Energy and Environment Engineering

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ENVIRONMENT AND ECOSYSTEMS

Introduction: Concept of an ecosystem- structure and functions of ecosystem. Components of ecosystem - producers, consumers, decomposers, Food chains, food webs, ecological pyramids, Energy flow in ecosystem. Bio-geo- chemical cycles, Hydrologic cycle Components of Environment and their relationship, Impact of technology on environment, Environmental degradation. Environmental planning of urban network services such as water supply, sewerage, solid waste management.

ENVIRONMENTAL POLLUTION

Water, air, soil, noise, thermal and radioactive, marine pollution: sources, effects and engineering control strategies. Drinking water quality and standards, Ambient air and noise quality standards

GLOBAL ENVIRONMENTAL ISSUES AND ITS MANAGEMENT

Engineering aspects of climate change. Acid rain, depletion of ozone layer. Concept of carbon credit. Concepts of Environmental impact assessment and Environmental audit. Environmental life cycle assessment

Life Cycle Assessment (LCA)

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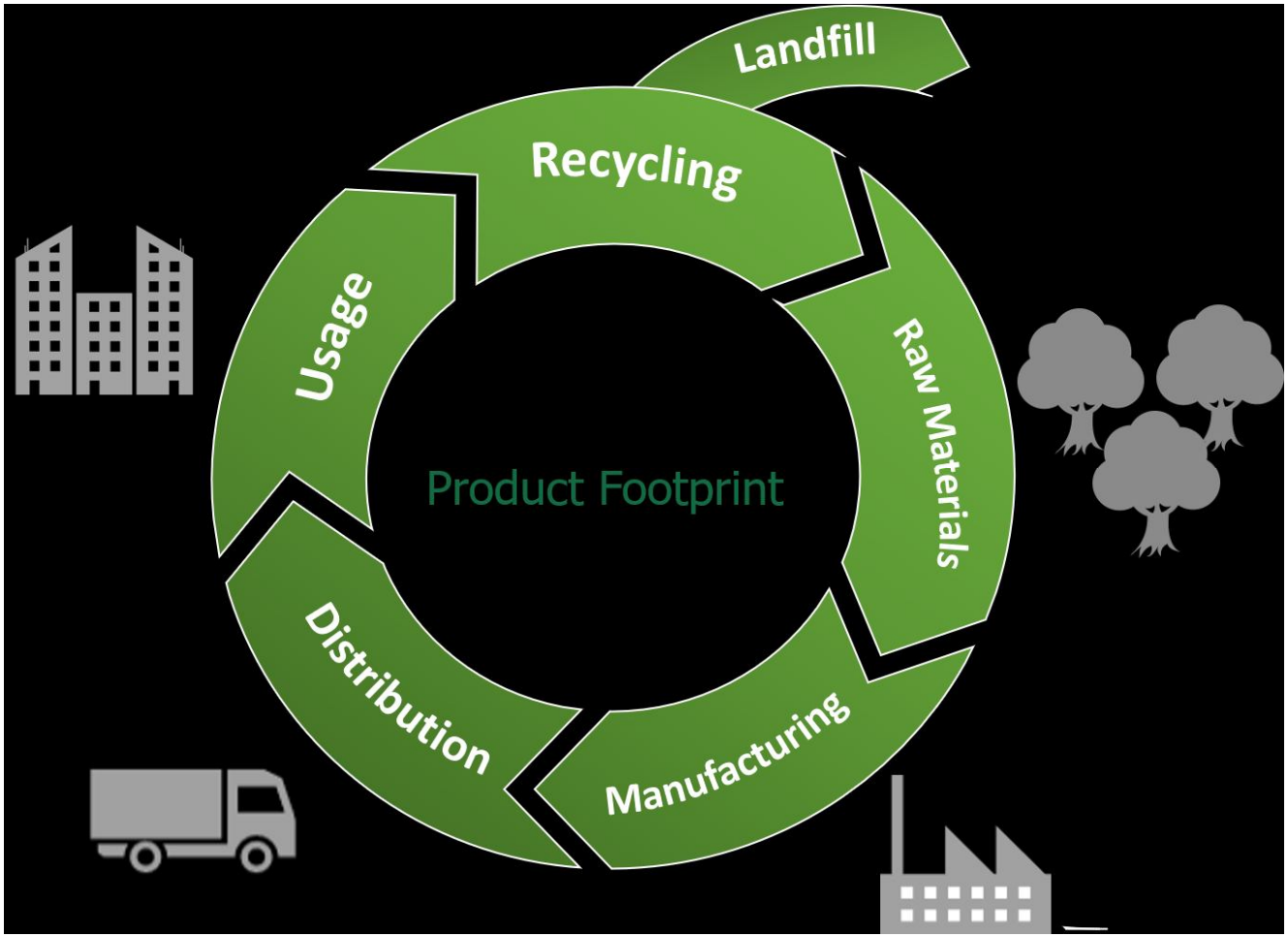
Life cycle assessment is a cradle-to-grave or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use

Life Cycle Assessment (LCA) is used as a tool to assess the environmental impacts of a product, process or activity throughout its life cycle; from the extraction of raw materials through to processing, transport, use and disposal.

Cradle-to-grave life cycle assessment (LCA) is a comprehensive tool that evaluates the environmental impacts of a product or service across its entire life cycle, from the extraction of raw materials ("cradle") to its final disposal or recycling ("grave")

Cradle-to-cradle (C2C) is a design approach that focuses on creating products with a circular lifecycle, minimizing waste and environmental impact

Product Lifecycle (Cradle to Grave)



Product Lifecycle (Cradle to Grave)

Product Lifecycle (Cradle to Grave)

Goals and Purpose of Life Cycle Analysis

- Analysing the quality of input and output of materials during the life cycle of a product
- Quantifying the inputs and outputs
- Assessing the various environmental implications
- Using the information collected to improve the various processes involved in life cycle of a product.
- Making public policies
- Achieving sustainability

Why adopt a Life Cycle approach?

A life cycle approach helps companies to make decisions and to know and environmentally improve their product. In fact, the incorporation of this approach is mandatory for all those who are or want to become certified under ISO 14001. Advantages of the use of Life Cycle Analysis for a company are the following:

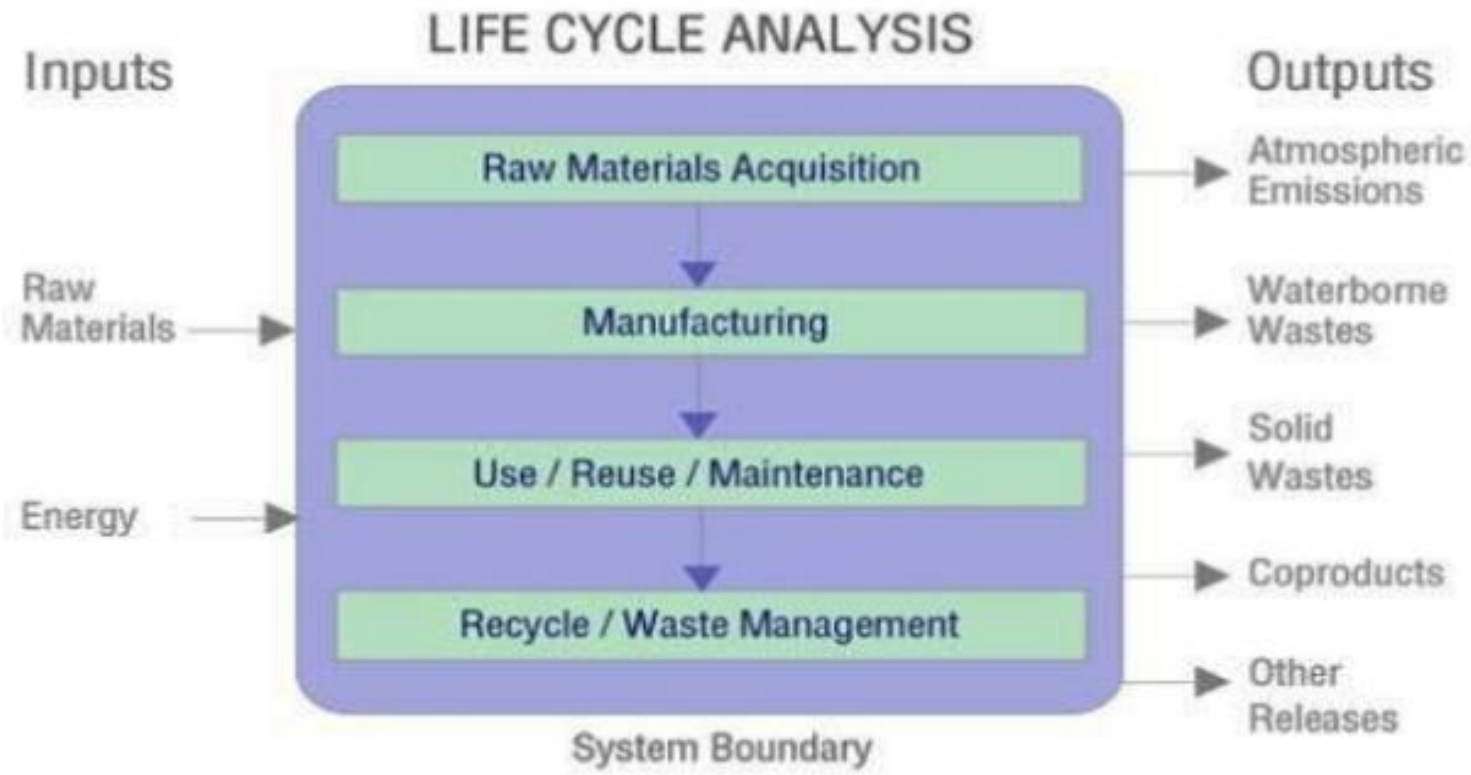
- ✓It allows you to better know your product and reduce its environmental impact, making it more sustainable.
- ✓Improves the image of the company and its transparency towards the market, reinforcing the commitment to sustainability.

Why adopt a Life Cycle approach?

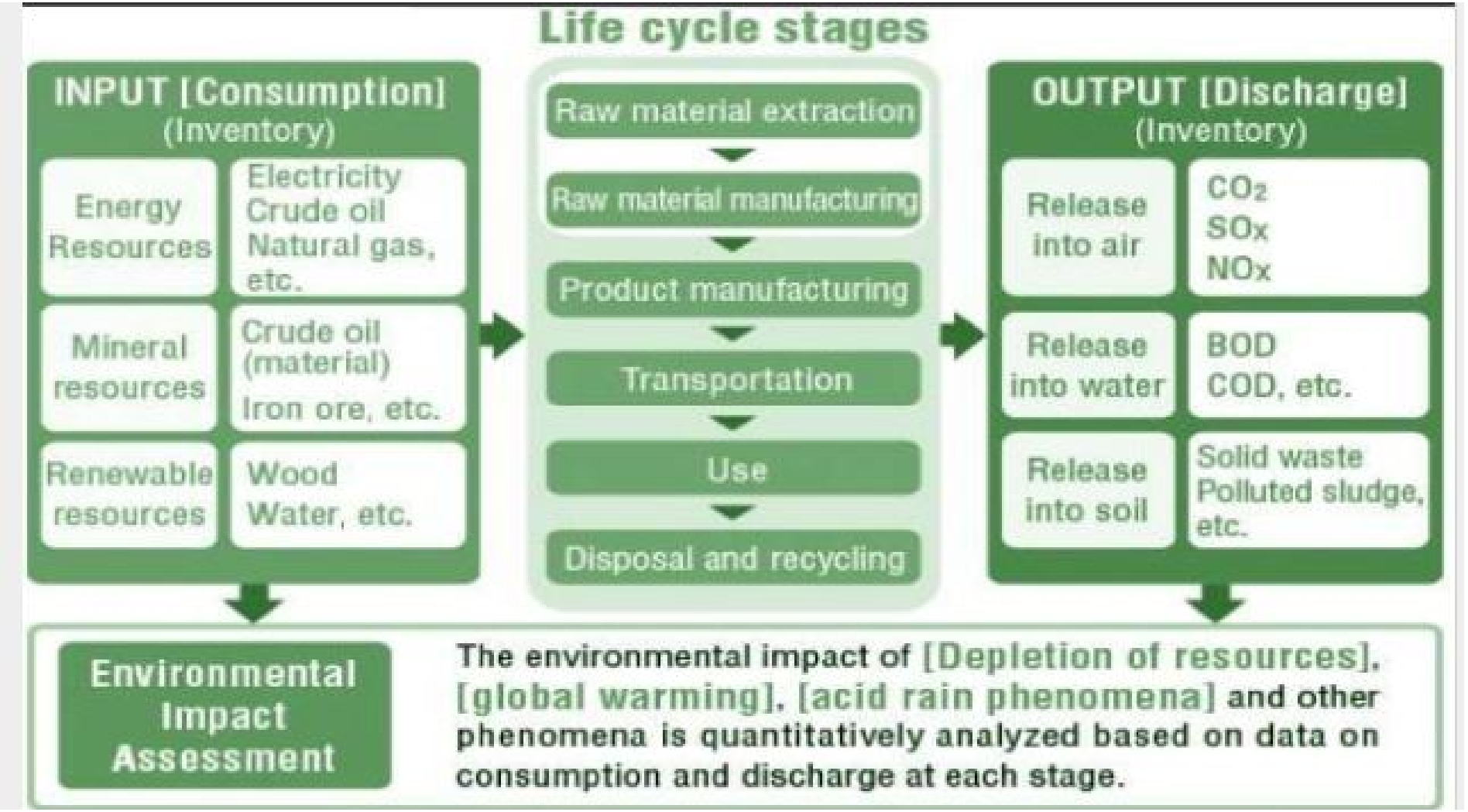
- ✓Serves as a basis for obtaining environmental label and certificates, such as Ecolabels or Environmental Product Declarations, or in the case of Buildings, to obtain points in sustainability certification systems such as Leed or Breeam.

- ✓It is an excellent tool to facilitate the purchase decision making online with the improvement of the environmental design of the product.

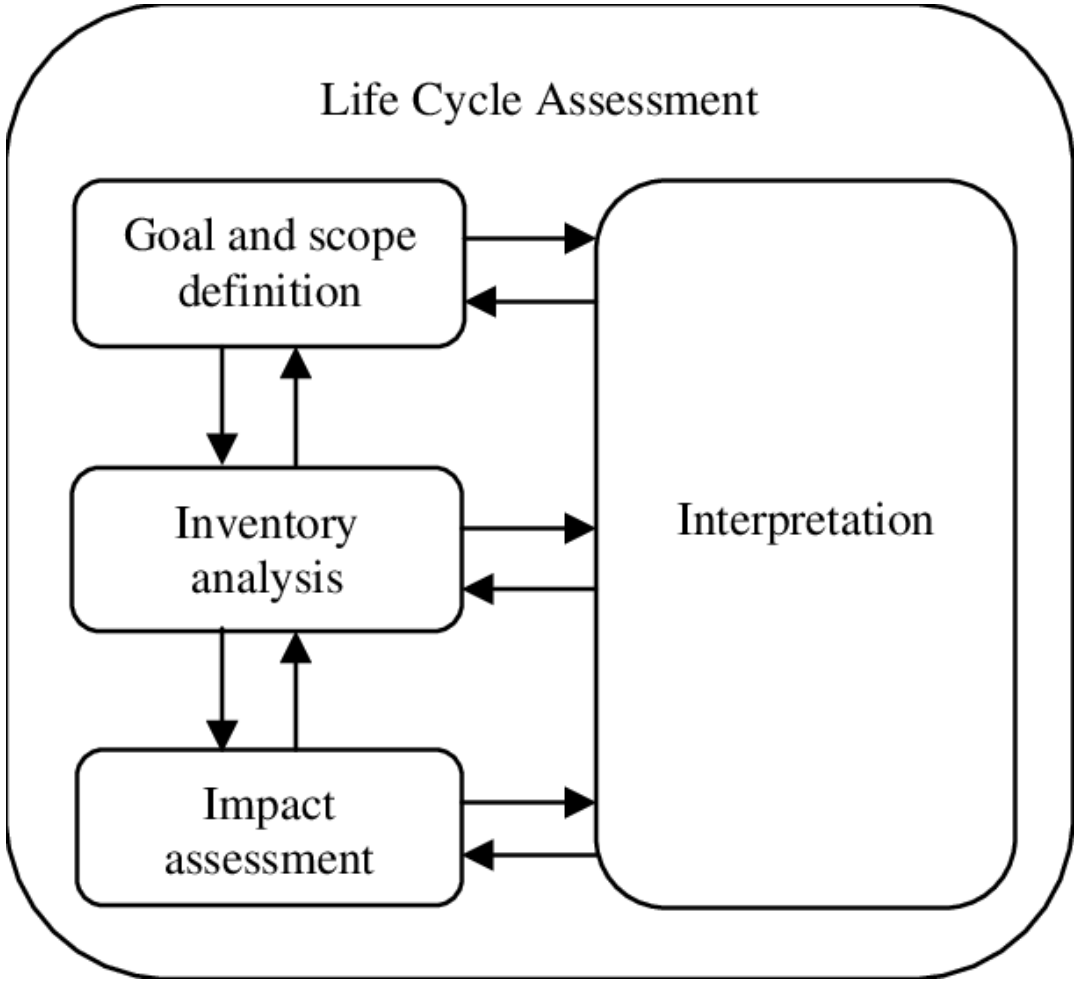
- ✓It improves the competitiveness of the products, as well as the image and the value of the brand, both in companies that compete in the global market, as in the case of smaller suppliers and producers.



Steps of a Product Lifecycle (Cradle to Grave)


Life cycle stages
INPUT [Consumption]
(Inventory)
Energy Resources
Electricity
Crude oil
Natural gas, etc.
Mineral resources
Crude oil (material)
Iron ore, etc.
Renewable resources
Wood
Water, etc.
Raw material extraction
Raw material manufacturing
Product manufacturing
Transportation
Use
Disposal and recycling
OUTPUT [Discharge]
(Inventory)
Release into air
CO2
SOx
NOx
Release into water
BOD
COD, etc.
Release into soil
Solid waste
Polluted sludge, etc.
Environmental Impact Assessment
The environmental impact of [Depletion of resources], [global warming], [acid rain phenomena] and other phenomena is quantitatively analyzed based on data on consumption and discharge at each stage.

Phases of Life Cycle Assessment



Impact Assessment and Interpretation

Impact Assessment: This phase is required for the evaluation of how significant the potential environmental implication is. The impact is a set of consequences on the human health and welfare of flora and fauna and future availability of resources which attributes to the input and output of the system.

Interpretation: It is a method to identify, quantify, check and evaluate the information collected from the LCI (life cycle inventory) and LCIA (life cycle impact assessment). Interpretation phase includes the summarisation of the results in the above two phases. Interpretation is required to check the accuracy of the results and communicate them accurately.

Steps of an LCA

How to assess the environmental impact?

1. Goal and scope definition articulates the objectives, functional unit under consideration, and regional and temporal boundaries of the assessment.

2. Inventory analysis entails the quantification of energy, water, and material resource requirements, and emissions to air, land, and water for all unit processes within the life cycle.

3. Impact assessment evaluates the human and ecological effects of the resource consumption and emissions to the environment associated with the lifecycle.

4. Interpretation of results includes an evaluation of the impact assessment results within the context of the limitations, uncertainty, and assumptions in the inventory data and scope.

LCI IMPACT ASSESSMENT

It is classification stage, where the inventory parameters are sorted and assigned to specific impact categories .These may be

- ✓Global warming potential (GWP),kg CO_2 emitted
- ✓Solid waste generated
- ✓Energy requirement
- ✓It involves selection of impact categories, category indicators, and characterization models;
- ✓impact measurement, where the categorized LCI flows are characterized, using one of many possible LCIA methodologies, into common equivalence units

Interpretation

- Identification of significant issues based on the results of the LCI and LCIA phases of an LCA.
- Evaluation of the study considering completeness, sensitivity and consistency checks.
- Conclusions, limitations and recommendations.
- To determine the level of confidence in the final results and communicate them in a fair, complete, and accurate manner.

Limitation of LCA

- LCA may not be reliable due to inaccurate or non-availability of data.
- Comparison of different products LCA may not be reliable due to differing system boundaries , differing uses and different statistical information.
- There may be a inconsistency in assumptions and methodology for LCA comparison of different product.

Thank You