BHARATHIDASAN UNIVERSITY
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Programme: M.Sc., Environmental Science

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Unit II

Life Cycle Assessment

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Life Cycle Assessment

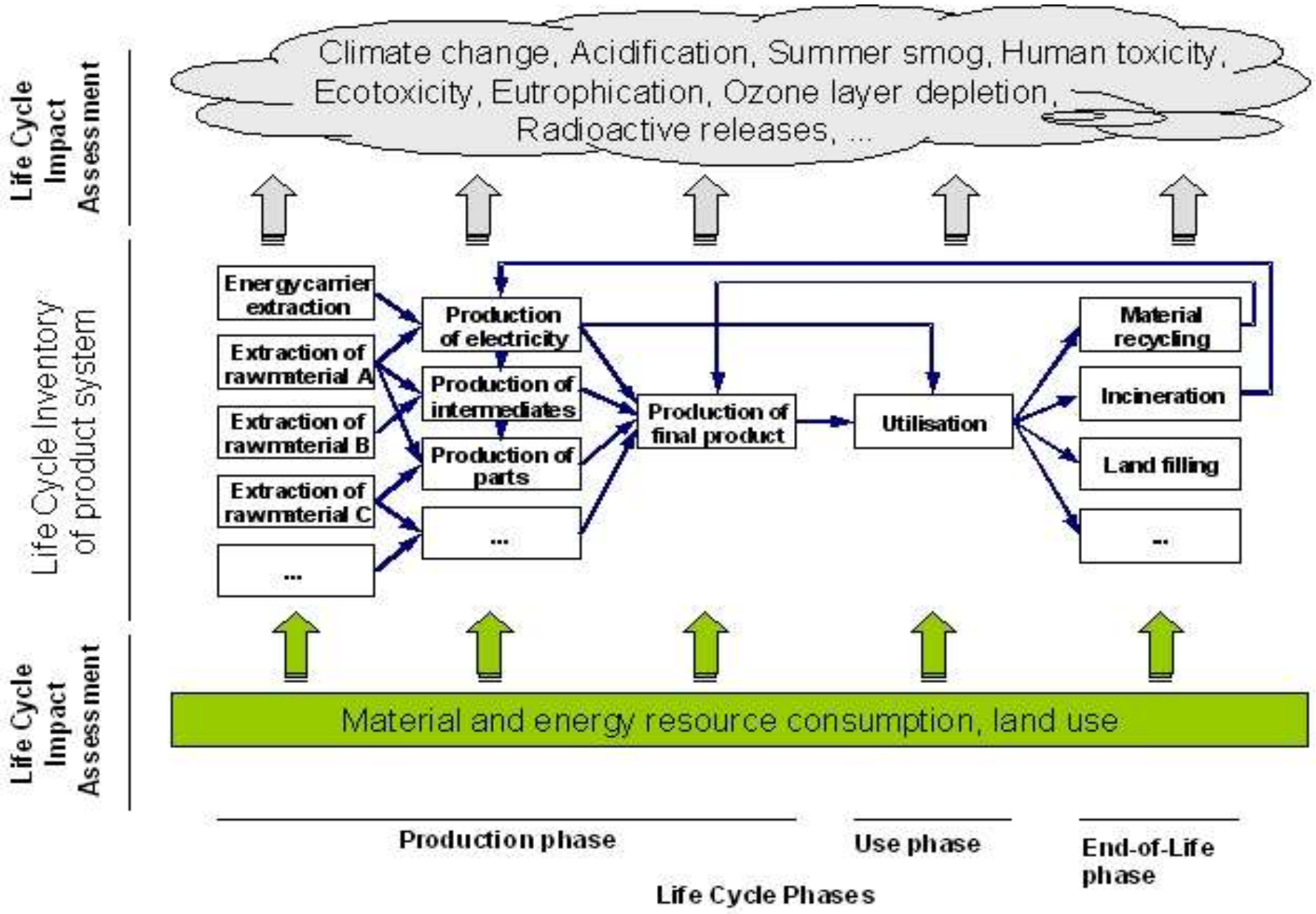
- A life-cycle assessment (LCA, also known as life-cycle analysis, eco balance, and cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).
- LCA involves the collection and evaluation of quantitative data on the inputs and outputs of material, energy and waste flows associated with a product over its entire life cycle so that the environmental impacts can be determined.
- LCAs can help avoid a narrow outlook on environmental concerns by:

-Compiling an inventory of relevant energy and material inputs and environmental releases;

-Evaluating the potential impacts associated with identified inputs and releases;

-Interpreting the results to help make a more informed decision.

- The LCA for a product is a summation of the impacts of:
- extraction of the relevant raw materials
- refinement and conversion to process materials
- manufacturing and packaging processes
- transportation and distribution at each stage
- operation or use during its lifetime
- at the end of its useful life, final transportation, waste treatment and disposal.
- Any recycling or recovery operations built into the life cycle should lead to a proportionate reduction in the adverse environmental impact.
- LCA is primarily intended for comparing the life cycles of alternative processes designed to achieve similar objectives in order to discover which of them is the most environmentally sound.


Life Cycle Impact Assessment
Climate change, Acidification, Summer smog, Human toxicity, Ecotoxicity, Eutrophication, Ozone layer depletion, Radioactive releases, ...
Life Cycle Inventory of product system
Energy carrier extraction
Extraction of rawmaterial A
Extraction of rawmaterial B
Extraction of rawmaterial C
...
Production of electricity
Production of intermediates
Production of parts
...
Production of final product
Utilisation
Material recycling
Incineration
Land filling
...
Life Cycle Impact Assessment
Material and energy resource consumption, land use
Production phase
Use phase
End-of-Life phase
Life Cycle Phases

- LCA can help to identify ways to reduce environmental impacts and make cost savings.
- LCA can also be used to assess compliance with environmental legislation. It is possible to see LCA as part of a more general trend towards improving systems for assessing many types of risk (e.g. risk assessment for occupational risk).
- The need for a better way of assessing the overall environmental effects of products, processes and services is widely recognised as is the need to limit pollution and the drain on natural resources.
- LCA provides a means for carrying out such assessment. Its precursors were the Global Modelling Studies and Energy Audits of the late 1960's and early 1970's, which attempted to assess the resource costs and environmental behaviour implications of different patterns of human behaviour.

- In the developed world in particular, governments are using a variety of means to try to reduce adverse effects on the environment.
- One approach to reducing the environmental impacts of purchased goods is to award "badges of acceptance" to items that are made, and operate in, an environmentally sound manner.
- The hope is that consumers will choose such products over those that are less 'environmentally friendly'.
- In the European Union the 'badge of acceptance' is called an “Eco-Label” and LCA provides the basis for deciding whether a product should be awarded an “Eco-Label”.

- LCA is a tool that can be used to assess the environmental impacts of products and services throughout their life cycle and identify ways to reduce these impacts.
- Other tools to reduce or eliminate impacts include Environmental Management Systems and Environmental Labelling Schemes.
- These tools form part of the European Commission's strategy for the implementation of Integrated Product Policy (IPP).
- IPP is an approach which aims to reduce the environmental impact of products throughout their life cycle.
- IPP is one of the priorities of the European Commission and part of the European Union's commitment to Sustainable Development.
- LCA is universally applicable to all sectors, products and services and can benefit all business.
- Conserving raw materials, saving energy and reducing waste will ultimately not only benefit the environment but also improve the economic efficiency of a business.

- LCA is not a purely objective process. It involves value judgements. Examples might be deciding which is more acceptable:

- an acidic emission or a particular toxic emission

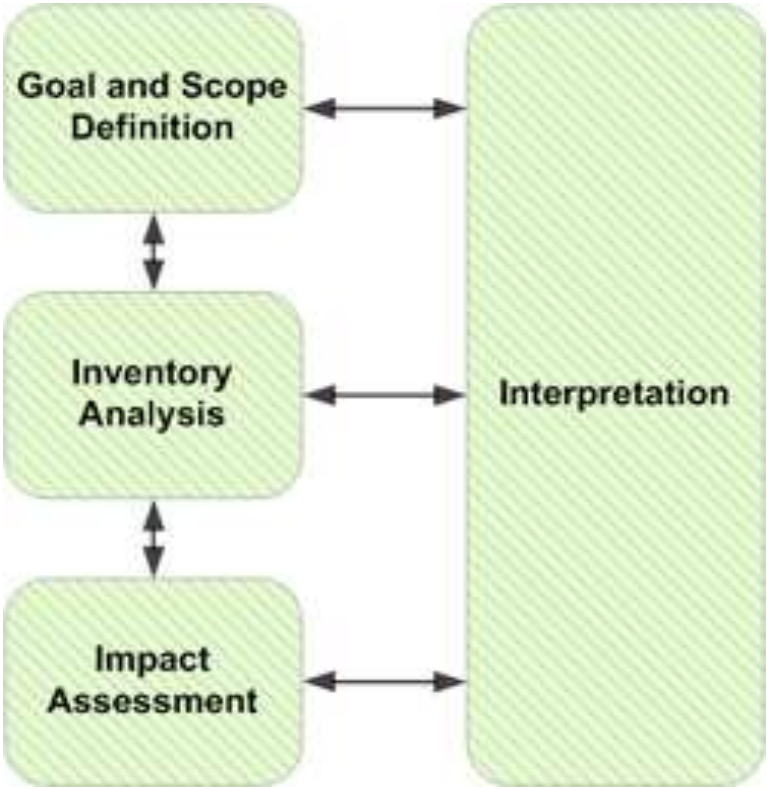
- greater energy demand or greater water consumption

- using a well managed landfill site or incineration

- heavy metal discharges or using chlorinated organic solvents.

- What is "acceptable" clearly raises very complex and difficult questions.
- A decision as to whether something is acceptable may well depend upon the aims and objectives of the person or persons concerned.
- Certain schools of thought maintain that insufficient attention is paid in LCA to the effects of various processes upon biodiversity.
- "Acceptability" may vary from place to place and from time to time.
- For example an LCA for a process in one part of the world may reach different conclusions to that for a virtually identical process elsewhere depending on the perceived or actual environmental threats in each area.
- The great value of LCA lies in the fact that any value judgements involved are clearly identified and transparent.
- It demands the examination of each and every phase in the "life" of the product, process or service under investigation.
- There must be no preconceptions if the exercise is to provide a realistic assessment.


Materials Resources and Extraction
End-of Life Issues (recycling, etc)
Processing Impact on Environment
LIFE CYCLE ANALYSIS
Materials for Green Energy
Design for sustainability
Use of Sustainable Materials
Economic, Social and Legislative Issues


Goal and Scope Definition
Inventory Analysis
Impact Assessment
Interpretation

LIFE-CYCLE STUDY REVEALS THAT INFINITELY RECYCLABLE ALUMINUM CAN MORE SUSTAINABLE THAN EVER

❖This LCA is an independent comprehensive life-cycle study that analyzed the entire production process – from bauxite mining to can manufacturing.

❖The study incorporated the latest available information on energy and material consumption, greenhouse gas emissions and other environmental releases.

❖The study examined the can manufacturing process using both the cradle-to-cradle closed-loop approach and the recycled content approach.

❖ It conformed to ISO methodology and was peer reviewed by respected professionals in the LCA community, including experts from the Society of Environmental Toxicology and Chemistry and the EPA.

❖“LCA is the universally accepted method to comprehensively assess the environmental impact of a product from the raw materials, through the production, distribution, use, disposal, and recycling of that product—its full life cycle,” said Nuno da Silva, Managing Director of PE Americas.

❖“The aluminum industry has made every effort to ensure the integrity and transparency of this important project,” Larkin said.

❖In addition to posting on the Association’s website, the results and supporting data have been provided to the EPA, where they will be used to update the existing Life-Cycle Inventory database and the agency’s Waste Reduction Model. Government officials in the U.S. and LCA experts around the world use these databases.

The independent study of aluminum cans, carried out by PE Americas, part of PE International, the international market leader in strategic consultancy, software solutions and extensive services in the field of sustainability, was undertaken to reduce their carbon footprint.

❖The results – confirming major reductions in the aluminum can's carbon footprint and energy use – have been provided to both Environmental Protection Agency (EPA) and Walmart, the Association said. Major findings include:

❖Reduction in overall carbon footprint of the aluminum can by **44 percent**

❖**30 percent** less energy usage

❖Reduction in package weight of 15%

❖**68 percent** total recycled content, the highest of any beverage package material.

❖“The data shows that we are using significantly less material and less energy to produce same-size beverage cans as compared with 17 years ago,” said Steve Larkin, president of the Aluminum Association.

❖“The aluminum industry has made tremendous gains in sustainability.

❖The aluminum can is more sustainable than ever.”

❖The study also confirmed our belief that the key to continuing to improve the carbon footprint of the aluminum can is to increase recycling rates” .

❖It is noted that the aluminum industry is committed to a goal to increase the recycling rate to 75 percent by 2015, up from it’s current rate of 54.2 percent.

❖ “Recycled aluminum uses 95 percent less energy and creates 95 percent less green house gas emissions than new aluminum,” .

❖The aluminum from an aluminum can, when recycled can be back on the shelf in as little as 60 days, and 34 cans can be made from just one pound of aluminum.

❖***The Aluminum Association, based in Arlington, Virginia, works globally to aggressively promote aluminum as the most sustainable and recyclable automotive, packaging and construction material in today's market. The Association represents U.S. and foreign-based primary producers of aluminum, aluminum recyclers and producers of fabricated products, as well as industry suppliers. Member companies operate more than 200 plants in the United States, with many conducting business worldwide.***

2 marks

What is Life cycle analysis?

Why LCA is termed as cradle to grave analysis?

5 marks

Explain the importance of life cycle analysis with an example .

Narrate a case study to stress the importance of life cycle analysis .