

THE SWISS PLATFORM OF LIFE CYCLE ASSESSMENT DATA IN THE BUILDING SECTOR

CONNECTING INDUSTRY, ADMINISTRATION,
BUILDERS AND RESEARCH

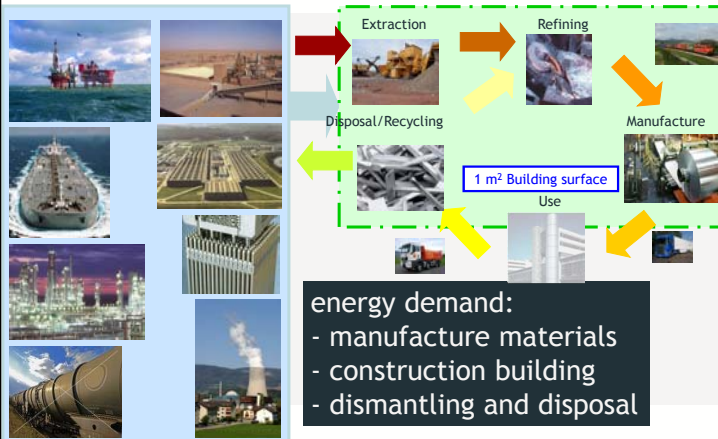
Dr. Rolf Frischknecht

Life Cycle Management Conference
August 27, 2013, Gothenburg, Sweden

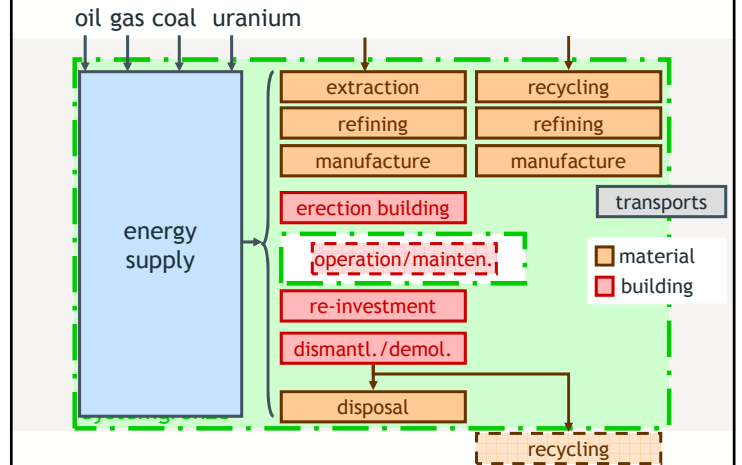
Appenzeller
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Embodied Energy of Buildings



Embodied energy of buildings



Life cycle thinking in building projects



optimisation of building shape	utilisation factor, compactness
retrofit or new construction	including operational energy demand, comfort, user flexibility and cost effectiveness
additional efforts of underground constructions	e.g. for parking lots not below building volume
construction type	massive, lightweight or mixed construction
supporting structure	large span width and projecting building elements
materials buildings envelop	composition of concrete and reinforcement multilayer vs. lightweight constructions, share of windows
windows	frame materials, glazing type, gas filling
optimisation building equipment	choice of energy carrier, heating system, ventilation concepts

Project planning

Source: treezee.com

Use of life cycle assessment data in the building sector



- **Goal:**
Quantify environmental impacts of building alternatives (e.g. architectural competition)
- **Measure/Quantify:**
Materialisation of the building (same basis like for cost estimation, -calculation), preliminary project or main project
- **Apply:**
life cycle assessment data of building materials, building elements, energy carriers, etc.

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



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: Partners



- Establish dialogue among following partners:
 - **Administration:** Environment, Energy, Buildings and Construction
 - **Research:** ETH Zürich, ecoinvent Centre
 - **Building owners:** KBOB, eco-bau, IPB
 - **Construction industry, Associations:** bauenschweiz (Planning, Production and Trade, Equipment), öbu (sustainability in business)
- Two bodies:
 - **Steering group:** strategy
 - **Expert group:** operational tasks

Platform LCA data in the building sector: tasks



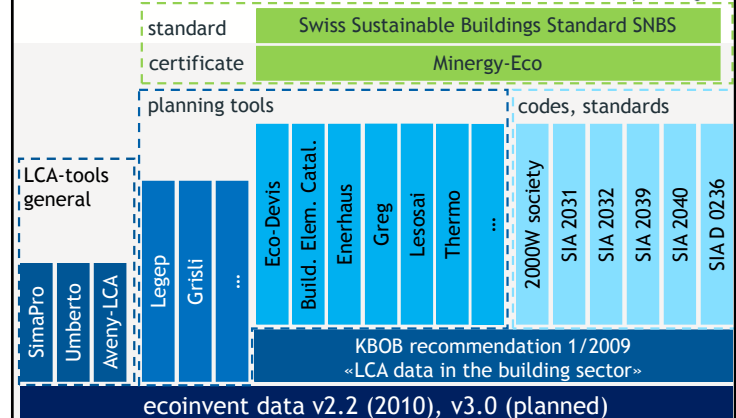
- offer reliable LCA data (“KBOB-List”)
- set priorities regarding updates and extensions of KBOB-list
- co-ordination and quality assurance of update projects
- support of LCA data projects
- organise exchange between administration, research, building owner, and associations (building industry)
- answer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

Data quality guidelines KBOB-data



- Quality guidelines
 - Based on ecoinvent (v2.2) quality guidelines
 - Complemented with manufacturer specific details (e.g. emission or renewable energy certificates)
 - Verification of LCA data by experts group
- Two types of LCA data:
 - Representative averages valid for Swiss market
 - Manufacturer and product specific
- Publication
 - Average data in printed and electronic version of KBOB-List
 - Manufacturer specific data in electronic version

Data source and its use



From ecoinvent to KBOB-List: indicators



ecoinvent data v2.2

inventory result

inventory
manufacture
building material

energy demand

resource demand

wastes

emissions

crude oil
hard coal
uranium
hydro power
CO₂
methane
SO₂
heavy metals
wastes

indicators

embodied energy

greenhouse gas emissions

environmental impacts

Examples from the KBOB-List 2009/1



GEBÄUDE	ENERGIE	TRANSPORTE	Bezug	Grösse	Einheit	UBP	Primärenergie		Treibhausgas-emissionen
							gesamt	Globale	
Literatur ESU-services, Version 1.41									
Heizungsgas							MJ	MJ	kg
Wärmeerzeuger	Elektr.	Treibstoffe							
Wärmeerzeuger	Atomk.	Diesel in Busmaschine	Endenergie	MJ	103	1.24	1.24	0.0828	
Wärmeerzeuger	Atomk.	Diesel in LKW	Endenergie	MJ	87.3	1.22	1.21	0.0835	
Erdsonden	Erdsch.	Benzin in PKW	Endenergie	MJ	79.8	1.29	1.28	0.0884	
Erdsonden	Kohlek.	Diesel in PKW	Endenergie	MJ	64.3	1.22	1.21	0.0837	
Erdsonden	Kohlek.	Biogas in PKW	Endenergie	MJ	32.2	0.452	0.411	0.0324	
Sonnenkollekt.	Heizk.	Erdsch. in Flugzeug	Endenergie	MJ	40.5	1.17	1.17	0.0651	
Sonnenkollekt.	Heizk.	Erdsch. in Flugzeug	Endenergie	MJ	57.1	1.19	1.19	0.0804	
Sonnenkollekt.	Stoek.	Aushubmaschine	Aushubvolumen	m ³	666	8.07	8.03	0.529	
Wärmeverteiler	Stoek.	Innenfrachter	Transportleistung	tkm	53.9	0.656	0.648	0.0463	
Wärmeverteiler	Photo.	Güterzug	Transportleistung	tkm	30.4	0.567	0.299	0.0143	
Wärmeverteiler	Windk.	Helikopter	Ersatzzeit	h	59200	1440	1440	96.9	
Wärmeverteiler	Windk.	Hochseefrachter	Transportleistung	tkm	18.1	0.170	0.167	0.0107	
Wärmeverteiler	Windk.	Hochseefrachter	Transportleistung	tkm	0.18	0.0003	0.089	0.00562	
Wärmeverteiler	Pumpe	Lieferwagen bis 3.5 t	Transportleistung	tkm	1750	26.9	26.2	1.54	
Lüftungsgas	Heizk.	LKW 20 bis 28 t	Transportleistung	tkm	219	3.26	3.22	0.193	
Lüftungsgas	CH-Vol.	LKW 3.5 bis 20 t	Transportleistung	tkm	316	4.64	4.57	0.277	
Lüftungsgas	CH-Vol.	LKW über 28 t	Transportleistung	tkm	150	2.26	2.23	0.136	
Abfallanlag.	UCTE	Luftstrahl.	Transportleistung	tkm	806	16.9	16.8	1.11	
Erderegister	Elektr.	Luftstrahl, Europa	Transportleistung	tkm	1950	33.4	32.5	1.96	
Lüftungsgas	Photo.	Luftstrahl, Interkontinental	Transportleistung	tkm	782	16.4	16.3	1.08	
Lüftungsgas	Windk.	Persoen-Transporte	Transportleistung	pkm	21.1	0.543	0.236	0.00818	
Lüftungsgas	Biogas	Fernreisezug	Transportleistung	pkm	50.6	1.01	0.381	0.0501	

Eco-devis tool



Beurteilungsgrösse: Graue Energie (fossil, nuklear, Wasser) zurück zur Suche berechnen zurücksetzen Berechnungsdokumentation Druck PDF 10%

Boden
BBS Verklebte Aussendämmung mit Lettenrost, Betondecke
Ausführung Classolle, p. 39 [kg/m³]
Beschreibung Verklebte Aussendämmung mit Lettenrost, Betondecke, Trittschalldämmung, UB Zement, Bodenbelag
Barwerttyp Boden gegen Ausstrahlung
Graue Energie (fossil, nuklear, Wasser) 24,82
Lebenszyklus pro a [MJ-Eq/m²a] 6,18
U-Wert [W/m²K] 0,19

nr.	Material / Schicht	Eco-Devis	Schichtdicke [m]	Lambda [W/mK]	Lebensdauer [a]	Masse [kg/m ³]	Herstellung [MJ-Eq] [1%]	Einbau [MJ-Eq] [1%]	Entsorgung [MJ-Eq] [1%]	Total [MJ-Eq] [1%]		
1	Zementunterlagsboden 7cm armiert [m ²]		0.07	2	50	120.0	152.12	12%	50.28	324.53	14%	
2	Dampfsperre PE		0.0001	0	35	0.1	8.57	1%	0.11	25.82	1%	
3	Glaswolle, p 100 [kg/m ³]		0.04	0.04	35	4.0	192.33	15%	384.67	3.14	23%	
4	Betondecke d=18cm (Fe 80kg/m ³) [m ²]		0.18	2.3	100	445.7	636.68	50%	0.00	93.86	29%	
5	Glaswolle, p 39 [kg/m ³]		0.16	0.04	35	4.8	230.80	18%	461.60	3.77	2%	
6	Lettenrost 60/80mm, a 0.66, (doppelt über Kreuz) [m ²]		0	0.14	35	7.9	13.74	1%	31.47	5.00	3%	
7	Masseholz Fichte / Tanne / Lärche, luftgetrocknet, gehobelt		0.015	0.13	50	6.1	24.68	2%	24.68	3.44	2%	
nicht gekennschätzt		bedingt gekennschätzt	gekennschätzt	591	1748.91	51%	1973.89	43%	339.18	4%	2481.72	189%

Graue Energie (fossil, nuklear, Wasser)

Schichten: [Barwertdiagramm]

Phasen: [Phasendiagramm]

Unique solution: Typically Swiss?



European Context: EPD



- European Standard EN 15804 Environmental Product Declarations of construction products adopted in Switzerland
- Full compliance of KBOB quality guidelines and EN 15804 on the level of inventory analysis
- Different set of environmental indicators
 - Environmental impacts (ecological scarcity 2006)
 - Cumulative energy demand (total and non renewable) upper heating value

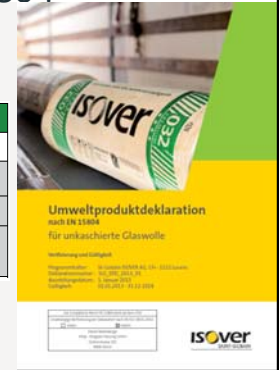
European context: EPDs according to EN 15804



5. Additional environmental information

		Herstellung	Entsorgung	Total
Environmental impacts	UBP	1981	18.4	1999
Greenhouse gas Emissions	kg CO ₂ eq	1.21	0.0151	1.23
Cumulative Energy demand	MJ	40.9	0.331	41.2
Cumulative Energy demand, non renewable	MJ	36.2	0.328	36.6

Manufacture
Disposal



Features of KBOB list



- Environmental impacts assessed according to Swiss legislation (ecological scarcity 2006)
- Complies with a “True and Fair View” requirement about environmental information
- Well established tool/indicators in Swiss construction sector (architects, planners, building owners)
- Full compatibility with European Product information legislation and EPD standards at very low additional costs

Conclusions



- KBOB recommendation 2009/1 serves
 - Choice of building alternatives
 - Choice of suppliers
 - Building labels
- KBOB recommendation 2009/1 is in line with LCI modelling of the European EPD standard
- Environmental assessments in the construction sector using KBOB recommendation 2009/1 is comprehensive and cost efficient



The Swiss System of LCA of construction materials and buildings allows for economic savings, be it in

EURO
POUND
DOLLAR



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)



Data basis for the building sector



KBOB **eco-bau** **IPB**

Koordinationskomitee der Bau- und Lagerhaltungsorgane der öffentlichen Bauämter
Comité de coordination des services de la construction et des membres des
Départements et constructeurs privés
Hilfsgemeinschaft privater professioneller Bauämter
Commissariat d'aide des autres d'avantage professionnels privés

EMPFEHLUNG*RECOMMANDATION*EMPFEHLUNG*RECOMMANDATION*EMPFEHLUNG
NACHHALTIGES BAUEN • CONSTRUCTION DURABLE • NACHHALTIGES BAUEN • CONSTRUCTION DURABLE • NACHHALTIGES BAUEN • CONSTRUCTION DURABLE

Ökobilanzdaten im Baubereich
Données des écobilans dans la construction

2009/1

Stand: Januar 2011 / Etat de janvier 2011

Wussten Sie ...

... dass Sie mit der Planung von Immobilien auch deren Umweltbelastung über Jahrzehnte hinaus beeinflussen?
... dass die Ökobilanzdaten im Baubereich die Basis sind für SIA 2031 Energieausweis für Gebäude (2008), SIA 2032 Graue Energie (2009), SIA 2039 Siedlungsinduzierte Mobilität (2010) und SIA 2040 Effizienzpfad Energie (2010)?
... dass die Aktualisierung dieser Daten durch die auf Seite 4 aufgeführten Organisationen sichergestellt wird?

Ökobilanzdaten

Ökobilanzdaten basieren auf branchenbezogenen Stoff- und Energieflüssen (EMPA/ecoinvent), welche bezüglich ihrer Umweltrelevanz bewertet werden. In dieser Empfehlung erfolgt die Gesamtbeurteilung mit der Methode der Ökobilanz. Kennzahlen sind nach der Umweltbilanzmethode

Saviez-vous ...

... que, au stade de la planification déjà, vous définissez les nuisances environnementales d'un bâtiment?
... que les données des éco-bilans pour la construction sont la base des cahiers techniques SIA 2031 Certificat énergétique des bâtiments (2008), SIA 2032 Energie grise (2009), SIA 2039 Mobilité induite (2010) et SIA 2040 En route pour l'efficacité énergétique (2010)?
... que les organisations figurant à la page 4 garantissent la mise à jour permanente de ces données?

Données des éco-bilans

Les données des éco-bilans se fondent sur les flux de matière et d'énergie propres à la branche (EMPA/ecoinvent), ils sont évalués compte tenu de leur influence sur l'environnement. Cette recommandation porte sur l'évaluation globale fondée sur la méthode de la saturation écologique, exprimée en indi

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



Latest News

Presentations from 3rd Int. ecoinvent Meeting available
All presentations from the 3rd International ecoinvent Meeting (on October 5, 2012, in St. Gallen, Switzerland) are now available on the ecoinvent website.
[news] 16.10.2012

ecoinvent v3 further postponed
Due to some technical problems, the release of ecoinvent v3 is unfortunately further postponed...
[news] 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...
[news] 24.07.2012

- more than 4'000 LCA datasets
- quality assured and harmonised
- more than 4'500 users
- in more than 40 countries

The ecoinvent Centre is the world's largest and most comprehensive data source for 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]

CAL 2001/acidification potential: 2
 CAL 2001/climate change: 5

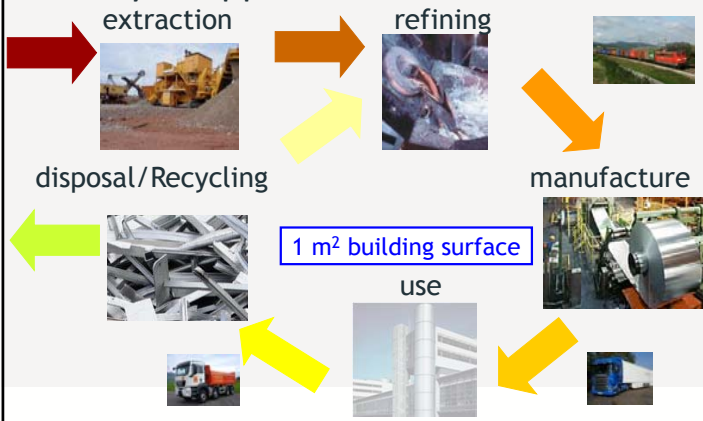
Name	Location	Mean value	Unit
<input type="checkbox"/> GWP 100a	GLO	1.0831	kg CO2-Eq
<input type="checkbox"/> GWP 20a	GLO	1.2336	kg CO2-Eq
<input type="checkbox"/> GWP 500a	GLO	1.0271	kg CO2-Eq
<input type="checkbox"/> lower limit of net GWP	GLO	1.0866	kg CO2-Eq
<input type="checkbox"/> upper limit of net GWP	GLO	1.0888	kg CO2-Eq

CAL 2001/eutrophication potential: 2
 CAL 2001/freshwater aquatic ecotoxicity: 4
 CAL 2001/freshwater sediment ecotoxicity: 4
 CAL 2001/human toxicity: 4

Name	Location	Mean value	Unit
<input type="checkbox"/> HTP 100a	GLO	0.53002	kg 1,4-DCB-Eq
<input type="checkbox"/> HTP 20a	GLO	0.52941	kg 1,4-DCB-Eq
<input type="checkbox"/> HTP 500a	GLO	0.53135	kg 1,4-DCB-Eq
<input type="checkbox"/> HTP infinite	GLO	0.71483	kg 1,4-DCB-Eq

CAL 2001/ionising radiation: 1
 CAL 2001/land use: 1
 CAL 2001/malodours air: 1
 CAL 2001/marine aquatic ecotoxicity: 4
 CAL 2001/marine sediment ecotoxicity: 4

Embodied Energy:
Life cycle approach



Online calculators



treeze fair life cycle thinking

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.

Parameters Reset Webtools Print page

District heat calculator		Environmental impacts	
	Share in %		
Heat production in district heating network	100.0%	Cumulative energy demand, heat	0.00 MJ/kgMJ
Heating plant, oil	7.03%	Cumulative energy demand, fossil	0.74 MJ/kgMJ
Heating plant, natural gas	46.92%	Cumulative energy demand, nuclear	0.00 MJ/kgMJ
Heating plant, wood	2.10%	Cumulative energy demand, renewable	0.00 MJ/kgMJ
Combined heat and power, mixed	0.00%	Cumulative energy demand, waste	0.00 MJ/kgMJ
Heating plant, geothermal	0.00%	Greenhouse gas emissions	0.00 kg CO2e/kgMJ
Combined heat and power, geothermal	0.00%	Carbon dioxide, fossil	0.00 kgMJ
Heating plant, HF air/water	0.00%	non-pHx 2008, (GWP)	24.9 MJ/kgMJ
Heating plant, HF biomass	0.00%		
Heating plant, HF water/condensate	0.00%		
Heating plant, HF geothermal/heat	46.40%		
Municipal solid waste incineration	0.00%		
Combined heat and power, biogas	0.00%		
Combined heat and power, natural gas	0.00%		
Combined heat and power, trigas	0.00%		
Sunrise	00.00%		

Losses due to distribution: 21.01%

Download report: [ThermischeGeothermie von Energysysteme.ch](#)