Life Cycle Assessment(LCA)

universal environmental sustainability assessment tool

Greg Ganczewski

COBRO – Packaging Research Institute

Sustainable Development

To use the traditional definition, sustainable development is:

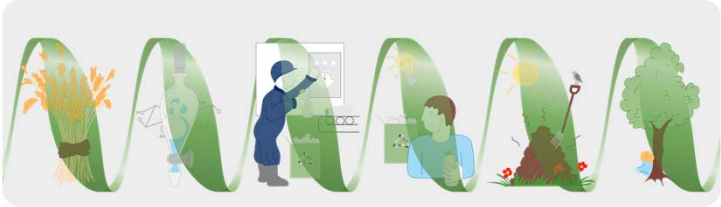
"development that meets the needs of the present without compromising the ability of future generations to meet their own needs", in other words ensuring that today's growth does not jeopardize the growth possibilities of future generations.

Sustainable development thus comprises three elements - economic, social and environmental - which have to be considered in equal measure at the political level. The strategy for sustainable development, adopted in 2001 and amended in 2005, is complemented inter alia by the principle of integrating environmental concerns with European policies which impact on the environment.

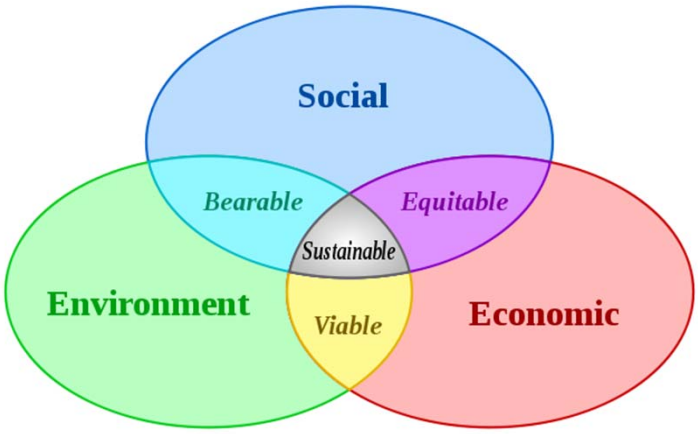
- source: http://europa.eu

Sustainable Development

Sustainable development concept for business, consists of taking into consideration widely understood **economic, environmental and social** issues in the **daily and long term operations of a company.**



Sustainable Development



Sustainable Development

Sustainable development concept for business consists of taking into consideration widely understood **economic, environmental and social** issues in the **daily and long term operations of a company**.

In plastic industrial practice that means being responsible for the introduction of new products on a plastics market from the perspective of those three issues.

This means that new products should be evaluated with regards to environmental, social and economic impacts they generate. **This evaluation, which gives equal rank to all three elements, should be performed in whole product life cycle stages (designing, manufacturing, using, recycling).**

Sustainable Development

This fulfilment has to be present in **all product life cycle stages**, starting from:

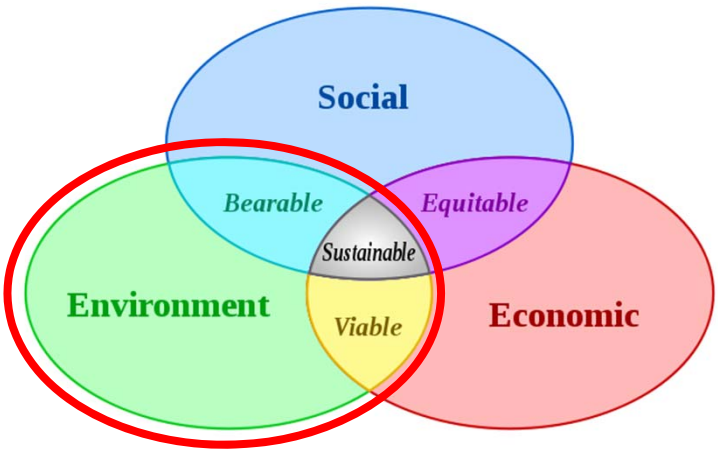
- production processes,
- delivery chain,
- processing methods,
- packaging,
- distribution,
- usage and
- waste management including transport.

At the same time sustainable products should match up or exceed conventional products by functional and quality properties, fulfil todays environmental protection standards, and also contribute to waste management system.

Sustainable Development

Due to the fact that paper materials are used in many industry branches it is hard to set an equal standards and specify define sustainable development policy for all of them. That is why basic standards should be set for all polymer products and for specific sustainability standards should be set for different groups of uses.

Sustainable Development



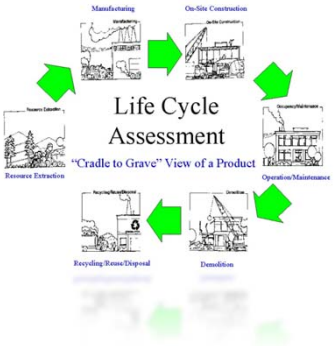
Sustainability – Environment

LCA method can be used to rate and compare a product with another products with similar functionality.

- LCA method consists of different criteria of evaluation in all life cycle stages of a selected product.
- Potential environmental influence of every life cycle process of a chosen product is quantitatively recorded in different impact categories

What is LCA??

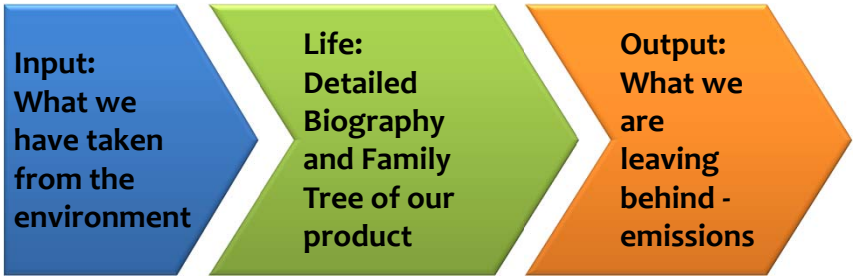
- LCA = Life Cycle Assessment
- Probably the most popular sustainability and environmental assessment methods
- Can be used to assess products, value chains, processes, whole companies, economy and even socio-cultural implications
- Its main goal is to assess the aspects of environmental impacts in whole life cycle of selected subject matter.



Packaging LCA

- Packaging LCA is used to assess the environmental impact of packaging and includes such factors as infrastructure (transport), multi-usability of packaging and how the packaging is/can be disposed.
- LCA is best used as a comparative assessment tool – i.e. in terms of packaging it is best to compare different packaging types for the same group of products.

What is LCA ??



LCA as a description of reality

LCA is used to *model* **complex** reality

+

Each *model* **simplifies** the reality

=

Contradiction – simplification distorts the reality

Main goal of LCA – minimise this distortion

How to use LCA

- Internal LCA – used by enterprises
  - 'knowing your product', identification of 'hot spots', strategic management goals
  - Marketing/Benchmarking
  - PR
  - Preparation for legislation changes, arguments for lobbying
- External LCA – full public reports
  - Published by public institutes/research institutes
  - Needs to be peer reviewed
  - Not often used by enterprises due to bad experiences in the '90 (benchmarking backfire)

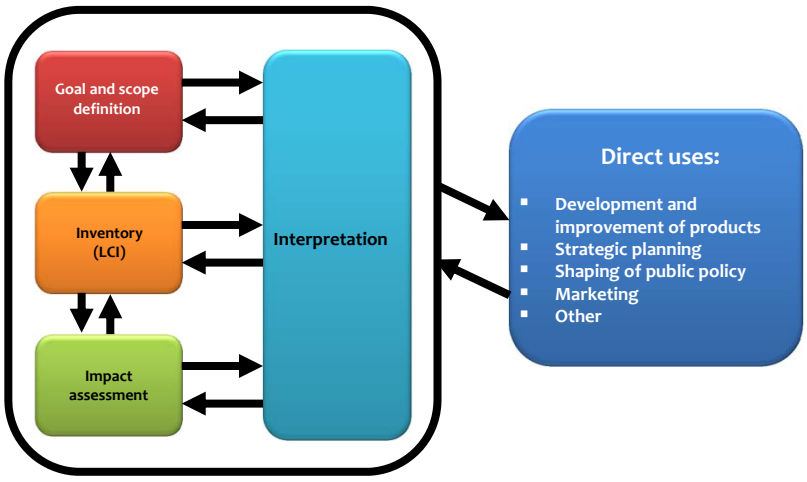
LCA Standards

- 2 main standards:
  - EN ISO 14040 – main concept
  - EN ISO 14044 – details
- Other relevant standards:
  - EN ISO 14020 series – Environmental labels and declarations
    - 14021 – Type II
    - 14024 – Type I
    - 14025 – Type III
  - 14064 – GHG emissions – *due soon*
  - 14067 – Carbon Footprint calculation – *due soon*

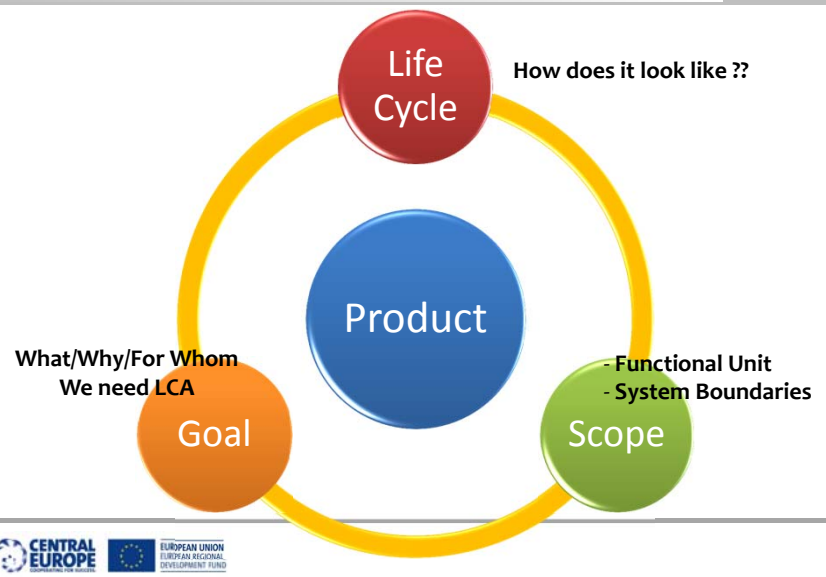
LCA CEN Reports

- 2 CEN Reports for packaging:
  - CR 12340:1996 – Recommendations for LCI of packaging systems
  - CR 13910:2009 – Criteria and methods for packaging LCA

LCA in 4 steps



Step 1 – Goal and Scope



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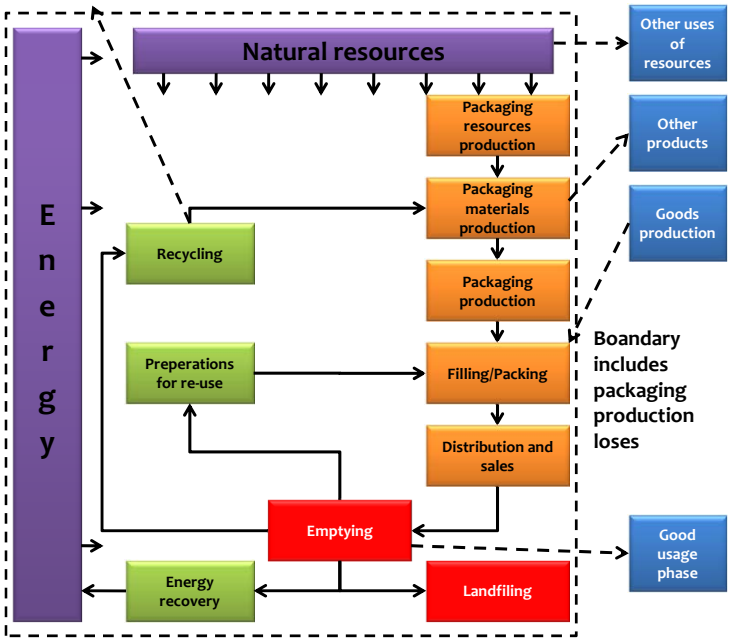


Step 1 – Goal and Scope
Functional Unit

- Unit of reference
- Quantitative system effect – unit has to measure same effect when comparing 2 or more products
- All data should be referenced to the functional unit

Step 1 – Goal and Scope
Functional Unit

Functional Unit examples:

- Paint: 20 m^2 area coverage for 20 years
- Ice-cream: kcal / mass / leisure time
- Beverage packaging: volume of beverage
- Public transport: person-kilometer
- Packaging waste: kg
- Shopping bags: 5 kg of shopping carried for 500 meters
- Hand towels: 10 000 washed hands

Step 2 – LCI

Data collection – depends on the goals and scope of our research.

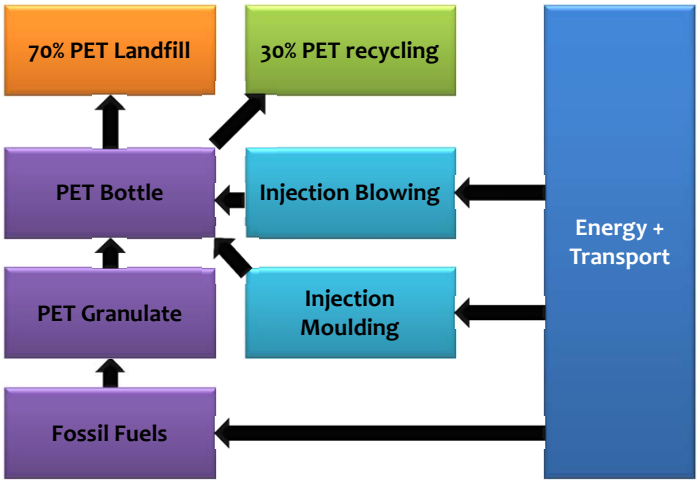
- What shall be taken into account:
  - System boundaries
  - Geography
  - Time of data collection
  - Functional Unit
  - Allocation methods
  - But most importantly: **Time and Money!!**

Step 2 – LCI

Step 2 effect – Process Tree

- Process Tree includes all LCI results in the form of inputs and outputs emissions from and to soil, atmosphere, water etc.
- Examples of quantitative results of LCI: CO_2, CFC, P, SO_2, NOx, DDT used/emitted during different stages of life cycle.

Step 2 – Process Tree
PET bottle – recycling 30%



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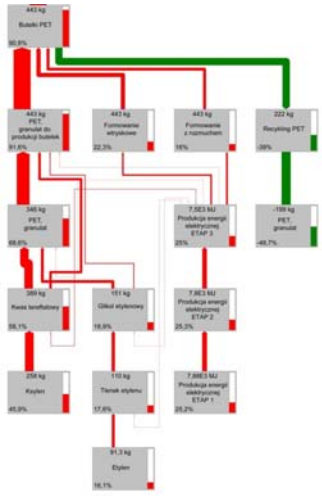

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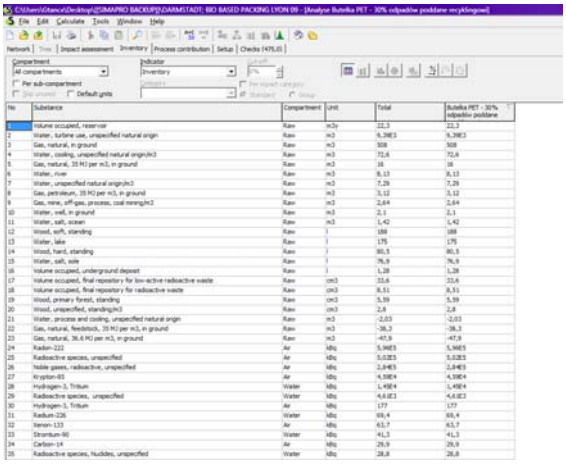


CENTRAL EUROPE
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Step 3 – Impact Assessment

- LCI results while interesting do not give us any specific information about the environmental impact of a particular product
- LCI results should be interpreted and characterised into impact categories
- There are many characterisation methods available, many of them with normalisation and weighting options

Step 3 – Method example

CML 2000

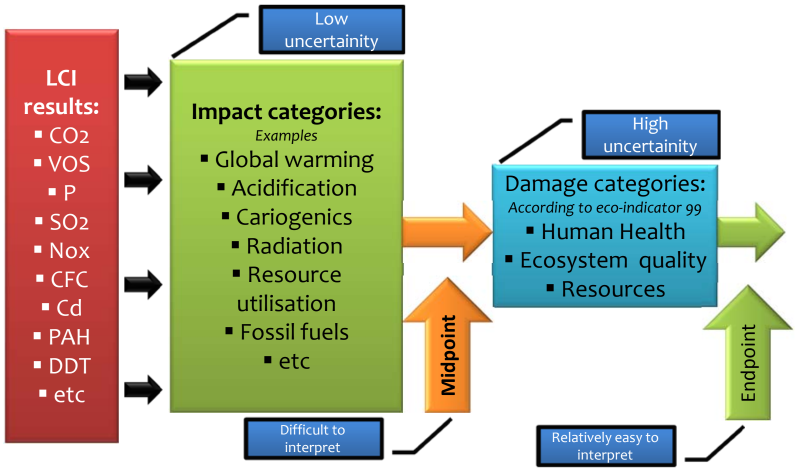
LCI result	Climate change	Acidification	Human toxicity
1000 gr CO2	x 1 = 1000		
10 gr. CH4	x 23 = 230		
10 gr. SO2		x 1 = 10	x 9.6E-2 = 0.96
5 gr. NOx		x 0.7 = 3.5	x 1.2 = 6
1E-7 gr dioxine			x 1.3E9 = 130
Total	1230	13.5	136.96

Human toxicity potentials

CO2-eq.

SO2-eq.

Step 3 –
Midpoint and Endpoint in a method



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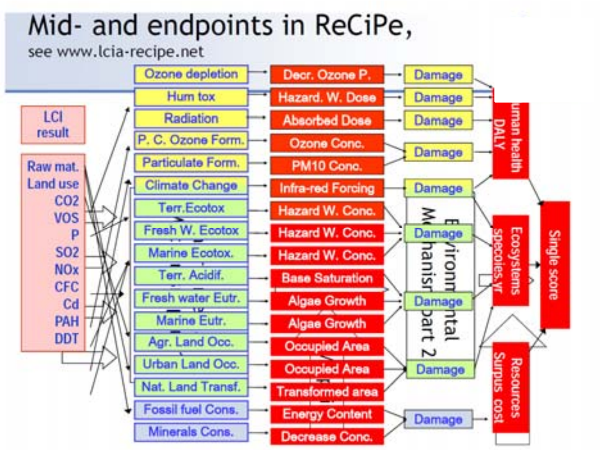
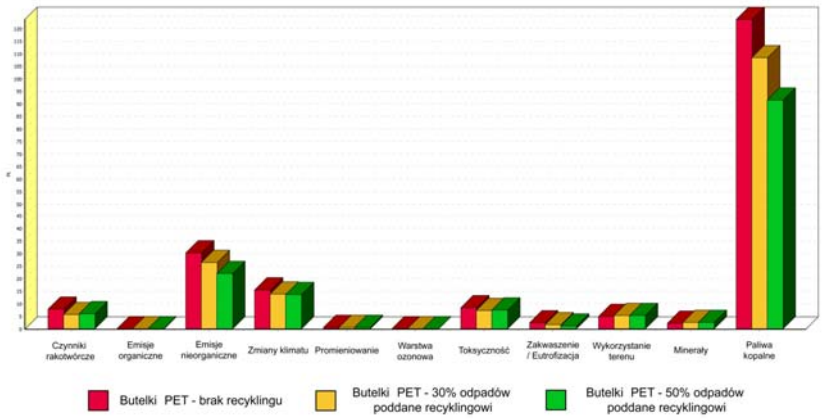


Step 3 – Impact Assessment

3 PET bottles – No recycling / recycling 30% & recycling 50%
Method: Eco-indicator 99



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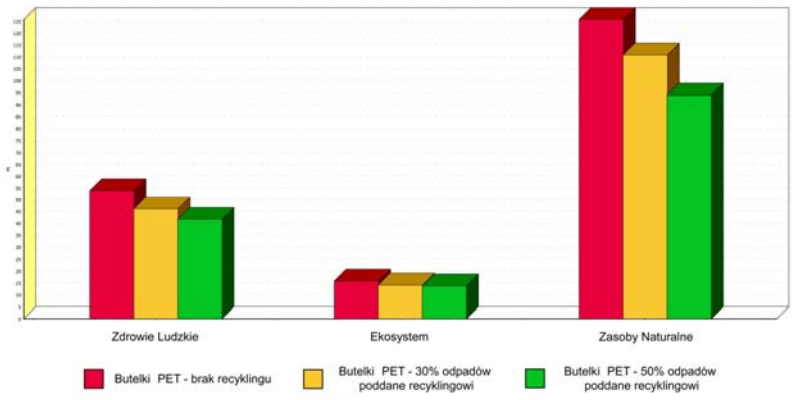

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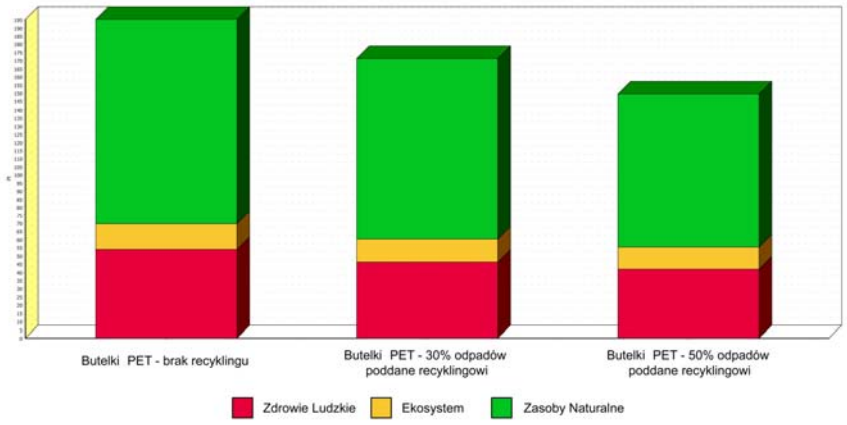


Step 4 – Interpretation

ISO 14044 standard recommends that before drawing conclusions and preparing a report from 3 previous steps, following elements should be checked:

- Check consistency of results with goal and scope definitions
- Check processes with highest environmental impact
- Check for anomalies (use best judgment)
- Check whether the method is consistent with assessed product
- Some methods omit substances present in the LCI – check whether the number of omitted substances influence the result by choosing a different method
- LCA is not objective, therefore it is helpful to check how the LCA results are dependent on our choices throughout the process.
- Perform uncertainty and sensitivity analysis where logical and possible. Prepare few scenarios.

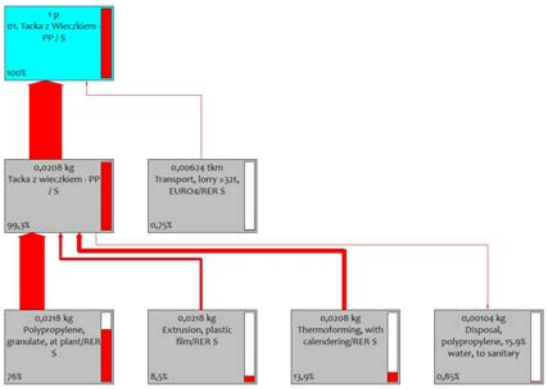
LCA Example

Cheery tomato container from the following materials :

1. **PP**
2. **PET**
3. **rPET**
4. **PLA**

LCA Example

PP container



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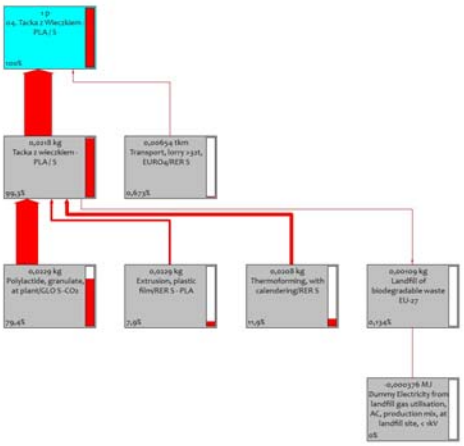
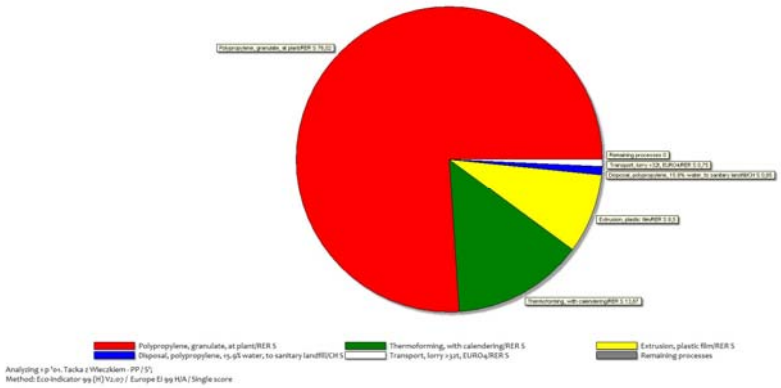


PLA container

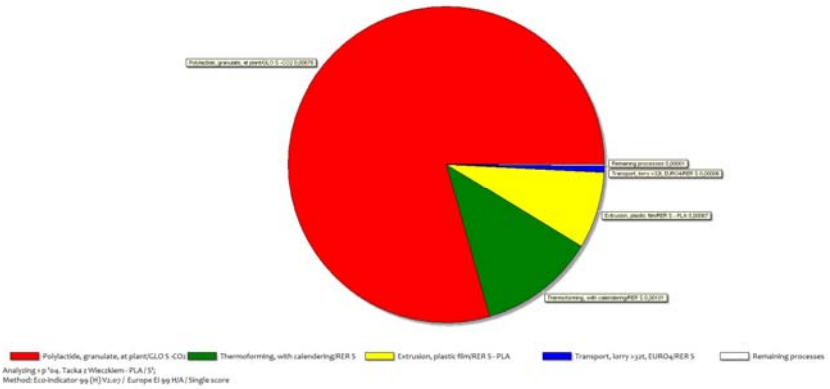
LCA Example

PP container



LCA Example

PLA container



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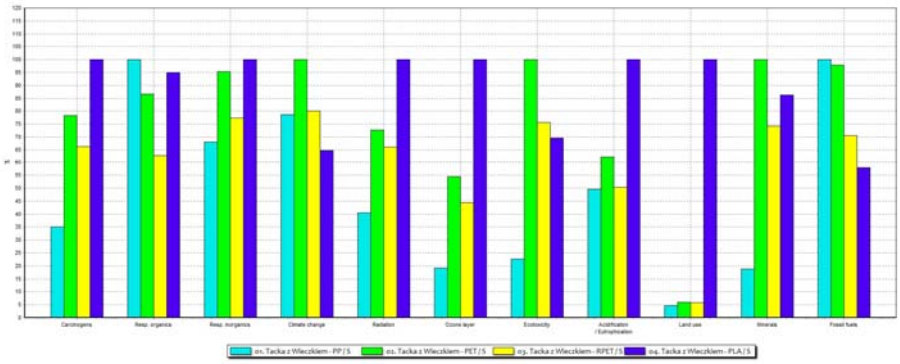
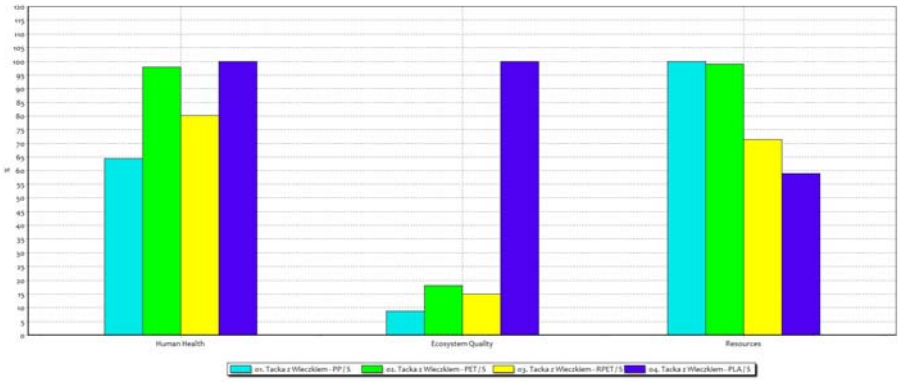


PP PET rPET PLA

LCA Example



PP PET rPET PLA

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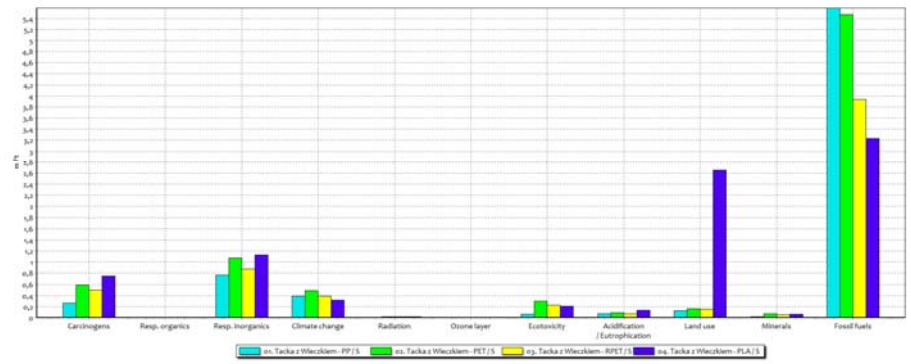

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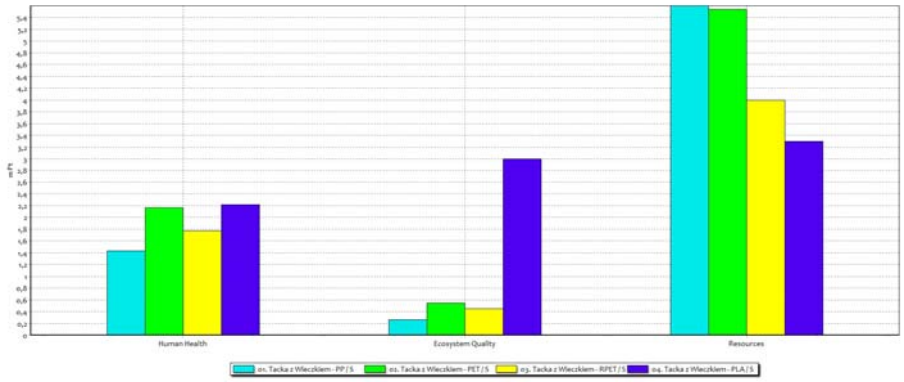


PP PET rPET PLA

Summary

Resources

Production of materials

Packaging production

Packaging

Product Distribution

Landfilling Recovery

- Natural resources utilisation
- Environmental damage
- Energy utilisation
- Gas emissions
- Liquid waste
- Solid waste
- Damage impact assessment

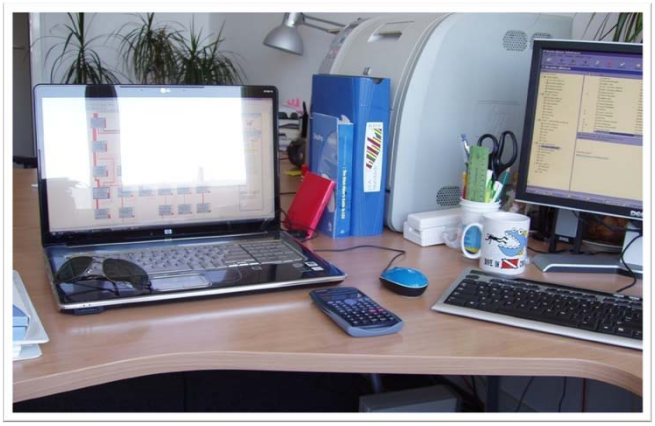
Summary

- LCA importance: selected beverage packaging in Germany is excused from obligatory deposit fees introduced from 1st of January 2003 based on LCA results
- Beverage packaging included in deposit fees legislation: single use packaging for beer, mineral water and carbonated drinks, i.e. **glass bottles, PET bottles and aluminium cans**
- Packaging excused from deposit fees include: **boxes from laminates and film bags for fruit juices, milk and non carbonated beverages.** Life Cycle Assessment of those materials proven to be similar to multi-use bottles, hence the provision.

LCA in EcoPaperLoop

- **Determination of environmental impacts for paper products and comparison**
- **Paper Packaging**
  - **Recyclable**
  - **Non-recyclable**
- **Graphic**
  - **Recyclable on similar quality level**
  - **Recyclable on lower quality level**
  - **Recyclable only for packaging**

Thank you!!



LCA Workstation