# ASSESSING ENVIRONMENTAL FOOTPRINTS ON A LIMITED PLANET

METABOLIC

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# THE NEED FOR A PLANET-FIT APPROACH

Companies, governments, and individuals are increasingly recognizing that the impacts humanity is having on the planet are untenable. Already, water pollution and regional water scarcity, changing climate and weather patterns, the loss of species and overfishing of the seas, degradation of natural and managed land systems, and many more environmental shifts all threaten the foundation on which human health and wellbeing depend.

> **If current consumption and production patterns continue to grow as they are projected to, material use will double by 2060 (UNEP, IRP, 2019). As a consequence, our planet will be put under more pressure.**

There are positive trends taking place as well. Governments around the world are pushing for increasingly ambitious sustainability targets and companies are committing to taking action. However, we have seen that despite best intentions, we are still not reaching the level of impact reduction that is required. The root cause is often our failure to consider the systemic effects of our efforts, such as:

- **We frequently address impacts in silos without consideration for other environmental repercussions.** For example, efforts to prevent climate change through a large-scale shift to biomass as a source of energy and materials could exacerbate existing pressures on land and water systems (burden shifting).
- **A lack of context may result in detrimental outcomes.** Ignoring spatial and temporal aspects also results in burden shifting, for example when importing soy as feed for domestic cattle.
- **Relative improvements can mask the implications of broader trends or even increase unsustainable behaviors.** If increases in consumption are greater than the speed of eco-economic decoupling, environmental impact will still increase.
- **Targets are often set based on the current state, rather than where we need to be.** We may be tempted to set targets based on incremental year-on-year improvements, without a clear vision of how high targets should be set to keep environmental systems within safe limits.

> **In order to achieve transformative change, we need frameworks that guide action which align with absolute physical and socio-economic boundaries and create awareness of the complexities inherent in those systems.**

The two frameworks explored in this leaflet offer instruments to measure progress more holistically, reduce the complexity, and align policy with thresholds identified by science.

# PLANETARY BOUNDARIES: A POWERFUL NARRATIVE ACROSS ENVIRONMENTAL "SILOS"

The **Planetary Boundaries (PBs)** framework has emerged as a way to address the challenges we are facing. The PBs define a "safe operating space" for humanity — the absolute thresholds for nine planetary systems, beyond which point human health and wellbeing is at risk. The PBs are designed as a holistic framework. All systems are crucial and interconnected, so it is key that we keep them all within safe limits. Currently, the world has crossed two boundaries: biogeochemical (nitrogen & phosphorus) flows and biospheric integrity (biodiversity). For two other boundaries: climate change and land-system change, we are also no longer in a safe operating space and facing increased risks. PBs send a strong message: Incremental improvements are not sufficient as long as impacts are beyond boundaries.

Complementary to the PBs framework is the concept of the **"Social Doughnut[1]"**. The idea is that while we should keep our environmental impacts below maximum thresholds, this must be done with consideration of the implications for global equality and social justice, which form the minimum "social foundation" threshold.

The **Science Based Targets Initiative (SBTi)** and **Science Based Targets Network (SBTN)** are actively working with companies and cities to define context-specific targets to ensure their activities fit within these absolute boundaries.

***Action:***

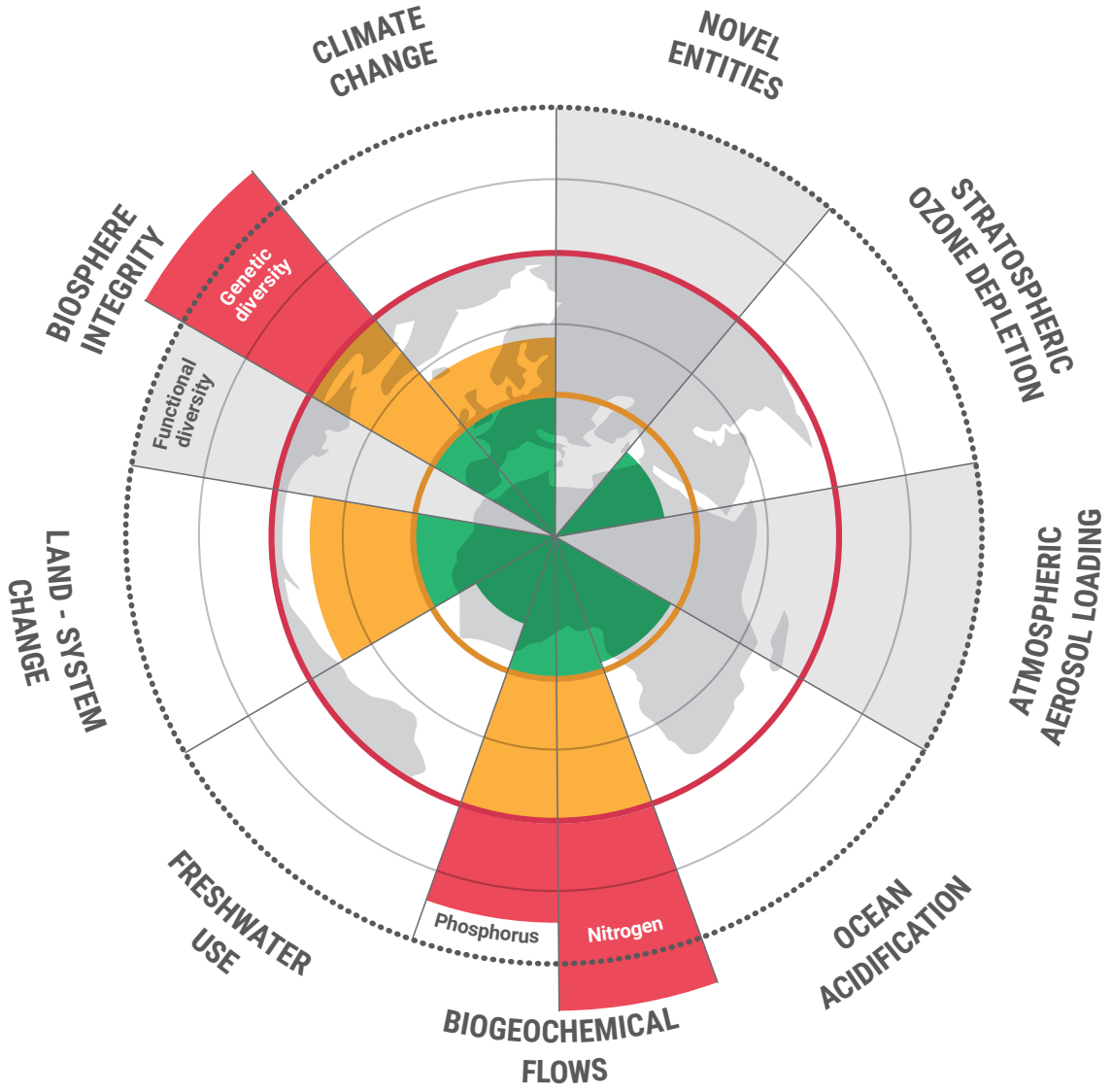
### Calculating the regional maximum allocation of planetary boundaries

The first step is establishing the limit of impacts that a region should have on the planet, given both the global and regional thresholds defined by the planetary boundaries. This requires allocating a maximum share that a region should have. However, there are many approaches to allocation.

The choice of allocation method has a large impact on the final outcomes. According to the joint EEA/FOEN report 'Is Europe Living Within the Limits of the Planet?' (2020), the median share that Europe should have ranges from 6.2 - 12.5% of the global boundaries, depending on which allocation method is selected. The simplest approach is to use a per capita allocation, with a possible range presented using other allocation approaches.

For other resources, please see "Further Information" at the end of this document.

[1] *See https://www.kateraworth.com/doughnut/*




Beyond zone of uncertainty (high risk)
In zone of uncertainty (increasing risk)
Below boundary (safe)
Boundary not yet quantified

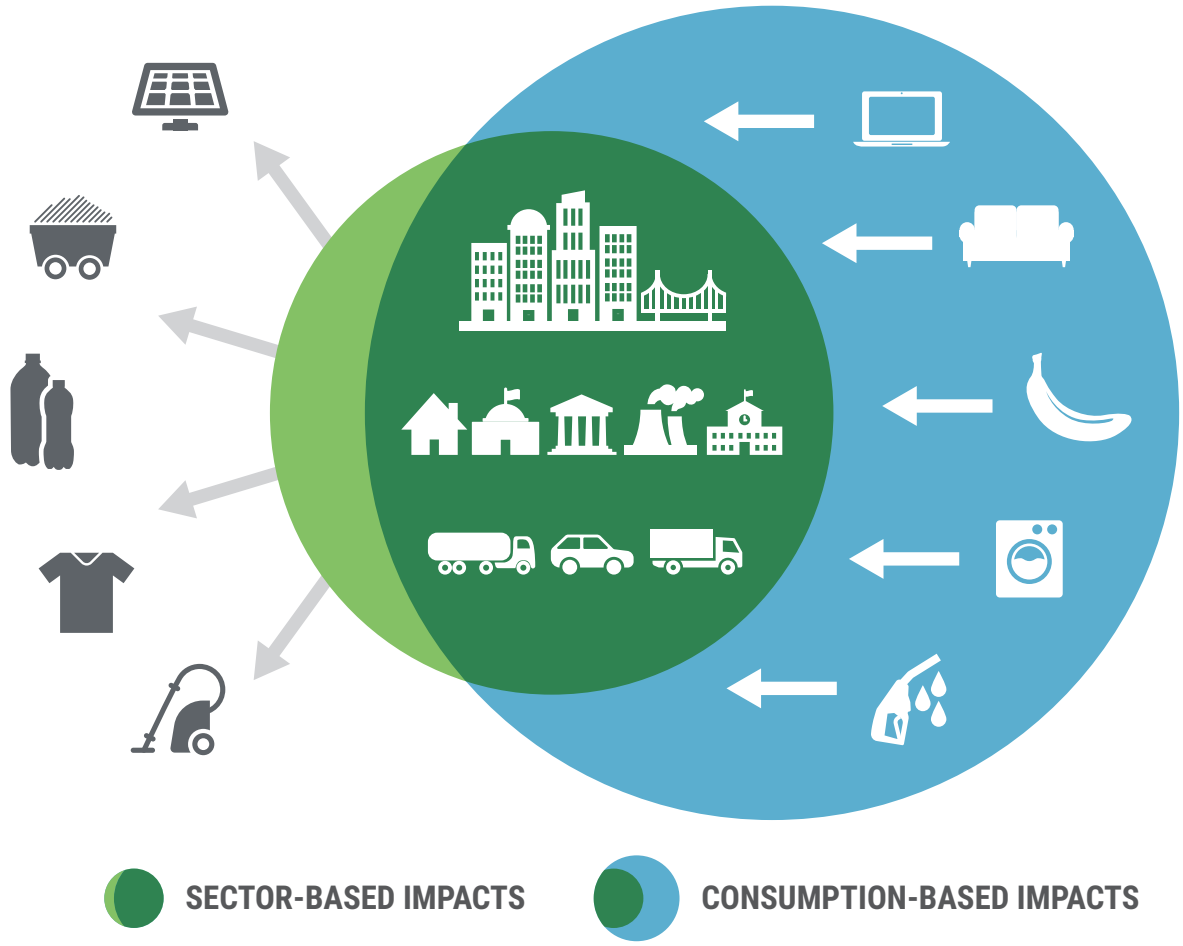
*Source: Steffen et al. Planetary Boundaries: Guiding human development on a changing planet, Science, 16 Janyary 2015.*
*Design: Globaia*

# FOOTPRINTS: BRINGING THE DEMAND-SIDE OF THE ECONOMY ON BOARD

Using a territorial, production-based impact assessment means that the impacts a region causes outside of its own geographic boundaries are not considered, which is especially critical in net-consuming, high-income countries. This is where a **Consumption-based footprinting approach** comes in.

Looking beyond only direct environmental impacts is crucial in a globalized world. For **companies**, this means looking at "Scope 3" impacts - the impacts that happen upstream and downstream that the company has no direct control over, but which occur as a result of the company's choices.

For **countries, cities, and other regions** the shift towards acting on indirect, systemic impacts is also taking place. The framework facilitating this is a **"Consumption-based" footprinting approach**. While countries or cities have traditionally focused on reducing local sources of impact, from electricity consumption or mobility for example, this only captures a small share of the impact that local decisions have on a global scale.




*A consumption-based approach allows for capturing the impact of imported goods and services that are produced or consumed within a region. Adapted from Portland Bureau of Planning and Sustainability's Climate Action Plan (2015).*

Especially as high-income countries increasingly rely on lower-income nations for raw materials and products, more impact takes place outside of national boundaries than within. As an example, C40 Cities recently mapped out the consumption-based emissions of their partner cities and found that 80% of the participating cities are "consuming cities", as their emissions related to consumption are higher than local, sector-based emissions.

## *Action:*

### Measuring the regional consumption-based footprint

To measure the consumption-based footprint:

1. Calculate all of the impacts caused by economic activities in the country / region (e.g. from using fuels, from agriculture, energy production, etc).
2. Add the "embodied" impacts of all products and services consumed in the region (e.g. impacts due to the products being produced, as well as transported, to the point of consumption)
3. Subtract the "embodied" impacts of products and services produced in the region that are exported.

| | Potential data sources |
|---|---|
| **Data on consumption** | • Statistics on the state of the environment<br>• Environmentally extended national Input-Output-Tables<br>• Household and business consumption data from surveys |
| **Data on material and product import and export** | • Production and trade databases (e.g. Prodcom, the IRP's Global Material Flows Database)<br>• Multi-Regional Input-Output (MRIO) models (Exiobase, Eora, WIOD) |
| **Data on impacts** | • Life Cycle Assessment databases (such as EcoInvent, GaBi)<br>• Environmentally extended input-output models (Exiobase) |

Various approaches for modelling environmental footprints exist. UNEP's Life Cycle Initiative SCP-HAT is currently exploring options for international harmonization of databases. For other resources, please see "Further Information" at the end of this document.

# TOWARDS A ONE PLANET APPROACH

Combining these two approaches can be a powerful tool for change. Planetary Boundaries provide a means to defining future-proof targets, using a holistic set of environmental indicators. A consumption-based footprinting approach allows us to measure a region's indirect impacts as well as direct ones.

**Together, these two approaches provide a method for a meaningful evaluation of absolute impacts, which can be acted on in a national or regional context.**

National and regional policies can change demand in key ways that affect the global footprint and can steer the local economy into fitting within the planetary boundaries. For example, policy can have an impact on unsustainable patterns of consumption by establishing economic incentives for sustainable behaviors, by defining a vision or roadmap to highlight opportunities for stakeholders to take action, or by raising awareness or guiding planning and management towards better outcomes.

***Action:***

### Combining approaches to identify impact hotspots

To focus efforts, high impact areas, or 'hotspots', should be identified. This is done by comparing the region's consumption-based environmental footprint with the regional boundary allocation. Where the thresholds are exceeded, action and reduction targets are required. To stay proportionate, the choice of policy measure would depend on where impacts occur and how severe the thresholds are exceeded; i.e. policies could range between soft, collaborative and voluntary measures to harder measures such as taxation or regulation.

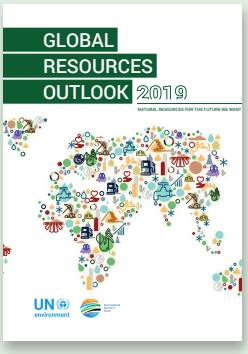
Once the national / regional boundary allocation has been set and the global footprint for the region has been assessed, these should be compared to identify where and how much the planetary boundaries have been crossed. For example, in countries like the Netherlands or Switzerland which rely on imports of feed to support meat and dairy production, global land use and nutrient impacts might be key focus areas if a consumption-based approach is taken. In this case, policymakers can raise industry awareness, for example through impact-focused sourcing guidelines for the sector.

# WHAT RECENT ASSESSMENTS TELL US

A number of recent studies have investigated the impacts of resource consumption, bringing planetary boundaries and non-domestic impacts into the accounting.

Overall, the studies conclude that impact levels of resource consumption exceed safe levels for a number of environmental parameters. There is an urgent need for widening the scope of environmental impact mitigation and raising ambition levels. While climate change already is a focus area many places, other issues such as eutrophication, biodiversity loss, and water stress also need urgent and ambitious action. By considering a fair budget allocation of consumption and impact, it is also clear that high-income areas are overconsuming disproportionately.

By applying this combination of methodologies policymakers can identify high-impact areas for action. Policymakers can also set fair evidence-based quantitative targets that collectively fit within the global budget, at for example regional, national and sectoral levels.




## *Global Resources Outlook*

***(UNEP, IRP 2019)***

This study presents an overview of global resource consumption and how the benefits and the negative impacts are allocated geographically. Some key conclusions include:

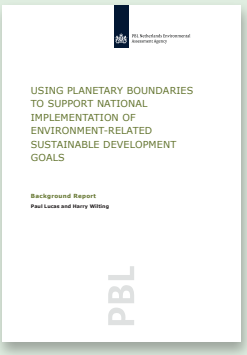
- Per capita material demand grew from 7 tons to 12 tons between 1970-2017.
- Material footprints in high-income countries were 60% higher than the upper-middle income group in 2017 and more than 13 times the level of the low-income group.
- The extraction and processing of materials, fuels, and food cause around half of global greenhouse gas emissions and more than 90% of biodiversity loss and water stress.


## *Is Europe living within the limits of our planet?*

***(FOEN, EEA 2020)***

This report builds on past work by the European Environment Agency (EEA) and FOEN. Focusing on Europe, it operationalizes the planetary boundaries framework and assesses consumption-based environmental footprints against these boundaries. It applies a number of different normative allocation approaches, to define a 'fair' European budget.

The study concludes that Europe exceeds the limit for three of the four assessed boundaries. It suggests that along with the core planetary boundaries of climate change and biosphere integrity, Europe should prioritize the additional key systemic challenges of nitrogen and phosphorus cycles as well as land-system change.

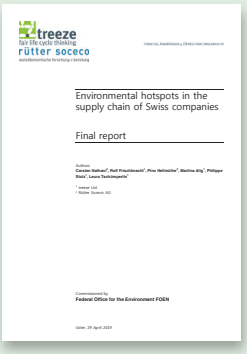



## *Using planetary boundaries to support national implementation of environment-related Sustainable Development Goals*

***(PBL 2018)***

The study explores how to set quantitative environmental targets for the Netherlands that are aligned with the SDGs. First, the study sets global targets based on the planetary boundaries. Then the Dutch fair share is calculated, using a set of different allocation methodologies.

The study concludes that when a consumption-based approach is applied, the Netherlands has already reached 'unsafe' and 'clear unsafe' levels on all five selected parameters (2010 figures). Consequently, according to the study the Dutch government might also need to set ambitious targets for land use, nutrient consumption, and biodiversity, where previous policies primarily focus on carbon emissions.




## *Environmental Hotspots in the Supply Chain of Swiss Companies*

***(treeze, rütter soceco 2019)***

This report presents an analysis of eight selected Swiss industries; meat, chemicals, machinery, real estate, health care, food, apparel, and electrical products. The study assesses their environmental footprint along their value chains and identifies key impact hotspots by applying the planetary boundaries framework.

In all industries analyzed, most of the environmental impacts do not occur in the industry itself, but in its supply chain.


## *Environment Switzerland*

***(FOEN 2018)***

The **report** by the Swiss government showcases the importance of considering both domestic and emissions outside of Swiss economic activity. It also identifies key impact areas for national policy to focus on.

Switzerland's per capita environmental impacts are well above the global average. While Switzerland's total domestic environmental footprint fell by around 7% between 2000 and 2015, this was partly countered by increased environmental impacts abroad. Key 2015 figures include:

- Nutrition has the most significant environmental effects, followed by housing and mobility.
- The Swiss per capita greenhouse gas footprint for 2015 was 14 tons of $CO_2$e. This is much higher than the estimated sustainable level of 0.6 tons and significantly above the European average.
- The material footprint (Raw Material Consumption, or RMC) is 17 tons per capita and well above the estimated equitable threshold value of 5.2 tons (on average).

# FURTHER INFORMATION

## References of the featured reports


- ***Oberle, B., Bringezu, S., Hatfield-Dodds, S., Hellweg, S., Schandl, H., & Clement, J.*** *(2019). Global Resources Outlook: 2019. International Resource Panel, United Nations Envio.*
- ***European Environment Agency (EEA) & The Swiss Federal Office for the Environment (FOEN).*** *(2020). Is Europe living within the limits of our planet? An assessment of Europe's environmental footprints in relation to planetary boundaries. EEA Report No 01/2020.*
- ***Lucas, P., & Wilting, H.*** *(2018). Using Planetary Boundaries to Support National Implementation of Environment-related: Sustainable Development Goals: Background Report. PBL Netherlands Environmental Assessment Agency.*
- ***Nathani, C., Frischknecht, R., Hellmüller, P., Alig, M., Stolz, P., & Tschümperlin, L.*** *(2019). Environmental Hotspots in the Supply Chain of Swiss Companies.*
- ***Swiss Federal Council.*** *(2018). Environment Switzerland 2018 .*


## Planetary Boundaries

The following resources give more detailed information about the Planetary Boundaries, including how they are set and the different allocation approaches that are possible to apply.


- ***Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Folke, C.*** *(2015). Planetary boundaries: Guiding human development on a changing planet. Science, 347(6223), 1259855.*
- ***Stockholm Resilience Centre:*** *https://stockholmresilience.org/research/research-news/2017-01-09-global-sustainability-national-responsibility.html*
- ***Sabag Muñoz, O. & Gladek, E.*** *(2017). One Planet Approaches: Methodology Mapping and Pathways Forward. Available at: https://www.metabolic.nl/publications/one-planet-approaches-methodology-mapping-and-pathways-forward/*


## Consumption-Based Footprinting Approaches

There are multiple approaches for assessing the footprints of a country or region. Examples include:

- Using emission and resource-use coefficients for foreign countries derived with life cycle inventories (LCIs) in combination with data on imports.
- Using emission and resource coefficients for foreign countries, derived with environmentally extended input-output (EE IO) data, or applying the Domestic Technology Assumption (DTA) – assuming imported products are produced with the same technologies as domestic products.
- Using available environmental global multiregional input-output (GMRIO) databases at face value or using official data for the country being assessed to adjust and rebalance an existing GMRIO. Another option is to use the full GMRIO model only to calculate pollution and resources in imports, rather than creating a new GMRIO adjusted to this specific country.

Ready-to-use software tools are available which enable an analysis of environmental pressures and impacts. These tools differ in scope, complexity and user-friendliness. Two examples include:

1. SCP-HAT[2]: This tool is easy to handle (for "beginners" and advanced users) and allows to obtain a quick, but rather coarse overview related to 189 countries. The split of impacts between 26 industrial sectors can also be indicated, but no supply-chain analysis can be performed. The tool includes the option of adding primary data to overwrite the input data.
2. Cabernard et al 2019.: This tool provides more details about economic sectors (163) and environmental impacts. It is the first tool allowing for detailed supply-chain analysis of sectors and regions without double counting. Furthermore, regional data was coupled with high-resolution land and water use maps to assess site-specific impacts accurately, before aggregating on country/region level. The tool is meant for experienced experts.

For further information, see:


- ***Stadler, K., Wood, R., Bulavskaya, T., Södersten, C.-J., Simas, M., Schmidt, S., et al., 2018.*** *EXIOBASE 3: developing a time series of detailed environmentally extended multi-regional input-output tables. J. Ind. Ecol. 22, 502– 515.*
- ***Tukker, A., de Koning, A., Owen, A., Lutter, S., Bruckner, M., Giljum, S., ... & Hoekstra, R.*** *(2018). Towards robust, authoritative assessments of environmental impacts embodied in trade: Current state and recommendations. Journal of Industrial Ecology, 22(3), 585-598.*
- ***Cabernard, Livia; Pfister, Stephan; Hellweg, Stefanie*** *(2019), "A new method for analyzing sustainability performance of global supply chains and its application to material resources", Mendeley Data, v2 http://dx.doi.org/10.17632/nddmgkm3cc.2*


[2] *See http://scp-hat.lifecycleinitiative.org/*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