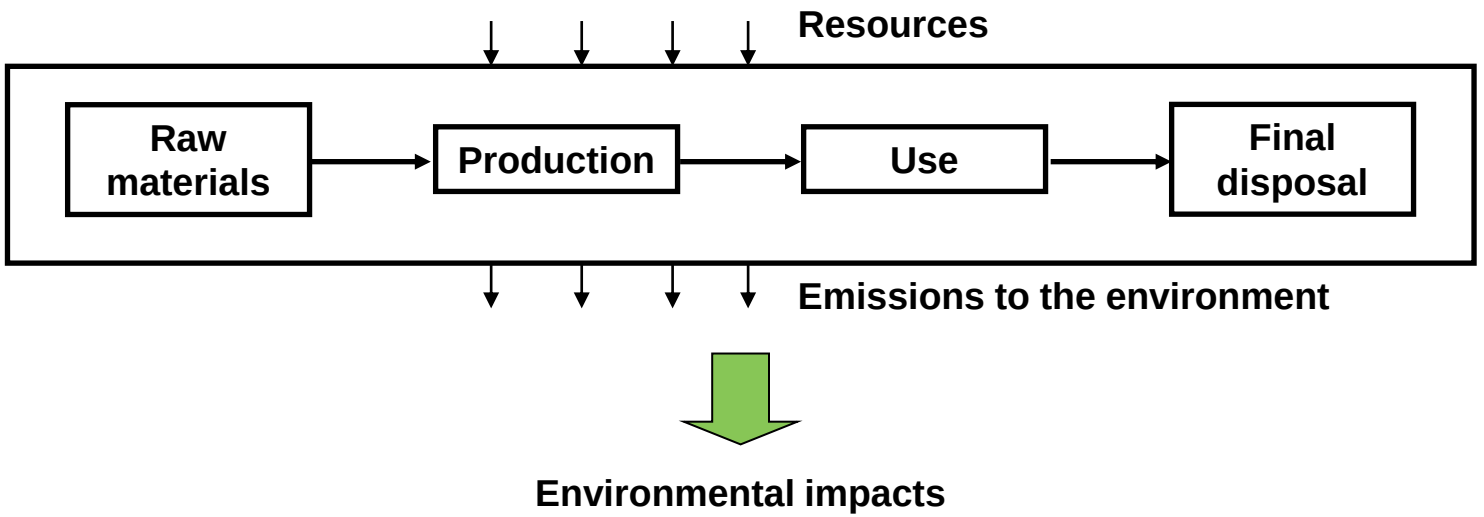
Análise de ciclo de vida

Life Cycle Assessment (LCA)

LCA studies the environmental aspects and potential impacts throughout a product's life (i.e. cradle-to-grave) from raw material acquisition through production, use and disposal.



APPLICATIONS

or

?

LCA of diapers - Franklin Associates Ltd, 1992

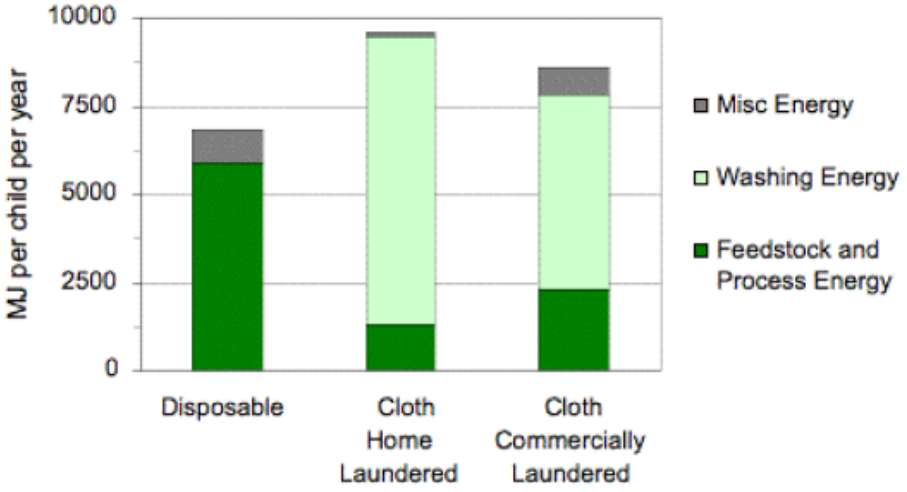


Figure 1 - Total energy used by each diaper type in one year. Feedstock and process energy includes energy used through cotton growing, material processing and diaper manufacture. It also includes energy used and embodied in bleach and detergent.

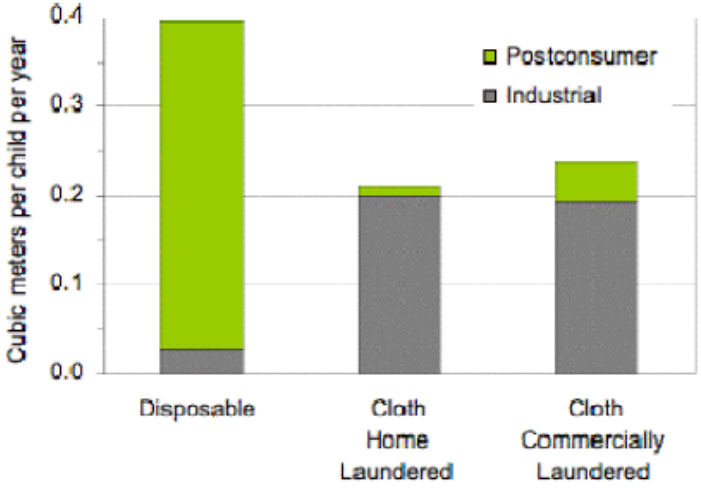


Figure 2 - Volume of solid waste per year. Industrial Waste includes waste used to produce the diaper such as raw material production and process, manufacture trimmings, and ash from electricity generation. Post consumer waste refers to substances thrown out: the diaper itself, child waste, and packaging.

APPLICATIONS

Support decision making

At industrial level:

Example: what is the best alternative for the end-of-life of industrial wastes?

Environmental assessment of valorisation alternatives for woody biomass ash in construction materials

Tamíris Pacheco da Costa, Paula Quinteiro, Luís A.C. Tarelho, Luís Arroja, Ana Cláudia Dias*

Resources, Conservation & Recycling 148 (2019) 67–79

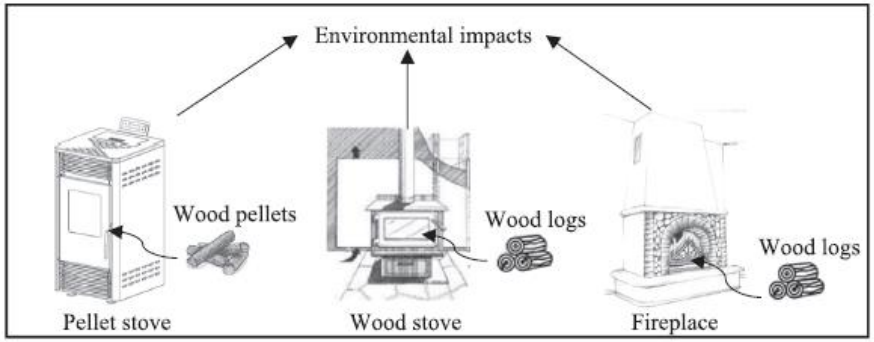
At the consumer level:

Example: what is the best alternative for residencial heating: wood pellets or wood split logs?

Life cycle assessment of wood pellets and wood split logs for residential heating

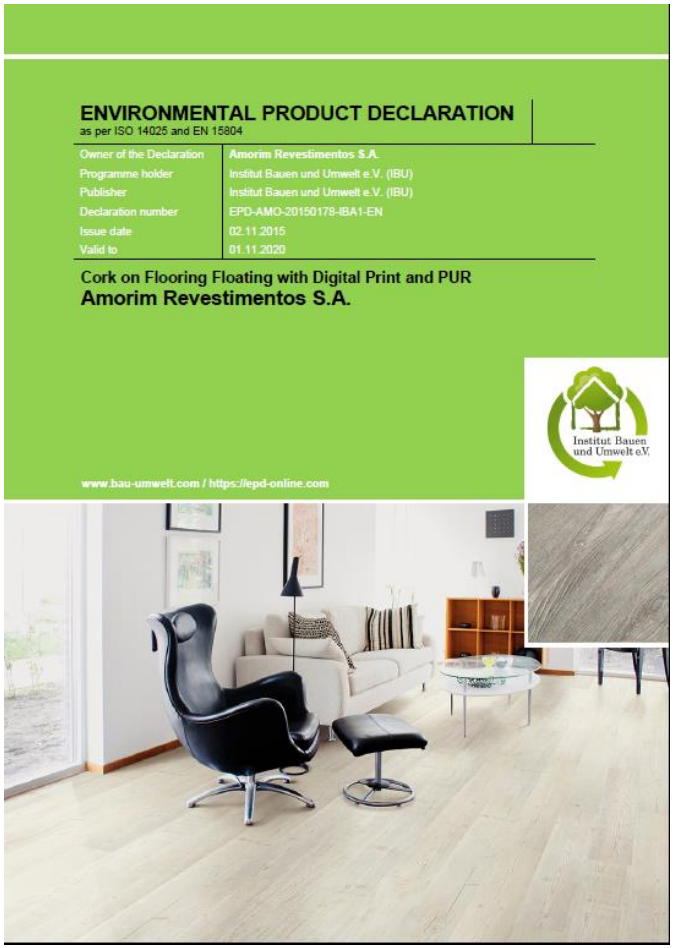
Paula Quinteiro [a,*], Luís Tarelho [a], Pedro Marques [b], Mario Martín-Gamboa [a], Fausto Freire [b], Luís Arroja [a], Ana Cláudia Dias [a]

Science of the Total Environment 689 (2019) 580–589

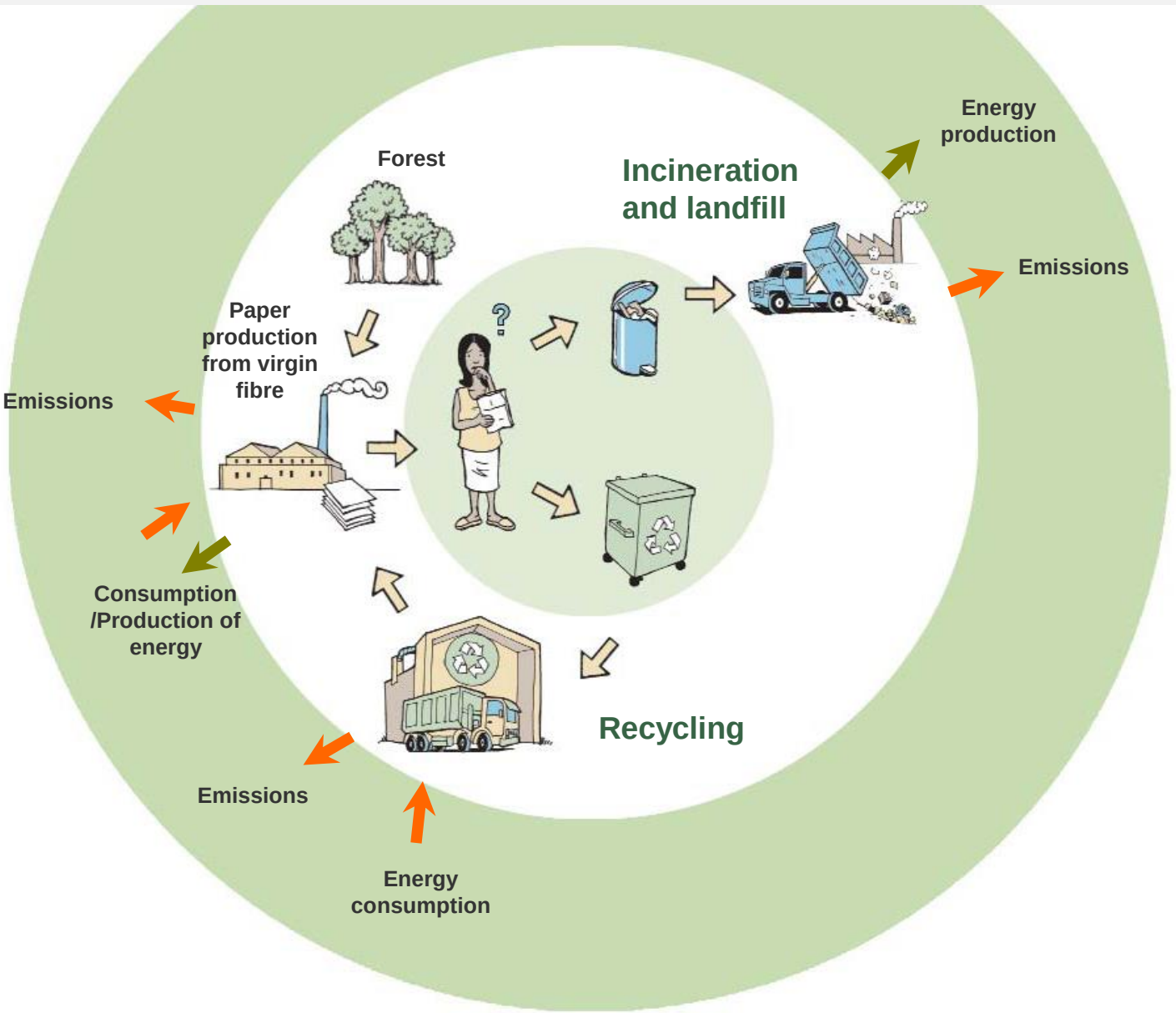


APPLICATIONS

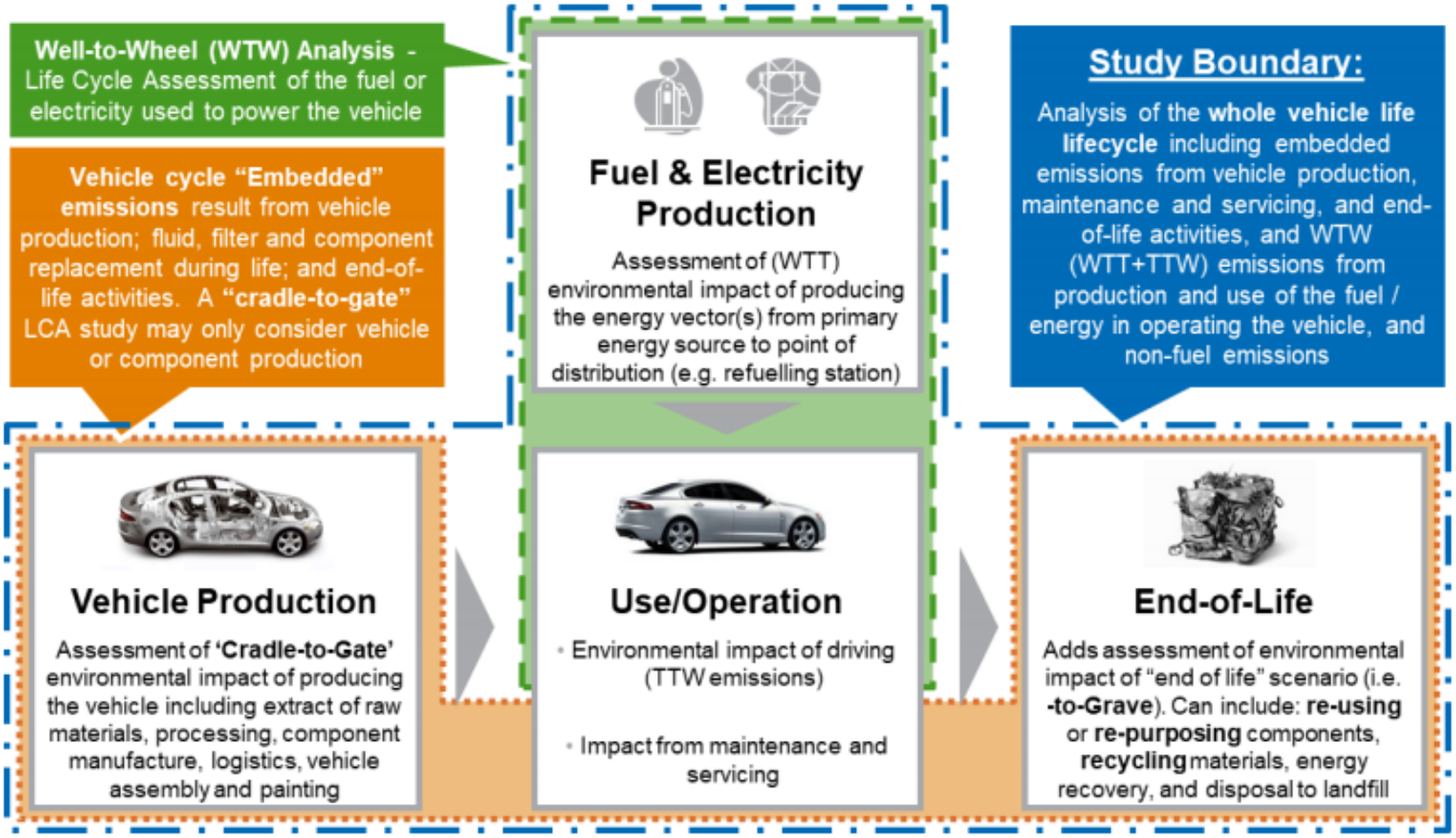
Marketing strategies



Example: what is the better alternative for the end-of-life of paper from an environmental point of view?



Example: electric vehicles or internal combustion engine vehicles?



Determining the environmental impacts of conventional and alternatively fuelled vehicles through LCA

APPLICATION OBJECTS OF LCA

- Products
- Activities and services (e.g.: travel, music concert)
- Sector
- Organizations (e.g.: schools, companies, hospitals)
- Territories (e.g.: country, city)

STRENGTHS AND WEAKNESSES

- **Strengths:**
  - Cradle-to-grave approach
  - Avoidance of problem shifting, for example:
    - from one life cycle stage to another (e.g., decreasing the impact at the use stage but increasing at the impact at the end-of-life)
    - from one geographic area to another (e.g., decreasing water use at a region where water availability is not a problem but increasing water use at a region with water scarcity)
    - from one environmental medium (e.g. water) to another (e.g. soil) (e.g., decreasing water pollution but increasing soil pollution)
  - Multicriteria approach (several environmental impacts)
  - Quantitative analysis

STRENGTHS AND WEAKNESSES

- **Weaknesses:**
  - Data requirements
  - Relevance of results
  - Time (and resource) consuming

GOAL AND SCOPE DEFINITION
DATA

- Data on **input flows**:
  - Consumption of raw materials
  - Consumption of ancillary materials
  - Consumption of electricity and fuels
  - Consumption of water
- Data on **output flows**:
  - Products and co-products
  - Emissions to air (CO_2, CO, SO_2, NO_x, particles, Hg, Fe, Zn, …)
  - Emissions to water (N, P, …)
  - Solid wastes
  - Others (land use, radiation, …)


ENTRADAS
SAÍDAS
Matérias Primas
Energias
Aquisição matérias primas
Produção (fabricação)
Utilização / Reutilização / Manutenção
Reciclagem / Gestão do resíduo
Emissões para o ar
Descargas para a água
Resíduos sólidos
Co-produtos
Outras descargas ambientais
Limite do sistema

Example – Impact category selection

- Impact categories
  - ✓ global warming
  - ✓ acidification
  - ✓ eutrophication
  - ✓ non-renewable resource depletion
  - ✓ photochemical oxidant formation
  - ✗ stratosferic ozone depletion
  - ✗ ecotoxicity
  - ✗ human toxicity
  - ✗ water use
  - ✗ land use

No inventory data available

No consensual methodology available

Example – Impact category selection

- Impact categories

  ✓ global warming

  Caused by greenhouse gas emissions:

  - CO_2
  - CH_4
  - N_2O
  - SF_6
  - Halons
  - CFCs (chlorofluorcarbons)
  - HCFCs (hydrochlorofluorcarbons)
  - HFCs (hydrofluorcarbons)
  - PFCs (perfluorcarbons)

Example – Impact category selection

- Impact categories

  ✓ acidification

  Deposition at the terrestrial surface of acid substances caused by the emission to air of acidifying gases such as:

  - SO_2
  - NOx
  - NH_3

Example – Impact category selection

- Impact categories
  - ✓ Eutrophication
    - Nitrogen
    - Phosphorus

Surplus of nutrients in aquatic mediums → Growth of algae → Growth of microorganisms that decompose the dead algae → Decrease of dissolved O_2 → Death of aerobic organisms → Increased amount of organic matter for decomposition

Development of anaerobic microorganisms that produce toxic compounds

Example – Impact category selection

- Impact categories
  - ✓ non-renewable resource depletion
    - Fossil resources (crude oil, coal, natural gas)
    - Mineral resources

Example – Impact category selection

- Impact categories
  - ✓ photochemical oxidant formation

    Formation of oxidants (mainly O_3) through a complex set of chemical reactions involving organic compounds and NO_x (mainly from the burning of fossil fuels), in the presence of sunlight