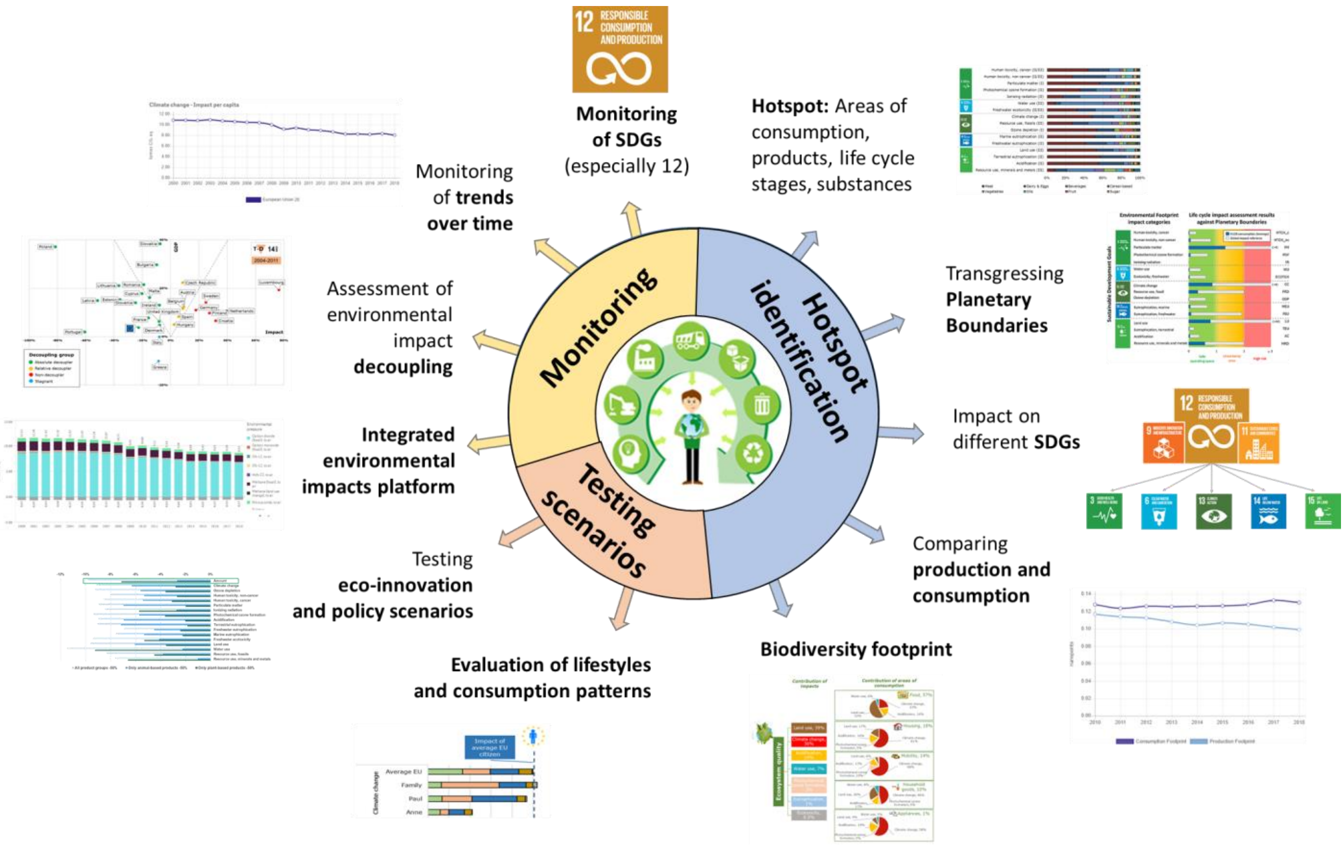
European Commission

SCIENCE FOR POLICY BRIEFS

Consumption Footprint: assessing the environmental impacts of EU consumption

Life Cycle Assessment (LCA) based set of indicators
for supporting the European Green Deal ambitions



Joint Research Centre

Highlights

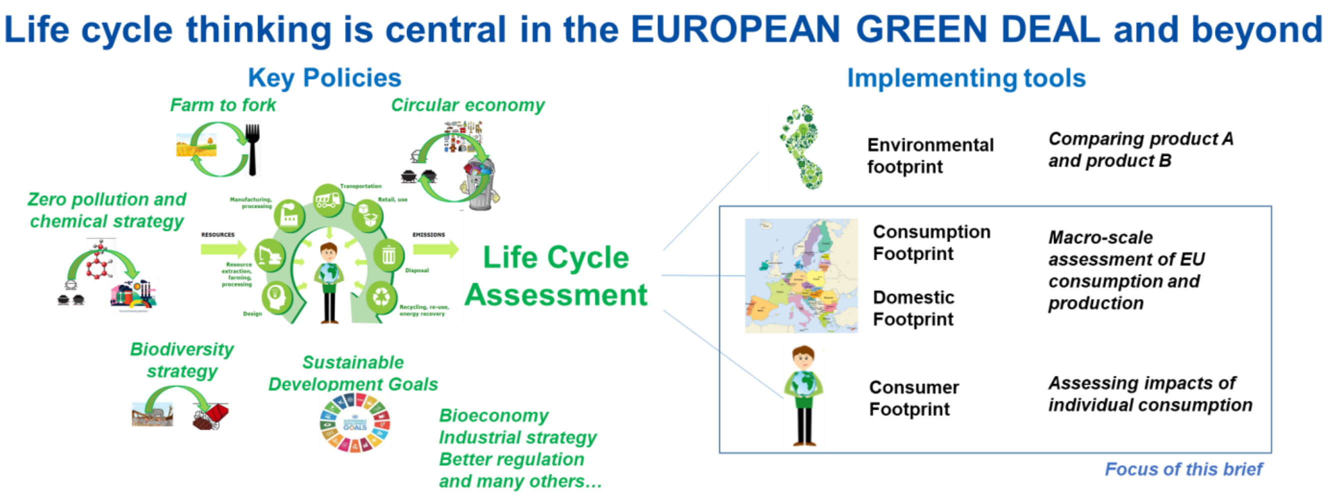
- The Consumption Footprint allows assessing environmental impacts of EU consumption in an integrated manner, considering 16 impact indicators addressing air, water and soil emissions and resource use.
- The EU is a “net importer of environmental impacts”, hence part of the impacts associated to EU consumption occurs in third countries.
- Domestic environmental impacts in the EU have decreased from 2010 to 2018, showing an absolute decoupling from economic growth. However, when the impacts of trade are included, the Consumption Footprint shows only a limited decoupling.
- Five areas of consumption have been assessed: food, mobility, housing, household goods and appliances.
- Impacts caused by the consumption of an average EU citizen are transgressing the planetary boundaries for several impact categories and up to 11 times, as is the case for for freshwater ecotoxicity.
- The Consumption Footprint Platform reports data on the environmental impact of consumption at the EU and Member State level for the period 2010-2018.
- The Consumer Footprint Calculator allows the calculation of the impacts caused by individual consumption, to unveil hotspots and illustrate the benefits of lifestyle changes.

Policy context

As part of its commitment towards more sustainable production and consumption, the European Commission developed a Life Cycle Assessment (LCA)-based framework to assess the environmental impacts of EU consumption and production. The framework includes two different indicators: 1) the **Domestic Footprint**, to quantify the overall impacts of domestic production and consumption happening within EU or Member States boundaries (territorial perspective) and 2) the **Consumption Footprint**, to assess the environmental impacts of consumption at EU and at Member State level, including impacts embodied in trade (consumption perspective).

These indicators are complementary and are relevant in the context of:

- achieving the Sustainable Development Goal (SDG) on **Responsible consumption and production (SDG 12)** and on **Sustainable economic growth (SDG 8)**, adopted in the **2030 Agenda for Sustainable Development** (2015) and contributing to other SDGs
- measuring to which extent Europe is achieving the goal of “**living well within the limits of our Planet”**, including assessing the progress towards the objectives of the EU **8th Environment Action Programme** (2020)
- contributing to the **Better Regulation initiative** (2021), by unveiling the potential role of LCA to support policy-making, such as in defining baseline scenarios to be used in policy impact assessment
- contributing to the implementation of the **Beyond Gross Domestic Product (GDP) Roadmap** (2009)
- contributing to the transition towards the **bioeconomy** and to the monitoring of progress towards achieving the objectives of the **Bioeconomy Strategy** (2018)
- monitoring progress towards the achievement of the **European Green Deal** (2019) ambitions, such as those in the **New Circular Economy Action Plan** (2020), the **Farm to Fork Strategy** (2020), the **Biodiversity Strategy** (2020), the **Chemical Strategy for Sustainability** (2020) and the **Zero Pollution Action Plan** (2021).

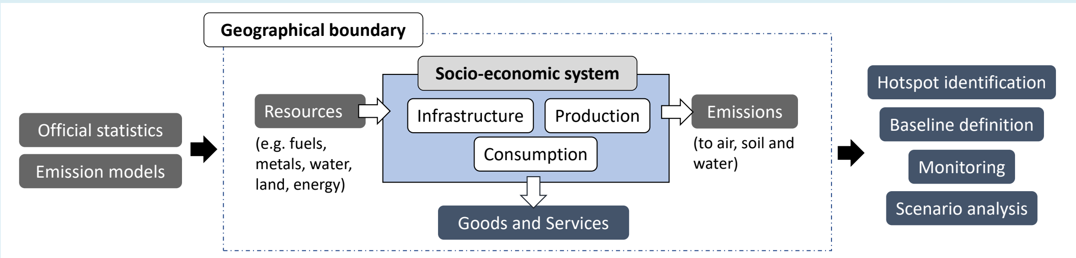


Terminology and methods

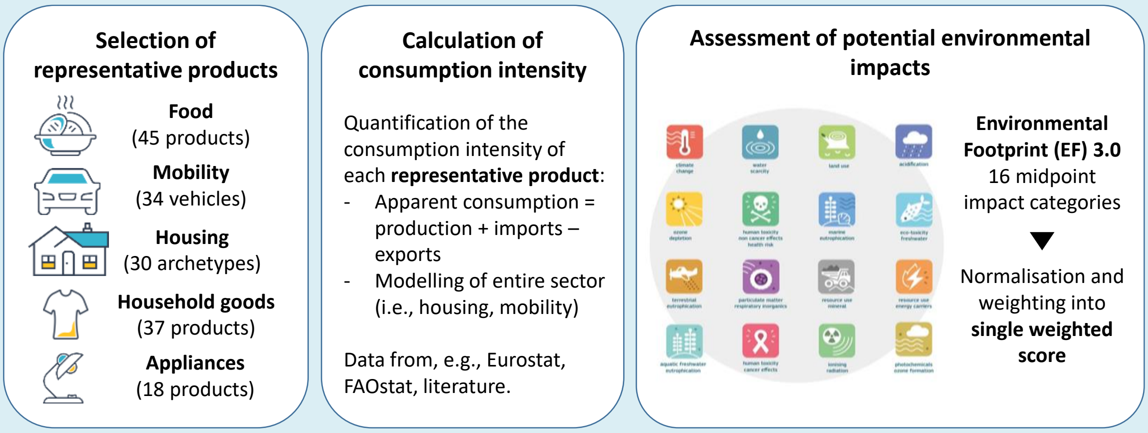
Life Cycle Assessment (LCA) is a method to assess burdens and benefits associated with products, sectors, and projects, along value chains, i.e. assessing impacts occurring from raw material extraction to their end of life. Compared to other methods, LCA has the advantage of assessing the potential shifting of burdens between different life cycle stages and different types of environmental impacts, thus allowing a comprehensive assessment and the unveiling of trade-offs.

The **Environmental Footprint (EF)** is an LCA-based method that allows the quantification of the environmental impacts and the comparison of products belonging to the same product category in case Product Environmental Footprint Category Rules are available. The Environmental Footprint (EF) method considers 16 environmental impact indicators, which can be aggregated into a single weighted score.

The **Domestic Footprint** is a set of 16 LCA-based indicators (also available as a single score) quantifying the environmental impacts caused by domestic production and consumption, hence limiting the scope to emissions released and resources extracted within the EU territory, which are translated into impacts by using the EF method.

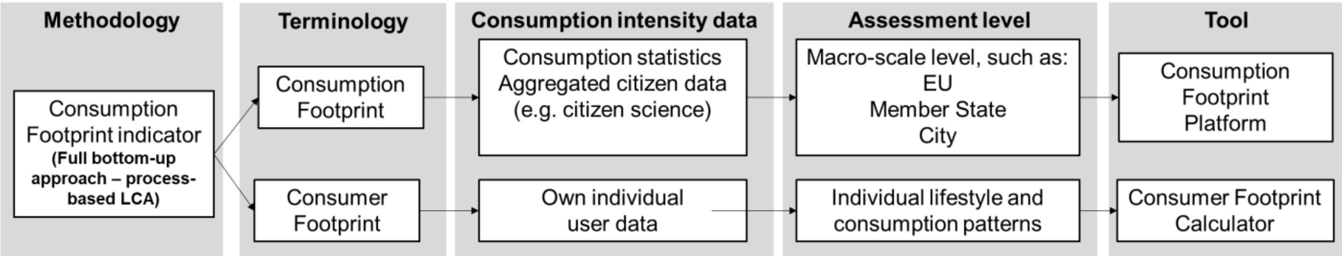


The **Consumption Footprint** is a set of 16 LCA-based indicators (also available as a single score) whose purpose is to quantify the environmental impacts of consumption at EU and Member State level. It is based on the combination of: i) the emissions to air, soil and water as well as the resources used along the life cycle of circa 160 representative products, belonging to 5 areas of consumption (food, mobility, housing, household goods, and appliances); ii) the consumption intensities of those products; iii) the Environmental Footprint (EF) impact assessment method, which translates emissions and resource consumption into potential environmental impacts.



It has to be noted that at the moment the **Consumption Footprint is not fully compliant with the EF** as: (a) the inventory modelling is not fully aligned to the EF guidance, particularly on background information; and (b) it is not using EF-compliant life cycle inventory data due to a limited data availability. However, it employs the EF method and follows EF modelling guidance to fill data gaps in the life cycle inventory of products (foreground data).

The Consumption Footprint indicators describe the impact of consumption at EU and Member State level, thereby representing the consumption patterns of the average citizen. These indicators are **obtained with a fully bottom-up approach**, based on LCA of representative products. This methodological choice results from a previous exercise testing three alternative approaches[1]: 1. fully bottom up (based on representative products); 2. partially bottom-up (trade based on representative products, domestic based on statistics); and 3. top down (input-output based). Based on the comparison of the results obtained with the three approaches and the need to ensure the highest granularity in modelling products' supply chains, the **selected approach for the Consumption Footprint is fully bottom-up**. Beyond assessing the impacts of an average citizen, impacts can be assessed as well at individual level, introducing individual consumption patterns in the Consumer Footprint Calculator. The terminology **Consumer Footprint** in this brief refers only to this use of the indicator.



Key results

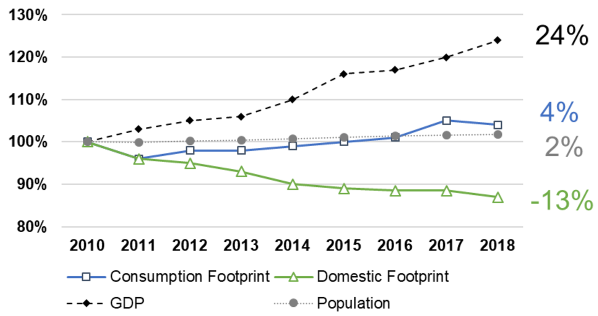
The Consumption Footprint results allow answering a number of questions, including:

What are the environmental impacts of consumption at EU and Member State level?

The **impacts of EU consumption are larger than those of domestic activities**, meaning that the impacts embedded in imports are higher than those embedded in exports. As a result, **the EU is responsible for a significant amount of environmental impacts** taking place beyond EU borders. Impacts are calculated for the 16 impact categories of the Environmental Footprint method (Commission Recommendation C(2021)9332 final): 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.

Is there a decoupling of environmental impacts from economic growth?

When considering the **environmental impacts generated within EU territories** (domestic impacts obtained with a territorial perspective) between 2010 and 2018, an **absolute decoupling** is observed in almost all impact indicators. This means that while there was economic growth (increasing Gross Domestic Product - GDP), the environmental impacts decreased in time. However, if the impacts of trade are accounted for (through the Consumption Footprint) a **limited decoupling** is observed (i.e., increase at a slower pace than the economy growth), as **the reduction in domestic impacts was fully offset by an increase in impacts of net trade** (i.e., imports minus exports). Impacts calculated with the consumption footprint increased over time (+4%), this is partly due to a growing population (+2%) and partly due to increases in consumption levels.



Evolution of Domestic Footprint and Consumption Footprint compared to Gross Domestic Product (GDP) and population.

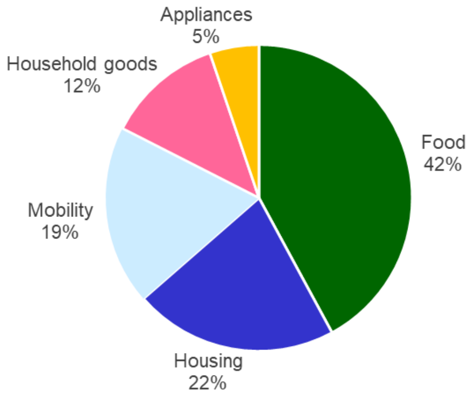
Which are the main areas of consumption driving the impacts?

Consumption of **food** emerges as one of the **main drivers of impacts** generated by an average EU citizen followed by **housing** (especially for space heating) and **mobility** (especially due to the use of private cars).

Which are the main products driving the impacts?

Animal-based products, e.g. meat, dairy, and eggs, are responbile for the largest share of the impacts of food consumption for most impact categories, due to their high impact per unit of product. **Passenger cars** cause more than 70% of the impacts caused by mobility (single score) due to their larger use compared to other means of transport. **Dwellings in moderate climate** are responsible for around 72% of the impacts of housing (single score), because of the larger amount of dwellings in this climate area. For the areas of consumption of household goods and appliances, different products contribute to a similar extent to the overall impacts.

[1] Sala, S., Beylot, A., Corrado, S., Crenna, E., Sanye Mengual, E. and Secchi, M., Indicators and assessment of the environmental impact of EU consumption, EUR 29648 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-99671-9, doi:10.2760/25774, JRC114814.



Consumption Footprint: contribution of each area of consumption for an average EU citizen in 2018.

How is the impact of consumption evolving over time?

Over the period 2010-2018, the amount of goods consumed increased in all areas of consumption resulting in an **overall increase of environmental impacts** by around 4%. The largest increases occured in food (+19%) and mobility (+7%). In the case of housing, the reduction of impacts (around 12%) was mainly driven by a general reduction of energy use in buildings especially for space heating, due to energy efficiency measures introduced since 2010. The benefits of policies affecting other areas of consumption were instead **offset by an increased consumption**, e.g. the progressive reduction of car emissions was offset by a more intensive use of cars. This highlights the **importance of putting in place policies simultaneously targeting an improvement in the environmental profile of products and encouraging responsible consumption patterns.**

What are the life cycle stages driving the environmental impact of consumption?

The relevance of life cycle stages is very much dependent on the area of consumption analysed and the representative products considered.

Primary production, for example, is the **hotspot** for almost all the impacts generated by the area of consumption **food**. Instead, **the majority of the impacts of mobility and housing are driven by the use phase**. As cars and dwellings have a longer life the impacts of their production are distributed along their entire life cycles, while in the use phase there is a continuous use of resources and related emissions and impacts. For **household goods and appliances**, the share of the impacts associated with one life cycle stage or the other is strictly dependent on the product considered (for example, the use phase is relevant for a refrigerator due to the energy consumed during operation while it is negligible for furniture products, which have a limited impact during their use).

Is there a link between the Consumption Footprint and the sustainable development goals (SDGs)?

The Consumption Footprint could be primarily used to monitor SDG12, on responsible production and consumption. Additionally, the 16 impact categories are linked with several other sustainable development goals, in particular SDG3 – good health and well being, SDG6 – clean water and sanitazion, SDG13 – climate action, SDG14 – life below water, and SDG 15 – life on land. Moreover, the assessment of decoupling can indicate progress towards SDG target 8.4 related to sustainable economic growth. As a parallel approach, social LCA could be applied to the Consumption Footprint to assess also social SDGs.

Link between the LCA-based Consumption Footprint indicator and the SDGs.

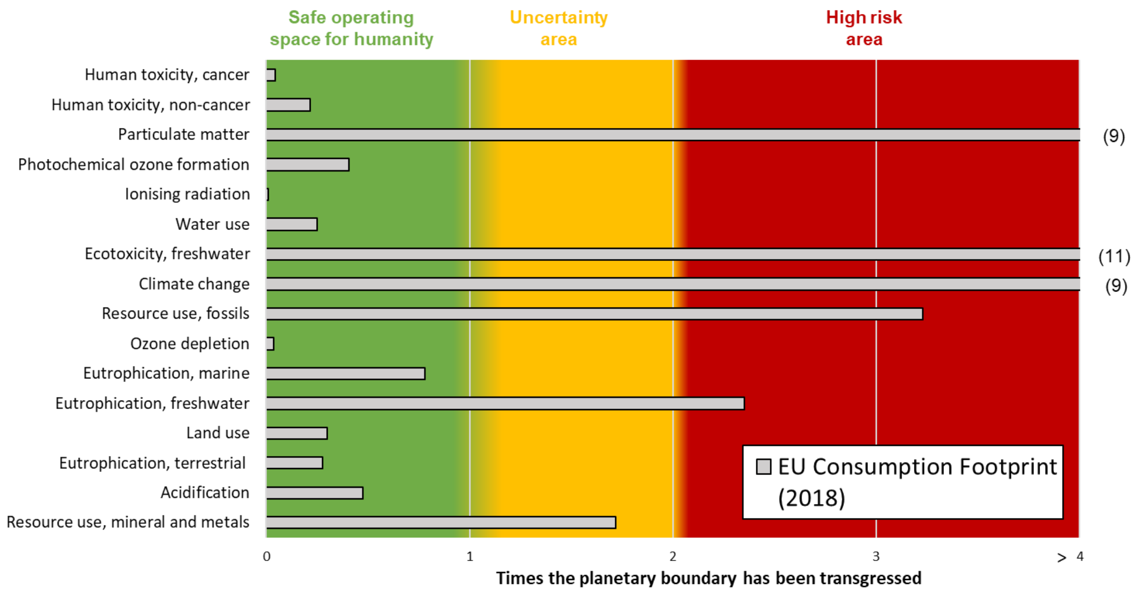
Is it possible to evaluate in a systemic manner the sustainability of transitions, solutions and ecoinnovations, towards the achivement of SDGs?

The **Consumption Footprint** in a certain year could be considered as a **baseline scenario against which different policy/technological/behavioural options could be tested**. The adoption of LCA can unveil trade-offs of ecoinnovation. The results from testing more than 50 scenarios on the different areas of consumption showed that, except in a few cases, **only an integrated action combining several interventions may ensure a significant reduction in environmental impacts**. For example, scenarios on circular economy were tested in support of defining Climate targets and are available in the Impact Assessment of the 2030 Climate Target Plan (SWD(2020) 176 final - PART 2/2).

Is EU consumption environmentally sustainable and within the planetary boundaries?

To assess the sustainability of EU consumption, the Consumption Footprint is compared against the planetary boundaries, namely the quantitative estimation of the Earth's carrying capacity, i.e. the "safe operating space for humanity". The assessment is performed at a per capita level, with Planetary Boundaries allocated equally among the global population.

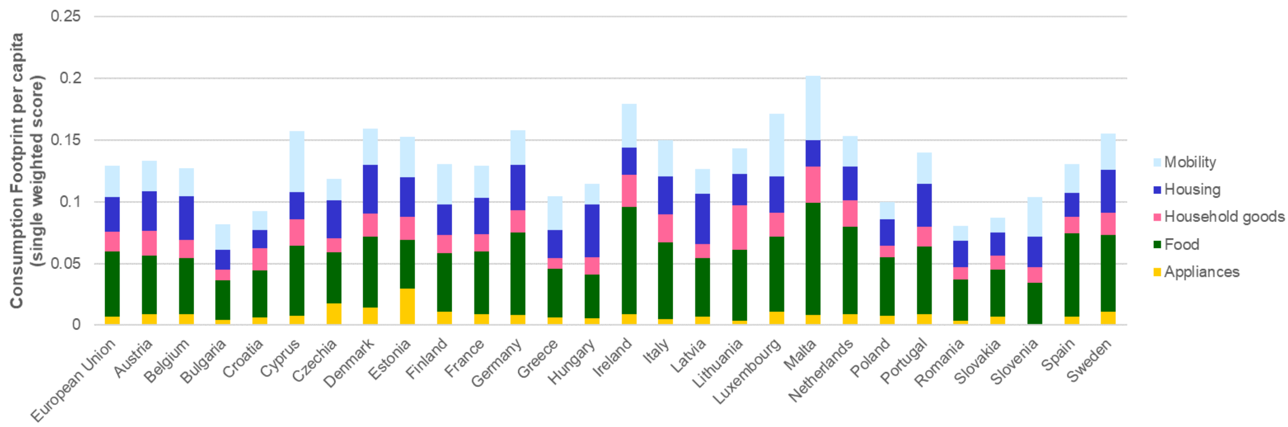
According to latest data, the environmental impacts of the consumption of an average EU citizen are **outside the safe operating space for humanity for several impact categories**. Despite the differences in the robustness of the various impact categories, these results show that for most categories the impacts are close to the threshold, when not already over it. For example, the climate change impact is 9 times beyond the limit of the planet.



Assessment of the EU Cosumption Footprint (2018) against the Planetary Boundaries, by impact category.

How does the contribution of different areas of consumption vary across Member States?

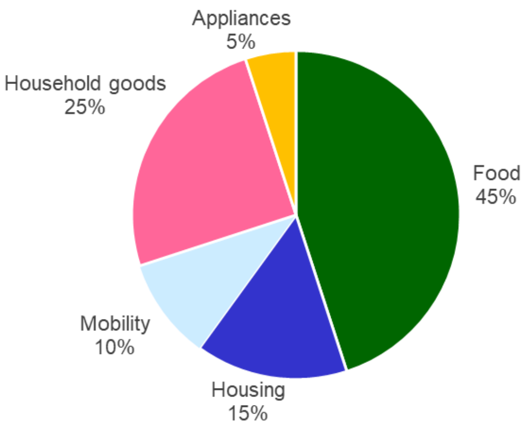
The Consumption Footprint per capita varies among the different Member States. **Food consumption is the main contributor in most EU countries**. Housing shows a larger relevance in moderate and cold countries compared to warm ones due to a higher **energy consumption for heating purposes**. The impacts linked to the consumption of household goods vary among countries depending on specific patterns and lifestyles. Mobility is more relevant in those countries requiring more air mobility due to specific characteristics (e.g., island such as Malta). Appliances generally reported the lowest contribution in all EU Member States, as the energy consumption during the use phase of appliances is considered in the housing area of consumption.



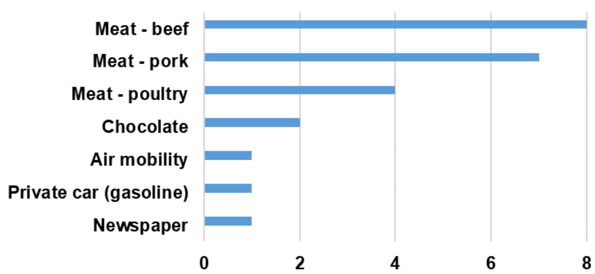
Consumption Footprint per capita in the EU and Member States, by area of consumption (2018).

What are the main drivers of biodiversity loss caused by EU consumption?

Protecting biodiversity is one of the main objectives of the European Green Deal, and there is an increased need for assessing the impacts of supply chains on biodiversity. The Consumption Footprint indicator could be used as a basis to assess the biodiversity footprint. JRC conducted a study on eight different methods to assess the biodiversity footprint, and all led to some converging messages. **Food consumption is the main driver of biodiversity impacts** of EU consumption. In general, top contributors among food products are **animal-based products and specific crops** (e.g. chocolate). Other relevant products are private cars, air mobility and paper products. The most important drivers of biodiversity loss are **land use** (including land use change) and **climate change impacts**, followed by **environmental pollution** (nutrients and chemical pollution).



Contribution to biodiversity impacts of EU consumption by area of consumption (2015), according to LC-IMPACT method (Verones et al., 2020)



Top contributing products to biodiversity impacts of EU consumption (2015). Number of times the product is among the top-3 contributors across the eight different LCIA methods evaluated.

Conclusions and outlook

The Consumption Footprint set of indicators may help assessing the main drivers of the environmental impacts of EU consumption. Food consumption, followed by housing and mobility, are responsible for the largest share of impacts. The **environmental impacts of the consumption of an average EU citizen are outside the safe operating space for humanity** for several impact indicators. Despite inherent uncertanties linked to this type of assessment, these results are indicating the need for action to significantly reduce the environmental impacts of consumption.

The **Consumption Footprint and Domestic Footprint indicators show considerable potential to support policy making through different uses**, e.g. hotspot identification, monitoring the evolution of impacts over time, testing scenarios and policy options, definition of baselines, or the assessment of the environmental impact of citizens' lifestyles.

LCA-based indicators can have a crucial role in ensuring that a systemic approach is adopted in environmental impact assessments as well as in helping unveil and assess trade-offs.

References and links

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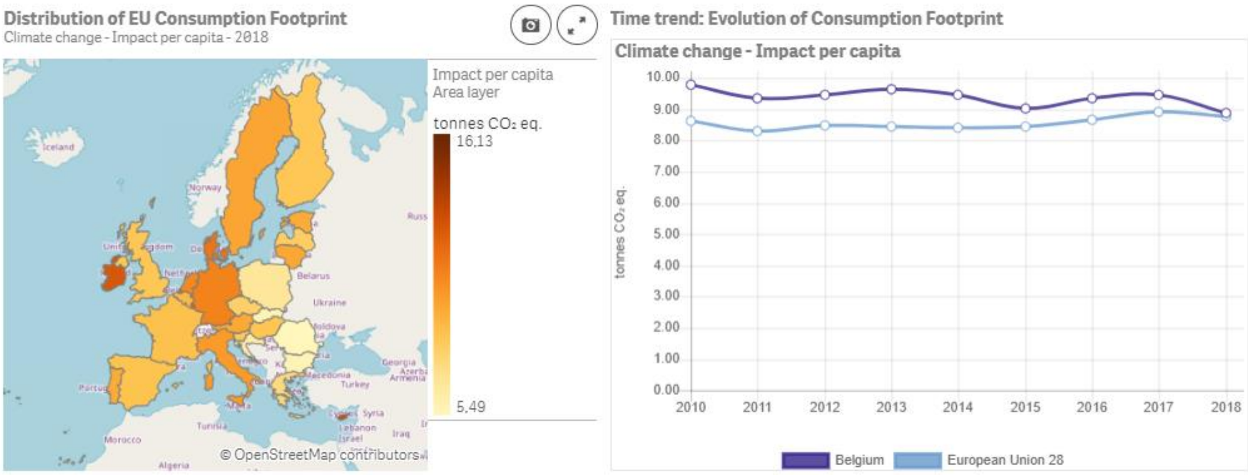
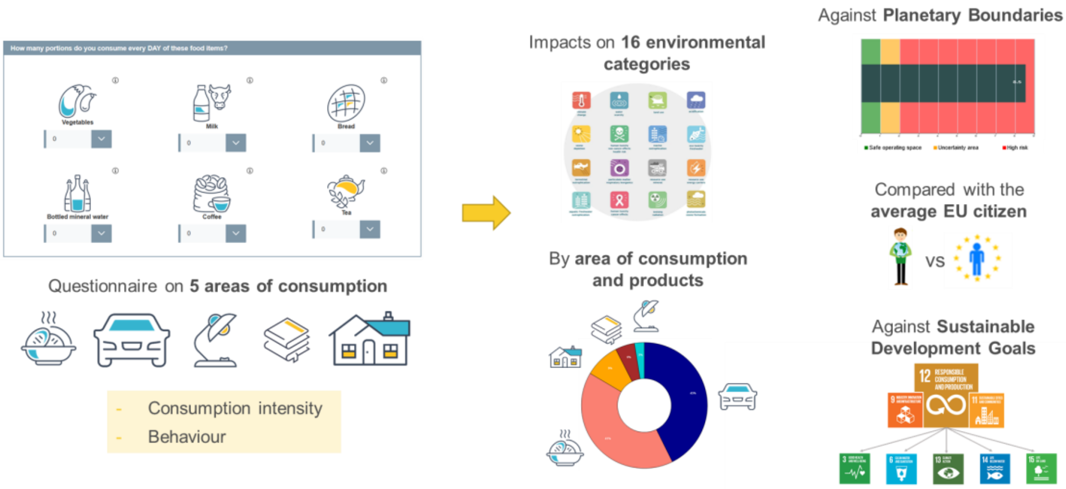
Developed platforms and tools

Through the **Consumption Footprint Platform** it is possible to explrore the results of the Consumption Footprint for the period 2010-2018, and of the Domestic Footprint for the period 2000-2018. Both indicators are available at EU and Member State level.



Example of chart provided in the Consumption Footprint Platform regarding the overall Consumption Footprint.

The **Consumer Footprint Calculator** allows EU citizens to calculate the environmental impacts of their consumption patterns and to evaluate how changes in their lifestyle may affect their personal footprint.



Overview of the structure of the Consumer Footprint Calculator: questionnaire and results visualization options.

Acknowledgements: We are indebted to Raluca Ionescu, Alicia Boyano Larriba and Barbara Bacigalupi for the continous support to this research and for having provided many helpful comments to improve the method and the tools.

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Disclaimer: The views expressed in this Science for Policy Brief are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.
These indicators are under continuous refinement and most updated results are available in the Consumption Footprint Platform accessible at https://eplca.jrc.ec.europa.eu/ConsumptionFootprintPlatform.html.
The study underpinning the calculation of the Consumption and Domestic Footprint started in 2016 and run in parallel to the Environmental Footprint (EF) pilot and transition phases. Hence, the modelling approach adopted and the life cycle inventory data used are not fully compliant with EF rules and are only intended to illustrate the use of Life Cycle Assessment (LCA) to define the baseline of impacts due to consumption in the EU (Consumption Footprint) or production in the EU (Domestic Footprint) and to monitor or test ecoinnovation and policy options against such baseline.