

# Assessing LCA data & methodology for the Energy using Product (EuP) directive



product ecology  
consultants

Michiel Oele

PRé Consultants, the Netherlands ([www.pre.nl](http://www.pre.nl))

# Introduction PRé Consultants



- Dedicated LCA consultancy since 1990
- Development of LCA methodologies (Eco-indicator 95/99; currently working on follow up with CML)
- Develop LCA software tools like SimaPro
- Share and network with partners in joined projects

# Overview



- Introduction Ecodesign directive on energy using products (EuP)
- Comparison EuP method with screening LCA

# Integrated Product Policy



- IPP : framework for product oriented environmental policy
  - Looks at all life cycle stages, stimulates life cycle thinking with all possible means.
  - Basis for new EU legislation, such thematic strategies for Waste and Resource use.
  - Ecodesign directive on Energy Using Product
-

# Energy using Products directive



- Energy using Products identified as important group for environmental improvement
  - All mass produced Energy Using products (EUP), must conform to one of three types of requirements
  - Non compliance will mean: No CE label, thus no access to market
-

# Tree ways to conform to requirements



- Annexe A: Maximum energy consumption in the use phase, probably no other requirements
- Annexe B: Ecodesign dossier must show the design team has minimised the relevant Key Environmental Performance Indicators (KEPI)  
Probably no target levels will be defined
- Annexe C: a good implementation of a product oriented environmental management system.

# EUP, Implementing measures



- 14 product groups have been identified
- EU asked VHK develop method for developing ecodesign criteria (MEEUP:Method for Evaluating EuP)
- Per product group a simplified LCA is made.
- Market information, improvement options were collected to calculate overall improvement
- Based on this, KePI's will be defined, or energy efficiency standards will be set
- Research for implementing measures is being done

# EUP, Implementing measures



- **Climate**
  1. CH Boilers
  2. Circulator pumps
  3. Room Air Conditioners
  4. Lighting
- **Electronics & ICT**
  5. Personal Computer systems
  6. Television sets
  7. Copiers large
  8. Copiers small
- **Domestic Appliances**
  9. Refrigerators
  10. Vacuum Cleaners
  11. Dishwashers

# MEEUP LCA method for product group studies



- VHK Consultants in Delft developed MEEUP database and impact assessment method:
  - Data from industry associations, commission reports and company environmental reports (consensus)
  - Collected for production, distribution, use and waste phase
  - Impact assessment based on EU standards
  - 15 impact categories, defined by EU commission
  - No normalisation, no weighting
  - Inventory data transformed into indicator sets

# Environmental Impacts, Resources



- **Energy consumption**
  - primary Gross Energy Requirement in MJ
  - electricity share (converted to primary)
- **Water consumption in m3**
- **Material use (in kg), incl. recycling credits**
  - Metals (St, Al, Cu)
  - Plastics(PE, PP, PS, etc.)
  - Others (glass, electronics, etc.)
- **Waste generation**
  - to landfill
  - to incinerator
- **Hazardous waste generation**
  - ROHS (exceptions)
  - non-ROHS (voluntary lists)

# Environmental Impacts, Emissions



- **Emissions to air**
  - greenhouse gases (GHG, CO<sub>2</sub>-eq.)
  - acidifying agents (SO<sub>2</sub>-eq., incl. NO<sub>x</sub> , also eutroph. NH<sub>3</sub>)
  - volatile organic compounds (VOC)
  - ozone depleting substances (ODP, CFC-11 eq.)
  - persistent organic pollutants (POP, e.g. PCB's, dioxins)
  - heavy metals (As, Cd, Hg, Ni, Pb; also PAHs)
  - particulate matter (PM)
- **Emissions to water**
  - heavy metals (Cd, Hg, etc.)
  - substances affecting oxygen balance (P, N, BOD, COD)
  - persistent organic pollutants (List I substances)
- **Other product specific**

# LCI: Unit processes (Table & Notes)



DRAFT 2 VHK for European Commission - 13 April 2005

This document is subject to a legal notice (see p. 2 of table)



## EuP EcoReport: MATERIALS & ENERGY UNIT INDICATORS

| Material              | Re-cyc<br>% | Energy     |              |           | Water       | Waste        | Emissions: To Air |           |           |         |           | To Water     |                  |         |             |          |
|-----------------------|-------------|------------|--------------|-----------|-------------|--------------|-------------------|-----------|-----------|---------|-----------|--------------|------------------|---------|-------------|----------|
|                       |             | prim<br>MJ | electr<br>MJ | fd<br>/MJ | proc<br>ltr | cool<br>/ltr | haz<br>g          | non<br>/g | GWP<br>kg | AD<br>g | VOC<br>mg | POP<br>i-Teq | PAH&H<br>M<br>mg | PM<br>g | Metal<br>mg | EUP<br>g |
| <b>Plastics in kg</b> |             |            |              |           |             |              |                   |           |           |         |           |              |                  |         |             |          |
| 1 LDPE                | 0%          | 78         | 13           | /52       | 3           | /45          | 4                 | /44       | 1.90      | 7       | 490       | 0            | 1                | 1       | 0           | 0.0      |
| 2 HDPE                | 0%          | 77         | 10           | /54       | 3           | /31          | 5                 | /38       | 1.81      | 6       | 160       | 0            | 2                | 1       | 0           | 0.0      |
| 3 LLDPE               | 0%          | 74         | 10           | /47       | 2           | /116         | 3                 | /31       | 1.86      | 6       | 70        | 0            | 0                | 1       | 0           | 0.0      |
| 4 PP                  | 0%          | 73         | 7            | /53       | 5           | /40          | 4                 | /28       | 1.97      | 6       | 18        | 0            | 2                | 1       | 0           | 0.2      |
| 5 PS                  | 0%          | 87         | 4            | /48       | 5           | /177         | 1                 | 22        | 2.79      | 17      | 0         | 0            | 604              | 2       | 1           | 0.0      |
| 6 EPS                 | 0%          | 84         | 3            | /48       | 6           | /176         | 1                 | 38        | 2.70      | 18      | 0         | 0            | 304              | 2       | 1           | 0.1      |
| 7 HI-PS               | 0%          | 92         | 5            | /49       | 6           | /186         | 1                 | 30        | 2.90      | 19      | 0         | 0            | 304              | 2       | 1           | 0.1      |
| 8 PVC                 | 0%          | 57         | 11           | /23       | 11          | /62          | 5                 | 67        | 2.16      | 15      | 0         | 0            | 0                | 3       | 1           | 0.3      |
| 9 SAN                 | 0%          | 89         | 4            | /47       | 6           | /163         | 4                 | /32       | 3.00      | 14      | 0         | 0            | 2                | 2       | 1           | 0.2      |
| 10 ABS                | 0%          | 95         | 7            | /46       | 9           | /165         | 10                | 92        | 3.32      | 18      | 0         | 0            | 9                | 3       | 3           | 0.6      |

# LCIA: Weighting Factors



**Table 1. Weighting factors per category**

|   |      |      |      |      |         |        |       |       |       |              |      |      |      |      |       |       |
|---|------|------|------|------|---------|--------|-------|-------|-------|--------------|------|------|------|------|-------|-------|
| <b>GHG emissions (air)</b>              | CO2  | CO   | N2O  | CH4  | CF4     | C2F6   | SF6   | R134a | other |              |      |      |      |      |       |       |
| weighting --> CO2 eq. GWP-100           | 1    | 1.57 | 296  | 21   | 6500    | 9200   | 22200 | 1300  | IPCC  |              |      |      |      |      |       |       |
| <b>Acidification emissions (air)</b>    | SOX  | NOX  | N2O  | NH3  | HF      | HCl    | H2S   | H2SO4 |       |              |      |      |      |      |       |       |
| AD weighting--> SO2 equivalent          | 1    | 0.7  | 1    | 1    | 1.6     | 0.88   | 1.49  | 0.65  |       |              |      |      |      |      |       |       |
| <b>Heavy Metals &amp; PAH's (air)</b>   | PAHs | Cd   | As   | Ni   | Cr      | Cu     | Hg    | Pb    | Zn    | HMU'         | AOX  | Al   | Mg   | K    | MU    | CO    |
| HM weighting -> Pb eq.                  | 100  | 20   | 20   | 4    | 2       | 2      | 1     | 1     | 1     | 1            | 0.02 | 0.04 | 0.04 | 0.04 | 0.039 | 0.001 |
| <b>Heavy Metals (water)</b>             | Hg   | Cd   | As   | Ni++ | Pb/HMU  | Cu+/++ | Cr    | Zn++  | B     | MU           |      |      |      |      |       |       |
| HM Weighting factor--> Pb eq.           | 20   | 4    | 4    | 1    | 1       | 0.5    | 0.5   | 0.1   | 0.03  | 0.002        |      |      |      |      |       |       |
| <b>Eutrophication emissions (water)</b> |      | P    | NO3- | NH4+ | Other N | COD    | DOC   | BOD   | TOC   | Susp. Solids |      |      |      |      |       |       |
| EUP weighting--> SO2 equivalent         |      | 3.07 | 0.1  | 0.33 | 0.42    | 0.022  | 0.066 | 0.11  | 0.066 | 0.08         |      |      |      |      |       |       |

**EC Directives** and official EU references with threshold and conversion values from which the weighting factors are derived: *IPCC* (GWP), *EC 850/2004* (POP), *2001/81/EC* (SOx, NOx, NH3, VOC), *1999/30/EC* (SO2, NOx, PM and Pb), *2000/69/EC* (aromatics, CO), *COM(2003)423* (As, Cd, Hg, Ni, PAH's), *1999/13/EC* (VOC), *EC 2037/2000* (ODP), *91/271/EC* & *98/15/EEC* (BOD, COD, P, N, susp. Solids to water), *76/464/EEC* (Metals etc. to water).

# LCIA: Recycling



**Table 6. Waste Scenario's: 2005 and 3 WEEE Scenario's: A= Business-as-Usual, B= Dematerialisation and C=Best Recycling.**

| Disposal scenario's      | 2005 |      | A    |     | B    |     | C    |      |
|--------------------------|------|------|------|-----|------|-----|------|------|
|                          | kt   | %    | kt   | %   | kt   | %   | kt   | %    |
| <b>TOTAL EuP waste</b>   | 8500 | 100% | 8075 | 95% | 6800 | 80% | 8925 | 105% |
| ◇ Metals/ Glass fraction | 6800 | 80%  | 6299 | 78% | 4760 | 70% | 7140 | 80%  |
| ◇ Plastics/ PWB fraction | 1700 | 20%  | 1777 | 22% | 2040 | 30% | 1785 | 20%  |
| <b>● Processed</b>       | 1275 | 15%  | 7671 | 95% | 6460 | 95% | 8479 | 95%  |
| Metals/ Glass            | 1020 |      | 5984 |     | 4522 |     | 6783 |      |
| - Recycled               | 969  | 95%  | 5684 | 95% | 4296 | 95% | 6444 | 95%  |
| - Landfill               | 51   | 5%   | 299  | 5%  | 226  | 5%  | 339  | 5%   |
| Plastics/ PWBs           | 255  |      | 1688 |     | 1938 |     | 1696 |      |
| - Re-use                 | 3    | 1%   | 17   | 1%  | 19   | 1%  | 85   | 5%   |
| - Recycled               | 20   | 8%   | 152  | 9%  | 310  | 16% | 1272 | 75%  |
| - Thermal recycling      | 0    | 0%   | 0    | 0%  | 1550 | 80% | 288  | 17%  |
| - Haz. incinerated       | 232  | 91%  | 1519 | 90% | 58   | 3%  | 51   | 3%   |
| <b>● Not processed</b>   |      |      |      |     |      |     |      |      |
| - Landfill               | 7225 | 85%  | 404  | 5%  | 340  | 5%  | 446  | 5%   |
| <b>RECYCLING/ RE-USE</b> | 992  | 12%  | 5853 | 72% | 4625 | 68% | 7800 | 87%  |
| THERMAL RECYCLING        | 0    | 0%   | 0    | 0%  | 1550 | 23% | 288  | 3%   |
| WASTE (Haz.inc.& landf.) | 7508 | 88%  | 2222 | 28% | 624  | 9%  | 836  | 9%   |

# MEEUP database in SimaPro



The screenshot displays the SimaPro software interface for the MEEUP database. The main window title is "\\edge\Project\EXTERN\CURSUS.025\EuP\Database\EuPDatabase; EuP indicators - [LCA Expl...". The interface is divided into several sections:

- Left Sidebar:** Contains navigation options such as "Wizards", "Product Systems", "Goal and scope", "Inventory", "Processes", "Impact assessment", "Interpretation", and "General data".
- Tree View:** Shows a hierarchical structure under "Processes", including "Material", "Energy", "Transport", "Processing", "Use", "Waste scenario", and "Waste treatment". The "Plastics" category is expanded.
- Main Table:** A table listing various plastic materials with columns for Name, Unit, Waste type, and Project. The table contains 16 rows of data.
- Right Sidebar:** Includes buttons for "Copy", "Delete", and "Used by", along with a checkbox for "Show DQI specifications".
- Bottom Section:** Lists various allocation and cut-off rules, many of which are marked with a red 'X' indicating they are not selected. A text input field shows "0% recycled content".

| Name      | Unit | Waste type | Project        |
|-----------|------|------------|----------------|
| ABS       | kg   | Plastics   | EuP in         |
| Epoxy     | kg   | Plastics   | EuP in         |
| EPS       | kg   | Plastics   |                |
| Flex PUR  | kg   | Plastics   |                |
| HDPE      | kg   | Plastics   | EuP in         |
| HI-PS     | kg   | Plastics   | EuP indicators |
| LDPE      | kg   | Plastics   | EuP indicators |
| LLDPE     | kg   | Plastics   | EuP indicators |
| PA 6      | kg   | Plastics   | EuP indicators |
| PC        | kg   | Plastics   | EuP indicators |
| PMMA      | kg   | Plastics   | EuP indicators |
| PP        | kg   | Plastics   | EuP indicators |
| PS        | kg   | Plastics   | EuP indicators |
| PVC       | kg   | Plastics   | EuP indicators |
| Rigid PUR | kg   | Plastics   | EuP indicators |
| SAN       | kg   | Plastics   | EuP indicators |

Bottom section checkboxes:

- Time period
- Geography
- Technology
- Representativeness
- Multiple output allocation
- Substitution allocation
- Waste treatment allocation
- Cut-off rules
- System boundary
- Boundary with nature

Input field: 0% recycled content

Status: 96 items, 0 items selected

Footer: EuP indicatoren V1.00, Medewerker

MEEUP data

# MEEUP Data



| Name  | Amount | Unit |  |
|---|--------|------|--|
| Flex PUR  | 1      | kg   |  |
| (Insert line here)                                |        |      |  |
| Known outputs to technosphere. Avoided products   |        |      |  |
| Name  | Amount | Unit |  |
| (Insert line here)                                |        |      |  |
| Inputs  |        |      |  |
| Known inputs from nature (resources)              |        |      |  |
| Name  | Amount | Unit |  |
| Energy, primary                                   | 104    | MJ   |  |
| Energy, electricity                               | 19     | MJ   |  |
| Energy, caloric value of feedstock                | 40     | MJ   |  |
| Water, processing                                 | 70     | l    |  |
| Water, cooling                                    | 298    | l    |  |
| (Insert line here)                                |        |      |  |
| Known inputs from technosphere (materials/fuels)  |        |      |  |
| Name  | Amount | Unit |  |
| (Insert line here)                                |        |      |  |
| Known inputs from technosphere (electricity/heat) |        |      |  |
| Name  | Amount | Unit |  |
| (Insert line here)                                |        |      |  |
| Outputs   |        |      |  |
| Emissions to air                                  |        |      |  |
| Name  | Amount | Unit |  |
| Global Warming Potential                          | 4,48   | kg   |  |
| Acidification Potential                           | 32     | g    |  |
| Volatile Organic Compounds                        | 0      | mg   |  |
| Persistent Organic Compounds                      | 0      | mg   |  |

Indicators instead of emissions

# Example Refrigerator



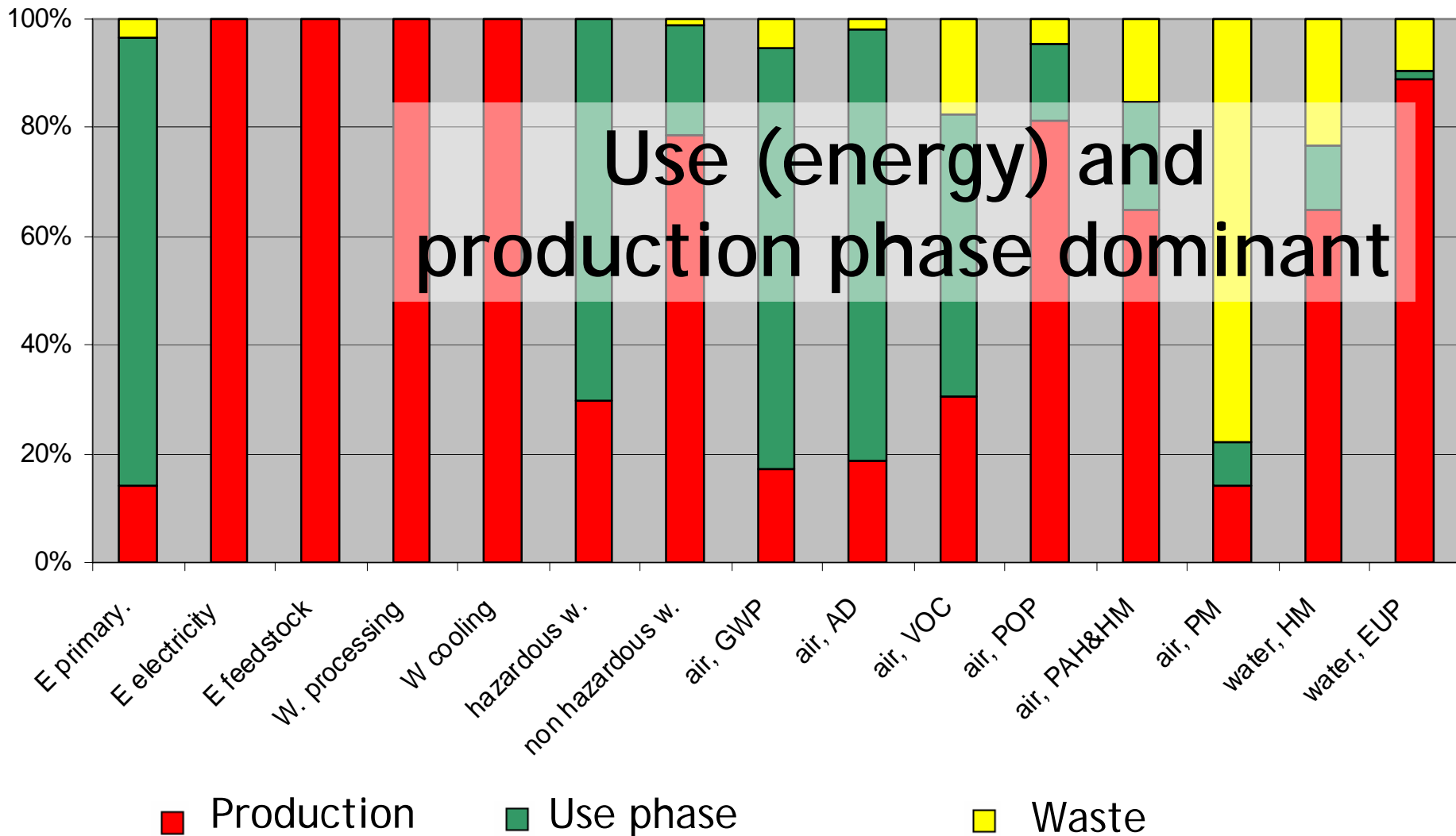
## Life cycle of a fridge

|                         |                           |      |                |
|-------------------------|---------------------------|------|----------------|
| Name                    | Koelkast 2 (BAS)          |      |                |
| Image                   |                           |      |                |
| Assembly                | Koelkast 2                |      |                |
|                         | 1                         | p    | Undefined      |
| Processes               | Amount                    | Unit | Distribution S |
| Maintenance Koelkast    | 1                         | p    | Undefined      |
| Gebruik Koelkast        | 3650                      | day  | Undefined      |
| (Insert line here)      |                           |      |                |
| Waste/Disposal scenario | Waste Koelkast 2 WEEE BAS |      |                |

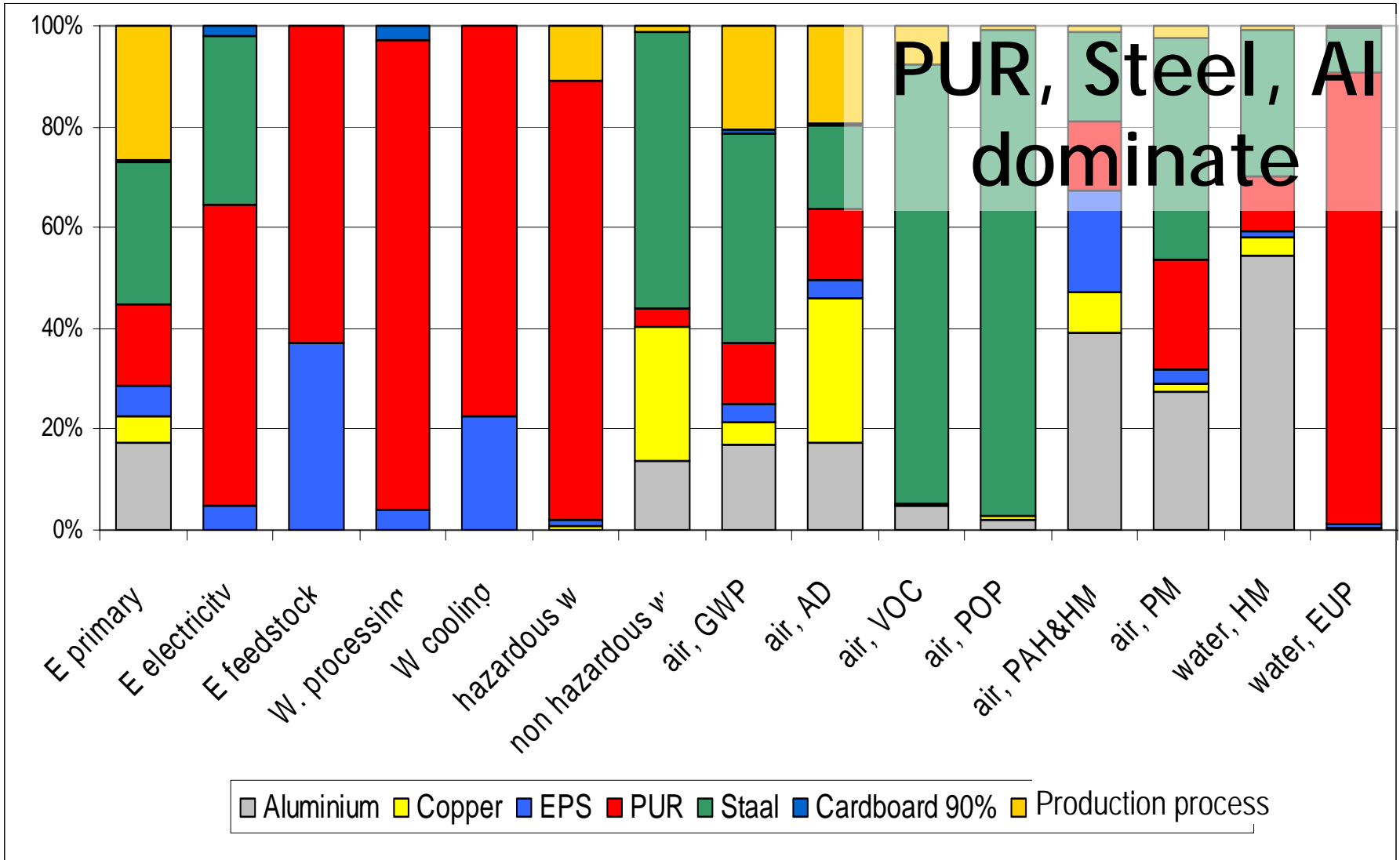
## Production of a fridge

|                        |                |      |     |
|------------------------|----------------|------|-----|
| Name                   | Koelkast 2 (d) |      |     |
| Image                  |                |      |     |
| Materials/Assemblies   | Amount         | Unit | [ ] |
| Al sheet/extrusion 11% | 3,7            | kg   |     |
| Cu winding wire 0%     | 1,4            | kg   |     |
| EPS                    | 3,1            | kg   |     |
| Flex PUR               | 6,3            | kg   |     |
| St sheet galv 5%       | 33,6           | kg   |     |
| Cardboard 90%          | 2              | kg   |     |
| EPS                    | 0,5            | kg   |     |
| (Insert line here)     |                |      |     |
| Processes              | Amount         | Unit | [ ] |
| all plastic parts      | 9,4            | kg   |     |
| sheetmetal plant       | 37,3           | kg   |     |

# EUP Analysis of the fridge life cycle



# EUP Analysis of fridge production



## KEPIs according to MEEUP

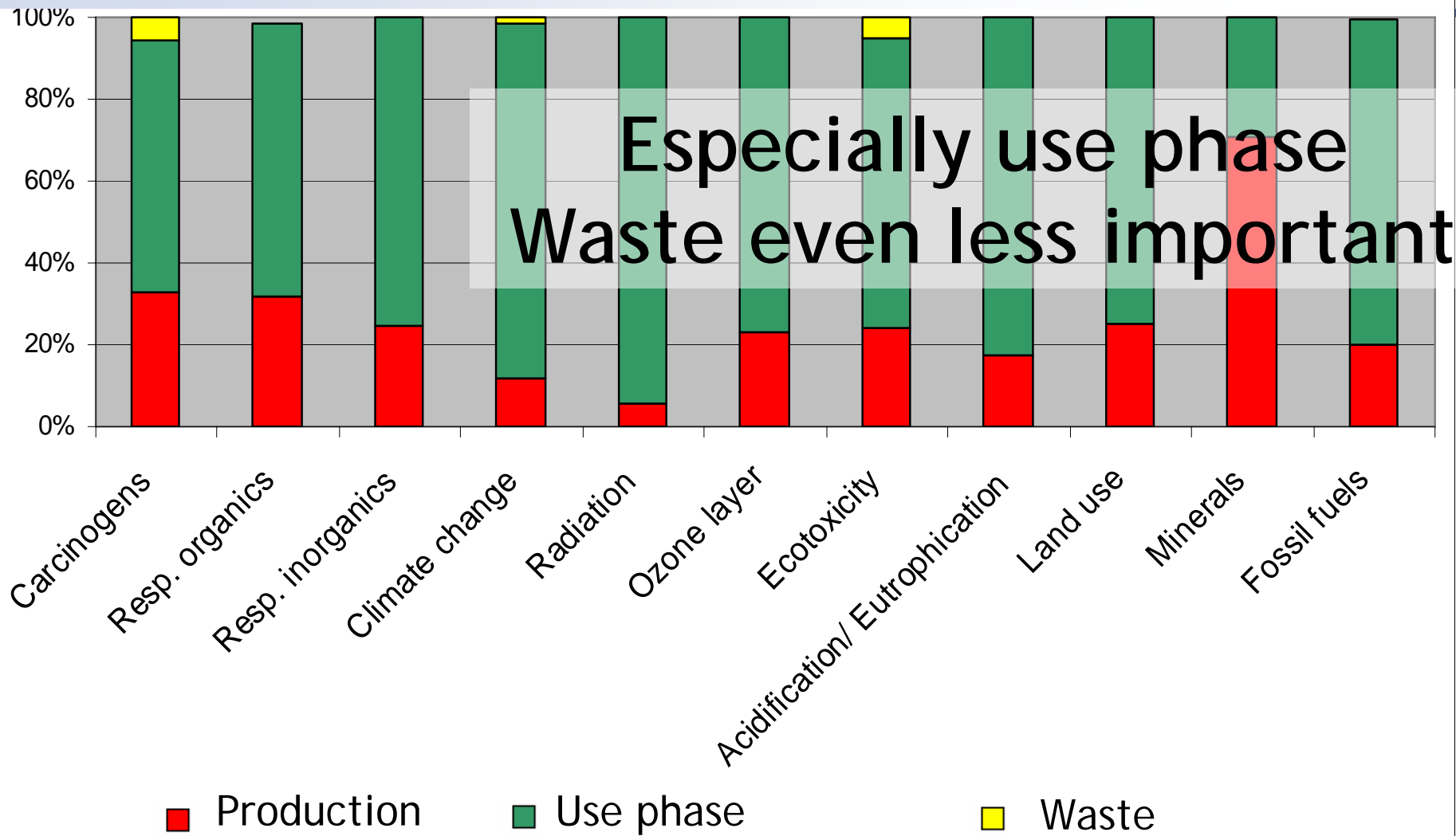
Energy in use phase

Kg Steel

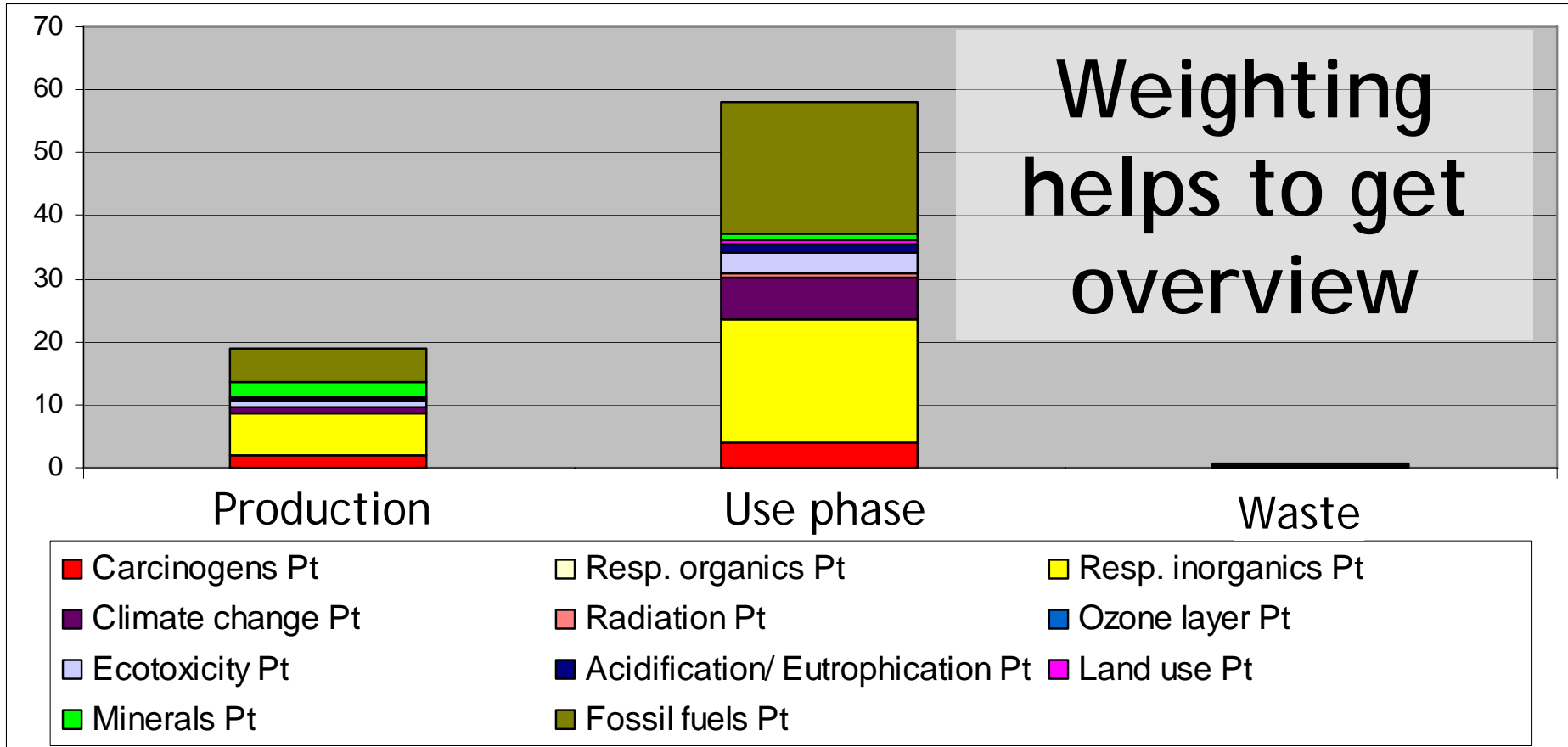
Kg PUR

Kg Aluminium

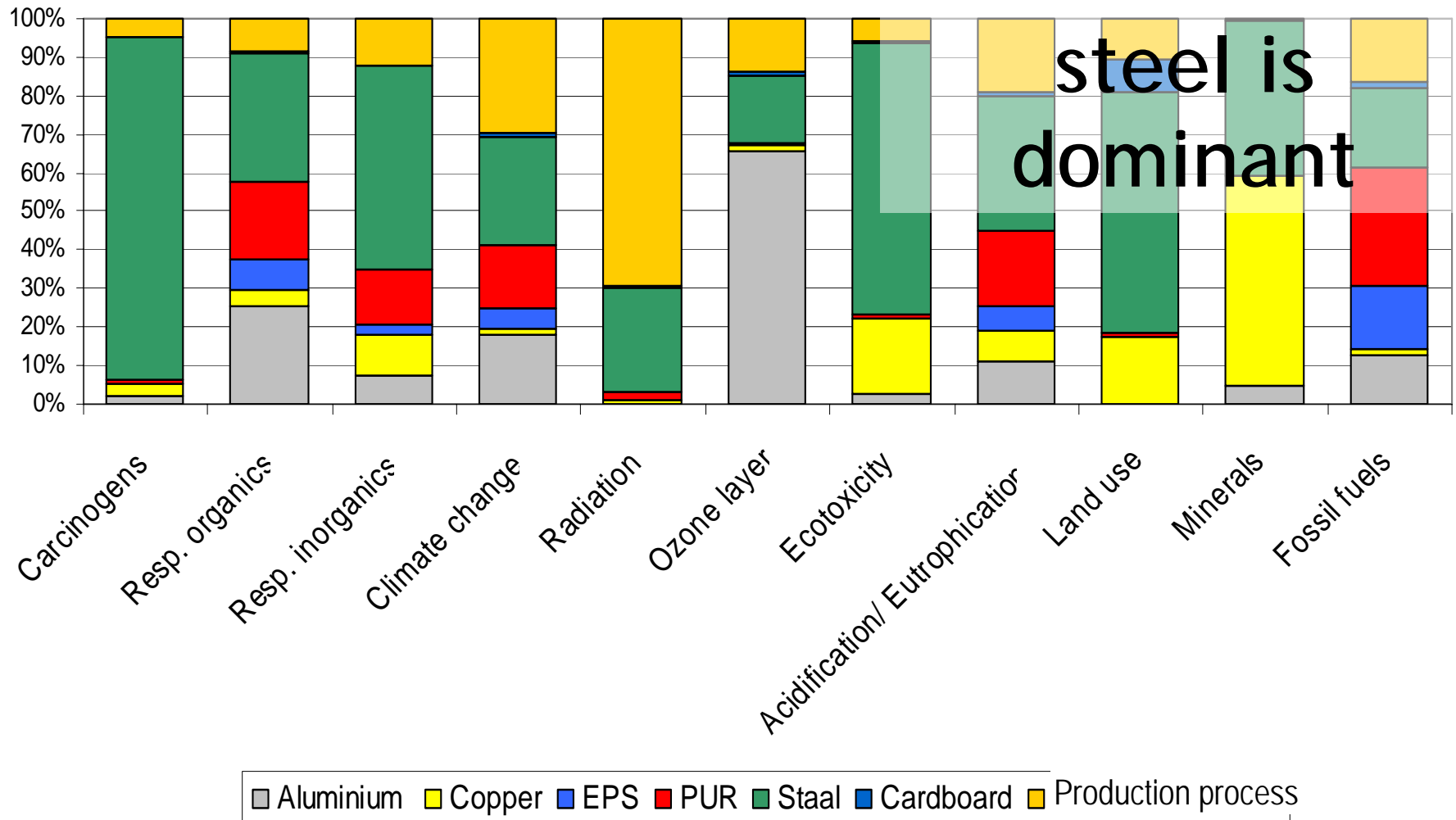
# Analysis of fridge life cycle with Eco-indicator 99



# Weighting the life cycle (EI99)



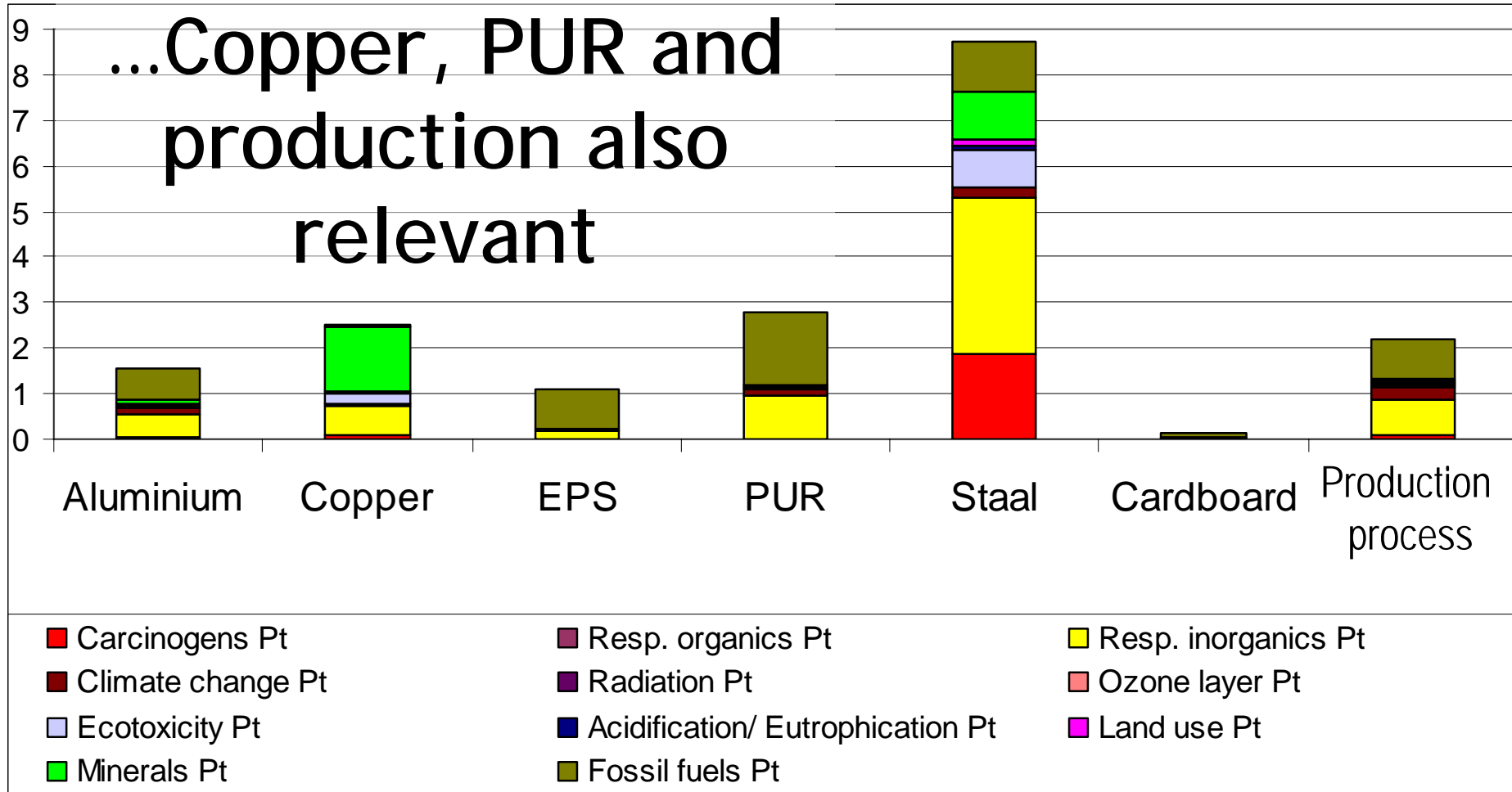
# Analysis of the production with Eco-indicator 99



# Analysis of the production with Eco-indicator 99



...Copper, PUR and production also relevant



# Comparing both methods



## KEPIs according to MEEUP

Energy in use phase

Kg Steel

Kg PUR

Kg Aluminium

## KEPIs according to Eco-indicator 99

Energy in use phase

Kg Steel

Kg PUR

Kg Cu

Energy use for production processes

- MEEUP method:
  - Simple method derived from EU regulations
  - Impact assessment debatable from scientific point: yes (but not from policy point of view)
  - Data from different sources, not always comparable (Consensus vs Debate?)
- MEEUP and LCA results do not differ much:  
the method serves its purpose
- Detailed LCA studies can always be made.