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JRC TECHNICAL REPORT

The Consumer Footprint Calculator

Estimating the environmental impacts of the consumption of EU citizens and their lifestyle

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Valeria De Laurentiis: contribution to tool design and underpinning calculations

Giulia Barbero Vignola: contribution to tool design, particularly on user interface and link to the Sustainable Development Goals (SDGs)

Luisa Marelli: manager of the knowSDGs platform

Esther Sanyé Mengual: contribution to tool design and underpinning calculations

Abstract

The Consumer Footprint Calculator has been designed to assess the environmental impacts due to EU citizens consumption patterns. The calculator is based on the consumption footprint indicator, which follows a life cycle-based approach. Such perspective allows for considering the entire supply-chain of products consumed by EU citizens. The consumption footprint applies the Environmental Footprint (EF) method to estimate the potential environmental impacts, displaying the results in 16 distinct impact categories (e.g. climate change, ecotoxicity etc.) and as a single weighted score.

The Consumer Footprint Calculator allows citizens to calculate the environmental impact of their personal consumption patterns by answering specific questions focused on five areas of consumption: food, mobility, appliances, household goods, and housing. Users can:

- understand the contribution of the different products to their overall environmental impacts
- compare them with those of the average EU citizen
- assessing the level to which they are surpassing Planetary Boundaries
- explore the link between their consumption patterns and the contribution to the environmentally related sustainable development goals

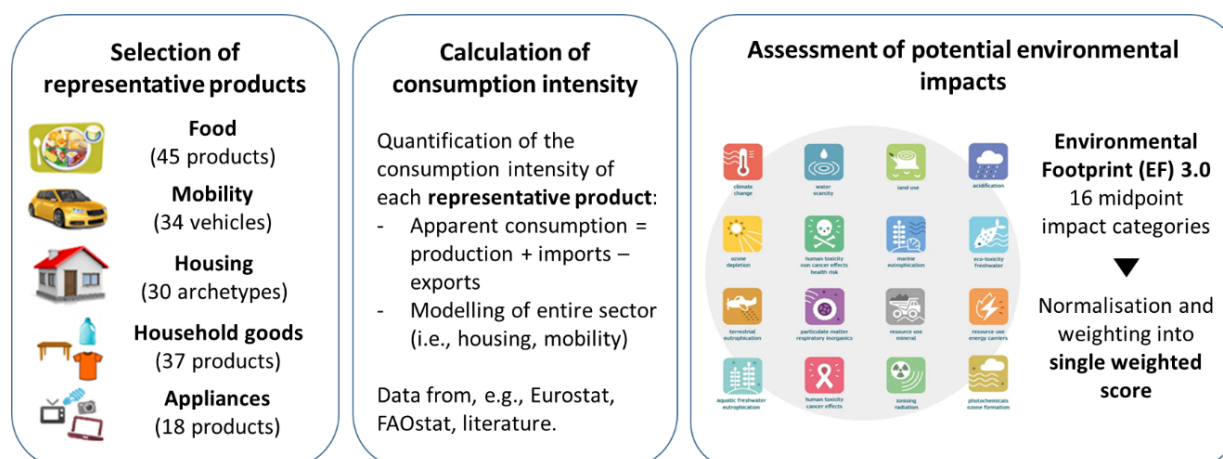
The main goal of the Consumer Footprint Calculator is to provide detailed information on the environmental impact of consumption patterns to citizens as the basis to identify sustainable actions towards reducing their contribution to the environmental impact of the overall EU consumption. The calculator can show the potential effect of changes in the consumption patterns and includes links to sustainable actions, such as the EC climate action tips or the individual pledges of the European Climate Pact, and the actions proposed in the United Nations' "Anatomy of Action" project.

1 Introduction

The Sustainable Development Goals (SDGs) include a specific objective on responsible consumption and production. Consumers' choices and related consumption patterns play a pivotal role in determining environmental impacts. A transition towards sustainability needs an adequate awareness of environmental impacts associated to consumption as well as levers to behavioural changes. Indeed, healthier and less impacting lifestyles could support the achievement of SDG 12 on responsible consumption and production¹. At the EU level, the European Green Deal (EC, 2019) and associated priorities aim at enhancing such transition, such as sustainable food production and consumption (Farm to Fork Strategy²), biodiversity conservation (EU Biodiversity Strategy for 2030³), circular economy (Circular Economy Action Plan⁴), and zero pollution (Zero Pollution Action Plan⁵). However, so far it was very difficult for an individual consumer to understand which products and which consumption patterns are associated with higher impacts.

Towards supporting awareness raising, the Joint Research Centre together with DG Environment developed the life cycle assessment (LCA)-based method for calculating **consumption footprint indicator(s)**⁶ at EU and country level (Figure 1) (Sala et al., 2019; Sala and Castellani, 2019). The consumption footprint assesses the environmental impacts of consumption by means of five baskets of representative products (BoPs), namely food (Castellani et al., 2017a), housing (Baldasari et al., 2017), mobility (Castellani et al., 2017b), household goods (Castellani et al., 2019), and appliances (Reale et al., 2019). For each area of consumption, a BoP has been defined by selecting the most consumed product groups and representative products based on consumption statistics leading to a total of around 165 representative products (Annex 1).

Figure 1. Overview of the calculation principles of the consumption footprint indicators.



For each representative product, the consumption intensity (e.g. apparent consumption = domestic + import - export) is quantified based on available statistics (e.g. Prodcom – (Eurostat, 2020a), Comext (Eurostat, 2020b)) and the environmental impacts of their life cycle is calculated by means of an LCA model. The assessment has a cradle to grave approach: from the extraction of raw materials to the end of life management. To complete the life cycle inventories of representative products, the consumption footprint employs background data from ecoinvent v3.6 (Wernet et al., 2016) and Agrifootprint 5.0 (Blonk Consultants, 2019) databases. The impact

¹ <https://sustainabledevelopment.un.org/>

² https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

³ https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

⁴ https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en

⁵ https://ec.europa.eu/environment/strategy/chemicals-strategy_en

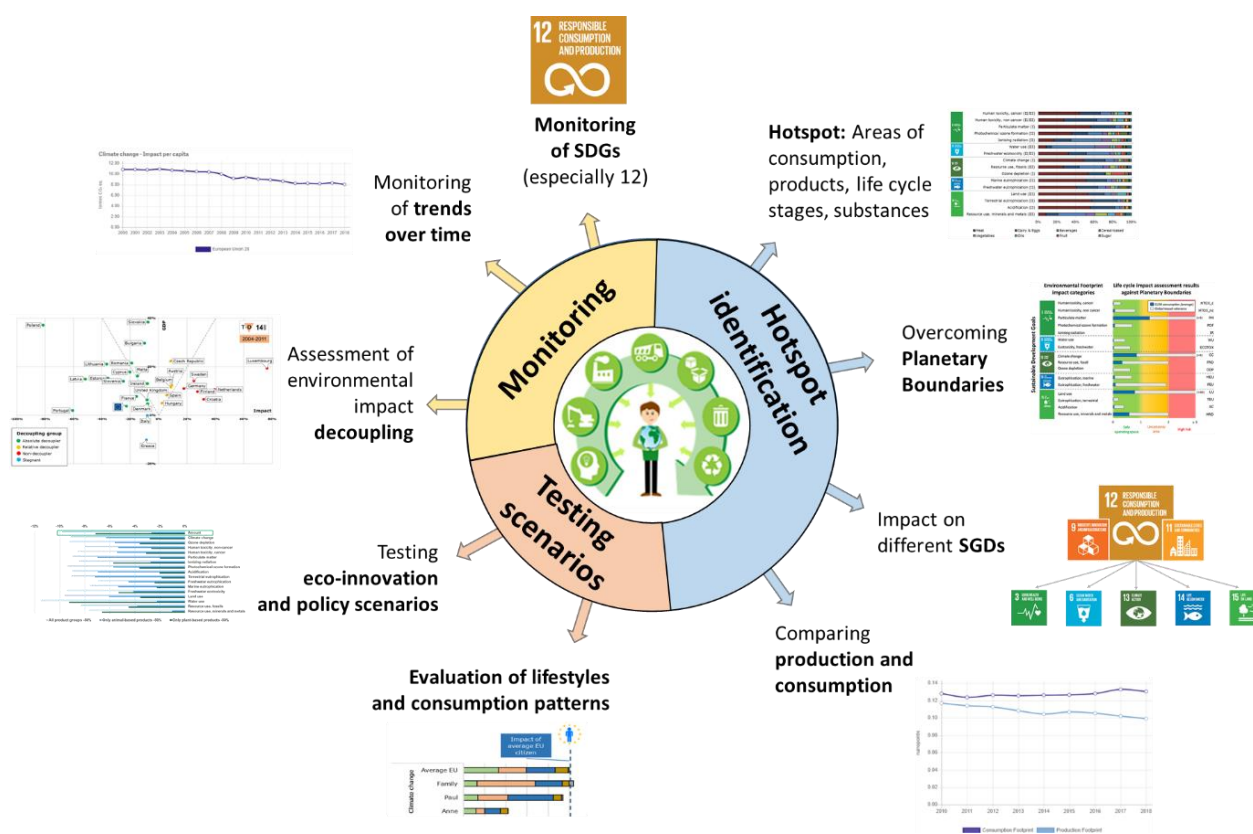
⁶ Note that previous versions of the consumption footprint indicator were termed Consumer Footprint. In the current framework, the indicator is termed consumption footprint with the ambition to assess the environmental impacts of EU and Member States consumption from a macro-scale approach based on consumption statistics. The current terminology is coherent with the methodological selection of the previously known as Consumer Footprint as the reference method to assess environmental impacts due to consumption. The indicator could be presented as single score as well as a set of 16 distinct environmental impact indicators

assessment method to assess the environmental impacts is the **Environmental Footprint method** (EC, 2013; recently updated EC, 2021), which is covering 16 environmental impact indicators⁷.

The Consumption footprint indicators can support policy-making as follows:

- Identification of **environmental hotspots**: the granularity of the indicators can provide information at different levels (environmental issues with the highest relevance, areas of consumption, product groups and products, life cycle stages of products, and of most relevant resource used or emissions to the environment) with assessment as 16 different environmental impact categories or as a single score and potentially including biodiversity footprint (Crenna et al., 2019)
- **Monitoring**: yearly updates of the indicators allow tracking the evolution of impacts associated with changes in production and consumption patterns that may be strategic for monitoring e.g. how far the EU is decoupling environmental impacts from economic growth, the benefits of transition towards a circular economy, the EU's ability to remain within the planetary boundaries as well as progress related to the SDGs (especially SDG12 on responsible consumption and production)
- Setting a baseline against which **testing policy options and scenarios**: the modularity of the indicators can formulate scenarios affecting not only lifestyles but all the stages along the supply-chain (from raw material extraction to end of life) as well as technological changes in the life cycle of products
- **Evaluating lifestyles and consumption patterns**, which can be compared to EU and Member State average lifestyles
- Identifying **transboundary and spillover effects**, since the indicators could support the assessment of the trade footprint, namely the amount of impacts embodied in imported goods

Figure 2. Features of the Consumption footprint indicators for policy support.

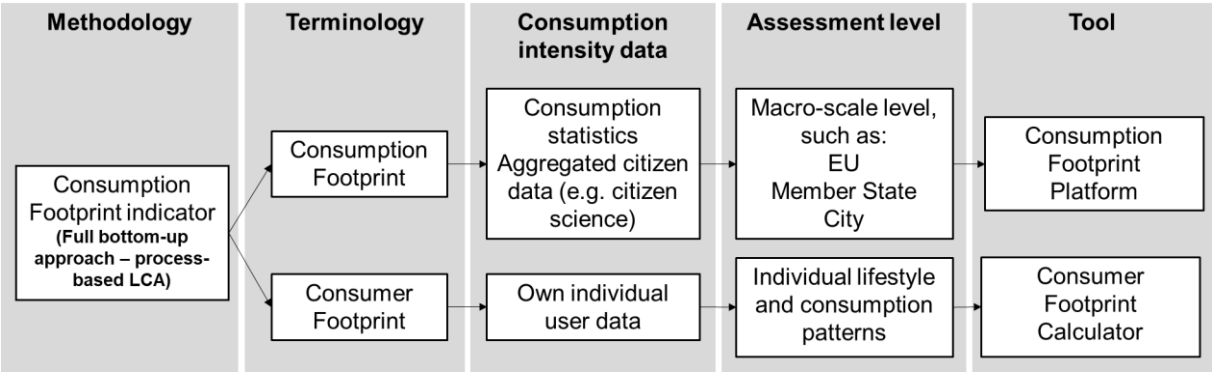


⁷ Climate change, ozone depletion, human toxicity – cancer, human toxicity – non-cancer, particulate matter, ionizing radiation – human health, photochemical ozone formation – human health, acidification, eutrophication – terrestrial, eutrophication – freshwater, eutrophication – marine, ecotoxicity – freshwater, land use, water use, resource use – minerals and metals, resource use - fossil.

Among these uses, the evaluation of lifestyles and consumption patterns may support an **increase in the awareness of citizens** about the environmental implications of their lifestyle. For this assessment level, the Consumption footprint indicator can be calculated employing different consumption intensity data, directly provided by the citizens (Figure 3).

In this context, the Joint Research Centre (JRC) developed the **Consumer Footprint Calculator** to allow EU citizens to calculate the environmental impacts of their consumption pattern, as well as to evaluate how changes in their lifestyle may affect their personal footprint. It considers five areas of consumption, namely food, mobility, housing, household appliances, and household goods.

Figure 3. Context of the Consumer Footprint Calculator and detailed elements of the use of the Consumption footprint indicator.



This report provides an overview of the Consumer Footprint Calculator (Chapter 2), presents the web-based (Chapter 3) and Excel-based (Chapter 4) versions, focusing on the different interfaces, and details the underpinning methodological assumptions (Chapter 5).

2 The Consumer Footprint Calculator

The **Consumer Footprint Calculator** is a tool for the quantification of the environmental impacts due to consumers' choices and consumption patterns. The tool is available both as an excel file⁸ and as a web application⁹. As web application, the tool makes use of a user-friendly interface to evaluate how changes in their lifestyle may affect their personal footprint.

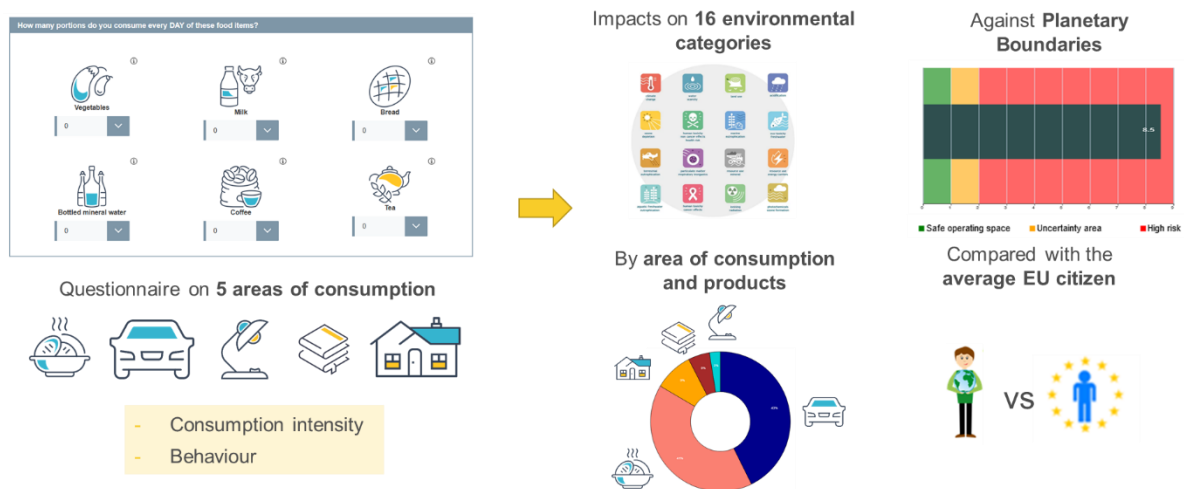
The following sections illustrate the contents of the web application version of the calculator and its functionalities.

2.1 Overview of the Calculator

In the web application, users can provide detailed information about their lifestyle through a **questionnaire** addressing consumption intensities of specific products (e.g., beef meat), ownership of products (e.g., appliances), characteristics of the household (e.g., year of construction of the building) and consumer behaviour (e.g., second-hand shopping, reparation of appliances). The consumption patterns are evaluated for five areas of consumption and results show:

- Impacts on the 16 environmental impact indicators of the Environmental Footprint, which are related to emissions generated into soil, water, and air as well as to resource use (Table 1). These 16 indicators are then summarised in a so called "single score", obtained after normalisation and weighting of the indicators
- Impacts by area of consumption and individual products
- How the impacts of consumption choices position compared to Planetary Boundaries (PBs), the ecological thresholds that define the so called "safe operating space for humanity" outside of which environmental catastrophes can happen
- A comparison with the environmental burdens of the consumption pattern of the average EU citizen

Figure 4. Overview of the Consumer Footprint Calculator.



With this comprehensive evaluation of individual lifestyles, the goal of the Consumer Footprint Calculator is to **increase the awareness of citizens** regarding the environmental impacts of their lifestyle. For this purpose, it aims at contributing to two main questions:

- What is the impact of our lifestyle?
 - Providing quantitative information to the citizen about the environmental impacts of their current lifestyle
 - Providing quantitative data to track the evolution of their impacts over time

⁸ Available at the following link https://eplca.jrc.ec.europa.eu/permalink/consumptionfootprint/2021_ConsumerFootprintCalculator_v1.xlsm

⁹ Available at the following link <https://knowsdqs.jrc.ec.europa.eu/cfc>

- Comparing their impacts with the average EU citizen and the Planetary Boundaries
- How can we improve our current environmental impacts?
- Identifying the consumption patterns (by area of consumption and products) contributing the most to our environmental impacts
 - Individuating those consumption patterns and behaviour that could be changed towards reducing our environmental impacts
 - Informing users on potential lifestyle changes by area of consumption based on available sustainable consumption campaigns at international and EU levels

2.2 Consumer footprint calculator: main methodological elements

The consumer footprint calculator contains the individual life cycle impact of more than 150 products in five areas of consumption (food, mobility, housing, household goods, and appliances). The full list of representative products is provided in Annex 1.

The life cycle assessment of these products is based on the assessment of the impacts along their entire life cycle, resulting from modelling of average products on the EU market. Those models are based on prevalent characteristics of the representative products consumed in EU. The input data in terms of emissions associated to the products as well as resources inputs are exclusively secondary data coming from ecoinvent v3.6 (Wernet et al., 2016) and Agrifootprint 5.0 (Blonk Consultants, 2019) databases, and literature as detailed in individual reports for each basket of product¹⁰.

As mentioned before, the emissions and resources are used as impact of environmental models to assess the 16 environmental impact categories reported in Table 1.

Table 1. Summary of the impact categories used in the Consumer Footprint Calculator: EF impact categories, abbreviations and units.

Impact category	Abbreviation	Unit
Climate change	CC	kg CO ₂ eq
Ozone depletion	ODP	kg CFC-11 eq
Human toxicity, cancer	HTOX_nc	CTUh
Human toxicity, non-cancer	HTOX_c	CTUh
Particulate matter	PM	disease incidences
Ionising radiation	IR	kBq U ²³⁵ eq.
Photochemical ozone formation	POF	kg NMVOC eq.
Acidification	AC	mol H ⁺ eq
Eutrophication, terrestrial	TEU	mol N eq
Eutrophication, freshwater	FEU	kg P eq
Eutrophication, marine	MEU	kg N eq
Land use	LU	pt
Ecotoxicity freshwater	ECOTOX	CTUe
Water use	WU	m ³ water eq
Resource use, fossil	FRD	MJ
Resource use, minerals and metals	MRD	kg Sb eq

¹⁰ Individual reports for areas of consumption are available at <https://eplca.jrc.ec.europa.eu/sustainableConsumption.html>

2.3 Peculiar features of the Consumer Footprint calculator compared to other footprint calculators

The **Consumer Footprint Calculator** has a number of peculiar features compared to other web-based calculators addressing individual footprints. Those features could be summarized as follows:

— Calculation:

- based on user-specific consumption data
- systemic cradle-to-grave approach, as basis of the modelling of the representative products
- prioritized EU market average data for emission factors
- possibility of testing alternative consumption patterns (e.g. entering different data)

— Results:

- consistent implementation of impact models (16 EF categories, beyond climate change)
- assessment against Planetary Boundaries and average EU citizen
- high granularity (5 areas of consumption, around 150 products)
- provision of general tips towards sustainable behaviour and lifestyle sustainability improvement

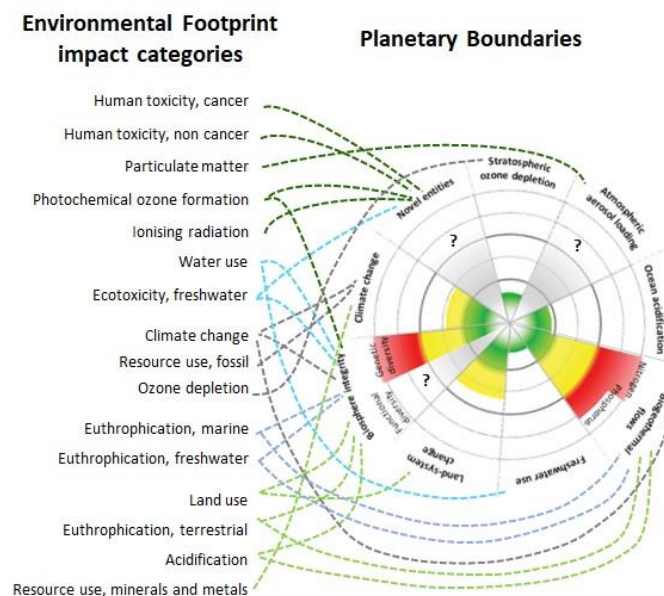
Two different versions of the Consumer Footprint Calculator were developed over time:

- A web-based version (Chapter 3): a publicly available version of the Calculator with higher level of user-friendly options and improved image¹¹
- An Excel-based version (Annex 2), more extended that can be used for educational purposes¹²

2.4 Link to the Planetary Boundaries

The 16 impact categories of the EF (Table 1) are associated to different environmental control variables of the Planetary Boundaries (PBs) framework. These nine processes were mapped and adapted to the metrics of the EF impact categories leading to Life Cycle Impact Assessment (LCIA)-based PBs (Sala et al., 2020) (Figure 5).

Figure 5. Link of the impact categories of the Environmental Footprint method with the different Planetary Boundaries.



¹¹ Available at the following link: <https://knowsdqs.jrc.ec.europa.eu/cfc>

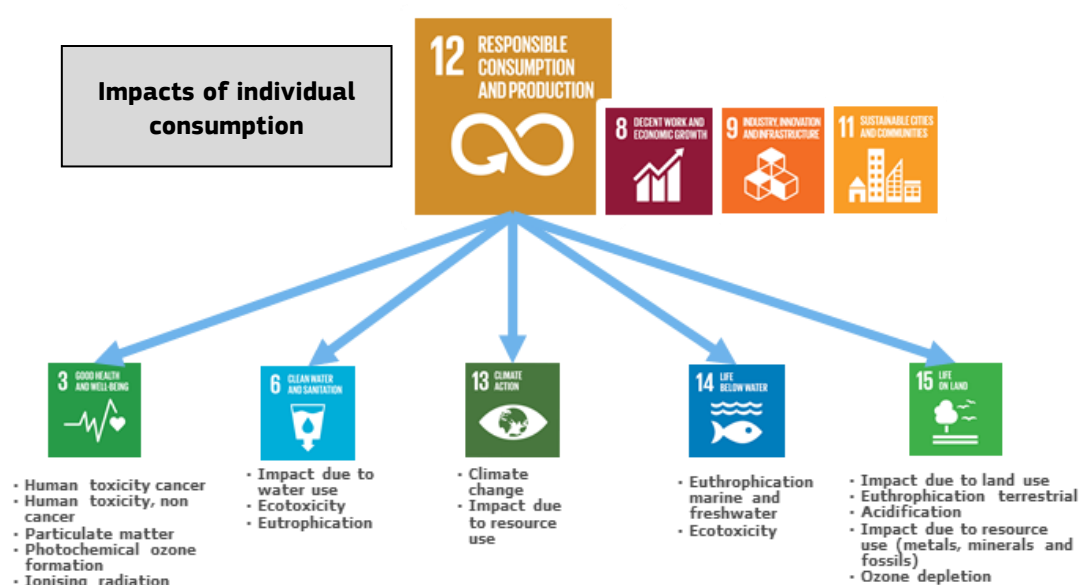
¹² Available at the following link https://eplca.jrc.ec.europa.eu/permalink/consumptionfootprint/2021_ConsumerFootprintCalculator_v1.xlsm

By linking the PBs with the Consumer Footprint Calculator impact categories, it is possible to estimate the extent to which the individual environmental impacts transgress the safe operating space for humanity.

2.5 Link to the Sustainable Development Goals

The calculator could be used in relation to Sustainable Development Goals (SDGs) in two ways: a) to assess individual contribution to the achievement of SGG 12 on responsible production and consumption; and b) to assess the implications of individual consumption patterns on environmentally related SDGs. To assess the link between environmental impacts and the different aspects covered by the SDGs, the 16 impact categories of the Environmental Footprint are mapped to specific SDGs (Figure 6). In the calculator, the impact on each SDG is calculated by aggregating the normalized and weighted impacts of the impact categories which are associated with that specific SDG. The single weighted score of the Consumer Footprint, which considers all the categories, addresses the impacts of consumption and can be employed to monitor the evolution towards a more responsible and sustainable consumption and production (SDG 12).

Figure 6. Link between the impact categories of the Environmental Footprint method and the SDGs.



3 The web-based Consumer Footprint Calculator

This sections details the structure and user interface of the web-based Consumer Footprint Calculator.

3.1 Structure of the calculator

The web-based calculator is structured in three main sections:

- A homepage
- A questionnaire
- A collection of results with sustainable lifestyle tips

3.1.1 Homepage

This introductory page describes the main goal and scope of the Consumer Footprint Calculator (Figure 7). The text includes links to specific background information that can be found online (e.g., project website¹³, Product Environmental Footprint website¹⁴).

Figure 7. Screenshot of the “Consumer Calculator Footprint” homepage.

Consumer Footprint Calculator

The Consumer Footprint Calculator allows you to calculate the **environmental impacts of your consumption pattern**, as well as to evaluate how changes in your lifestyle may affect your personal footprint. It considers five areas of consumption, namely food, mobility, housing, household appliances, and household goods.

The tool is based on a life cycle thinking approach, meaning that it considers the impacts occurring along the entire life cycle of the products and the energy that you consume.

The Consumer Footprint calculator covers 16 environmental impact indicators related to emissions generated into soil, water, and air as well as to resource use. These 16 indicators are those adopted in the European Commission **Product Environmental Footprint method** and can be summarised in a so-called “single score”. This Calculator allows you to evaluate the impacts of your consumption, to help achieve SDG 12 on responsible consumption, and many other Sustainable Development Goals.

3HR_t 7

What code is in the image?



¹³ <http://eplca.jrc.ec.europa.eu/sustainableConsumption.html>

¹⁴ <https://ec.europa.eu/environment/eussd/smgp/index.htm>

3.1.2 Questionnaire

The questionnaire is composed of six main sections:

- Profiling: compilation of information for analysing the results (i.e., gender, age group, country¹⁵)
- Food: compilation of data regarding the weekly consumption of different food products
- Mobility: compilation of data regarding mobility habits and characteristics of the vehicles
- Appliances: compilation of data regarding ownership of appliances and consumer behaviour
- Household goods: compilation of data regarding consumption of household goods and consumer behaviour
- Housing: compilation of data regarding characteristics of the household, energy and water consumption

All answers provided in the questionnaire are not linked to any personal information of the respondent.

The link of each question to the SDGs is detailed along the questionnaire by including the different SDG icons. A description of the link to each SDG is provided to users through a tooltip. As well, icons and other information are provided to make the experience of users friendlier (Figure 8).

Figure 8. Screenshot of the questionnaire regarding food consumption.

The screenshot shows a questionnaire titled "How many portions do you consume every WEEK of these food items?:". A tooltip provides an example of a portion: "one tomato or an average bowl of salad (200 g or 80 g of leafy vegetables)". The questionnaire displays six food categories, each with an icon, an information icon, and a numeric input field set to 0:

- Vegetables (icon of two tomatoes)
- Seasonal fruit (icon of an apple)
- Tropical fruit (icon of a banana)
- Nuts (icon of a nut)
- Legumes (icon of a pea pod)
- Potatoes (icon of two potatoes)

On the right side of the interface, there is a vertical stack of four SDG icons:

- SDG 2: ZERO HUNGER (orange icon with a bowl)
- SDG 15: LIFE ON LAND (green icon with a tree)
- SDG 6: CLEAN WATER AND SANITATION (blue icon with a water drop)
- SDG 13: CLIMATE ACTION (green icon with a globe and flame)

3.1.3 Results

The users can then explore the environmental impacts of their own lifestyle through five results sections:

- Assessment against planetary boundaries (Figure 9)
- Results by area of consumption (Figure 10)
- Comparison with average EU citizen (Figure 11)
- Product contribution to overall impacts (Figure 12)
- Assessment against Sustainable Development Goals (Figure 14)

¹⁵ Profiling questions were added due to the relevance of socio-demographic (e.g., age influence (Zheng et al. 2022)). Furthermore, specific profiling questions include aspects about EC staff as the Consumer Footprint calculator was meant to be used for internal exercises at the EC. Those entries refer to: being an EC worker, the EC service, the EC working site.

3.1.3.1 Assessment against planetary boundaries

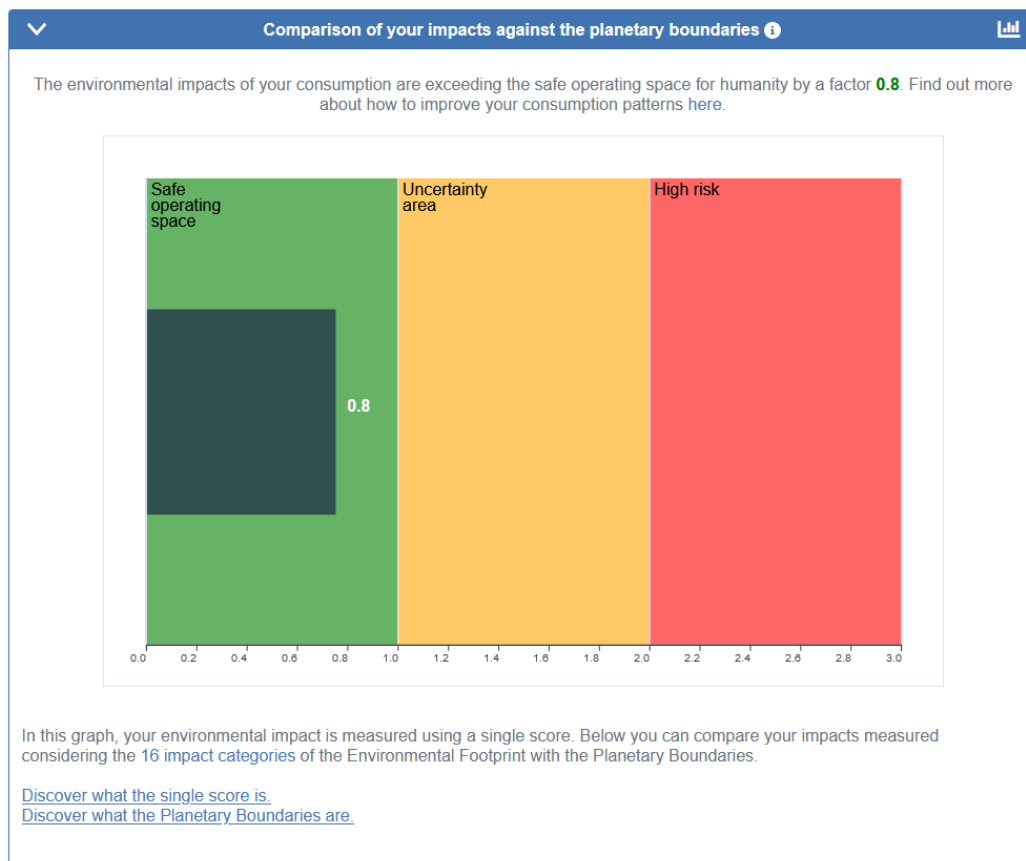
Users can assess their environmental impacts **against planetary boundaries** (Figure 9). The concept of the Planetary Boundaries was proposed in 2009 by a group of Earth system and environmental scientists. The group wanted to define a "safe operating space for humanity" for the international community as a precondition for sustainable development. The framework is based on scientific evidence that human actions since the Industrial Revolution have become the main driver of global environmental change. The "safe operating space" is defined as the threshold to maintain the Holocene state¹⁶. When this is crossed the planet's biophysical subsystems and processes could shift to a new state with potential negative consequences for humans (Rockström et al., 2009).

The planetary boundaries has been divided by global population to assess the relative share of safe operating space each individual has. This value is considered in the assessment reported in the calculator. The assessment against the Planetary Boundaries evaluates whether the impact lays:

- Within the planetary boundary, impact < 1
- Within the uncertainty area¹⁷, $1 < \text{impact} < 2$
- In the high risk area, impact >2

Users can evaluate their results against the Planetary Boundaries (namely the Earth capacity to sustain life and ecosystems) by individual impact category as well as a single weighted score.

Figure 9. Screenshot of the results section: Assessment against planetary boundaries for the single weighted score.



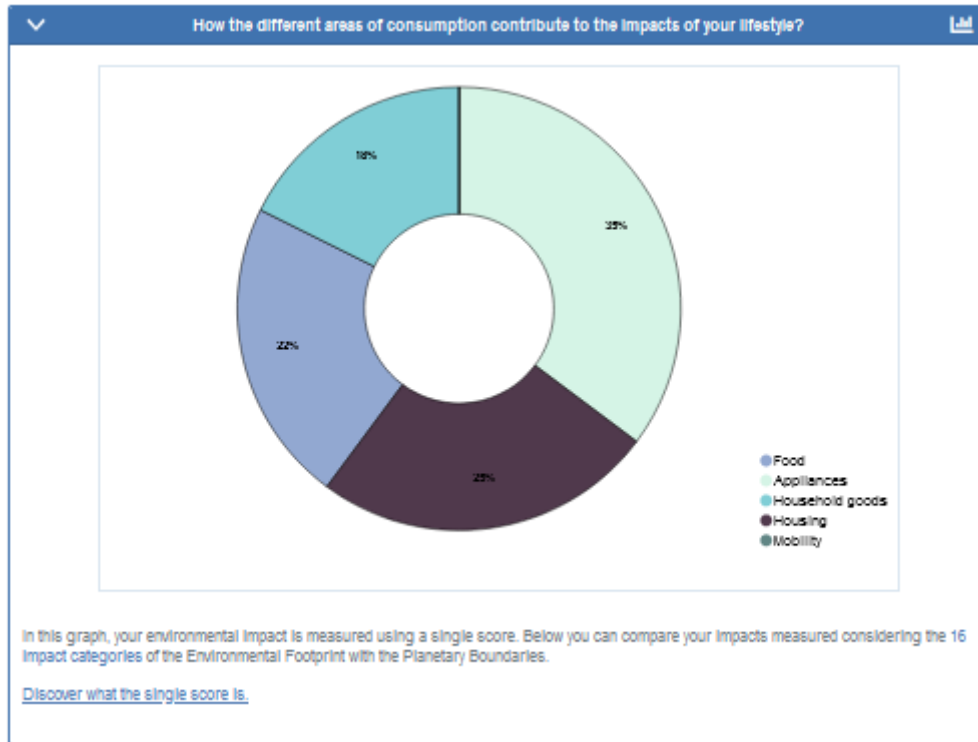
¹⁶ Holocene is the name for the most recent interval of Earth history and includes the present day. Although generally regarded as having begun 10,000 radiocarbon (¹⁴C) years, or the last 11,500 calibrated (i.e., calendar) years (Gibbard & Head, 2020).

¹⁷ The definition of a Planetary Boundary includes an uncertainty area, defined as the double of the boundary (Sala et al., 2020), to encompass the uncertainty in quantifying a biophysical threshold (intrinsic uncertainty, behaviour of complex systems, feedback mechanisms, overshoot timing) (Rockström et al., 2009).

3.1.3.2 Results by area of consumption

Users can explore how the five areas of consumption are contributing to their environmental impacts (Figure 10) by individual impact category type and aggregated into a single weighted score.

Figure 10. Screenshot of the results section: Results by area of consumption for the single weighted score.



3.1.3.3 Comparison with the environmental impacts of an average EU citizen

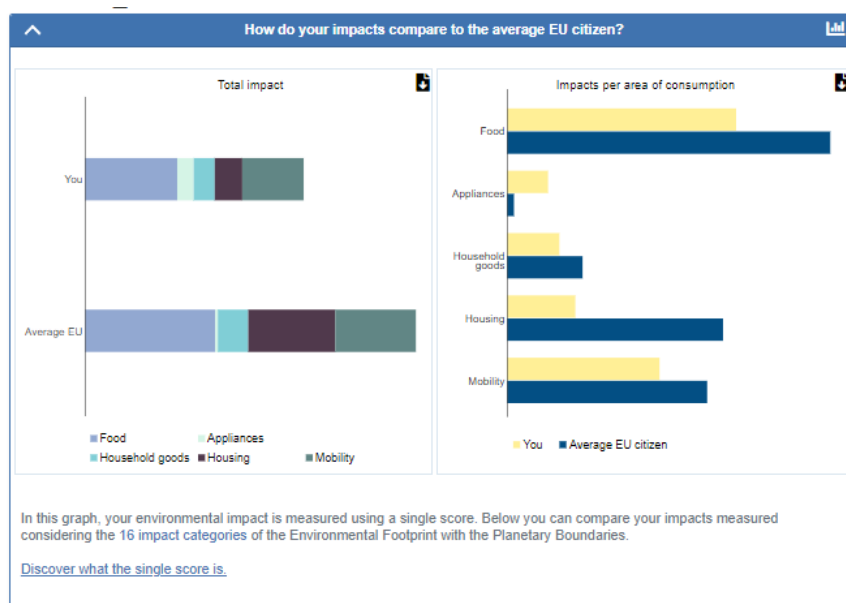
The environmental impacts of the questionnaire respondent could be compared against those of an **average EU citizen** (Figure 11). The impact of the average EU citizen results from the calculation of the overall impact of EU production and consumption in a reference year (2018¹⁸) calculated in the consumption footprint and divided by the EU population in the same year.

The result of the comparison could be explored considering

- the overall impact and the differences by area of consumption
- the contribution of the different areas of consumption to the overall impact
- both as individual impact category and as a single score

¹⁸ Overtime, the reference year will be updated in the platform to reflect the more recent data on consumption footprint at EU level.

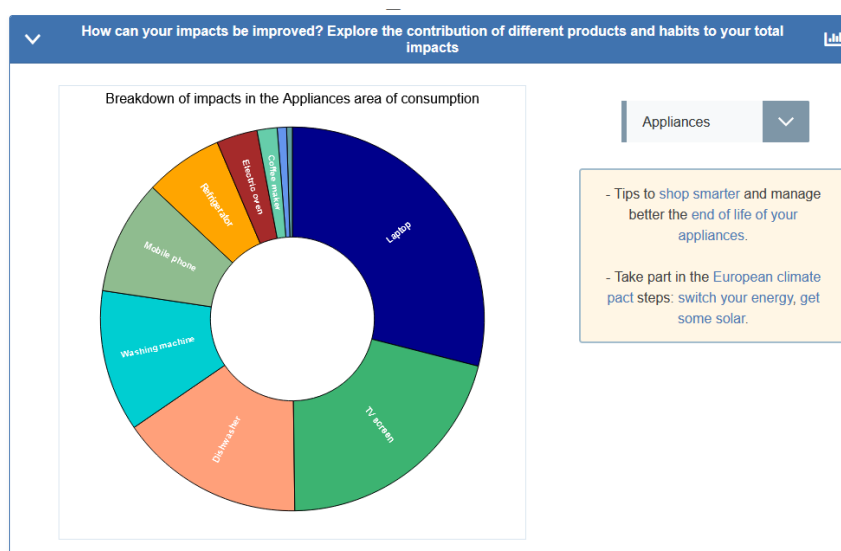
Figure 11. Screenshot of the results section: Comparison with average EU citizen for the single score.



3.1.3.4 Product contribution to overall impacts

One of the main advantages of the Consumer Footprint Calculator compared to other calculators is the granularity of the results. Users can explore the **product contribution to their impacts** (Figure 12). This analysis of the results allows the identification of the products groups contributing the most to the overall individual environmental impact. Such identification can provide users with detailed information on the potential consumption patterns and behaviour to modify towards reducing their environmental impacts. For this purpose, this section includes links to sustainable actions, such as EC climate action tips¹⁹, the individual pledges²⁰ of the European Climate Pact²¹, and the United Nations' "Anatomy of Action" project²².

Figure 12. Screenshot of the results section: Product contribution to overall impacts.



¹⁹ https://ec.europa.eu/clima/citizens/tips/reuse_en

²⁰ <https://www.count-us-in.org/en-gb/16-steps/>

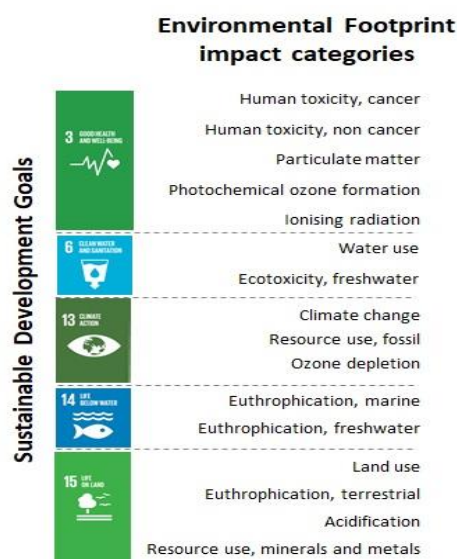
²¹ https://europa.eu/climate-pact/index_en

²² <https://anatomyofaction.org/>

3.1.3.5 Assessment against Sustainable Development Goals

Users can evaluate their environmental impacts taking a SDGs perspective, by evaluating the impacts to the environmental issues covered by different SDGs (Figure 14). The impact categories are grouped as presented in Figure 14.

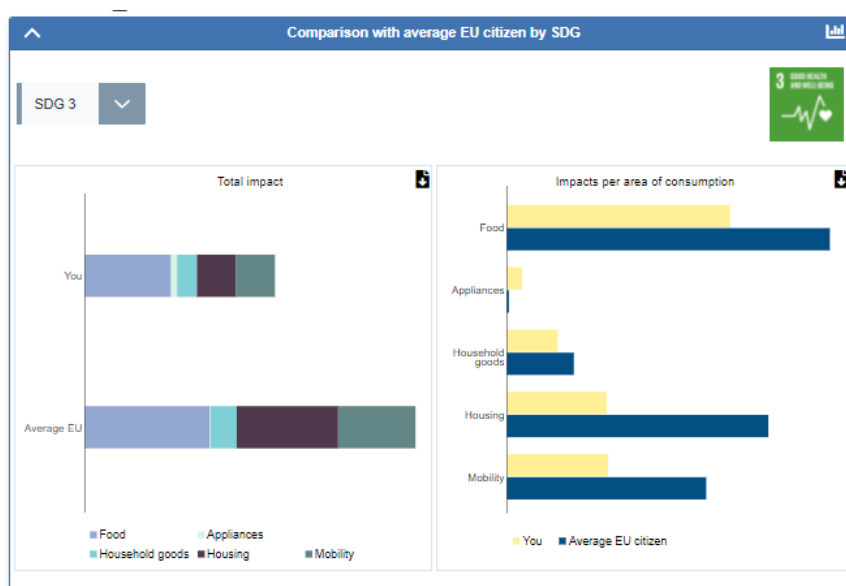
Figure 13. Link between the impact categories of the Environmental Footprint method and the SDGs.



Results can be explored considering:

- The comparison with the EU average citizen in terms of overall impact and by area of consumption in relation to the specific SDG at stake
- The contribution of the different areas of consumption to the overall impact

Figure 14. Screenshot of the results section: Assessment against Sustainable Development Goals.



3.2 User interface details

This section details icons and navigation, as well as data compilation options of the web-based Consumer Footprint Calculator.

3.2.1 Icons and navigation

To guide the use of the Consumer Footprint Calculator, the interface includes specific icons (Table 2).

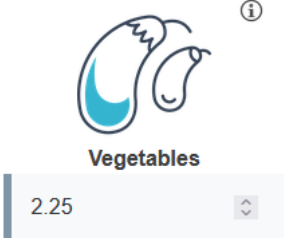
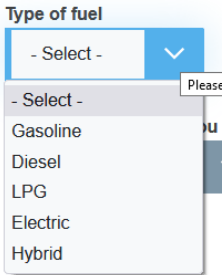

Table 2. Icons employed in the web-based Consumer Footprint Calculator to guide the users along the different steps.

Icon	Description
	Navigation buttons to move between different pages of the Calculator.
	The compilation of a captcha is required for the users in order to increase the security of the tool and the data provided by the user.
	Icons discriminating the scope of the questions, which can refer to: <ul style="list-style-type: none"> - individual consumption: consumption performed by the user - household consumption: consumption performed by the entire household
	Information icon to provide specific details about the question in a tooltip.
	Once the questionnaire has been completed, the 'Calculate' icon leads the user to the results section.
	This icon allows users to go back to the questionnaire to modify their answers.

3.2.2 Data compilation

Three different options are in place in order to compile user data. Table 3 provides an example and describes these options.

Table 3. Data compilation options.

Option	Description
	<p>Option to enter or select through the arrows specific consumption amounts.</p> <p>For food products, amounts can be detailed to 0.25 units per week (in case an item is consumed once per month) with a maximum value of 50 portions.</p>
	<p>Drop-down menus provide specific categories or quantitative ranges to enter information in the questionnaire.</p>
	<p>A slider provides a range of continuous values in which the users can indicate their reply.</p>

3.2.3 Data retrieval

Users are recommended to bookmark the link of their results page. This link contains a user-specific token and provides access to the same results later on time. This allows users:

- Checking their results later on time
- Evaluating their results with modified consumption patterns. In this website, a specific icon (see last icon in Table 2) allows users to go back to the questionnaire to modify their answers

3.3 The KnowSDGs platform

The web-based version of the Consumer Footprint Calculator is hosted in the EC platform KnowSDGs (Knowledge base for the Sustainable Development Goals)²³. This platform provides tools and knowledge on policies, indicators, methods and data to support the evidence-based implementation of the Sustainable Development Goals (SDGs). After presenting the SDG framework with a description of all the goals, targets and indicators, the platform offers interactive tools to support policy makers, scientists and citizens to deepen their knowledge and contextualize their daily actions within the SDGs perspective (Figure 15).

²³ <https://knowsdgs.jrc.ec.europa.eu/>

Figure 15. Tools available in the KnowSDG platform.



The Consumer Footprint Calculator is mainly linked to SDG 12 (responsible consumption and production), even though consumption choices have several implications on other SDGs, considering the socio-economic and environmental impacts associated with products. In this context, the Calculator is an important tool to engage citizens, by assessing the sustainability of their choices, raising their awareness, providing concrete tips to improve their behaviour. Empower people by better understanding the impacts of their individual choices is key in starting behavioural changes towards more sustainable lifestyles, thus fostering SDGs achievement. The impact categories explored in the Consumer Footprint Calculator have links with specific SDGs (Figure 16).

Figure 16. Links between EF impact categories and SDGs.



4 Updates and technical specifications: from the Consumer Footprint to the Consumer Footprint Calculator

This version of the Consumer Footprint Calculator has been updated compared to preliminary versions (Sala et al., 2019) in three main aspects:

- user-friendliness: the way in which questions are posed, making the user more likely able to answer (e.g. the user is asked to report the number of portions of food consumed weekly or daily instead of the overall yearly food consumption)
- specific product coverage: the questions of the calculator address a selection of products from each area of consumption to avoid posing an excessive number of questions and asking questions that might be hard to answer (i.e., no questions are reported for some products that have an extremely low unitary impact or whose consumption is not easily quantifiable by the user, for which the consumption of the average EU citizen in 2018 is considered)
- number of representative products: in alignment with the consumption footprint indicator, a larger number of representative products is covered in the current version of the Calculator
- life cycle inventory of representative products: in alignment with the consumption footprint indicator, the underpinning life cycle inventory data for the individual representative products have been updated to the latest ecoinvent and agrifootprint versions
- impact assessment model: in alignment with the consumption footprint indicator, the current version considers the last update of the Environmental Footprint method for the impact assessment (EF 3.0)

A detailed description of the questions for each area of consumption is provided in this chapter.

Note that the five areas of consumption addressed in this Calculator are covered by specific EU policies addressing the improvement of environmental profile of lifestyles:

- Food: Farm to Fork Strategy²⁴
- Mobility: Strategy for sustainable and smart mobility²⁵, and related proposals
- Appliances: Energy Directive²⁶ or Right to repair²⁷
- Household goods: Sustainable products initiative²⁸ and proposal for Regulation on eco-design , EU Strategy for Sustainable Textiles²⁹
- Housing: Renovation wave³⁰, revision of Construction product regulation³¹

4.1 Food

Considering that people are rarely aware of the amount of different food products they consume in a year, users are asked to report the portions of food consumed weekly. Users can select decimal numbers, for instance in case they consume a portion of a food item once per month, and they can enter a weekly consumption of 0.25 portions³². To support users, an “example of one portion” is reported for each food product describing a portion both in qualitative and quantitative terms. Not having found reference documents for the entire EU, the contents of this column are defined mainly based on Italian and Irish references (e.g., SINU, 2014).

Compared to the list of products in the Basket of Products Food, the following assumptions were made:

- Apples, oranges, and strawberries are taken as proxies for seasonal fruit

²⁴ https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

²⁵ https://transport.ec.europa.eu/transport-themes/mobility-strategy_en

²⁶ https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules_en

²⁷ <https://repair.eu/ca/>

²⁸ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative_en

²⁹ <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12822-EU-strategy-for-sustainable-textiles>

³⁰ https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

³¹ https://ec.europa.eu/growth/sectors/construction/construction-products-regulation-cpr_en

³² While in the webtool all values between 0 and 50 spacing 0.25 are allowed, for technical restrictions the excel-based tool only allows to select whole numbers between 0 and 50 plus 0.25 and 0.5.

- Bananas and avocados are considered as proxies for tropical fruit
- Almonds and cashew nuts are considered as proxies for nuts
- Tomatoes, broccoli and carrots are considered as proxies for vegetables
- Milk is considered as proxy for yoghurt
- Cod, salmon, and shrimps are considered as proxies for fresh seafood, while canned tuna is a proxy for shelf-stable seafood
- Beans, chickpeas and lentils are considered as proxies for legumes
- Tofu is a proxy for soy-based meat substitutes, while soy milk is a proxy for plant-based milk
- Rice and quinoa are considered as proxies for grain cereals
- Biscuits are considered as proxy for biscuits and cakes and chocolate as a proxy for confectionary products

Whenever two or more products are used to build a proxy of a larger group of products, the weighted average of their impacts is calculated based on the consumption of the average EU citizen, as estimated in the Consumption footprint indicator for the year 2015.

In some cases, questions refer to a specific food item considered as a proxy of a larger group (e.g. for biscuits and chocolate), therefore the yearly consumed amount is multiplied by an upscale factor derived from consumption statistics (e.g. as the ratio between the apparent consumption of “biscuits and cakes” and the apparent consumption of “biscuits”).

For some products, i.e. sugar, vegetable oils, and butter, no questions are asked to the user and the apparent consumption of an average EU citizen in 2015 is considered (Table 3).

Table 4. Consumption intensity of an average EU citizen in 2015 for the food products not included in the questionnaire (from EC-JRC, 2021). The quantities reported are upscaled to the total consumption of the group of products they represent (e.g. sunflower oil and olive oil are upscaled to represent the entire consumption of vegetal oils).

Product	Consumption intensity	Unit
Olive oil	4.7	kg/year
Sunflower oil	5.8	kg/year
Sugar from beet	31.0	kg/year
Butter	4.7	kg/year
Palm oil	13.9	kg/year
Rapeseed oil	3.7	kg/year
Soyabean oil	2.4	kg/year

In the case of water consumption, the user is asked to only indicate the consumption of bottled water as the consumption of tap water (including drinking purposes) is already accounted for in questions related to housing. This is clarified in the description of the portions.

The size of portions in the tool reflect nutritional recommendations. However, people likely consume portions of different sizes. To overcome this issue, the user can modify the number of portions accordingly, based on the description of portion size provided.

4.2 Mobility

For the area of consumption mobility, questions regarding personal travelling and commuting are asked per type of vehicle (car, motorcycle, public transportation, and flights). For all the vehicles, the occupancy factor of

the BoP is considered (Castellani et al., 2017b), apart from cars - where a user-specific occupancy factor is employed. Users can also indicate whether they travel or commute mostly by bike or on foot, particularly for those cases where no use of other private vehicles is reported.

If the user answers yes to the question “Do you travel or commute by car?”, information on the total number of cars present in the household is required. When extra cars are added in the household (i.e. on top of the one owned by the user), a share of the environmental impacts of the infrastructure of the additional car(s) (from the extraction of raw materials to the end of life management) is considered. The share is calculated by dividing the number of extra cars by the number of household members. This aims at reflecting in the consumer footprint the ownership pattern of the household regarding cars. Then, the user is asked to provide the information regarding the technical details of the vehicle and the annual distance for the car mostly employed by the user. Finally, the occupancy factor is determined by asking the user the number of passengers, if any, that he/she usually travels with.

For motorcycles, the user is asked to provide the information regarding the technical details of the vehicle and the annual distance travelled. In this case, for simplicity the average EU occupancy factor for motorcycles is used (1.1) (Castellani et al., 2017b).

When the user is not aware of the annual distance either by car or motorcycle, this can be indicated in the question “Do you know approximately how many km you travel by car/moped or motorcycle every year?” and the annual distance of the average citizen of the respective country is considered.

For public transport, questions refer to the monthly hours spent on each type of vehicle. Average distance per hour have been assumed per transport type as follows: 22 km (bus), 33 km (metro), 18 km (urban train), and 150 km (high speed train). Data to estimate the average speed of the former three means of transportation is taken from European Commission (2016), while for the latter from European Court of Auditors (2018).

Regarding flights, the average km of national and continental flights is taken from the BoP Mobility (Castellani et al., 2017b). The user is asked to report the number of national and continental roundtrip flights taken, meaning that the distances in the BoP are multiplied by 2. In the case of extra-EU flights, the user is asked to indicate the yearly number of hours spent on these flights and the average speed of 767km per hour is assumed (estimated from the average length and duration of long-haul flights at global level in 2006, according to Wilkerson et al. 2010).

4.3 Appliances

The user is asked to report the number of appliances in his/her household. To calculate the impacts, this amount is divided by the number of people sharing the house (asked in the general questions reported in the section on housing). For appliances related to lighting, no questions are included and the apparent consumption of an average EU citizen in 2015 is considered (Table 4).

Table 5. Consumption intensity of an average EU citizen in 2015 for the household appliances not included in the questionnaire (from Reale et al., 2019).

Product	Consumption intensity	Unit
Compact Fluorescent Lamp	3.36	product/year
Incandescent lamp	5.94	product/year
Halogen lamp, low voltage	1.261	product/year
Halogen lamp, mains voltage	1.12	product/year
LED (1000lm)	0.03	product/year

The electricity consumption during the use phase of appliances is considered in the area of consumption of housing, altogether with the overall electricity consumption in the household. This has been clarified in the results visualization. As a result, the tool is not addressing questions on the energy efficiency of the appliances neither the time of utilization.

To consider the behaviour of consumers regarding appliances, the tool includes a question on reparability: “When your appliances break down, do you try to have them fixed before replacing them?”. As the model assumes that maintenance and repair are done to ensure the appliance is used for the assumed lifespan, if the answer of this question is “No” a penalty is considered, where the impact of the appliances is increased as a shorter lifespan is considered.

Beyond household appliances, the user is also asked about **personal technological devices**. This aims at quantifying the number of functioning mobile phones in use and how often they are replaced. Based on the stated lifespan of the phones, the impact per year of use is calculated. If users replace their phone every year, or every two years, it is assumed that no maintenance is performed (battery replacement) in the evaluation of environmental impacts; while longer lifespans (>2 years) consider the need of maintenance. The question addresses possession of mobile phones in use rather than total amount of mobile phones (both in use and those kept in home after use) as the life cycle model already considers the fact that citizens keep extra mobile phones at home instead of managing them as electronic waste.

4.4 Household goods

The area of consumption household goods covers a broad range of products such as clothes, furniture, detergents, and products for personal care. To avoid an excessive number of difficult questions for the user, questions regarding personal goods purchased are asked on a limited number of products, i.e. shoes, clothes, newspapers, and books. For all the other products no questions are asked and the apparent consumption of an average EU citizen in 2015 is considered (Table 5).

Regarding **footwear**, questions address two groups of shoes, namely waterproof shoes, and sport, leisure or fashion shoes. While the first one corresponds to a representative product of the BoP household goods, the second one represents a group of products. The impact of ‘sport, leisure or fashion shoes’ has been calculated as the average impact of the three representative products: sport shoes, leisure shoes, and fashion shoes. Such approach was taken to simplify the questionnaire and considering that the environmental impact of the different shoe types in the group was similar.

Regarding **clothes** and **physical books**, the questionnaire includes ranges of products purchased per year, which are defined based on personal experience. Ranges were preferred instead of individual units since it would be difficult for users to determine the specific number of items bought each year. To calculate the impact, the median value of the range is considered. Upscale factors are used in both cases as the selected clothes are a proxy of a larger group of apparel products (e.g., jackets, gloves) and physical books and newspaper are proxies of other paper products (e.g., journals, other graphic products).

Towards addressing sustainable behaviour, the tool includes a question on the consumption of second-hand clothes. The user can indicate the share of clothes that have been bought second-hand. A reduced environmental impact for this share of clothes is considered according to the scenarios modelled in the BoP household goods (Castellani et al., 2019).

Concerning **physical newspaper**, the questionnaire addresses the consumption intensity in temporal terms: How often a physical newspaper is bought. The annual consumption of newspaper has then been calculated replicating the indicated trend along an entire year.

Table 6. Consumption intensity of an average EU citizen in 2015 for the household goods products not included in the questionnaire (from EC-JRC, 2021).

Product	Consumption intensity	Unit
All-Purpose cleaner	11.01	kg/year
Dishwasher detergent	2.68	kg/year
Hand dishwasher detergent	1.92	kg/year
Laundry liquid detergent	11.05	kg/year
Laundry powder detergent	3.42	kg/year
Baby diaper	4.04	kg/year
Sanitary pad	4.97	kg/year
Tampon	0.11	kg/year
Breast pad	0.70	kg/year
Bar soap	2.22	kg/year
Liquid soap	2.29	kg/year
Shampoo	2.07	kg/year
Hair conditioner	0.47	kg/year
Wardrobe	0.82	product/year
Kitchen cabinet	1.40	product/year
Sofa	0.62	product/year
Wooden seat	0.92	product/year
Wooden table	0.62	product/year
Bed mattress	0.10	product/year
Toilet paper	86.27	kg/year

4.5 Housing

Concerning the area of consumption housing, a set of general questions on the number of people sharing the same house (information used for calculating the impacts of appliances and housing) and the country where the user lives (used to identify the climatic area for housing) is included. Within housing, the impacts of three components are assessed: 1. infrastructure, 2. energy, and 3. water consumption. The resulting impacts are divided by the number of occupants in the house.

Regarding infrastructure, the type of house archetype is identified according to the information provided by the user on their location (i.e. country), the type of house (single family or multi-family), and the year of construction or major refurbishment. The environmental impact of the infrastructure corresponds to the different archetypes

defined in the BoP housing (Baldassarri et al., 2017). If the user is not able to answer to the question on the year of construction or refurbishment of the house, the option “I don’t know” can be selected. In this case, an estimation of the impacts linked to the infrastructure of the house is done considering a weighted average of the relevant house archetypes (those for the location and type of house selected), based on the EU housing stock as reported in the BoP housing (Baldassarri et al., 2017)

On energy consumption, questions address the electricity consumption, including the electricity source (from the grid, from micro-CHP, from photovoltaic panels), and the heating demand (including the heating system type and the energy source). Electricity from the grid is modelled considering the country-specific electricity mix, based on the location reported by the user. A green electricity mix from grid, satisfying the energy demand only from renewable energy sources, has been also included. It is defined by the International Energy Agency data on electricity from renewables in EU 28 for the year 2017 (44.18% from wind; 40.39% from hydro; 14.55% from solar photovoltaic; 0.82% from geothermal; 0.06% from tide) (IEA, 2020). In case users do not know their electricity use, they are provided the option “I don’t know”. Here the electricity use is modelled considering the average use according to the location and house archetype.

Questions on the energy used for heating are posed in the following way. The user is first asked whether he/she has an autonomous system (i.e. own boiler or similar) or is connected to a centralised system. Then, the user is asked about the energy source used and the consumption value. The range of answers provided for these two questions depends on whether the user has an autonomous or centralised system. For instance, the option “district heating” is only provided in case of centralised system, and the unit of measures of the consumption values are different (it is expected that a user with an autonomous system fuelled by methane will receive a bill with consumption amounts expressed in cubic meters, as the methane is directly purchased from the supplier, while a user with a centralised system with the same energy source will instead receive a bill with consumption amounts expressed in kWh, as the heat energy purchased is produced by a common boiler). When a centralised system is in place, the user might not know the energy source used for heating. In this case she/he can select the option “I don’t know” and the calculation of impacts is performed considering the average EU mix of energy used for heating. This average has been calculated from the International Energy Agency data on heating mix in EU 28 for the year 2017 (36.54% from natural gas; 25.35% from coal; 19.84% from biofuels 10.12% from waste; 3.94% from oil; 0.43% from geothermal; 0.07% from solar thermal; 3.70% from nuclear and other sources) (IEA, 2020).

In case the user does not know the amount of energy used for heating (therefore selecting the option “I don’t know”), this quantity is estimated considering the average energy used for heating according to the following information (provided by the user):

- Year of construction or refurbishment
- House typology (detached, semi-detached, terrace house / apartment)
- Climatic zone (depending on the country)

To make this estimation data on energy used for heating at EU level for the different house archetypes were collected.

Users are also asked about their consumption of water for sanitation. In case they do not know the answer water use is modelled considering the average use according to the location and house archetype.

5 Further developments

Further developments of the Consumer Footprint Calculator aim at including updates of the Consumption footprint indicator (e.g. new products and areas of consumption), expand the consideration of sustainable behaviour and integrate Member State-level data.

The tool has been tested with different stakeholders within and beyond the European Commission. Based on the feedback received over the testing phase of the tool, a number of possible improvements. These potential improvements can be classified in four main groups. Within these groups, improvements are provided from higher feasibility and short-term opportunities to more resource-demanding and long-term proposals.

Content updates:

- Inclusion of new products following the update of the Consumption footprint indicator (e.g. further food products or appliances)
- Inclusion of new areas of consumption modelled in the Consumption footprint indicator (e.g. tourism)
- Inclusion of sustainable lifestyle options (e.g., consumption of local or organic food products)
- Inclusion of elements to measure the impact of teleworking (e.g. digital and electronic products)

Expansion of assessment:

- Integration of social impacts and other SDGs, including specific questions (e.g. fair trade, sustainable finance)
- Consideration of environmental impacts at the Member State level, based on regionalized models for the consumption footprint

Additional calculation options:

- Possibility to distinguish work-related mobility from personal mobility

Additional IT solutions:

- Inclusion of a comparison not only with the average EU citizen but also with the average Member State citizen, based on developments of Member State-level consumption footprints
- Inclusion of an option to check the overall amount of food consumption reported, e.g. including a daily calories ingestion according to the reported consumption pattern
- Possibility to save the individual consumption choices and track the changes over time

6 Access to the Consumer Footprint Calculator

The Consumer Footprint Calculator can be accessed through the following links:

— To access the web-based tool:

<https://knowsdgs.jrc.ec.europa.eu/cfc>

— To access the Excel-based calculator:

https://eplca.jrc.ec.europa.eu/permalink/consumptionfootprint/2021_ConsumerFootprintCalculator_v1.xlsm

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List of abbreviations

BoP	Basket of representative Products
CFC	Chlorofluorocarbons
CTU	Comparative toxic unit
EF	Environmental Footprint
EU	European Union
LCA	Life Cycle Assessment
LCT	Life Cycle Thinking
MJ	Megajoule
NM VOC	Non-methane volatile organic compounds
PB	Planetary Boundary
SDG	Sustainable Development Goal

Impact categories of the Environmental Footprint

CC	Climate change
ODP	Ozone depletion
HTOX_nc	Human toxicity, cancer
HTOX_c	Human toxicity, non-cancer
PM	Particulate matter
IR	Ionising radiation
POF	Photochemical ozone formation
AC	Acidification
TEU	Eutrophication, terrestrial
FEU	Eutrophication, freshwater
MEU	Eutrophication, marine
LU	Land use
ECOTOX	Ecotoxicity freshwater
WU	Water use
FRD	Resource use, fossil
MRD	Resource use, minerals and metals

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Annexes

Annex 1. List of representative products per area of consumption

Table A1-1. Product groups and representative products of the area of consumption: Food.

Product group	Representative product
MEAT	Pork meat
	Beef meat
	Poultry meat
FISH & SEAFOOD	Salmon
	Cod
	Shrimps
	Tuna
DAIRY	Milk
	Cheese
	Butter
EGGS	Eggs
CEREAL-BASED PRODUCTS	Bread
	Pasta
	Rice
	Quinoa
SUGAR	Sugar
OILS	Sunflower oil
	Olive oil
	Rapeseed oil
	Soybean oil
	Palm oil
TUBERS	Potatoes
VEGETABLES	Tomatoes
	Broccoli
	Carrots
LEGUMES	Beans
	Chickpeas
	Lentils
LEGUME PRODUCTS	Tofu
	Soy drink
FRUITS	Apples
	Oranges
	Bananas
	Avocados
	Strawberries
NUTS & SEEDS	Almonds
	Cashew
COFFEE & TEA	Coffee
	Tea

Product group	Representative product
BEVERAGES	Beer
	Wine
	Mineral water
CONFECTIONERY PRODUCTS	Biscuits
	Chocolate
PRE-PREPARED MEALS	Meat-based dishes

Table A1-2. Product groups and representative products of the area of consumption: Appliances.

Product group	Representative product	
REFRIGERATION	Combined fridge-freezer	
DISHWASHING	Dishwasher (10p)	
	Dishwasher (13p)	
WASHING	Washing machine	
	Electric condenser tumble dryer	
ELECTRONICS	TV	
	Notebook	
	Mobile phone	
LIGHTING	Compact fluorescent lamp with integrated ballast (CFLi)	
	Halogen lamp, low voltage (model with reflector – R) (HLLVR)	
	Halogen lamp, mains voltage (model HLLME)	
	Incandescent lamp (GLS)	
	Light Emitting Diodes (LED)	
AIR CONDITIONING	Air conditioner	
DOMESTIC COOKING APPLIANCES	Electric oven	
	Coffee maker	
CLEANING APPLIANCES	Vacuum cleaner	
BATHROOM APPLIANCES	Hair dryer	

Table A1-3. Product groups and representative products of the area of consumption: Household goods.

Product group	Representative product
DETERGENTS	All-purpose cleaners
	Detergent for dishwashers
	Hand dishwashing detergents
	Laundry detergents liquid
	Laundry detergents powder
SANITARY PRODUCTS	Baby diapers
	Sanitary pads
	Tampons
	Breast pads
PERSONAL CARE PRODUCTS	Bar soap
	Liquid soap
	Shampoo
	Hair conditioner
FURNITURE	Bedroom wooden furniture
	Kitchen furniture
	Upholstered seat
	Non-upholstered seat
	Dining room table
BED MATRESSES	Mattress
FOOTWEAR	Work and waterproof
	Sport
	Leisure
	Fashion
CLOTHING	T-shirt
	Women blouse
	Men trousers
	Jeans
PAPER PRODUCTS	Newspaper
	Book
	Toilet paper
PLASTIC PRODUCTS	Toys
	Plastic articles of apparel and clothing
	Hair-related products
	Sandals
	Household plastic articles
	Furniture of plastic
	Sleeping bags

Table A1-4. Classification of residential building stock in representative products of the area of consumption: Housing.

Type of building	Climate zone	Construction period	Representative product (reference dwelling)
Multifamily house (MFH)	Cold	< 1945	MFHcold_45
		1945 - 1969	MFHcold_4569
		1970 - 1989	MFHcold_7089
		1990 - 2010	MFHcold_9010
		> 2010	MFHcold_10
	Moderate	< 1945	MFHmoderate_45
		1945 - 1969	MFHmoderate_4569
		1970 - 1989	MFHmoderate_7089
		1990 - 2010	MFHmoderate_9010
		> 2010	MFHmoderate_10
	Warm	< 1945	MFHwarm_45
		1945 - 1969	MFHwarm_4569
		1970 - 1989	MFHwarm_7089
		1990 - 2010	MFHwarm_9010
		> 2010	MFHwarm_10
Single family house (SFH)	Cold	< 1945	SFHcold_45
		1945 - 1969	SFHcold_4569
		1970 - 1989	SFHcold_7089
		1990 - 2010	SFHcold_9010
		> 2010	SFHcold_10
	Moderate	< 1945	SFHmoderate_45
		1945 - 1969	SFHmoderate_4569
		1970 - 1989	SFHmoderate_7089
		1990 - 2010	SFHmoderate_9010
		> 2010	SFHmoderate_10
	Warm	< 1945	SFHwarm_45
		1945 - 1969	SFHwarm_4569
		1970 - 1989	SFHwarm_7089
		1990 - 2010	SFHwarm_9010
		> 2010	SFHwarm_10

Table A1-5. Classification of mobility intensity in representative products of the area of consumption: Mobility.

Transport type	Vehicle type	Vehicle subtype	Technology
Road transport	Passenger car	Gasoline <1.4 L	Conventional; Euro_1; Euro_2; Euro_3
		Gasoline <1.4 L	Euro_4
		Gasoline <1.4 L	Euro_5
		Gasoline <1.4 L	Euro_6
		Gasoline 1.4 - 2.0 L	Conventional; Euro_1; Euro_2; Euro_3
		Gasoline 1.4 - 2.0 L	Euro_4
		Gasoline 1.4 - 2.0 L	Euro_5
		Gasoline 1.4 - 2.0 L	Euro_6
		Gasoline >2.0 L	Conventional; Euro_1; Euro_2; Euro_3
		Gasoline >2.0 L	Euro_4
		Gasoline >2.0 L	Euro_5
		Gasoline >2.0 L	Euro_6
		Diesel 1.4 - 2.0 L	Conventional; Euro_1; Euro_2; Euro_3
		Diesel 1.4 - 2.0 L	Euro_4
		Diesel 1,4 - 2.0 L	Euro_5
		Diesel 1,4 - 2.0 L	Euro_6
		Diesel >2.0 L	Conventional; Euro_1; Euro_2; Euro_3
		Diesel >2.0 L	Euro_4
		Diesel >2.0 L	Euro_5
		Diesel >2.0 L	Euro_6
		LPG	Conventional; Euro_1; Euro_2; Euro_3; Euro_4; Euro_5
		Electric	Total
		Hybrid	Total
	2-wheelers	Mopeds <50 cm ³	Conventional; Euro_1; Euro_2; Euro_3
		Motorcycles <125cm ³	Conventional
		Motorcycles >125 cm ³	Conventional;Euro_1; Euro_2; Euro_3
	Bus	Urban Buses Standard 15 - 18 t	Conventional; Euro_1; Euro_2; Euro_3; Euro_4; Euro_5
		Coaches Standard <=18 t	C Conventional; Euro_1; Euro_2; Euro_3; Euro_4; Euro_5 Conventional;Euro_1; Euro_2;Euro_3; Euro_4;Euro_5
		Urban CNG Buses	Euro_1; Euro_2; Euro_3
Rail transport	Train	Electric	Total
		Diesel	Total
Air transport	Plane	National	Total
		Intra EU	Total
		Extra EU	Total

Annex 2. The Excel-based Consumer Footprint Calculator

This sections details the structure and user interface of the Excel-based Consumer Footprint Calculator³³.

Structure of the calculator

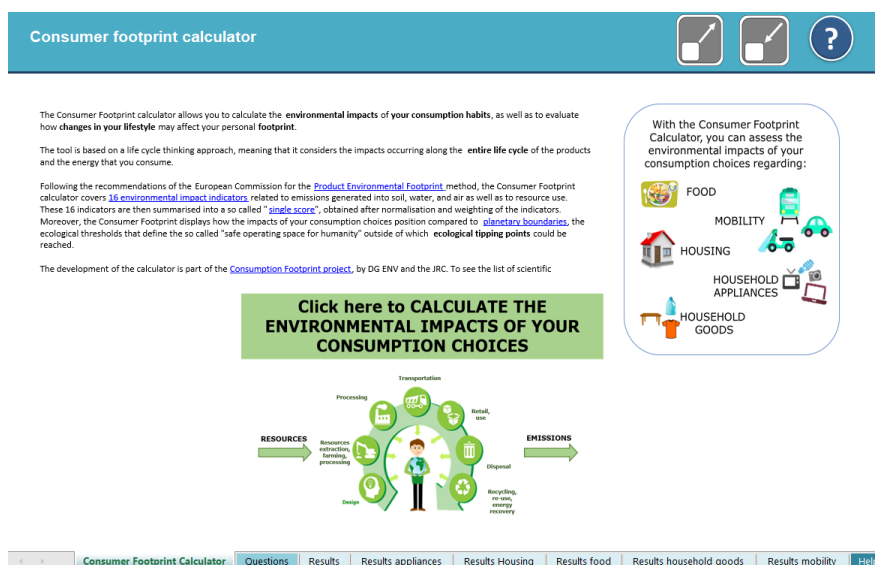
The Excel-based calculator is structured in nine sheets:

- Consumer Footprint Calculator. This page introduces the Consumer Footprint calculator, as well as relevant information and references.
- Questions. This is the main body of the calculator, where users can respond to specific questions in order to calculate the environmental impacts caused by their lifestyle.
- Results. The overall environmental impacts of the indicated consumption intensities are displayed.
- Results appliances. The environmental impacts associated to the consumption of the BoP appliances are visualized in detail.
- Results housing. The environmental impacts associated to the consumption of the BoP housing are visualized in detail.
- Results food. The environmental impacts associated to the consumption of the BoP food are visualized in detail.
- Results household goods. The environmental impacts associated to the consumption of the BoP household goods are visualized in detail.
- Results mobility. The environmental impacts associated to the consumption of the BoP mobility are visualized in detail.
- Help. This sheet provides some tips on the use of the calculator.

Consumer Footprint Calculator

This introductory page describes the main goal, scope and methodological aspects of the Consumer Footprint Calculator (Figure A2-1). The text includes links to specific background information that can be found online (e.g. information on the Product Environmental Footprint) or in the same Excel sheet (Figure A2-2). This page guides the users to the next step for calculating the environmental impacts of their consumption choices.

Figure A2-1. Screenshot of the “Consumer Calculator Footprint” sheet.

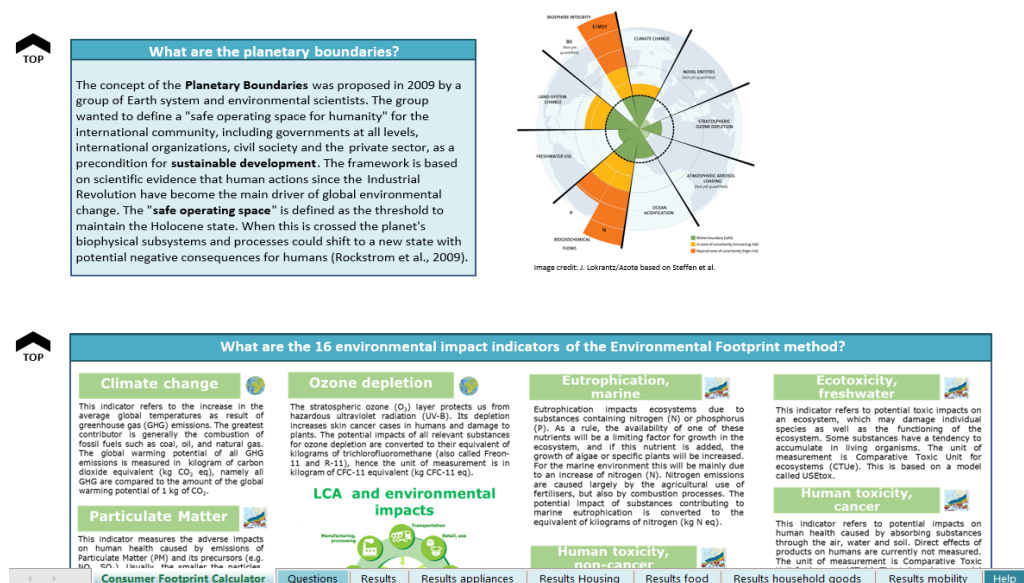


³³ Available at the following link
https://eplca.jrc.ec.europa.eu/permalink/consumptionfootprint/2021_ConsumerFootprintCalculator_v1.xlsm

The included information in the Excel sheet provides a background to the user on:

- Planetary Boundaries, describing the framework and including a definition of the “safe operating space” concept.
- Impact categories, including a description of the 16 impact categories of the Environmental Footprint method.
- Single score, clarifying what a single score is and how this is calculated in the Consumer Footprint Calculator.
- References, listing relevant references of the Consumption footprint and the LC-IND2 projects.

Figure A2-2. Example of included information in the “Consumer Footprint Calculator” sheet.



Questions

The section “Questions” gathers data on the consumption patterns of the user (Figure A2-3). For each of the five areas of consumption, the user is asked about their consumption patterns. Once the users have compiled the questionnaire, the calculator guides them to “Calculate results”. The aspects addressed in the questionnaire are the following, by area of consumption:

- Food: to calculate the amount and types of food consumed in a year, the user is asked about the number of portions of specific food products consumed weekly. Quantitative examples of portions are provided (e.g. 1 portion of milk refers to a glass of milk of 200 mL).
- Mobility: questions regarding passenger car and/or motorcycle ownership (including general information and average travelled distance), public transportation and air mobility gather data on the mobility patterns of users.
- Appliances: the number of household appliances owned by the user’s household can be here indicated, as well as the user behaviour regarding the reparation of appliances. Furthermore, users are asked about his ownership of mobile phones and frequency of replacement.
- Household goods: the user can provide information on the number of shoes, clothes (including the share of second hand-sourced clothes), physical newspaper and books purchased yearly.
- Housing: the user is asked general questions about their household (e.g. location, typology), as well as on the consumption and source of energy (both for electricity and heating purposes) and on the use of sanitary water in their household. The questionnaire includes options to indicate renewable energy sources, such as the use of photovoltaic panels or the consumption of 100% renewable electricity mix.

Figure A2-3. Screenshot of the “Questions” sheet.

Consumer footprint calculator

Food

Personal food consumption (both at home and out of home)

How many portions do you consume every WEEK of:

Vegetables	1	One tomato or an average bowl of salad (200 g or 80 g of leafy vegetables)
Milk	1	One glass of milk (200 ml)
Bread	2	A small bread roll (50g)
Bottled mineral water	1	1 litre bottle (leave blank if you drink tap water as considered below)
Coffee	1	1 cup of espresso (30ml)
Tea	1	1 cup of tea (200ml)
Chocolate	0.25	4 squares of chocolate (20g)
Seasonal fruit	0.5	One big fruit (e.g. apple) or two small fruit (e.g. mandarines) (150 g)
Tropical fruit	0.5	One banana or a slice of ananas (150 g)
Nuts	1	A handful of nuts (30g)
Yoghurt	4	A small pot of yoghurt (125 g)
Beef meat	3	A cooked steak big as the palm of one hand (100 g)
Pork meat	2	A cooked steak big as the palm of one hand (100 g)
Poultry meat	1	A cooked steak big as the palm of one hand (100g)
Fresh seafood	2	1 small fish or a medium fillet (150g)
Shell-stable seafood	2	1 small can of tuna (50g)
Plant-based milk	2	One glass of plant-based milk (200 ml)
Eggs	4	One egg (50g)
Cheese	1	A small mozzarella (100g), or 50g of ripened cheese
Legumes	3	A portion of dry legumes (50 g) or canned legumes (150 g)
Soy-based meat substitutes (e.g. tofu)	2	100 g of tofu
Pasta	3	80 g of uncooked pasta
Cereal grains	0.5	80 g of uncooked rice, quinoa etc.
Potatoes	2	2 small potatoes (200g)
Pre-prepared meals	4	One portion (350g)
Biscuits and cakes	0.5	One croissant (50g)
Wine	3	1 glass of 125 ml
Beer	1	One can of beer (330ml)

Mobility

Personal travelling and commuting

Do you travel or commute by car?

Yes

How many cars does your household own?

2

Please provide the following information about the car you use the most:

Type of fuel

Gasoline

Engine displacement of your car

1400 - 2000 cm³ OR 1.4 - 2 L

Euro standard

Euro 6

How many passengers do you usually take?

one person

How many km do you travel by car every year?

3000

Do you have a moped or a motorcycle?

Yes

What is the engine displacement of your moped/motorcycle?

50 cm³ or less

How many km do you travel by moped or motorcycle every year?

18000

How many hours per month do you spend on the following types of public transport (including commuting, leisure, etc.) ?

Trains - urban

8

Trains - high speed

15

Metro

3

Bus/coach

0

How many times per year do you take national flights?

0

How many times per year do you take flights inside Europe?

2

How many hours per year do you spend on flights outside Europe?

0

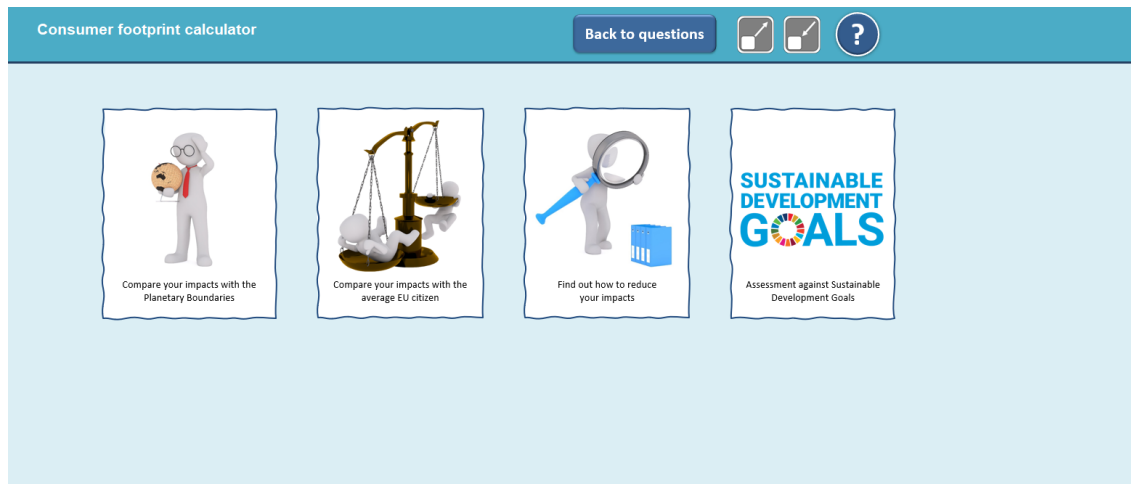
Results

The Results section provides visualizations of the environmental burdens of users’ consumption patterns.

The following results can be explored (Figure A2-4):

- The assessment of the user’s environmental impacts against the planetary boundaries, including both the overall environmental impact results (single score) and results for each of the 16 impact categories.
- A comparison of the total impact (single score) and the results by impact category with the average EU citizen, by area of consumption.
- The contribution of the different areas of consumption and products to the overall environmental impact (single score).
- The assessment of the user’s environmental impacts against selected SDGs

Figure A2-4 Screenshot of the “Results” sheet.



— Comparison of the impacts against the Planetary Boundaries

The first section of the results displays the comparison of the environmental impacts of the consumption patterns of the user against the Planetary Boundaries. The user can have an idea on how much its consumption pattern relate to a desired consumption pattern within the safe operating space for humanity, as defined in the Planetary Boundaries framework, including also a quantitative statement: “Overall your environmental impact is 2,3 times over the safe operating space of earth”. The user can also observe the contribution of the different areas of consumption to the resulting environmental impact (Figure A2-5).

Figure A2-5. Screenshot of results addressing the comparison of the environmental impacts against the Planetary Boundaries.



The graph displays the impact (single score or by impact category) against the Planetary Boundaries, distinguishing between three areas:

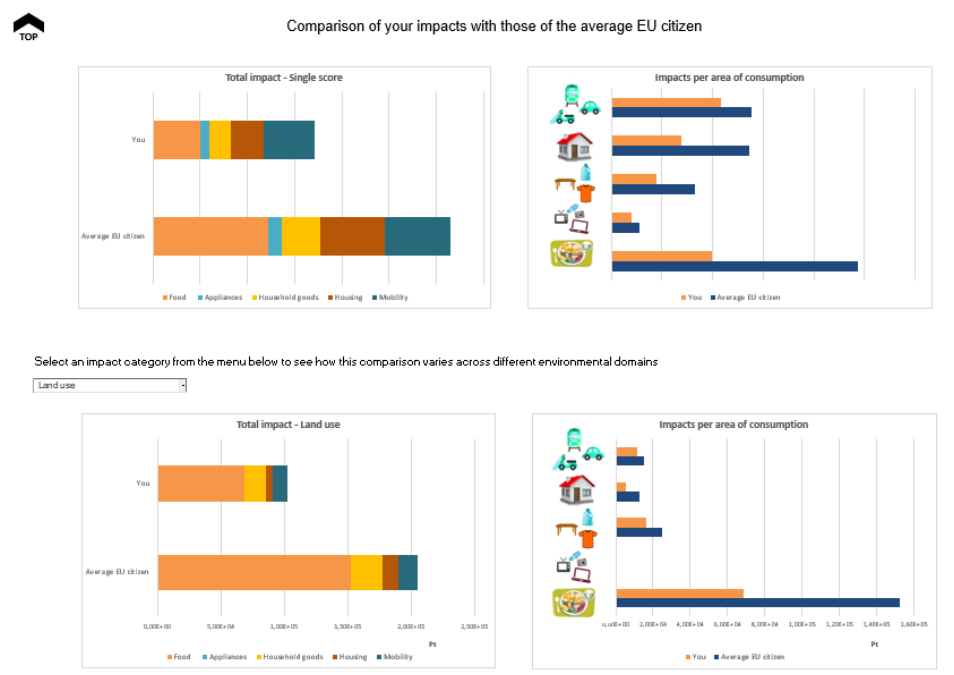
- Safe operating space: Values under 1 indicate that if the global population would share the same consumption patterns as the user, the global impact of consumption would lie in the safe operating space

for humanity, where the global impact of consumption would not be associated to negative impacts in the environment that can lead to a tipping point, from which the ecosystem might not be able to return to the current state.

- Uncertainty area: Values between 1 and 2 indicate that if the global population would share the same consumption patterns as the user, the global impact of consumption would lie in the uncertainty area, where the actual consequences of the impact on the ecosystems are uncertain due to the complexity of the ecologic processes and systems considered in the estimation of the Planetary Boundaries.
- High risk area: Values higher than 2 are considered extreme values indicating that if the global population would share the same consumption patterns as the user, the global impact of consumption would lie in the high-risk area, in which ecological systems and processes can reach a tipping point leading to a new state with potential negative consequences for humanity.
- Comparison of the impacts with those of the average EU citizen

The second section of the results displays the comparison of the environmental impacts of the consumption patterns of the user with those of the average EU citizen, enabling users to understand how their impacts compare with those of the average EU citizen across the different areas of consumption. The user can explore not only the total impact (single score) but also the individual impact categories towards identifying how the comparison varies across the different environmental domains covered in the Environmental Footprint method (Figure A2-6).

Figure A2-6. Screenshot of results addressing the comparison of the environmental impacts with those of the average EU citizen.



- Contribution of different products and habits to the total impacts

The third section of the results displays the contribution of the five areas of consumption and the main products contributing to the overall environmental impact (single score) of the consumption pattern of the user (Figure A2-7). Such evaluation allows the user to identify the main hotspots in terms of products and habits in their consumption pattern contributing to their environmental impact thereby identifying areas where changes towards improvement can be implemented. Next to the results, the user can access the detailed results per area of consumption, as described in the following section.

Figure A2-7. Screenshot of results addressing the contribution of different products and habits to the overall environmental impact of the user's consumption pattern.

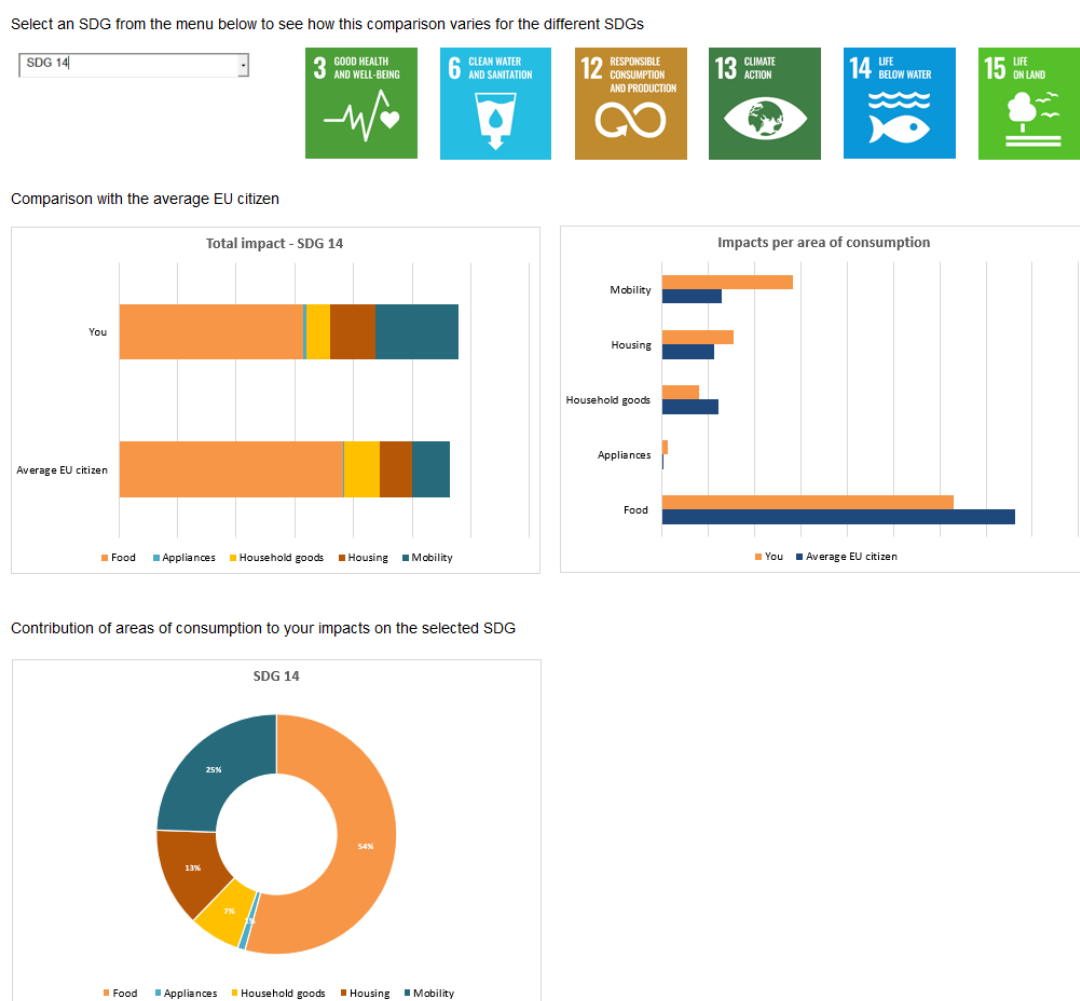


— Assessment against SDGs

The same analysis illustrated in Section 4.1.3.2 (comparison of the user with the average EU citizen) and in Section 4.1.3.3 at the level of area of consumption (contribution of different areas of consumption to the overall impacts) for the single score, is here performed with an alternative weighting system, that enables to measure the impact of the user on six selected SDGs (Figure A2-8):

- SDG 12, which is represented by the single weighted score.
- SDG 3, SDG 6, SDG 13, SDG 14, and SDG 15, which are quantified by the aggregation of specific impact categories (as explained in Section 2.4).

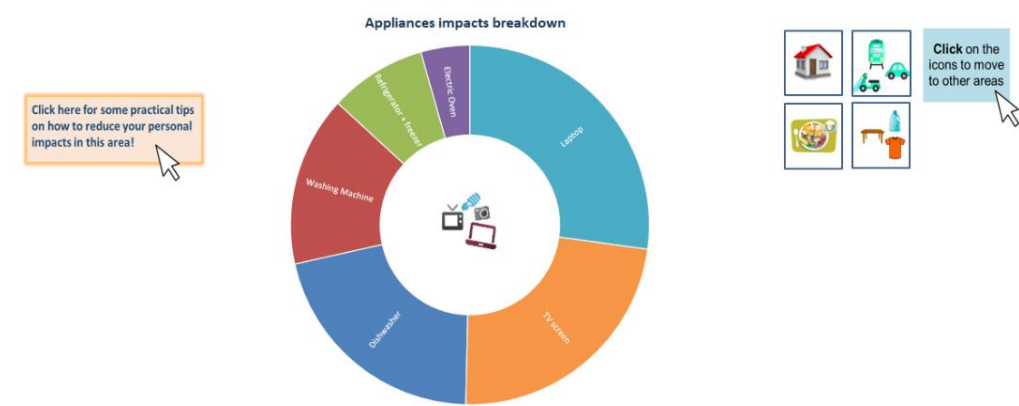
Figure A2-8. Screenshot of results performing the assessment against SDGs



— Results per area of consumption

The tool includes five sheets focused on the detailed results per area of consumption. In these sections, the user can explore the breakdown per product of the overall environmental impact (single score) to the specific area of consumption (Figure A2-9). The user is provided practical tips to reduce their personal impact in that area of consumption by accessing specific positive actions (see Section 3.1.3.4). From each page, the user can easily access the results in other areas of consumption through specific icons.

Figure A2-9. Screenshot of results for the area of consumption appliances.



Help

The tool includes a help page describing the main instructions for the users to fill in the questionnaire and navigate the results.

— User interface

An easy-to-use interface was developed to ensure the user-friendliness of the calculator for users with all levels of Excel and to avoid potential interpretation errors. The interface is fully operational when used with versions of Microsoft Office from 2016 onwards and Macros are enabled.

— Icons and navigation






The interface makes use of specific icons to guide the users along the different steps of the questionnaire and to explore the results not only at the overall consumption level but also for each area of consumption (Table A2-1).

Table A2-1. Icons and actions employed in the Consumer Footprint Calculator to guide the users along the different steps.

Icon	Action
	Icon available in the “Consumer Footprint Calculator” sheet to go to the next sheet: “Questions”, where the users can provide information on their consumption patterns.
	Icon available in the “Questions” sheet to go to the next sheet: “Results”, where the user can explore the overall results.
	Examples of icons available in the “Results” sheet to guide the user through the results.
	Icons available in the “Results” sheet to guide the user to the sheets devoted to the detailed results for each area of consumption.
	Icon available in the different “Results” sheets to allow the user to go back to the “Questions” sheet and verify the indicated information.
	Icon available in the different “Results BoP” sheets to allow the user to go back to the “Results” sheet to explore the environmental impacts of the overall consumption.
	Icons available in the different “Results BoP” sheets to allow the user to move between the detailed results for the five areas of consumption.

With the aim of easing the navigation of the users and adjust the interface to their needs, different icons have been included in the Consumer Footprint Calculator (Table A2-2).

Table A2-2. Icons and actions employed in the Consumer Footprint Calculator to enhance user-friendliness.

Icon	Action
	Icon available in the “Consumer Footprint Calculator” sheet to go back to the top of the page once explored the background information and references provided, and in the “Results” sheet to go back to the Results menu
	Icon available in each sheet, the user can click on to expand the view to full screen
	Icon available in each sheet, the user can click on to return to the normal screen view
	Icon available in each sheet, the user can click on to go to the “Help” sheet.
	<p>Icon available in the Questions sheet, the user can click on to erase all previous answers to start a new compilation.</p> <p>Note that after reset, results include already the impacts of those representative products that are not detailed in the questionnaire and for which EU average consumption is considered (see sections 3.1, 3.3 and 3.4).</p>

— Data entry

Drop-down menus, sliders and spin buttons have been employed in the questionnaire and in the visualization of the results. All answers can be provided through drop-down menus, sliders and spin buttons in the “Questions” sheet. This makes the Calculator easier and quicker to fill in, thereby avoiding potential errors when typing figures and different interpretations over the correct unit of measure (Figure A2-10).

Figure A2-10. Example of a drop-down menu to indicate the type of fuel of the user’s car and a slider to indicate the annual travelled distance.

Mobility

Personal travelling and commuting

Do you travel or commute by car? Yes

How many cars does your household own? 2

Please provide the following information about the car you use the most:

Type of fuel Gasoline

Engine displacement of your car Gasoline

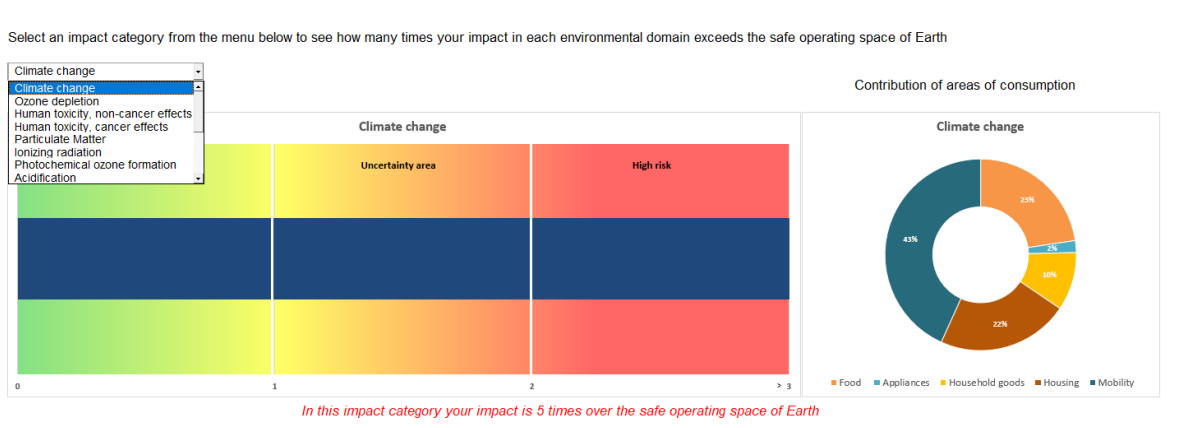
Euro standard Diesel

How many passengers do you usually take? One person

How many km do you travel by car every year? 3000

In the results section, drop-down menus allow the user to scroll through the 16 impact categories to reduce the number of charts in the different “Results” sheets (Figure A2-11).

Figure A2-11. Drop-down menu for the selection of the impact category to be displayed in the detailed information by impact category.



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