



# Comparing the EU consumption footprint against planetary boundaries

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# Content

- The Consumption Footprint
- From relative to absolute sustainability assessment
- Assessing the Consumption Footprint against Planetary Boundaries (PBs)

# The LCA team at the JRC



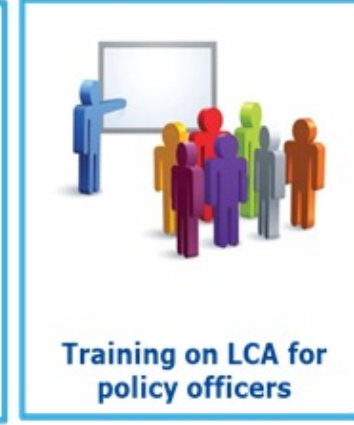
European Platform on LCA



Environmental Footprint (PEF and OEF)



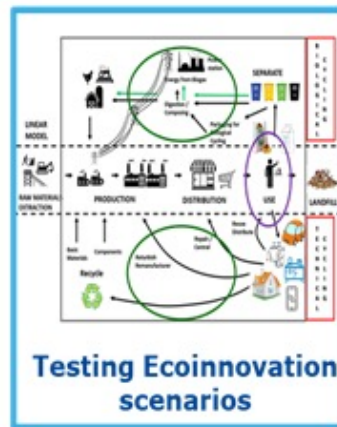
Biodiversity footprint



Training on LCA for policy officers



Environmental impact of EU consumption



Testing Ecoinnovation scenarios



SDGs and LCA



LCA for the impact assessment of policies

# Life cycle thinking



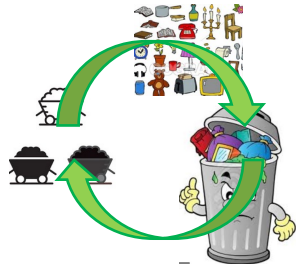
# Life cycle thinking is central in the EUROPEAN GREEN DEAL and beyond

## Key Policies

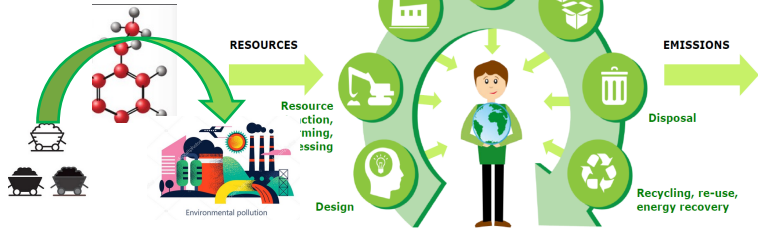
### Farm to fork



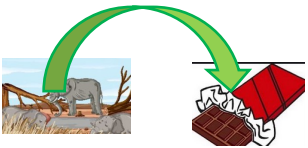
### Circular economy



### Zero pollution and chemical strategy



### Biodiversity strategy



### Sustainable Development Goals



*Bioeconomy strategy  
Industrial strategy  
Better regulation  
New Consumer Agenda*

*and many others...*

## Life Cycle Assessment

## Implementing tools



**Environmental footprint**

*Comparing product A and product B*



**Consumption Footprint**

*Macro-scale assessment of EU consumption and production*

**Domestic Footprint**



**Consumer Footprint**

*Assessing impacts of individual consumption*

# The Consumption Footprint

# Consumption Footprint

**Consumption Footprint:** set of 16 life cycle-based indicators whose purpose is to **assess the environmental impacts of the consumption patterns at EU and Member State levels.**

## Selection of representative products



### Food

(45 products)



### Mobility

(34 vehicles)



### Housing

(30 archetypes)



### Household goods

(37 products)



### Appliances

(18 products)

## Calculation of consumption intensity

Quantification of the consumption intensity of each **representative product:**

- Apparent consumption = production + imports – exports
- Modelling of entire sector (i.e., housing, mobility)

Data from, e.g., Eurostat, FAOstat, literature.

## Assessment of potential environmental impacts



climate change



water scarcity



land use



acidification



ozone depletion



human toxicity  
non cancer effects  
health risk



marine eutrophication



eco-toxicity  
freshwater



terrestrial eutrophication



particulate matter  
respiratory inorganics



resource use  
mineral



resource use  
energy carriers



aquatic freshwater eutrophication



human toxicity  
cancer effects



ionising radiation



photochemicals  
ozone formation

**Environmental Footprint (EF) 3.0**  
16 midpoint impact categories



Normalisation and weighting into **single weighted score**

# Which products are considered?



## FOOD

45 food products → more than 85% of consumed food products



## HOUSEHOLD GOODS

37 products groups: textile, detergents, furniture, etc.



## MOBILITY

All car types, trains, planes (34) → 90% mobility means



## HOUSING

30 archetypes of housing in EU, per climatic region and year of construction → 100% building stock



## APPLIANCES

18 appliances, e.g. white goods, laptops, etc. → those in eco-design and beyond

### Selection criteria:

- Market share
- Environmental relevance
- Emerging markets
- Data availability



# Data sources

## Consumption intensity



**Apparent consumption** = Production + Imports – Exports



- **Eurostat:** food, appliances, and household goods
- **FAOSTAT, EFSA:** Food



**Modelling entire sector** distributed into archetypes:

- **Housing:** EU Buildings database, TABULA web-tool, Hotmaps project
- **Mobility:** Eurostat, Statistical pocketbook



## Environmental impact

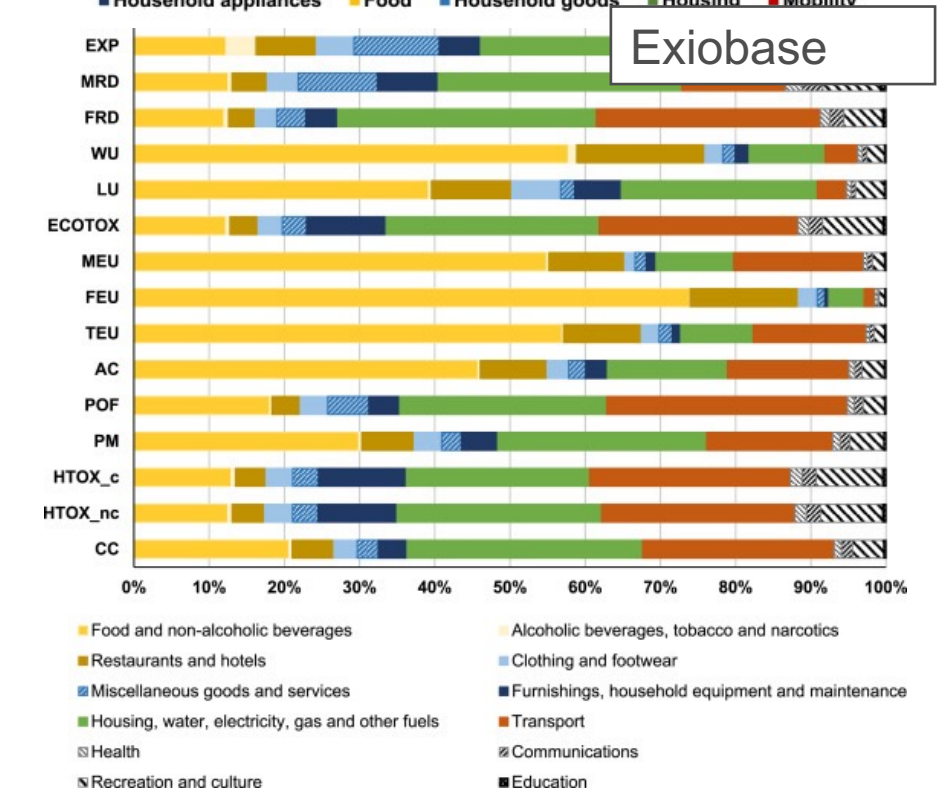
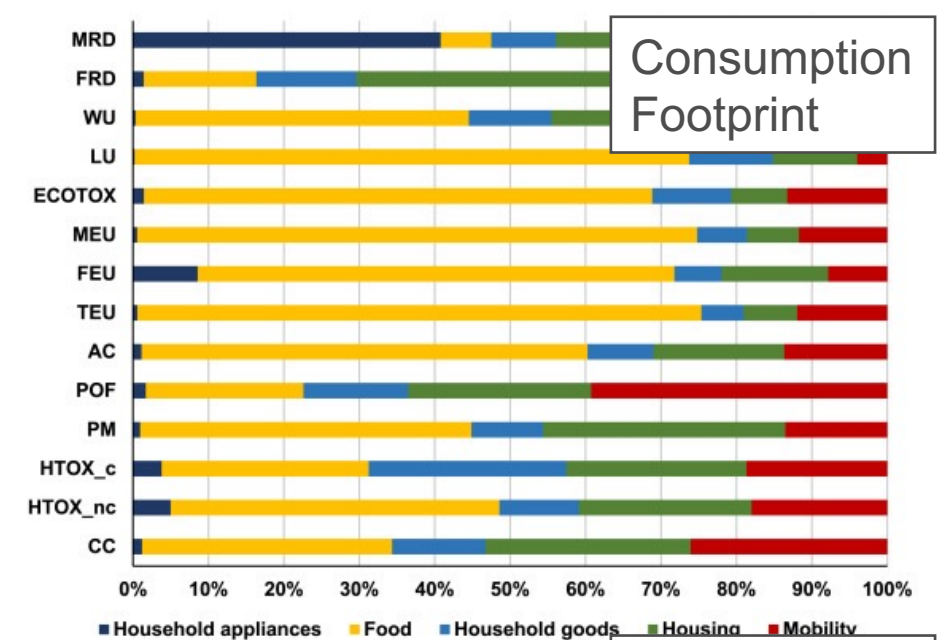
**Cradle-to-grave approach:** from production of inputs to end of life (incl. wastewater)

Data sources, e.g.:

- **Product Environmental Footprint Category Rules** (average EU market)
- **Product Environmental Footprint general rules**
- **Literature**
- **LCI databases**

# Process-based VS. input-output Bottom-up VS. top-down

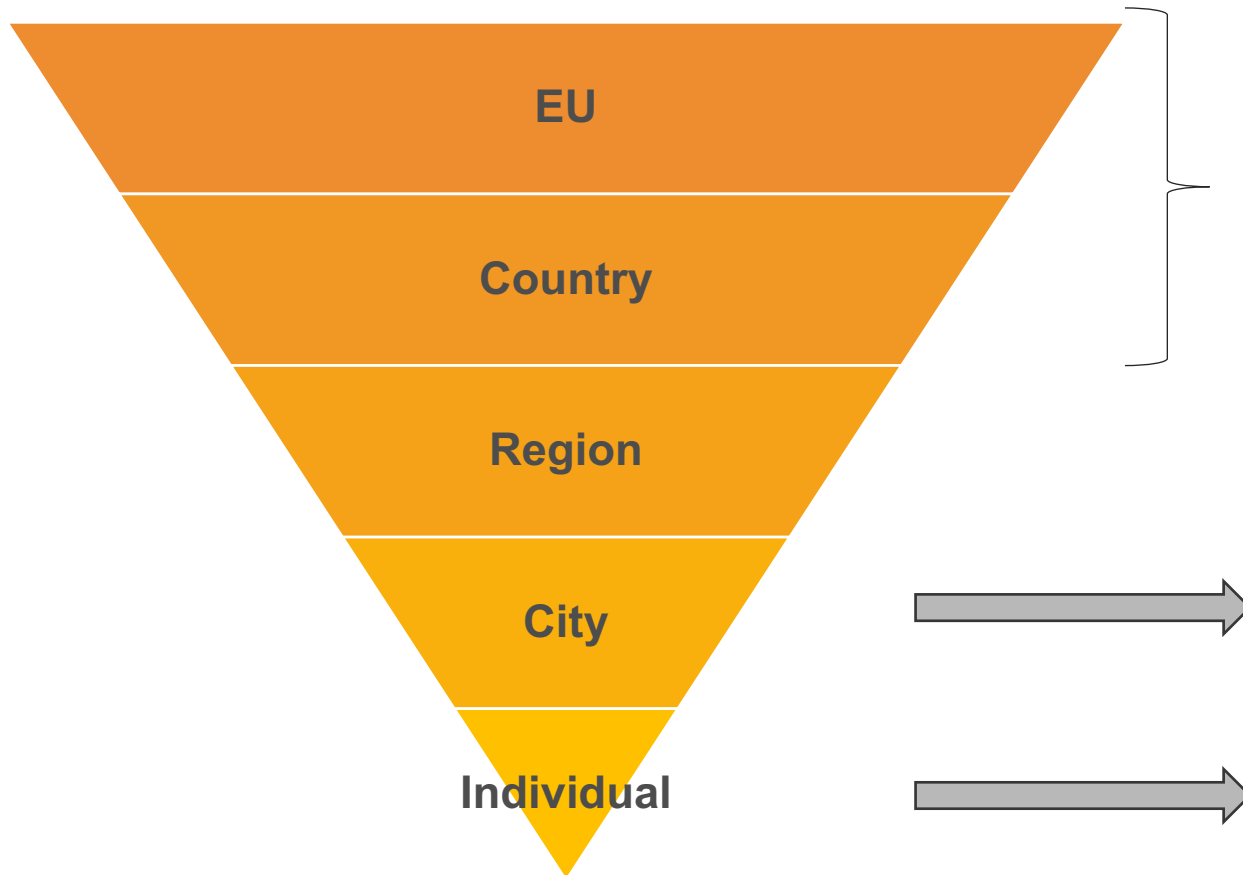
Aspect	Consumption Footprint	IO-based footprints
Coverage of environmental impacts	16 impact categories of the Environmental Footprint	14 impact categories of the Environmental Footprint
Number of elementary flows	Around 1500 flows	78 elementary flows
Coverage of consumption	Partial exclusion of services, coverage of representative products	Full economy coverage
Granularity	Representative product, life cycle stage, processes, elementary flow	Sector/product, elementary flow
Data availability	2010-2018 (2020 forthcoming)	Depending on DB, exiobase3 up to 2011



Castellani et al. (2019). Environmental impacts of household consumption in Europe: Comparing process-based LCA and environmentally extended input-output analysis. *Journal of cleaner production*, 240, 117966.

# Scalability of Consumption Footprint

## Geographical scale



## Current applications

Consumption Footprint Platform

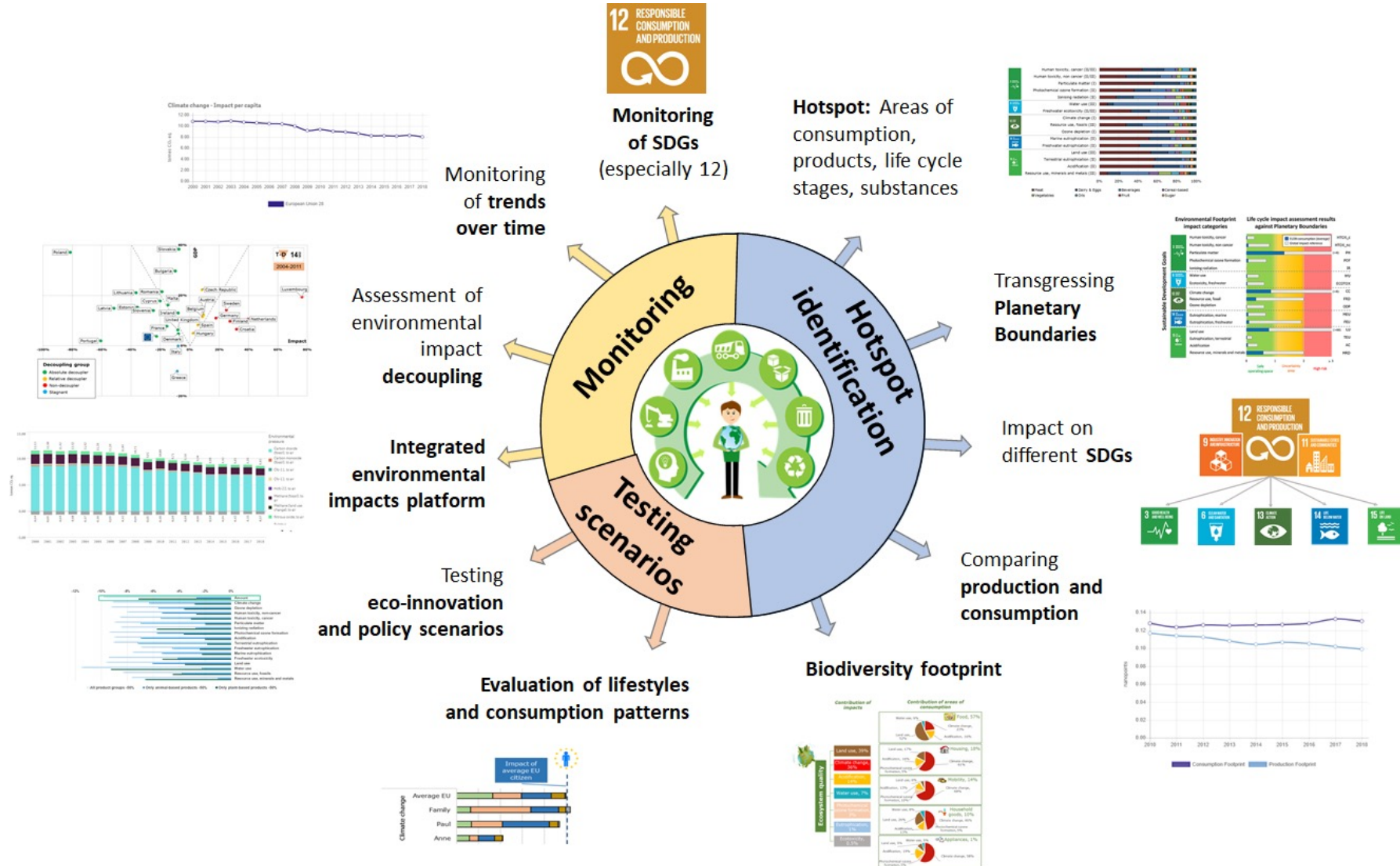
*\*Collaboration with the Spanish  
Ministry of Consumer Affairs*

*\*Collaboration with UBA (Germany)*

Pilot implementations: [Turin \(Italy\)](#),  
Leuven (Belgium)

Consumer Footprint Calculator

# Features of consumption-based footprints



# Consumption Footprint tools

## Consumer Footprint Calculator

English

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 aggregated into a 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.



6 5 7 4 8

(EN, IT and ES – forthcoming)

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

## Welcome to the Consumption Footprint Platform

The European Commission has developed a **Life Cycle Assessment (LCA)-based framework to monitor the evolution of the overall environmental footprint of EU production and consumption** and compare the footprint against planetary boundaries. The Domestic Footprint and Consumption Footprint indicators respond to key challenges posed by the need of a systemic and holistic assessment of transition towards sustainability and represent a key set of indicators to support the ambitions of the European Green Deal, such as circular economy (Circular Economy Action Plan), zero pollution (Zero Pollution Action Plan), sustainable food production (Farm to Fork Strategy) and biodiversity conservation (EU Biodiversity Strategy for 2030).



▶ DOMESTIC FOOTPRINT	▶ CONSUMPTION FOOTPRINT	▶ Assessment of DECOUPLING
▶ Comparing PRODUCTION and CONSUMPTION	▶ Consumption Footprint by PRODUCT	▶ Assessment against PLANETARY BOUNDARIES
▶ Assessment against SDGs	▶ Impacts of the food system	Download data
		About

<https://eplca.jrc.ec.europa.eu/ConsumptionFootprintPlatform.html>

(forthcoming)

## Member States - Consumption footprint Tool

Select country  
European Union 27

Select year  
2020

Select consumption area  
Food

Select impact category  
Climate change

Select the level of detail:  
 Per capita  Country

Home General overview of impacts Explore time trends Explore products contributions Modify intensity At

## Welcome to the Member States - Consumption footprint tool

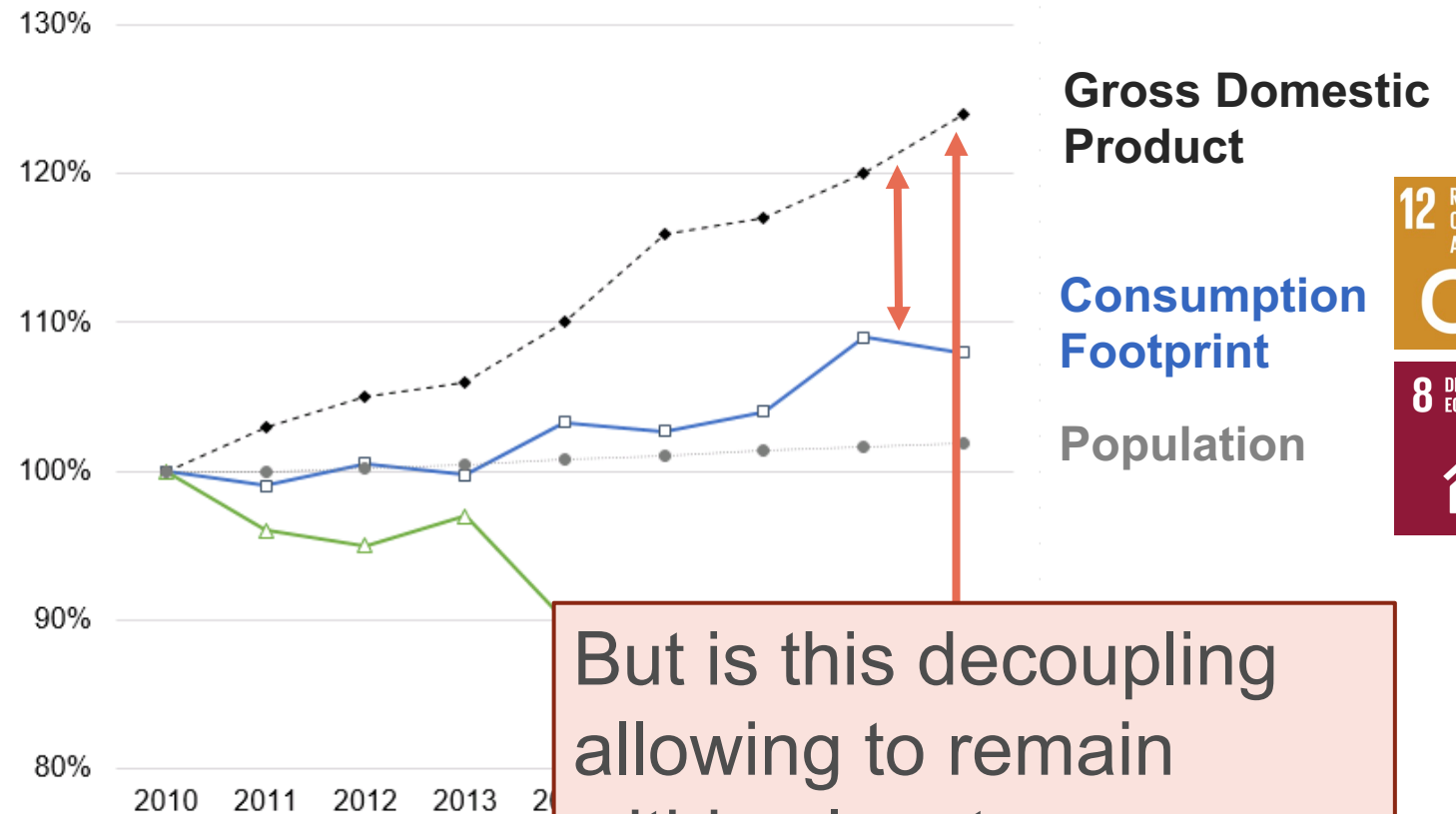
The Member States - Consumption footprint tool supports EU27 (2020) Member States to calculate their environmental performance over 16 impact categories including, among others, climate change, land use and human toxicity. Member States can estimate their consumption footprint through employing different national data sources to define the consumption intensity of products.

Using the Member States - Consumption footprint tool you can:

# From relative to absolute sustainability assessment

# Relative sustainability: Monitoring trends over time and decoupling (2010-2018)

- Domestic Footprint: **absolute decoupling** in almost all impact indicators.
- Consumption Footprint: **limited decoupling**



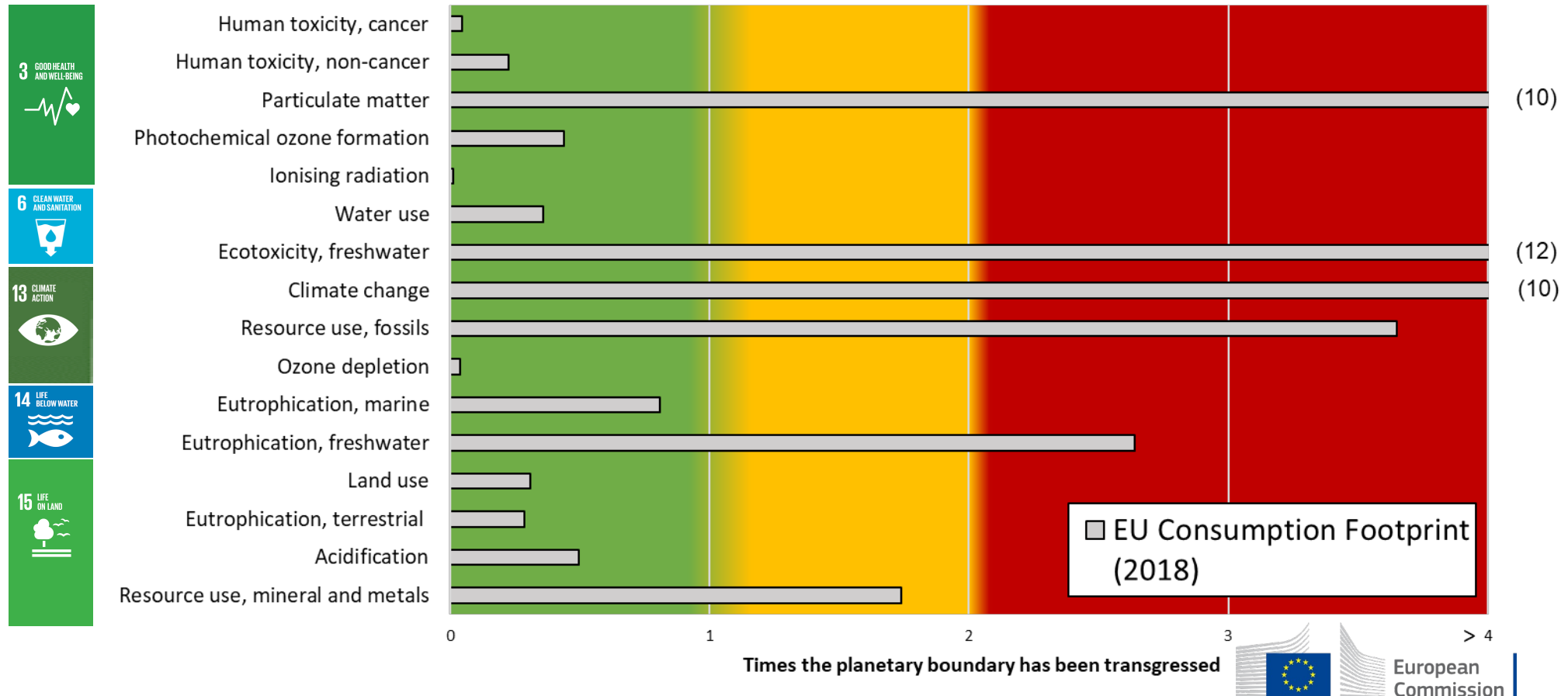
But is this decoupling allowing to remain within planetary boundaries?

# Absolute sustainability: Transgressing Planetary Boundaries

## EU Consumption Footprint (2018)

Current consumption patterns transgress the limits of our planet in different impact categories.

Allocation per capita (egalitarian)





# Assessing the Consumption Footprint against Planetary Boundaries (PBs)

# Planetary boundaries and life cycle assessment

## Environmental pressure

(Life cycle inventory)

*Emission of carbon dioxide*

*Emission of methane*



## Environmental impact

(Life cycle impact assessment)



*Global warming potential (kg CO<sub>2</sub> eq)*



*Global warming potential (kg CO<sub>2</sub> eq)*

### Use of the metrics of the control variable of the PBs framework

LCIA method to assess the environmental pressure from a PBs lens

e.g. PB-LCIA (Ryberg et al., 2018)

### Adapt the PBs metrics of the control variable to the LCIA metrics

Map and derive PBs for LCIA impact categories

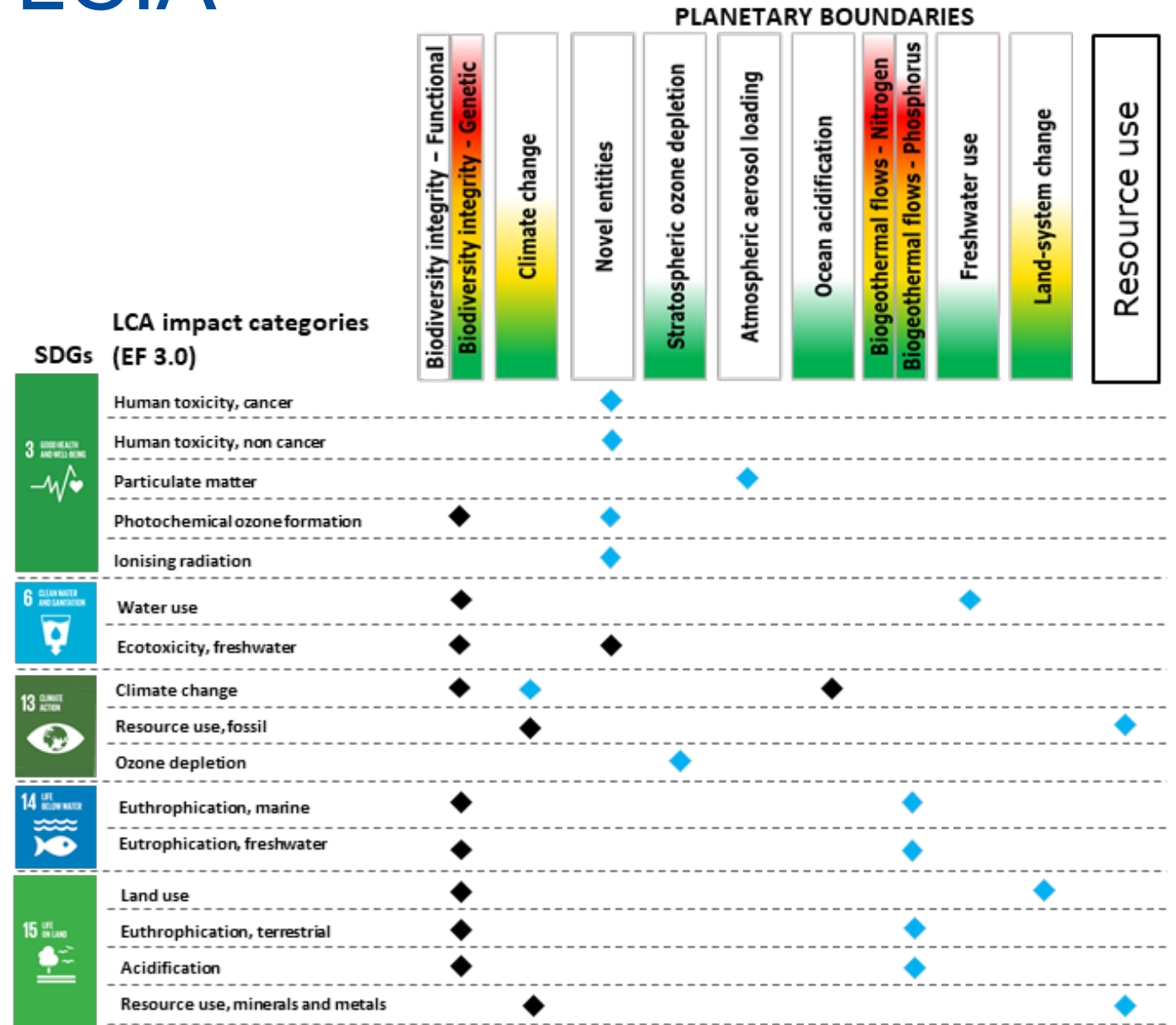
e.g. LCIA-based PBs for Environmental Footprint (Sala et al., 2020)

# Mapping PBs with LCIA impact categories

Connecting LCA impact categories with the 16 EF impact categories

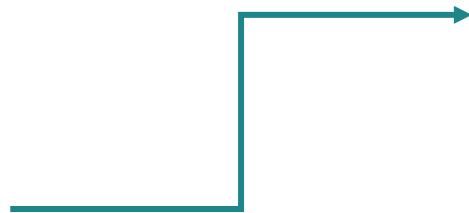
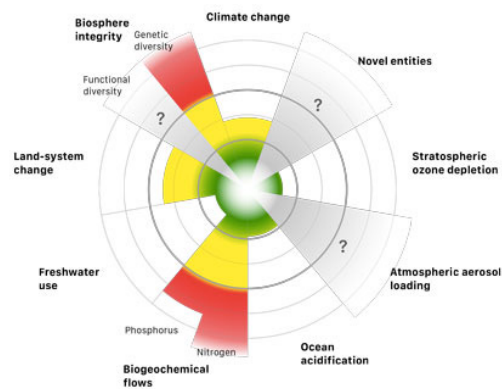
Blue – link

Black – mapped category



Sala et al. (2020). Environmental sustainability of European production and consumption assessed against planetary boundaries. *Journal of environmental management*, 269, 110686.

# Set of PB factors used in Environmental Footprint (3.0)



Impact category	Planetary Boundary (PB)	PB per capita	Unit
Acidification	1.00E+12	1.45E+02	mol H <sup>+</sup> eq.
Climate change	6.81E+12	9.85E+02	kg CO <sub>2</sub> eq.
Ozone depletion	5.39E+08	7.79E-02	kg CFC-11 eq.
Human toxicity, non-cancer	4.10E+06	5.93E-04	CTUh
Human toxicity, cancer	9.62E+05	1.39E-04	CTUh
Particulate matter	5.16E+05	7.46E-05	disease incidence
Ionising radiation	5.27E+14	7.62E+04	kg U-235 eq.
Photochemical ozone formation	4.07E+11	5.88E+01	kg NMVOC eq.
Eutrophication, terrestrial	6.13E+12	8.86E+02	mol N eq.
Eutrophication, freshwater	5.81E+09	8.40E-01	kg P eq.
Eutrophication, marine	2.01E+11	2.91E+01	kg N eq.
Ecotoxicity, freshwater	1.31E+14	1.89E+04	CTUe
Land use	3.98E+15	5.75E+05	Pt
Water use	1.82E+14	2.63E+04	m <sup>3</sup> water eq.
Resource use, fossil	2.24E+14	3.24E+04	MJ
Resource use, mineral and metals	2.19E+08	3.17E-02	kg Sb eq.

Sala et al. (2020). Environmental sustainability of European production and consumption assessed against planetary boundaries. *Journal of environmental management*, 269, 110686.

# Planetary boundaries related to human health impacts

Impact category	Approach
Photochemical ozone formation	Carrying capacity (Bjørn and Hauschild, 2015)
Human toxicity (cancer and non-cancer effects), particulate matter, and ionising radiation	Concept of “acceptable environmental burden” of disease (Vargas-Gonzalez et al., 2019) Measured in DALYs (Disability-Adjusted Life Years)



The burden was defined based on the concentration of PM<sub>2.5</sub> estimated as tolerable for a healthy environment (i.e. 10 µg m<sup>-3</sup> as recommended by WHO (2006)): 0.0016 DALYs.

# Planetary boundaries related to climate action, water and terrestrial life protection

Impact category	Approach
<b>Climate change, ozone depletion, eutrophication</b> -both marine and freshwater- and <b>ecotoxicity</b>	Carrying capacity (Bjørn and Hauschild, 2015)
<b>Terrestrial eutrophication, acidification and water use</b>	Carrying capacity (Bjørn and Hauschild, 2015) Adapted metric
<b>Land use</b>	Carrying capacity (Bjørn and Hauschild, 2015) Based on ecological boundary for soil erosion

# Planetary boundaries for resource use

Impact category	Approach
Resource use – both fossils and minerals and metals	Application of the <b>concept of Factor 2</b> as proposed by the UN resource panel to the EF global normalisation reference for resources (Crenna et al., 2019)

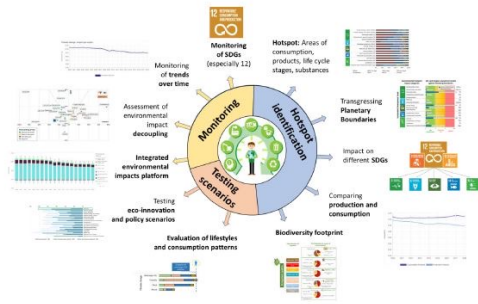
- PBs framework excludes resource use
- No carrying capacities or similar in available literature
- A reduction in material consumption by a factor 2 (namely 50%) at the global level is proposed by the UN Resource Panel to achieve environmental sustainability.
- Contrary to the other impact categories, the principle applied for resources use is more normative than the boundary or carrying capacity approach.

# Recent publications



## Consumption Footprint: assessing the environmental impacts of EU consumption

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



<https://publications.jrc.ec.europa.eu/repository/handle/JRC126257>

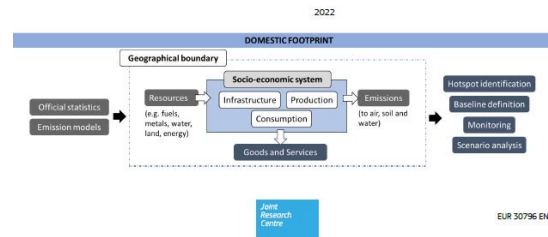


## JRC TECHNICAL REPORT

### Domestic Footprint of the EU and Member States: methodology and results (2010-2018)

Assessing the environmental domestic impacts of production and consumption activities

Esther Sanjé Mengual, Davide Tosches, Serenella Sala



EUR 30796 EN

<https://publications.jrc.ec.europa.eu/repository/handle/JRC125941>



## JRC TECHNICAL REPORT

### The Consumer Footprint Calculator

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

Sala, S., De Laurentis, V., Barbero Vignola, G., Marelli, L., Sanjé Mengual, E.

2022



EUR 31089 EN

<https://publications.jrc.ec.europa.eu/repository/handle/JRC129382>

(ES, EN)



[https://www.consumo.gob.es/es/system/tdf/prensa/Informe de Sostenibilidad del consumo en Espana%CC%83a EU MinCon.pdf?file=1&type=node&id=1126&force](https://www.consumo.gob.es/es/system/tdf/prensa/Informe%20de%20Sostenibilidad%20del%20consumo%20en%20Espa%C3%91a%20EU%20MinCon.pdf?file=1&type=node&id=1126&force)

+ info: <https://eplca.jrc.ec.europa.eu/sustainableConsumption.html>



# Conclusion and outlook

- Need of moving beyond the decoupling concepts, which is not enough to remain within planetary boundaries
- The adaptation of Planetary Boundaries to life cycle assessment operationalize the assessment of absolute sustainability at product and system scales
- The PBs framework can be complemented for missing aspects, such as “resources use” by relying on other internationally agreed targets
- Operationalisation of the framework to specific evaluations (e.g. a specific sector/ product) is a high priority for policy support
- Planetary boundaries can be used to define science-based policy targets
- Link PBs – consumption footprint in monitoring frameworks (e.g. CEAP, 8EAP, resilience dashboards) allows monitoring transgression of PB

# Links and contact



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

- Consumption Footprint Platform

<https://eplca.jrc.ec.europa.eu/ConsumptionFootprintPlatform.html>

- Consumer Footprint Calculator

<https://eplca.jrc.ec.europa.eu/ConsumerFootprint.html>



[JRC-ConsumptionFootprint@ec.europa.eu](mailto:JRC-ConsumptionFootprint@ec.europa.eu)

# Thank you



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<https://eplca.jrc.ec.europa.eu/sustainableConsumption.html>  
Consumer Footprint Calculator  
<https://eplca.jrc.ec.europa.eu/ConsumerFootprint.html>



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