



# ECOSIGN

## Basic Concepts on Ecodesign

### UNIT 4: Life Cycle Assessment and Costs



# Objectives

- Know the Life Cycle Assessment and the associated costs.
- Know methodologies, tools and data sets applied to perform the Life Cycle Assessment.



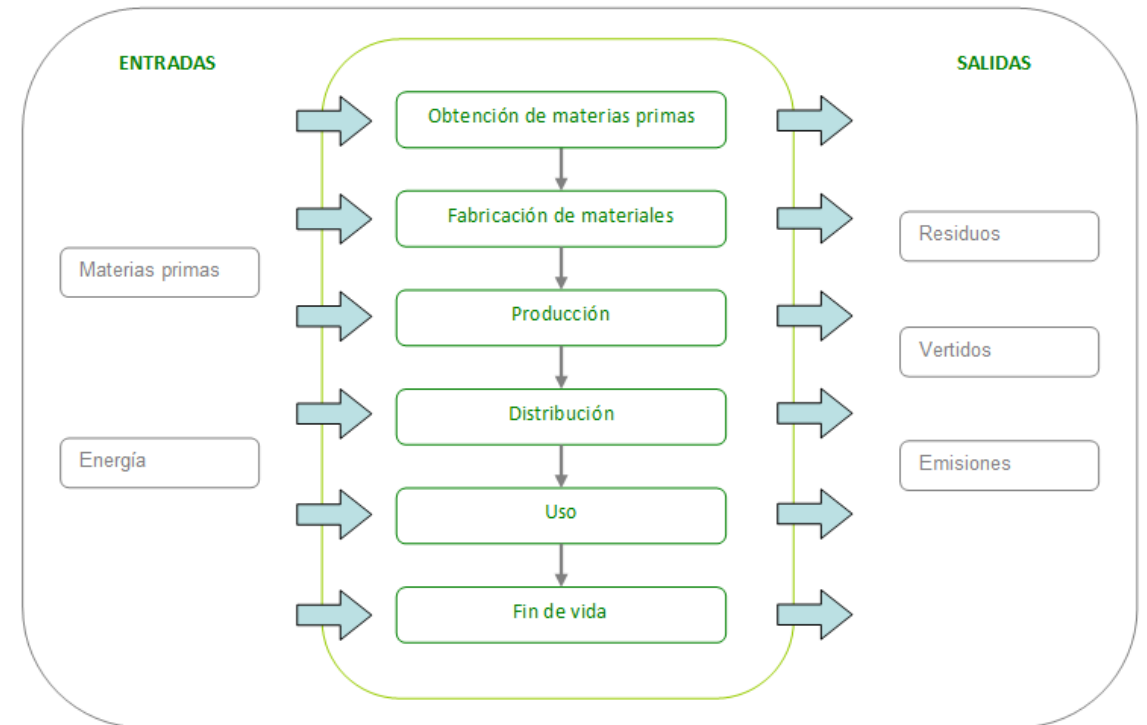
## 4.1 Definition of Life Cycle Assessment

### Definition of “LIFE CYCLE ASSESSMENT” (According to ISO 14040):

A technique to determine the potential environmental aspects and impacts associated to a product, service or process, with a compilation of the system inputs and outputs; the assessment of the potential environmental impacts associated to those inputs and outputs; and the interpretation of the results from the inventory and impact stages related to the objects of study.

*“Life Cycle Assessment (LCA) is one of the most used methodologies to improve the environmental behaviour of products, processes and activities”.*

### Life Cycle stages



## 4.1 Definition of Life Cycle Assessment

### SUMMARY OF THE STANDARD APPLICABLE TO CARRY OUT A LCA

- ISO 14040:2006. Environmental Management. Life Cycle Assessment. Principles and framework. Specific measures are ex-post issued.
- ISO 14044:2006. Environmental Management. Life Cycle Assessment. Requirements and guidelines.
- “ILCD Handbook” (International Reference Life Cycle Data System). 2012. Issued by the European Platform on Life Cycle Assessment.
  - They develop also the “ILCD Data Network” (Reference data sets development).

*The LCA is the base for sustainable consumption and production, the technical support of:*

- Ecodesign.
- Carbon footprints (GHG emissions), hydro, environmental, etc.
- Eco-labelling type I (Ecolabel, etc.) and type III (Environmental Product Declaration -EPD).
- GPP: Green Public Procurement.

## 4.1 Definition of Life Cycle Assessment

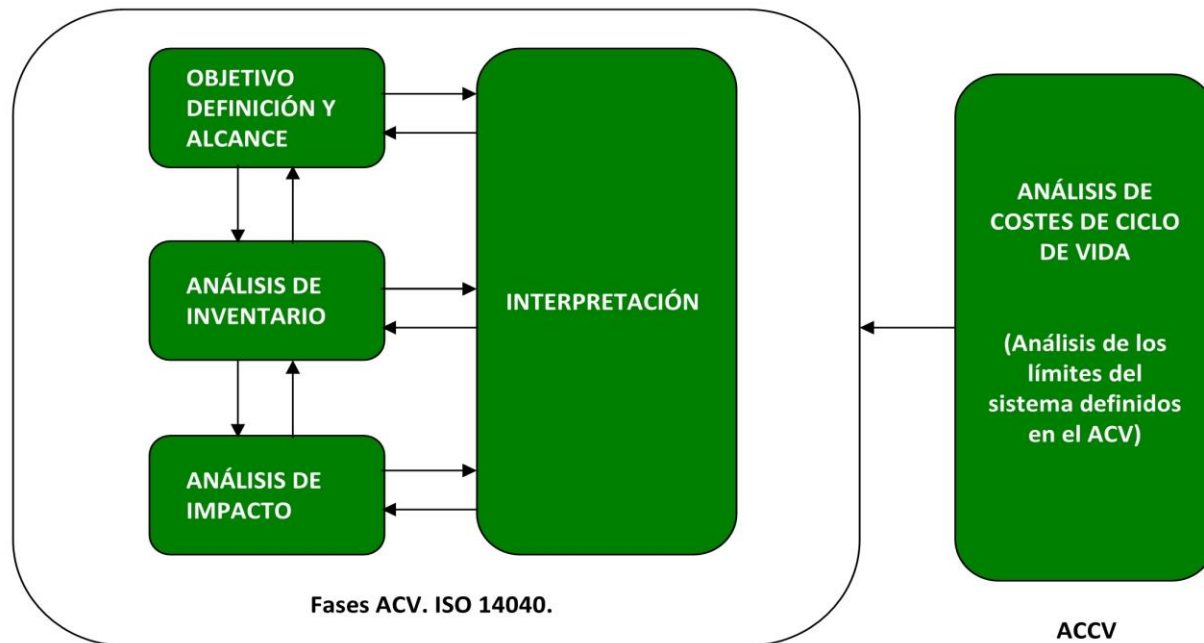
### **BENEFITS OF LIFE CYCLE ASSESSMENT (LCA)**

- It provides information about the negative environmental impacts. Holistic approach of LC stages, not only manufacturing. Clear image.
- It is helpful to take decisions and actions to reduce and to remove negative environmental impacts. It promotes product development and design with a better environmental performance.
- It is helpful to avoid that an implemented solution to an environmental problem of a certain stage generates an even worse problem in another stage of the cycle.
- It is the technical support of Ecodesign and “Eco-labelling”. Integrated in the marketing strategy of the product, it helps making known that environmental criteria have been taken into account during the design.
- LCA is an instrument not only for environmental protection and preservation of natural resources, but also for costs reduction and the improvement of the competitiveness of a company.



## 4.2 Life Cycle Assessment Stages

### MAIN STAGES OF A LCA



STAGE 1: GOAL AND SCOPE DEFINITION

STAGE 2: INVENTORY ANALYSIS

STAGE 3: IMPACT ASSESSMENT

STAGE 4: INTERPRETATION

When required:

STAGE 5: LIFE CYCLE COSTING ANALYSIS

## 4.2 Life Cycle Assessment Stages

### 4.2.1 Stage 1: Goal and Scope Definition

#### STAGE 1 OBJECTIVE:

##### DEFINE:

- Aim of the study.
  - Reason for undertaking the study.
  - Target audience.
  - Description of the chosen system: functional unit, system boundaries, data quality requirements, stated hypothesis, assessment methods, selecting impact categories, etc.
- Description of the chosen system:
    - Functional unit.
    - System boundaries.
    - Data quality requirements.
    - Stated hypothesis.
    - Assessment methods.
    - Selecting impact categories.
    - Etc.

*“LCA may be applied to a product,  
process or activity”*

## 4.2 Life Cycle Assessment Stages

### 4.2.1 Stage 1: Goal and Scope Definition

#### BASIC CONCEPTS ON LCA

##### FUNCTIONAL UNIT

###### ■ Definition:

Reference unit to measure the performance of the product inputs and outputs. Its function must be identified and quantified in order to compare different products or systems.

*“The “functional unit” allows working in a manner corresponding to alternative systems for its comparison”:*

##### Functional unit examples:

- Two different products cannot be compared, but its service can.

Example: milk packages, glass and HDPE.

The functional unit would be: “the distribution of a certain amount of milk” (e.g. 100,000 litres or another quantity).

- When the two products belong to the same category.

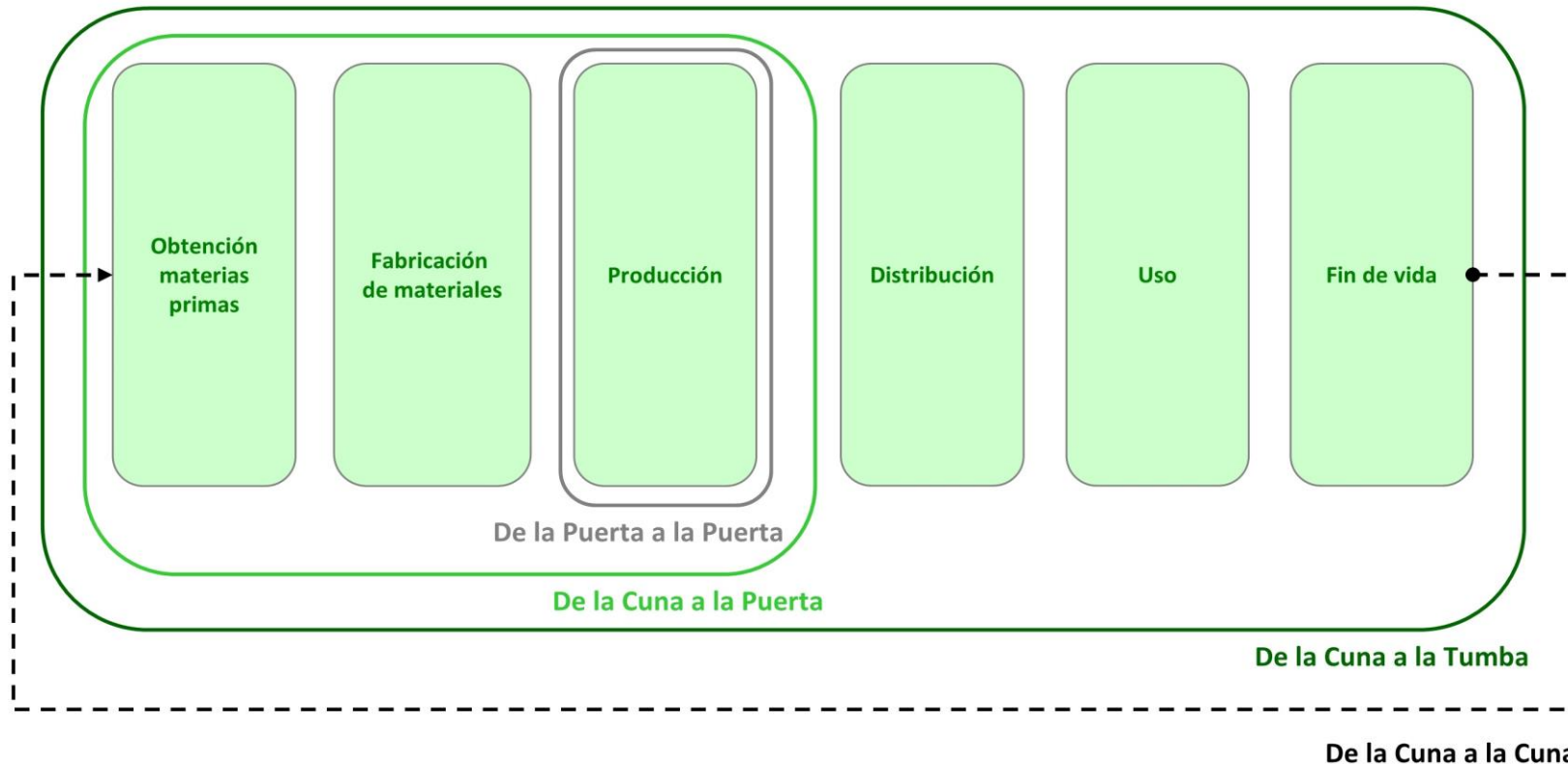
- Example: two chairs, the functional unit for the study of each product is “a chair”.



## 4.2 Life Cycle Assessment Stages

### 4.2.1 Stage 1: Goal and Scope Definition

#### BASIC CONCEPTS ON LCA



#### SYSTEM BOUNDARIES

- Determine which unitary processes must be included in the LCA.
- The possible “system boundaries” of a LCA are:
  - From “Cradle to Gate”.
  - From “Gate to Gate”.
  - From “Cradle to Grave”.
  - From “Cradle to Cradle”.

## 4.2 Life Cycle Assessment Stages

### 4.2.2 Stage 2: Inventory Analysis (LCI)

#### STAGE 2 OBJECTIVES:

**THE NECESSARY DATA IS COLLECTED FOR THE ENVIRONMENTAL ASSESSMENT OF THE PRODUCT, PROCESS OR ACTIVITY**

Necessary data:

- Knowledge of materials and their origin, processes, consumed energy, transportation, waste, emissions, etc.
- Data quality and its availability.
  - Data collection: directly collected or from reliable data sets.
- Ongoing validation of inventory data → Are the data representative and valid?

*To identify and quantify the inputs and outputs of the chosen system for the LCA, i.e. the environmental “aspects” related to the functional unit.*

#### Most used data sets:

- ECOINVENT
- IDEMAT
- TEAM
- BUWAL 250
- ETH-ESU

## 4.2 Life Cycle Assessment Stages

### 4.2.3 Stage 3: Life Cycle Impact Assessment

#### **STAGE 3 OBJECTIVE:**

**THE INVENTORY IS TRANSLATED INTO POSSIBLE INDICATORS OF ENVIRONMENTAL IMPACT, related to: the environment, human health and disposal of natural resources.**

#### **STAGES OF THE LIFE CCLE IMPACT ASSESSMENT**

- 1. Classification of impact categories. (Mandatory).**
- 2. Characterisation or “modelling” of inventory data. (Mandatory).**
- 3. Normalisation, grouping and weighting. (Optional).**

## 4.2 Life Cycle Assessment Stages

### 4.2.3 Stage 3: Life Cycle Impact Assessment

#### STAGES OF LIFE CYCLE IMPACT ASSESSMENT

##### CLASSIFICATION OF IMPACT CATEGORIES

- Chosen categories depend on the aim of the study, the profile and the accuracy for the required results.
- Data are assigned to each impact category according to the expected environmental effect.
- A substance must be considered in each and every category if it contributes to several impact categories.

##### CHARACTERISATION OR MODELLING OF INVENTORY DATA

- Once every substance in the inventory is assigned, using the classification, to one or more categories, their value is compared with regard to the reference of such category.
- Using the “characterisation factors” per impact category, environmental effects become equivalent units.

##### NORMALISATION, GROUPING AND WEIGHTING

- Normalisation: is the conversion of the characterisation results to neutral global units. The extent of the contribution to each impact category on the local environmental problem is depicted.
- Grouping: is the classification of impact categories in global groups.
- Weighting: is the conversion of the characterised values results to a common unit.

## 4.2 Life Cycle Assessment Stages

### 4.2.4 Stage 3: Life Cycle Impact Assessment

#### Environmental Impact Categories according to SETAC

- |                                   |        |  |
|-----------------------------------|--------|--|
| ■ Global warming                  | —————→ | ■ Global Warming Potential (GWP)                   |
| ■ Use of energy resources         | —————→ | ■ Quantity consumed                                |
| ■ Ozone depletion                 | —————→ | ■ Ozone Depletion Potential (ODP)                  |
| ■ Eutrophication                  | —————→ | ■ Eutrophication Potential (EP)                    |
| ■ Acidification                   | —————→ | ■ Acidification Potential (AP)                     |
| ■ Raw material consumption        | —————→ | ■ Quantity consumed                                |
| ■ Photochemical oxidant formation | —————→ | ■ Photochemical Oxidant Formation Potential (POFP) |

#### Characterisation factor

## 4.2 Life Cycle Assessmente Stages

### 4.2.4 Stage 3: Life Cycle Impact Assessment

#### Methodologies for the life cycle impact assessment

- CML-IA
- Ecological scarcity 2013
- EDIP 2003
- EPD (2013)
- EPS 2015d and EPS 2015dx
- ILCD 2011 Midpoint+
- Impact 2002+
- ReCiPe 2016
- BEES
- TRACI 2.1

- The chosen method will vary depending on the level of information required and the aim of the LCA (internal, external, product comparison, etc).
- Some methods intend to define an environmental profile quantifying “midpoints”, which represents the many impact categories, some others try to assess “endpoints” on the environment.

## 4.3 Assessment of Life Cycle Costing

- The Life Cycle Costing (LCC):

Considers all costs, including the environmental impact during the entire life cycle, in the design and development stage of a product, process or activity.

- A product, process or activity costs during the entire life cycle may be:
  - Direct (easily visible): costs of raw materials and labour.
  - Indirect (less visible): costs of the productivity loss due to generated waste, emissions, etc.

*“LCC is a voluntary instrument that the organisation may introduce or implement”.*

*LCC includes every money flow related to a product during its entire life, combines economic with environmental parameters and is useful in the decision-taking process.*

## 4.4 Software for the implementation of LCA and Assessment of LCC

- The Life Cycle Assessment (LCA) is complex because it involves great analysis work, carrying out large calculations and the use of data sets.
- The use of software tools for LCA is very extended.
- Some software tools already include a module to carry out the assessment of the Life Cycle Costing (LCC).

*Las diferentes herramientas software facilitan el desarrollo de un estudio de Análisis de Ciclo de Vida (ACV), especialmente las fases de: Inventario, Evaluación de impactos e Interpretación de resultados.*

*Well known software tools for the implementation of LCA*

- SimaPro
- GaBi
- TEAM™
- UMBERTO
- Eco-it
- Air.e LCA
- Open LCA



Thank you for your attention

## Basic Concepts on Ecodesign

UNIT 4: Life Cycle Assessment and Costs.

