Training

Introduction to the Life Cycle Assessment

August 2022 | © EcoAct

ecoact
an atos company

Agenda

1. Overview of the Life Cycle Assessment (LCA)
2. Impact categories – Measuring impact
3. The main phases of a LCA
4. Data requirements for a LCA
5. Key questions – before starting a LCA

Overview:
Life Cycle Assessment (LCA)

Life Cycle Assessment

As a value driver

- Leading question:

  What environmental impact does a product /service have on the world?

- Secondary questions:
  - How high are the emissions of the product or service?
  - How does it compare to other products in our portfolio?
  - What are the biggest leverages to reduce the impact of our product?
  - Can we be more efficient in manufacturing it?

- The goal of a LCA is to provide information to
  - comply with regulatory requirements, e.g., standardized tenders for public projects
  - mitigate risks associated with carbon emissions in the value chain, e.g., the carbon border tax being discussed in the EU
  - differentiate against competitors
  - facilitate organizational decision-making

Life Cycle Assessment

As a value driver

Facilitate organizational decision-making on:

Product development & R&D

- More efficient use of company resources
- Comparison of different materials
- Comparison of different products

Supply Chain Management & Procurement

- In many industries, suppliers can make up to 80% of a product's emissions (scope 3)
- Understand the environmental impact of different suppliers

Marketing & Sales

- Understand how sustainable your products really are and where you stand in the market
- Enable a price premium

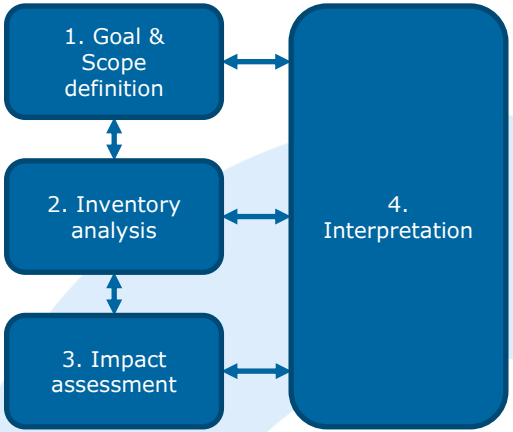
Executive Level & Strategic Management

- Provision of valuable information for strategic decisions on the company's portfolio
- New perspective from a broader point of view

Life Cycle Assessment

An overview

- Life Cycle Assessment (LCA) is a tool to calculate the environmental impacts of products and services
- Defined in international standards: ISO 14040 & 14044
- LCA comprises 4 phases
- Extends throughout the lifecycle of a product



Generic product lifecycle

ecoact
an atos company

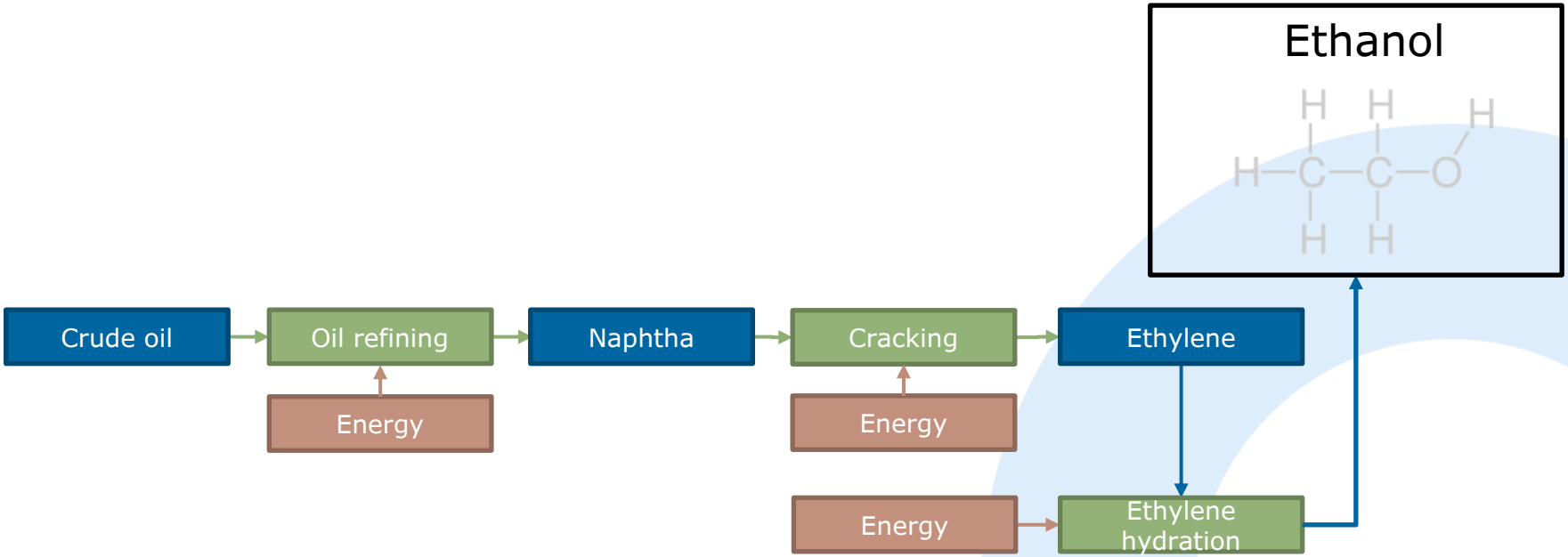
5 Stages in the Lifecycle of a Product

- **Cradle-to-grave:** entails all 5 stages, from the sourcing of the raw materials to the disposal of the product.
- **Cradle-to-gate:** only entails the first 2 stages (raw materials & production), often used for environmental product declarations.
- **Cradle-to-cradle:** concept within the Circular Economy, exchanges the waste stage with a recycling process that makes products reusable for another product.
- **Gate-to-gate:** limitation to one of the 5 stages, to reduce complexity of the assessment. Single assessments can later be linked together to a complete LCA.

ecoact
an atos company

Principle of Life Cycle Assessment

The upstream emissions



ecoact
an atos company

Impact categories – Measuring impact

Impact Categories

Measuring impact

Impact categories are defined according to the goals of the LCA and are what the organization wants to measure their impact in.

- They group different emissions emitted across a product's life cycle, according to their effect on the environment into different categories. Emissions from harvesting raw materials are very different from those of energy production.
- During the Life Cycle Impact Assessment of a LCA (2. phase), different emissions that have the same environmental impact are converted into one unit that translates into one impact category.

'Equivalents' make a single metric for a particular environmental impact possible

- For example, the impact category 'climate change', expressed in kg CO2 equivalents (kg CO2-eq) entails all emissions that have a GHG effect, e.g., carbon emissions (CO_2), methane (CH_4) or laughing gas (N_2O).

Impact Categories

Measuring impact

- **Climate change** — [kg CO_2eq] A measure of greenhouse gas emissions, such as CO2 and methane. These emissions are causing an increase in the Earth's absorption of radiation emitted by the sun, increasing the greenhouse effect. This can in turn have adverse impacts on ecosystem health, human health and material welfare.

- **Eutrophication** — [kg PO_4eq; kg N-eq; mol N-eq] Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which include nitrogen (N) and phosphorus (P). Nutrient enrichment can cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems (e.g., potentially toxic algal blooms). In aquatic ecosystems, increased biomass production may lead to depressed oxygen levels because of the additional consumption of oxygen in biomass decomposition.

- **Acidification**— [kg mol H^+] A measure of emissions that cause acidifying effects to the environment. The acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H^+) concentration in the presence of water, thus decreasing the pH value (e.g., acid rain). Potential effects include fish mortality, forest decline and the deterioration of building materials.

Impact Categories

Measuring impact

- **Photochemical ozone formation** — [mol N-eq] A measure of emissions of precursors that contribute to ground level smog formation (mainly ozone O3), produced by the reaction of VOC and carbon monoxide in the presence of nitrogen oxides under the influence of UV light. Ground level ozone can be detrimental to human health and ecosystems and may also damage crops.

- **Particulate matter** — [Disease incidence] A measure of particulate matter emissions and precursors to secondary particulates, such as SO2 and NOx from sources like fossil fuel combustion, wood combustion and dust particles from roads and fields. Particulate matter causes negative human health effects, including respiratory illness and an increase in overall mortality rates.

- **Ozone depletion**— [kg CFC-11-eq] A measure of air emissions that contribute to the depletion of the stratospheric ozone layer (i.e., the ozone hole). Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the Earth's surface with detrimental effects on humans and plants.

The main phases of a LCA

The main phases of a LCA

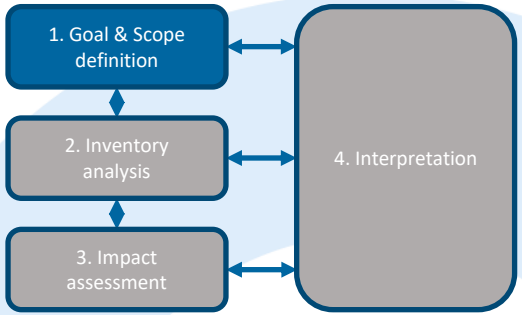
Four phases

- **Goal and Scope Definition:**

  In this phase, the product or service that is to be assessed is defined. A functional basis for comparison is set up as well as the required level of detail and the impact categories. A goal which determines the scope needs to be defined, including objective, application and audience of the LCA. Lastly, it needs to be determined whether or not there should be a critical review of that goal.

  Key questions are:

  - What will be assessed and to what extent?
  - What is the goal of the LCA?
  - Which impact categories are to be addressed?
  - What will not be assessed?



ecoact
an atos company

The main phases of a LCA

Four phases

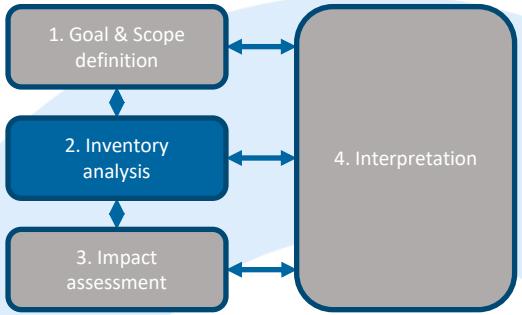
- **Inventory Analysis:**

  This is the phase that requires the largest amount of time and work to fulfill.

  Here, a data compilation and an inventory analysis of extractions from and releases into the environment is performed. The final inventory provides an overview of all environmental inputs and outputs associated with the life cycle of a product or service. These are to be evaluated in the next stages of the LCA.

  The goal is to measure everything that flows in and out of the system defined in phase 1.

  This includes raw materials and resources (including energy), as well as emissions by substance and it requires quantitative information on the level of the company, process, or product. In some case, qualitative data might also be required, in the forms of interviews. The quality of the data collected is crucial: the more details, the better.



ecoact
an atos company

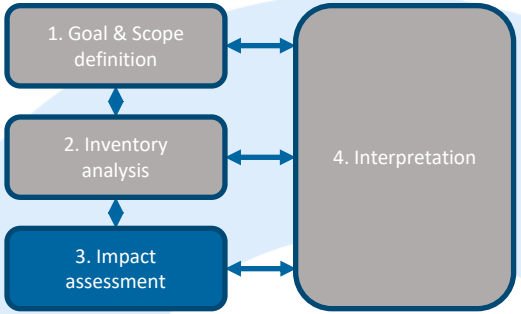
The main phases of a LCA

Four phases

- **Impact Assessment:**

  In this phase, resource use and emissions generated are classified according to their potential impacts and quantified for a limited number of impact categories, which may then be assessed in terms of their relative importance for the goal of the LCA study.

  1. Selection of indicators and models
     For this, the impact categories need to be defined more precisely according to the company's goals defined in phase 1.
  2. Classification of Life Cycle Inventory
     In a second step, the emissions assessed during phase 2 are assigned to the defined impact categories.
  3. Impact measurement
     The equivalents are calculated and summed up in overall impact category totals, e.g., Global Warming Potential (kg CO2-eq), Depletion potential of the stratosphere ozone layer (kg CFC-11-eq),…



ecoact
an atos company

The main phases of a LCA

Four phases

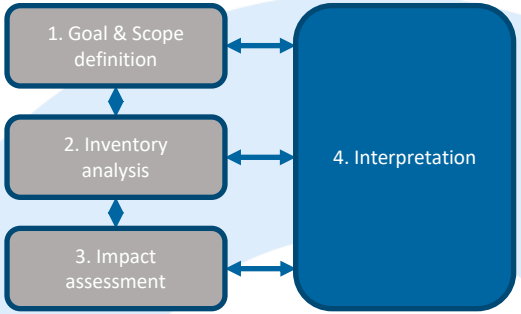
- **Interpretation:**

  With the above information, the results are then discussed in terms of contributions, relevance, robustness, data quality and limitations. A systematic evaluation of opportunities for reducing the negative effects of the product(s) or service(s) on the environment is performed.

  Avoiding burden shifting between impact categories or life cycle phases is key. Avoiding burden shifting – mitigation of an environmental problem by worsening another – is a core strength of the LCA approach.

  The results need to be put into context to recognize the whole picture and the role the LCA's results may play in it.

  Interpretations of intermediary results are valuable to obtain a picture of the process and progress of the LCA.



ecoact
an atos company

Data Requirements for a LCA

4

ecoact
an atos company

Data Requirements

- **Primary Data:** Data obtained through direct measurements or calculations by the company. Primary data make it possible to identify relevant opportunities for emission reductions.

  Example: kg consumption of raw materials for product X in 2022.

- **Secondary Data:** Any data other than primary. Used where no primary data is available. Typically, of lower quality and relevance than primary data. Limited ability to reduce emissions with secondary data.

  Example: ratio of energy consumption per square meter.

ecoact
an atos company

How is data collected?

- Normally collected through data collection templates.
- Automated data collection through source systems.
- The level of detail ("black box" vs. individual process steps) depends on data availability, the time available for data collection, the relevance of the data point and the scope of the LCA.
- Sources of primary data include bills of materials/recipes, PLM software, utility bills, meter readings, procurement records, waste inventories, emissions permit reports, equipment specs as well as measurements in production lines.
- Sources of secondary data include LCA databases, technical literature, journal papers, conference presentations, patents, and others.
- All collected data need to be quality assured and checked for completeness and consistency, e.g., via checks of mass balance, emission profile, energy intensities, water balance and the like.

Selecting primary data

- Generally use Recipe, Bill of Materials, Formulation etc. interchangeably

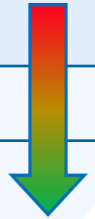
Type of BoM	Description	Accurateness
Engineering BoM	Reflecting the product as it is being designed	
Production BoM	Reflects the product as it is intended to be produced	
Purchase Order	Actual materials purchased to produce the product	

ecoact
an atos company

Selecting primary data

- Utility attribution

Type of utility data	Description	Accurateness
Site/plant average	Mass allocation based on site/plant total production	
Machine hours	Time required to produce material	
Production BoM	Estimated energy consumption for production	



ecoact
an atos company

Selecting secondary data

- Location:

Priority	Data location	Accurateness
4	Proxy region/country	
3	Global mix	
2	Country within region	
1	Specific Region	

ecoact
an atos company

Key questions - before starting a LCA

Key questions – Product & Processes

- How is your company organized? – e.g. divisions, individual companies, regions
  - Who has decision-making power over production processes? Or P&L accountability?
- How would you envision the structure of the PCFs according to this organization?
- How complete is Bill of Material information for the products you produce? (e.g. in ~%)
- Which fields are used to describe the BoM? – e.g. product ID, business process, etc.
- For products with multiple outputs, does the BoM specify what is the main product and what is the co-product?
  - Do any processes produce residues (e.g. captured CO_2)? – how is this detailed/dealt with in the BoM?
- Do you have complete information on the production costs for each product or market prices?

Key questions – Supplier Information

- What is the relative ratio between external purchases and internal transfers of raw materials?
- How is procurement data organised?
  - By:
    - Product ID (as per BOMs)?
    - Division/company/region
- What procurement data is available? – volumes, prices, source (location)
- Do your company use tolling?
  - If so, are you currently collecting data (“on-stage”/utility) on emissions from tollers?
- What ability/detail would you like to see on the emissions of procured materials?

ecoact
an atos company

Key questions – Emissions Data

- Have you already conducted LCAs/PCFs? – how many and for what types of products?
- Which data sources (e.g. LCA databases) have you used for these assessments?
  - Would you like to use these for the PCF platform?
  - Do you have licenses for these data sources?
- How has your Scope 3 category 1 (purchased goods & services) been calculated?
- Do you currently collect product carbon footprint (PCF) data from your suppliers?
- What do you see as the main challenge for obtaining emissions data for your raw materials?

ecoact
an atos company

Key questions – Utilities

- Do you have a complete Scope 1 & 2 footprint according to the GHG protocol?
- Has this footprint been verified?
- What is the highest level of detail this footprint is broken down into?
  - Site (e.g. Barcelona)
  - Plant (e.g. steam cracker)
  - Line (e.g. production line 1)
- Does the inventory describe generated energy? E.g. excess steam?
- How has emissions from wastewater been calculated? – and to what detail?
- How has emissions from waste been calculated? – and to what detail?
- Are there any other utilities relevant to your production?

ecoact
an atos company

Your climate experts.
Your partners for positive change.

EcoAct, an Atos company, is an international advisory consultancy and project developer that works with clients to meet the demands of climate change. We work with many large and complex multinational organisations to offer solutions to their sustainability challenges.

EcoAct UK
+44 (0) 203 589 9444
ukoffice@eco-act.com

EcoAct France
+33 (0)1 83 64 08 70
contact@eco-act.com

EcoAct Turkey
+90 (0) 312 437 05 92
turkeyoffice@eco-act.com

EcoAct Spain
+34 935 851 122
contacta@eco-act.com

EcoAct USA
+1 917 744 9660
usaoffice@eco-act.com

EcoAct Kenya
+254 708 066 725
info@climatepal.com

ecoact
an atos company