

LCA of buildings Activities in Switzerland

Dr. Rolf Frischknecht

Dr. Viola John

IEA Annex 57 Meeting

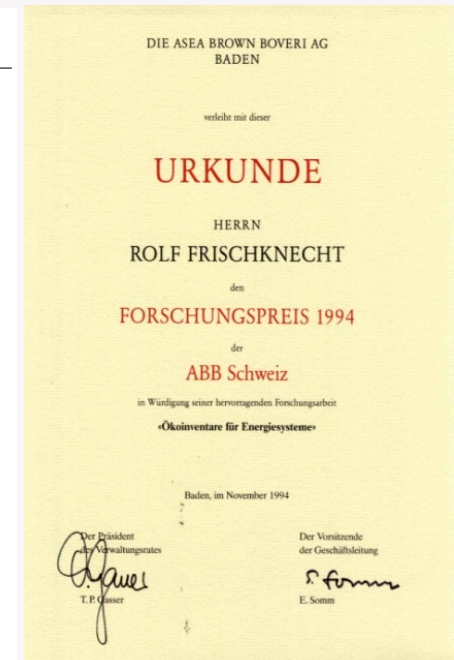
September 23-24, 2013, Graz, Austria

Overview


- Introduction
- LCA tradition in Switzerland
- LCA data in the building sector: the “KBOB-list”
- Conclusions

Cornerstone of the ecoinvent data base

- 1994, ETH Zürich:
“Ökoinventare von Energiesystemen”
about 500 data sets covering
 - energy supply
 - building materials and chemicals
 - transport services
 - waste management








current data source: ecoinvent data v2.2



Swiss Centre for Life Cycle Inventories

a Competence Centre of



Direct access to database

Username:

Password:

[Forgot your password?](#)

Organisation **Database** **Documentation** **News** **ecoinvent v3**

Latest News

Presentations from 3rd Int. ecoinvent Meeting available

All presentations from the 3rd International ecoinvent Meeting (on October 5, 2012, in St-Malo,...

[\[more\]](#) 15.10.2012

ecoinvent v3 further postponed ...

Due to some technical problems, the release of ecoinvent v3 is unfortunately further postponed....

[\[more\]](#) 09.10.2012

ecoinvent v3 – release date shifts to September 2012!

In the last month, the ecoinvent Centre team together with the editorial board worked very hard to...

[\[more\]](#) 24.07.2012

- more than 4'000 LCA datasets

- quality assured and harmonised

- more than 4'500 users

- in more than 40 countries

Welcome to the ecoinvent Centre portal

The ecoinvent Centre - a Competence Centre of ETHZ, EPFL, PSI, Empa and ART - is the world's leading, supplier of consistent and transparent life cycle inventory (LCI) data of its own quality with the **database ecoinvent data v2.2** and offers science-based, industrial, international life cycle assessment (LCA) and life cycle management (LCM) data and services.

ecoinvent data v2.2 ...

- contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services.

ecoinvent database: extensive, transparent contents



cumulative LCIA results Expand all				rock wool, at plant, CH, [kg]
⊕ CML 2001/acidification potential: 2				
⊖ CML 2001/climate change: 5				
Name	Location	Mean value	Unit	
⊕ GWP 100a	GLO	1.0831	kg CO2-Eq	
⊕ GWP 20a	GLO	1.2336	kg CO2-Eq	
⊕ GWP 500a	GLO	1.0271	kg CO2-Eq	
⊕ lower limit of net GWP	GLO	1.0866	kg CO2-Eq	
⊕ upper limit of net GWP	GLO	1.0888	kg CO2-Eq	
⊕ CML 2001/eutrophication potential: 2				
⊕ CML 2001/freshwater aquatic ecotoxicity: 4				
⊕ CML 2001/freshwater sediment ecotoxicity: 4				
⊖ CML 2001/human toxicity: 4				
Name	Location	Mean value	Unit	
⊕ HTP 100a	GLO	0.53002	kg 1,4-DCB-Eq	
⊕ HTP 20a	GLO	0.52941	kg 1,4-DCB-Eq	
⊕ HTP 500a	GLO	0.53135	kg 1,4-DCB-Eq	
⊕ HTP infinite	GLO	0.71483	kg 1,4-DCB-Eq	
⊕ CML 2001/ionising radiation: 1				
⊕ CML 2001/land use: 1				
⊕ CML 2001/malodours air: 1				
⊕ CML 2001/marine aquatic ecotoxicity: 4				
⊕ CML 2001/marine sediment ecotoxicity: 4				
⊖ CML 2001/photochemical oxidation (summer smog): 5				

Decision making situations in building project planning

optimisation of building shape	utilisation factor, compactness
retrofit or new construction	including operational energy demand, comfort, user flexibility and cost effectiveness
construction type	massive, lightweight or mixed construction
supporting structure	large span width and projecting building elements composition of concrete and reinforcement
Selection of supplier	Environmental performance of supplier (incl. shipping)

Project planning



 average
 manufacturer specific

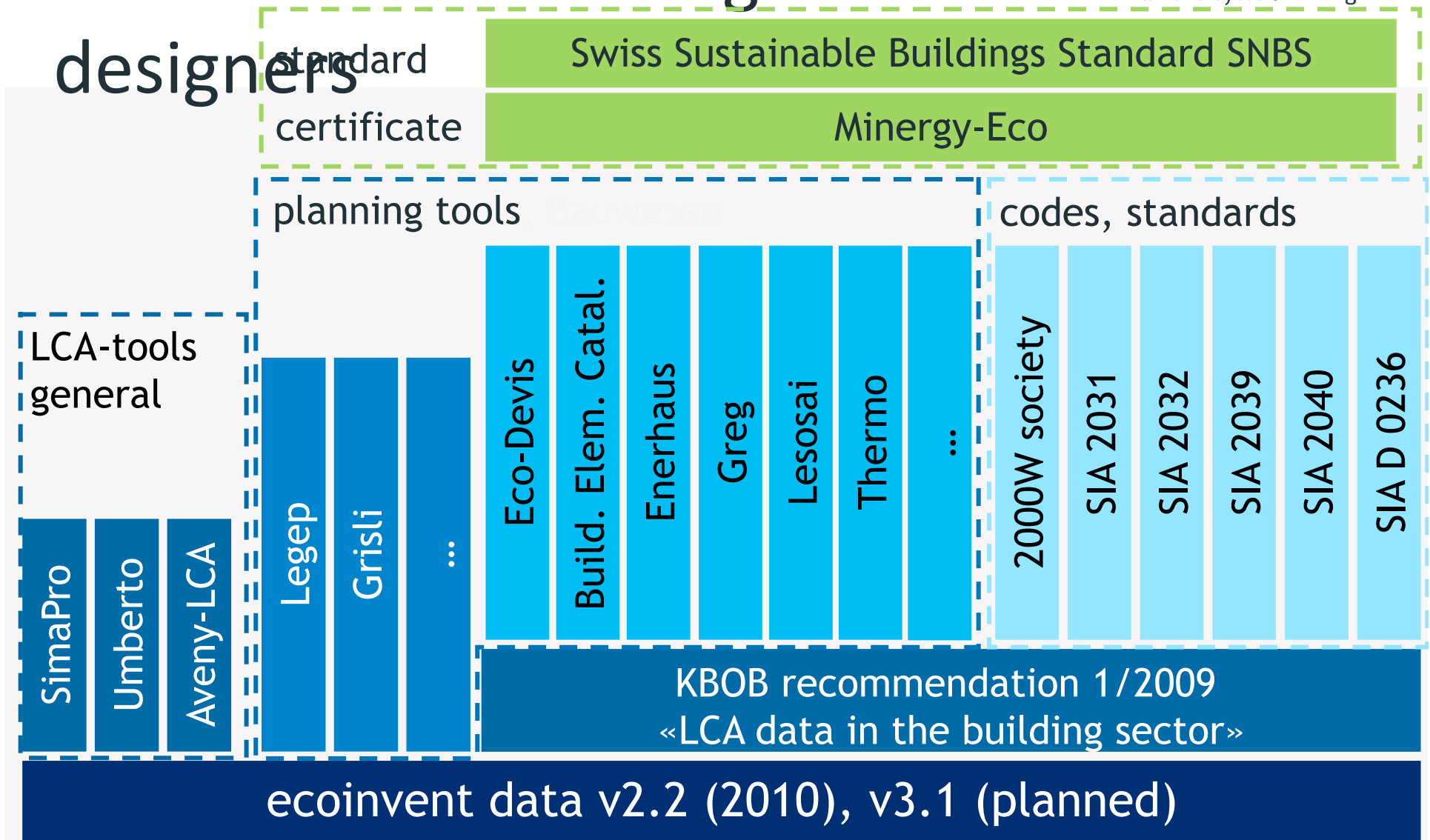
Requirements on LCA data in the building sector

- **Relevance:** availability of LCA data on most important building materials and elements
- **Consistency:** same methodology and similar data quality should be applied for all building materials
- **Timeliness:** data should represent today's situation
- **Independence:** data should be investigated and modelled independent of particular interests
- **Quality:** data should be verified by independent third party

Platform LCA data in the building sector: tasks

- offer reliable LCA data (“KBOB-List”)
- set priorities regarding updates and extensions of KBOB-list
- co-ordination and quality assurance of update projects
- support of LCA data projects
- organise exchange between administration, research, building owner, and associations (building industry)
- answer to questions and claims
- discuss and clarify methodological questions

How to reach building designers



Use of LCA data in the building sector

LCA parameters
building materials:
KBOB-list



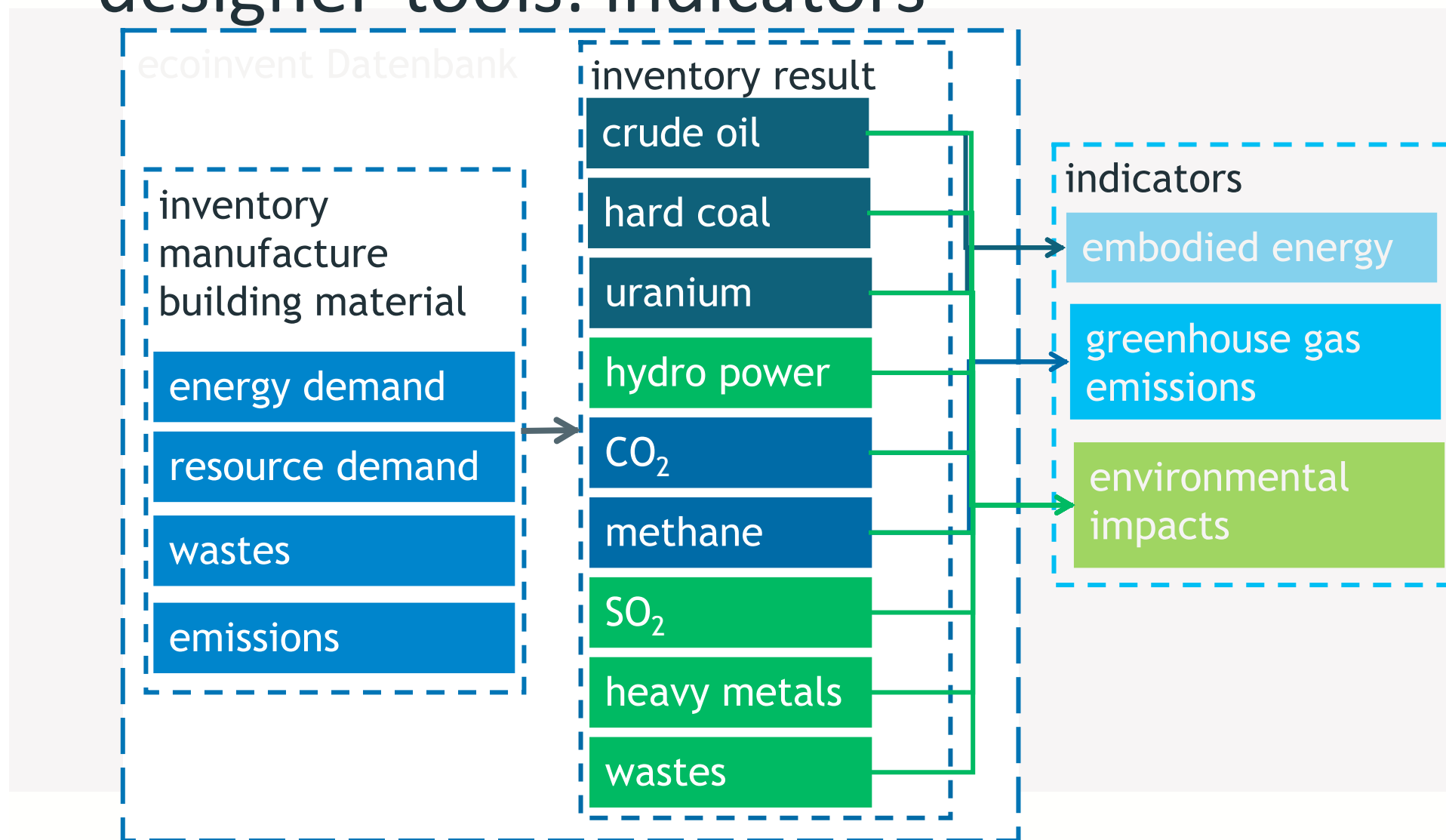
LCA parameters
building elements:
planning tools



calculate LCA parameters
of the building:
architect/planner

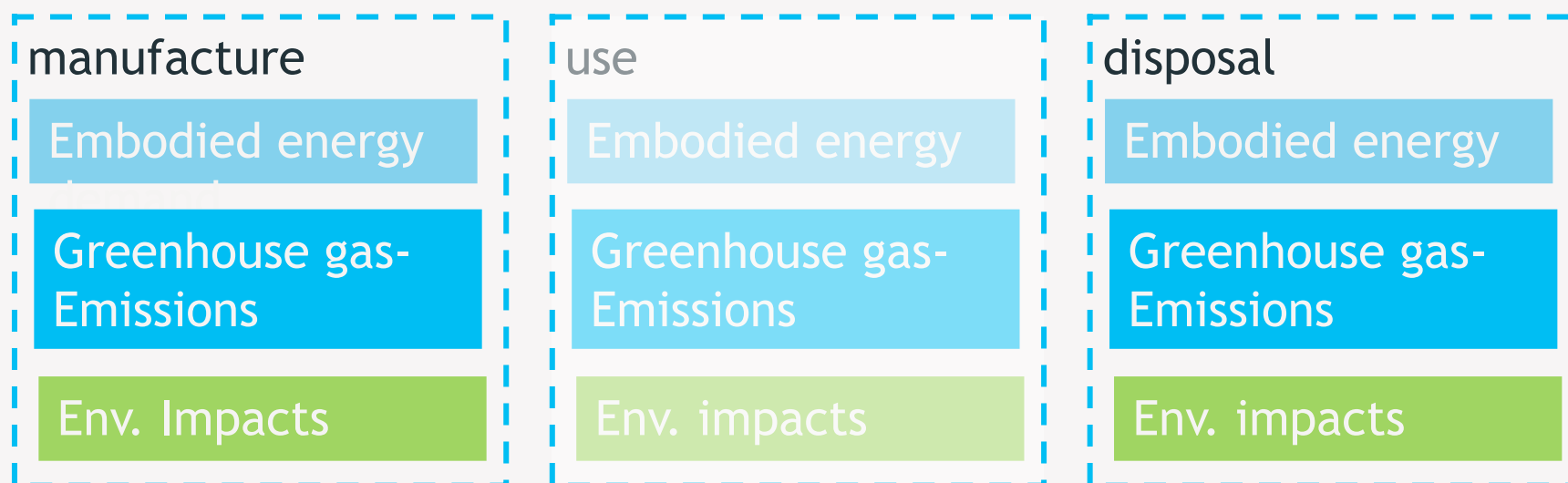


From ecoinvent to building designer-tools: indicators



From ecoinvent to building designer-tools

building materials



- Total: requirements/emissions manufacture + disposal
- investigate/quantify requirements/emissions of use phase separately!

Embodied energy and carbon of buildings: Swiss benchmarks

- Current state:
 - SIA 2040 SIA-Efficiency path 2050
 - benchmark values: energy, greenhouse gas emissions

Dwellings	Cumulative energy demand		Greenhouse gas emissions	
MJ/m ²	New	Refurb.	New	Refurb.
Construction	110	60	8.5	5.0
Operation	200	250	2.5	5.0
Mobility	130	130	5.5	5.5
Target value	440		16.5	15.5

Thank you very much for your attention!

contact:

frischknecht@treeze.ch

Websites:

www.kbob.ch > Publikationen > Nachhaltiges Bauen

www.eco-bau.ch > Planungswerkzeuge > Ökobilanzdaten

www.treeze.ch (calculators)

Contributions to IEA Annex 57

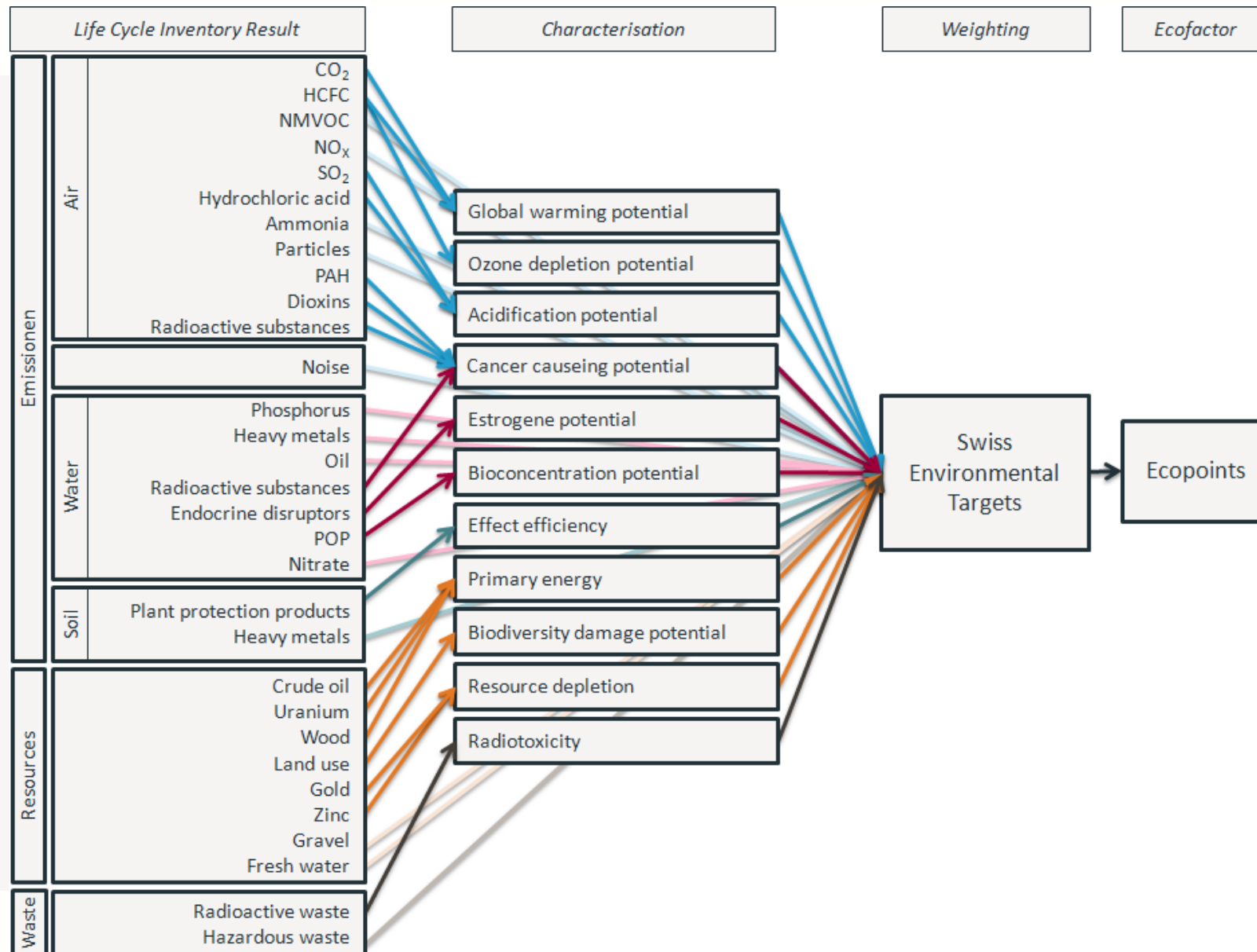


- Project contents commissioned by OFEN
- Methodology comparison: cumulative energy demand (Subtasks 1 & 3)
 - Survey of approaches
 - Proposal of a consistent approach
- Case studies buildings (Subtask 4)
 - 13 buildings of City of Zürich
 - Assess CED, GWP and environmental impacts
- Methodological discussions (Subtask 3)
 - Feedback on Annex 57 documents
 - Provide documents for feedback

Environmental impacts of buildings, benchmarks

- Quantify environmental impacts of buildings
- Environmental impacts quantified with ecological scarcity method
- Analyse 30+ buildings with regard to environmental impacts caused in construction, operation, demolition and induced mobility
- Main goal:
Derive benchmark values for environmental impacts of buildings

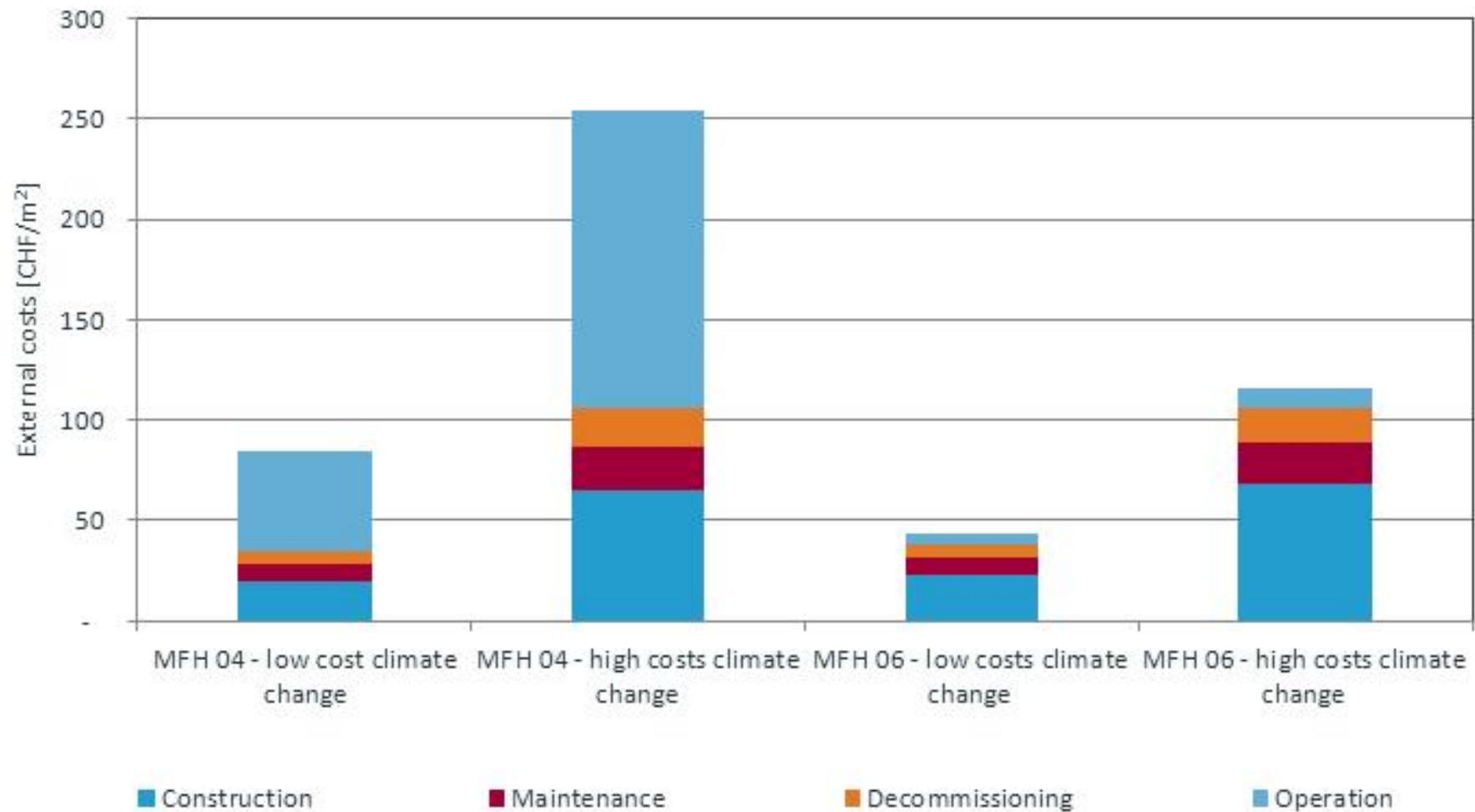
Ecological scarcity method



Environmental external costs of buildings

- Environmental external costs of construction, maintenance, decommissioning and operation
- 2 buildings (John 2012):
 - MF04: moderate energy standard
 - MF06: high level energy standard
- Two external costs approaches:
 - NEEDS project (EU FP6 project, follow up of ExternE)
 - Swiss external cost figures covering primary and secondary particles only
- Goal: Decision support whether or not to use external cost factors in building investments

Environmental external costs of buildings



Conclusions

- request for environmental information about building products and buildings is steadily increasing (Minergy-Eco certificate)
- More and more planning tools offer LCA information
- KBOB recommendation 2009/1 “LCA data in the building sector” is comprehensive, up-to-date and cost-efficient basis to assess the environmental impacts of building projects
- platform “Ökobilanzdaten im Baubereich” facilitates exchange between administration, research, building owners and construction industry

Examples from the KBOB-List 2009/1

GEBÄUDE	ENERGIE	TRANSPORTE	Bezug		UBP	Primärenergie Energie primaire		Treibhausgas- emissionen
			Grösse	Einheit		Gesamt	Graue Energie (nicht erneuerbar)	
	[Literatur ESU-services, Version 1.4]			Unité	UBP	globale	Energie grise (non renouvelable)	Emissions de gaz à effet de serre
Heizungsanlag					-	MJ	MJ	kg
Wärmeerzeuger		Treibstoffe						
Wärmeerzeuger	Elektr	Diesel in Baumaschine	Endenergie	MJ	103	1.24	1.24	0.0828
Wärmeerzeuger	Atomk	Diesel in LKW	Endenergie	MJ	87.3	1.22	1.21	0.0835
Wärmeerzeuger	Erdgas	Benzin in PKW	Endenergie	MJ	79.5	1.29	1.28	0.0884
Erdsonden,	Kohlek	Diesel in PKW	Endenergie	MJ	54.3	1.22	1.21	0.0837
Erdsonden,	Kraftw	Biogas in PKW	Endenergie	MJ	32.2	0.452	0.411	0.0324
Erdsonden,	Kehric	Erdgas in PKW	Endenergie	MJ	40.5	1.17	1.17	0.0651
Sonnenkollekt	Heizkr	Kerosin in Flugzeug	Endenergie	MJ	57.1	1.19	1.19	0.0804
Sonnenkollekt	Blockh	Güter-Transporte						
Sonnenkollekt	Blockh	Aushub maschinell	Aushubvolumen	m3	665	8.07	8.03	0.529
Wärmeverteiler	Blockh	Binnenfrachter	Transportleistung	tkm	53.9	0.656	0.648	0.0463
Wärmeverteiler	Photov	Güterzug	Transportleistung	tkm	30.4	0.567	0.299	0.0143
Wärmeverteiler	Windk	Helikopter	Einsatzzeit	h	55200	1440	1440	96.9
Wärmeverteiler	Wasse	Hochseefrachter	Transportleistung	tkm	18.1	0.170	0.167	0.0107
Wärmeverteiler	Pumps	Hochseetanker	Transportleistung	tkm	9.18	0.0903	0.089	0.00562
Lüftungsanlage	Heizkr	Lieferwagen bis 3,5 t	Transportleistung	tkm	1750	26.9	26.2	1.54
Lüftungsanlage	CH-Pr	LKW 20 bis 28 t	Transportleistung	tkm	215	3.26	3.22	0.193
Lüftungsanlage	CH-Ve	LKW 3.5 bis 20 t	Transportleistung	tkm	315	4.64	4.57	0.277
Abluftanlage	UCTE	LKW über 28 t	Transportleistung	tkm	150	2.36	2.33	0.136
Erdregister	Elektr	Luftfracht	Transportleistung	tkm	805	16.9	16.8	1.11
Lüftungsanlage	Photov	Luftfracht, Europa	Transportleistung	tkm	1550	33.4	32.5	1.95
Lüftungsanlage	Windk	Luftfracht, Interkontinental	Transportleistung	tkm	782	16.4	16.3	1.08
Lüftungsanlage	Biogas	Personen-Transporte						
Lüftungsanlage	Reaio	Fernreisezug	Transportleistung	pkm	21.1	0.543	0.236	0.00818
Erdregister		ICE	Transportleistung	pkm	50.9	1.03	0.981	0.0601

Online calculators

District Heat Calculator

The district heat calculator calculates the environmental impacts per MJ of district heat according to the given production shares. The share of losses can be adjusted in order to reflect a specific case.

Recalculate

Reset

Webtools

Print page

District heat calculator

Heat production in district heating network	Share in %
Heating plant, oil	7.30%
Heating plant, natural gas	40.50%
Heating plant, wood	2.10%
Combined heat and power, wood	0.00%
Heating plant, geothermal	0.00%
Combined heat and power, geothermal	0.00%
Heating plant, HP air/water	0.85%
Heating plant, HP brine/water	0.85%
Heating plant, HP wastewater/water	0.00%
Heating plant, HP groundwater/water	0.00%
Municipal solid waste incineration	48.40%
Combined heat and power, diesel	0.00%
Combined heat and power, natural gas	0.00%
Combined heat and power, biogas	0.00%
Summe	100.00%

Losses due to distribution

20.00%

Environmental impacts

Cumulative energy demand, total	0.85	MJ-eq/MJ
Cumulative energy demand, fossil	0.74	MJ-eq/MJ
Cumulative energy demand, nuclear	0.06	MJ-eq/MJ
Cumulative energy demand, renewable	0.06	MJ-eq/MJ
Cumulative energy demand, waste	0.58	MJ-eq/MJ
Greenhouse gas emissions	0.045	kg CO ₂ -eq/MJ
Carbon dioxide, fossil	0.042	kg/MJ
eco-points 2006 (UBP)	24.9	UBP/MJ

The district heat calculator calculates the environmental impacts per MJ of district heat according to the given production shares. The share of losses can be adjusted in order to reflect a specific case. The default values correspond to the Swiss average according to the Swiss statistics on district heat (Fernwärmestatistik Schweiz) of the year 2006. The button "Reset" restores the default values. Further information on the calculation of the environmental impacts is available in the project report "Primärenergiefaktoren von Energiesystemen" (only in German).

[Download report "Primärenergiefaktoren von Energiesystemen"](#)

Nuclear power

6'440'740

12.67%