

ISAP Working Group WG2

# Environmental Considerations for Cold Recycling, Energy and Emissions: an EU perspective

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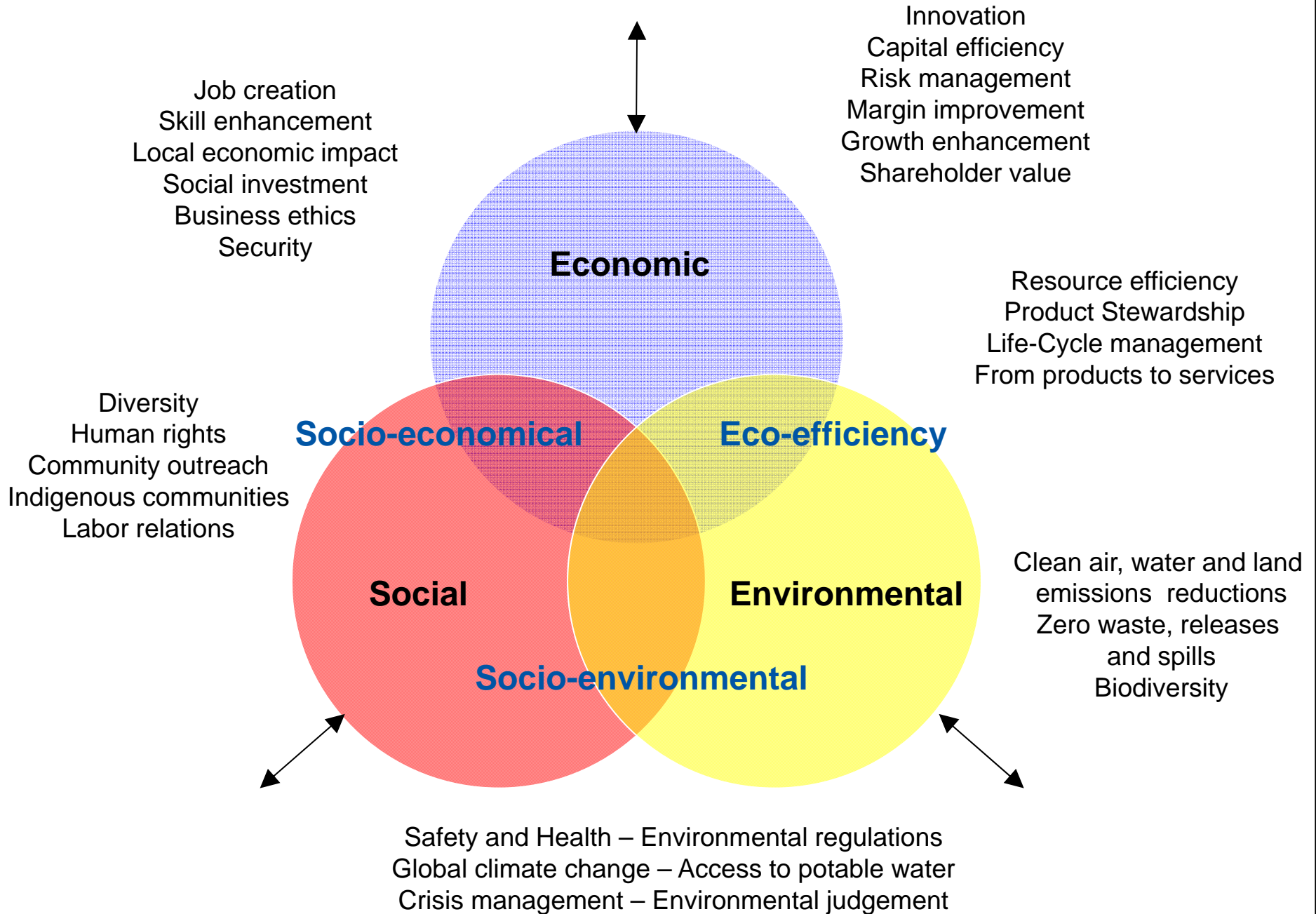
- **Sustainability**
- **Recycling in Europe**
- **LCA**
- **European approach to sustainability**
- **How is sustainable contracting promoted in the Netherlands**

# Sustainability

- *"Meeting the needs of the present generation without compromising the ability of future generations to meet their needs."* (Our Common Future, Brundtland, 1987)

People, Profit, Planet

- Is it possible to provide an objectively quantified environmental effect of recycling



# General opinion EU (political, private): Preservation of the Environment is necessary

- Reduce energy consumption
- Reduce global warming (reduce CO<sub>2</sub> production)
- Reduce acidity levels
- Reduce use of virgin materials
- Promote recycling
- Reduce fine dust levels
- Reduce noise levels
- Etc etc

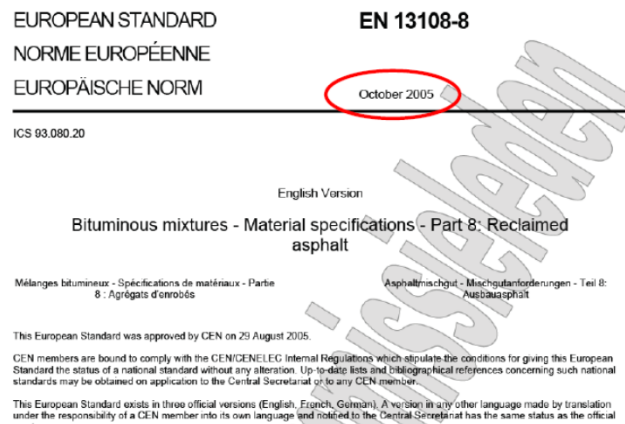
# Developments last decade in Europe with recycling (including cold mixes)

- European Union encourages Road Authorities to recycle:
  - PARAMIX: 2001-2003
  - SAMARIS: 2002-2006
  - SCORE: 2002-2005
  - EAPA activities: 2004, 2008
  - Re-Road-End of life strategies op asphalt pavements: 2009-
  - Direct-Mat: web database 2009-

# European norm on reclaimed asphalt

used for the intended purpose in a safe and environmentally responsible way.”

EN 13108-8  
Reclaimed Asphalt



**Non-waste status** should only be obtained after the waste has undergone treatment which results in a product that meets **specific European quality criteria**, ensuring that it may be used for the intended purpose in a safe and environmentally responsible way

# Definition recycling (EAPA)????

## Recycling - Reuse

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- Recycling: same function as in the original application  
(adding the reclaimed asphalt to new asphalt mixes)
- Re-use: utilisation a lesser function than in the original application  
(reclaimed asphalt as foundation, fill or base course material)





# Asphalt in Figures 2008

## → Recycling

Country	Available reclaimed asphalt (tonnes)	% of available reclaimed asphalt used in			
		Hot and warm recycling	Half warm recycling	Cold recycling	Unbound layers
Austria	350 000				
Belgium	1 500 000	55			
Czech Republic	1 500 000	25	0	30	30
Denmark	414 000	59	0	0	41
Finland	500 000				
France	6 500 000	23		< 2	> 40
Germany	14 000 000	82			18
Greece	0	0	0	0	0
Great Britain	4 000 000				
Hungary	27 560	26	0	18	41
Iceland	30 000				25
Ireland	80 000	15			
Italy	13 000 000				
Netherlands	3 500 000	83		0,50	
Norway	720 000	11	≈ 0	10	63
Poland	1 100 000	4			
Romania	18 000	60	10	10	5
Slovenia	25 600	51		49	
Spain	1 150 000	48	14	18	30
Sweden	1 000 000	65	20	10	5
Switzerland	1 100 000	50		50	
Turkey	1 168 000	2			98

# Numbers from EAPA 2008

- Yearly asphalt production in Europe: 330 million ton
- Available for recycling: 52 million ton
- This quantity is recycled/re-used for 86% at the moment

# Conclusions EAPA

- Asphalt is 100% recyclable and should remain
- Client can stimulate recycling
- Legislation can stimulate recycling
- Recycling is important for sustainability: responsibility of product-owner and road owner.

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**For a sustainable future  
recycling is essential**

**We are ready**

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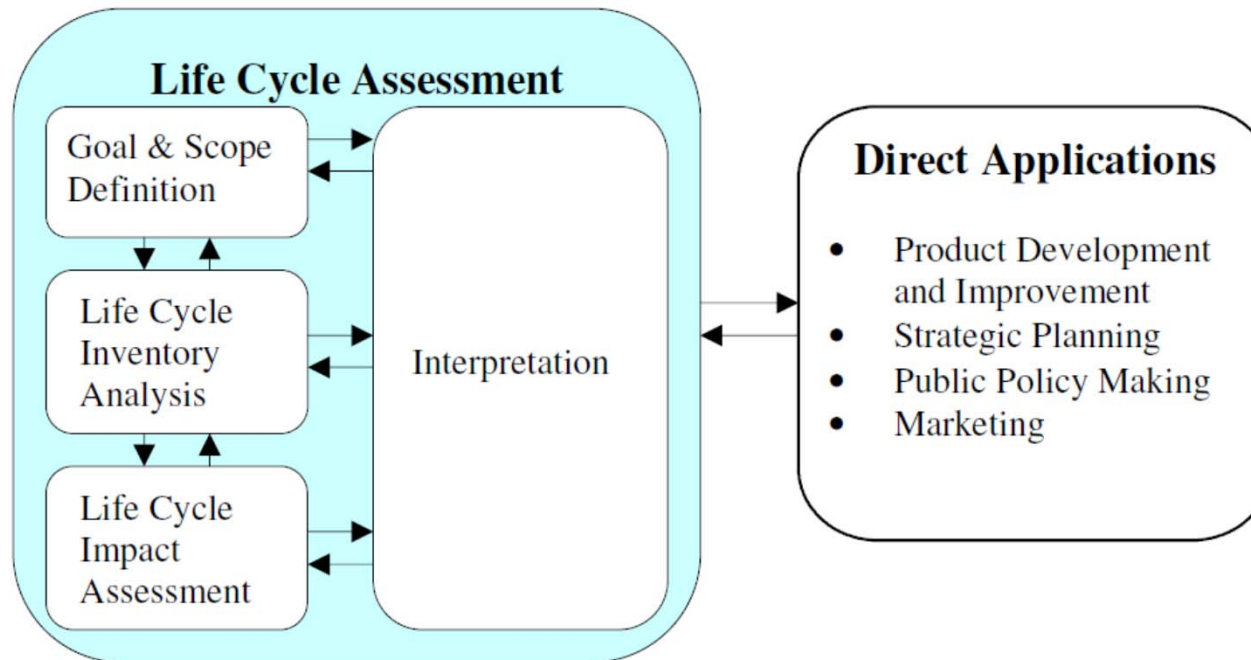
# LCA: Life Cycle Assessment

- The use of (recycled) materials in pavement construction should be supported by a full assessment of the associated environmental impacts including:
  - Energy consumption
  - Emissions and leaching
  - Etcetera
- LCA is widely accepted in other industries
- ISO 14040 series

# LCA

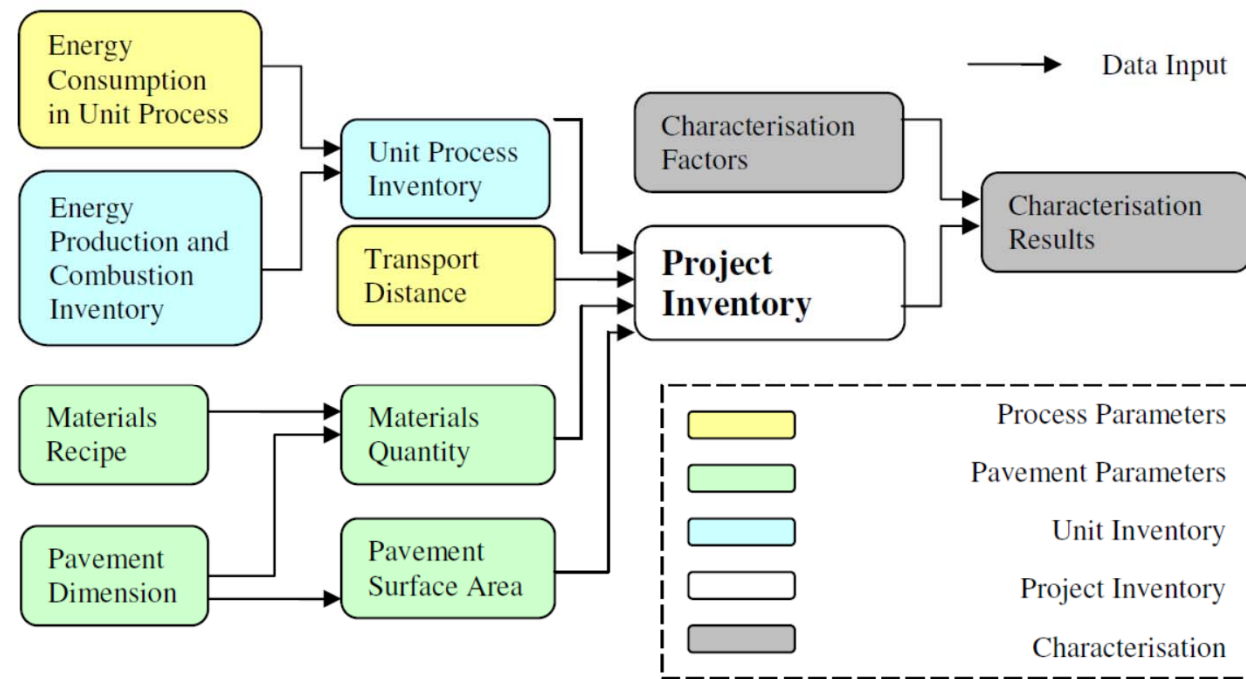
- LCA starts with a definition of the aim and scope of the study
- LCI = Life cycle inventory development: all significant environmental impacts (input + output) are quantified and compiled
- LCIA = Life cycle impact assessment

# Framework of LCA (ISO14040)



## Worksheets in LCA model

Worksheet	Description	Sub-worksheet
Process Parameters	Data on transport distance and fuel efficiency, energy consumption of unit processes in a pavement project	'Energy in transport' 'Energy in materials production' 'Energy in pavement construction'
Pavement Parameters	Data on pavement dimension and materials recipe, determine the tonnage of materials in a pavement project	'Pavement dimensions' 'Materials recipe' 'Pavement life time'
Unit Inventory	Inventory data for unit operation of transport, materials production and pavement construction	'Energy production' 'Combustion of fossil fuels' 'Transport vehicle operation' 'Construction vehicle operation'
Project Inventory	Unit inventory data are aggregated into the unit of the pavement project	'Production process' 'Transport process' 'Construction process'
Characterisation Results	Inventory results are assigned to defined impact categories, characterised by selected models and presented by category indicators	'Global warming' 'Acidification' 'Human toxicity' 'Eco-toxicity', etc



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## Relationships between worksheets in LCA model

# Europe

- **European targets:**
  - **20% CO<sub>2</sub> reduction in 2020 compared to 1990**
  - **Sustainable energy in 2020 from 2% now tot 14%**



# European developments in which environment-information is needed



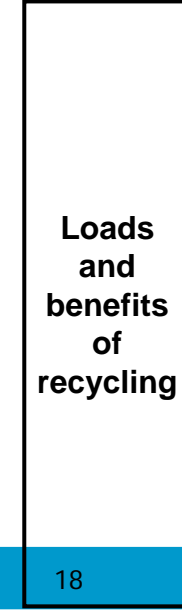
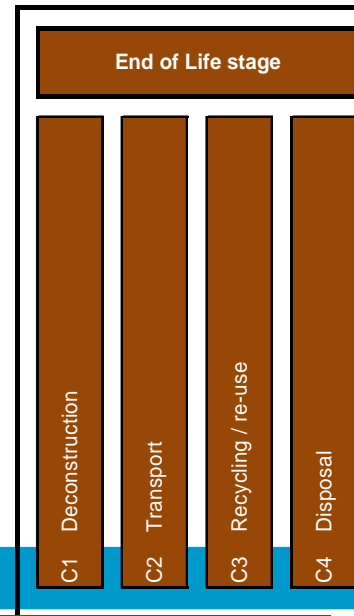
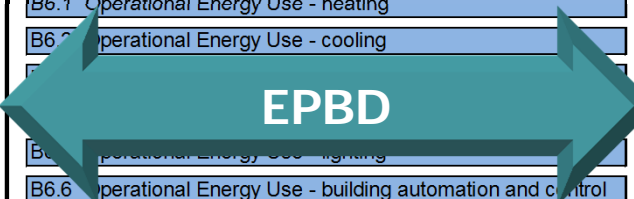
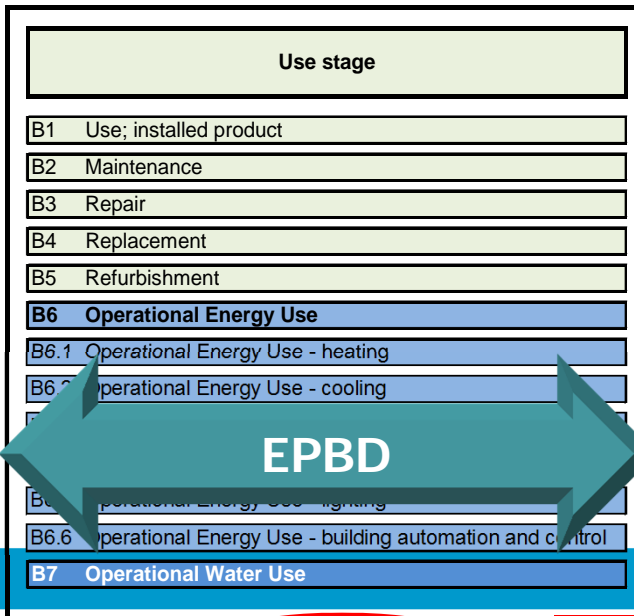
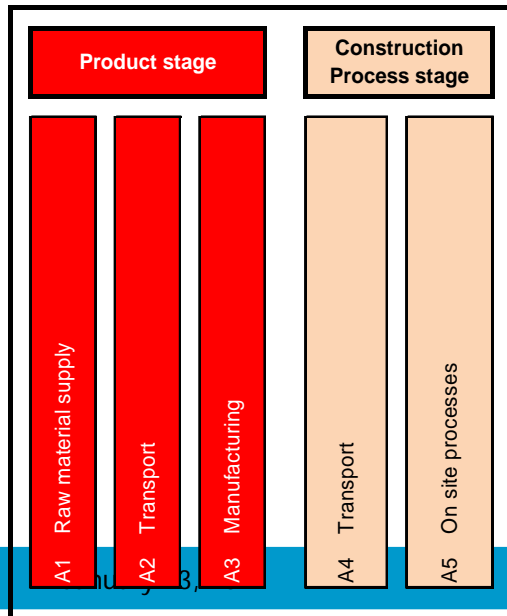
- Building products directive - CPR: BWR3 en BWR7
- SCP-SIP
  - EcoDesign: Directive 2009/125/EC
  - Ecolabel: Regulation no. 66/2010 25 van November 2009
  - Energylabel: Directive 2010/30/EC
  - Green Public Procurement (June 2010)
- Ecolabel for Buildings
- EPBD
- Waste Framework Directive
- Dangerous Substances
- Reach
- Resource Efficiency



# European approach



BEFORE USE                      USE                      AFTER USE



# Reduce diversity of measuring environmental performance for building industry

- LEED



- NEPD



- BREEAM / Green Guide



- DGNB / IBU



Institut Bauen und Umwelt e.V.

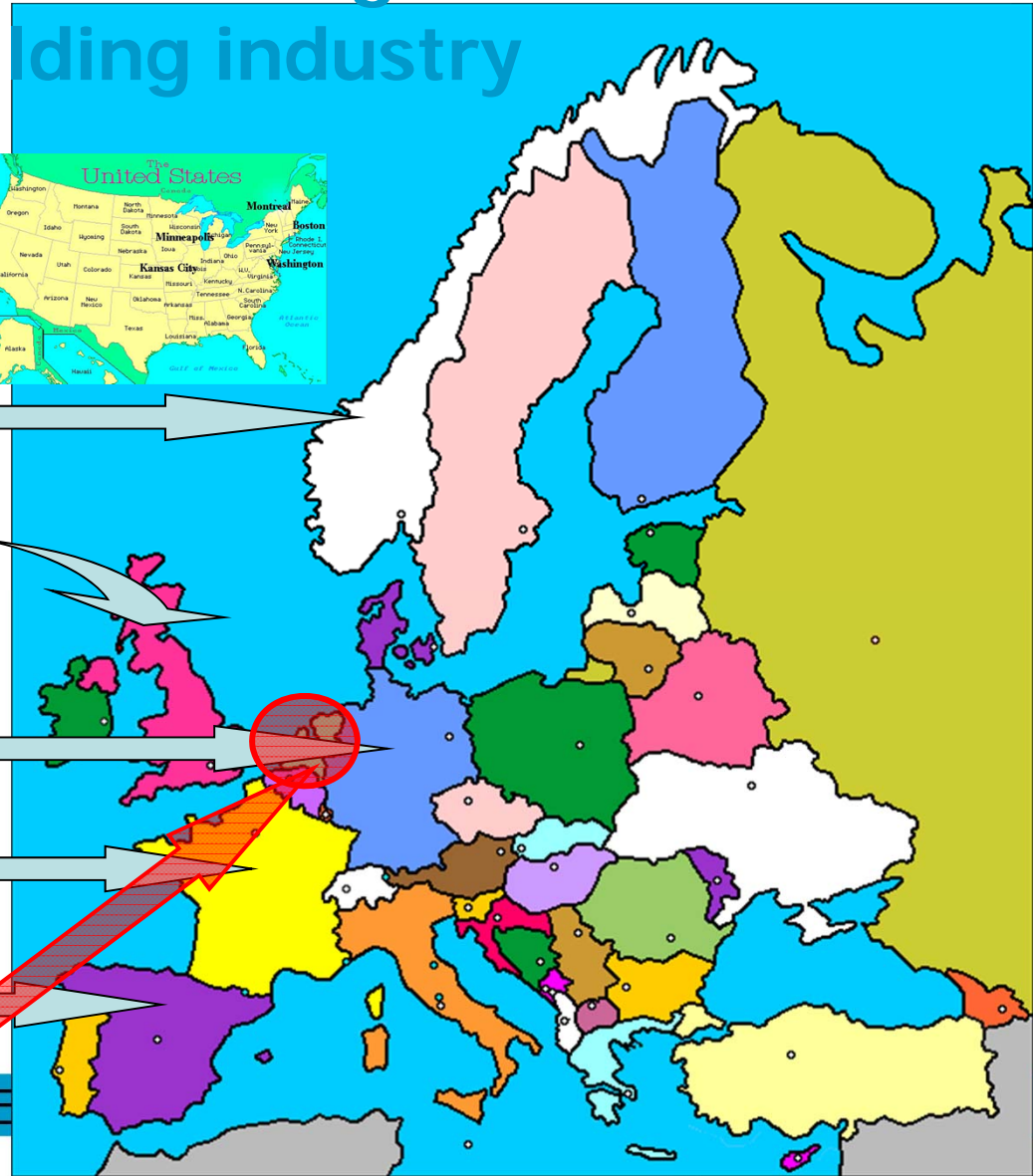
- HQE/FDES



- EPD

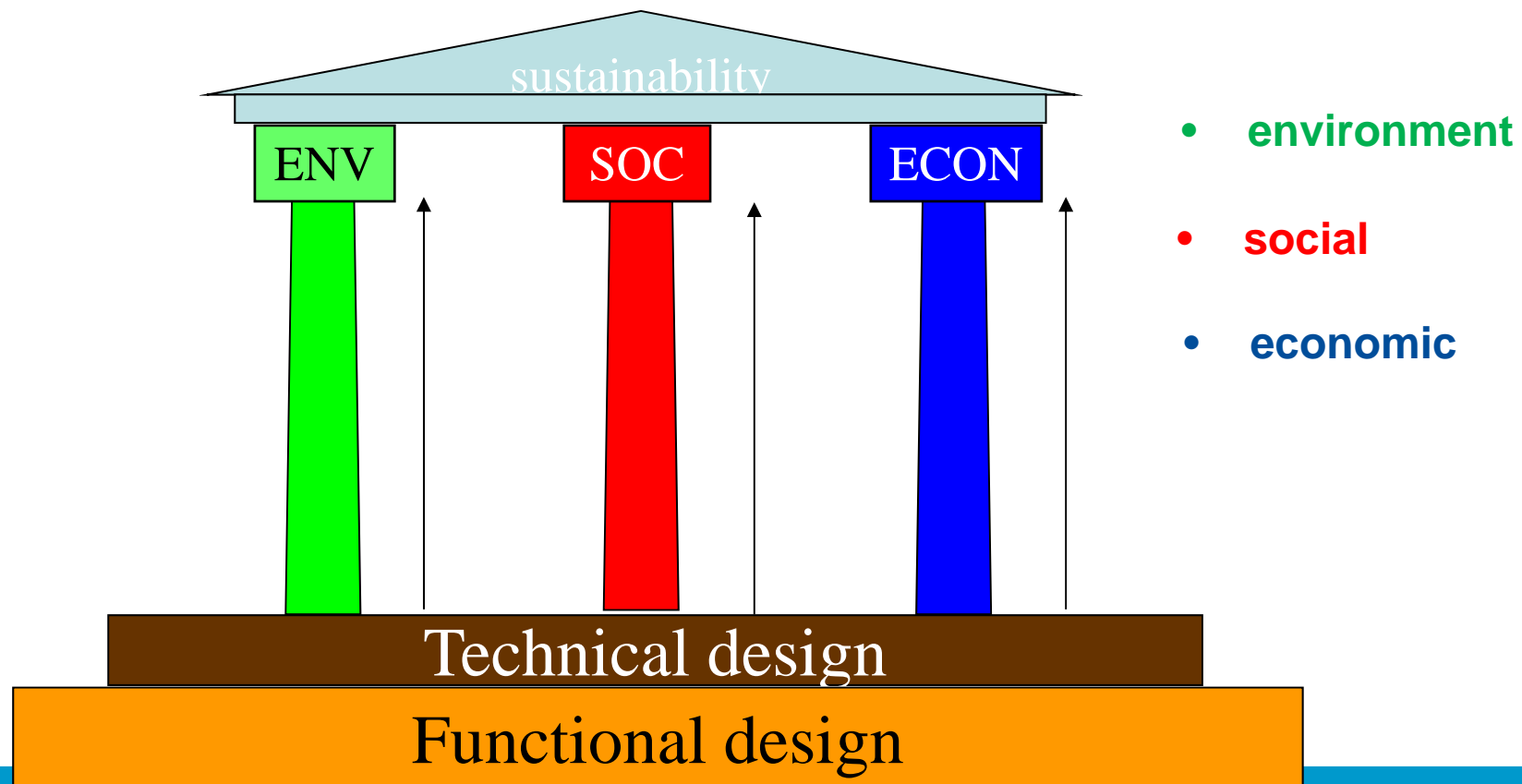
- MRPI / Nat.dbase /

GPR - GreenCalc - DuboCalc - BRE



# European harmonisation: CEN TC350

## Sustainability of construction works



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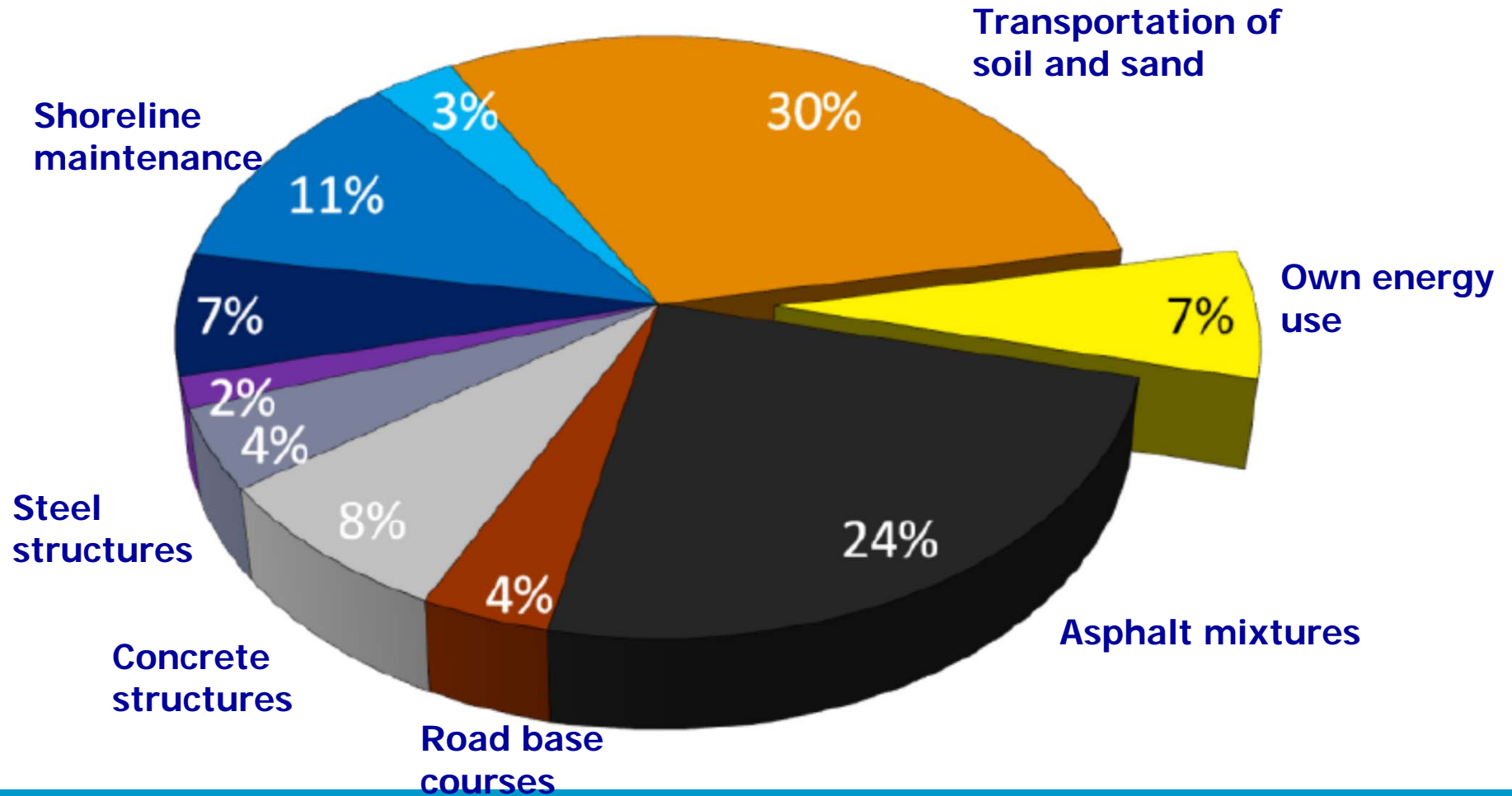
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# Example:

## Dutch government: Sustainability strategy

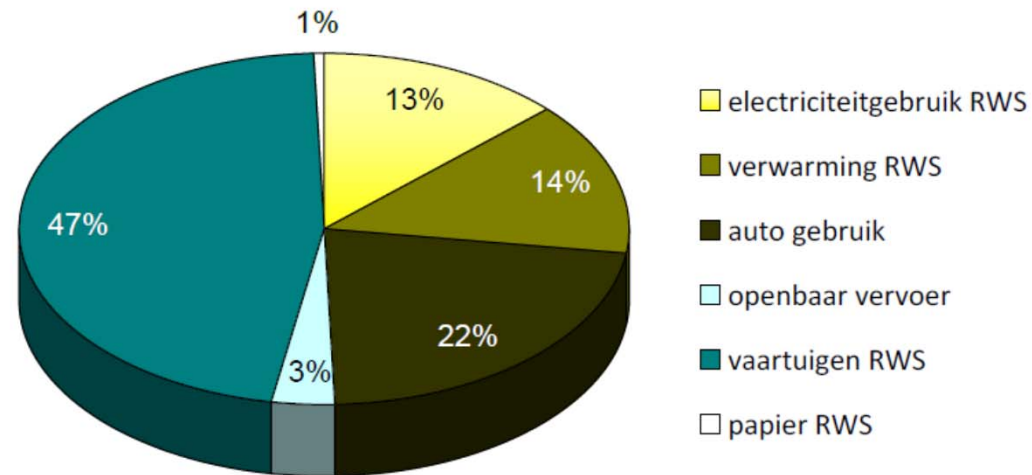
- Target sustainable purchasing:
  - Dutch DoT is from 2010 purchasing 100% sustainable:
    - DuboCalc (sustainable design)
    - CO<sub>2</sub> performance ladder)

# CO<sub>2</sub> Footprint Division DutchDoT (0.9 Mton/year)



# Carbon footprint DoT: own use

CO2 uitstoot energieverbruik



# Target in CO<sub>2</sub> Reduction the coming decade

- Pavements 28%
- Earth and sand transportation 30%
- Dredging 21%



# Asphalt Use DoT (unfortunately all hot mix at the moment)

- **Maintenance:**
  - 550 kton PAC
  - 250 kton base course mixture
- **New structures:**
  - 80 kton PAC
  - 600 kton base course mixture
  - after 2014 much less

# CO<sub>2</sub> Production Asphalt Mixtures

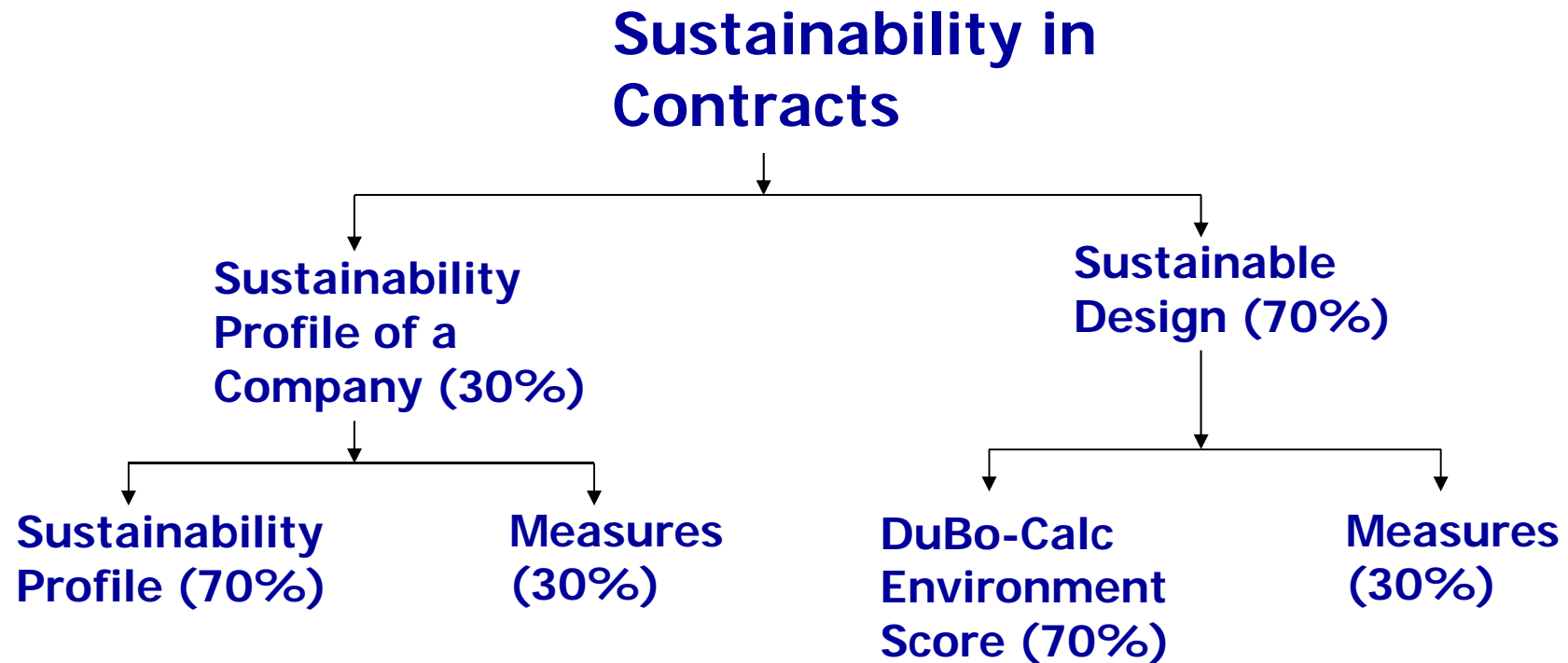
- 44% production and transportation raw materials
- 31% production of the asphalt mixture
- 18% transportation and laying/compacting asphalt mixture
- 7% maintenance/milling
  
- Do we have this information for cold mixes???

# CO<sub>2</sub> Footprint Cement

- 56% decarbonation of limestone
- 30% burning fuels
- 8% electricity production
- 4% fuel supply
- 2% others

# How is Sustainable Contracting promoted in the Netherlands?

# Sustainable contracting in the Netherlands



# Sustainability Profile of a Company

- **What is the company's policy with respect to**
  - energy use
  - energy reduction
  - communication
  - CO<sub>2</sub> reduction policies
  - CO<sub>2</sub> management in the company
- **Company should not only look to itself but also to suppliers etc**

# DuboCalc

- **Software tool to determine environmental effects of usage of materials and energy for building structures**
- **10 environmentally important aspects are evaluated by means of one single indicator: the Environmental Cost Indicator**

# Some Aspects considered

- Acidification ( $\text{SO}_2$  equivalent) € 4 / kg
- Damage to Ozone layer (CFK-11 eq) € 30 / kg
- Climate change ( $\text{CO}_2$  eq) € 0.05 / kg
- Eco-toxicity (1.4-DCB eq dichlorobenzene) € 0.06 / kg
- Smog ( $\text{C}_2\text{H}_2$  eq) € 2 / kg



# How Calculated

- **Data base of products and materials for which environmental load is determined**
- **Based on type and quantities of materials used ECI is calculated**
- **ECI is used as fictitious increase of bid**

# Best Options seen at the moment

- Thin inlays - 8%
- Rejuvenation techniques - 15%
- Remix - 9%
- Thinner structures - 20%
- Blast furnace cement - 22%
- Recycling PAC - 10%
- Low temperature asphalt - 5 a 10 %

# Can we compare cold recycling with hot mix asphalt?

	<b>HMA</b>	<b>Cold Recycling</b>
<b>System</b>	<ul style="list-style-type: none"> <li>* Fully recyclable</li> <li>* Closed-loop</li> </ul>	<ul style="list-style-type: none"> <li>equivalent for cold</li> <li>equivalent for cold</li> </ul>
<b>Materials</b>	<ul style="list-style-type: none"> <li>* Fossil fuel based binder</li> <li>* Minerals aggregates</li> <li>* Mineral filler</li> <li>* Engineered chemicals</li> </ul>	<ul style="list-style-type: none"> <li>equivalent for cold</li> <li>equivalent for cold, often less equivalent</li> <li>not necessary</li> </ul>
<b>Energy</b>	<ul style="list-style-type: none"> <li>* Hot asphalt mixing</li> <li>* Different fuel types</li> </ul>	<ul style="list-style-type: none"> <li>much lower temperature</li> <li>natural gas/bio-oil</li> </ul>
<b>Emissions</b>	<ul style="list-style-type: none"> <li>* Different emission pattern</li> <li>* Application Soot, VOC, PAH</li> <li>* Tar?</li> </ul>	<ul style="list-style-type: none"> <li>much less for cold</li> <li>much less for cold</li> <li>no</li> </ul>
<b>Logistics</b>	<ul style="list-style-type: none"> <li>* Different distances</li> </ul>	<ul style="list-style-type: none"> <li>Probably much less for cold</li> </ul>
<b>Durability</b>	<ul style="list-style-type: none"> <li>* maintenance &amp; replacements</li> </ul>	<ul style="list-style-type: none"> <li>No clear models yet for cold</li> </ul>

# Important considerations

- Cold recycling needs to have available:
  - All information for an LCA, this also means:
    - Good design method to be able to compare with other designs
    - Information on service life of cold recycling solutions to support the design

# 24 parameters in stead of 10 as used in duboCalc in near future?

Environm. effects from LCA- prEN 15804
Broeikaseffect (GWP)
Ozonlaagaantasting (ODP)
Verzuring (AP)
Vermesting (NP)
Zomersmog (POCP)
Uitputting grondstoffen – niet fossiel (ADP) – fossiel (MJ)

Envir. effects from LCA- NEN 8006
6 as above
Humane toxicity
EcoTox (eq. terr.)

Resource use prEN 15804
Renew. prim.energy (MJ)
Renew. prim. energy resources raw material (MJ)
Total renewable (MJ)
Non renewable primary energy (MJ)
Non renew primary energy resources raw material (MJ)
Total non renewable (MJ)
Secondary material (kg)
Renew. Sec. fuels (MJ)
Non renew. sec. fuels (MJ)
Net fresh water (m3)

Resource use NEN 8006
Energy (MJ)

Waste prEN15804
Hazardous waste (kg)
Non hazardous waste (kg)
Radioactive waste (kg)
Waste NEN 8006
Dangerous waste (kg)
Non-dangerous waste (kg)

Output flows prEN15804
Components for re-use (kg)
Materials for recycling (kg)
Materials for energy recovery (kg)
Exported energy (MJ)