (21%) to plastic.

What are the differences between composting and anaerobic digestion?

Composting and anaerobic digestion are two common biological processes used to treat the source-separated organic fraction. As a result of composting, one can obtain compost, that can be used as an alternative to fertilizers. On the other hand, anaerobic digestion processes generate biogas (a source of energy) and a digestate fraction that can be eventually composted. In terms of greenhouse gas emissions, anaerobic digestion tends to have a lower footprint. However, composting presents other benefits, such as lower costs, easier to implement and scale up and it helps enrich local soil. On many occasions, composting is the most common solution for small & medium municipalities (who have greater ability to compost at homes & in the community), whereas anaerobic digestion may be used mostly in larger municipalities[2].

2.2.4. Residual waste (MSW non-source separated)

The amount of residual waste is automatically calculated based on the difference between the total generation of waste and the amount of source-separated materials.

Where does the residual waste go?

The tool distinguishes different destinations for residual waste:

- Mechanical-Biological Treatment (MBT) plant, with either composting or anaerobic digestion processes. Mechanical–biological treatment (MBT) plants treat municipal solid waste (MSW), with the aim to minimize the environmental impact associated with the residues landfilling and to add values to waste outflows for a potential utilization. MBT consists in a combination of mechanical processes (shredding, size, density and magnetic separation, densification, etc.) and biological treatment (aerobic or anaerobic degradation) of the organic fraction mechanically separated. Discover more on MBT plants here.
- Material Recovery and Biological Treatment (MRBT) plant. Discover more on MRBT here.
- Incineration & "energy recovery" methods
- Landfill

[2] For more information regarding composting and anaerobic digestion, one can read this Policy Paper from Zero Waste Europe:

Each of these waste treatment options is modelled within the tool, by considering a set of parameters (recovery efficiency, energy consumption, operation emissions, etc.). Some of the emissions depend on the waste composition.

In the case of MBT/MRBT treatment plants, where does the stabilised organic fraction (SOF) go?

This section allows the user to indicate the destination of the stabilised organic fraction, also known as biostabilized fraction. This is an aspect that may be very country-specific, since there exist different strategies and legal frameworks across Europe. Whereas some countries allow to use it in agriculture, in most situations the destination will be landfilling or incineration.

In the case of MBT/MRBT treatment plants, where does the output residual fraction go (excluding SOF)?

This section allows the user to indicate the destination of the output residual fraction. This may be very site-specific, depending on the waste treatment Infrastructure available In the region. The options presented In the tool are: landfill, Incineration and the preparation of Refuse Derived Fuels (RDFs). This last option consists of sending the output residual fraction to a treatment plant with the aim to transform the waste Into a RDF, Increasing Its heating value and reducing the potential harmful effects after combustion.

If the user has specific data on the efficiency of waste treatment plants…

The tool comes with a set of automated efficiency parameters for all waste treatment options. The background data provided by the tool is based on the performance of a set of European waste treatment installations[3]. However, there may be quite different situations across Europe. For this reason, the user may have specific data on different aspects (e.g. recovery of materials in MBT processes, biogas capture in landfills, energy recovery in incineration processes…).

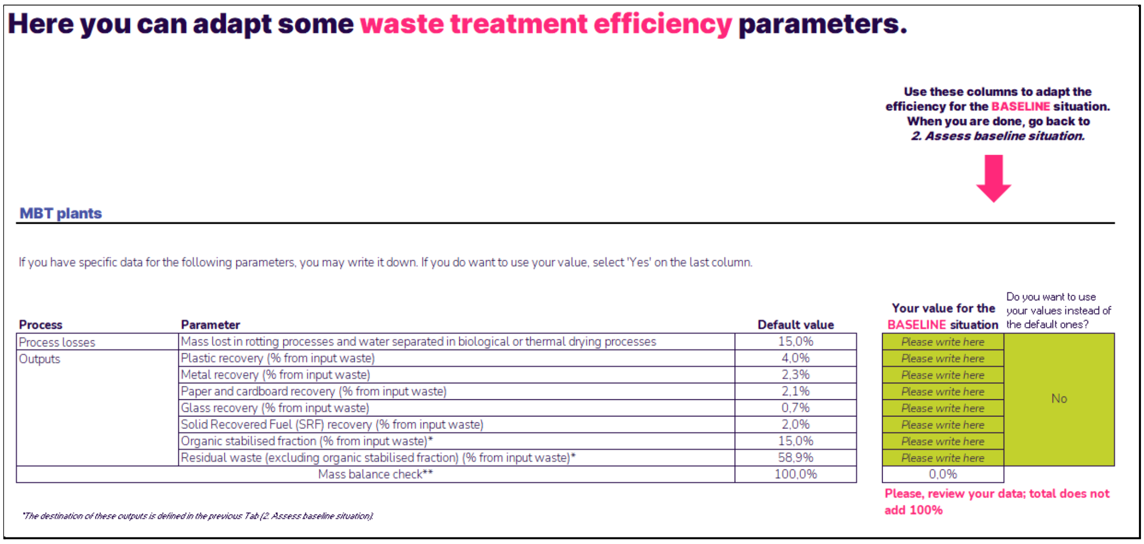
This is particularly important for some waste treatment plants and parameters, such as MBT plants. These installations show a strong variability of the different flow characteristics, mainly due to the heterogeneity of the input MSW and to the different configurations of processing units employed in MBT plants. Therefore, most suitable end-uses or disposal options for the MBT outputs are site-specific.

If the user has specific data on the efficiency of waste treatment plans, it is possible to click on the 'Treatment efficiency' button (Figure 8).

[3] The parameters used for M(R)BT installations are based both on data from real installations, the findings and assumptions from a policy briefing from Zero Waste Europe and the review performed by Di Leonardo et al. (2012). In the case of the landfill biogas capture, the default value is obtained from the National Inventory Reports. As for the electricity mix, is obtained from Ecoinvent 3.6.

Figure 8. Tool screenshot showing the option to adapt the treatment efficiency and waste composition.

This will take the user to a new worksheet (with the tab: "2.1. Treatment Efficiency", see Figure 9), in which it will be possible to adapt some parameters[4]. The user can decide to update the parameters for all or only a few plants. After introducing the new parameters, it is necessary to select 'Yes' from the drop-down list to activate calculations based on the user's data. The process is reversible, so the user can click 'No' at any time to Indicate that default data should be used.



Here you can adapt some waste treatment efficiency parameters.

Use these columns to adapt the efficiency for the BASELINE situation. When you are done, go back to *2. Assess baseline situation.*

MBT plants

If you have specific data for the following parameters, you may write it down. If you do want to use your value, select 'Yes' on the last column.

Process	Parameter	Default value	Your value for the BASELINE situation	Do you want to use your values instead of the default ones?
Process losses	Mass lost in rotting processes and water separated in biological or thermal drying processes	15,0%	Please write here	No
Outputs	Plastic recovery (% from input waste)	4,0%	Please write here	
	Metal recovery (% from input waste)	2,3%	Please write here	
	Paper and cardboard recovery (% from input waste)	2,1%	Please write here	
	Glass recovery (% from input waste)	0,7%	Please write here	
	Solid Recovered Fuel (SRF) recovery (% from input waste)	2,0%	Please write here	
	Organic stabilised fraction (% from input waste)*	15,0%	Please write here	
	Residual waste (excluding organic stabilised fraction) (% from input waste)*	58,9%	Please write here	
	Mass balance check**	100,0%	0,0%	

Please, review your data; total does not add 100%

The destination of these outputs is defined in the previous Tab (2. Assess baseline situation).

Figure 9. Tool screenshot showing the default parameters from MBT plants, which can be adjusted by the user.

In this worksheet, the user may choose to substitute the default country-specific electricity emission factor (obtained from ecoinvent), with a specific electricity mix emission factor. This can be done both to define a new electricity emission factor to account for the impact of the consumed energy (Consumed electricity emission factor) and the avoided impact related to energy valorization practices (Avoided electricity emission factor). The definition of these parameters both for the baseline situation and the future scenario, will allow the tool to model a decarbonization process of the energy sector during the action plan implantation.

[4] In worksheet "2.1. Treatment efficiency" the user will be able to adapt the efficiency parameters both for the baseline situation and the future scenario. At this moment, the user will start with the baseline situation, and will pay no attention to the future scenario options.

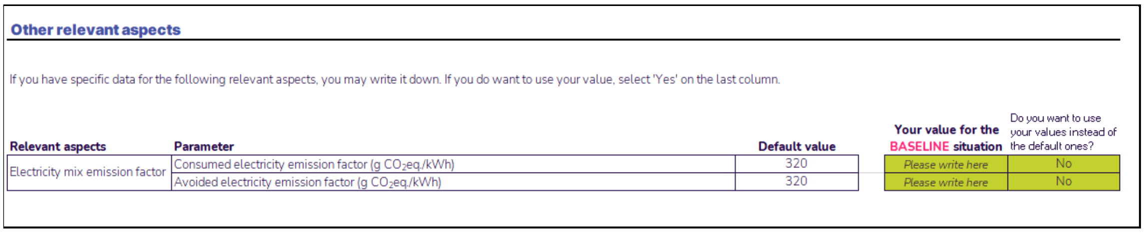


Figure 10. Tool screenshot showing the default value of the electricity mix emission factors, which can be adjusted by the user.

The user can go back to the worksheet "2. Assess baseline situation" by clicking on the located at the bottom (Figure 11).

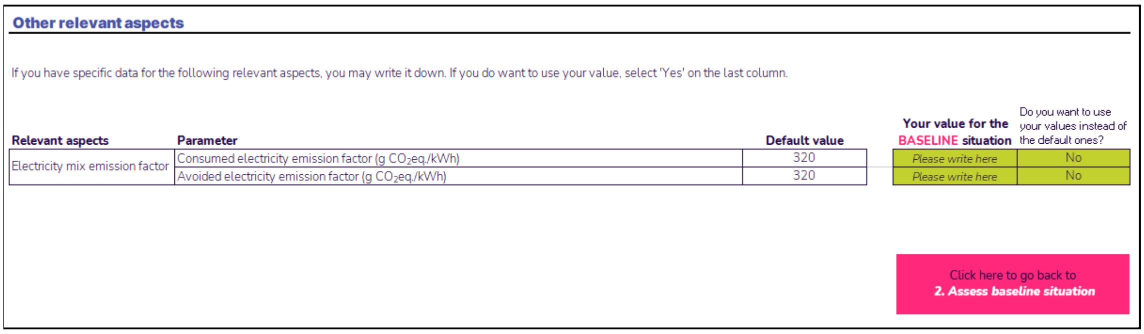


Figure 11. Tool screenshot showing the button to go back to 2. Assess baseline situation.

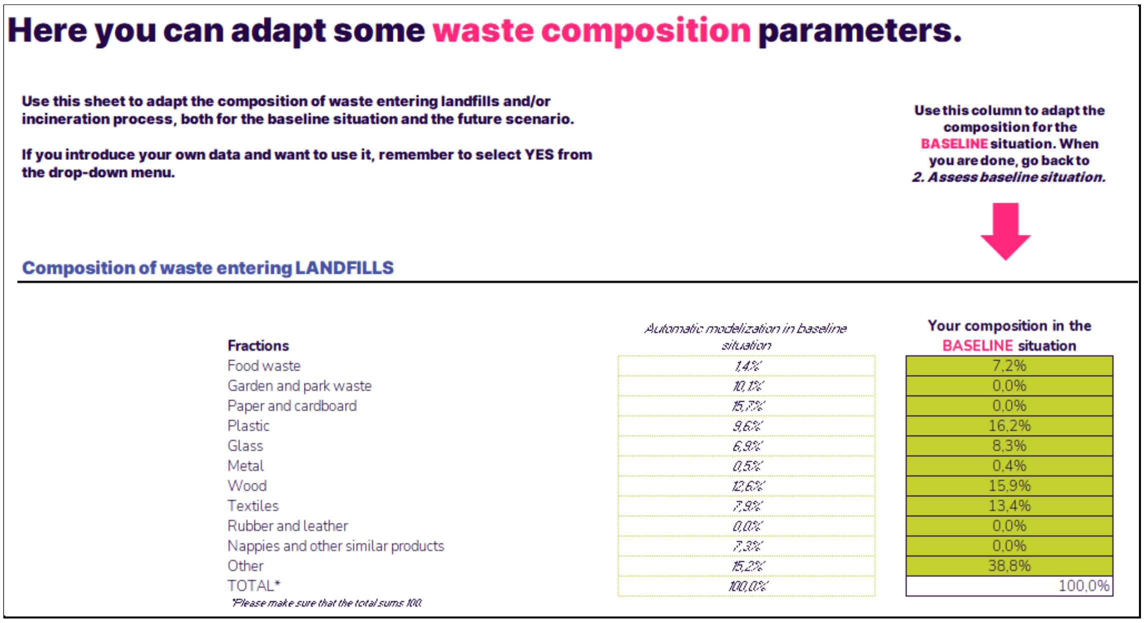
If the user has specific data on the composition of waste entering landfills and/or incineration processes…

By default, the composition of the residual waste (MSW non-source separated) is derived from the overall MSW composition, by simply subtracting the source-separated collection materials (by mass) from the overall MSW stream. The compositions of these waste streams are utilised in a number of in-built algorithms.

However, waste composition may be very site-specific and, at the same time, has a very important effect on GHG emissions (e.g. burning plastic emits huge amounts of CO2, or landfilling biodegradables emits methane). For this reason, if the user has local waste composition data, it is very suggested to insert it. If not, a default model of waste composition will be used.

In a similar way to the configuration of the waste treatment efficiency, it is possible to click on the 'Waste Composition' button (Figure 8). This will take the user to a new worksheet (with the tab: "2.2. Waste composition", see Figure 12), in which it will be possible to adapt the composition of waste[5]. After Introducing the new parameters, it is necessary to select 'Yes' from the drop-down list (the process is reversible, so the user can click 'No' at any time to indicate that default data should be used).

[5] In worksheet "2.2. Waste composition" the user will be able to adapt the efficiency parameters both for the baseline situation and the future scenario. At this moment, the user will start with the baseline situation, and will pay no attention to the future scenario options.



Here you can adapt some waste composition parameters.

Use this sheet to adapt the composition of waste entering landfills and/or incineration process, both for the baseline situation and the future scenario.

If you introduce your own data and want to use it, remember to select YES from the drop-down menu.

Use this column to adapt the composition for the BASELINE situation. When you are done, go back to *2. Assess baseline situation.*

Composition of waste entering LANDFILLS

Fractions	*Automatic modelization in baseline situation*	Your composition in the BASELINE situation
Food waste	*1,4%*	7,2%
Garden and park waste	*10,1%*	0,0%
Paper and cardboard	*15,7%*	0,0%
Plastic	*9,6%*	16,2%
Glass	*6,9%*	8,3%
Metal	*0,5%*	0,4%
Wood	*12,6%*	15,9%
Textiles	*7,9%*	13,4%
Rubber and leather	*0,0%*	0,0%
Nappies and other similar products	*7,3%*	0,0%
Other	*15,2%*	38,8%
TOTAL*	*100,0%*	100,0%

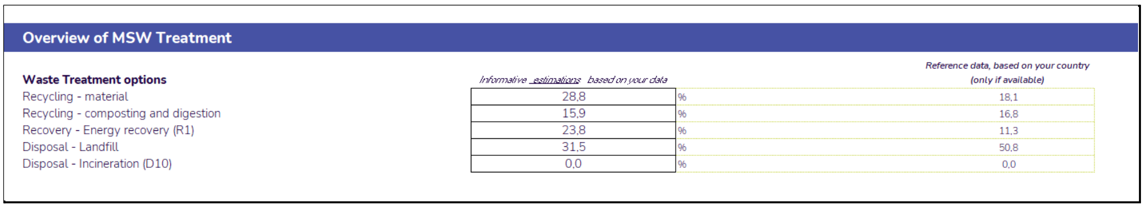
**Please make sure that the total sums 100*

Figure 12. Tool screenshot showing the option to introduce the composition of waste entering landfills.

The user can go back to the worksheet "2. Assess baseline situation" by clicking on the button located at the bottom (Figure 11).

2.2.5. Overview. Overall MSW Treatment.

The aim of this section is to present some automatically calculated indicators of the waste management system in the baseline situation. The estimations provided here are calculated in accordance with environmental statistics and accounts, based on the previously inputted data. This will allow the user to compare the local performance with reference data for the selected country (Figure 13).



Overview of MSW Treatment

Waste Treatment options	*Informative estimations based on your data*		*Reference data, based on your country (only if available)*
Recycling - material	28,8	%	18,1
Recycling - composting and digestion	15,9	%	16,8
Recovery - Energy recovery (R1)	23,8	%	11,3
Disposal - Landfill	31,5	%	50,8
Disposal - Incineration (D10)	0,0	%	0,0

Figure 13. Tool screenshot showing the 'Overview' section.

Waste Treatment Options

A total of five options are distinguished (Figure 14):

- Recycling – material (excluding composting or fermentation)
- Recycling - composting and digestion
- Disposal - Landfill
- Incineration (with and without energy recovery)
    - Disposal Incineration (disposal) (D10)
    - Recovery - Incineration (with energy recovery) (R1)

The flow chart below illustrates the usual municipal waste treatment operations.

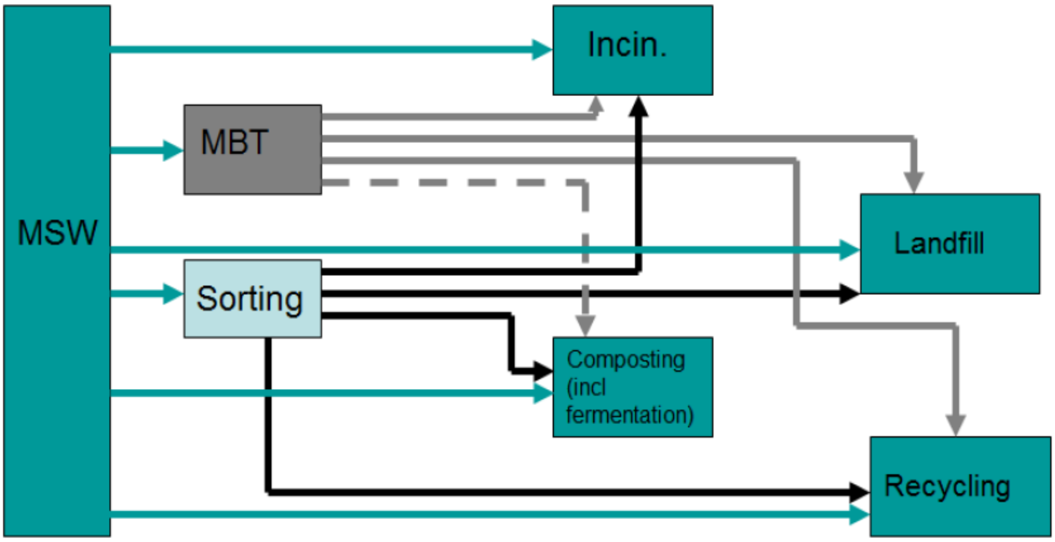


Figure 14. Municipal waste treatment options. Source: European Commission

Additional notes:

- Municipal waste treatment shall be broken down by the four categories landfill, incineration, recycling and composting/digestion as shown in Figure 1;
- For sorting and MBT, the outputs shall be allocated to these four above treatment categories.
- For composting/digestion, only separately collected organics are accepted for reporting.
- Secondary wastes from the above four treatment operations shall not be considered.
- Municipal waste can either be recycled directly or after pre-treatment operations.
- The biological treatment of residual waste in an MBT cannot be regarded as composting, when the product of that treatment is subsequently landfilled, incinerated or otherwise not used for the purpose mentioned above.

Figure 15 shows the different situations that can be found across Europe.

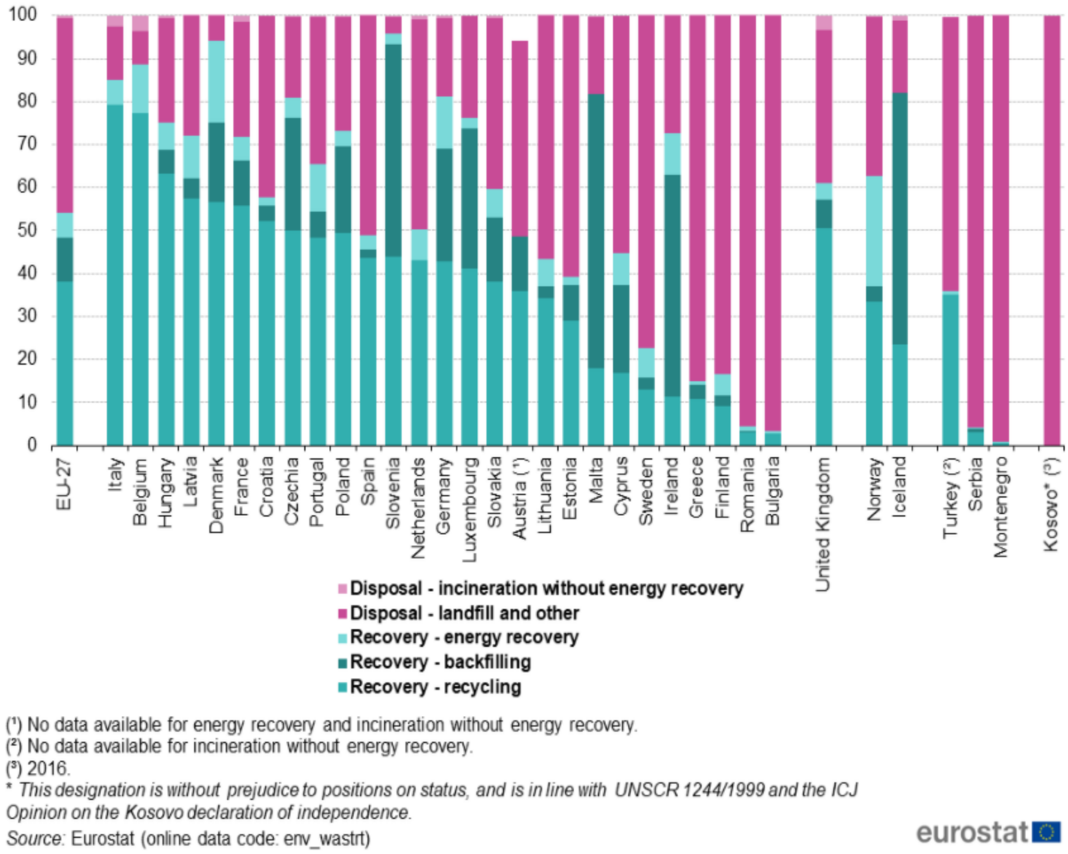


Figure 15. Waste treatment by type of recovery and disposal, 2018 (% share of total). Source: Eurostat.

More details on the statistics can be found in European Commission.

Waste Diversion Rate

This consists of the diversion rate of MSW from harmful disposal methods and false[6] solutions. These methods include waste being sent to landfills, for incineration and other burning methods such as waste-to-energy or refuse-derived-fuel plants. Other methods and false solutions include gasification, pyrolysis and chemically recycling materials into fuels.

How should waste statistics be reported?

The "Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD" (2020) is the current reference document to provide guidance to Member States on the reporting of municipal waste data. It has been used to define the waste treatment categories in the 'Overview of MSW Treatment' subsection in the tool. The referred guidance document will be further improved and expanded as more experience becomes available with data collection and reporting. For revised versions of the guidance document, please check https://ec.europa.eu/eurostat/web/waste/methodology.

[6] The term 'false solutions' is used to refer to unsustainable solutions which are considered as problem shifting and not solving the problem.

2.2.6. Waste collection and transport

This section allows the user to introduce information regarding the collection and transportation of the waste generated in the city. This includes the collection and transport of waste to the place of treatment or discharge by municipal services or similar institutions, or by public or private corporations, specialized enterprises, or general government. Collection of municipal waste may be selective, that is to say, carried out for a specific type of product, or undifferentiated, in other words, covering all kinds of waste at the same time.

The tool allows the user to introduce information using tonne-kilometre (tkm) as a unit. A tonne-kilometre, abbreviated as tkm, is a unit of measure of transport which represents the transport of one tonne of waste by a given transport mode over a distance of one kilometre. For example, if a city transports 10 tonnes of waste along a distance of 5 Km, this will result in 50 tkm, calculated by multiplying the tonnes by the distance. The tool considers the use of garbage trucks, and distinguishes two parts (Figure 16):

- Collection and urban transport. Here the user should indicate the tKm travelled by garbage trucks corresponding to the waste collection routes and the travels within the city. For this first part, a higher energy consumption due to the operations taking place is considered (for example, the garbage truck uses a loader to pick up the trash bins and a compactor with a packer blade inside to compress the garbage when loading into the hopper).
- Interurban transport. Here the user should indicate the tKm travelled by garbage trucks out of the city, in their way to waste treatment plants.

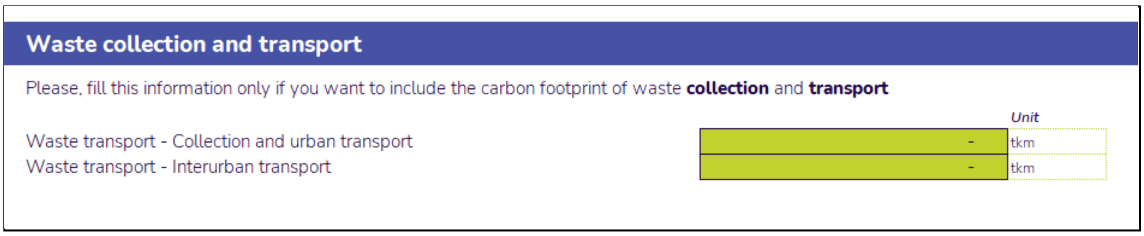


Figure 16. Tool screenshot showing the waste collection and transport.

3. SET PRIORITIES

This step allows the user to describe their zero waste vision and priorities for the city, in the short, mid or long term (Figure 17).

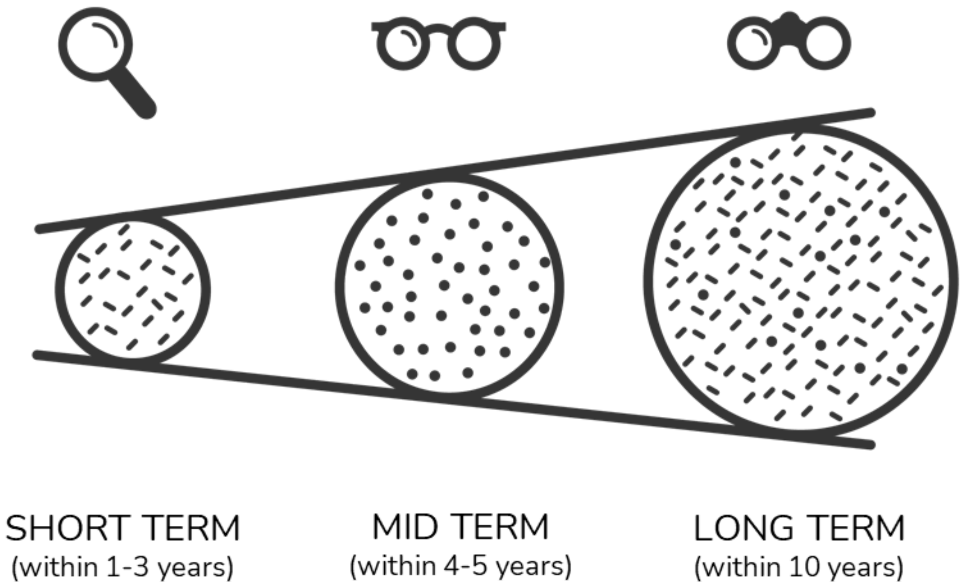


Figure 17. The tool allows to work in different timeframes: from the short-term (within 1-3 years) to the long term (within 10 years).

3.1. Your vision

In this step, the user can define their vision of the city under the zero waste framework (Figure 18). What is the overall aim and targets? What are the priority areas? What impact will this have on the city? All answers are welcome. This optional exercise can be useful to align the team towards a shared vision. Information introduced here will not be used for any calculation.

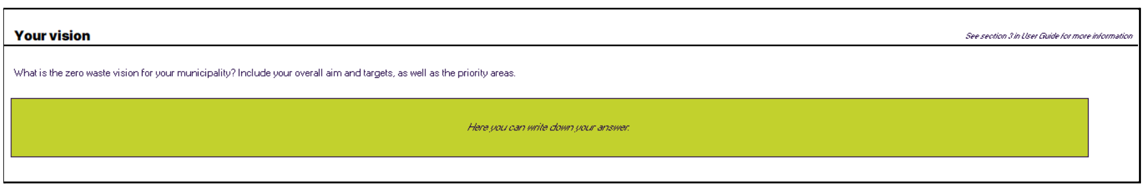
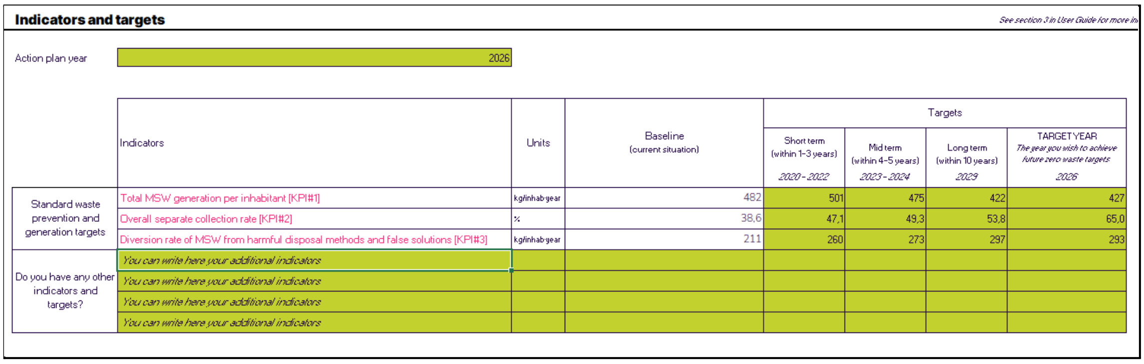


Figure 18. Tool screenshot showing the 'Your vision' section.

3.2. Indicators and targets

The user can see the current performance (baseline year) by means of three by-default Key Performance Indicators (KPIs). In addition to these, the user can establish other performance indicators, by writing them down in the table (Figure 19).



Indicators and targets — *See section 3 in User Guide for more in*

Action plan year: 2026

	Indicators	Units	Baseline (current situation)	Targets: Short term (within 1-3 years) *2020 - 2022*	Targets: Mid term (within 4-5 years) *2023 - 2024*	Targets: Long term (within 10 years) *2029*	Targets: TARGET YEAR *The year you wish to achieve future zero waste targets* *2026*
Standard waste prevention and generation targets	Total MSW generation per inhabitant [KPI#1]	kg/inhab·year	482	501	475	422	427
	Overall separate collection rate [KPI#2]	%	38,6	47,1	49,3	53,8	65,0
	Diversion rate of MSW from harmful disposal methods and false solutions [KPI#3]	kg/inhab·year	211	260	273	297	293
Do you have any other indicators and targets?	*You can write here your additional indicators*						
	You can write here your additional indicators						
	You can write here your additional indicators						
	You can write here your additional indicators						

Figure 19. Tool screenshot showing the set of indicators and targets.

After deciding the Key Performance Indicators, the user can establish targets for each one. These targets can be set for different timeframes. Optionally, the user can define them for the short, mid and long term. However, what is a must is to establish the Action Plan year in the last column, as the temporal reference to define the Zero Waste Action Plan. In other words, the setting of the action plan year establishes the timeframe for the Future Scenario. Therefore, all actions that will be introduced later in the tool will be implemented within the period between the baseline situation and the future scenario (action plan year) (Figure 20).

Figure 20. Diagram representing the timeframe considered within the tool.

4. ZERO WASTE CITY ACTION PLAN

In this section, the user will be able to introduce a series of zero waste strategies (or actions) as part of their zero waste vision (see Figure 1 for an overview of potential actions). To do so, the user must go through the following important steps:

- Step 1. First of all, it is necessary to list the strategies/actions that are going to be implemented by the municipality (up to 15 maximum) in the Main Table (Figure 21). Be aware that the table starts with four rows and as the user writes down more strategies, new boxes (rows) will be automatically added.
- Step 2. Once that is done, the user can click the button 'Click here to edit' for each of the strategies, in order to provide specific information about them.
- Step 3. After introducing the information for all strategies/actions, the user can go back to the Main table to have an overview of the effects of the whole set of strategies.
- Step 4. Finally, it is the time to set an efficiency ratio, if necessary, for the several strategies.

Main table (overview of strategies) *See section 4 in User Guide for more information*

	Strategy / Action		Zero Waste Hierarchy	Waste Streams affected	Added elements	Avoided elements	Efficiency ratio
1	Reusable nappies and menstrual products campaign	Click here to edit	1. Refuse / Rethink / Redesign	Nappies and other similar hygiene and menstrual products	NO	NO	100%
2	Foster the reusing culture in the city	Click here to edit	3. Preparation for reuse	Textiles	NO	NO	100%
3	Redistribution of food surplus	Click here to edit	2. Reduce and reuse	Food waste	NO	YES	100%
4	Promote reusable containers	Click here to edit	1. Refuse / Rethink / Redesign	Plastic	NO	YES	100%
5	Biowaste compost	Click here to edit	4. Recycling / composting / anaerobic digestion	Food waste	NO	NO	100%
6	Selective collection: increase of quantity and quality	Click here to edit	4. Recycling / composting / anaerobic digestion	Food waste	NO	NO	100%
7	Promoting tap water and reducing the use of single-use plastic bottles	Click here to edit	1. Refuse / Rethink / Redesign	Plastic	NO	NO	100%
8		Click here to edit	0	0	NO	NO	100%

Figure 21. Tool screenshot showing the main table with an overview of the zero waste strategies.

What is the efficiency ratio in the Main Table?

As shown in the Main Table (Figure 21), the last column is titled ‘Efficiency ratio’. This factor might be used for those cases in which different ZW strategies interfere each other, and consequently it is necessary to adjust the outcomes of the strategies. By default, the efficiency rate is set at 100%. Optionally, for the most evident situations in which one can expect interferences/synergies, the user could adjust the efficiency by introducing a correction factor.

Let’s see an example. One can define two different (but interrelated) strategies: a campaign to reduce food waste and a new door-to-door system to collect the organic fraction. If both actions take place simultaneously, the expected Increase of collected organic fraction might be reduced due to the reduction in the generation of this waste stream. In that case, the user could establish an efficiency ratio (for example, of 80 or 90%). It Is suggested to use this ratio only when evidences of interference are available.

4.1. Details on each strategy / Action

Each zero waste strategy requires the introduction of information organized into a template, named ‘ZW strategy card’ (Figure 22). Each card should be used for a specific strategy, with a total of 15 cards available. In case that the user needs more cards, it is possible to add several strategies into the same card (with the only disadvantage of adding the environmental benefits in an integrated manner and, therefore, preventing to assess the individual effect of each strategy).

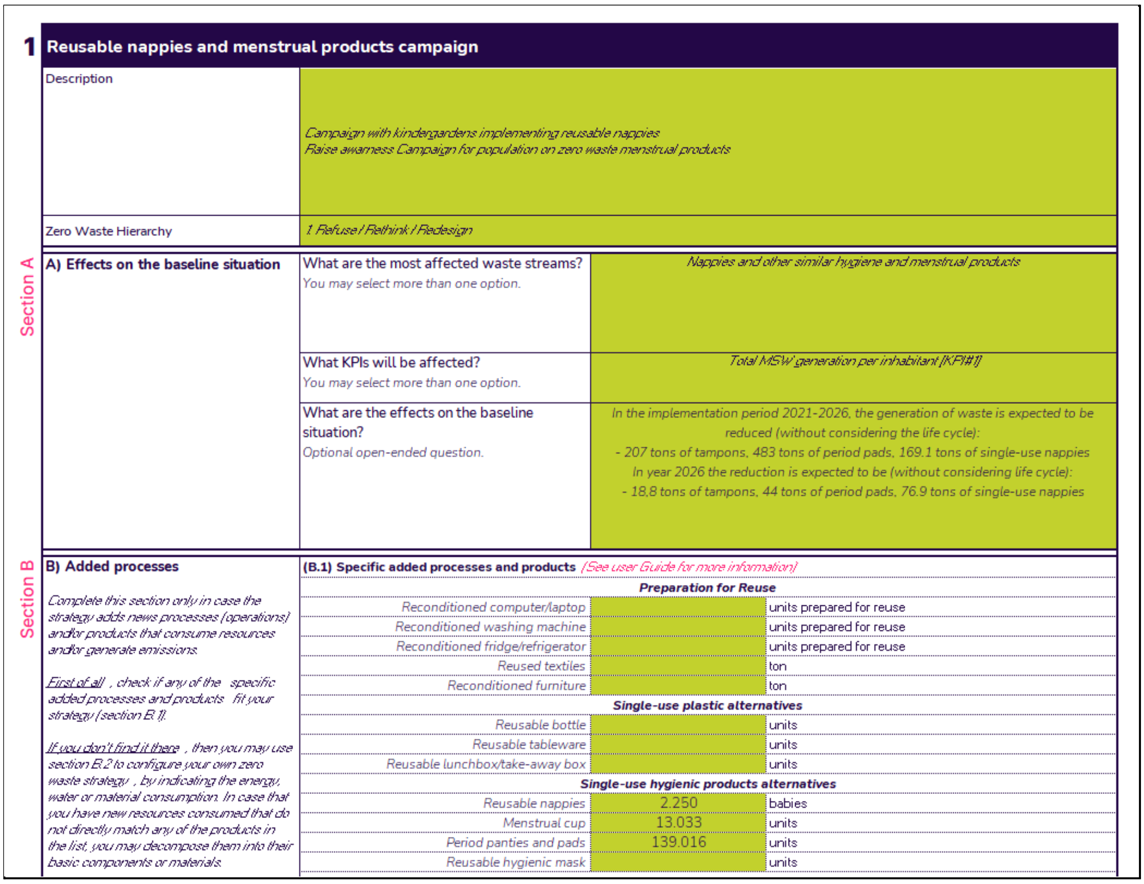


Figure 22. Tool screenshot showing a part of the ZW strategy cards, used to collect the information related to each strategy.

The structure of the ZW strategy cards has four main parts, as shown in Figure 23.

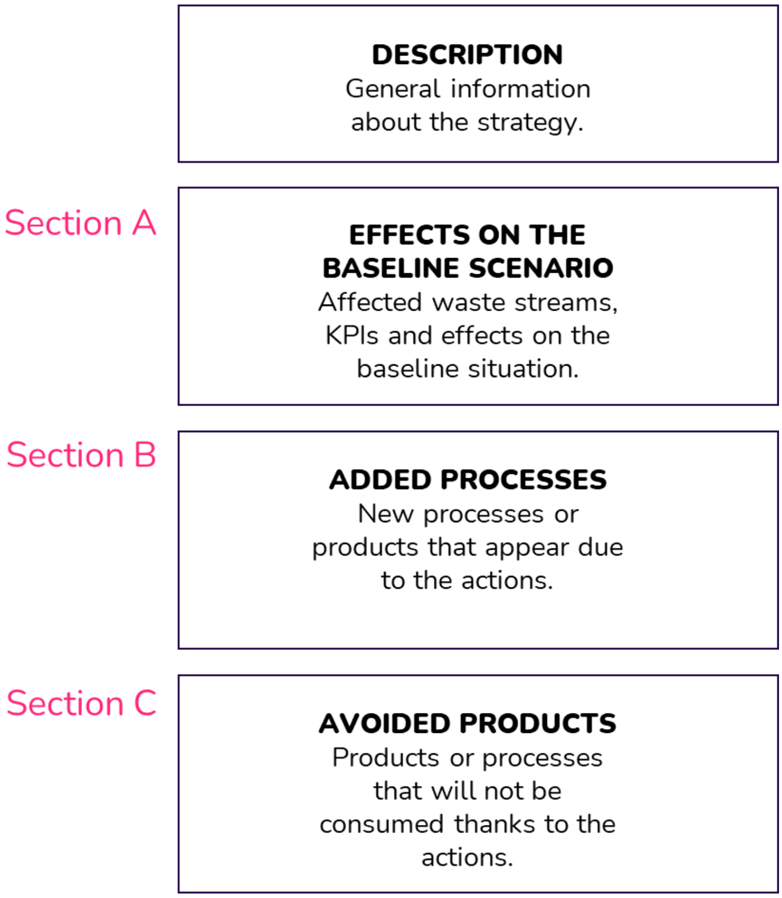


Figure 23. Structure of the ZW strategy cards, organized into four parts.

Description

This first part of the ZW strategy card shall be used to introduce a description of the strategy to be implemented. In addition to this, the strategy has to be classified into one of the seven levels of the zero waste hierarchy (see Aim of the tool in this guide for more details).

Section A. Effects on the baseline scenario

For all kind of strategies, the user will need to complete this section, answering the three questions:

- What are the most affected waste streams?
- Wkat KPIs will be affected?
- What are the effects on the baseline situation?

The last question is of special relevance, since later it will be used to configure the waste management system in the future scenario. For this reason, it is advised to pay special attention to answer it and provide as much detail as possible.

Section B. Added processes

This section allows the user to introduce information on the added processes or products due to the implementation of the strategy. For example, in the case of a reusable nappies campaign, new kits of reusable nappies will need to be produced and used. Or in the case of computer preparation for reuse, new processes will appear (collecting old computers and repairing them).

Section B distinguishes two alternative subparts:

- *Section B.1*. Here the user will find a set of common ZW strategies, related to Preparation for Reuse operations and alternatives to single-use plastics and single-use hygienic products. If the strategy to be introduced fits with any of these, the user will use Section B.1. to introduce data about the strategy. If this is not the case, the user will move to Section B.2. It is envisaged that the user will use either section B.1 or section B.2 (not both).
- *Section B.2.* If the strategies defined in section B.1. do not fit the strategy that the user wants to introduce, this section will be used to configure any kind of zero waste strategy. To do so, the user will need to estimate the amount of resources consumed to implement the strategy (energy, water, materials…).

Section C. Avoided products

This section allows the user to estimate the effects of the strategies, in terms of the avoided products that will not need to be produced, due to a reduction in the consumption of new products. Therefore, this section will be used only for waste prevention strategies, which correspond to the following levels of the ZW hierarchy: (1) refuse/rethink/redesign, (2) reduce and reuse and (3) preparation for reuse.

In a similar way as in Section B, section C distinguishes two alternative subparts:

- *Section C.1*. It will be used only in case that section B.1 has been previously used for a given strategy. Here the user will be able to introduce the amount of products saved from being produced, related to the strategy. For example, if the user indicates in Section B.1. that 100 tonnes of textile are prepared for reuse, here it will be possible to indicate that this strategy will save, for example, 50 tonnes of new textile from being produced. The tool will provide estimated values to help the user.
- *Section C.2.* It will be useful to indicate that any kind of product or resource is saved from being produced.

When preparing the action plan, it is of utmost importance to complete the strategy card with as much detail as possible.

It is especially important to describe with detail the several actions and complete section A. This will be extremely helpful later to define the future scenario. In addition to this, sections B and C can be relevant for some actions.

Again, the user should read the User Guide to fully understand the assumptions underlying sections B.1 (added processes) and C.1. (avoided products) of the strategy card. There the user will find details on the considerations by default for the pre-defined zero waste strategies and, consequently, the user will be able to adapt -if necessary- the information introduced in section C.1.

It has been observed that there may be very site-specific conditions that can differ from background data introduced in the tool. For example, in the case of a reusable nappies campaign, default data pre-introduced in the tool considers that reusable nappies are used for 2 years and a half all day and night. However, the strategy planned for the case study city considers its use only in kindergartens. As a result, the final number of disposable nappies that will be prevented will be smaller than the automatically calculated by the tool.

Section C

C) Avoided products

Complete this section only in case the strategy avoids the consumption of new products. Products are only avoided in the prevention strategies/actions, i.e. in the three first steps of the ZW Hierarchy (Refuse/Reghink/Redesign; Reduce and reuse; Preparation for reuse).

If you introduced information on section (B.1. Added processes), then you should use section C.1. here. In column F you will see an estimated value for the avoided products. Use this value or adapt it in column D.

In case you used section (B.2. Added processes), then you may also complete section C.2 here to indicate the avoided products of your strategy. Note: in case that you have a product that combines several materials, if you don't find it in the 'Specific products' list, you can disagreggate it into their material components.

Check the ***User Guide*** *for more information and*

(C.1) Specific avoided processes and products *(See user Guide for more information)*

			Estimated values
Avoided products from Preparation for Reuse			
New computer		units	
New washing machine		units	
New fridge/refrigerator		units	
New textile products		tons	
New furniture		tons	
Single-use plastic alternatives			
Single-use bottle		units	
Single-use tableware		units	
Single-use lunchbox/take-away box		units	
Single-use hygienic products alternatives			
Disposable nappies	4.380.750	units	8.541.000
Disposable sanitary towels	40.288.491	units	75.347.400
Disposable tampons	17.264.014	units	32.252.024
Disposable surgical masks		units	
Disposable FFPX masks		units	

Figure 24. Example of avoided products related to a campaign against single-use hygienic products. It can be seen that the estimated values by the tool are higher than the ones assumed in this example. It is the user who will need to decide if estimated values are right or another consideration should be made.

Two main approaches can be useful to estimate the effects of the actions.

As for the expected effects of the actions, it has been observed that there are two alternative approaches:

- The user can estimate the effect based on the likely results from the actions. For example, if one imagines that 1000 families will participate in a reusable nappies campaign, the user can assume that each family will save a given number of disposable nappies.
- The user can consider that the actions will achieve some specific targets, and he/she configures them based on its achievement. For example, the Spanish National Framework Plan for Waste Management (2016-2022) aims to achieve 50% preparing for re-use and recycling by 2020 of which 2% will be prepared for re-use deriving mainly from textiles, WEEE and furniture and from other waste streams. Therefore, the user can consider that a specific action will achieve the 2% target for preparation for re-use. This approach has been used to estimate the effect of the action 'Foster the reusing culture in the city', which considers preparation for re-use of WEEE, textile and furniture.

All kind of zero waste strategies must have the description of the action. In addition to this, it is also necessary to complete Section A, in which the user will describe the effects of the strategy on the baseline situation.

For a better assessment of the effects of ZW strategies on the future waste management scenario and the GHG emissions, it is also advisable to go through sections B and C. The information introduced there will allow the tool to get more accurate results.

Remember that Section B may be used for all kind of strategies that have new processes or products associated to their implementation. In the case of section C, it will only be used for waste prevention strategies (levels 1 to 3 in the ZW hierarchy).

4.2. Details on each strategy / Action

4.2.1. Zero waste strategies Integrated within the tool

A total of 12 zero waste strategies have been assessed and integrated within the tool (Figure 25). The user can see them in sections B.1 and C.1 within the ZW Strategy Cards. These strategies have been selected, since they are considered a priority for Zero Waste Europe, and they are amongst some of the most common ZW strategies. All these strategies fit within the first three levels of the ZW hierarchy.

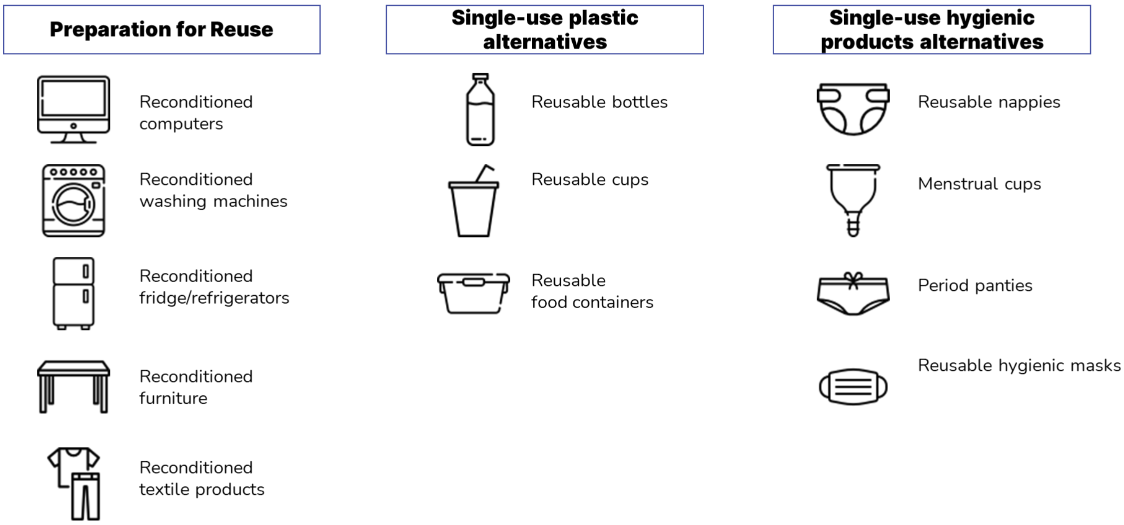


Figure 25. Overview of zero waste strategies that have been analysed and introduced in the tool.

For each of these strategies, research has been carried out in order to estimate what are the average added processes and avoided products (Table 2). As added processes, one can find all those activities and operations that take place due to the introduction and implementation of the strategy. For example, in the case of Preparation for Reuse of computers, the old devices need to be collected, reconditioned and redistributed. Or in the case of hygienic face masks, the reusable ones need to be produced and maintained (during their use, several washing operations are necessary). On the other hand, as avoided products, there are those products that do not need to be produced, since they are not necessary any more (e.g. a new computer, that is substituted by a repaired one, or single use hygienic masks, substituted by the reusable ones). To make a fair comparison, a life cycle approach is necessary (so one must compare the production and maintenance of a reusable product with the production of several single-use products -that do not require maintenance).

Table 2. Limits of the assessment considered in each of the zero waste strategies. Be aware that the end of life impacts are not accounted for within the 'added processes' and 'avoided products' categories. Instead, they are considered within the assessment of the baseline situation and the future scenario. For this reason, each ZW strategy will show a potential increase and/or reduction of waste, and will be modelized within the future scenario assessment.

ZW STRATEGY	**ADDED PROCESSES** The impact of new added processes is accounted for.	**AVOIDED PRODUCTS** The impact of producing new products is accounted for.
Preparation for Reuse > WEEEs, Textile & Furniture.	Collection and Distribution operations. Preparation for reuse processes (incl. substitution of components).	Production of new products (substituted by the reconditioned products).
Single-use plastics alternatives > Bottles, cups and containers.	Production and maintenance of new reusable products.	Production of single-use plastic products (substituted by the new reusable products).
Single-use hygienic products alternatives > Nappies, hygienic masks, menstrual cups, period panties.	Production and maintenance of new reusable hygienic products.	Production of single-use hygienic products (substituted by the new reusable products).
Strategies against food waste	Non-defined by default. The user will need to create new added processes, if necessary.	Production of new food products (substituted by saved food).

For example, in the case of reconditioned computers, a set of parameters have been pre-defined. Let's see it in an illustrative example (Figure 26). In this case, let's imagine that from 100 computers collected for its preparation for reuse, an average total of 25 computers can be effectively reconditioned[7]. The expected life time of these reconditioned computers is 3.000 hours each. Therefore, 5 reconditioned computers would be necessary to substitute the function provided by a new one, which has an expected life time of 15.000h. As a result, the substitution factor in this case would be 20% (1 reconditioned computer saves 0.2 new computers from being produced). The preparation for reuse of computers adds some processes to the system and therefore some GHG emissions. On the other hand, this strategy avoids the production of new computers, and the generation of an equivalent amount of waste (that will not enter the future waste stream).

[7] Actually, this success ratio may be very site-specific, depending on the attributes/characteristics of the elements entering the preparation for reuse process, which in turn depends on their origin and the waste collection schemes in place.

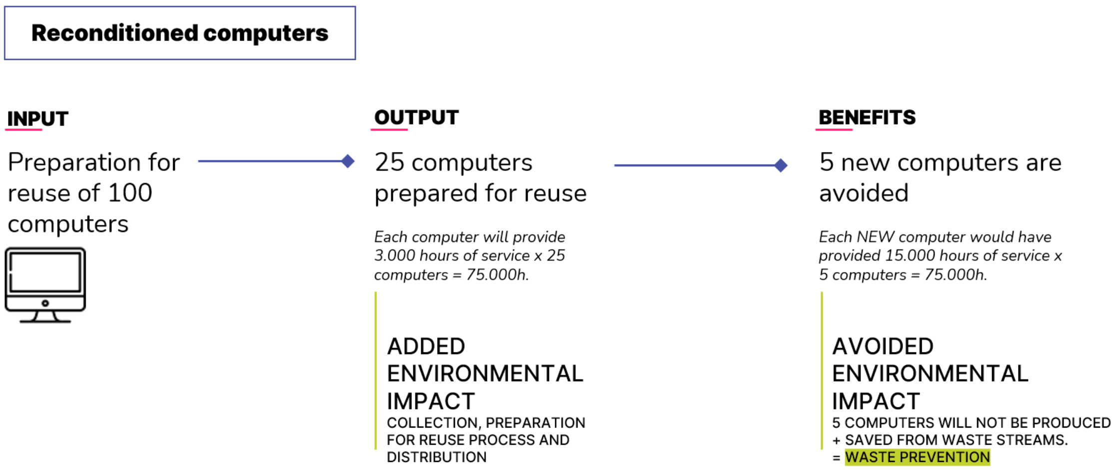


Figure 26. Representation of the balance for reconditioned computers. The figures presented here are only used for illustrative purposes.

Since the success ratio of preparation for reuse processes may vary depending on several factors, the user will be required to introduce (in section B.1) the amount of elements (computers, washing machines, textile, furniture…) effectively prepared for reuse (successful OUTPUT of the preparation for reuse process), instead of the amount collected and introduced into a preparation for reuse process (INPUT to the process).

In ANNEX II: ZERO WASTE STRATEGIES one can read the assumptions made for each of the most common zero waste strategies shown in Figure 25.

What if the user would like to adapt the assumptions underlying the set of ZW strategies included in Figure 25?

It can happen that the user would like to use one of the strategies included in the tool (sections B.1 and C.1 of the ZW strategy card), but the assumptions made by the tool (and presented in the Annex) do not fit the user considerations. One of these assumptions is the amount of products avoided due to a specific strategy. In the case shown previously in Figure 26, for 25 prepared for reuse computers one would avoid the production of 5 new computers, which Is obtained by considering a lifetime of 3000 hours per reused computer. Let's imagine that a given municipality is recovering used computers and applying a preparation for reuse strategy to reuse the devices in schools but, in their experience, the recovered devices do not have a lifetime of 3000 hours, but 2400 hours. In this situation, the user could take this into account, by specifying the amount of products avoided. Instead of considering 5 avoided computers, the user could estimate that they would be avoiding 4 computers (this number is calculated by multiplying 25 reused computers by 2400 hours and dividing it by 15000 hours per each new computer) (Figure 27).

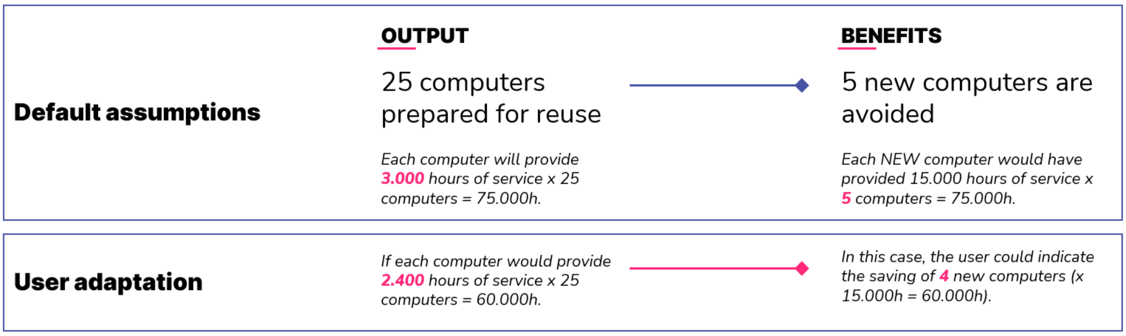
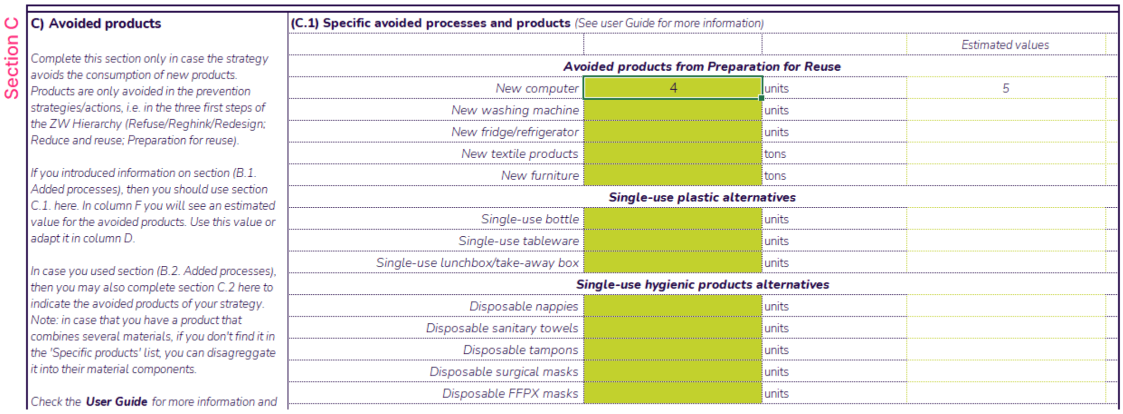


Figure 27. Example of the adaptation of the ZW assumptions set by default

Therefore, in the tool the user would adapt the information in section C.1, by introducing 4 in the corresponding green cell (instead of taking for granted the estimated value shown on the right part of Figure 28).



(C.1) Specific avoided processes and products (See user Guide for more information)			Estimated values
Avoided products from Preparation for Reuse			
New computer	4	units	5
New washing machine		units	
New fridge/refrigerator		units	
New textile products		tons	
New furniture		tons	
Single-use plastic alternatives			
Single-use bottle		units	
Single-use tableware		units	
Single-use lunchbox/take-away box		units	
Single-use hygienic products alternatives			
Disposable nappies		units	
Disposable sanitary towels		units	
Disposable tampons		units	
Disposable surgical masks		units	
Disposable FFPX masks		units	

Figure 28. Tool screenshot showing an example of the adaptation of the ZW strategies set by default.

What if the user wants to introduce ZW strategies that do not fit any of those shown in** Figure 25**?

This is actually a quite common situation, since the tool has a delimited set of strategies focusing on the prevention of single-use products and on some preparation for reuse processes. However, the universe of ZW strategies is much broader, as can be seen in section 1.1. For this reason, it is not possible to foresee and pre-introduce all kinds of strategies that users may think of across the different levels of the zero waste hierarchy.

However, any kind of strategy can potentially be introduced in the tool, starting with a description and a first reflection about the effects on the baseline scenario (section A in the ZW strategy card):

- What are the most affected waste streams?
- What KPIs will be affected?
- What are the effects on the baseline scenario?

With the answers to these questions, the user will have some inputs to adapt the future waste management scenario. For example, if the strategy would be "to establish door-to-door collection systems", the main effect would be an increase on the source-separated waste collection rates. This effect shall be introduced later in step 5. 'Future baseline scenario'.

After identifying the effects on the baseline situation, the user will need to estimate what are the added processes related to the strategy, if existing. By added processes, one means any kind of new operations, processes or products introduced in the system in order to implement the strategy (by 'new' we mean that did not exist before). In the case of door-to-door collection systems, we add new smaller waste containers and transportation routes, but we avoid the use of kerbside containers and their transportation routes. The user could introduce this information, by completing the section B.2 in the ZW strategy card. As shown in Figure 29, the user could estimate how much plastic is spent on the containers that will be distributed to households, and what are the transportation distances related to new waste collection routes. Any kind of new added processes or consumption should be adapted to the list of elements (organised in two categories: energy and water consumption, and consumption of components and/or products).

(B.2) Basic added consumptions (use if your added processes do not match the previous specific processes and products)		
Energy and water consumption (life-cycle perspective)		
Electricity (grid mix)		kWh
Natural gas		m3
Coal		ton
Diesel		l
Petrol		l
Water		m3
Consumption of components and/or products, by material (life-cycle perspective)		
Food: fish and shelfish		ton
Food: meat		ton
Food: dairy products		ton
Food: fruits, nuts, vegetables and tubers		ton
Food: legumes and cereals		ton
Food: average		ton
Garden and park waste		ton
Paper and cardboard products		ton
Plastic products (e.g. plastic packaging)		ton
Glass products		ton
Metal products (e.g. Aluminium can)		ton
Wooden products (e.g. Furniture)		ton
Textile products		ton
Rubber and leather products		ton
Nappies		ton
Other		ton
Transportation (by road)		ton·km

Figure 29. Tool screenshot showing the 'Basic added consumption'

Finally, the user will need to estimate the avoided products related to the strategy, if existing. In this case, the user will work In Section C.2. The logic will be the same: are there any savings in energy or water consumption, or products? In the case of door-to-door systems, the user might introduce here the waste container materials and the distances travelled by waste trucks.

In the example of door-to-door collection systems, one might assume that the avoided products offset the added ones. Actually, this would simplify the exercise of completing the strategy card and it could be accepted, since the most important effect in terms of GHG emissions will be the increase of waste source-separation ratios (which will be introduced in the tool later, in step 5).

When the user specifies added or avoided electricity consumptions, the associated impact is calculated using the default electricity emission factor according to the selected country (see Electricity mix emission factor). However, if the user defines a specific electricity factor in the '2.1. Treatment Efficiency' worksheet, the impact of this electricity will be calculated using an average of the consumed electricity emission factors specified both for the baseline situation and the future scenario.

IMPORTANT: When considering ADDED processes due to a zero waste strategy, one should consider a life cycle perspective, including the production and use life cycle stages (e.g. the production of reusable bottles and its maintenance). In the case of AVOIDED products, one should consider those elements avoided by the zero waste strategy (e.g. the amount of single-use plastic bottles saved by the reusable ones, which will not be produced anymore).

What about food waste reduction strategies?

Food waste is, together with the strategies shown in Figure 25, amongst the current waste prevention priorities. Nevertheless, the user will not find by-default waste reduction strategies in section B.1 within the ZW strategy card neither in Annex II. The reason is that there are many different processes and strategies that may contribute to food waste reduction, which makes it difficult to establish a generic option for all situations. However, the tool has a set of food categories (see Figure 30) that allow the user to indicate the results of most food waste reduction strategies.

(C.2) Avoided basic consumptions *(use if your avoided processes do not match the previous specific processes and products)*		
Energy and water avoided consumption (life-cycle perspective)		
Electricity (grid mix)		kWh
Natural gas		m3
Coal		ton
Diesel		l
Petrol		l
Water		m3
Monomaterial products (life-cycle perspective)		
Food: fish and shelfish		ton
Food: meat		ton
Food: dairy products		ton
Food: fruits, nuts, vegetables and tubers		ton
Food: legumes and cereals		ton
Food: average		ton
Garden and park waste		ton
Paper and cardboard products		ton
Plastic products (e.g. plastic packaging)		ton

Figure 30. Tool screenshot showing different food categories that could be saved thanks to food waste reduction strategies.

5. FUTURE SCENARIO

At this step, the user will need to configure the future scenario, based on the effects of the designed/planned zero waste strategies. To ease this process, the tool will first provide some insights based on previously inserted data (section 5.1) and later will allow the user to adapt the baseline situation to transform it into the future scenario.

5.1. THE EFFECTS OF THE ZERO WASTE STRATEGIES ON THE WASTE AND RESOURCES SYSTEM

To start with, the tool summarizes the effect on KPIs and waste streams of the ZW strategies defined in step 4, as shown in Figure 31. This will provide an overview of some potential effects (changes) in the baseline situation.

What KPIs are affected? *(according to the information provided by the user)*	
Total MSW generation per inhabitant [KPI#1]	YES
Overall separate collection rate [KPI#2]	YES
Diversion rate of MSW from harmful disposal methods and false solutions [KPI#3]	YES

What waste fractions are affected?		**Potential amount of waste prevented?** (TONS OF WASTE)	
Food waste	YES	*1491*	tons
Garden and park waste	NO	*0*	tons
Paper and cardboard	NO	*50*	tons
Plastic	YES	*1095*	tons
Glass	NO	*0*	tons
Metal	NO	*-1590*	tons
Wood	NO	*0*	tons
Textiles	YES	*188*	tons
Rubber and leather	NO	*0*	tons
Nappies and other similar hygiene and menstrual products	YES	*163*	tons
Other (e.g. mineral waste, ceramics, chemical wastes, etc.)	NO	*67*	tons

Figure 31. Tool screenshot showing the KPIs and waste fractions affected by the defined ZW strategies.

In addition, the tool estimates the potential amount of waste prevented (as shown in Figure 31 and in Figure 32). This estimation represents an indicative figure of the amount of waste that could be eventually prevented according to the described strategies (under a life cycle approach). This means that this waste could be prevented throughout different timeframes (e.g. a campaign to introduce reusable nappies would result in single-use nappies savings for a period of more than 2 years). Therefore, one can not automatically deduct these figures from the future waste generation (in section 5.2).

Note that the potential amount of prevented waste may show a negative number when added materials in a specific fraction are higher than the avoided ones. This will happen when the avoided and added materials of a ZW strategy belong to different fractions and this difference is not offset by the combination of all strategies. For example, applying a single ZW strategy of replacing metal single-use lunchboxes by plastic reusable containers will show a negative value of prevented metal waste.

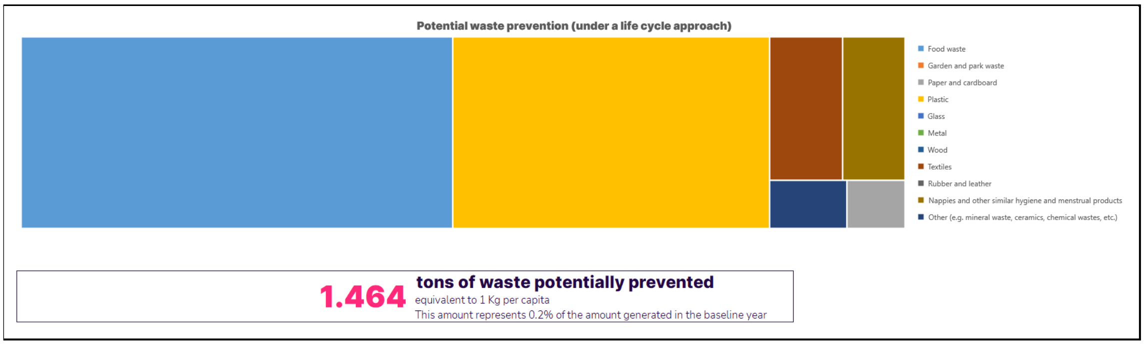


Figure 32. Tool screenshot showing the potential waste prevention related to the ZW strategies.

In addition to this, this section shows a summary of the effects of the strategies set in the action plan to the baseline situation. It is especially important that the user goes through all this information to reflect on how the future scenario will be.

Zero waste strategies	Effects on the baseline situation
1 - Reusable nappies and menstrual products campaign	In the implementation period 2021-2026, the generation of waste is expected to be reduced (without considering the life cycle): - 207 tons of tampons, 483 tons of period pads, 169.1 tons of single-use nappies
2 - Foster the reusing culture in the city	Reduction and reuse of WEEE, textile and furniture. It is expected that in the implementation period (2021-2026) 1,396,291 units of AEE (6,981 tons), 10,472 tons of textile and 13,962 tons of bulky (wood) will be prepared for reuse. By 2026,
3 - Redistribution of food surplus	In 2026, the generation of 1490.75 tons will be saved. In 2026 the generation of food waste is estimated at 4472.25 tons
4 - Promote reusable containers	Reduction of the single-use packaging (mainly paper and plastic). During the implementation period (2021-2026) it is estimated that 18,022,880 units of plastic cups for cold drinks and plastic tableware, and 50 tons of paper-cardboard (derived from hot
5 - Biowaste compost	It is expected that between 2021-2026 1 015.6 tons of FORM will have been self-composted, so they will have been prevented from going to municipal collection (for accounting purposes it is considered a reduction). It is estimated that in 2026 48.36 tons of
6 - Selective collection: increase of quantity and quality	- Increase of the separate collection rates - Reduction of residual waste A target of 65% selective collection of conventional fractions (including WEEE collected in
7 - Promoting tap water and reducing the use of single-use plastic bottles	In 2026, the generation of 34 062 913 bottles of water, equivalent to 1 022 tons of plastic, is expected to be avoided.

Figure 33. Tool screenshot showing the summary of effects of ZW strategies on the baseline situation.

5.2. Future scenario

After reviewing the effects of the strategies to the waste management system, it is time to define the future scenario. The parameters that define it are exactly the same that were used to define the baseline situation. At this point, it is the time to indicate how the future scenario would look like. To do so, the tool shows the original parameters (baseline situation) and asks the user to introduce the expected parameters in the green cells, corresponding to the future scenario. The user could write down the same values as in the baseline situation or adapt them based on the expected effects of the action plan (Figure 34).

Fractions	*Your data here*	*Unit*	*Baseline data*
Organic matter	189.437	ton/year	122.84
Glass	45.366	ton/year	39.14
Plastic	52.082	ton/year	19.67
Metals	9.427	ton/year	5.26
Paper and cardboard	64.887	ton/year	62.34
Wood	24.352	ton/year	3.90
Textile	6.442	ton/year	1.21
Waste Electrical and Electronic Equipment (WEEE)	0	ton/year	-
Others	0	ton/year	50.33
TOTAL	391.993	ton/year	304.71

Figure 34. Tool screenshot showing the green cells for any adjustments, and the baseline data as a reference.

The structure of this section is the same as in section 2. The main difference is that in this occasion, the user will see the 'baseline situation' data, whereas before one could find background data for the specific country. Therefore, in case of doubt, one can refer to section 2.2. Baseline waste management data (current situation) in this User Guide.

Defining the future scenario can be complex, but one can start by adapting the baseline parameters.

By default, the tool shows a future scenario that is identic to the baseline situation. Therefore, the user should review these parameters and adapt those that are expected to change based on the action plan (for example, an increase in source-separation of some waste fractions). When facing the challenge to configure the future scenario, it can be useful to think that no one knows how the future will look like, but it is better to make some guesses rather than not making any forecast because of the lack of data. In any case, it is important to be aware of the limitations and uncertainties when analysing the results.

Probably, one of the most complex parameters is the future waste composition since it depends on many different factors. If the user does not have other criteria, he/she can make use of the estimates provided by the tool.

How can one define the future waste composition?

The tool provides a pre-emptive model of the waste composition, based on the potential effect of the measures on the waste composition (Figure 35). However, it should not be taken for granted, since:

- the prevention of some waste streams may have an effect on a timeframe beyond the year established for the future scenario.
- there may be other changes in the system (consumer behaviours, legislation, circular production and consumption models) that may affect the waste composition.

To clarify the first of these two aspects, let's see an example. A municipality could be choosing year 2020 as the baseline situation and could set 2022 as the future scenario. When defining actions, one of these could be the implementation of a campaign to foster reusable nappies. The campaign could be implemented in 2021. According to different studies, one kit of reusable nappies would be used for 2.5 years, saving a total of 3796 single-use nappies (equivalent to 147 Kg of waste). Thus, this amount of prevented waste would be shown in the tool (Figure 31) and used to estimate GHG savings. However, it would also be considered for the waste modelization, but in practice this reduction would take place within 2.5 years (therefore from 2021 to 2023). For this reason, the estimate of the future composition in this case should not be taken for granted.

Baseline situation (%)	Baseline situation (ton)	Avoided waste (ton)	Future (ton)	Future composition
31,2	246380	1491	244889	**31,1%**
4,6	35975	0	35975	**4,6%**
16,9	133485	50	133435	**16,9%**
9,9	78182	1095	77087	**9,8%**
8,6	67453	0	67453	**8,6%**
2,3	17964	-1590	19553	**2,5%**
6,2	48992	0	48992	**6,2%**
3,7	29427	188	29239	**3,7%**
0,0	0	0	0	**0,0%**
3,3	26271	163	26108	**3,3%**
13,3	104737	0	104737	**13,3%**
100,0	**788865**	**1397**	**787468**	**100,0%**

Figure 35. Tool screenshot with the modelization of the future waste composition.

5.3. Indicators and targets - Expected future performance

This section pretends to summarize the expected future performance, compared to the targets set previously in step "3. Set Priorities". To do so, it shows the performance in the baseline situation, the defined target and the expected future performance.

Key performance indicators	Units	Baseline 2019	Defined targets 2026	Expected future performance 2026	
Total MSW generation per inhabitant [KPI#1]	kg/inhab·year	482,0	427,1	472,6	Not accomplished target
Overall separate collection rate [KPI#2]	%	38,6	65,0	49,9	Not accomplished target
Diversion rate of MSW from harmful disposal methods and false solutions [KPI#3]	kg/inhab·year	210,9	292,5	255,8	Not accomplished target
You can write here your additional indicators			0,0		
You can write here your additional indicators			0,0		
You can write here your additional indicators			0,0		
You can write here your additional indicators			0,0		

Figure 36. Tool screenshot showing the summary table to compare the expected future performance with the defined targets.

6. REDUCTION IN GREENHOUSE GAS (GHG) EMISSIONS FROM THE ZERO WASTE STRATEGIES

So far, the user has dealt with information regarding the baseline situation, the zero waste strategies and the future scenario, in many occasions referring to different amounts of generated or prevented waste. But data regarding GHG emissions has not been introduced yet.

This will change in this step since it will allow the user to see the GHG effects of the waste management system and the zero waste strategies. Before moving on, it is important that the user validates that the previous steps have been completed, by selecting 'Yes' on the drop-down list (Figure 37).

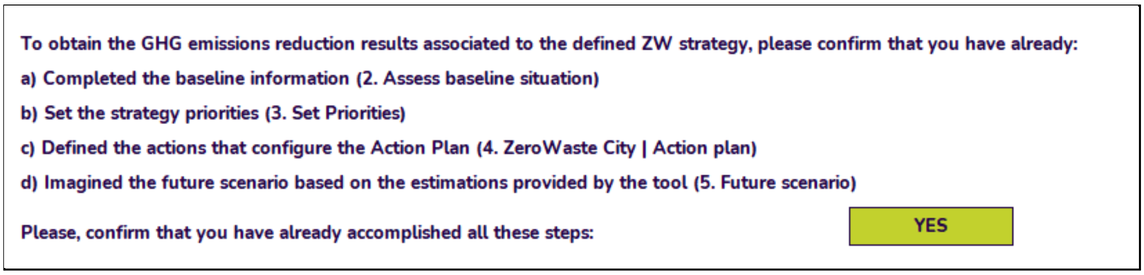


Figure 37. Tool screenshot showing the requisites necessary before moving into the GHG assessment.

After this, the user will not need to introduce any more information.

6.1. An overview of the GHG emissions from your municipality

This section presents the main results in terms of GHG emissions. The user can see the environmental effects of the baseline situation and the future scenario. This information is disaggregated into:

- *Waste management generated emissions*. For example: the emissions from Incineration processes or from methane emissions In a landfill.
- *Waste management avoided emissions*. For example: the estimated emissions that are saved thanks to material and energy valorisation processes.
- *Added emissions due to ZW strategies.* These emissions correspond to those added processes and products related to the actions oncluded on the action plan. For example: the production and maintenance of reusable menstrual cups.
- *Avoided emissions due to ZW strategies.* These emissions correspond to the avoided products thanks to the strategies, such as not producing single-use plastic bottles.

An overview of the GHG emissions from your municipality

Scenario	Waste management generated emissions	Waste management avoided emissions	Emissions due to the zero waste strategies		TOTAL	Unit
			Added	Avoided		
Baseline situation 2019	334.858	-165.143			**169.715**	ton CO2eq
Future scenario 2026	204.831	-211.146	51.263	92.438	**137.387**	ton CO2eq

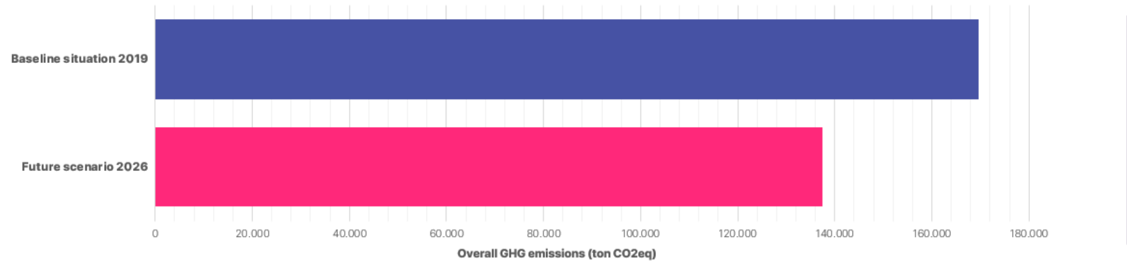


Figure 38. Tool screenshot showing the first overall results in terms of GHG emissions.

How are GHG emissions calculated?

The tool includes a series of algorithms that transform data introduced by users into GHG emissions. To do so, the tool has a set of in-built parameters for each of the waste treatment operations and zero waste strategies. These parameters relate to the inputs (e.g. consumption of resources) and outputs (e.g. generation of emissions) of each element, which are then transformed into GHG emissions by considering an emission factor.

For example, if the tool considers that each ton of waste treated in a MBT process consumes 40 kWh of electricity, the total electricity consumption is calculated considering how much waste is treated with this technology. Then, this amount is transformed into emissions, by considering the emission factor of the selected country (e.g. 350 grams of CO_2eq/kWh).

As for the biodegradation and combustion of waste, the IPCC guidelines (http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html) are taken into account. This means that emissions of CO2 of fossil origin, methane and nitrous oxide are accounted for.

The environmental impact calculation is based on the Global Warming Potential method for a 100-year time horizon, as defined in the 5th Assessment Report[8] developed by the IPCC (Intergovernmental Panel on Climate Change), a body from the United Nations created to assess the science related to climate change. This report was released on 2013 and uses the following characterisation factors to calculate the global warming potential of the different greenhouse gases:

GHG industrial name	Chemical formula	GWP values for 100-year time horizon
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265

What about biogenic emissions?

Waste management operations are a source of carbon emissions, both from fossil and biogenic origin. For example, incineration processes emit fossil CO_2 from the combustion of plastics and biogenic CO_2 from the combustion of biodegradable materials, such as paper or organic matter. Most biogenic carbon emissions come from the biological degradation of waste (in aerobic or anaerobic processes) and from the combustion of biodegradable waste.

The calculation approach used in the tool for waste treatment operations (solid waste disposal, biological treatment of solid waste and incineration) accounts for fossil carbon emissions in line with the IPCC Guidelines for National Greenhouse Gas Inventories. According to IPCC, non-fossil CO2 is considered to be part of the natural carbon balance and therefore not a contributor to atmospheric concentrations of CO2. Thus, the guidelines establish that biogenic emissions should be reported and recorded as an information item (*memo item*), but just not included in sectoral totals (that is to say, in the total emissions from the waste sector or the energy sector). Additionally, IPCC establishes that any net changes in carbon stock of biogenic origin are covered in the AFOLU (Agriculture, Forestry and Other Land Use) chapter. For this reason, and taking into account the complexity to estimate biogenic emissions, these have not been considered in the tool.

Nevertheless, according to the report 'The Potential Contribution of Waste Management to a Low Carbon Economy', the issue of biogenic carbon may be problematic, and may be leading to significant underestimates of the contribution made by biogenic greenhouse gases to global climate change. One of the reasons is that there is a significant difference between the way in which biogenic emissions of CO_2 are generated by different waste treatment processes (e.g. landfill emissions occur over an extended period of time, while incineration emissions occur instantaneously), which has implications for how effectively they can be sequestered by the growth of

[8] IPCC 5th Assessment Report:
https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter08_FINAL.pdf

biomass. According to the authors, what is of utmost importance is to reduce the leakage of materials into residual waste treatments (either landfill or incineration). In line with this, all residual waste treatments are important contributors to GHG emissions, and the benefits of switching from landfill to incineration are slight. Furthermore, as energy systems decarbonise, so the impact of the processes for which the net effect is more strongly determined by the amount of energy generated will tend to decline. Because it seems unlikely that climate change can be arrested without significant decarbonisation of energy sources, so it would appear that technologies such as incineration will become less attractive over time.

IMPORTANT:

The tool should not be used to perform a comparative assessment of the contribution of waste treatment technologies to climate change (e.g. landfill vs incineration), since the results do not incorporate CO2 emissions from non-fossil sources.

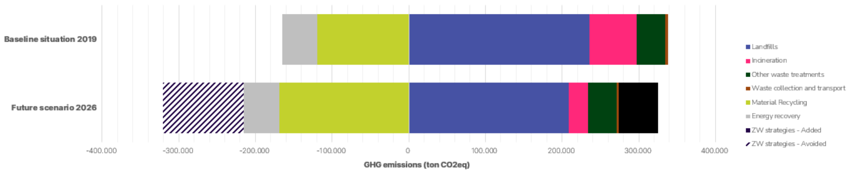
However, it should be used to connect the waste-resource and the climate agendas, by providing a means to highlight the effects of an improved waste management system, reconceptualised as resource management system in which materials are continually cycling through the economy and where the leakage of materials into residual waste treatments is minimised. In this sense, the effects of waste prevention and waste recycling are the dominant determining factors in climate change performance.

6.2. Details on the waste management GHG emissions

This section aims to provide further detail on the generated and avoided emissions from waste management (Figure 39). It puts emphasis on the emissions related to landfills and Incineration, since these are commonly the main sources of GHG emissions. On the other hand, distinction Is also made between avoided emissions from material and from energy recovery.

Details on the waste management GHG emissions

Scenario	Generated emissions from waste management				Avoided emissions from waste management		Zero waste strategies		TOTAL	Unit
	Landfills	Incineration	Other waste treatments	Waste collection and transport	Material Recycling	Energy recovery	Added impacts	Avoided impacts		
Baseline situation 2019	235.680	61.552	37.625	3.055	-119.776	-45.367			**172.770**	ton CO2eq
Future scenario 2026	208.567	25.018	37.044	3.042	-168.512	-46.878	51.263	-105.520	**4.023**	ton CO2eq
Difference between 2026 and 2019	-12%	-59%	-2%	0%	41%	3%			-98%	



For informative purposes

Carbon storage in landfills		
47.346	ton CO2eq	*Baseline situation 2019*
35.630	ton CO2eq	*Future scenario 2026*

Figure 39. Tool screenshot showing the details on the GHG emissions, distinguishing emissions from landfilling and incineration processes.

What about carbon sequestration in landfills?

During incineration all the carbon within the waste is assumed to be released as carbon dioxide because of its combustion. Conversely, during landfilling, biogenic carbon that does not degrade remains stored. Carbon sequestration to potential emission to atmosphere is described by the “Carbon Sink” concept, that generally refers to any process that avoids the emission of GHG. According to this concept, landfill represents a carbon storage and only the degradable fraction of biogenic source carbon contained in the disposed waste can be emitted as CO_2 and CH_4 into the atmosphere, while the fossil source carbon can be assumed not degradable. It is worth mentioning that the carbon associated with fossil one was stored prior to burial in a landfill (e.g. in a buried petroleum reservoir) so that only biogenic carbon contributes “positively” to global warming. The tool shows an estimate of the carbon sequestration in landfills for the baseline situation and the future scenario. This value is not automatically added to the total carbon balance, and it is only shown for informative purposes.

6.3. Details on the GHG effect of each ZW strategy

Finally, this las section aims to provide more detail on the added and avoided emissions of each ZW strategy, by means of a table and a visual graph (Figure 40). Please remember that having a more favourable balance does not mean that one strategy is preferrable than others, since the effect on the baseline should also be considered.

Details on the GHG effect of each zero waste strategy

Zero waste Strategy	Added	Avoided	Balance	Unit
1 - Reusable nappies and menstrual products campaign	796	-1.925	-1.129	ton CO2eq
2 - Foster the reusing culture in the city	46.853	-86.694	-39.842	ton CO2eq
3 - Redistribution of food surplus	0	-6	-6	ton CO2eq
4 - Promote reusable containers	3.614	-703	2.911	ton CO2eq
5 - Biowaste compost	0	0	0	ton CO2eq
6 - Selective collection: increase of quantity and quality	0	0	0	ton CO2eq
7 - Promoting tap water and reducing the use of single-use plastic bottles	0	-3.109	-3.109	ton CO2eq
TOTAL	**51.263**	**-92.438**	**-41.176**	ton CO2eq

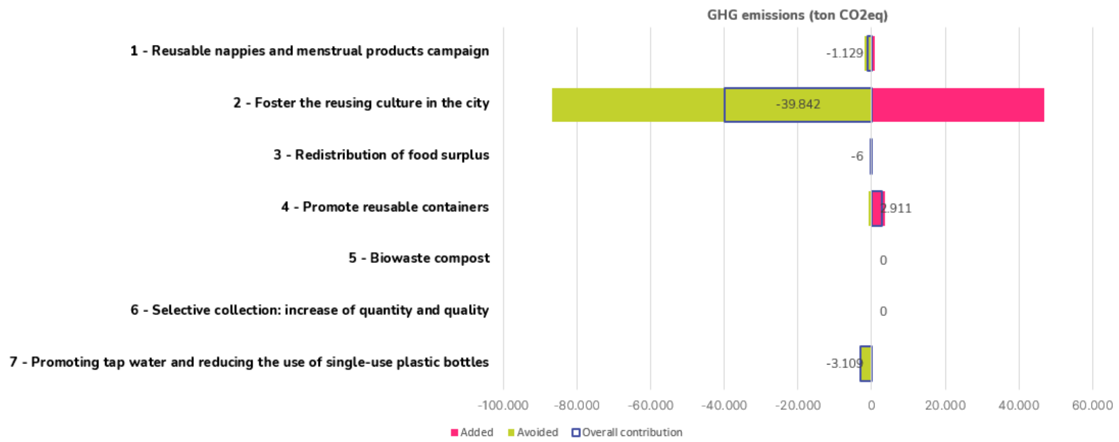


Figure 40. Tool screenshot showing the GHG emission from the several ZW strategies.

6.4. Contextualization of GHG emissions reduction

This section aims to offer an alternative representation of the results of the reduction of GHG emissions, using other units than CO_2 equivalent emissions. To do so, the tool shows the following equivalent results:

- Avoided kilometres travelled by car.
- Avoided round-the-world trips by plane.
- Trees fixing CO_2 eq during a year.
- Equivalent annual emissions per European citizen.

7. ZERO WASTE CITIES CERTIFICATION

7.1. Overview

The Carbon Calculator tool has been designed specifically with local authorities in mind, given the unique role that cities and towns can play in leading the transition to a circular economy.

Local authorities, often hubs of innovation and action, are amongst the best places to fight waste generation, where efforts to advocate and implement more sustainable and efficient resource management can have the greatest impact.

Recognising the need for a more robust and formal system for guiding European municipalities towards zero waste, the Mission Zero Academy (MiZA), together with the European non-governmental organisation Zero Waste Europe (ZWE), designed the world's first Zero Waste Cities Certification.

This independent third-party assessed certification standard is based on over 10 years of expertise and on ZWE's and its members' experience at the local level, supporting the adoption of community-centred zero waste models throughout Europe.

7.2. How the Carbon Calculator and Certification can work together for you

The Carbon Calculator tool has been created to supplement and support the work of municipalities who wish to become or are already on the journey to become Zero Waste Certified. The data needed to complete the baseline scenario, the information and targets behind the zero waste strategies, as well as the consequential results that the Calculator provides, could all be effectively embedded within a municipality's application for Certification. The results of the calculator can be used in, for example, setting goals, as one parameter when making decisions about the most impactful actions and when communicating about the results of the zero waste strategy. It can also help aligning the zero waste work with different climate strategies.

The Certification and Calculator have been aligned to maximise the impact of the work done by municipalities. For those already on their journey towards the Certification, they will have a large amount of data already prepared to make the most out of this tool. And vice-versa, the research and preparation needed to use the Carbon Calculator tool effectively will result in the user having prepared a good bank of data and evidence to support their Certification application.

You can see examples below of some of the many criteria within the Zero Waste Cities Certification which a municipality would have data on and be better prepared to score a higher number of points on after using the Calculator:

The municipality implements a **programme for organic waste management** capable of achieving the minimum standards set by national or EU regulations. **REQUIRED**

The municipality facilitates and supports **wider waste prevention measures** that are implemented by a wider range of actors within the local community. **UP TO 10 POINTS ***

The municipality **assesses the positive climate impacts** of its zero waste plan and communicates about the results to the public. **UP TO 4 POINTS ***

7.3. The benefits of becoming a Zero Waste Certified City

For any European municipality wishing to reduce the volume of waste it generates, the Certification provides a robust framework that can become a municipal to-do list for a zero waste strategy.

Not only has the model been proven to reduce waste, but through adopting the policies within the Certification, municipalities can also:

- Reduce their expenditure on waste management,
- Establish a clear plan for aligning with national and EU requirements on waste and the circular economy
- Reduce the amount of GhG emissions they emit,
- Create more local jobs in sustainable sectors, and
- Have a tool to connect more with the local community.

The Mission Zero Academy hosts and coordinates the whole Certification process. By providing online and offline resources and services, such as this Carbon Calculator, MiZA helps guide organisations and municipalities on their journey to zero waste.

7.4. The process to become a Zero Waste Certified City

The Zero Waste Cities Certification process comprises just 5 simple steps:

- Expression of Interest – submitted by the municipality to local Zero Waste Europe (ZWE) members or Mission Zero Academy.
- Commitment – in this phase, the municipality acquires the status of Zero Waste Candidate City and needs to create and present its own certification roadmap, under the specific requirements reported here.
- Implementation – the municipality then has a maximum of 2 years to implement and complete the Certification scorecard and submit evidence to the formal auditor in order to be certified.
- Certification – after a successful third party assessment focusing on the performance level and impact, the Candidate Municipality becomes a Zero Waste Certified City. Have a look at our Certification criteria for Certified Cities.
- Yearly improvements – following its Certification, a Municipality must carry out yearly improvements to monitor and enhance the outcomes achieved. They will be subjected to new audit processes every 3 years to confirm the Certification status, with the possibility to level up under a 5-star system.

7.5. Next Steps

Given the increasing waste generation levels on average across Europe, it is clear that the need for Zero Waste Cities is more pressing and urgent than ever. The Carbon Calculator tool has been designed to provide municipalities with greater data and understanding on the climate benefits that their waste prevention policies can have.

Should any local authority who uses the Carbon Calculator tool wish to take the next step and align their plans with the world's first Certification system for Zero Waste Cities, you can discover more and register your interest here.

8. ANNEX I: BACKGROUND DATA

This annex presents the sources of background data for the available countries (Figure 41).

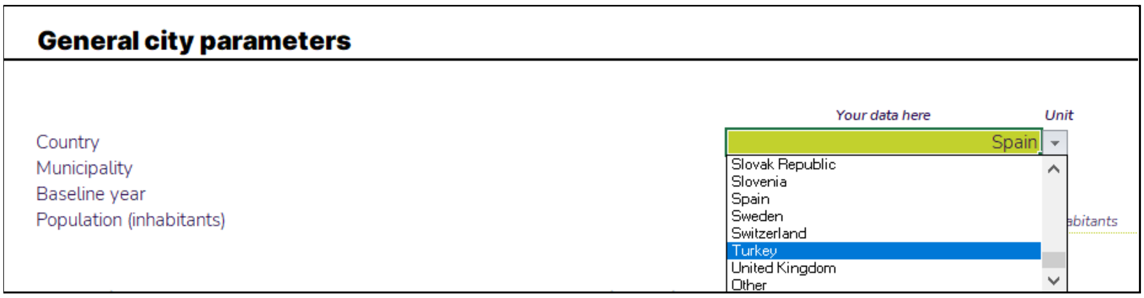
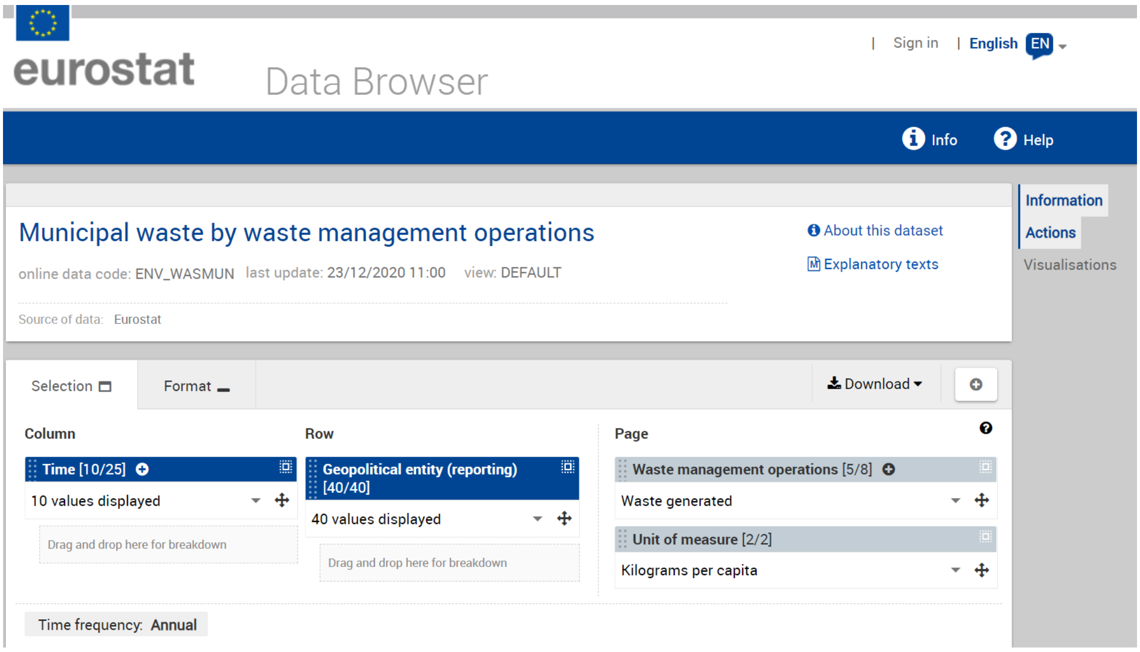


Figure 41. Tool screenshot showing the drop-down list of available countries.

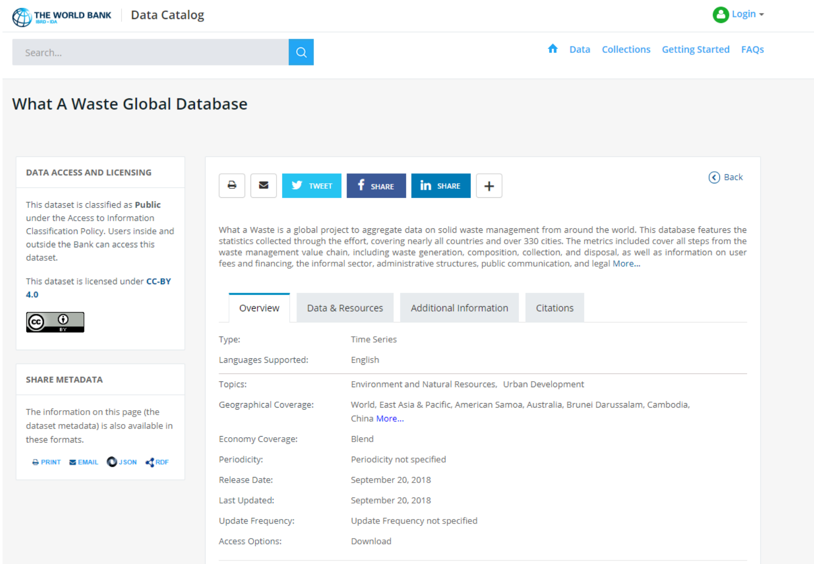
Waste generation and treatment

Source: [Eurostat]



Waste composition

Source: [World Bank]



Landfill biogas capture

Source: United Nations Climate Change

Electricity mix emission factor

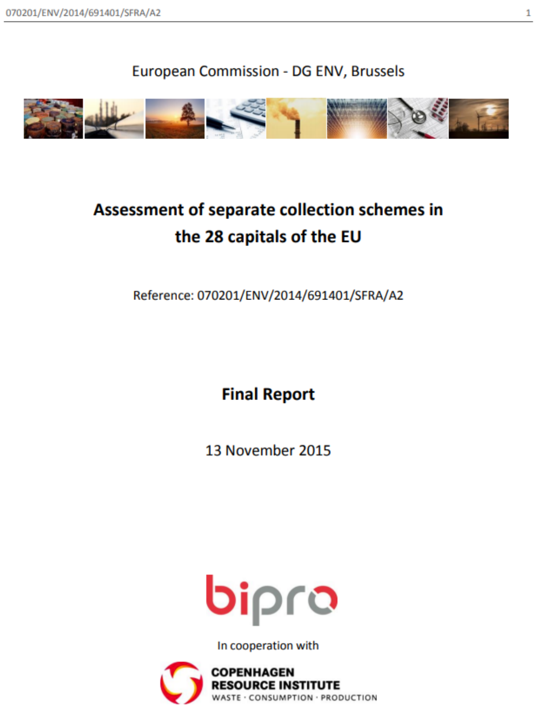
Source: Ecoinvent 3.6 according to the selected country. This factor can also be specified by the user in the ‘2.1. Treatment Efficiency’ worksheet (see Residual waste (MSW non-source separated) section) to model a possible decarbonization of the energy sector.

Source-separation of waste

Not available country-wide in a homogeneous way.

Available at city-scale for EU capital cities.

Source: [Assessment of separate collection schemes in the 28 capitals of the EU.]


070201/ENV/2014/691401/SFRA/A2 1

European Commission - DG ENV, Brussels

Assessment of separate collection schemes in the 28 capitals of the EU

Reference: 070201/ENV/2014/691401/SFRA/A2

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