DESHEALTH

Module 2

Environmental Assessment

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LIFE CYCLE ASSESSMENT (LCA)

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ESCI-UPF
In Life Cycle and Climate Change

ESCI upf.

Funded by the European Union

CONTENTS

Beyond carbon footprint

Objective

Life Cycle Assessment

What is it & what is it for?

LCA Phases

Sensitivity analyses

Key aspects of LCAs

LCA Tools

Life Cycle Thinking?

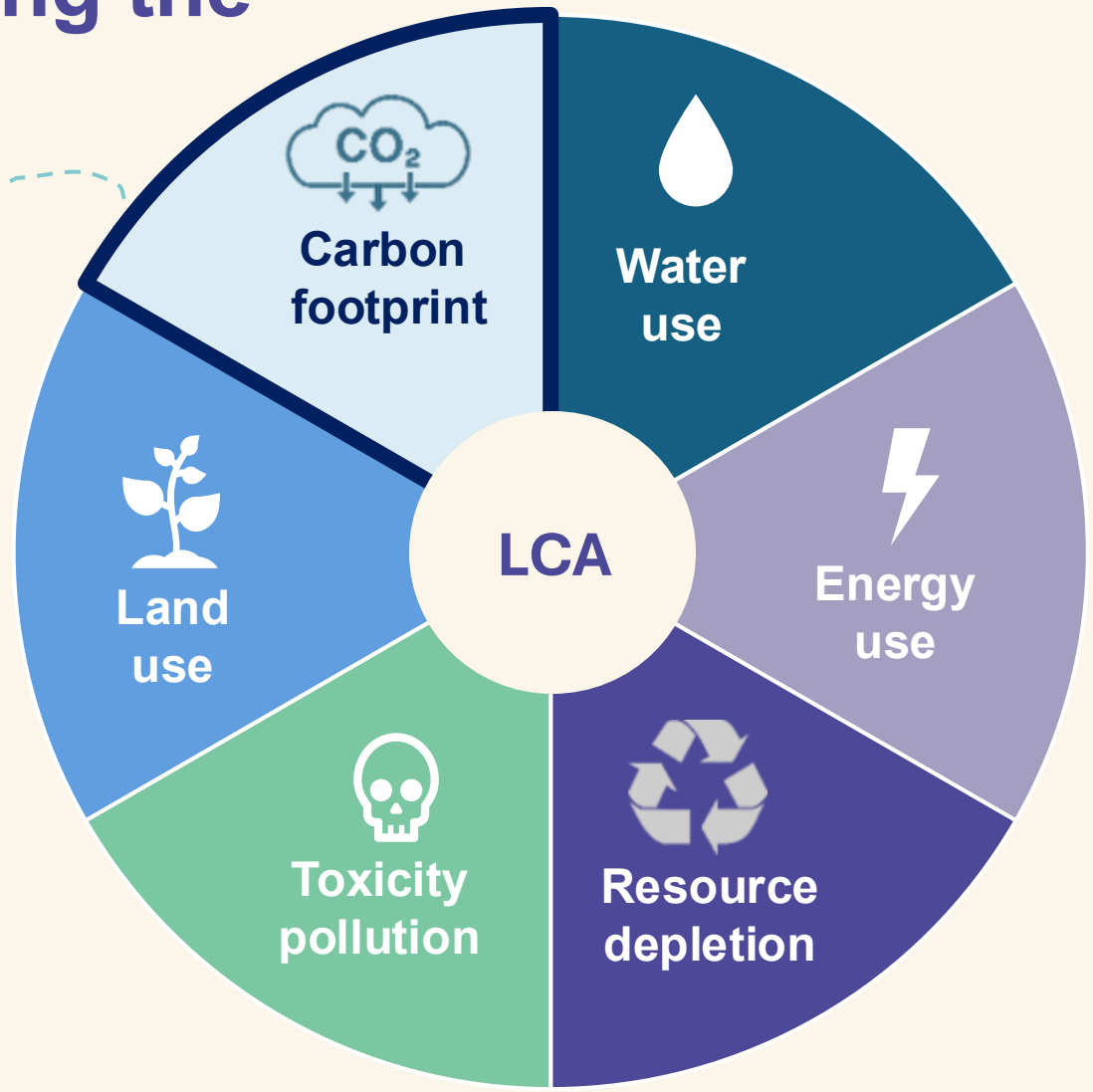
Life Cycle Assessment (LCA) is a **methodology** used to understand the **environmental impacts** of *healthcare* products, services, or processes across all stages of their life cycle—from raw material extraction and manufacturing, through use, to final disposal

This approach helps identify **critical hotspots** and uncover **opportunities** to make healthcare **more sustainable** by reducing **resource consumption** and minimizing **waste**

WHAT IS IT &
WHAT IS IT FOR?

Beyond Carbon: Understanding the Full Life Cycle Assessment

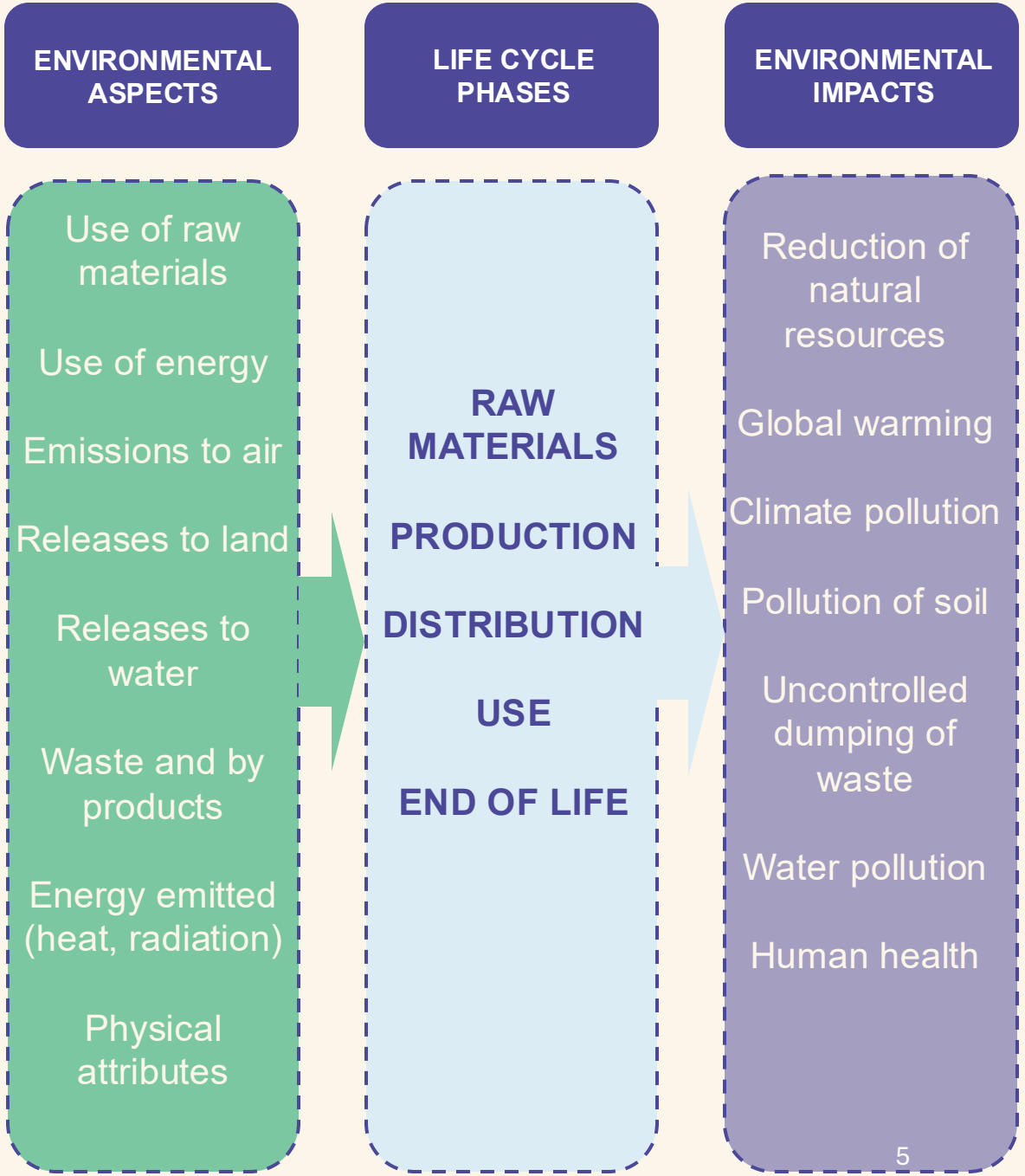
carbon footprint is just one slice of the full life cycle assessment cake!



The objective of conducting an LCA:

To gain a deeper understanding of the system under study by **translating emissions and waste** into specific **impact categories**, following a clear cause-and-effect pathway

Life Cycle Thinking: Objective

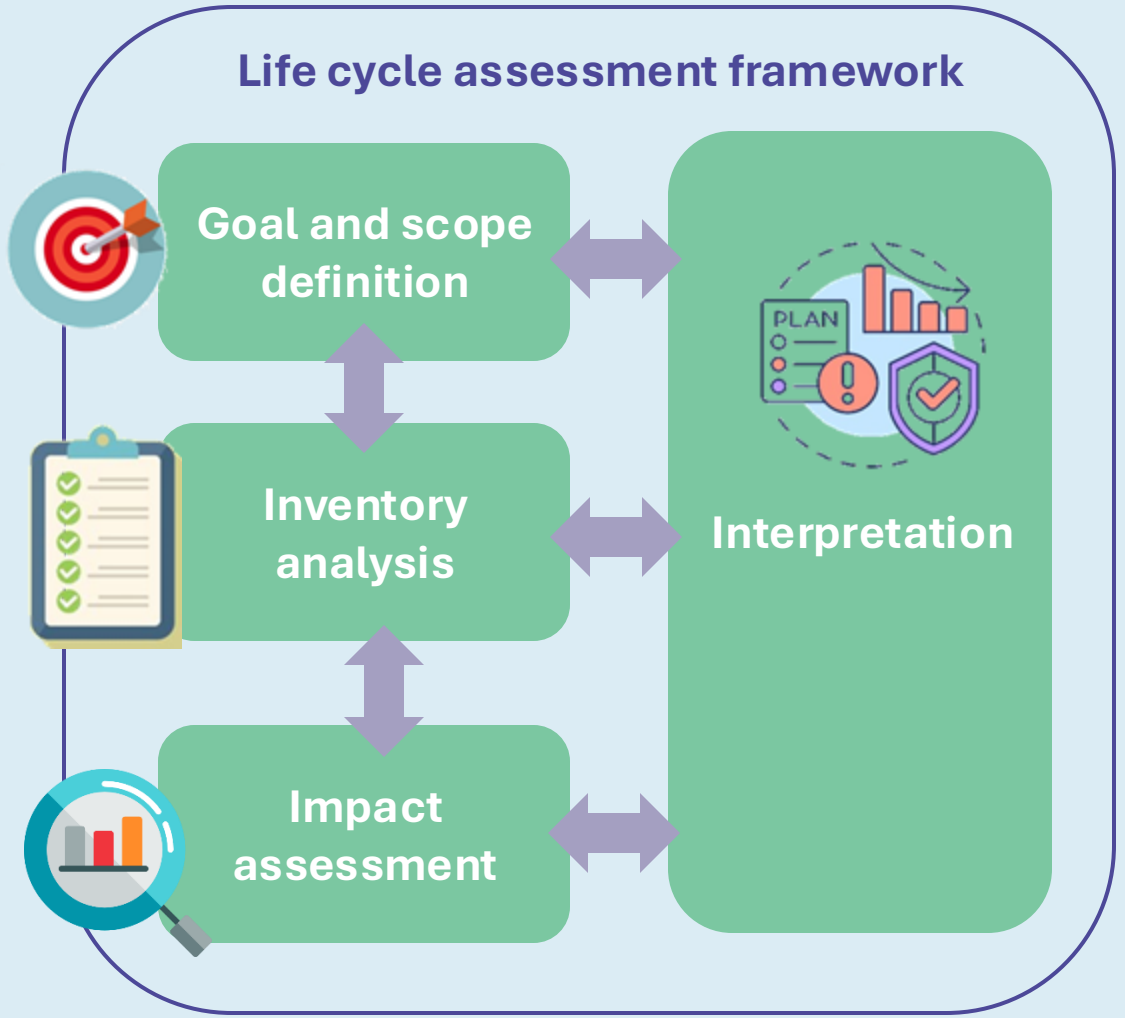


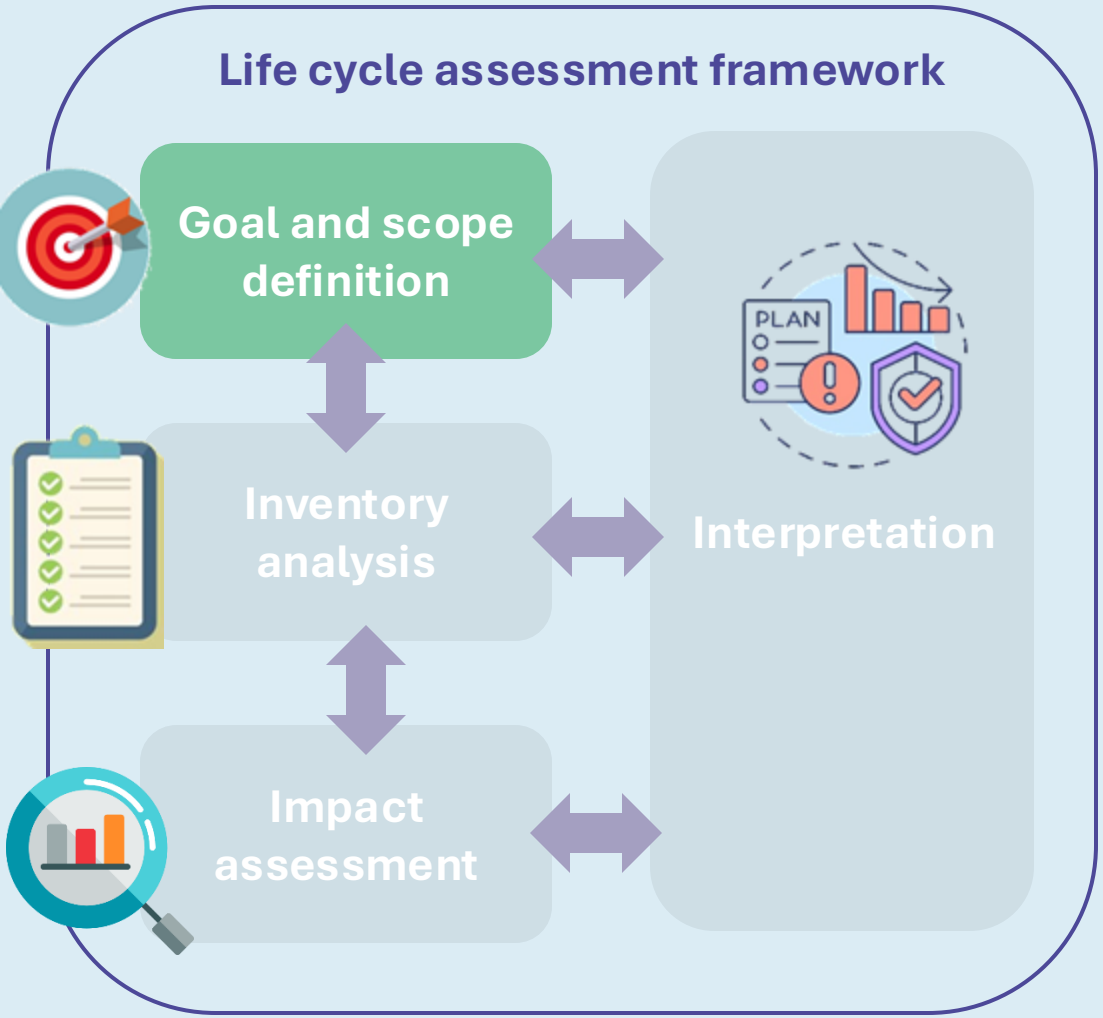
Source: Ecodesign Training kit

LCA Phases

The phases of a Life Cycle Assessment are defined in the **ISO standards 14040 and 14044**

Iterate, evaluate, improve – the life cycle way



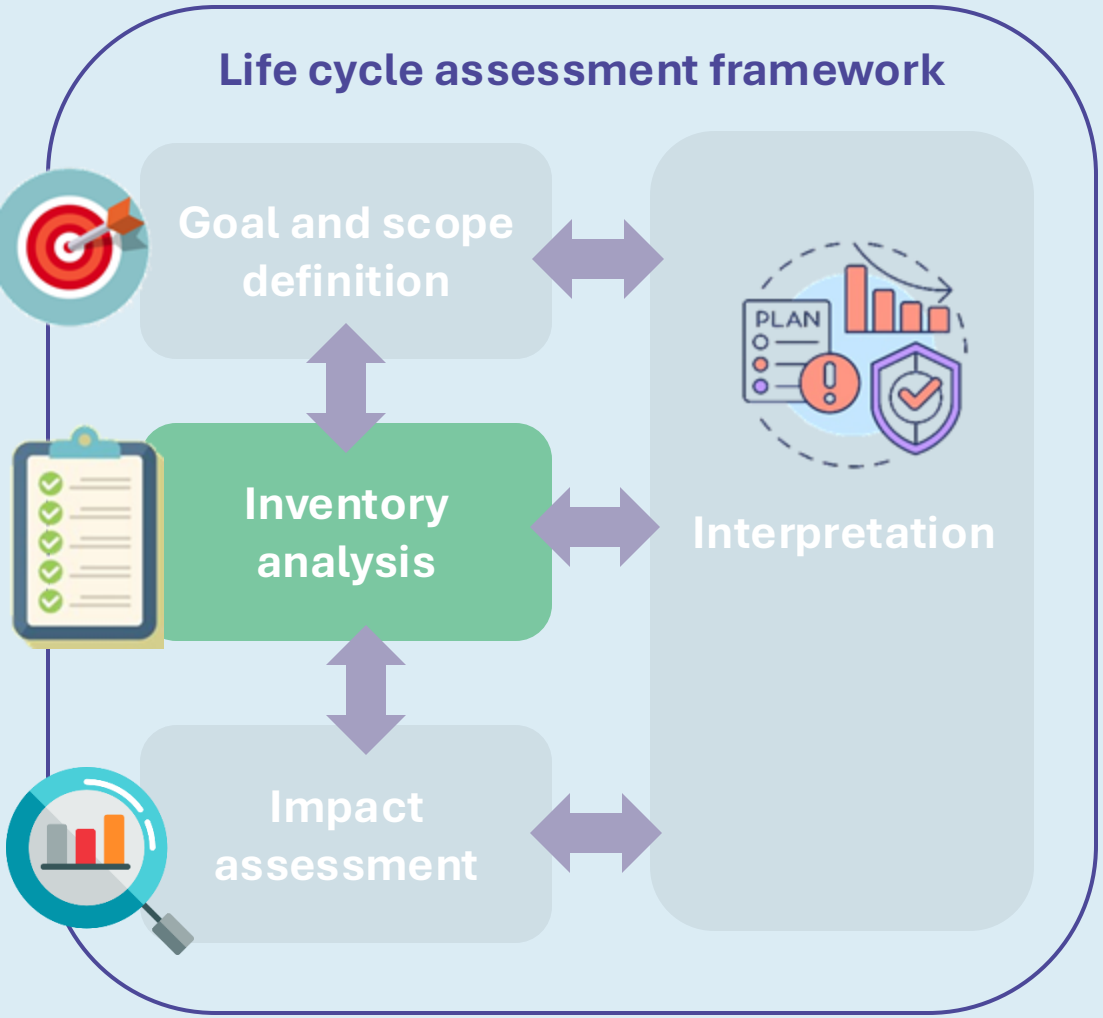


PHASE 01
Goal & Scope Definition

LCA aims to comprehensively understand the **system's resource use, emissions, and overall environmental burden**. It seeks to identify critical hotspots and areas for improvement to enhance sustainability within healthcare practices.

Scope of LCA covers the **entire life cycle of healthcare services**, from extracting raw materials and manufacturing medical equipment and pharmaceuticals, to hospital operations, patient care, and waste management.

The **system boundaries** are *cradle-to-grave*, including upstream and downstream processes, such as transportation, use and disposal.

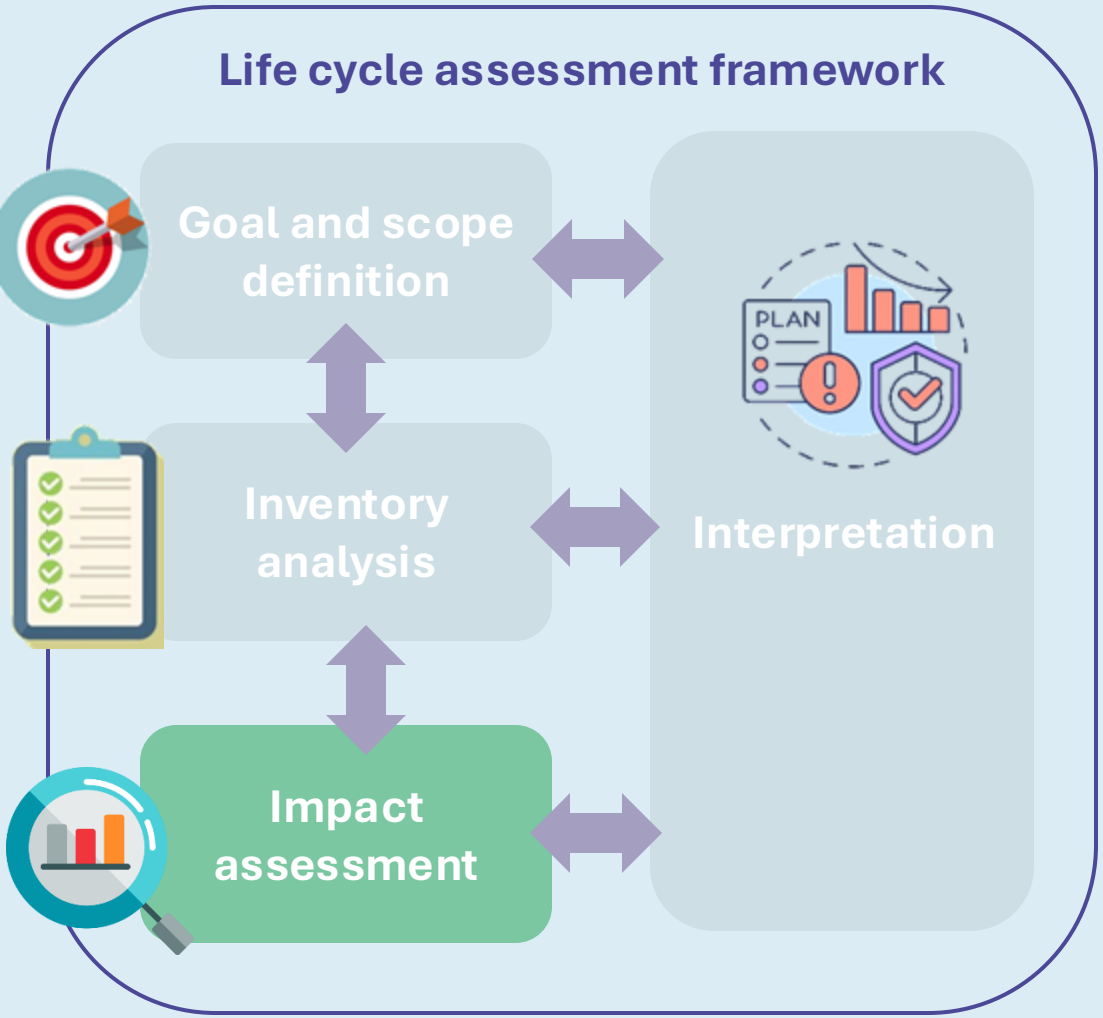


PHASE 02
Inventory Analysis

Inventory Analysis for a healthcare system involves collecting data on **all resource inputs** (e.g., energy, water, pharmaceuticals, medical supplies) and **outputs** (e.g., emissions, wastewater, medical waste) throughout the life cycle of healthcare services.

This **data** is sourced from **hospital records, utility reports**, and **life cycle inventory databases.**

The analysis helps identify key environmental hotspots, such as energy-intensive processes and pharmaceutical waste, providing a foundation for assessing the system's overall environmental impact.

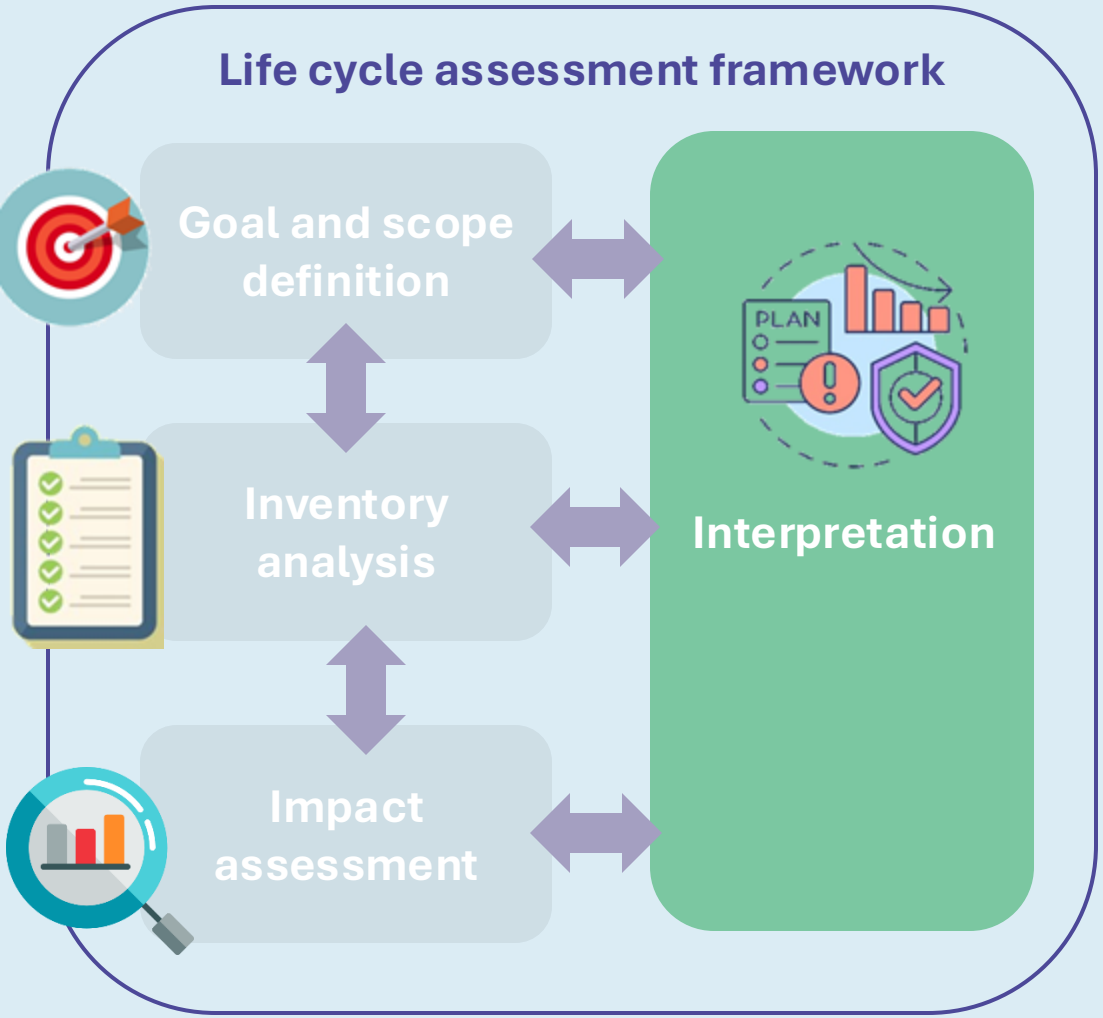


PHASE 03
Impact Assessment

In this phase, the system evaluates potential **environmental impacts** using data from the inventory analysis. Resource use and emissions are **translated into measurable effects** across impact categories such as global warming potential (GWP), human toxicity, resource depletion, water consumption, and waste generation.

For a healthcare system, key contributors include **energy use, waste disposal, and pharmaceutical emissions**.

This phase identifies critical environmental burdens, guiding efforts to improve sustainability in healthcare operations.



PHASE 04
Interpretation

The **interpretation phase** involves **analyzing and evaluating the results** from the impact assessment to **identify key environmental hotspots** and areas for improvement.

This phase ensures the findings **align with the study's goals**, concluding the most significant environmental impacts.

Recommendations are then made to **reduce the healthcare system's environmental footprint,** such as optimizing energy efficiency, reducing single-use materials, or improving waste management practices.

This phase also includes a *sensitivity analysis* to validate the robustness of the results and ensure informed decision-making.

Examples of Sensitivity Analyses for Health Care System LCAs

	Energy source	Switching from fossil fuels to renewable energy	↓ Reduced GWP, lower emissions, decreased resource depletion
	**Single-use vs. Reusable equipment**	Using reusable surgical instruments instead of disposable	↓ Reduced waste generation, lower energy/resource use
	**Transportation mode**	Switching from road to rail or sourcing locally	↓ Reduced fuel consumption and associated emissions
	**Waste management**	Comparing incineration, recycling and landfill disposal	→ Differences in emissions, toxicity and resource recovery

Key aspects of LCAs

Function of the system

Defines what the product or service is intended to achieve

Delivering a vaccination program; providing surgical care

Functional unit (FU)

Defines the reference unit for comparison

1 patient vaccinated; 1 successful surgery

System boundaries

Determines which life cycle stages are included

From production of medical supplies to disposal of surgical instruments; from energy use in hospital operations to waste treatment of used materials

Assumptions & Limitations

Clear documentation of choices, exclusions, and uncertainties for transparency and reliability

Assuming average electricity mix for hospital operations; excluding minor consumables like disposable gloves or syringes

LCA Tools

LCA software is a **tool** that is used to conduct Life Cycle Assessments more **efficiently and effectively.**

LCA software can help simplify the complex task of **collecting and analyzing data** throughout the whole system.

Main LCA Tools

SimaPro is a widely used Life Cycle Assessment (LCA) software that offers a robust framework for evaluating the environmental impacts of products and services. It features an extensive Life Cycle Inventory (LCI) database with thousands of materials and processes, simplifying data collection and analysis across a product's entire life cycle. https://simapro.com/

Sphera's LCA for Experts (formerly GaBi) integrates LCA modeling and reporting software with reliable, consistent environmental data. With over 20 sector-specific databases, Sphera empowers organizations to assess environmental impacts across each product life cycle and make informed, data-driven decisions. https://sphera.com/

OpenLCA is a free and open-source software tool for conducting LCA and other sustainability assessments. It is designed to be flexible and customizable, allowing users to adapt the software to their specific needs and conduct a wide range of sustainability assessments. https://www.openlca.org/

Supplementary LCA Tools: Healthcare Focus

IDEMAT XLS

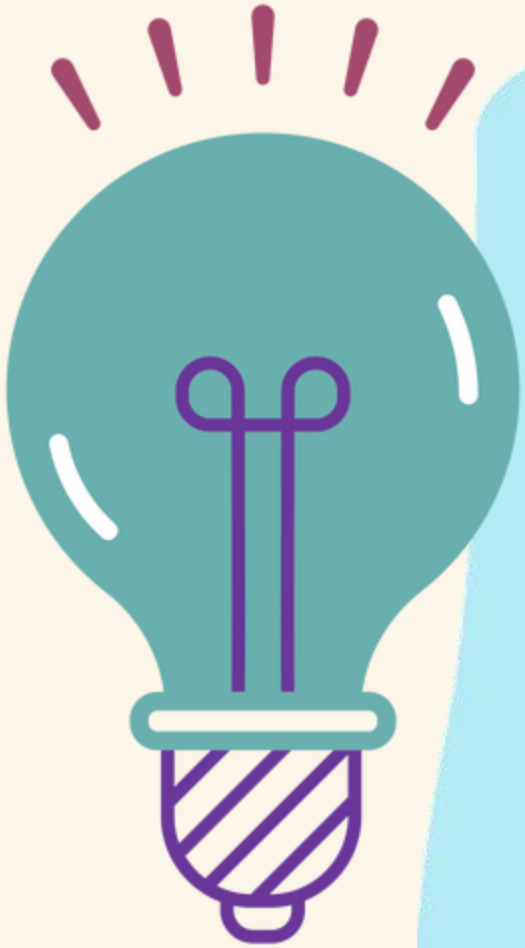
IDEMAT is a TU Delft Excel-based **LCA database/tool** that helps calculate the environmental impact of products and materials. It provides results using **ReCiPe2016, Carbon Footprint, CED, and Ecological Footprint methods**, making it a practical and educational resource for sustainable design and engineering.

YOU WILL FIND OUT LATER DURING THE PRACTICAL EXERCISES!

HealthcareLCA

HealthcareLCA is a public database that compiles peer-reviewed studies on the **environmental impacts of healthcare**. It brings together over 7,000 impact values from 3,000 products and activities, drawing on 20 years of research across 190 countries. Covering everything **from individual pharmaceuticals to entire health systems**, it serves as a comprehensive resource to help researchers, policymakers, and healthcare providers understand and reduce healthcare's environmental footprint. https://healthcarelca.com/

Take-home message



LCA turns data into action,

helping healthcare systems

decarbonize and reduce their

environmental impact

Any questions or comments?

Thank you for your attention!

'What we measure today shapes the sustainable healthcare of tomorrow'

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

Funded by the European Union