

Lifecycle Analysis and Modelling for Sustainability

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Agenda

- Lifecycle Analysis
 - What is it?
 - How do you do it?
 - How is it being used?
- Sustainability
 - Three dimensions
- Broadening the perception of what an LCA can do!

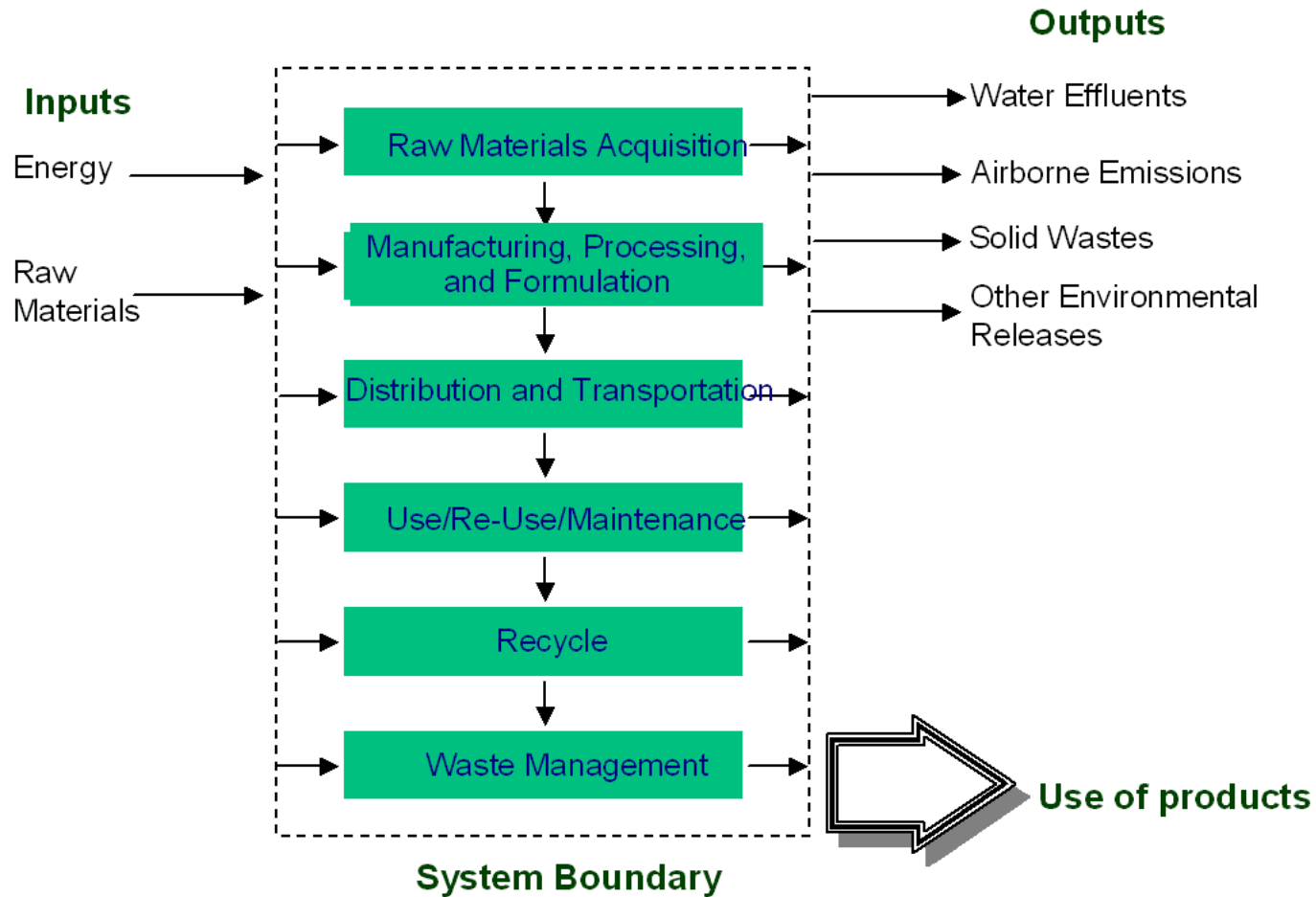
Life Cycle Assessment

- Life Cycle Assessment (LCA) is a technique for assessing the potential environmental 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, and
 - **interpreting** the results of the inventory and impact phases in relation to the objectives of the study.
- Source: US EPA

What is LCA?

- LCA is a cradle to-grave approach for assessing industrial systems
- Begins with gathering the raw materials from the the earth and ends when the materials are returned to the earth
- Evaluates all of the stages as if they are interdependent
- Provides a comprehensive view of all environmental impacts and allows a more accurate assessment of environmental trade-offs

Life Cycle Stages



Benefits Of LCA

- Helps decision makers select options that provide the lowest environmental impact
 - This is used with other information such as cost and performance to select a product or process
- Companies can claim one product is better than another on the basis of LCA
- LCA inventory process helps to narrow in on the area where the biggest reductions in environmental emissions can be made

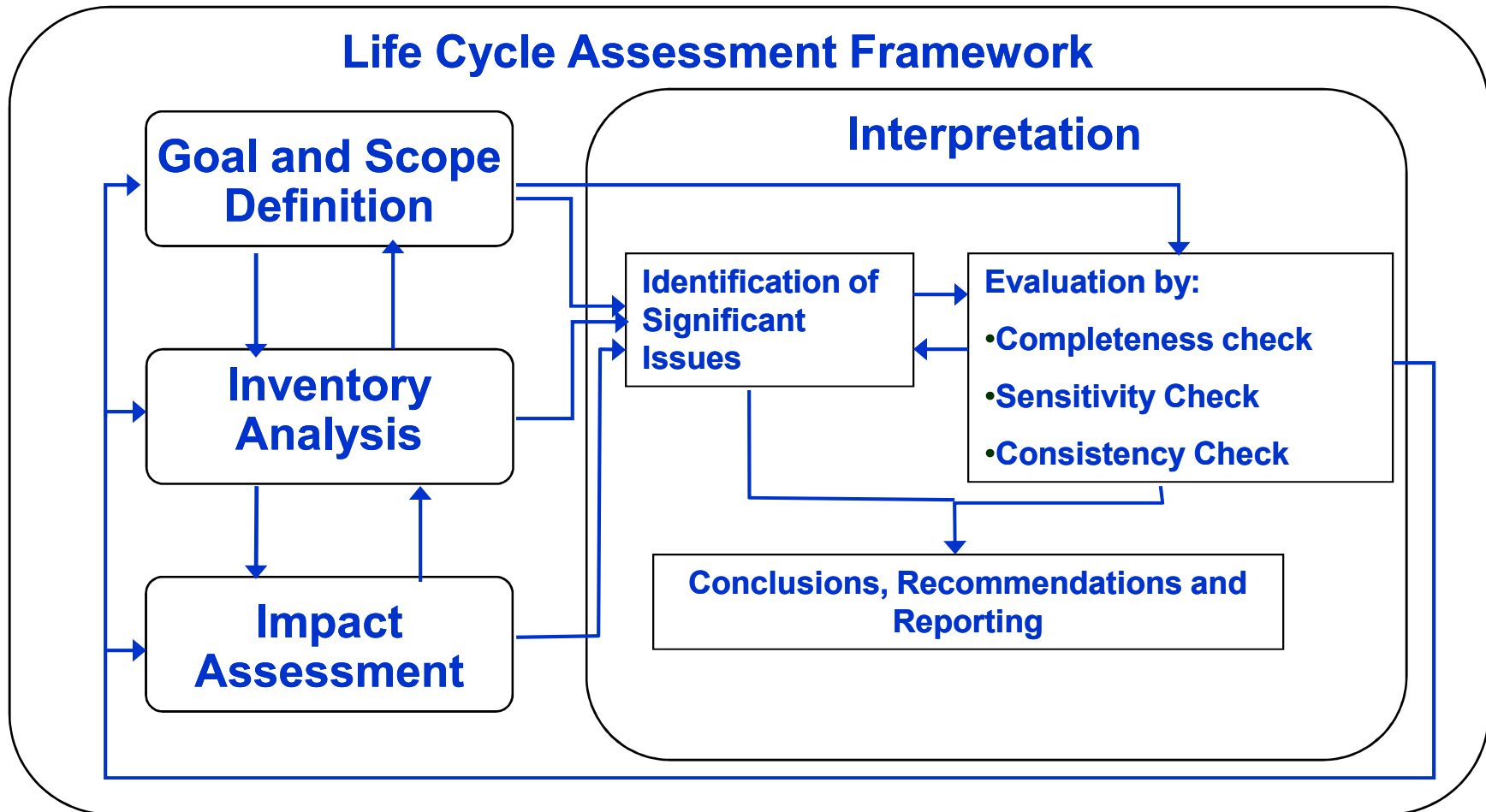
Limitations of LCA

- Can be time and resource intensive
 - Availability and accuracy of data can influence the results
- Most LCA's won't determine which product works the best or is the most cost effective
- LCA's need to be used as one component of the decision making process assessing the trade-offs with cost and performance

Phases of LCA

- **Goal Definition and Scoping** - Define and describe the product, process or activity. Establish the context in which the assessment is to be made and identify the boundaries and environmental effects to be reviewed for the assessment
- **Inventory Analysis** - Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, wastewater discharge)
- **Impact Assessment** - Assess the human and ecological effects of energy, water, and material usage and the environmental releases identified in the inventory analysis
- **Interpretation** - Evaluate the results of the inventory analysis and impact assessment to select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results

Phases of LCA



Life Cycle Assessment Principles

- The ISO 14040 standard for Life Cycle Assessment has seven principles:
 1. Life Cycle Perspective
 - 2. Environmental Focus**
 3. Relative Approach and Functional Unit
 4. Iterative Approach
 5. Transparency
 6. Comprehensiveness
 - 7. Priority of Scientific Approach**

How are LCAs Being Used?

- Government:
 - LCAs of fuels used for determining preferred fuel pathways for receiving government support.
- ENGOs:
 - Utilized LCAs to support positions in calling for increased attention to broad sustainability issues.
- Consumers:
 - Results of fuels' LCAs have been presented by various organizations and utilized indirectly in advertising campaigns with the hope of influencing consumer choice.
- Industry:
 - In North America, LCA are used mostly for environmental compliance and a little bit for advertising or market support.

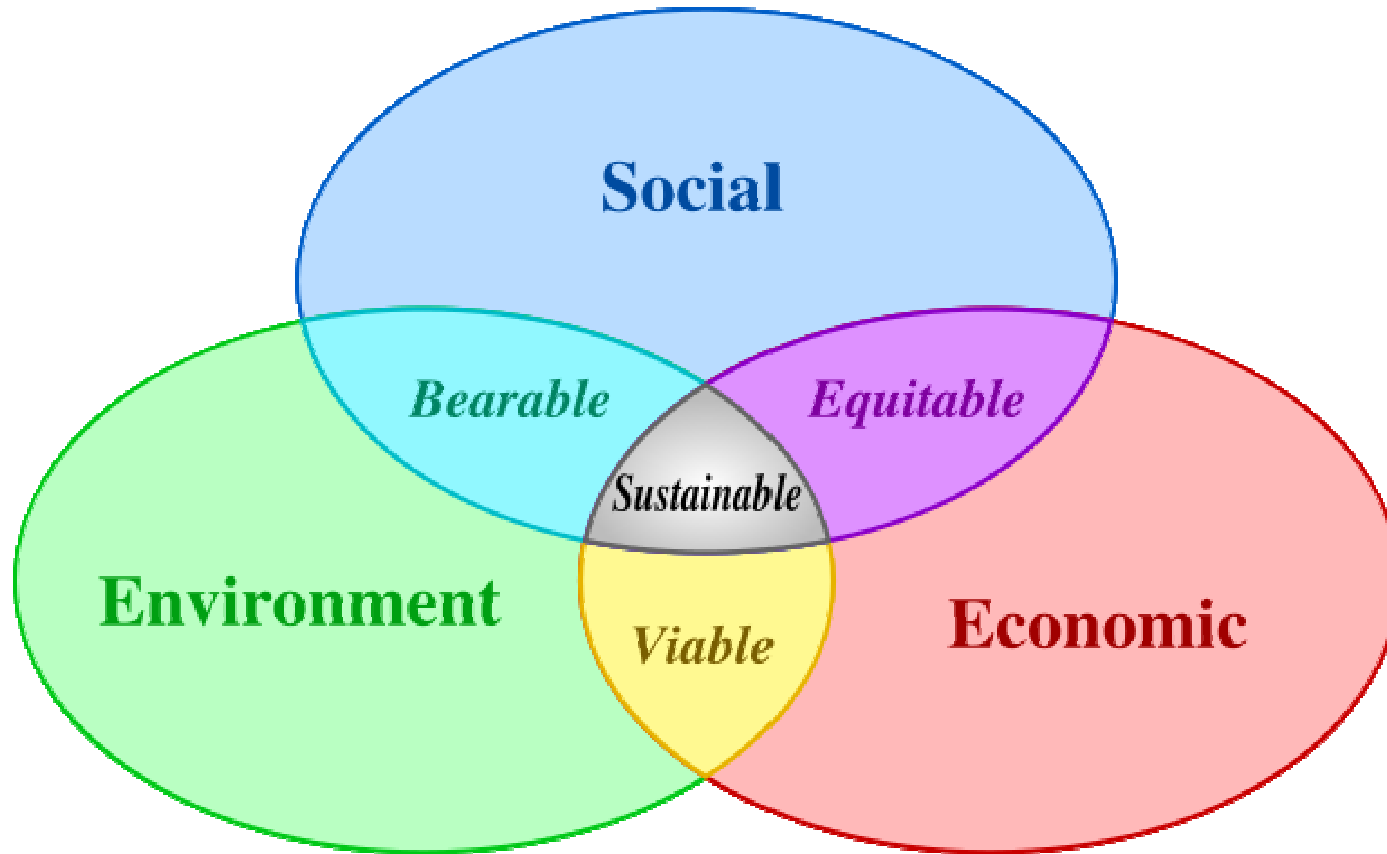
The Role of Modelling in Policy Development

- Fuel LCAs are very complex and some governments are finding that they must be simplified in order to be used for regulatory purposes.
- Thus we are seeing a divergence in approach between “scientific” LCAs and “regulatory” LCAs.
- The success of these regulatory LCAs is yet to be determined.
- LCAs can be one component of a broad economic, environmental and energy based approach to modelling future scenarios.

ENGOS

- Some ENGOS are misusing or distorting the LCA process or results to support their positions.
 - Are GHG emissions from oil sands derived fuels
 - 100% higher than conventional oil?
 - 30% higher?
 - 10% higher?
 - It depends on how you define lifecycle.

Sustainability



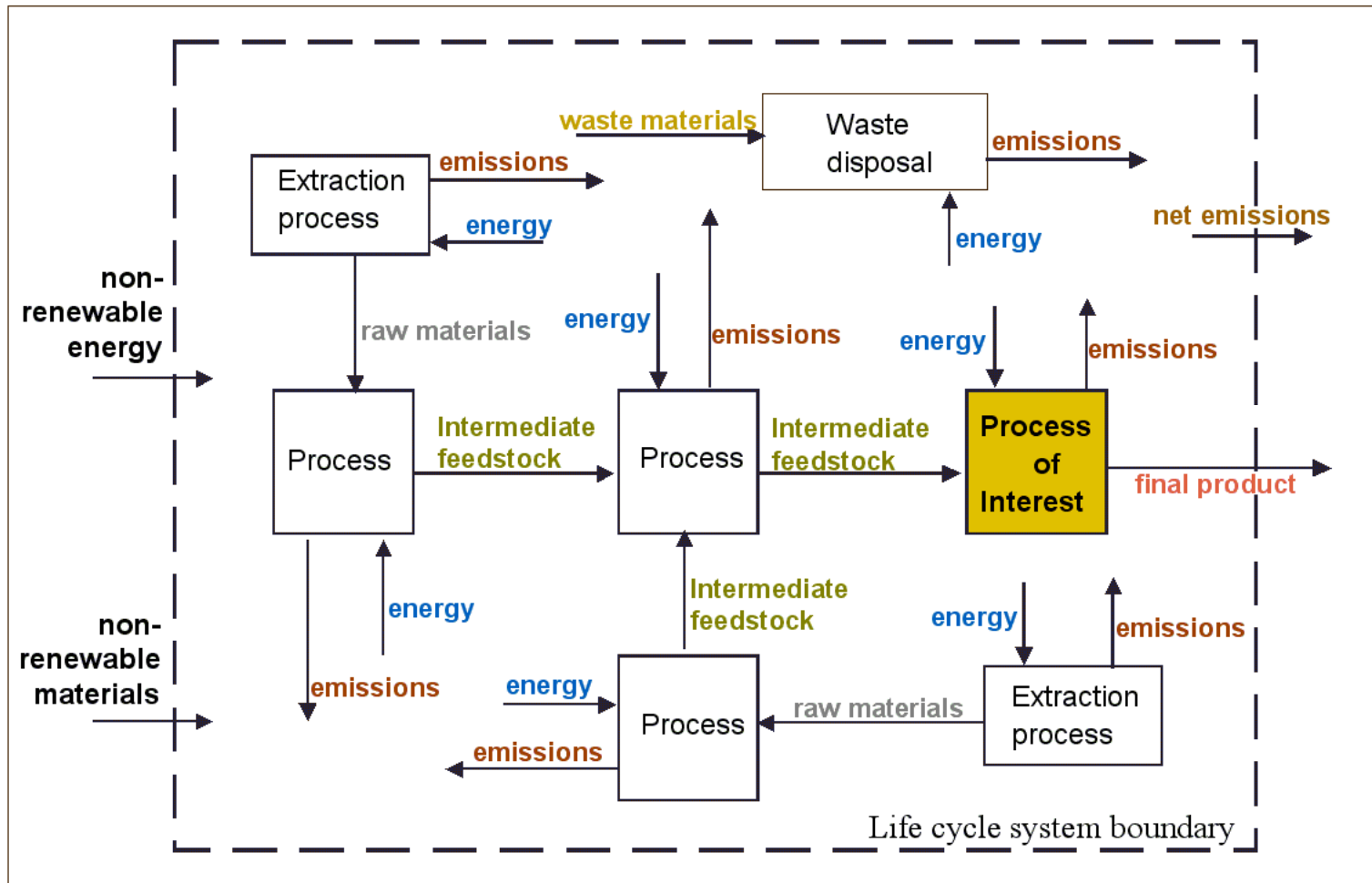
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LCA and Sustainability Conflicts?

- Sustainability has to consider not only the environment but also the social and economic implications.
- Yet an ISO LCA has a focus on the environment and is to use scientific priority in assessing trade-offs.
- It is probably easier to see the overlap between the environment and some aspects of social and rationalize that the conflict between the social and environmental aspects are not that significant.
- But the environment and the bottom line are often seen to be an either/or choice.
 - Does it have to be that way?

Process Chain Life Cycle Analysis



Economic I/O Model LCA

- The traditional economic input-output model (matrix) indicating economic transactions between industries can be appended with information on emissions to the environment.
- In effect, this creates an additional column representing "the environment" sector, and the value in each row represents the pollutant "output" from an industry sector that is "input" to "the environment" sector.
- Just as one can model how increased demand for output from one sector influences the output of other sectors, with an appended model one can also model how increased demand for output from one sector influences the output of pollutants to the environment.

Economics and the Environment

- So there is a link between the environment and economic activity.
- EIO-LCA models tend to be too coarse to be helpful in identifying and reducing emission emissions at the plant level.
- But process chain LCA models can provide the level of detail to identify the relationship between the inputs (cost) and the outputs (emissions).

What Can be Done?

- LCA models can be used in combination with process simulation models and financial models to identify the environmental and financial implications of process changes.
- This creates enviro-techno-economic models.
- There are a few organizations who have developed models that combine two of the three components but the real opportunity (and reward) is a model that combines all three.
 - (S&T)² have developed one enviro-techno model for an oil sands developer and one enviro-techno-economic model for an ethanol producer.

What are the Benefits

- A more efficient process
- Lower environmental burden
- Better financial performance
- All at the same time.

Conclusions

- Lifecycle Analysis can be used to address the three components of sustainability.
- The bottom line and environmental performance need not be mutually exclusive.
- It does require a bit different (broader) perspective to lifecycle modelling than it typically used but it can be done.



The significant problems we have cannot be solved at the same level of thinking with which we created them.

Albert Einstein



Thank You