Basic Concepts on Ecodesign

UNIT 4: Life Cycle Assessment and Costs

Funded by the Erasmus+ Programme of the European Union

Ecoinnovation Skills for European Designers, Project number: 562573-EPP-1-2015-1-SI-EPPKA2-SSA.

Objectives

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

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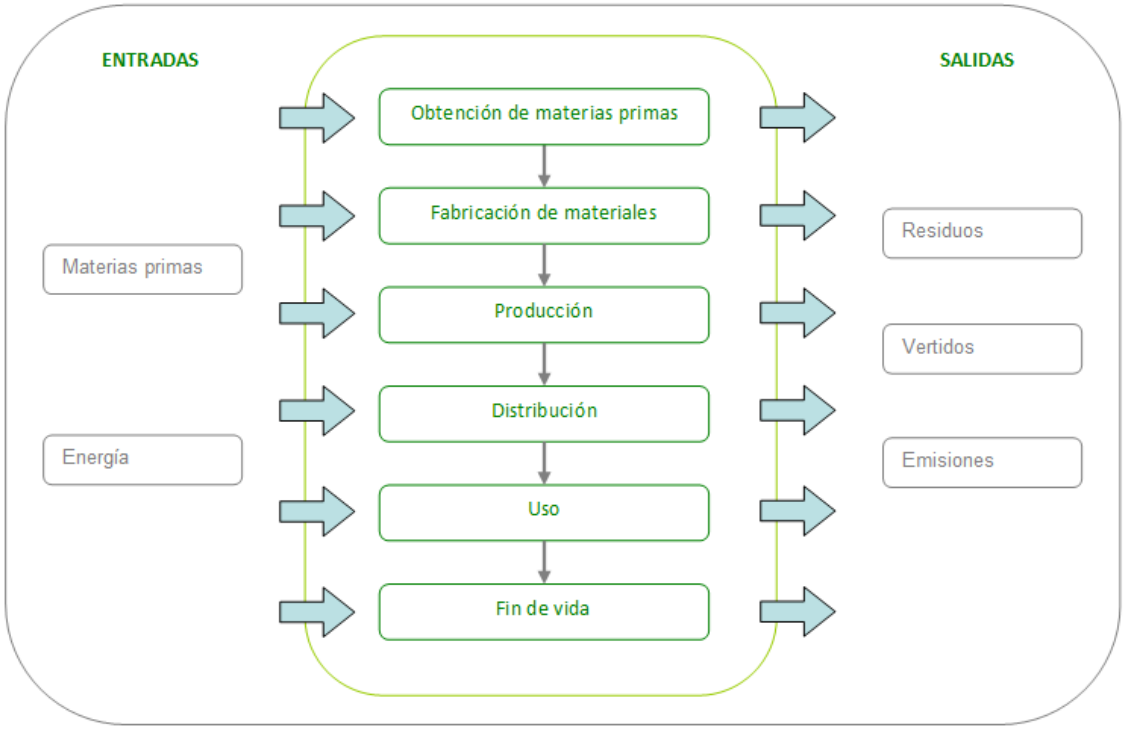
4.1Definition of Life Cycle Assessment

Definition of "LIFE CIYCLE 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



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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.

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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.

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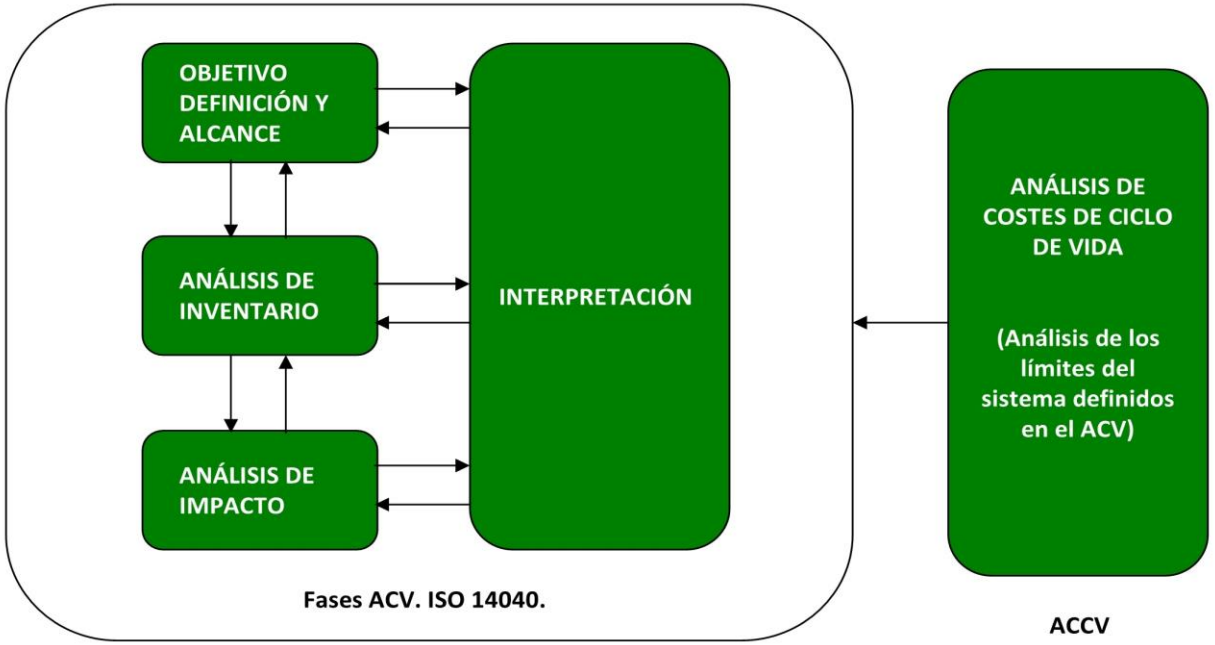
4.2 Life Cycle Assessment Stages

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

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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 quailty requirements, stated hypothesis, assessment methods, selecting impact categories, etc.

"LCA may be applied to a product, process or activity"

- Description of the chosen system:
  - Functional unit.
  - System boundaries.
  - Data quality requirements.
  - Stated hypothesis.
  - Assessment methods.
  - Selecting impact categories.
  - Etc.

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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".

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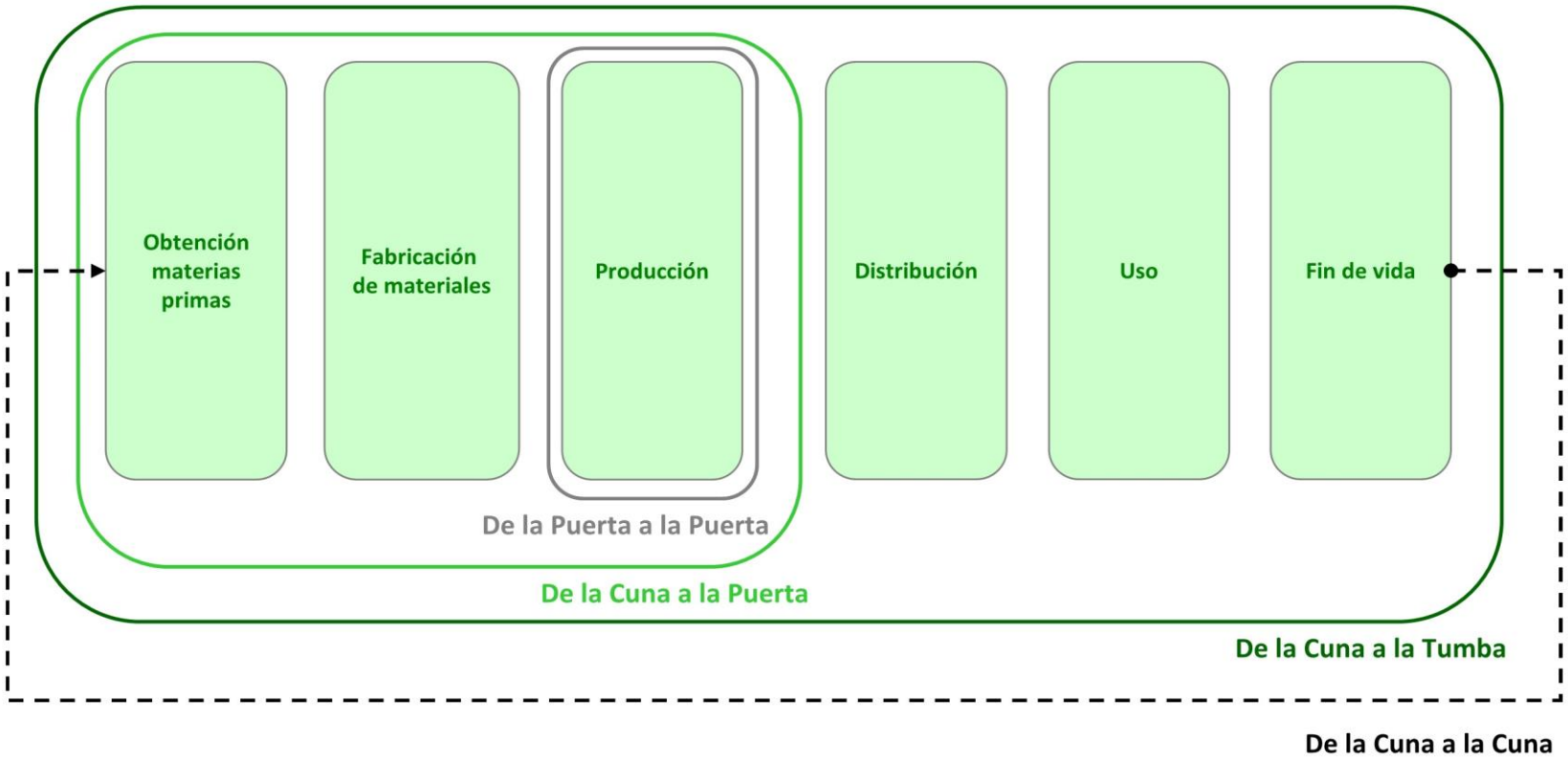
4.2 Life Cycle Assessment Stages
4.2.1 Stage 1: Goal and Scope Definition

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".

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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

Neccesary 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 validatoin 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

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4.2Life 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).

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4.2Life 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 conversión 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 conversión of the characterised values results to a common unit.

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4.2Life Cycle Assessment Stages
4.2.4 Stage 3: Life Cycle Impact Assessment

Environmental Impact Categories according to SETAC	Characterisation factor
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)

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4.2Life 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.

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4.3Assessment 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 curing 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 decisión-taking process.

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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

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Thank your for your attention

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