EXERCISE ON LIFE CYCLE ASSESSMENT

LIFE CYCLE ASSESSMENT

- > INTRODUCTION
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- > METHODOLOGY
- > LIFE CYCLE INVENTORY ANALYSIS
- > CASE STUDY: LCA STUDY PET vs ALUMINIUM

Introduction

- ➤ Life Cycle: Consecutive and interlinked stages of a product or service system, from the extraction of natural resources to the final disposal.
- ➤ It considers all the environmental impact right from the extraction of raw material to its final disposal.
- ➤ It considers both qualitative and quantitative aspects.
- ➤ Life cycle assessment is a tool for systematic evaluation of the environmental impact of a product throughout each stage of its life cycle.

What is LCA?

Life-cycle assessment (LCA, also known as life-cycle analysis, ecobalance, and cradle-to-grave analysis)[is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling.

Life Cycle Assessment (LCA) is a technique for assessing the potential environmental aspects and potential aspects associated with a product (or service), by:

- Compiling an **inventory** of relevant inputs and outputs,
- Evaluating the potential environmental impacts associated with those inputs and outputs,
- Interpreting the results of the inventory and impact phases in relation to the objectives of the study.

Need of LCA

- To study the impact of our goods, services and technology on our environment
- > To identify and implement ways of improving environment from the adverse effect.
- To identify the environmental consequence of a decision or a proposed change in the system under study
- > It can help us during design stage and manufacturing stage of new product

What is LCA Used for?

- Manufacturers typically use LCA's to reduce the environmental impact of their products by examining the inputs and outputs of their products, with the aim of producing a more environmentally friendly product.
- They might achieve this by implementing a more efficient production process or simply by sourcing raw materials from locations closer to the production facility.

Components of LCA / Stages of LCA Methodology

An LCA consists of 4 basic stages:

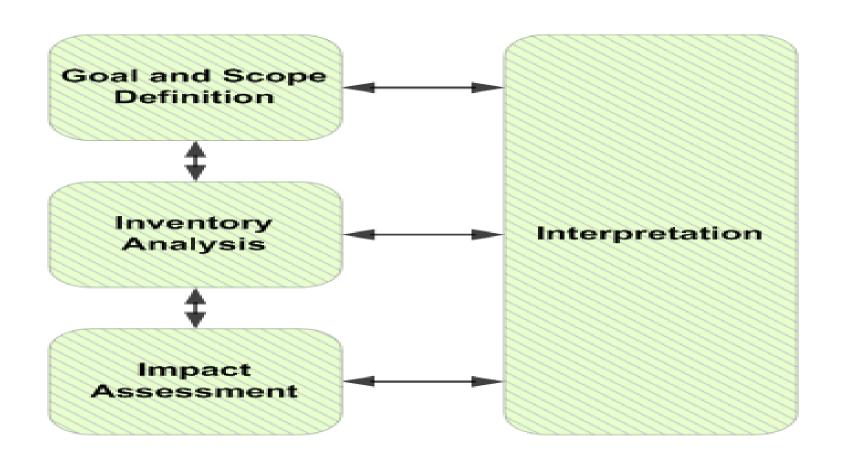
- 1. Goal and scope definition define and describe the product, process or activity in question. Define the boundaries and environmental effects to be assessed and the purpose of the study.
- 2. Inventory analysis identify and quantify energy and materials inputs and outputs e.g. raw materials required, energy required for production processes, waste and by-products, emissions, materials that can be recycled etc.
- **3. Impact assessment** assess the potential impacts on the environment and population of energy, materials, emissions etc. based on the inventory analysis.

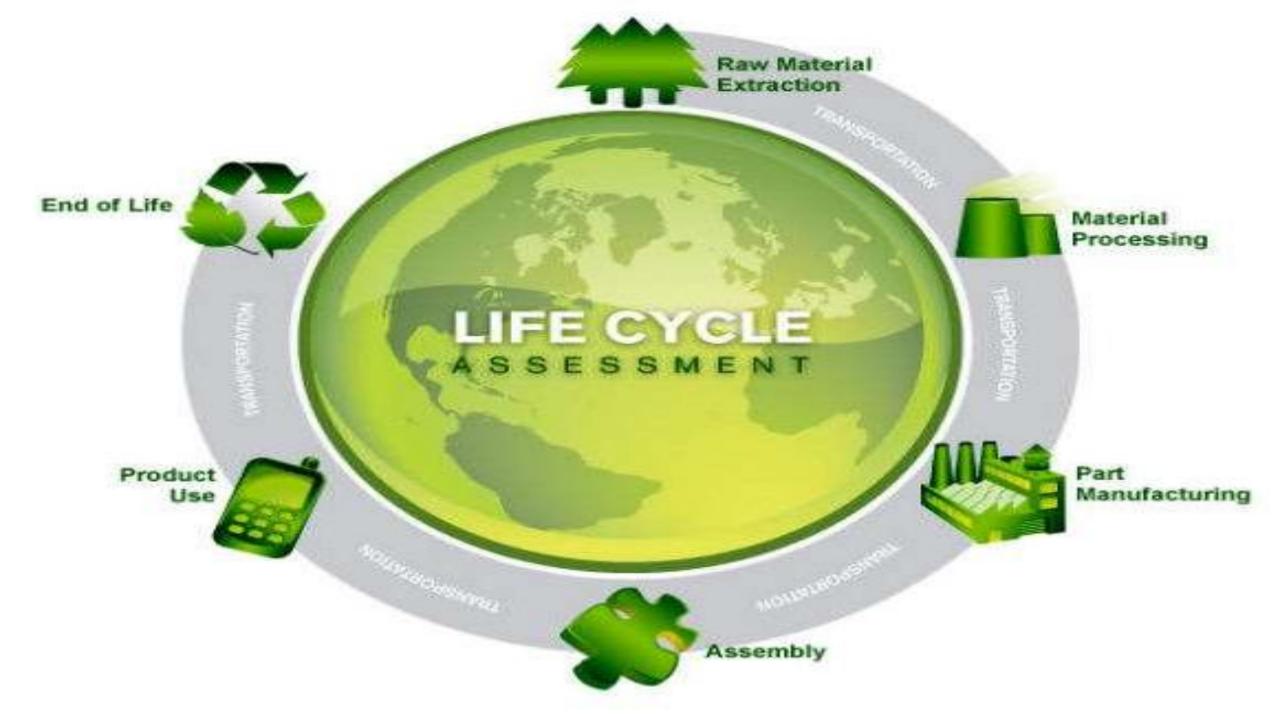
Components of LCA / Stages of an LCA

4. Improvement analyses – with a clear picture of the items involved (inventory analysis) and impact assessment, evaluate the results obtained to identify areas where improvements can be made. Once tested with a positive outcome implement these changes to improve sustainability.

The major processes that need to be evaluated in an LCA study are raw material acquisition, materials manufacture, production, use/reuse/maintenance and waste management.

PHASES OF LIFE CYCLE ASSESSMENT





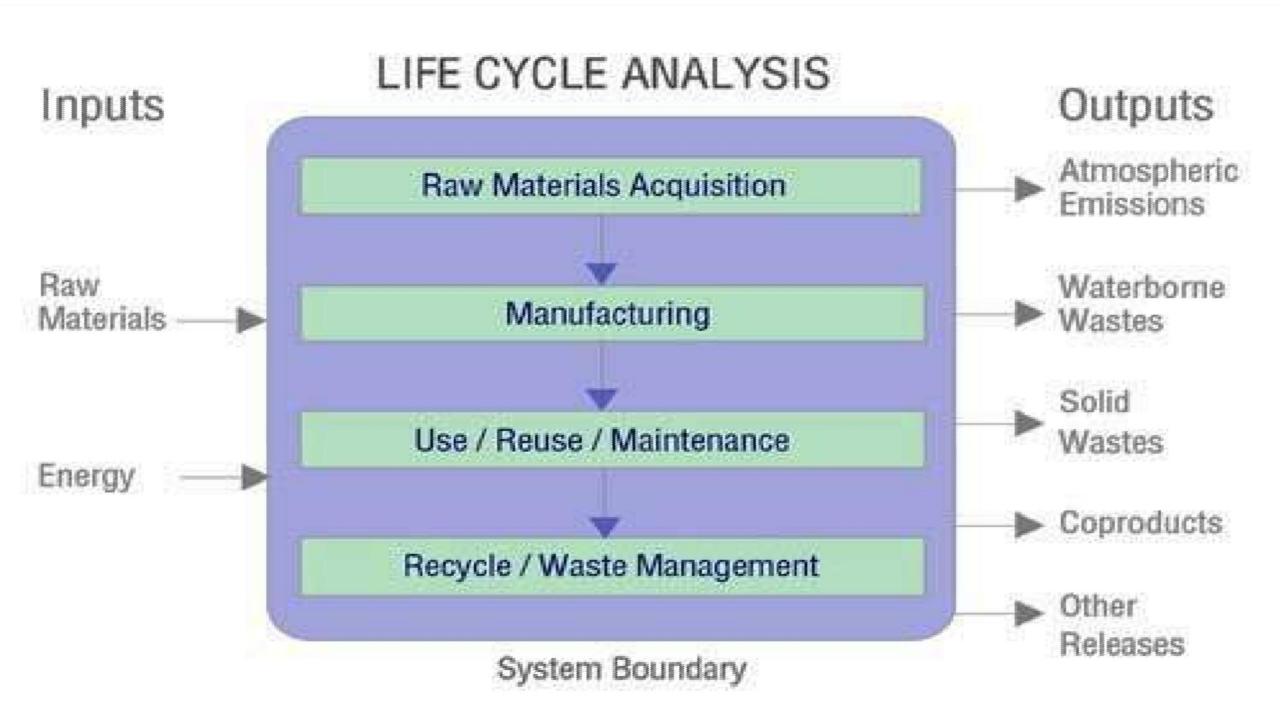
Life cycle inventory analysis

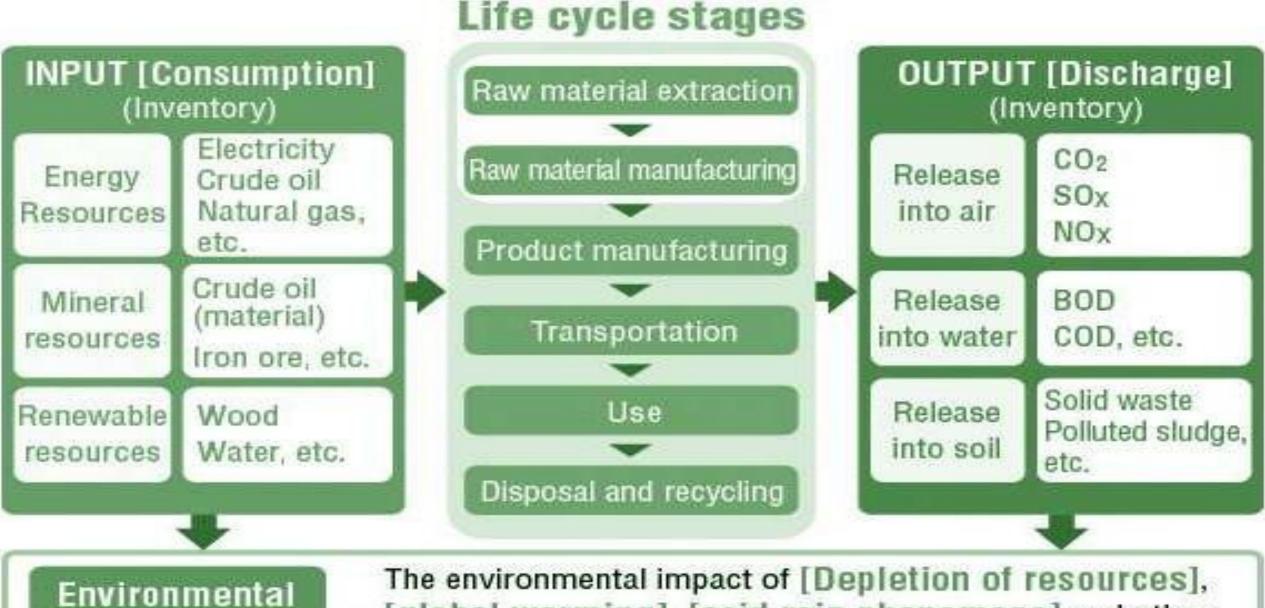
Life cycle inventory analysis includes the creation of input and output flows from and to nature for a particular product system.

The first major part in a Life Cycle Assessment (LCA) of a product is the identification and quantification of raw materials usage, energy consumption and wastes released.

This step is also known as Life Cycle Inventory (LCI). In the case of products like surfactants or their raw materials the steps covered in a LCI study are:

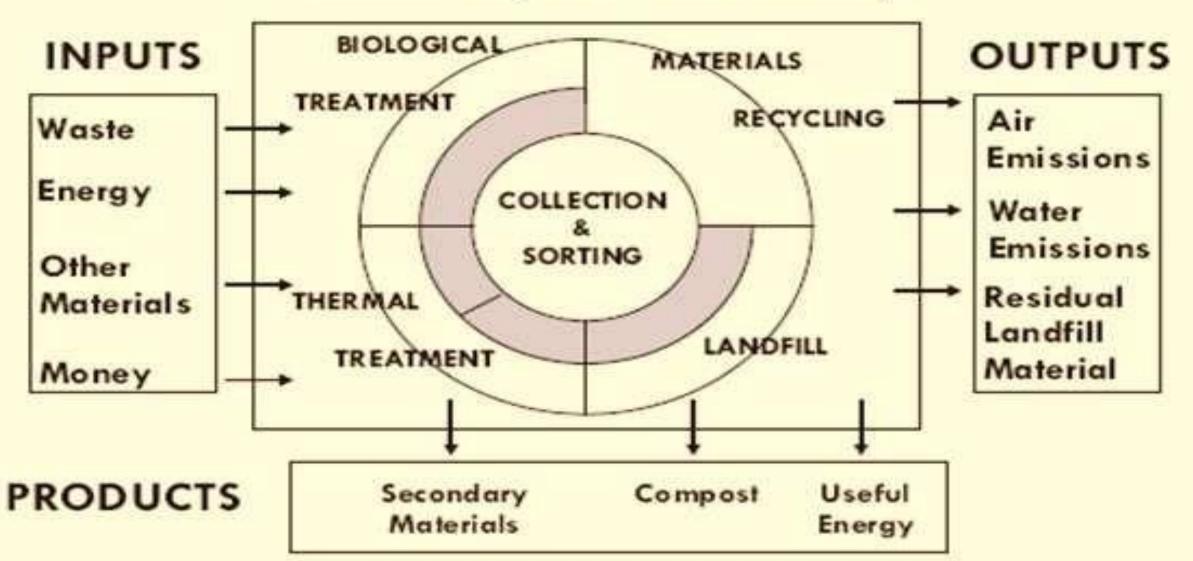
Raw Material Sourcing and Procurement Manufacturing Distribution Use Disposal





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.

Integrated waste management: a Life Cycle Inventory



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 co₂ 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

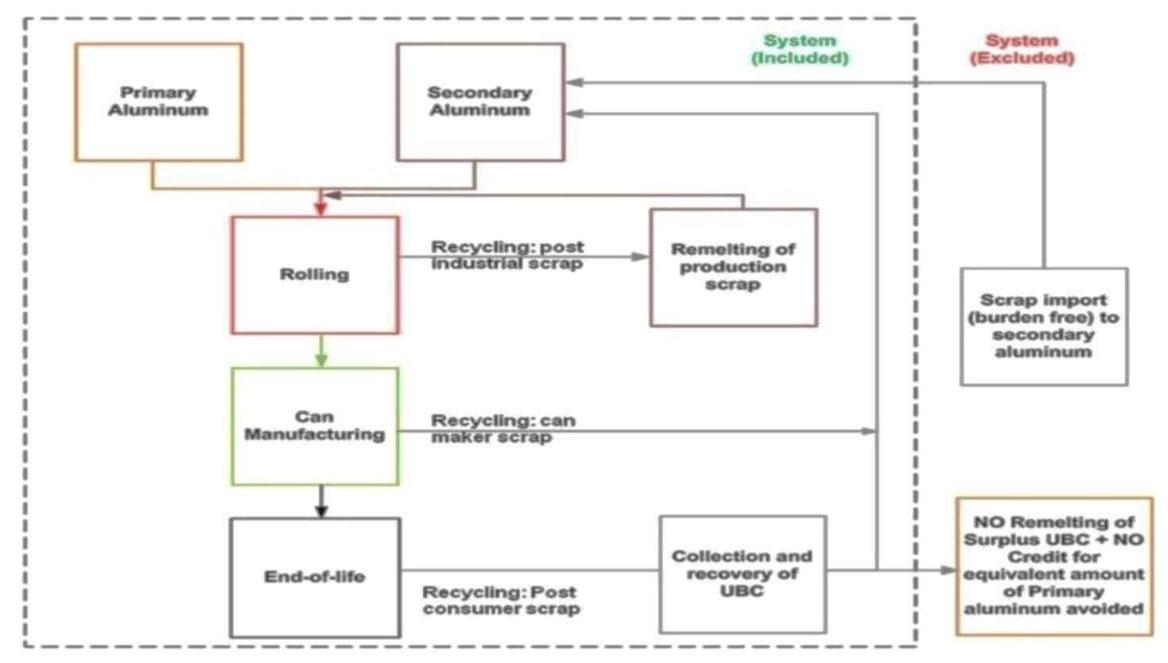
- ➤ Identification of significant issues based on the results of the LCI and LCIA phases of an LCA
- Evaluation of the study considering completeness, sensitivity and consistency checks; and Conclusions, limitations and recommendations
- > To determine the level of confidence in the final results and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

USES

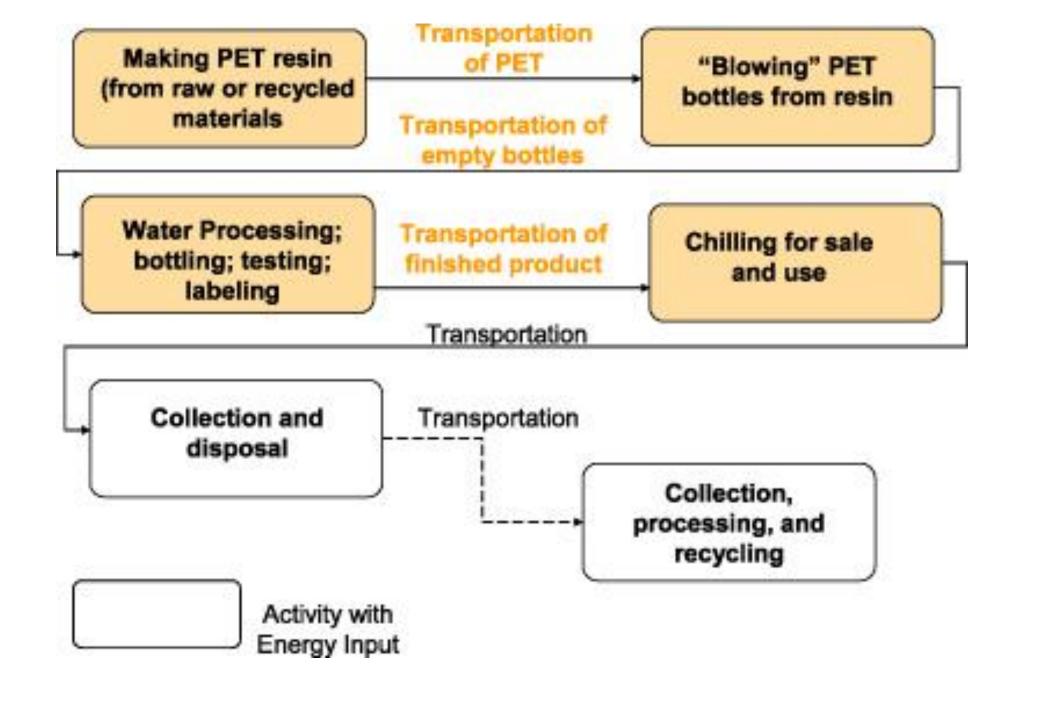
- ➤ In business strategy decision making.
- ➤ In research and development sector.
- ➤ In waste management.
- > It building project guidelines for construction sector.
- ➤ It provides a reliable base for comparing the relative environmental merit of different products.

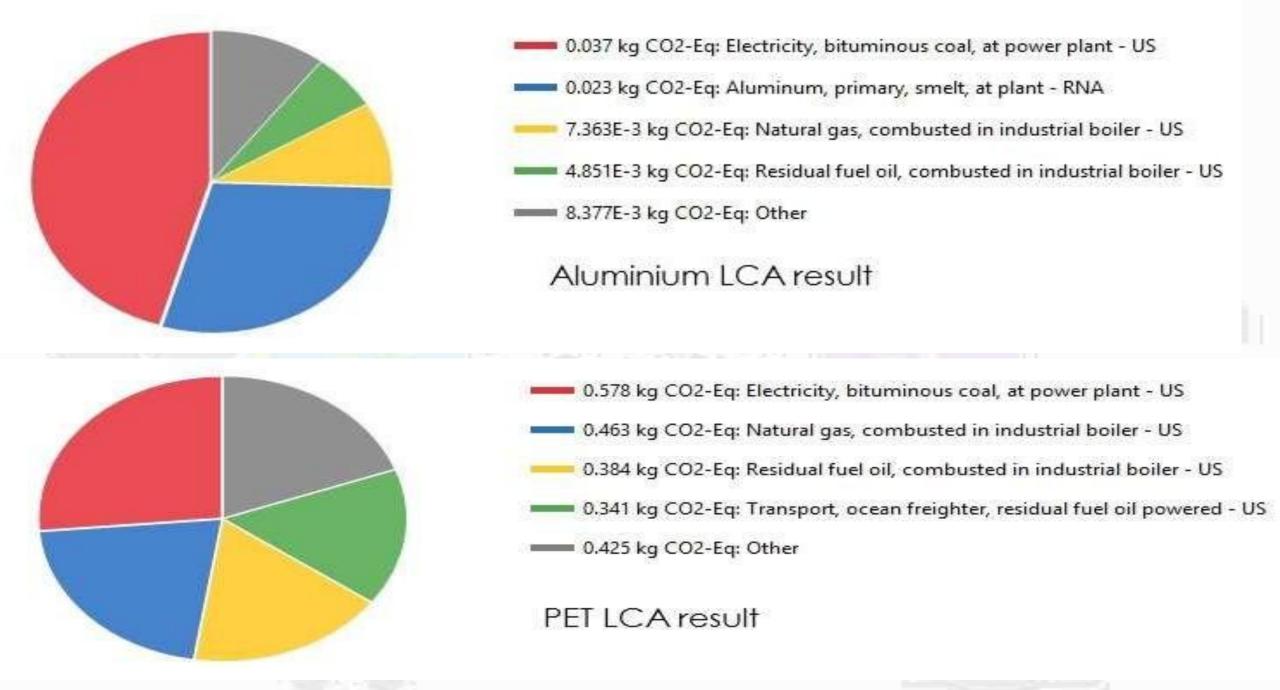
CASE STUDY: LCA COMPARISON OF PET vs ALUMINIUM

- The goal of this case study is to compare environmental impact between two different materials of a typical 500ml beer bottle.
- The system boundary of this assessment includes production, consumption and disposal of the bottle within the US.
- > Assessment method is based on IPCC 2007 methodology.
- The case study is based on U.S. Life Cycle Inventory Database
- > PET is known as Polyethylene terephthalate



Alumium inventory diagram (source:open lca case study,sarah winter ,October 2014)





LIMITATIONS

- > 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 products.

Questions

What is life cycle of product?

What is meant by life cycle assessment?

Explain different stages of LCA Methodology? With diagram

What is LCI and LCIA and it's significances?

What are the advantages, disadvantages and limitations of LCA?

THANK YOU