



# Life Cycle Assessment of Products and Services to Assess Sustainability

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**What is LCA?**

**What is Life Cycle of  
Product or Service?**

**What is Sustainability?**

**LCA is the report on total effect of Emissions to the soil, water and air during the life cycle of the product+ Interpretation+Recommendations**

**Life Cycle = Extraction+production +use+disposal (EoL)**

**How to make the report -> ISO 14043**



# How to Do an LCA?

- **Collect Data**

**(Inhouse/Outside)**

- **Surveys**

- **Define Scenario's**

- **Structure Data and Define Functional Unit**

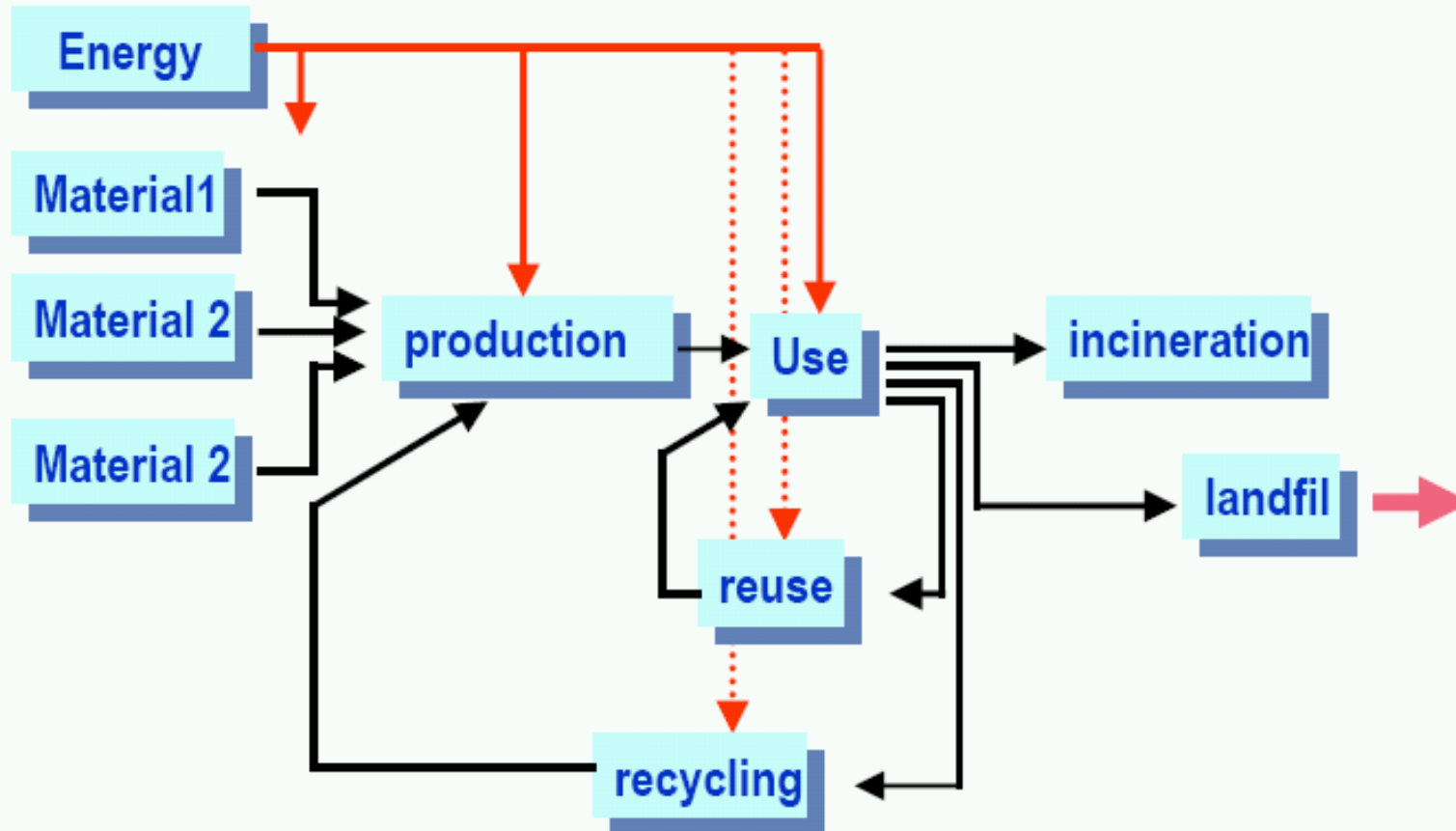


# **Use LCA software such as SimaPro**

- SimaPro has Methods to Compute eco-indicators**
- SimaPro has LCI Databases e.g. Ecolnvent**
- Easy Report/Result Generator**



# Process tree

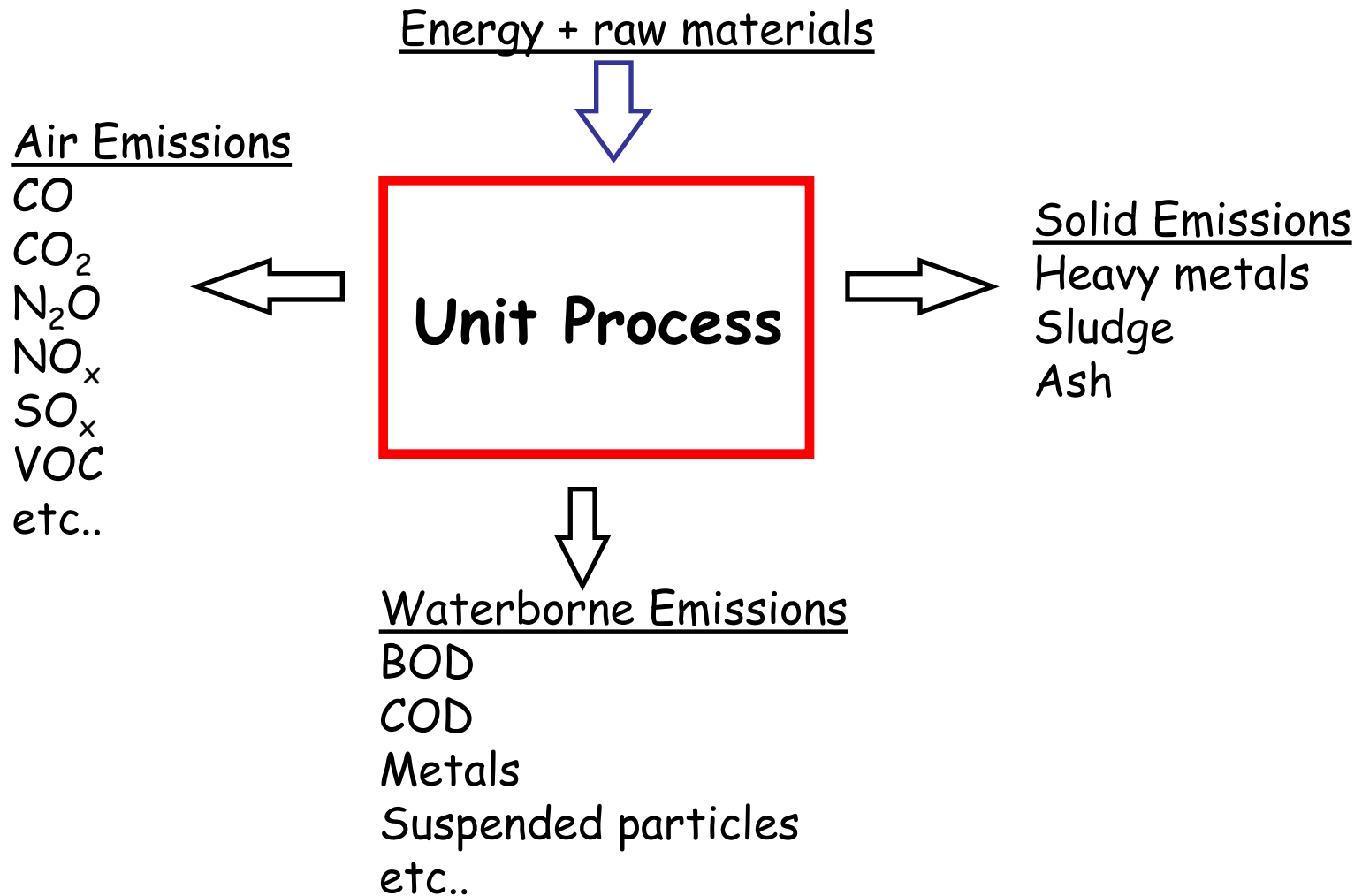


## LCI result

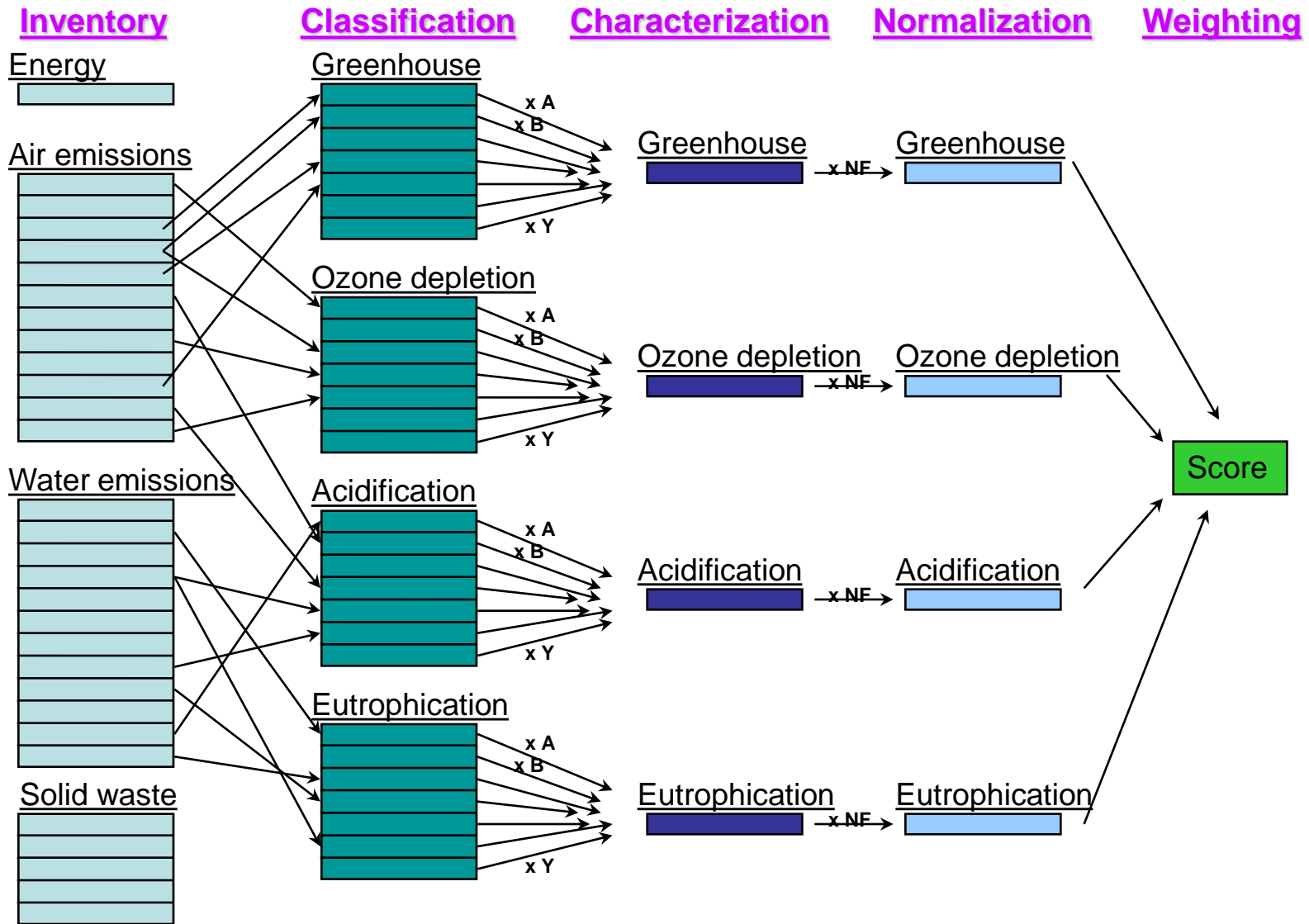
- Raw materials
- Land use
- CO2
- VOS
- P
- SO2
- NOx
- CFC
- Cd
- PAH
- DDT



# Data collection



# Life Cycle Impact Assessment





# 1. Classification/ characterization



LCI result	Climate change	Acidification	Human tox.
1000 gr CO <sub>2</sub>	x 1 = 1000		
10 gr. CH <sub>4</sub>	x 21 = 210		
10 gr. SO <sub>2</sub>		x 1 = 10	x 1.2 = 12
5 gr. NO <sub>x</sub>		x 0.7 = 3.5	x 0.78 = 3.9
10 <sup>-6</sup> gr dioxine			x 3.3x10 <sup>6</sup> = 3.3
Total	1210	13.5	19.4

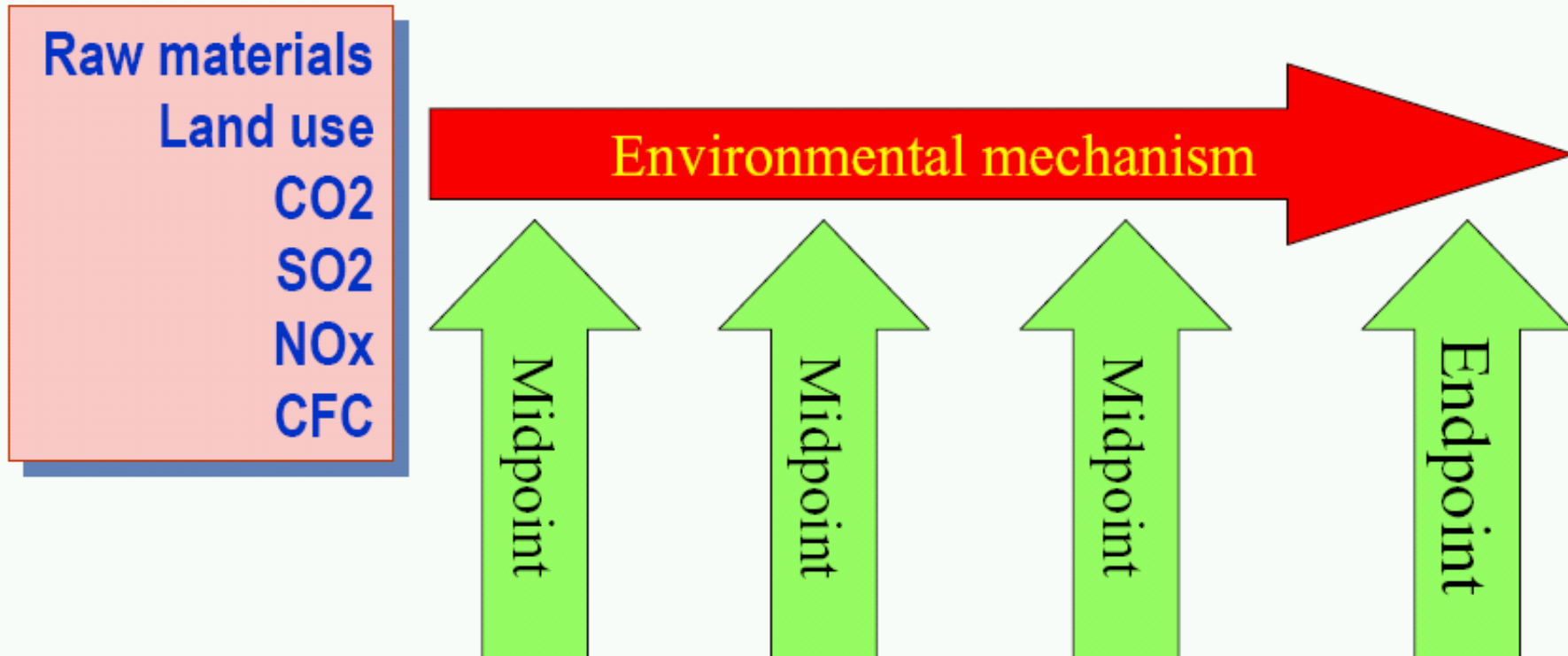
## 2. Normalization/Weighting more subjective ISO require 1. Classification/Characterization

# Midpoint method:

## Interpretation of characterized results

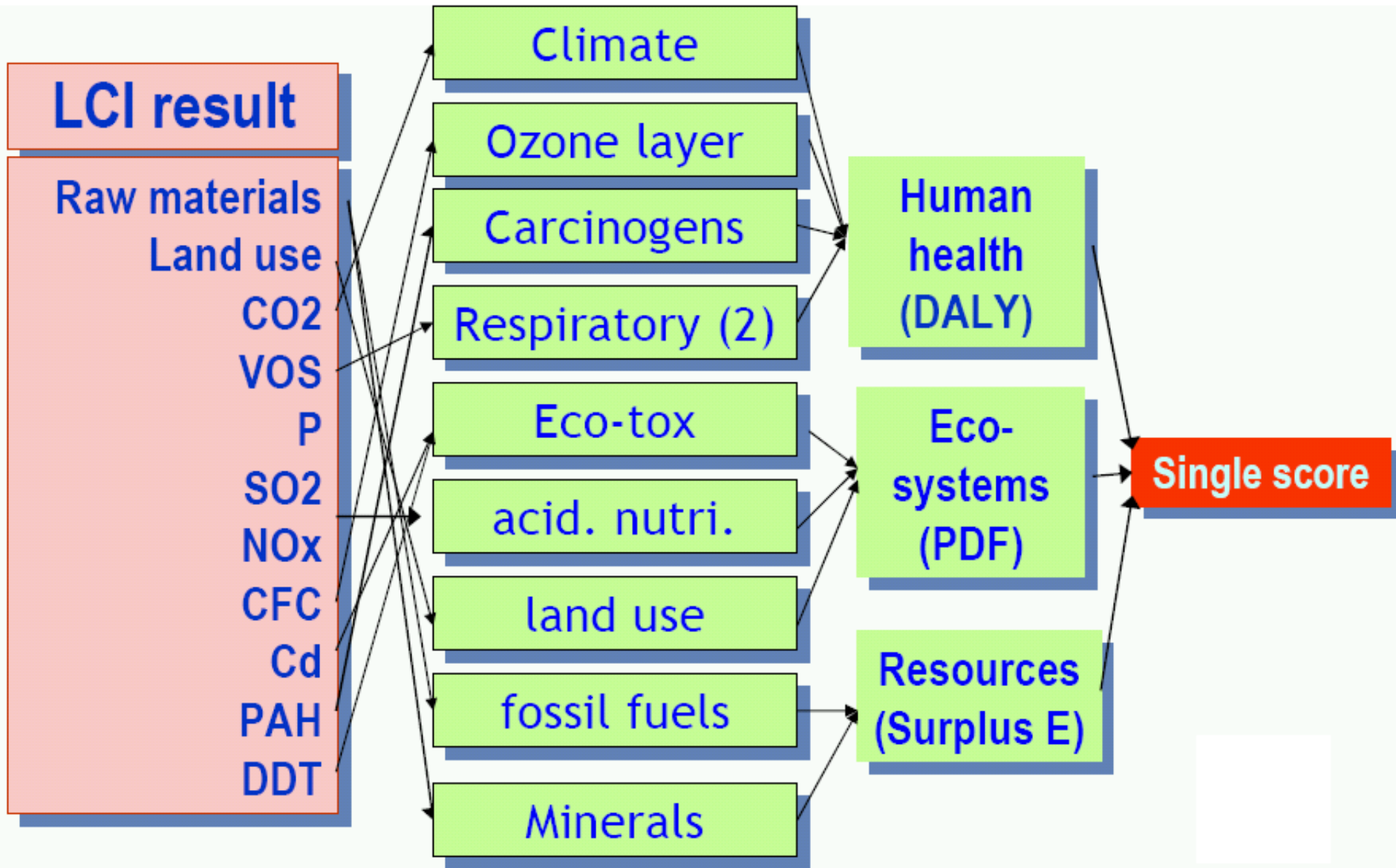
- All results are in different units, and the units are rather abstract, like:
  - CO2 equivalents,
  - SO2 equivalents
  - Some sort of toxic potential
- Because of this, interpretation is very difficult.
- Next slide shows comparison between two product systems

- Schematic cause-response pathway
- Endpoint reflects “issue of concern”, like flooding, extinction of species, or human lives lost
- Impact category indicator is chosen along the environmental mechanism (midpoint)



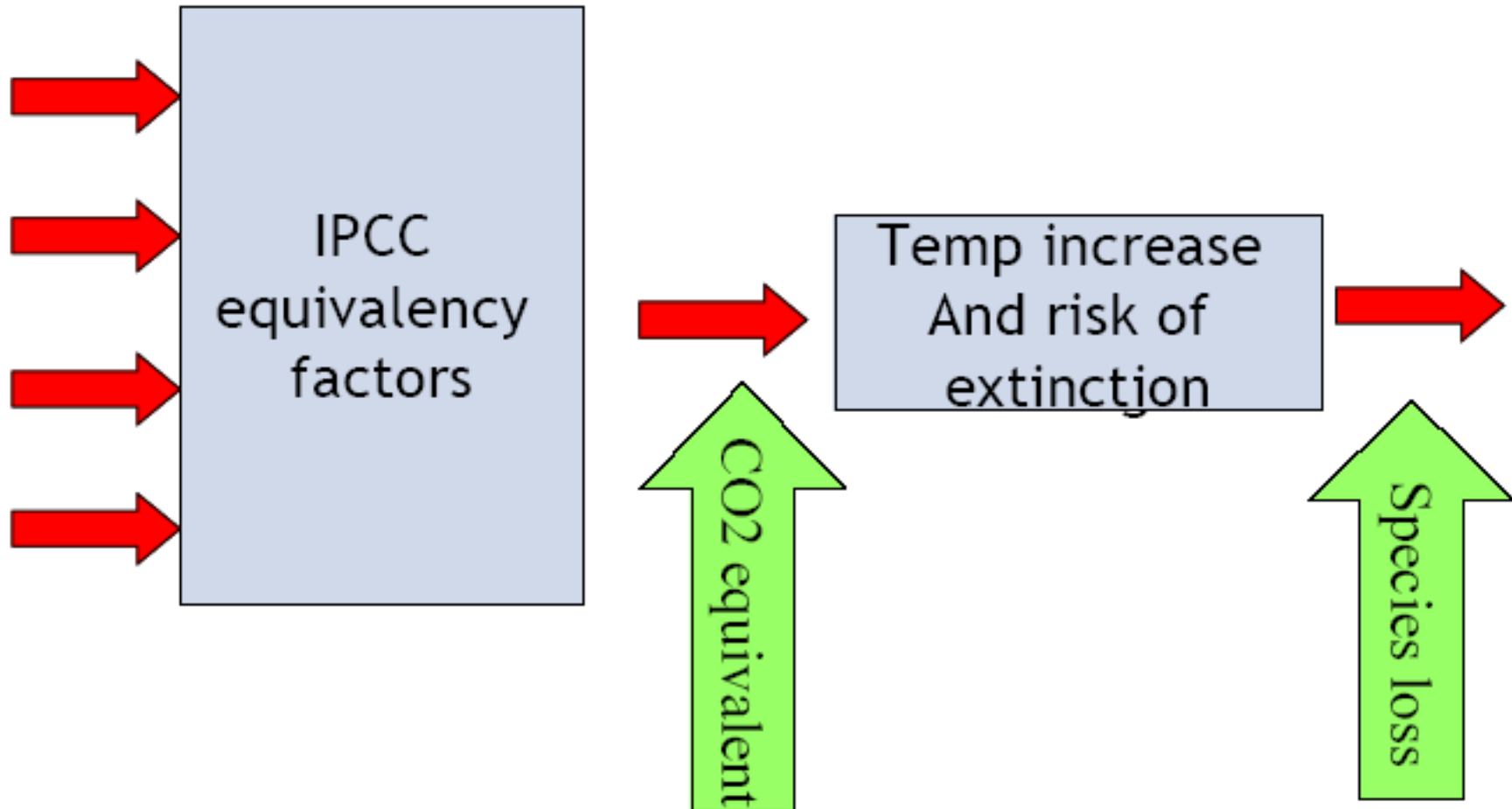


# Endpoint Method in Detail (EI99)



# Example of ReCiPe

- Midpoint taken at first point where impacts are unified



# INTERPRETATION

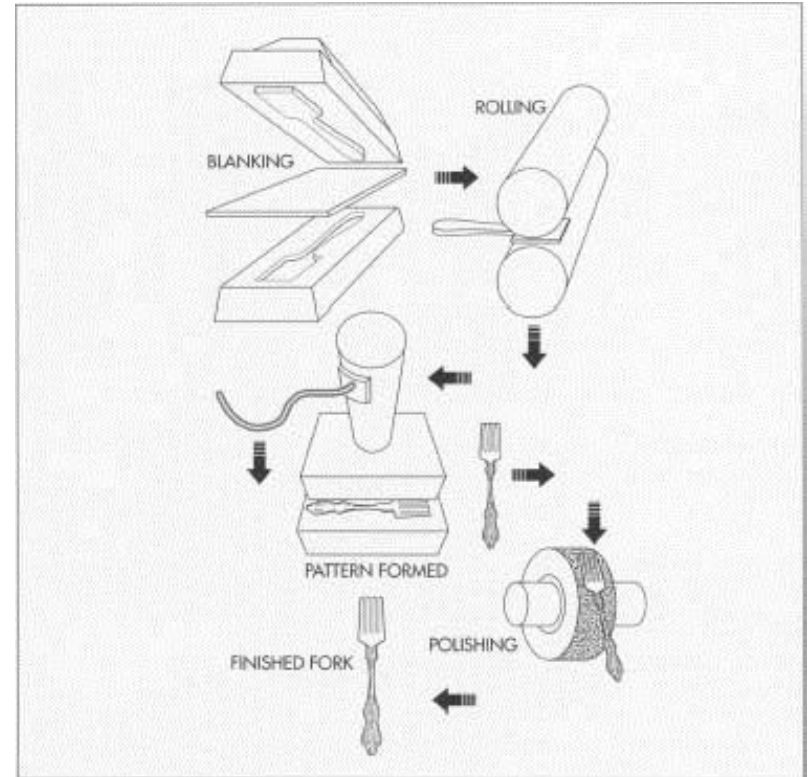
- Are my conclusions valid and robust?
- Draft your conclusions
- Test how robust they are, according to ISO 14043



# Spoon Comparative LCA with Simapro



## PROCESS



# **Functional Unit:**

***Using a Spoon for 10 Year***



# **Reference Flows:**

- ***8 Al Spoons***
- ***3 Stainless Steel Spoons***
- ***15 Ceramic Spoons***
- ***15 Melamine Spoons***
- ***10 Wooden Spoons***

**1 Spoon dishwashed every 2.5 days**



# Surveys

- **Average Life of each spoon type**
  - > needed for FU and Reference Flow
- **Average number of spoons per person in family**
- **Average numbers of dishwashes in family**
  - > 3times a day
- **Average dishwashes per spoon every -> 2.5 days**
- **What is the equivalence between washing a 1 liter bottle and washing a spoon**
  - > 1bottle wash is equivalent to 5 spoon washes



Functional unit

Using a spoon for 10 years

Reference flows

8Al spoons/355 spoons/15CeramicSpoons/15Melamine/10Wooden spoon - 1 spoon dishwashed once every 2.5 days

Alternative scenarios

Recycle Mterial/Landfill/Take Back

C:\Documents and Settings\All Users\Documents\SimaPro\Database\Starter; ComparativeLCA\_Spoon

File Edit Calculate Tools Window Help



LCA Explorer

Wizards

- Wizards
- Product Systems
- Develop wizards
- Wizard variables

Goal and scope

- Description
- Libraries
- DQI Requirements

Inventory

- Processes
- Product stages**
- System descriptions
- Waste types
- Parameters

Product stages

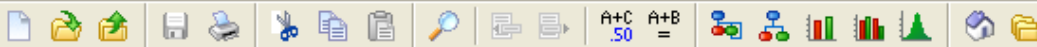
- Assembly
  - Others
- Life cycle
  - Others
- Disposal scenario
- Disassembly
- Reuse

Name	Project
Al Spoon	ComparativeLCA_Spoon
Ceramic Spoon	ComparativeLCA_Spoon
Melamine Spoon	ComparativeLCA_Spoon
Plastic Bag 12 Spoons	ComparativeLCA_Spoon
SS Spoon	ComparativeLCA_Spoon
Wooden Spoon	ComparativeLCA_Spoon



C:\Documents and Settings\All Users\Documents\SimaPro\Database\Starter; ComparativeLCA\_Spoon

File Edit Calculate Tools Window Help



LCA Explorer

Name	Project	Status
Al Spoon	ComparativeLCA_Spoon	

- New
- Edit
- View
- Copy
- Delete
- Used by

Edit assembly product stage 'Al Spoon'

Input/output Parameters

Name	Image	Comment
Al Spoon		<input type="text"/>

Status

Materials/Assemblies	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
AlCuSiMg (2036) I	20	g	Undefined			
Plastic Bag 12 Spoons	1/12 = 0.0833	p				

(Insert line here)

Processes	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
Forging aluminium I	30	g	Undefined			
Washing bottles (1 l)	26	p	Undefined			
Delivery van <3.5t	0.02	kgkm	Undefined			

(Insert line here)

LCA Explorer

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Product stages

- Assembly
  - Others
- Life cycle
  - Others
- Disposal scenario

Name	Project	Status
Al Spoon	ComparativeLCA_Spoon	
Ceramic Spoon	ComparativeLCA_Spoon	
Melamine Spoon	ComparativeLCA_Spoon	
Plastic Bag 12 Spoons	ComparativeLCA_Spoon	

Edit assembly product stage 'Plastic Bag 12 Spoons'

Input/output Parameters

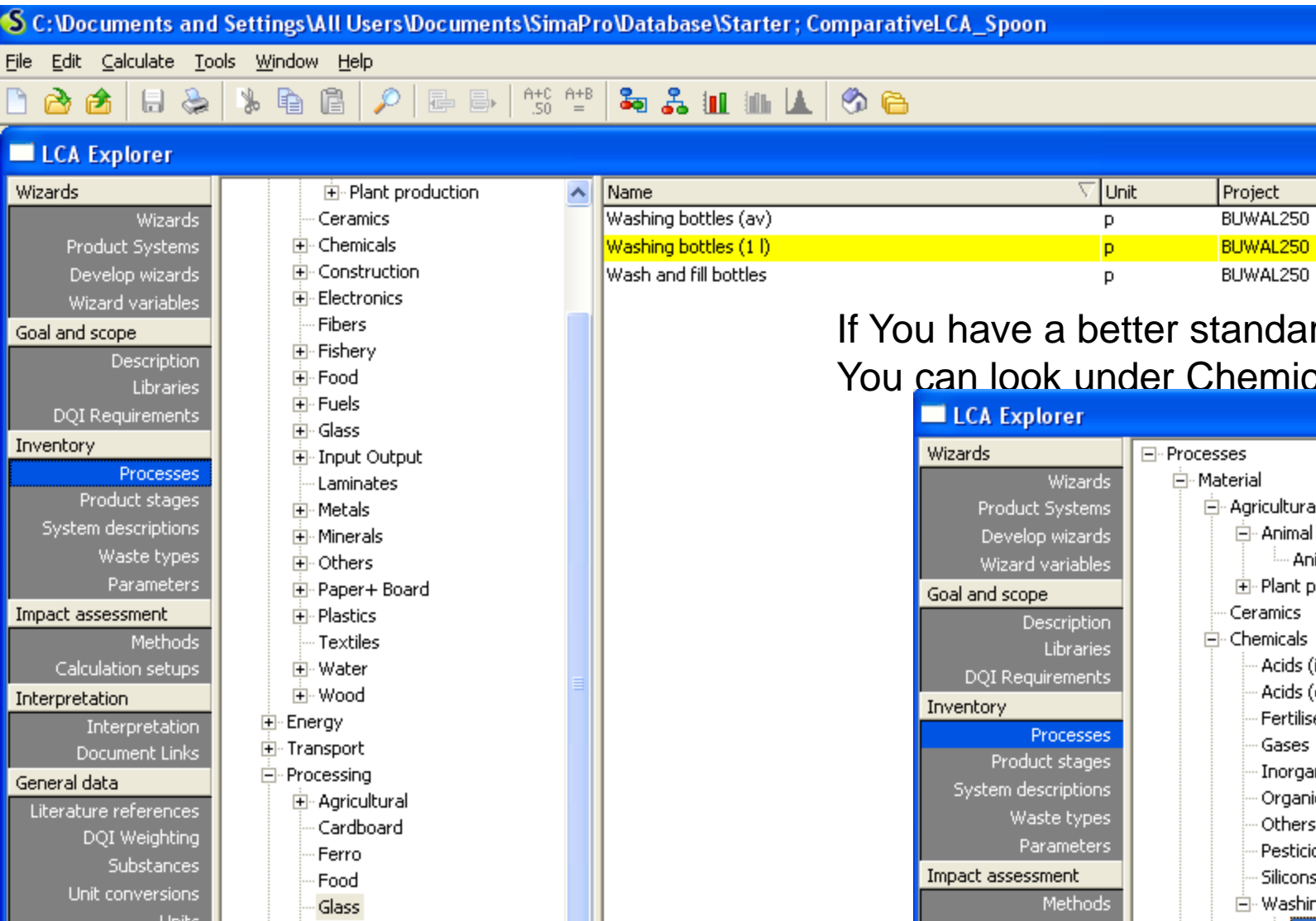
Name	Image	Comment
Plastic Bag 12 Spoons		

Status

Materials/Assemblies	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
PVC film (calendered) A	5	g	Undefined			
(Insert line here)						

Processes	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
Blow foil extrusion	10	g	Undefined			
(Insert line here)						

# Proxy Process for Cleaning/Dishwashing Spoon Processes -> Glass -> washing Bottles

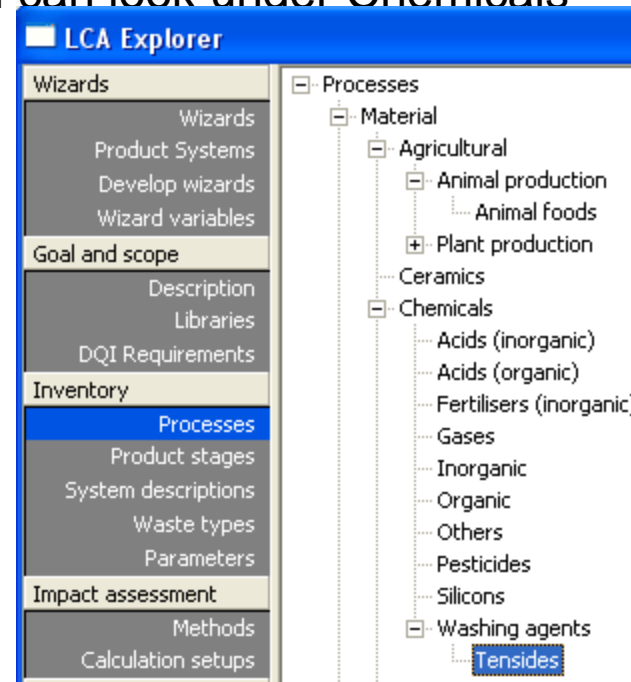


The screenshot shows the LCA Explorer software interface. The main window displays a list of processes with the following data:

Name	Unit	Project
Washing bottles (av)	p	BUWAL250
Washing bottles (1 l)	p	BUWAL250
Wash and fill bottles	p	BUWAL250

The left sidebar shows a tree view of categories, with 'Glass' selected under 'Chemicals'. The right sidebar shows a detailed view of the selected process, including sections for Wizards, Goal and scope, Inventory, Impact assessment, and Interpretation.

If You have a better standard database  
You can look under Chemicals



This screenshot shows a different view of the LCA Explorer software, focusing on the 'Chemicals' category. The left sidebar shows the 'Processes' section selected. The right sidebar shows a tree view of the 'Chemicals' category, with 'Tensides' selected under 'Washing agents'.



Now we can compare Al/Ceramic spoon until end of 1 life span  
Al spoon 10/8 years ; Ceramic spoon 10/15 years

**New calculation setup**

General | Parameter sets | Analysis groups | Chart options

Name:

Comment:

Calculation function:

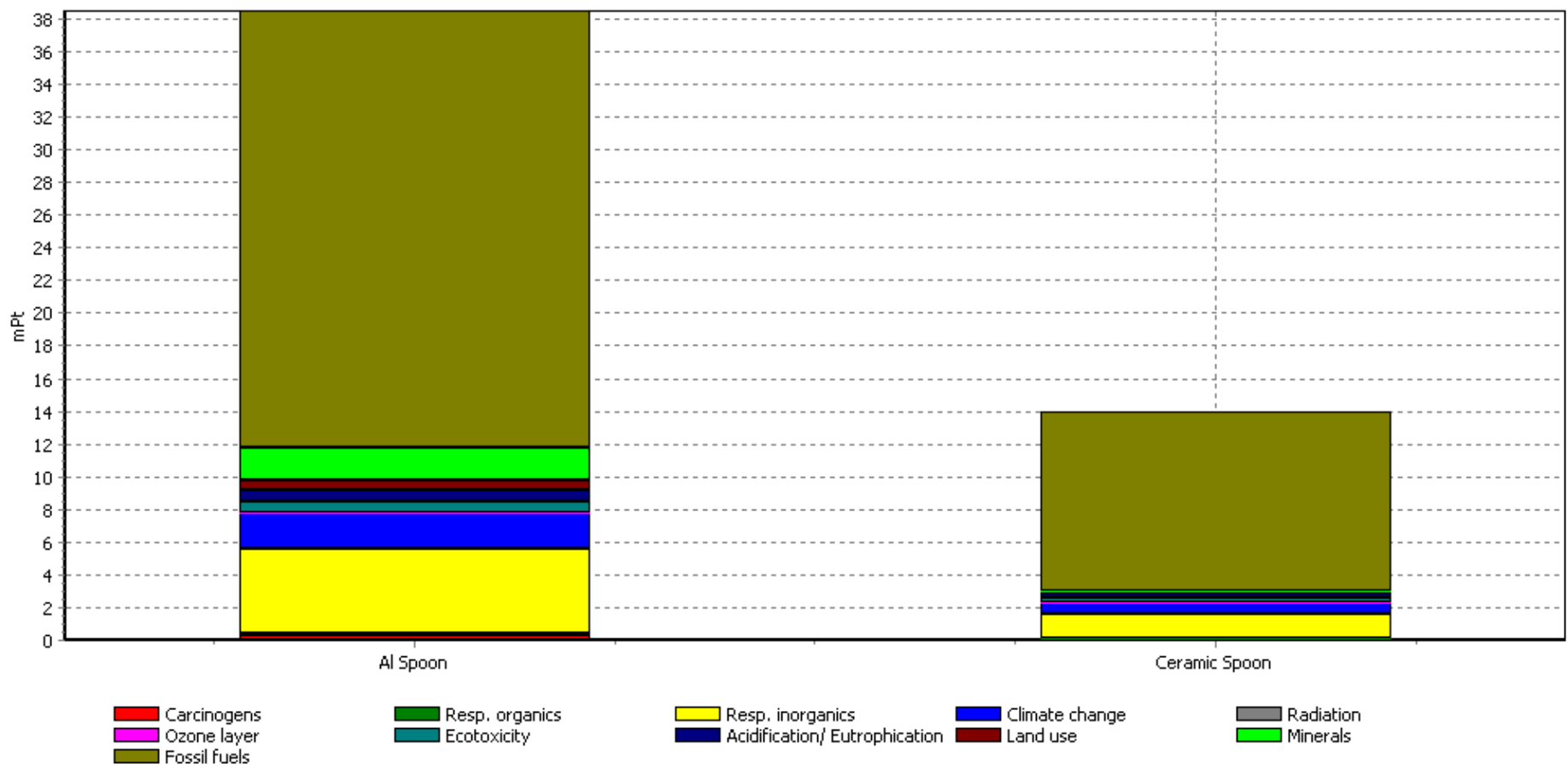
- Network
- Tree
- Analyze
- Compare
- Uncertainty analysis

Method: **Eco-indicator 99 (H) V2.03 / Europe EI 99 H/H**

Product	Amount	Unit	Project	Comment
Al Spoon	1	p	ComparativeLCA_Spoon	
Ceramic Spoon	1	p	ComparativeLCA_Spoon	

Switches:

Buttons: Help, Calculate, Close



Comparing 1 p 'Al Spoon' with 1 p 'Ceramic Spoon'; Method: Eco-indicator 99 (H) V2.03 / Europe EI 99 H/H / single score



We Can also compare 8 Al Spoons with 15 Ceramic spoons (10 year spoon use)  
See FU

The screenshot shows a software interface with a table of products and a 'New calculation setup' dialog box. The table lists 'Al Spoon' and 'Ceramic Spoon' under the project 'ComparativeLCA\_Spoon'. The dialog box is open to the 'General' tab and shows a 'Compare' calculation function selected. It includes a table with columns for Product, Amount, Unit, Project, and Comment, containing the same data as the background table.

Name	Project	Status
Al Spoon	ComparativeLCA_Spoon	
Ceramic Spoon	ComparativeLCA_Spoon	

Product	Amount	Unit	Project	Comment
Al Spoon	8	p	ComparativeLCA_Spoon	
Ceramic Spoon	15	p	ComparativeLCA_Spoon	



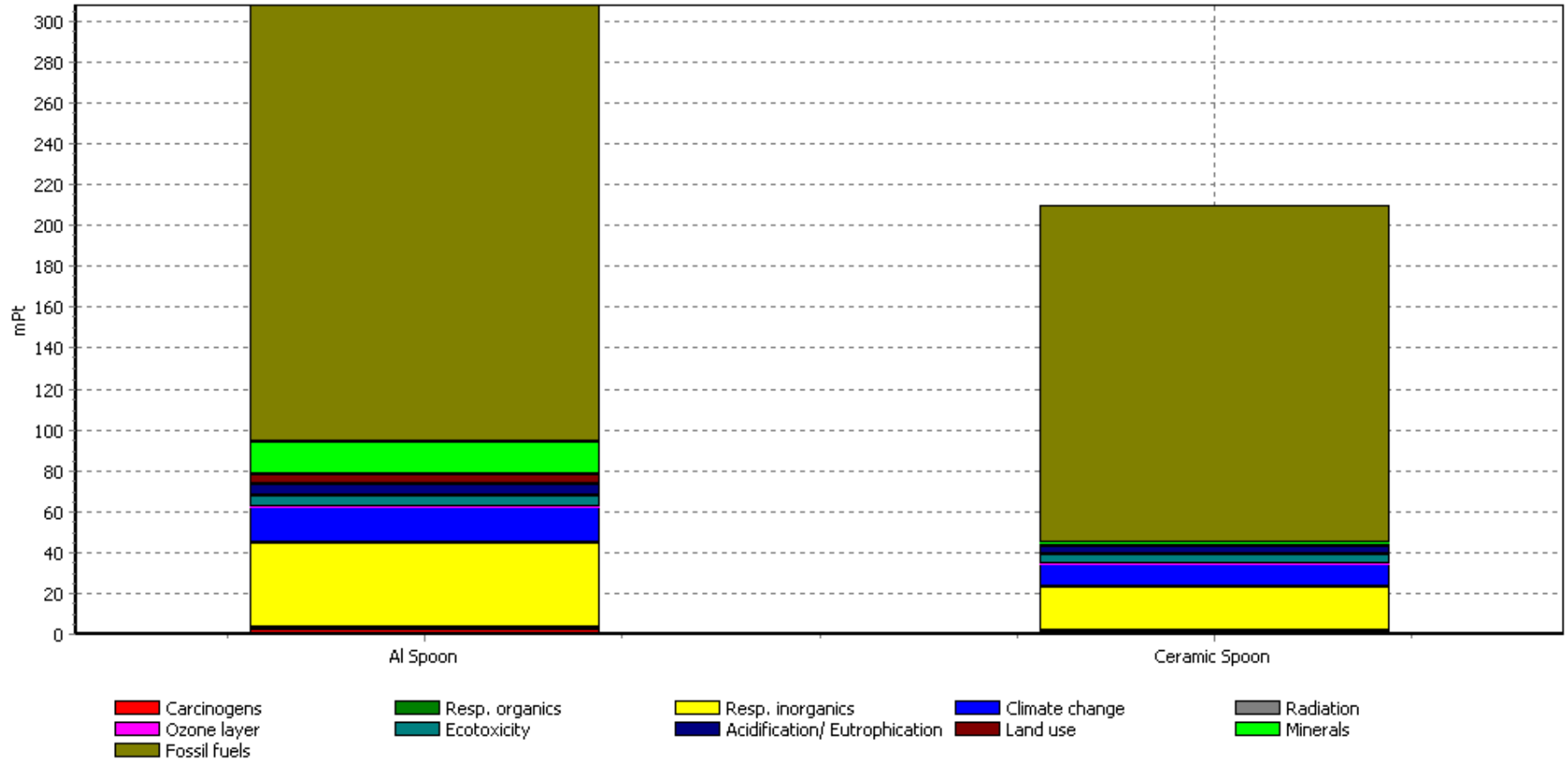


Impact assessment | Inventory | Process contribution | Setup | Checks (348,0)

Characterization | Damage Assessment | Normalization | Weighting | Single score

Skip categories: Never

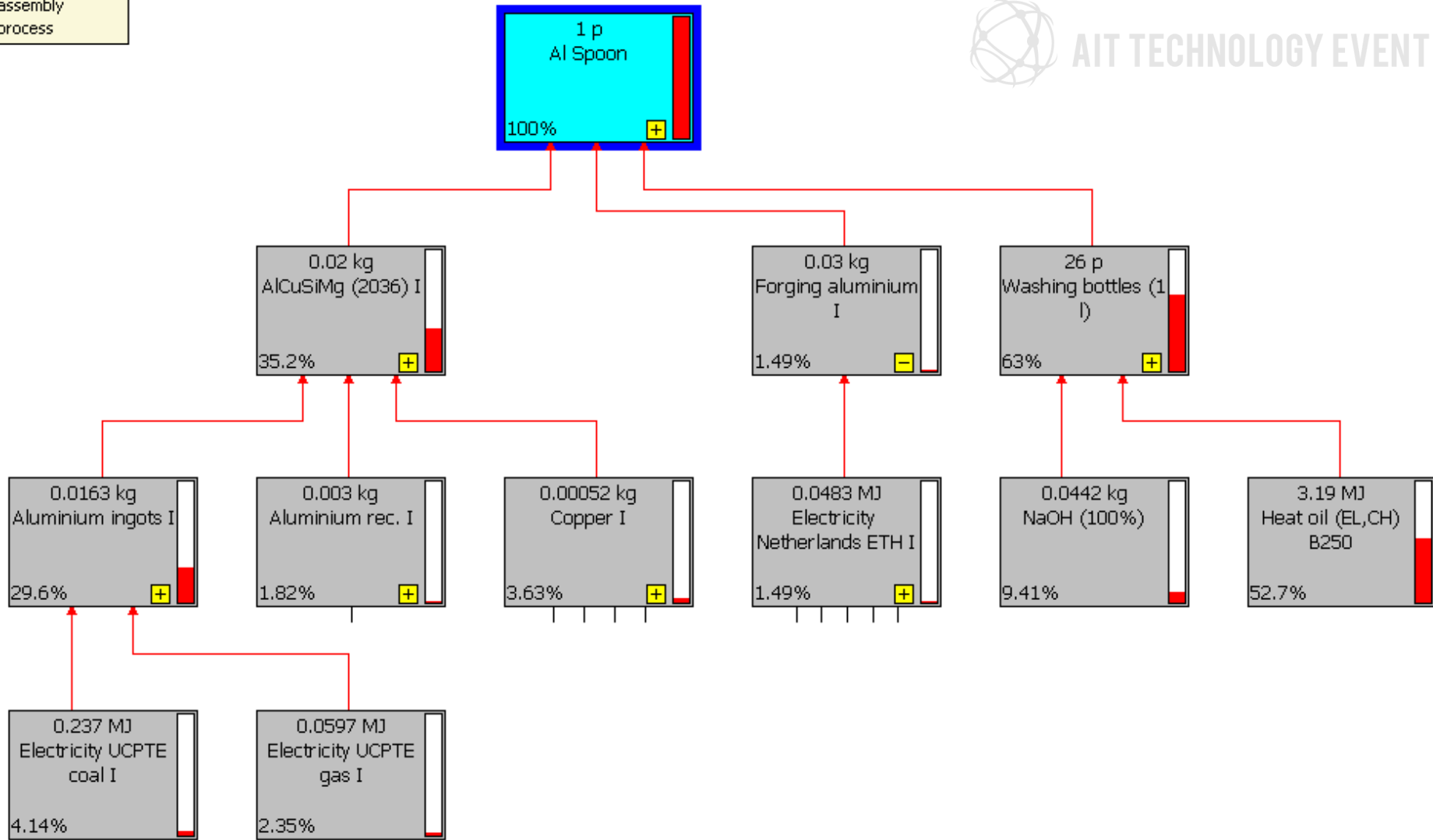
Per impact category



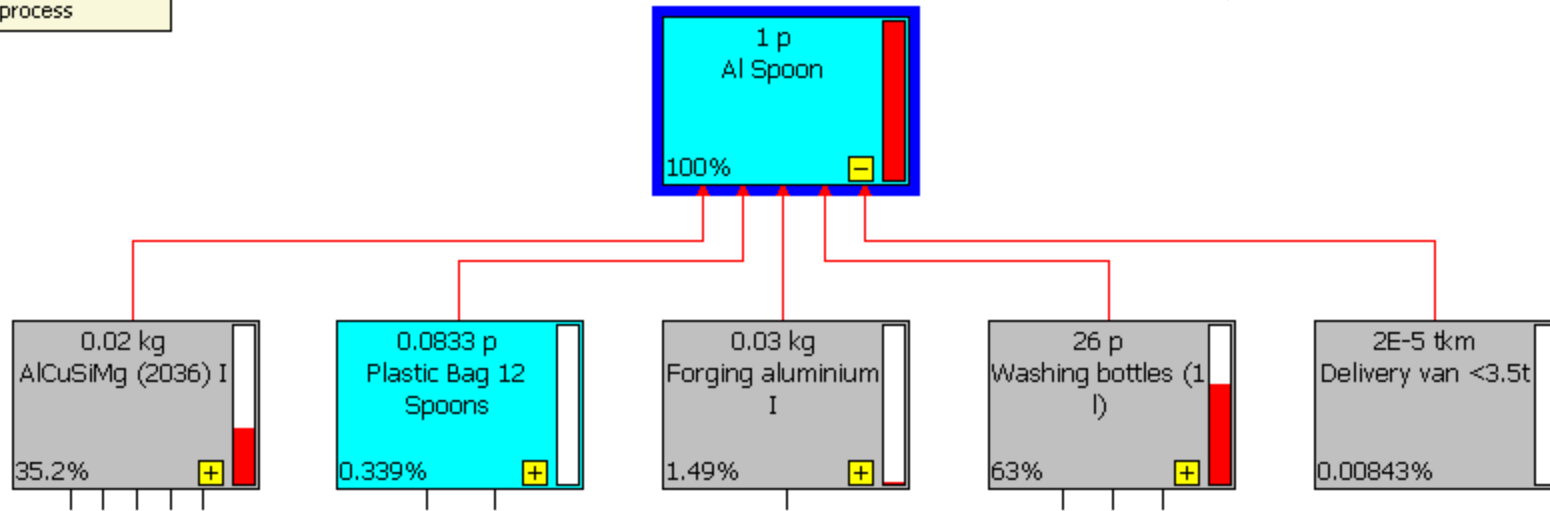
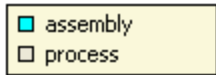
Comparing 8 p 'Al Spoon' with 15 p 'Ceramic Spoon'; Method: Eco-indicator 99 (H) V2.03 / Europe EI 99 H/H / single score



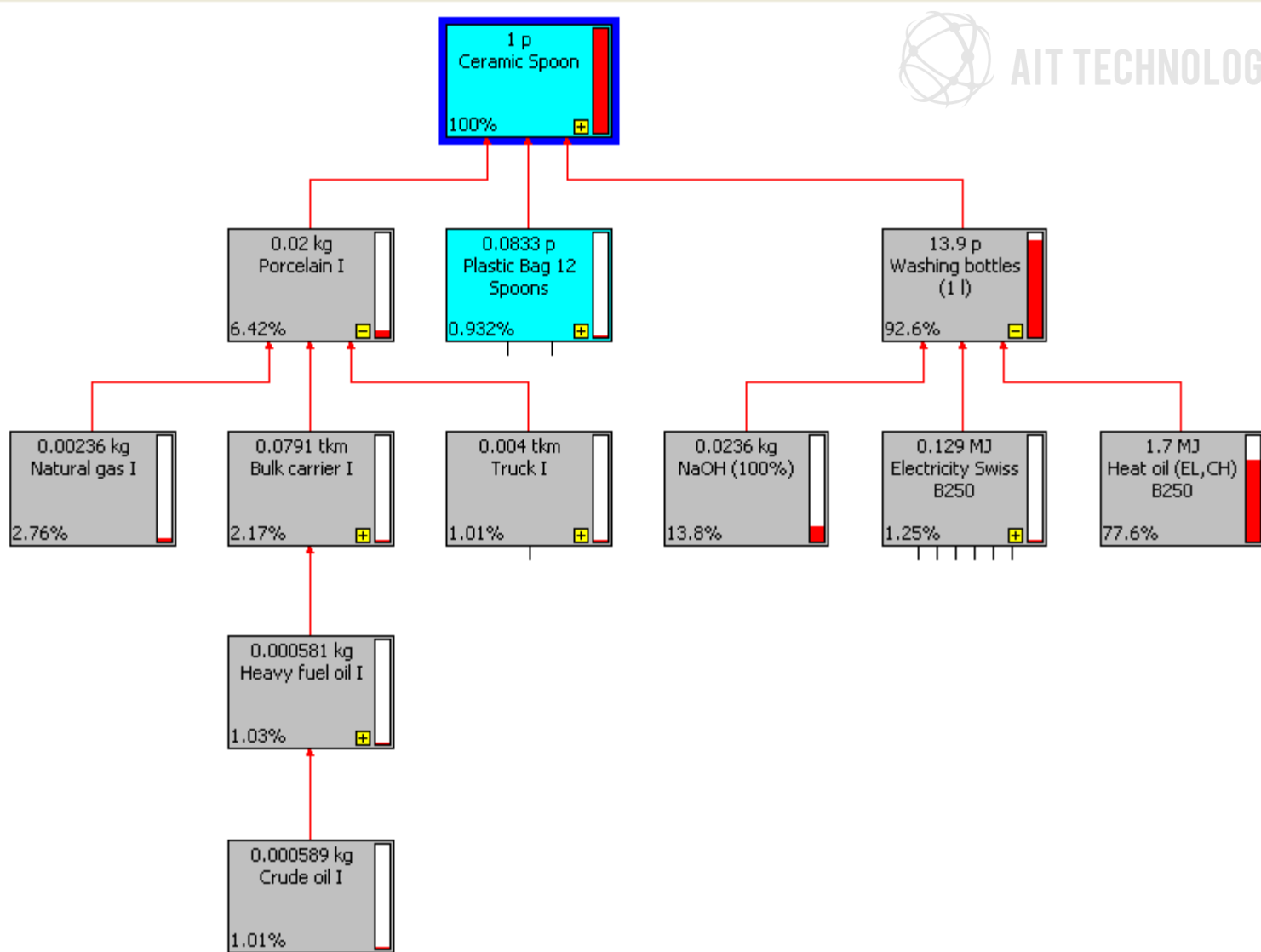
■ assembly  
□ process



Process tree for 1 aluminum spoon until the end of the USE phase



Process tree for 1 aluminum spoon until the end of the USE phase  
With Expanded First level (Click on + sign) to show packaging



Process tree for 1 Ceramic spoon until the end of the USE phase not all processes are shown only most impacting – to show click on + signs

C:\Documents and Settings\All Users\Documents\Simapro\Database\Starter; ComparativeLCA\_Spoon - [LCA Explorer]

File Edit Calculate Tools Window Help

Wizards

- Wizards
- Product Systems
- Develop wizards
- Wizard variables

Goal and scope

- Description
- Libraries
- DQI Requirements

Inventory

- Processes
- Product stages**

Product stages

- Assembly
  - Others
- Life cycle
  - Others**
- Disposal scenario
- Disassembly
- Reuse

Name	Project	Assembly
LIFE AL Spoon EOL Landfilling	ComparativeLCA_Spoon	Al Spoon
LIFE Ceramic Spoon EOL Landfilling	ComparativeLCA_Spoon	Ceramic Spoon

We will now complete the life cycle for the AL spoon and Ceramic spoon  
 The End Of Life we will consider is Landfilling and Recycling



**LCA Explorer**

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- Waste types
- Parameters

Impact assessment

- Methods
- Calculation setups

Interpretation

- Interpretation
- Document Links

General data

- Literature references
- DQI Weighting
- Substances
- Unit conversions
- Units
- Quantities
- Images

Name	Project	Assembly
LIFE AL Spoon EOL Landfilling	ComparativeLCA_Spoon	AL Spoon

**S View life cycle product stage 'Life AL Spoon EOL Landfilling'**

Input/output Parameters

Name: LIFE AL Spoon EOL Landfilling

Status:

Assembly	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
AL Spoon	1	p	Undefined			

Processes

Processes	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
Delivery van (<3.5t) B250	0.020	kgkm	Undefined			

Waste/Disposal scenario

Landfill B250 (98)

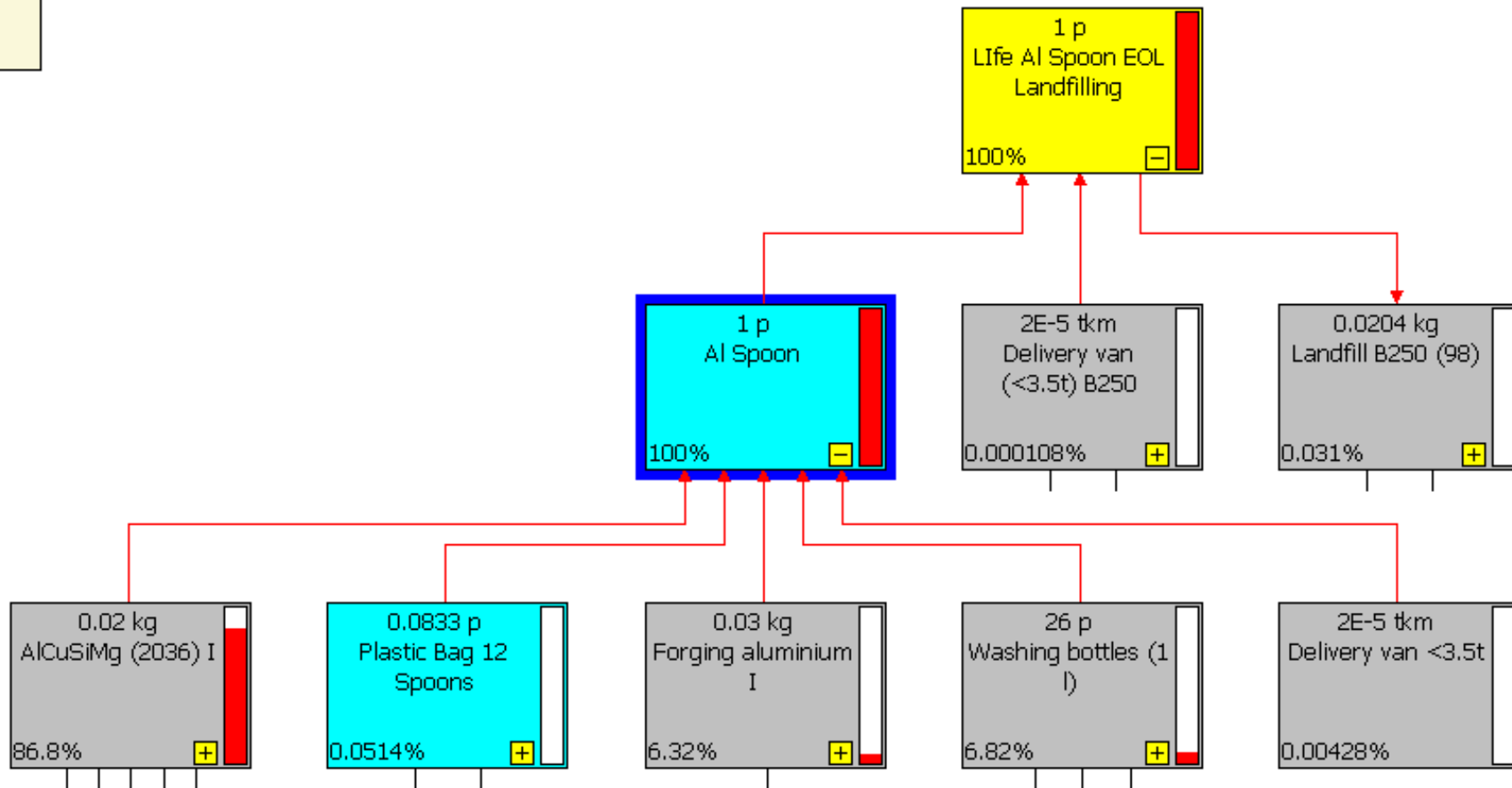
Additional life cycles

Additional life cycles	Number	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
------------------------	--------	--------------	----------------------------	-----	---------

We will now complete the life cycle for the AL spoon With the transportation to the landfill And the Landfill Waste/Disposal from Buwal B250 Standard database in Simapro



- assembly
- life cycle
- process



Partial Tree for the complete life cycle of AL spoon with Landfill EOL



**LCA Explorer**

Wizards  
 Product Systems  
 Develop wizards  
 Wizard variables

Goal and scope  
 Description  
 Libraries  
 DQI Requirements

Inventory  
 Processes  
**Product stages**  
 System descriptions  
 Waste types  
 Parameters

Impact assessment  
 Methods  
 Calculation setups

Interpretation  
 Interpretation  
 Document Links

General data  
 Literature references  
 DQI Weighting  
 Substances  
 Unit conversions  
 Units  
 Quantities  
 Images

Product stages  
 Assembly  
 Others

Name	Project	Assembly
Life Al Spoon EOL Landfill	ComparativeLCA_Spoon	Al Spoon
Life Al Spoon EOL Recycling	ComparativeLCA_Spoon	Al Spoon

**View life cycle product stage 'Life Al Spoon EOL Recycling'**

Input/output Parameters

Name: Life Al Spoon EOL Recycling  
 Image:

Status:

Assembly	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
Al Spoon	1	p	Undefined			

Processes

Processes	Amount	Unit	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment
Delivery van (<3.5t) B250	0.020	kgkm	Undefined			

Waste/Disposal scenario  
 Recycling only B250 avoided

Additional life cycles

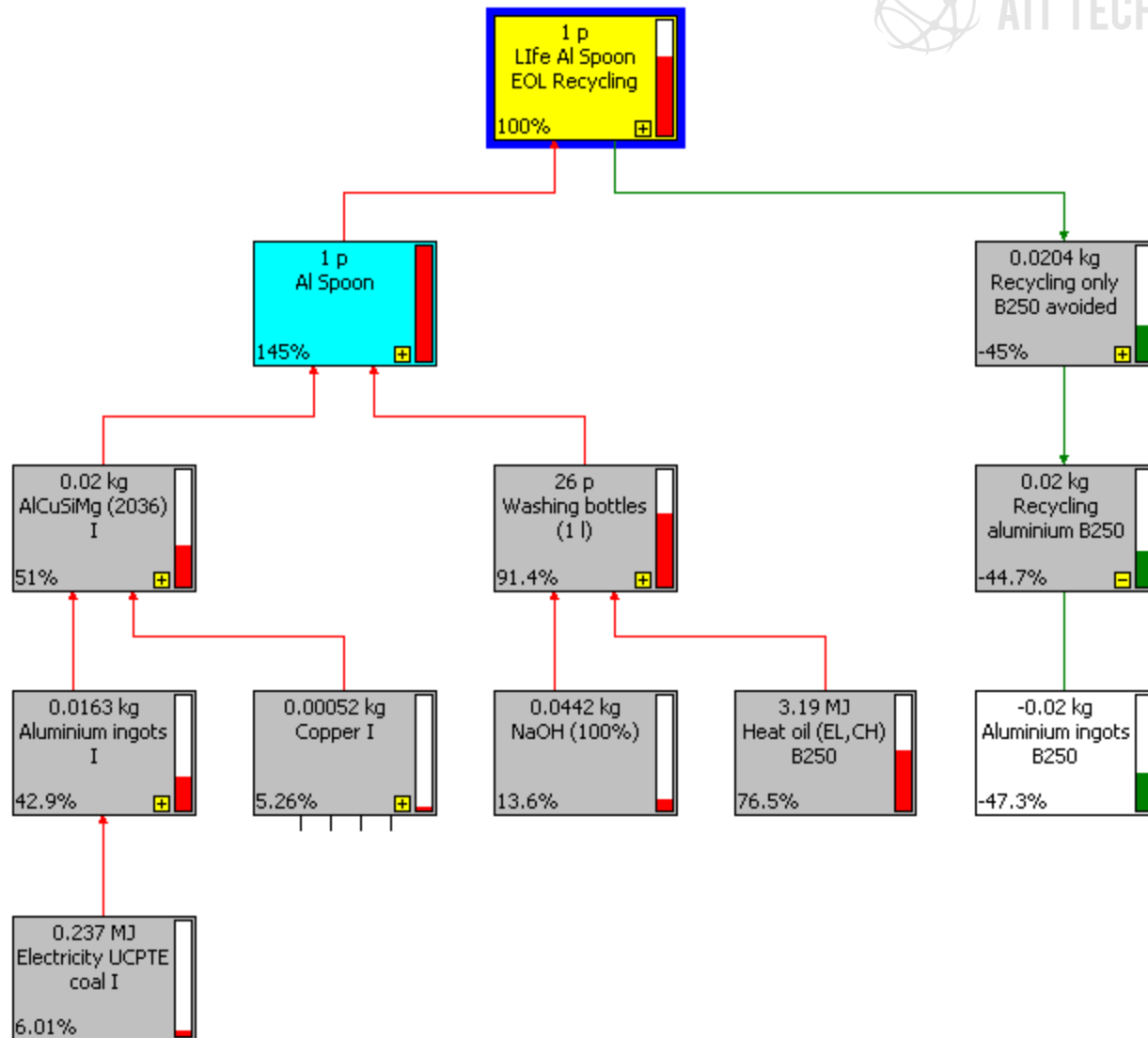
Additional life cycles	Number	Distribution	SD <sup>2</sup> or 2*SDMin	Max	Comment

Complete life cycle for the AL spoon with the transportation and the recycled Waste/Disposal from Buwal B250 Standard database in Simapro





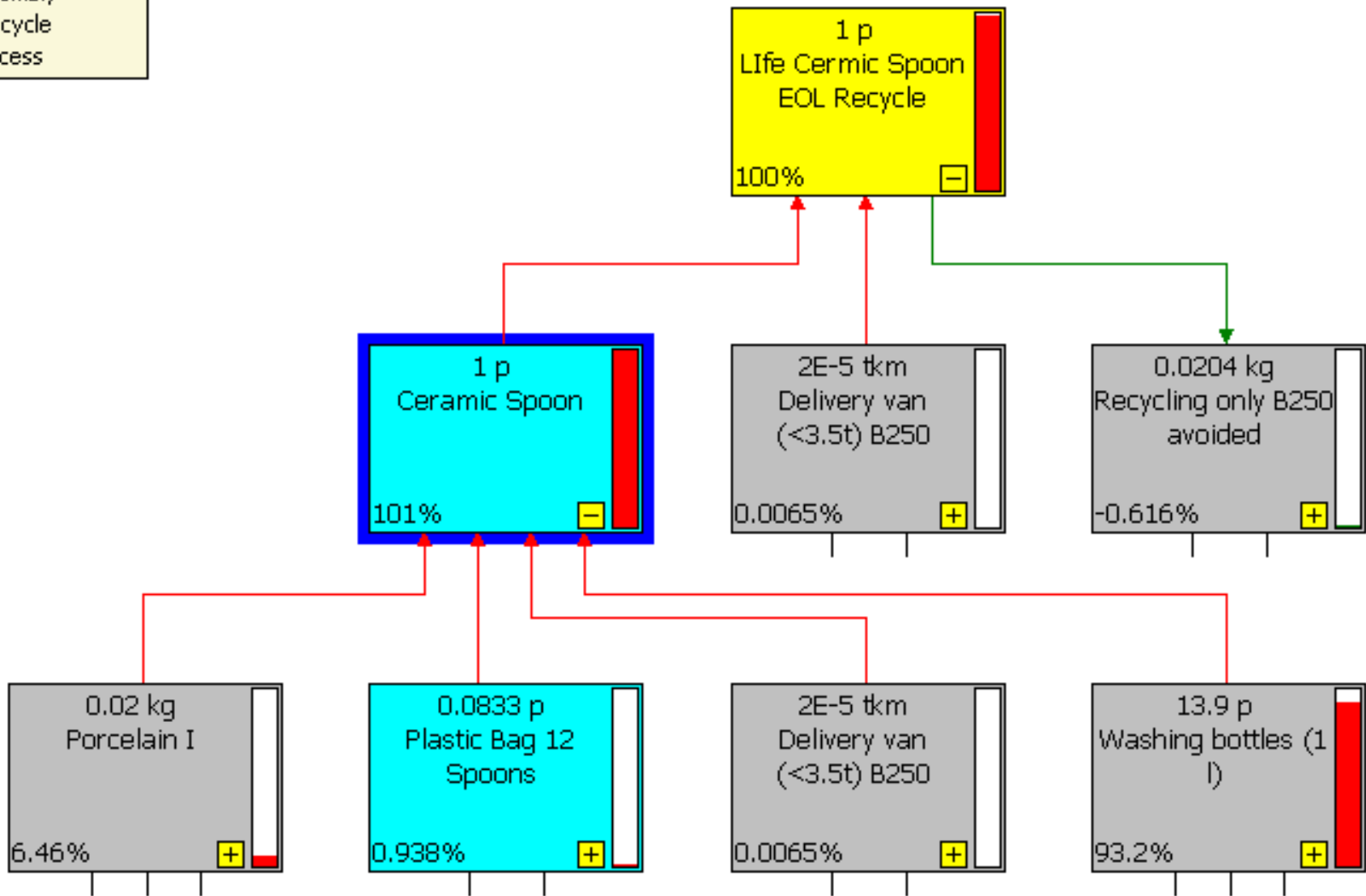
- assembly
- life cycle
- process



Partial Tree for the complete life cycle of AL spoon with Recycle EO  
Note the “Green Color” bar!!!



- assembly
- life cycle
- process





**LCA Explorer**

Wizards

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- DQI Requirements

Inventory

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- Product stages**
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Impact assessment

- Methods
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- Quantities
- Images

Product stages

- Assembly
  - Others
- Life cycle
  - Others
- Disposal scenario
- Disassembly
- Reuse

Name	Project	Assembly
Life Cermic Spoon EOL Recycle	ComparativeLCA_Spoon	Ceramic Spoon
Life Cermic Spoon EOL Landfilling	ComparativeLCA_Spoon	Ceramic Spoon
Life Al Spoon EOL Recycling	ComparativeLCA_Spoon	Al Spoon
Life Al Spoon EOL Landfill	ComparativeLCA_Spoon	Al Spoon

**S New calculation setup**

General | Parameter sets | Analysis groups | Chart options

Name:

Comment:

Calculation function

- Network
- Tree
- Analyze
- Compare
- Uncertainty analysis

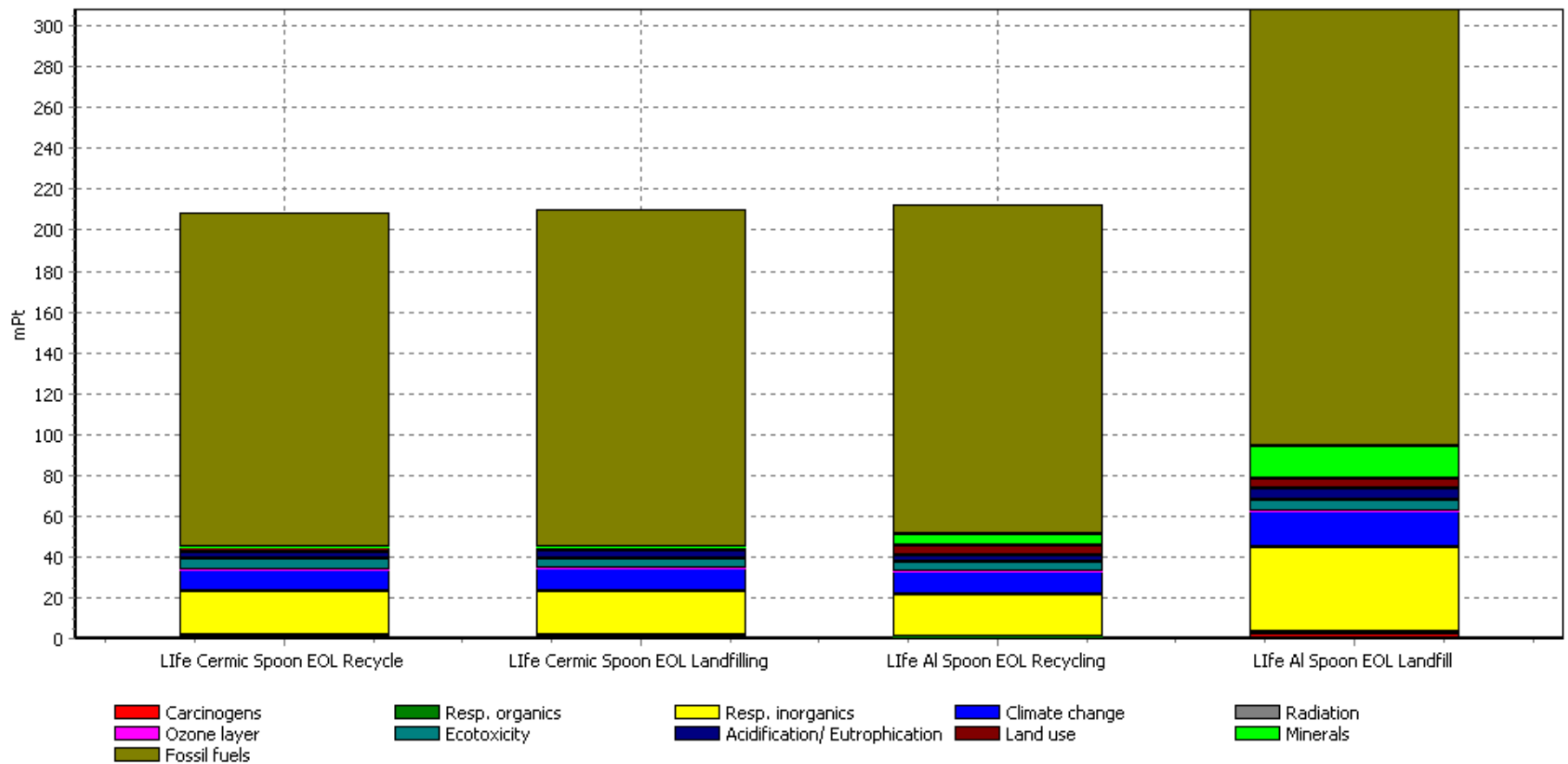
Method

Eco-indicator 99 (H) V2.03 / Europe EI 99 H/H

Product	Amount	Unit	Project	Comment
Life Cermic Spoon EOL Recycle	15	p	ComparativeLCA_Spoon	
Life Cermic Spoon EOL Landfilling	15	p	ComparativeLCA_Spoon	
Life Al Spoon EOL Recycling	8	p	ComparativeLCA_Spoon	
Life Al Spoon EOL Landfill	8	p	ComparativeLCA_Spoon	

Buttons: Help, Calculate, Close

## Comparing Al/Ceramic spoon Use over 10 year with Landfill or Recycling EOL



Comparing 15 p 'Life Ceramic Spoon EOL Recycle', 15 p 'Life Ceramic Spoon EOL Landfilling', 8 p 'Life Al Spoon EOL Recycling' and 8 p 'Life Al Spoon EOL Landfill'; Method: Eco-indicator 99 (H) V2.03 / Europe

Comparing Al/Ceramic spoon Use over 10 year with Landfill or Recycling EOL  
 How to Conclude?!@\$%&\*



**Thank You For Your  
Attention!!  
Any Questions??**

**bohez@ait.ac.th**