DESHEALTH

Module 2

Environmental Assessment

Marta Santamaria
PhD Student

CARBON FOOTPRINT

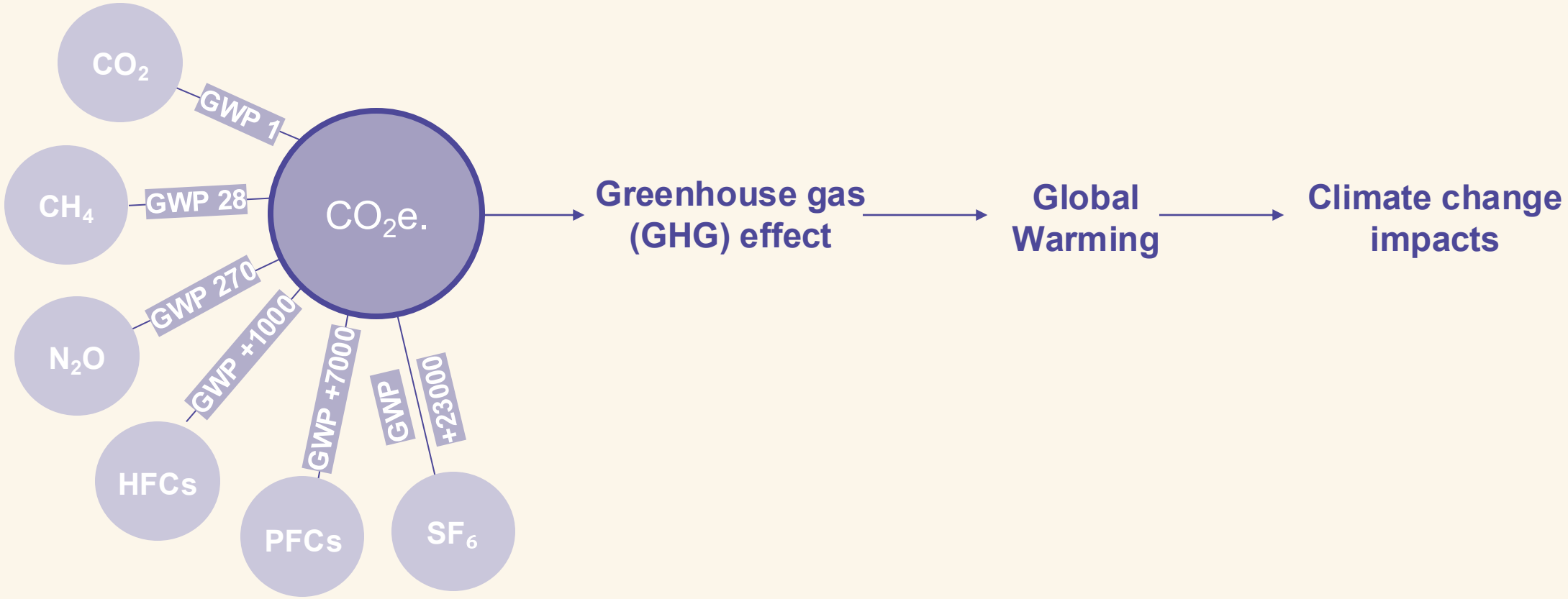
UNESCO Chair
ESCI-UPF
In Life Cycle and Climate Change

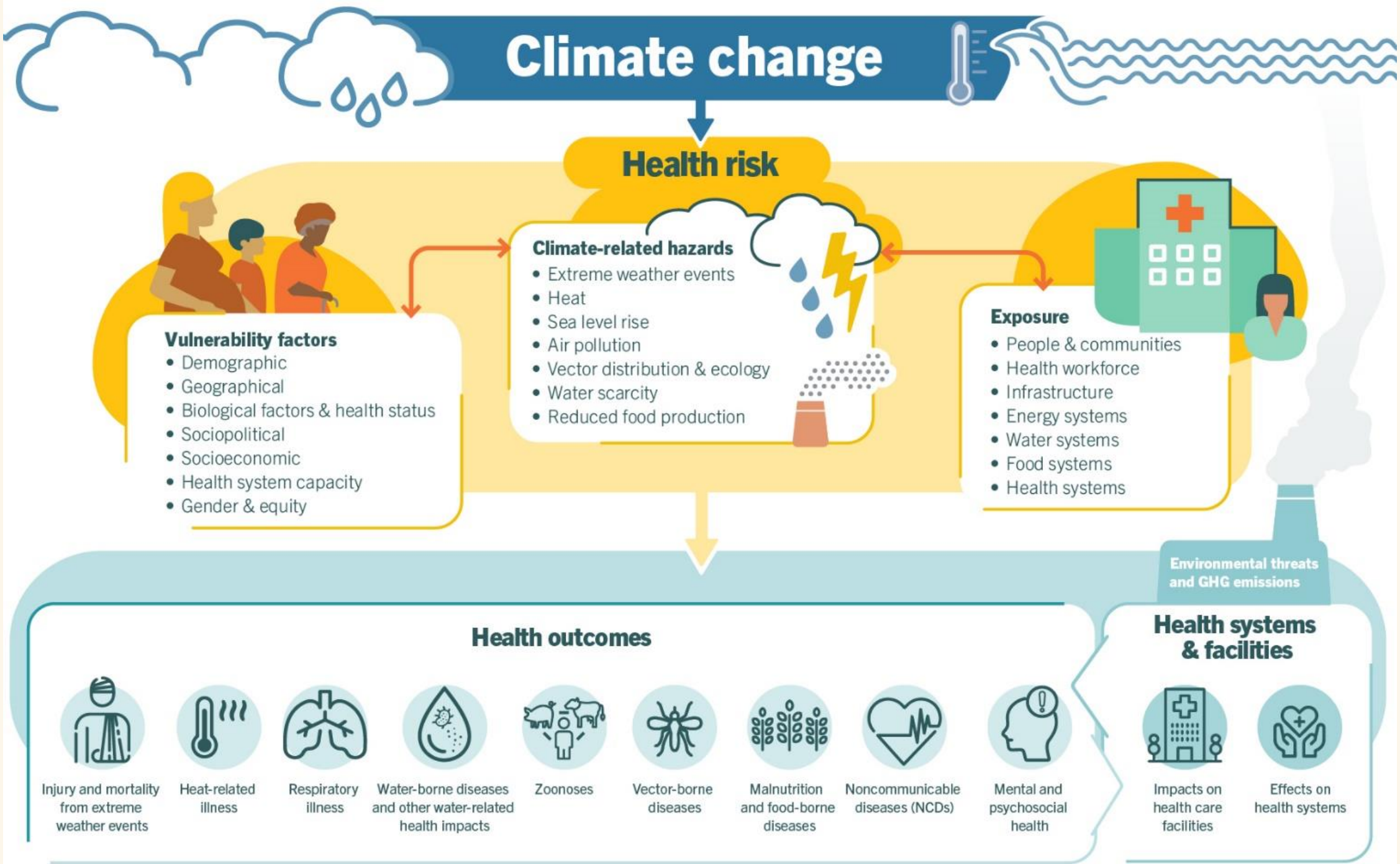
ESCI upf.

Funded by the European Union

Carbon footprint

The carbon footprint is a measure of the **greenhouse gas emissions released into the atmosphere** by a particular person, organisation, product, or activity. It is an indicator of the **contribution to global warming**.

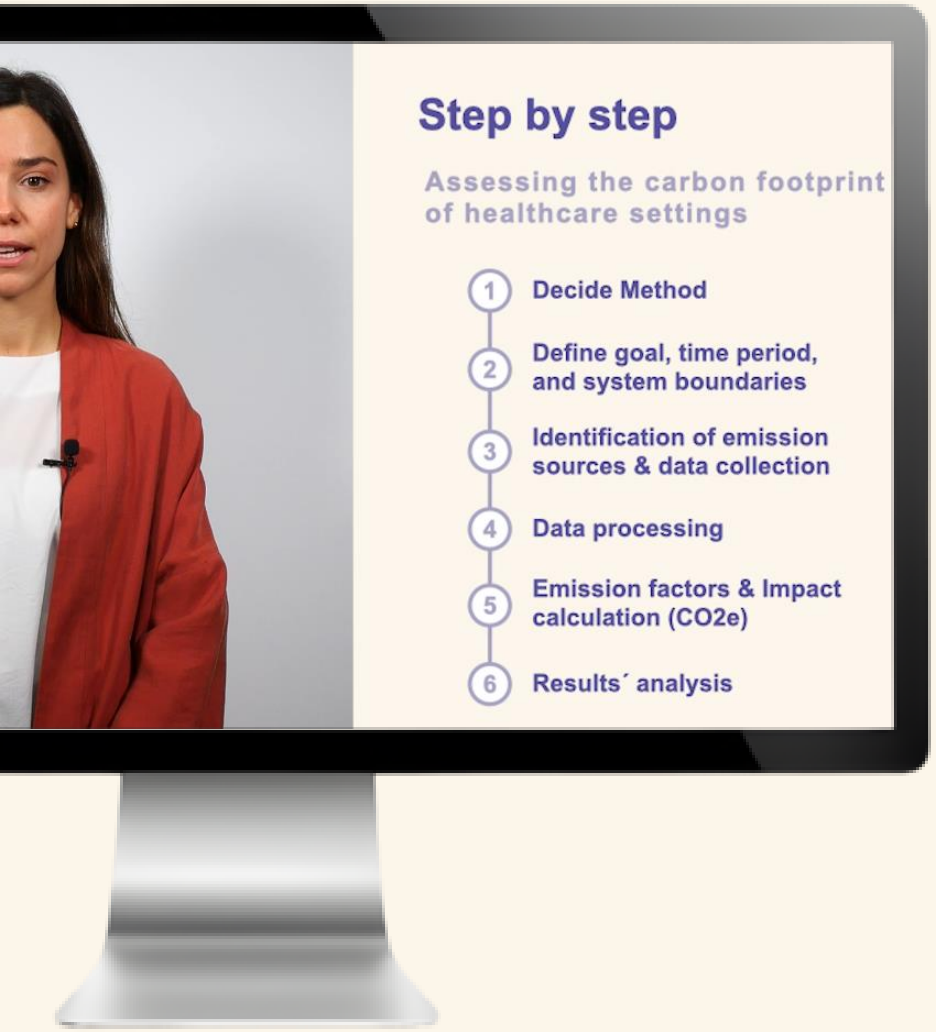


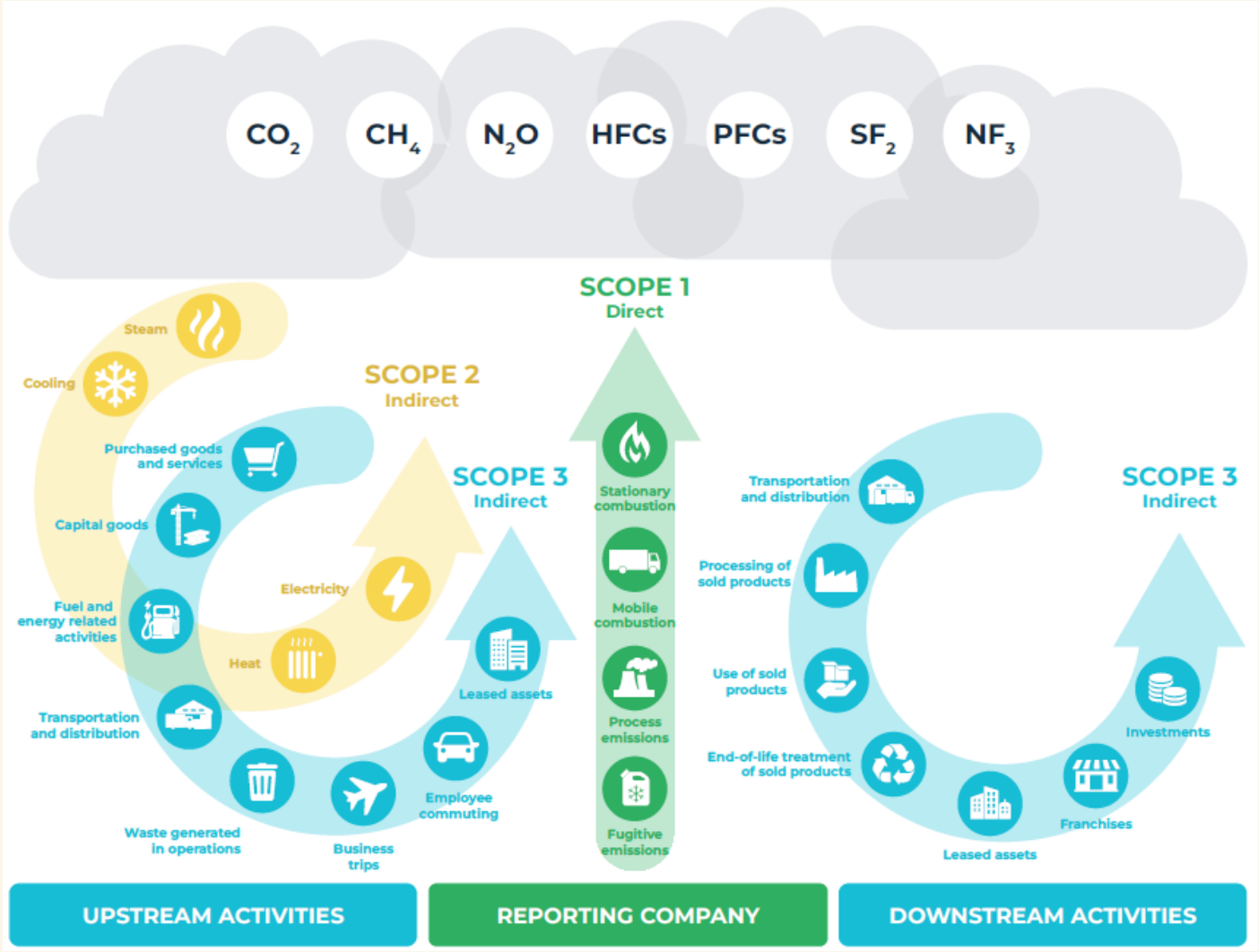


Overview of climate-sensitive health risks. Retrieved from https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

Corporate carbon footprint

Deshealth online course – Module 3





GREENHOUSE GAS PROTOCOL

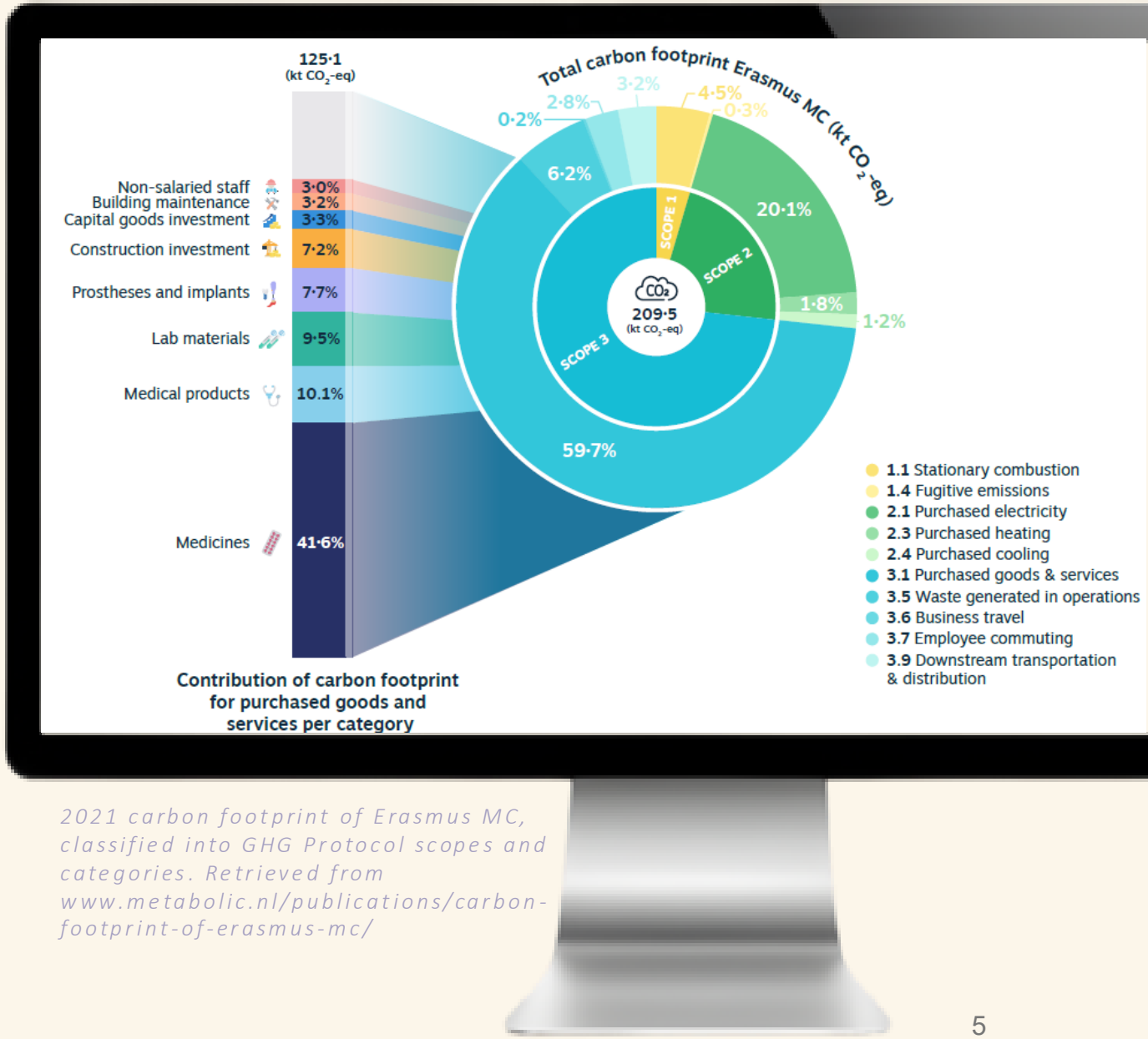
ISO 14064

Overview of Greenhouse Gas Protocol Categories adapted by Metabolic Consulting. Carbon footprint of Erasmus MC (2021). Retrieved from www.metabolic.nl/publications/carbon-footprint-of-erasmus-mc/

Corporate carbon footprint

The major **carbon hotspots** are the indirect emissions derived from **purchased goods and services**

PRODUCT-LEVEL



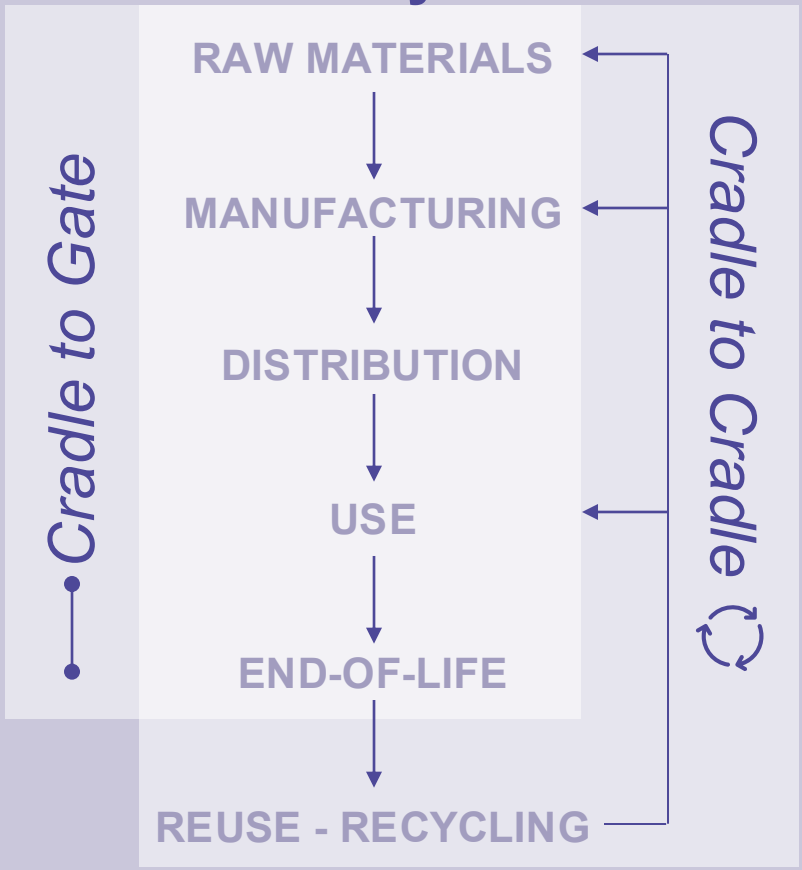
2021 carbon footprint of Erasmus MC, classified into GHG Protocol scopes and categories. Retrieved from www.metabolic.nl/publications/carbon-footprint-of-erasmus-mc/

Product–level carbon footprint

Quantification of GHG emissions (CO_2.e)

associated with **the life cycle of a product**

Life-cycle



Why?

- Reducing the carbon footprint equivalent
- Improvements in product design: eco-design
- Comparison with other products
- Communication (labels, procurement, reporting)

Main standards

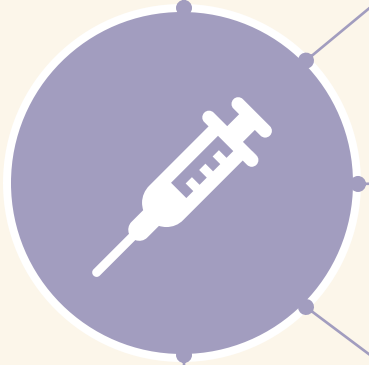
ISO 14067

Requirements for quantifying the carbon footprint of products, covering the entire product life-cycle.

Product Environmental Footprint (PEF)

Not required for healthcare yet.
It requires a multi-impact LCA method: carbon footprint plus 15 other impact categories.

The Functional Unit



Basic unit (most common)
“1 sterile, single-use 0.5 mL syringe ready for injection.”

Service delivered (linked to use purpose)
“The delivery of 1 U of insulin to a patient.”

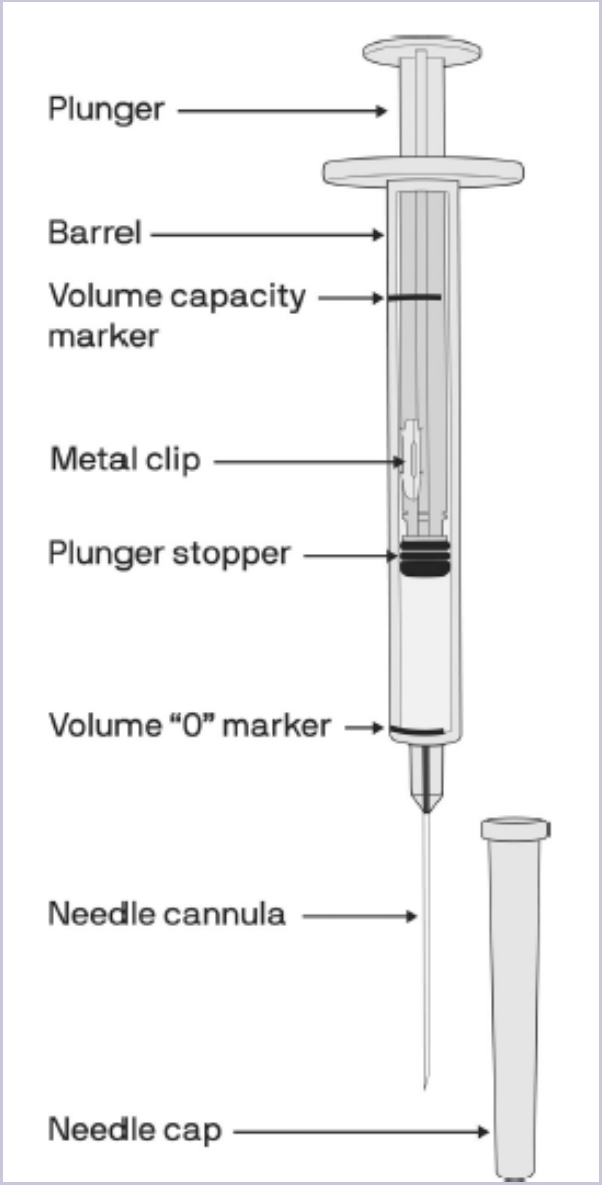
Weight- or volume-based
“Box: Per 100 syringes of 10 mL capacity.”
“Per 1,000 mL of solution delivered using syringes.”

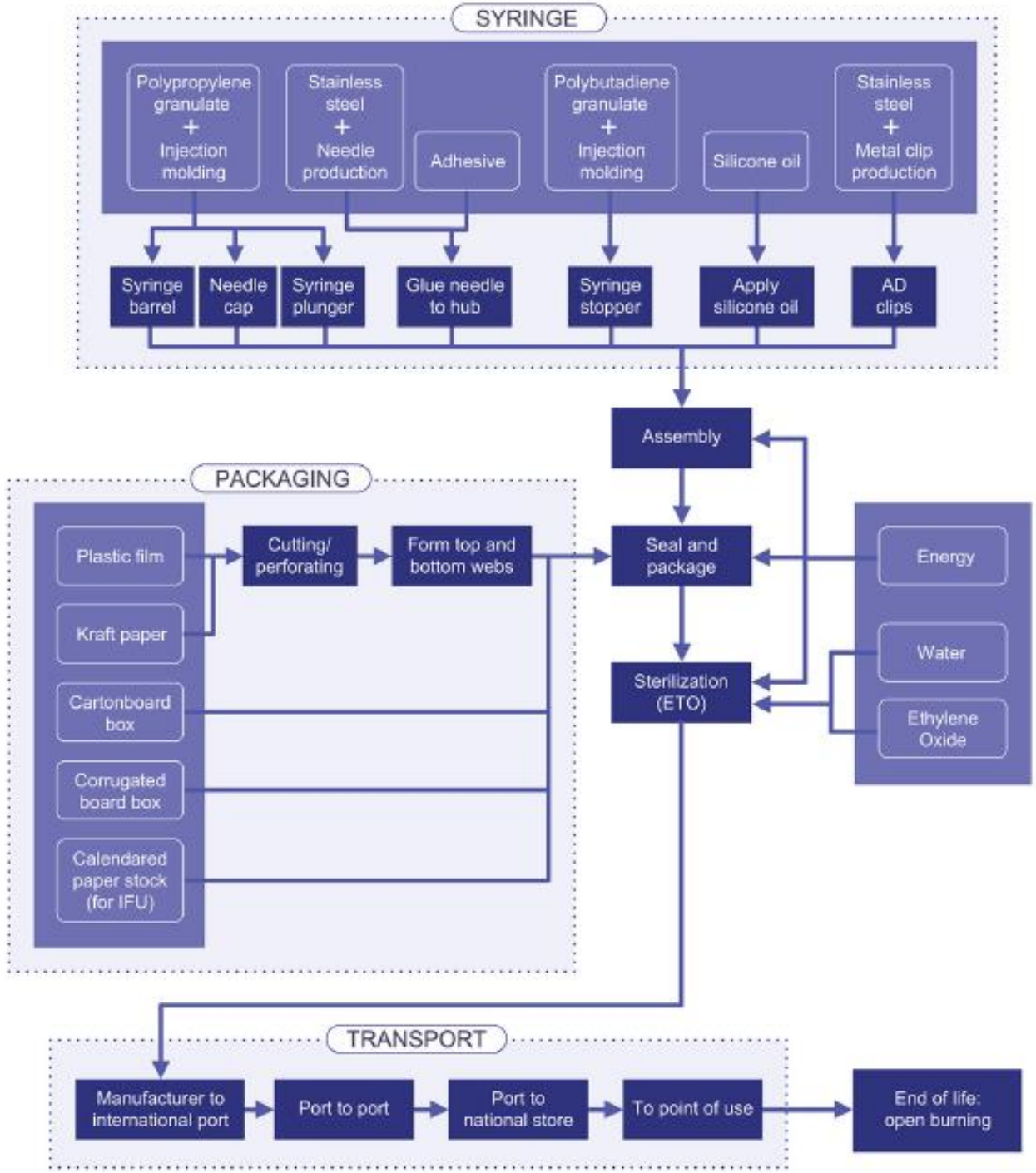
Time- or patient-based
“All syringes required to treat 1 patient during a 5-day hospital stay.”
“Annual consumption of syringes per hospital bed.”

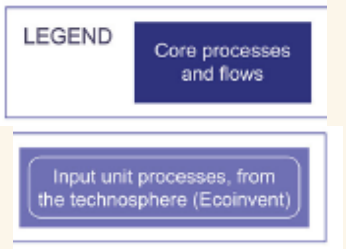
Comparative functional units (reusable vs. disposable)
“Number of injections delivered by 1 reusable syringe during its lifetime (e.g., 100 injections).

Life-cycle inventory

Single-use 0.5 mL syringe ready for injection







Diesburg S, Wollen A and Jarrahian C. Cradle-to-grave greenhouse gas emissions from a 0.5-mL, auto-disable syringe used in low- and middle-income country immunization programs: assessing global warming potential using life cycle assessment methodology VeriXiv 2025, 2:130 https://doi.org/10.12688/verixiv.1158.1

Impact Assessment

using LCA software and database (Ecoinvent)

Table 2. Details of the life cycle inventory values, calculations, and inputs for the life cycle assessment calculations.

Flow	Calculation	Amount (per syringe)	Ecoinvent-specific flow provider
Materials and parts production			
Polypropylene granulate - syringe barrel	1.45g/0.994 (Direct measurement divided by a loss factor required for use of injection molding unit process)	1.46 g	market for polypropylene, granulate |APOS, U - GLO
Injection molding - syringe barrel	1.45g/0.99 (Direct measurement divided by a loss factor required for use of injection molding unit process)	1.46 g	market for injection molding |APOS, U - GLO
Polypropylene granulate - syringe plunger	0.695g/0.994 (Direct measurement divided by a loss factor required for use of injection molding unit process)	0.699 g	market for polypropylene, granulate |APOS, U - GLO
Injection molding - syringe plunger	0.695g/0.994 (Direct measurement divided by a loss factor required for use of injection molding unit process)	0.699 g	market for injection molding |APOS, U - GLO
Polypropylene granulate - needle cap	0.465g/0.994 (Direct measurement divided by a loss factor required for use of injection molding unit process)	0.467 g	market for polypropylene, granulate |APOS, U - GLO
Injection molding - needle cap	0.465g/0.994 (Direct measurement divided by a loss factor required for use of injection molding unit process)	0.467 g	market for injection molding |APOS, U - GLO

Diesburg S, Wollen A and Jarrahian C. Cradle-to-grave greenhouse gas emissions from a 0.5-mL, auto-disable syringe used in low- and middle-income country immunization programs: assessing global warming potential using life cycle assessment methodology VeriXiv 2025, 2:130 https://doi.org/10.12688/verixiv.1158.1

Results and Analysis

- Identify **carbon hotspots**
- Highlight **opportunities for reduction**: lighter syringes, reusable options, alternative waste management.
- **Sensitivity analysis** to compare alternatives and test improvements: *"What if we reduce weight by 10%? Or switch to reusable options?"*

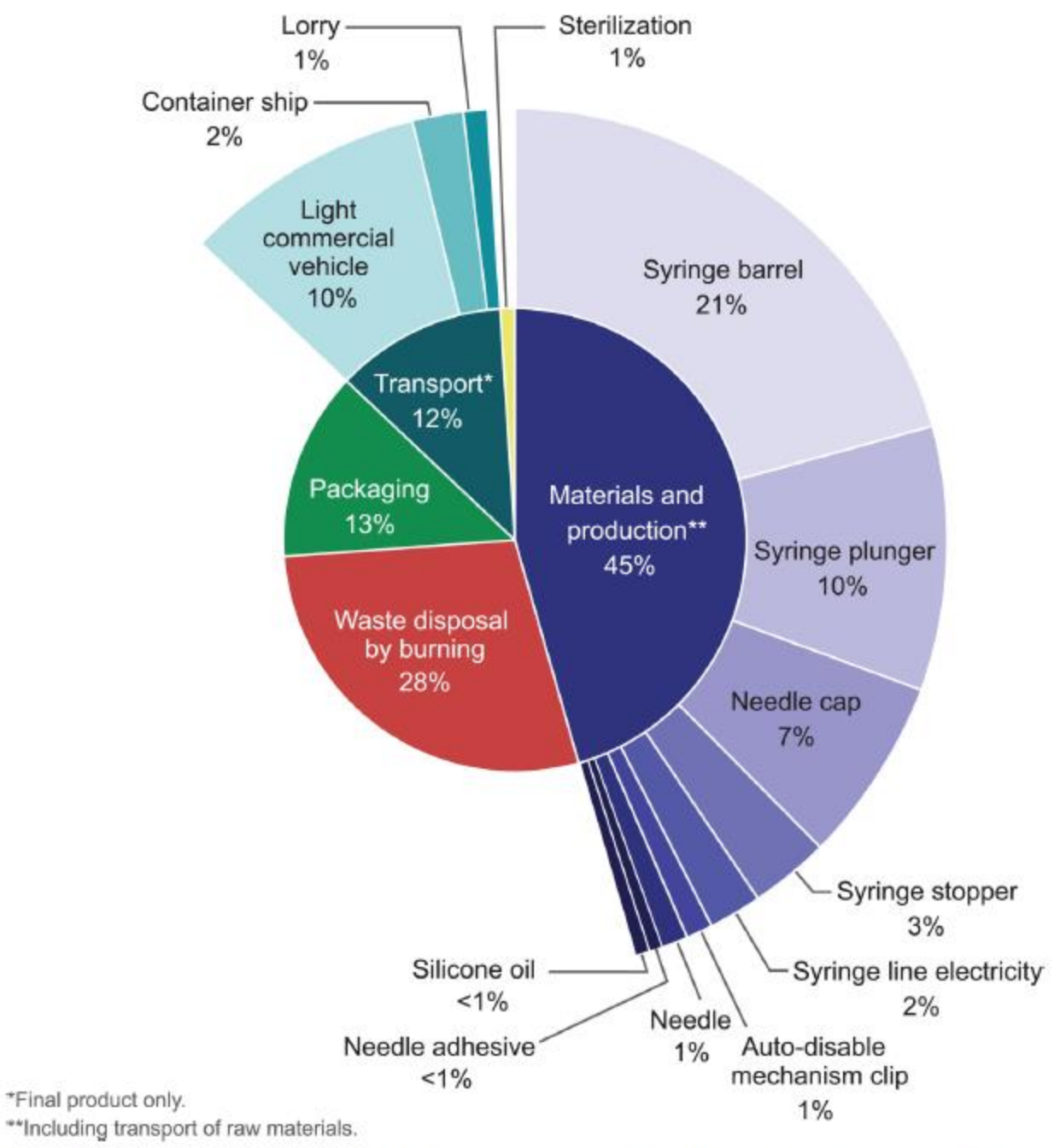


Figure 3. Aggregated percentages of total life cycle emissions for the different steps of the product life cycle.

Diesburg S, Wollen A and Jarrahian C. Cradle-to-grave greenhouse gas emissions from a 0.5-mL, auto-disable syringe used in low- and middle-income country immunization programs: assessing global warming potential using life cycle assessment methodology VeriXiv 2025, 2:130 https://doi.org/10.12688/verixiv.1158.1

Module 2

Environmental Assessment

Marta antamaria
PhD Student

DESHEALTH

Erasmus+ Project n. 20203-1-IT02-KA220-HED_000157600

Funded by the European Union