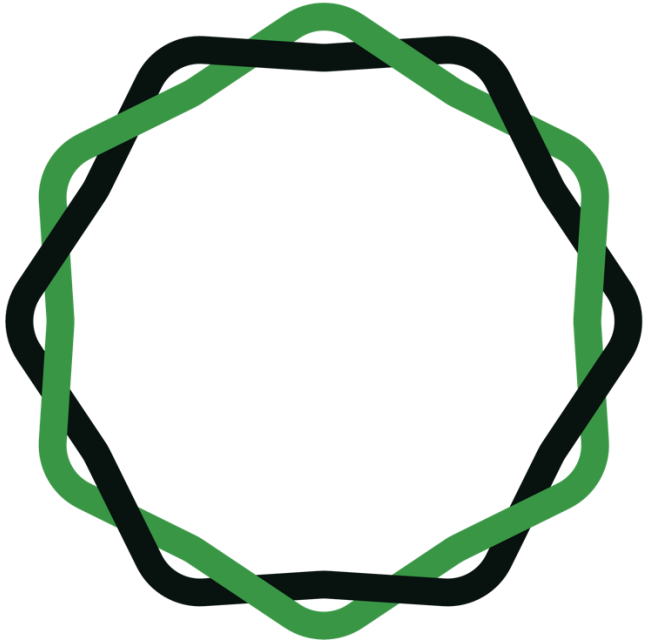

Environmental Footprinting

Green Chemistry Change Management

Tabitha Petchey
Green Rose Chemistry
18 Sep 2024

Agenda

- What is an Environmental Footprint?
  - Overview
  - EU Chemicals Context
- Methods of Assessment
  - LCA
  - PEF
  - Common Challenges
  - Assessing Methodology
- Conclusions and Further Reading

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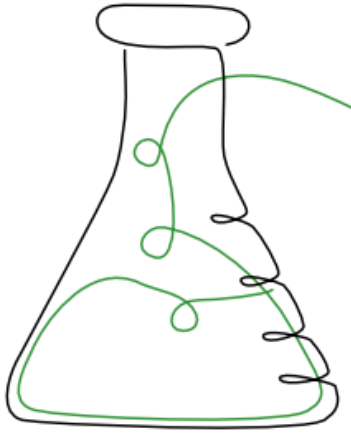
What is an Environmental Footprint?



Concept Overview

- Environmental footprinting (EF) is an attempt to measure the **total impact of a person, product, or organisation on the surrounding environment**
- Analyses resource use and emissions
- Many different methods of analysis
- Scope can be very narrow or very broad

Source: European Commission

EF and Chemicals

- EU Chemicals Strategy for Sustainability (CSS) calls for minimising environmental footprint
- SSbD chemicals framework requires measuring impact of chemical and its production on planetary boundaries
- EF in the form of life cycle assessment (LCA) is used in many industry sectors
- LCA is rapidly increasing in importance in chemicals sector

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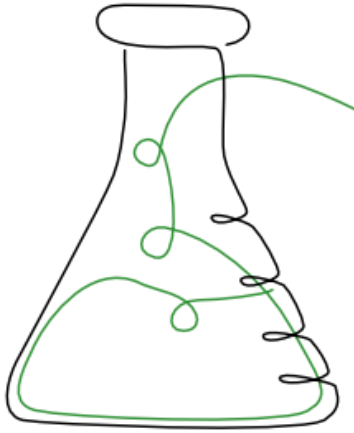
Methods of Assessment

Introduction to LCA



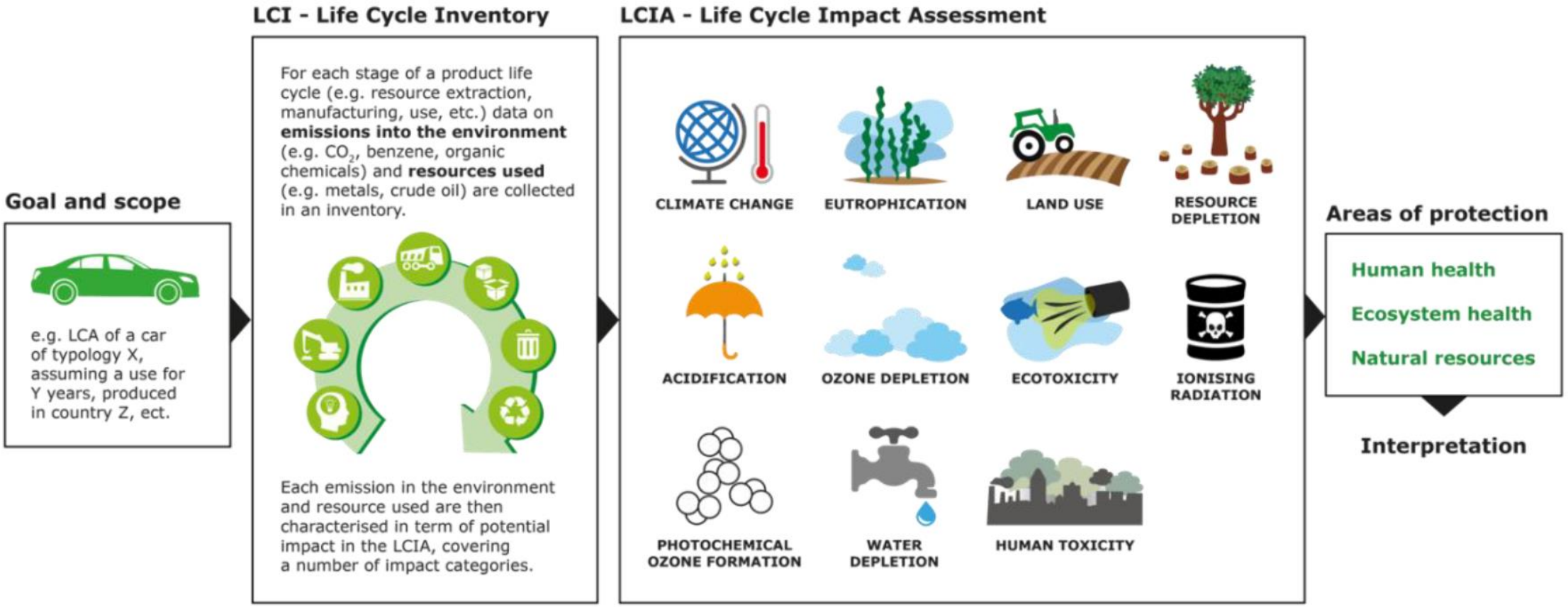
What Is Life Cycle Assessment?

- A method to assess the overall environmental impact associated with all stages of a product's life
- Used since the 1980s, standardised starting in late 1990s
- EU uptake from 2005 onwards
- Complex discipline regulated by many different standards

LCA Standards

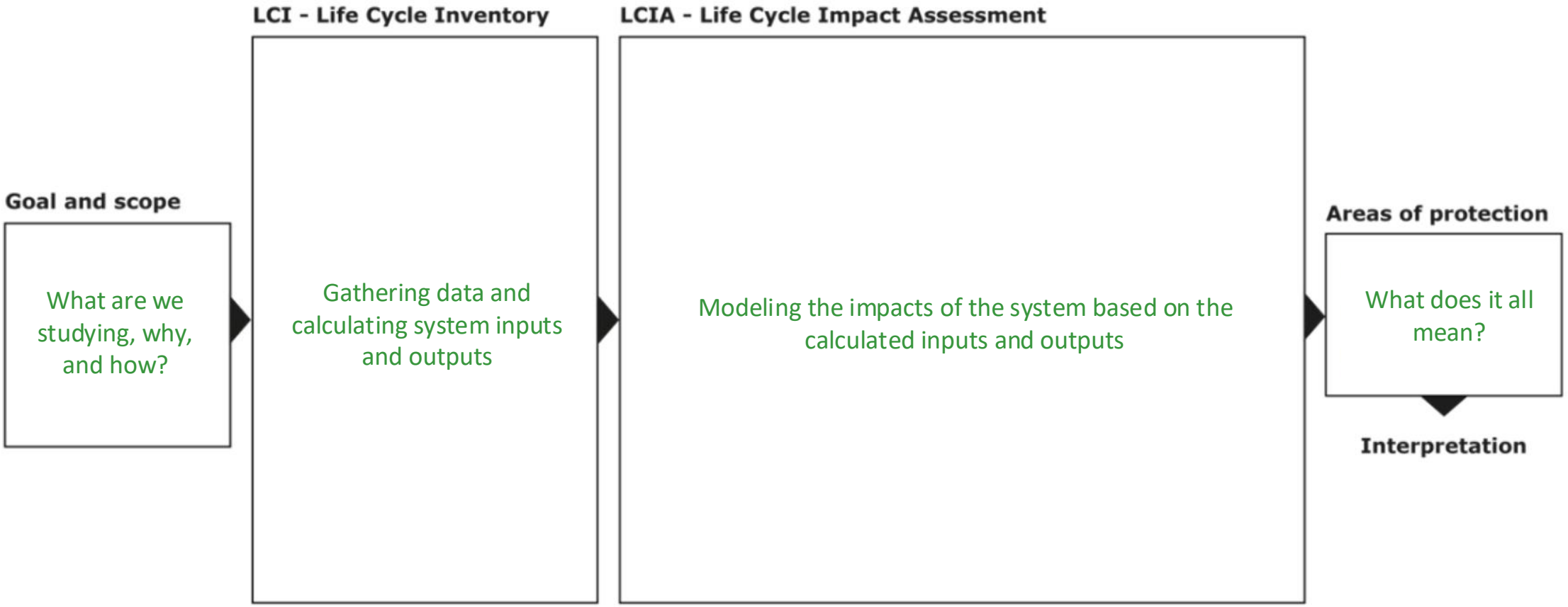
- ISO 14040: principles and framework
- ISO 14044: requirements and guidelines
- ISO 14067: specific to carbon footprint
- ILCD: EU handbook, consistent with ISO 14040/14044
- PAS 2050: specific to GHG emissions, UK but widely used
- BPX 30-323: environmental footprinting in France
- Many more…

LCA Methodology



Source: European Commission

LCA Methodology



Flexibility and Interpretation

- LCA has been widely used for decades
- Still difficult to compare across assessments
  - High level of flexibility, many choices for assessors
  - Different scope – “apples to oranges”
  - Can choose to study any impact (20+ categories)
  - No specification of impact assessment methods
- Clear communication of LCA results is challenging
  - Normalisation and weighting results is optional, even discouraged
  - Reports are complex and lengthy, style differs by assessor

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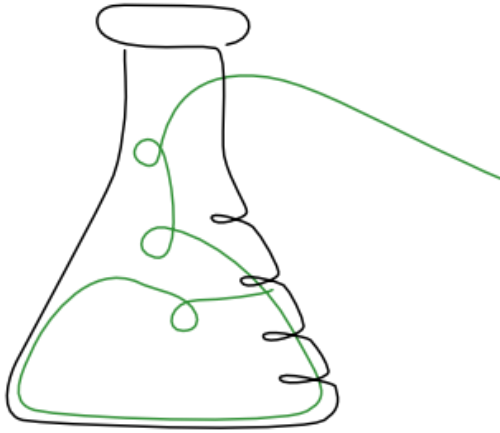
Methods of Assessment

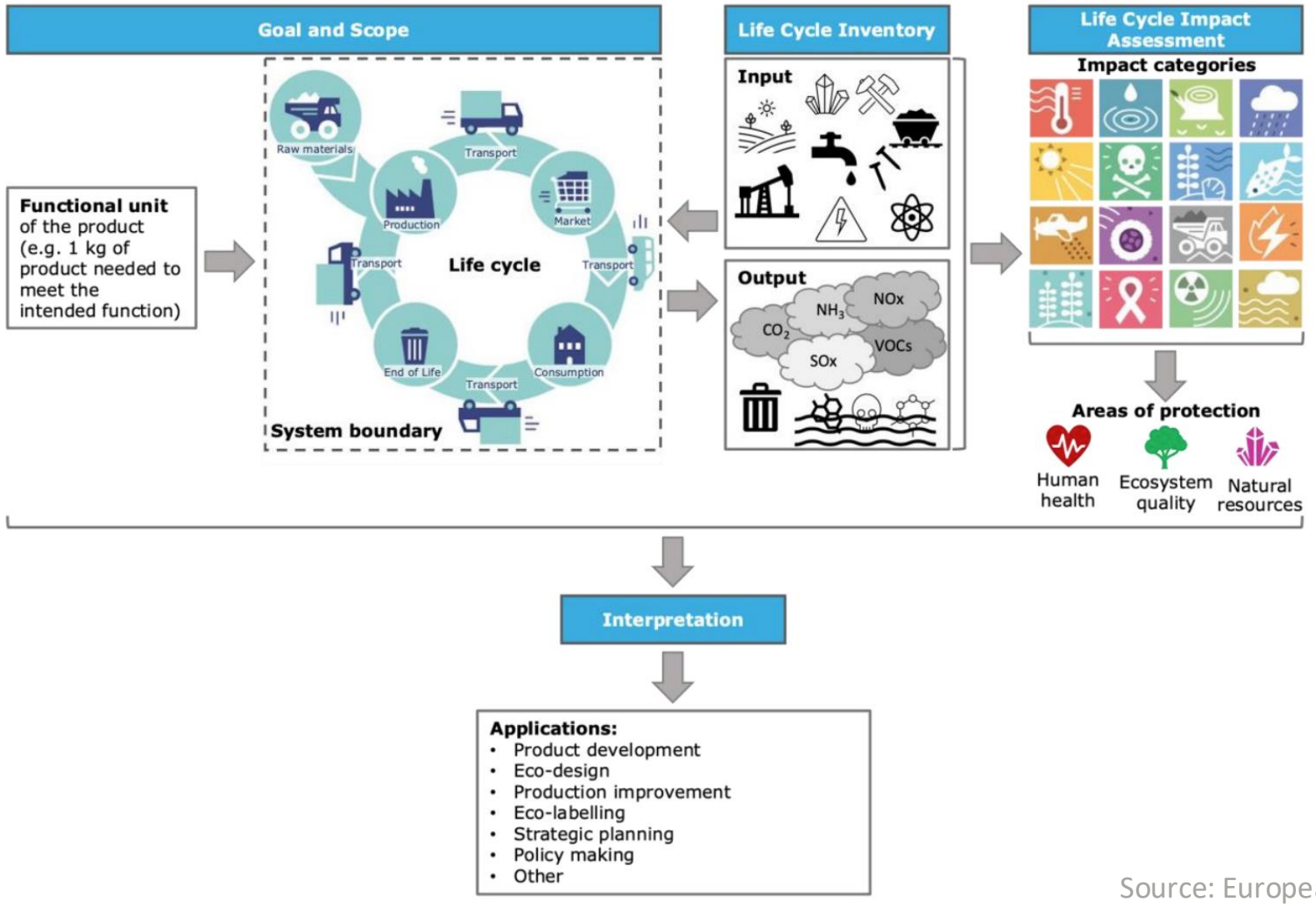
Introduction to PEF



Environmental Footprint (EF) Initiative

- Initiative from the European Commission (EC)
- Based on LCA methods
- Common framework that promotes fair competition and simplifies labelling
- Currently in a transition (beta) phase
- Includes footprints for products (**PEF**) and organisations (**OEF**)

PEF Methodology



Source: European Commission

More consistent and reproducible

- EF narrows down the LCA methodology
- Specific methods for footprinting products or organisations
- Rules for specific product categories (PEFCR)
- Aspects of the scope - functional unit, system boundaries – as well as baseline reference values are defined within product categories
- Public databases to improve data consistency

Easier to communicate

- EF simplifies communication of LCA
- Specific default impact methods
- Weighting factors to calculate a single score
- Requirements and templates for reporting results

Easier to communicate

LCA (smol, 2023)

which stage creates the most carbon in the capsule's life?

Nearly 70% of the capsule's carbon footprint comes into play at stage 10 which is basically from how the capsule is used in the home.

Essentially, this carbon is being created by the amount of electricity needed to heat up the water for our washing machine's cycle. This is why the temperature we choose for our laundry can make such a big difference to our carbon footprint. The cooler the temperature, the less electricity is needed. and the lower the footprint of your capsule.

Manufacturing the ingredients that go into the capsule is the second biggest contributor to a capsule's carbon footprint but it only accounts for 15% of the total because so much of the capsule's footprint comes from how it is used in our homes.

Interestingly our LCA discovered that transportation stages and creation of packaging played only a tiny contribution to the carbon footprint of our capsules.

a quick cut.

Because almost three quarters of the laundry capsule's footprint comes at the stage where we use it to do our washing at home - there is one super simple way we can all immediately reduce our capsule's carbon footprint.

And it's as easy as just selecting a cooler wash cycle.

Cutting the temperature of our washes from 40°C to 20°C gives an enormous 41% cut in a capsule's carbon footprint. And the great news with this is that smol capsules are designed for cooler wash temperatures; in fact our smol bio capsules *need* lower temperatures for their enzy

Knowing that our customers can have a real and champion the cooler wash! Of course lots of bra smol we go one step further...

How about cutting back on your laundry altoge

We consider it a priority to inform customers ho concentrating on fewer loads that are full rather out our #washwell information. It's really not so

We've even put together some top tips on no-wa extra great bonus with all this is it not only cuts y want lower bills?

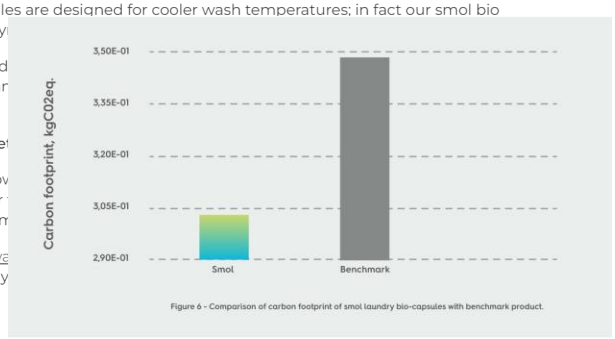


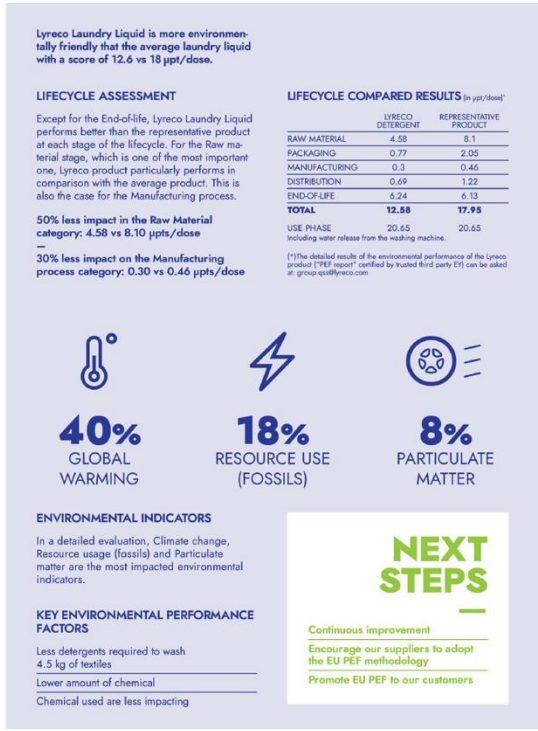
Figure 6 - Comparison of carbon footprint of smol laundry bio-capsules with benchmark product.

smol saves carbon compared to other capsule brands.

Looking across all 12 stages of our capsule's life, smol can save you 13% in its carbon output compared to competitor capsules.

But if you exclude the "at home use" (that is stage 10, which is just generated by running the wash) then smol has a 35% lower carbon output than comparative capsule brands.

PEF (Lyreco, 2024)



Category Rules (PEFCR)

- Help to focus the EF on the most important aspects
- Increase relevance, reproducibility, and consistency
- Allow direct comparison across studies – “apples to apples”
- Reduce effort and cost of an EF study

Table 48 *Weighting factors for Environmental Footprint (EF) 3.1*

Impact categories	WF [%]
Acidification	6.20%
Climate change	21.06%
Ecotoxicity, freshwater	1.92%
EF-particulate matter	8.96%
Eutrophication, freshwater	2.80%
Eutrophication, marine	2.96%
Eutrophication, terrestrial	3.71%
Human toxicity, cancer	2.13%

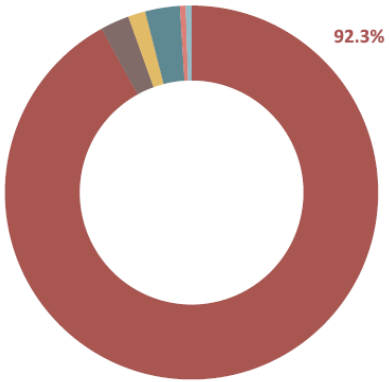
Category/Sector Rules (PEFCR)

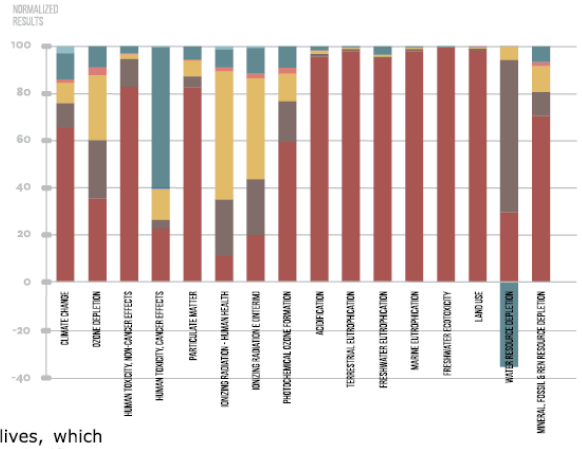
PEF Factsheet

EXTRA VIRGIN OLIVE OIL

In glass or bag-in-box container

The main results of the PEF study





The most critical stage of olive oil is the cultivation of olives, which accounts for more than 90% of the total PEF. The most significant process of olive cultivation is pomace fertilization, which accounts for more than 80% of the total impact.

Cardboard bottle boxes
Bottle caps
Olive oil in glass container distribution
75 cl glass containers
Processing 1 kg of olives
Olives cultivation
1l of olive oil bottled in 75 cl bottle

For the detailed PEF report, please contact myproduct@mycompany.com

PEFCR Factsheet

PEF = 13.3 µpt

(30% better of the representative product)

PEF
LAUNDRY LIQUID DETERGENT

SCORING METHOD

This environmental product declaration is based on the European Product Environmental Footprint method (PEF). PEF category rule (PEFCR) for the laundry liquid detergents was designed by a committee of industry experts and validated by a steering committee chaired by the EC.

The PEF and PEFCR allow calculating the environmental performance of laundry liquid detergents according to the functional unit. The single score in micropoints (µpt) is the result of characterisation, normalisation, weighting and aggregation of all environmental indicators at each stages of the product lifecycle. The PEF score is compared with the score of a representative laundry liquid detergent with average European characteristics (18 µpt/dose). The closer this score is to zero, the less impact it has on the environment.

Functional unit: 1 dose of product per 1 wash.

LIFE CYCLE ASSESSMENT

Except for the end of life our laundry liquid performs better than the representative product at all lifecycle stage.

*Results in µpt/dose	Our detergent	Representative product
Raw materials	5.5	8.1
Manufacturing	0.6	2.0
Packaging	0.7	0.5
Distribution	0.4	1.2
End of life	6.1	6.1
Total	13.3	17.9

The use phase accounts for 26.65 µpt/dose, in line with the representative product.

For the detailed results, please contact myproduct@mycompany.com

ENVIRONMENTAL INDICATORS

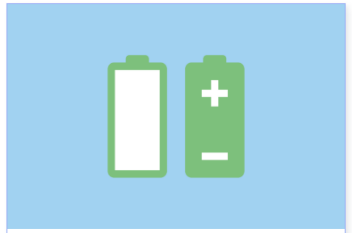
In a detailed evaluation, Climate change, Resource use (fossils) and Particulate matter are the most relevant impact indicatos.

Climate change	Particulate matter	Resource use (fossils)
39%	**6%**	**21%**

EF is still in development

- Pilot phase from 2013-2018
- Transition phase from 2019-2024
- Currently only 10 product categories in existence
  - There were previously 19
  - “Expired” at the end of 2021 and needed updating
  - The new site does not make it clear how long these will last
  - More product categories in development
- Need dozens (hundreds?) more before we can confidently compare products in most industries
- EC is committed to supporting EF standard, but specifics are not clear yet

Existing PEFCR



Batteries and Accumulators

Beer

Decorative Paints

Feed for Food-Producing Animals

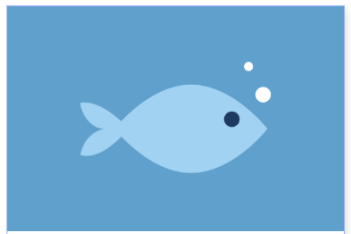
Pasta

Pet Food

Cut Flowers and Potted Plants

Synthetic Turf

Apparel and Footwear



Marine Fish

https://green-business.ec.europa.eu/environmental-footprint-methods/pef-method_en

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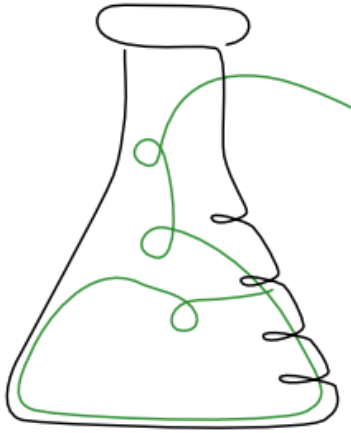
Methods of Assessment

Common Challenges



Scope

Narrow ⟷ Broad

High confidence
Low generalisability

Should Elina drive or take the bus from her house to work this morning?

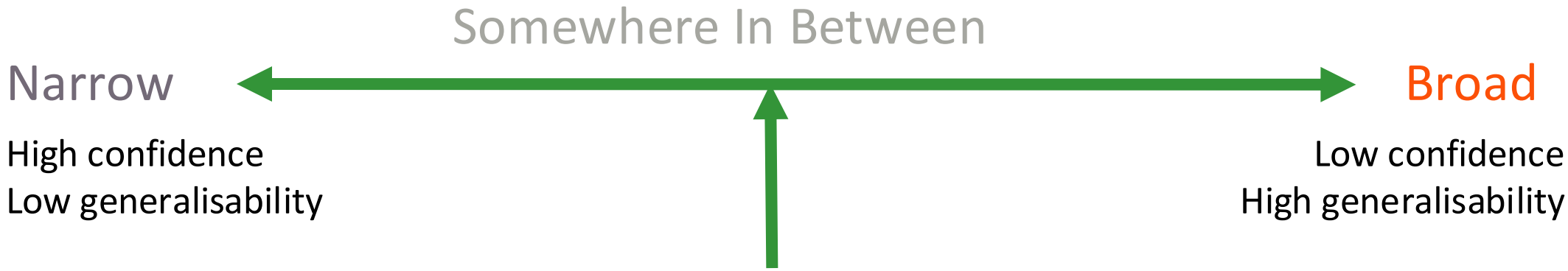
- Minimal assumptions – can identify car, bus, fuel, distance, traffic, weather, passenger weight, etc.
- Results will have very high confidence
- Cannot be used for any other case, even Elina's neighbour

Low confidence
High generalisability

Should people drive or take the bus?

- Must assume basically everything – don't even know the distance
- Generalisable to everyone on Earth!
- But result confidence is so low as to be useless

Scope



Should the average office worker in Vienna drive or take the bus to work in the morning?

- Assumptions can be made with some accuracy
- Results will have some confidence
- Generalisable to some cases, but limited by geography, time, technology

Boundaries

Narrow ⟷ Wide

Quick and easy
Low accuracy

Time-consuming and challenging
High accuracy

Environmental footprint of a brand of laundry detergent:

- considers impacts from manufacture up to the point of sale only

Environmental impact of a brand of laundry detergent:

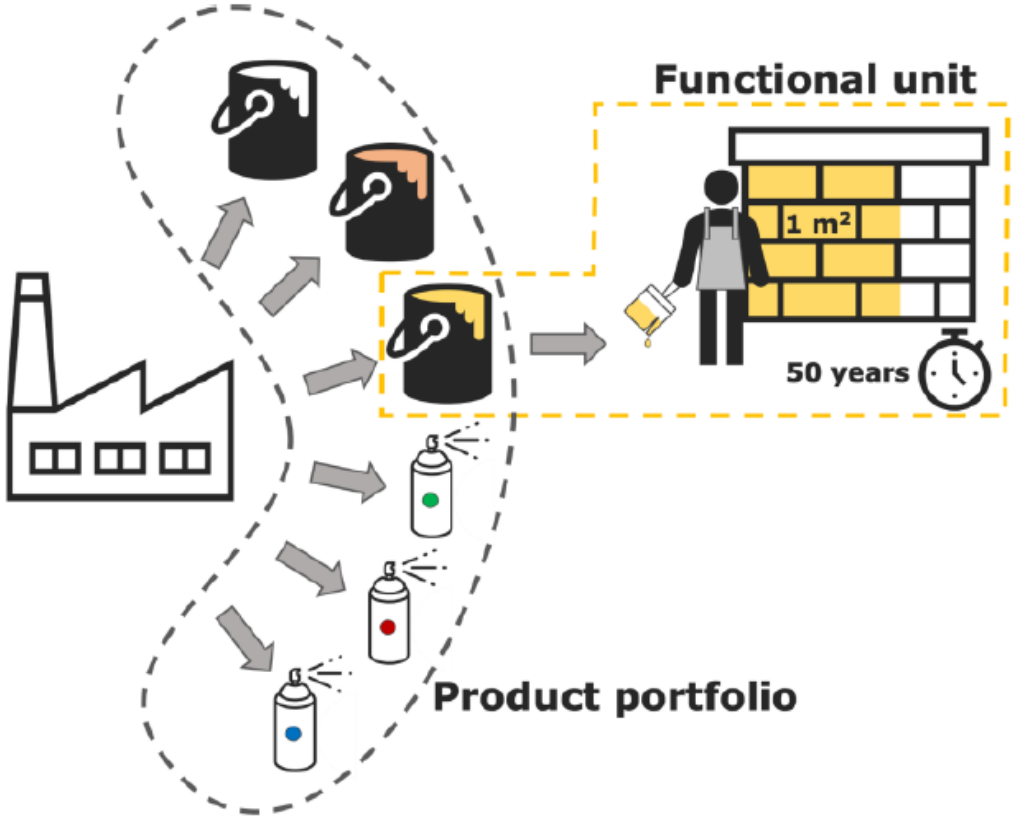
- considers manufacture up to the point of sale
- includes the impacts while in use
- includes the impacts at end-of-life

Boundaries

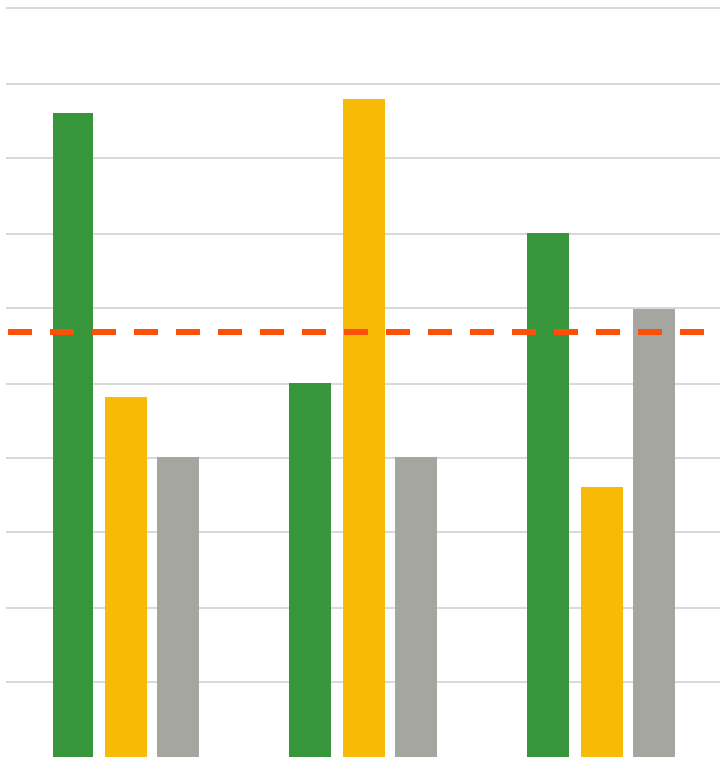
- Wider boundaries are more accurate, but also more expensive
- Boundaries that are too narrow can create inaccurate results
  - Indirect land use change
  - Marine plastic pollution
- Capital goods? Co-products?
- PAS2050: Boundaries should include all emissions/removals over 1% of anticipated total GHG emissions
- ISO 14040: Iterative route using sensitivity analysis, but no specific cut-off
- PEFCR specify system boundaries

Functional Unit

- Quantify performance of the product being studied
  - What
  - How much
  - How long
  - How well
- “to protect and decorate 1 m^2 of substrate for 50 years at a specified quality level (minimum 98% opacity)”
- Reference flow: amount of product needed, e.g. kg of paint



Baseline or Benchmark

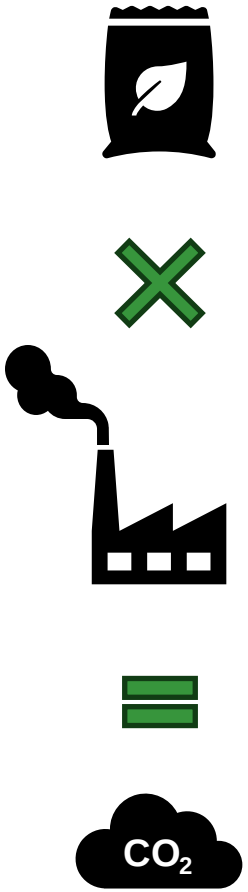


- Reference value to compare LCA results against
- Hard to choose a representative value
  - What is an average building?
- Can make results appear misleadingly bad or good
  - Latest dishwasher vs. model from 10 years ago
- Baselines also have boundaries to consider
  - Waste as feedstock – what would happen to the waste otherwise?
- PEFCR specify benchmark products

Data Gaps

- Some processes have no data available
- Importance can be underestimated, leading to exclusion (poor system boundaries)
- Approximations can be incorrect
  - Too broad (average consumer behaviour in North America)
  - Bad extrapolation (EU energy mixture to approximate China's)
- Generic/extrapolated data limited to <10% of each impact category in PEF

Emission Factors



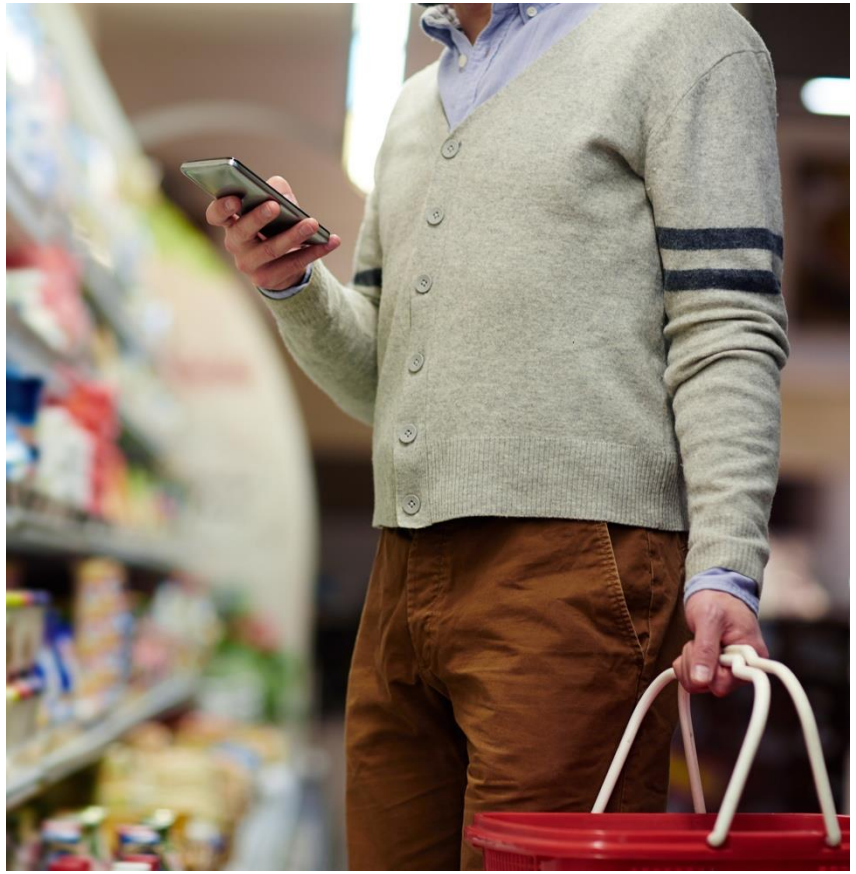
- "Off the shelf" figures from previous studies
- Serve as shortcut approximations to make LCA possible
- Example: LCA of Indian rice production
  - Must analyse fertilisers, pesticides, machinery, animal feed, irrigation systems...
  - Fertiliser emissions factor - urea production in India averages 0.7 kg CO_2eq/kg urea
- Must assess whether the values are reliable and representative for the case being studied
  - If urea figure came from poorly designed LCA, may not be reliable
  - If urea is being produced in Germany, may not be a representative value

End of Life Scenarios

- Notoriously difficult, especially for consumer products
- Very little accurate data available on recycling rates
- Mismanagement and accidental release (e.g. littering)
- Waste management practices vary drastically with region and time
- Moving towards a circular economy adds difficulty
- May be mitigated by PEFCR

Consumer Behaviour

- Often comes up in LCA of disposable vs. reusable items
- Usually unsubstantiated assumptions
- Depends on current behaviour, culture, ability to influence behaviour
- Be wary of optimistic assumptions



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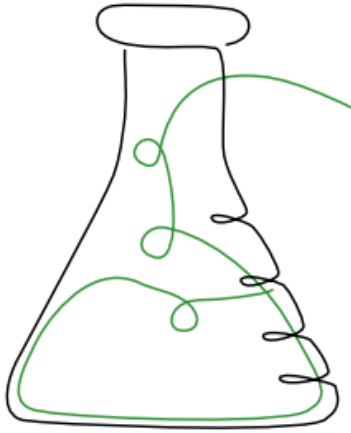
Methods of Assessment

Assessing Methodology



Questions to Ask

- What standards do they follow?
- Where do they source their data?
- How are data gaps handled?
- What sort of sensitivity analysis do they do?
- Do they use a third party for validation?
- What sort of LCAs have they previously done?
- What will be in the report?

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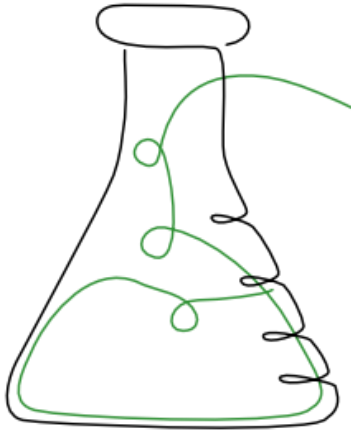
Conclusions



To sum up…

- Environmental footprinting is of critical importance for a sustainable chemicals industry
- LCA is valuable when done well, but too flexible and often misinterpreted
- Environmental Footprint initiative attempts to harmonise LCA methods and communication for the EU
- Learning to analyse LCA/PEF is a critical skill

Further Reading

- 2021 EC Simple Guide to EF
  https://ec.europa.eu/environment/eussd/smgp/pdf/EF%20simple%20guide_v7_clen.pdf
- 2021 EC Recommendation on EF
  https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021H2279
- JRC key documents for EF Transition Phase (2019 – present)
  https://eplca.jrc.ec.europa.eu/EFtransition.html
- JRC key documents for EF Pilot Phase (2013-2018)
  https://eplca.jrc.ec.europa.eu/EFpilot.html
- Nodes providing EF compliant data
  https://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml

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Questions?

Contact Tabitha Petchey at tabitha.petchey@greenrosechemistry.com.