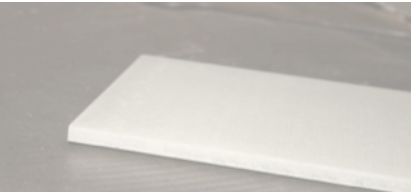
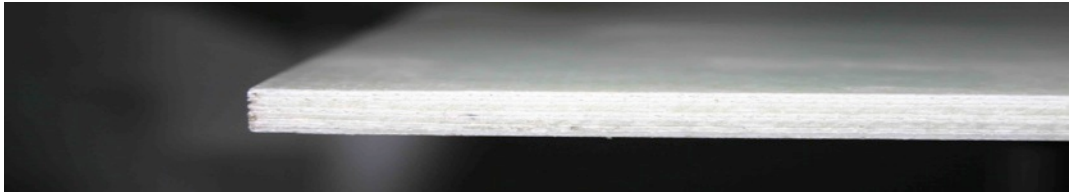
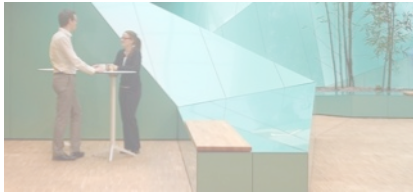
Romain Sacchi
Msc. Environmental Sc.

Life Cycle Analysis

A multi-faceted tool to assess and improve

NBE Morgenmøde om LCA

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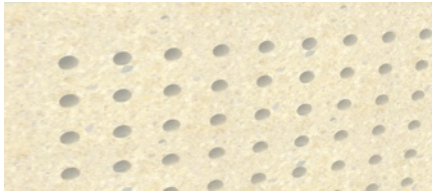


27 years old

From Marseilles, France

2006 – 2009 Logistics management bachelor degree

2009 – 2010 Micro- and macro-economics

2010 – 2012 Env. Manag. Sustainability Sc. AAU

2012 Fibertex Personal Care

2012 – 2014 Barsmark/SUNBY

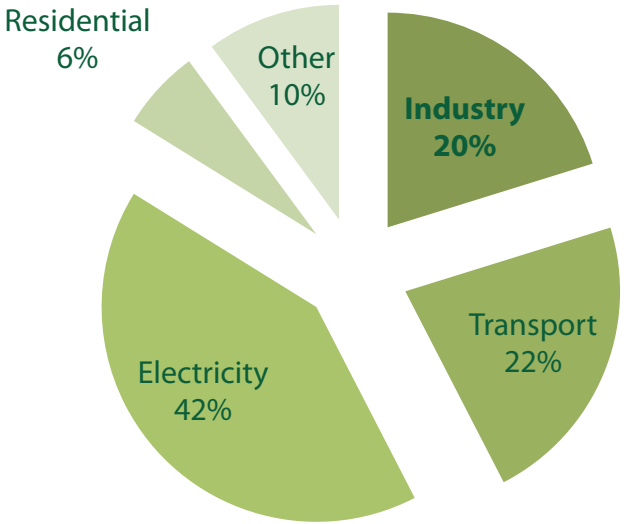
+ 80%

Increase in GHG emissions since 1970

(Internat. Panel on Climate Change)

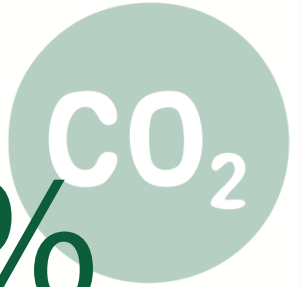
World GHG emissions in 2010

(Internat. Energy Agency 2012)



28%

of world energy serves industrial operations.



81%

of that energy is based on fossil fuels.

2001

The Integrated Product Policy

Aims for a sustainable development of the technosphere

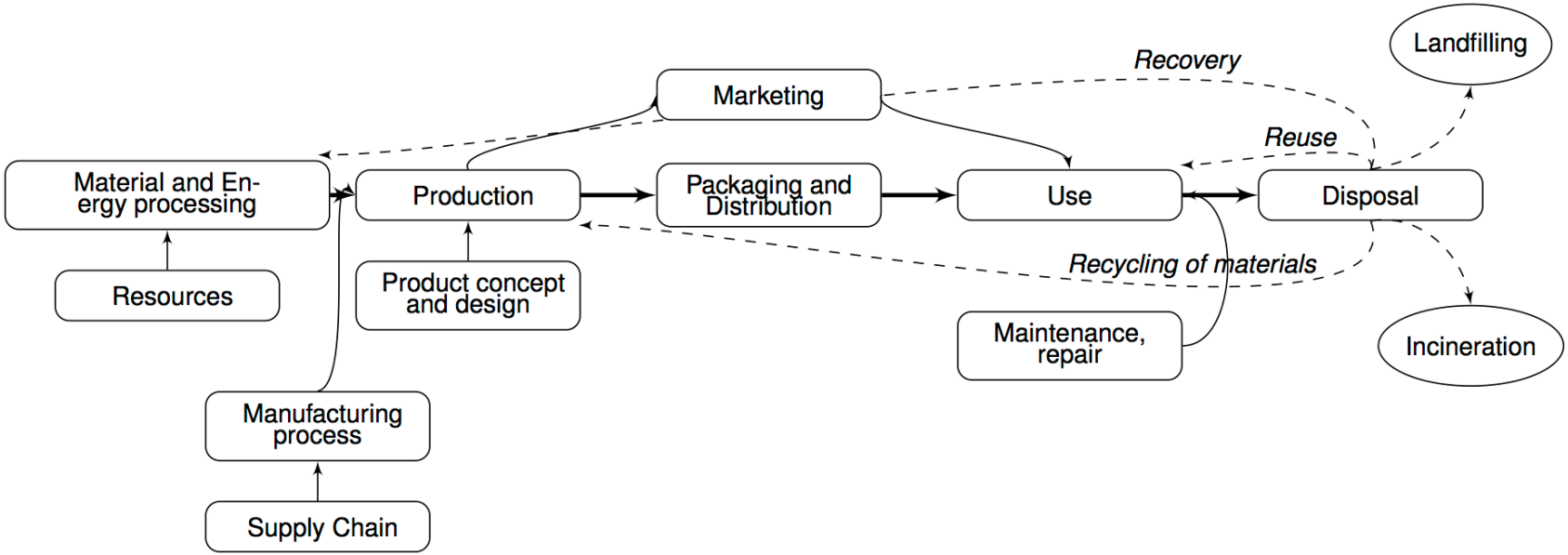
Strong focus on the products manufacture side

Deliver environmentally and qualitatively superior products

Manufacturers should account for all of their products life cycle stages

Environmental, social and economic costs included in the decision-making process

Avoid shifting the environmental burden from one phase to another



Cradle Grave

Collecting data on material and energy use, costs and social parameters

ISO 14040:2006, Life cycle assessment – Principles and Framework

ISO 14044:2006, Life cycle assessment – Requirements and guidelines

Methodology (What scope? What units? What allocation? What do I want to show?)

Quality requirements (Is my data good enough? Are the results meaningful? Am I being objective?)

Technical requirements (reliable statistics, relevant impacts, updated models)

One product or service? Peer-reviewed by an interest-free expert

Comparison between products or services? Peer-reviewed by a panel of professionals.

Know what you want to achieve (marketing, CSR, prevention, customers)

Have access to data and statistics

LCA software

LCA database

LCA models

Time

Peer-review

Scope

- Functional unit
- Reference flow
- Product system

Inventory

- Energy consumption
- Material consumption

Impact assessment

- Global warming
- Content of recycled material
- Sustainable energy
- Acidification impact

Interpretation

- How does it perform compared to the market?
- What can be improved? How?

1 kg of banana from Honduras to Denmark

120L of water
3kWh of electricity
2L of gasoline
500g of fertilizer
1m^2 of arable land

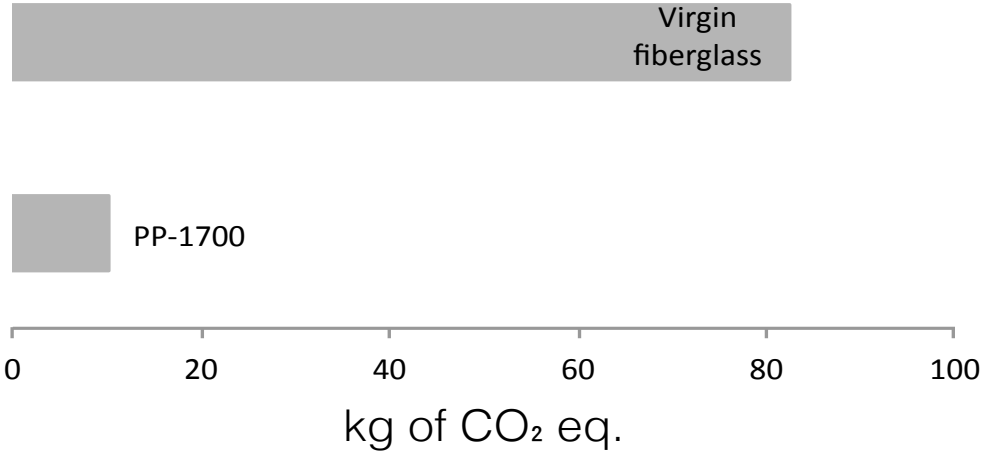
Global warm.: 5kg of CO_2
Freshwater: 10L
Eutroph.: 1kg of Po

Compared to bananas from Spain?
Less freshwater but more transport.

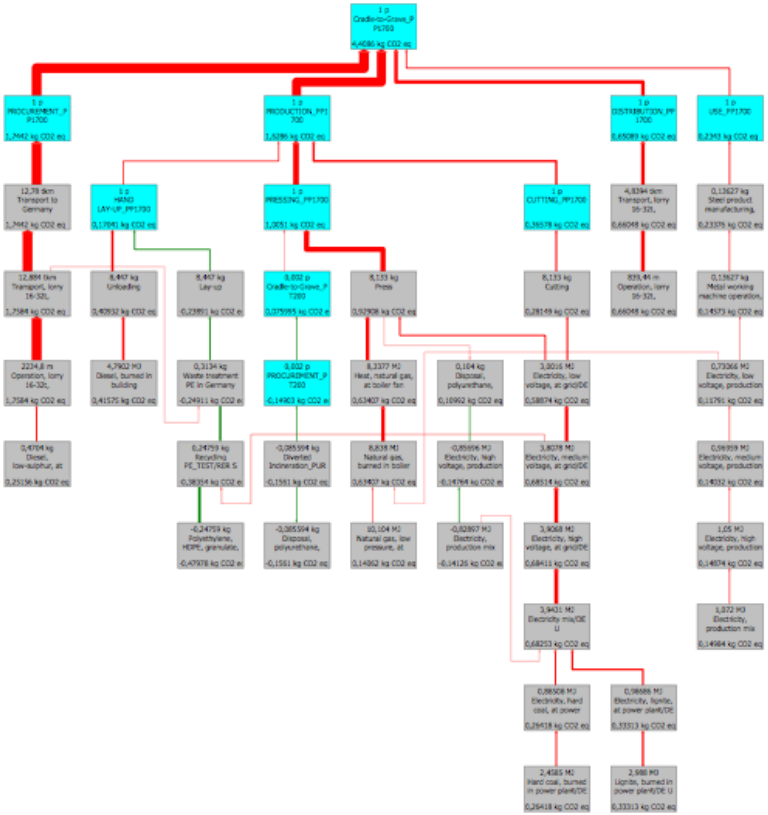
Assess

Carbon footprint

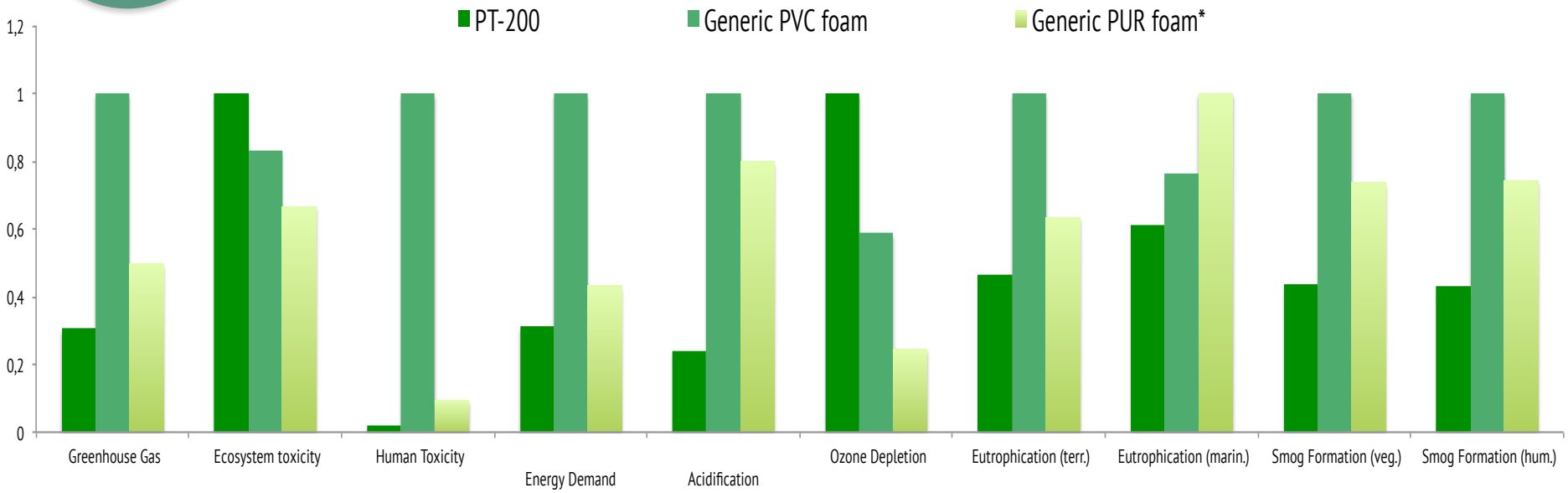
1m², 10 mm, cradle-to-gate, 50 years, GWP100a



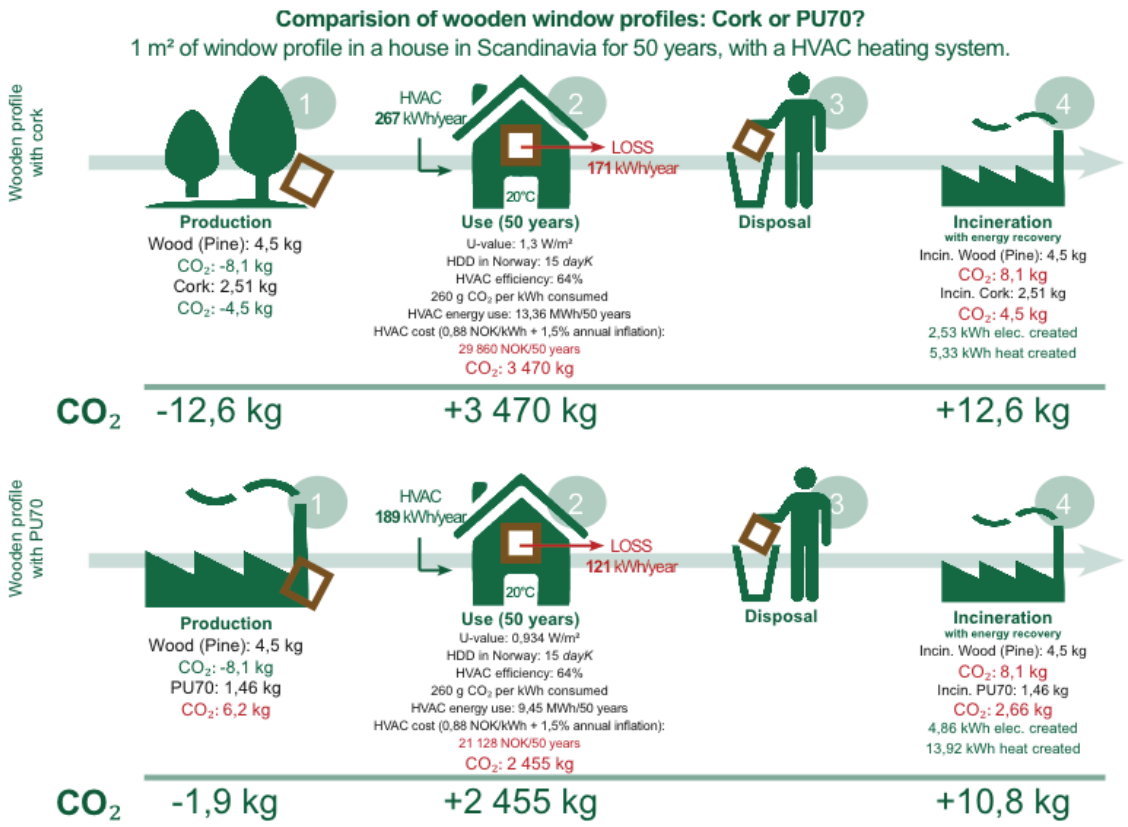
Assess



Compare


PT-200
Generic PVC foam
Generic PUR foam*
1,2
1
0,8
0,6
0,4
0,2
0
Greenhouse Gas
Ecosystem toxicity
Human Toxicity
Energy Demand
Acidification
Ozone Depletion
Eutrophication (terr.)
Eutrophication (marin.)
Smog Formation (veg.)
Smog Formation (hum.)

Encompass


Comparision of wooden window profiles: Cork or PU70?
1 m² of window profile in a house in Scandinavia for 50 years, with a HVAC heating system.
Wooden profile with cork
1
Production
Wood (Pine): 4,5 kg
CO2: -8,1 kg
Cork: 2,51 kg
CO2: -4,5 kg
2
HVAC
267 kWh/year
LOSS
171 kWh/year
20°C
Use (50 years)
U-value: 1,3 W/m²
HDD in Norway: 15 dayK
HVAC efficiency: 64%
260 g CO2 per kWh consumed
HVAC energy use: 13,36 MWh/50 years
HVAC cost (0,88 NOK/kWh + 1,5% annual inflation):
29 860 NOK/50 years
CO2: 3 470 kg
3
Disposal
4
Incineration
with energy recovery
Incin. Wood (Pine): 4,5 kg
CO2: 8,1 kg
Incin. Cork: 2,51 kg
CO2: 4,5 kg
2,53 kWh elec. created
5,33 kWh heat created
CO2
-12,6 kg
+3 470 kg
+12,6 kg
Wooden profile with PU70
1
Production
Wood (Pine): 4,5 kg
CO2: -8,1 kg
PU70: 1,46 kg
CO2: 6,2 kg
2
HVAC
189 kWh/year
LOSS
121 kWh/year
20°C
Use (50 years)
U-value: 0,934 W/m²
HDD in Norway: 15 dayK
HVAC efficiency: 64%
260 g CO2 per kWh consumed
HVAC energy use: 9,45 MWh/50 years
HVAC cost (0,88 NOK/kWh + 1,5% annual inflation):
21 128 NOK/50 years
CO2: 2 455 kg
3
Disposal
4
Incineration
with energy recovery
Incin. Wood (Pine): 4,5 kg
CO2: 8,1 kg
Incin. PU70: 1,46 kg
CO2: 2,66 kg
4,86 kWh elec. created
13,92 kWh heat created
CO2
-1,9 kg
+2 455 kg
+10,8 kg

Integrate

	Environment (LCA)	Economic (LCC)	Social (SLCA)
Sourcing	30 tkm average 20% mat. from EU 15% CO_2 2% sensitive chemicals	Increasing costs	1/3 raw material from sensitive areas High unemployment rate Chronic diseases
Making	30% CO_2 45% wind energy	Most costly phase	CSR within the company
Transport	80% DK	3% cost	
Use	60% CO_2 Lack data		Improves health, comfort
Disposal	-10% CO_2 30% mat. recycled	Taxes	

Monitor

2012

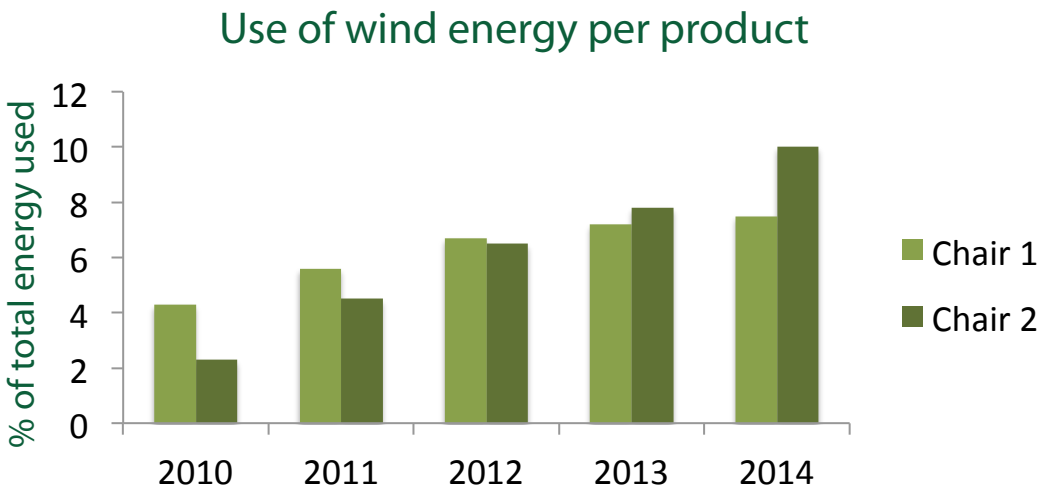
	Enviro
Sourcing	30 tkm a 20% mat 15% CO_2 2% sens chemica
Making	30% CO_2 45% win
Transport	80% DK
Use	60% CO_2 Lack dat
Disposal	-10% CO_2 30% mat. recycled Taxes

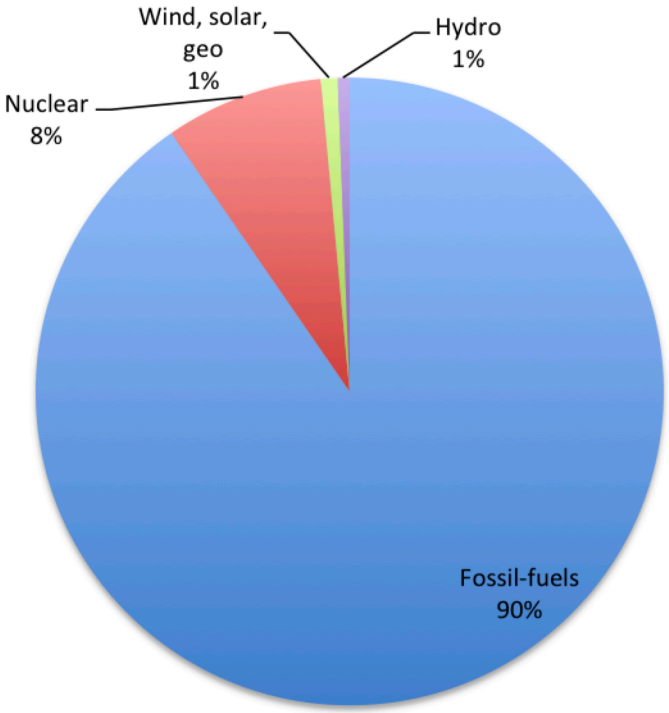
2013

	Enviro
Sourcing	30 tkm av 20% mat. 15% CO_2 2% sensit chemicals
Making	30% CO_2 45% winc
Transport	80% DK
Use	60% CO_2 Lack data
Disposal	-10% CO_2 30% mat. recycled Taxes

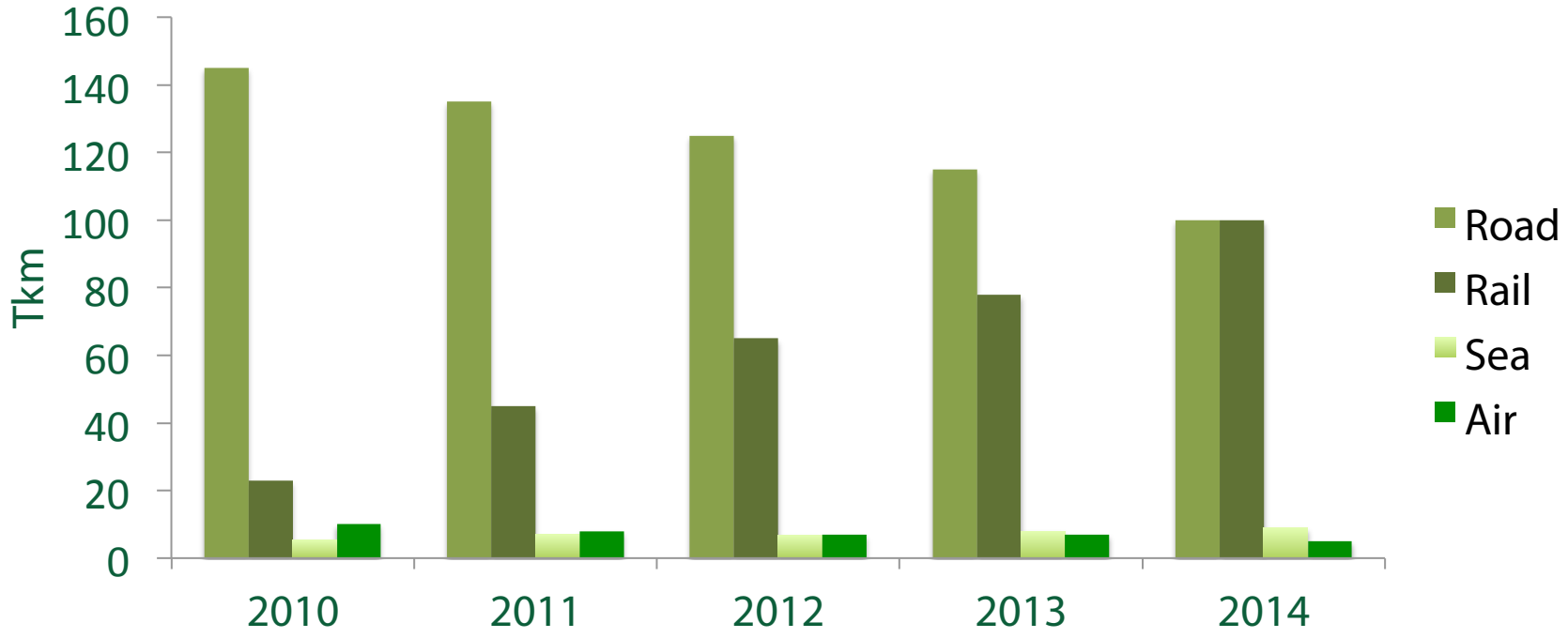
2014

	Environment	Economic	Social
Sourcing	30 tkm average 20% mat. from EU 15% CO_2 2% sensitive chemicals	Increasing costs	1/3 raw material from sensitive areas High unemployment rate Chronic diseases
Making	30% CO_2 45% wind energy	Most costly phase	CSR within the company
Transport	80% DK	3% cost	
Use	60% CO_2 Lack data		Improves health, comfort
Disposal	-10% CO_2 30% mat. recycled	Taxes	


Use of wind energy per product
% of total energy used
12
10
8
6
4
2
0
2010
2011
2012
2013
2014
Chair 1
Chair 2


Wind, solar, geo 1%
Hydro 1%
Nuclear 8%
Fossil-fuels 90%

Average transport, means of transport



Carbon footprint, per product

Prevent

REACH, registration, evaluation, authorization and restriction of chemicals
Is there any chemicals in my product system forbidden?
Likely to become forbidden?
To which process are they attached?
Can they be substituted?

Eco- and human-toxicity, using UseTOX characterization factors				
Substances	**LCIA results**	**Eco-toxicity (CTUe)**	**Human-toxicity (non-carcinogenic) (CTUh)**	**Human-toxicity (carcinogenic) (CTUh)**
Acrolein (air)	651ng		$5{,}27\times10^{-13}$	
Benzene (water)	1,23mg	$1{,}77\times10^{-4}$		
Benzene (air)	14,41mg		$1{,}33\times10^{-12}$	$5{,}26\times10^{-12}$
Carbon disulfide (air)	396µg		$1{,}85\times10^{-11}$	
Cumene	222µg	$1{,}47\times10^{-4}$		
Ethyl-benzene	3,38mg	$1{,}59\times10^{-4}$		
Formaldehyde (air)	2,81µg	$7{,}64\times10^{-5}$	$6{,}198\times10^{-13}$	$5{,}5\times10^{-11}$
Hexane (air)	27mg		$6{,}53\times10^{-12}$	
Phenol	22,18mg	$2{,}496\times10^{-3}$		
Tetrachlorodibenzo-p-dioxin	1,05ng			$3{,}09\times10^{-11}$
Tetrachloroethene	10,2mg		$1{,}66\times10^{-11}$	$4{,}39\times10^{-12}$
Toluene (air)	10,6mg		$9{,}55\times10^{-13}$	
Toluene (water)	17,84mg	$2{,}5\times10^{-4}$		
Xylene (water)	14,14mg	$2{,}8\times10^{-4}$		
Xylene (air)	10,26mg		$1{,}09\times10^{-12}$	

Note: figures rounding may not match with totals.

Decision

Design
- The product can be disassembled?
- Use of recycled material?

Sourcing
- Stop using copper?
- Aluminium instead of plastics?

Making
- Relocate to Poland?
- Use natural gas instead of electricity?

Transport
- Increase sea transport?

Use
- What if I make my product stronger?
- Remove all suspicious chemicals?

Disposal
- If it can be incinerated?

Labels

	Description
Type I	a voluntary, multiple-criteria based, third party program that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a product category, based on life cycle considerations
Type II	informative environmental self-declaration claims
Type III	voluntary programs that provide quantified environmental data of a product, based on life cycle assessment, and verified by that or another qualified third party

Conclusion

Several reasons to do an LCA on a product/service

monitor costs

competitive advantage

assist in design

optimisation

eco-labeling

compare scenarios

chemicals prevention

compensate

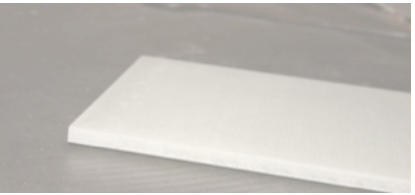
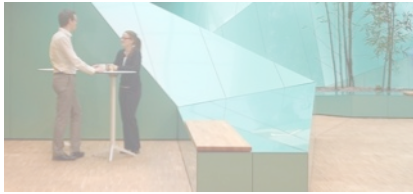
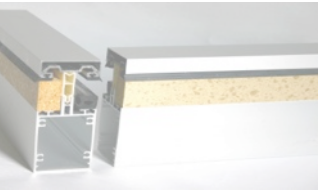
CSR

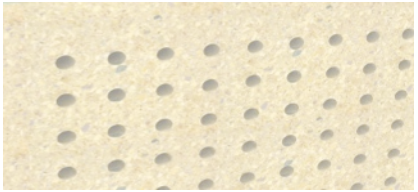
customers

transparency

compliance

RECYCLED DESIGN by GETWASTED
12 kg of CO_2 eq.
high density polyurethane foam
Production waste foam collected from refrigerator, car and foam producers and compressed to produce high density insulating boards. Dimension-stable when immersed in water, this material is ideal for use in humid environments, where organic materials, such as wood or timber, would decay.
glass fiber-reinforced epoxy matrix
Production waste material collected from wind turbine blade manufacture sites in Europe and pressed into high strength fiberglass boards. Entirely inorganic, the material is corrosion- and rot-resistant as well as acid- and bullet-proof.
8 kg of waste put to a better use



Additional information

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