New approaches in MoeK 13:
global land use
noise
abiotic resources

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treeze Ltd., Uster
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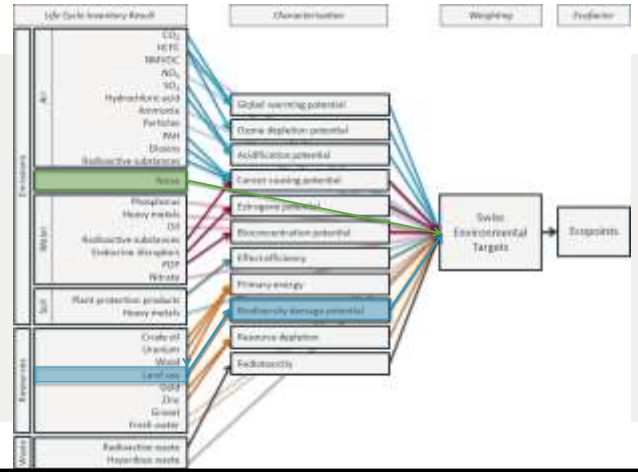
Basic scheme Swiss ecofactors '13



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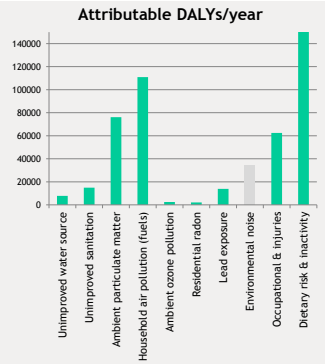
Environmental relevance: human health



Jolliet, O., R. Frischknecht, et al. (2013). "Global guidance on environmental life cycle impact assessment indicators: Findings of the Glasgow scoping workshop." Int J LCA in preparation.

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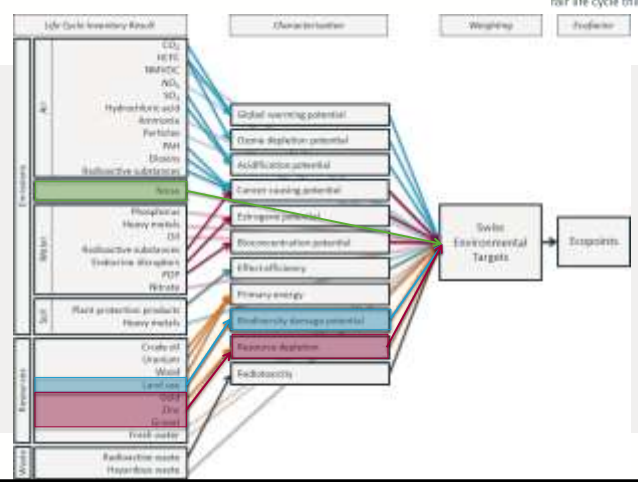
Basic scheme Swiss ecofactors '13



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Global land use





Eco-factor Swiss settlement area

	Edition 2013	Edition 2006
Normalization (km²*a SA-eq.)	2'437	3'378
Current Flow (km²)	3'027	2'791
Critical Flow (km²)	3'535	3'224
Weighting (-)	0.73	0.749
Eco-factor (EP/(m²*a SA-eq.))	**300**	220

- Current flow: Swiss settlement area
- Critical flow: Sustainability goal: 400 m² per inhabitant, future population in 2035
- Normalization: characterized settlement area

Characterization factors

- Characterization factors are based on the biodiversity damage potential (BDP)
- Ratio of anticipated number of species and the actually encountered number of species
- Considers plants, vertebrates, invertebrates
- Global average BDPs, according to de Baan et al. (2012)
- Reference «substance» is the urban settlement area

de Baan, L., R. Alkemade, and T. Koellner, (2012) *Land use impacts on biodiversity in LCA: a global approach*. The International Journal of Life Cycle Assessment, 2012: p. 1-15.

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Swiss eco-factors

- Characterization factors
- Eco-factor for Swiss settlement area
- Eco-factors for several land use types valid for Switzerland

→ Extrapolation to global land use

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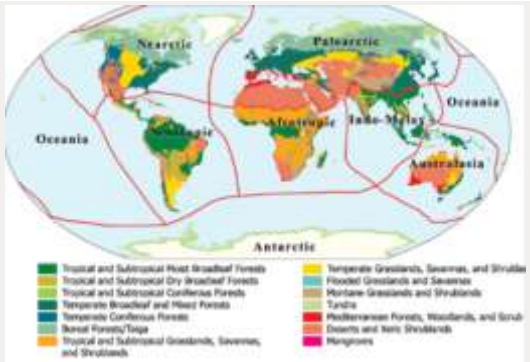
Concept of 14 Bioms



Olson, D.M., Dinerstein, E., Wikramanayake, E.D., Burgess, N.D., Powell, G.V.N., Underwood, E.C., D'Amico, J.A., Itoua, I., Strand, H., Morrison, J.C., Loucks, C.J., Allnutt, T.F., Ricketts, T.H., Kura, Y., Lamoreux, J.F., Wettengel, W.W., Hedao, P. & Kassem, K.R., *Terrestrial ecoregions of the world: a new map of life on earth.* Bioscience, 2001. **51**: p. 933–938.

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Extrapolation

- Extrapolation of characterization factors to all biomes over plant biodiversity (Kier et al. 2005)
- Reference «Biome» is Biome 5 (Switzerland)

		Ratio to Biome 5
Biom 1	Tropical and subtropical moist broadleaf forests	1.968
Biom 5	*Temperate coniferous forests*	*1.0*
Biom 7	Tropical and subtropical grasslands, savannas and shrublands	0.788
Biom 10	Montane grasslands and shrublands	0.839
Biom 11	Tundra	0.209
Biom 12	Mediterranean forests, woodlands and scrub	1.440
Biom 13	Deserts and xeric shrublands	0.526

Kier, G., et al., *Global patterns of plant diversity and floristic knowledge.* Journal of Biogeography, 2005. **32**: p. 1107–1116

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Resulting Eco-factors

CORINE+	Land use types	Biom 1 (UBP/m2)	Biom 5 (UBP/m2)	Biom 8 (UBP/m2)	Biom 11 (UBP/m2)	Biom 13 (UBP/m2)	Edition 2006 (UBP/m2)
		Tropical and subtropical moist broadleaf forests	***Temperate coniferous forests***	*Temperate grasslands, savannas and shrublands*	*Tundra*	*Deserts and xeric shrublands*	
	Settlement areas						
111	Occupation, urban, continuously built	600	**300**	240	250	420	260
112	Occupation, urban, discontinuously built	360	**180**	140	150	250	220
114	Occupation, rural settlement	360	**180**	140	150	250	190
121	Occupation, industrial area	600	**300**	240	250	420	220
	Agricultural areas						
211	Occupation, arable, non-irrigated	810	**420**	330	330	600	100
211c	Occupation, arable, organic	290	**150**	110	120	210	59
22	Occupation, permanent crop	570	**290**	230	240	420	29
231	Occupation, pasture and meadow	450	**230**	180	190	330	57
244	Occupation, agro-forestry areas	270	**140**	110	110	200	
	Forests and shrubs						
311	Occupation, broad leafed forest	60	**30**	24	26	45	15
312	Occupation, coniferous forest	60	**30**	24	26	45	15
312a	Occupation, coniferous plantations	240	**120**	96	100	180	100

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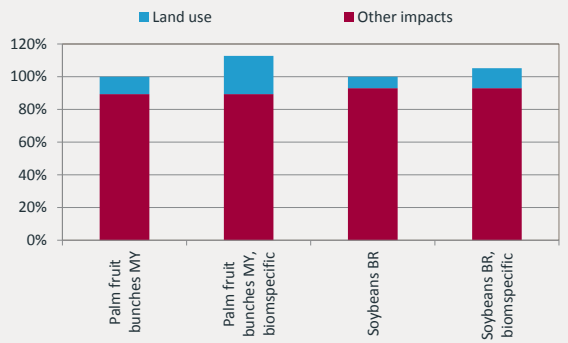
Example



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Noise

Definition and health effects

- «unwanted sound» that can have a physical, mental, social or economic impact on the population exposed to it
- Noise is a physical phenomenon
  - measureable (decibel, dB)
- its perception is individual in nature and it therefore includes a socio-psychological component
  - corrected for the sensitivity of the human ear (A-weighting, dB(A), dB A)

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Noise

- Individual eco-factors for noise from
  - Road traffic
  - Rail traffic
  - Air traffic
- Other sources of noise are not considered

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Eco-factor «HA persons»

	Road	Rail	Air
Normalization (HAp/a)	800'000	800'000	800'000
Current Flow (HAp/a)	716'000	61'000	27'000
Critical Flow (HAp/a)	436'000	33'000	15'000
Weighting (-)	2.7	3.5	3.3
Eco-factor (EP/HAp)	**3'400'000**	**4'300'000**	**4'100'000**

HAp: highly annoyed person

- Normalization: HAp of traffic noise
- Current flow: SonBASE, exposure-response curves according to EEA
- Critical flow: HAp if noise pollution is reduced by 5 dB(A)

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Implementation

- Introduction of new elementary flows

  → «noise kilometer»

- Added to traffic operation datasets

Elementary flow	Unit
Noise, aircraft, passenger	pkm
Noise, aircraft, freight	tkm
Noise, rail, passenger train, average	pkm
Noise, rail, freight train	tkm
Noise, road, passenger car, average	km
Noise, road, lorry, average	km

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Eco-factor «noise kilometer»

Eco-factors are calculated based on eco-factors for «highly annoyed» persons, traffic performance and average noise level of each transportation mean

Elementary flow	Unit	Eco-factor
Noise, aircraft, passenger	EP/pkm	1.4
Noise, aircraft, freight	EP/tkm	14
Noise, rail, passenger train, average	EP/pkm	5.2
Noise, rail, freight train	EP/tkm	15
Noise, road, passenger car, average	EP/km	21
Noise, road, lorry, average	EP/km	210

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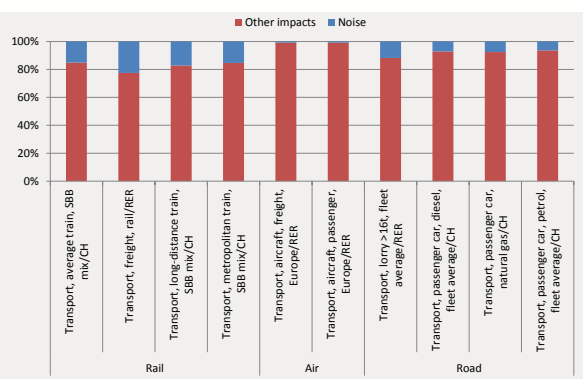
Examples



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Abiotic resources (minerals & metals)

Political goal

- Switzerland should reduce its resource consumption to sustainable levels (Federal Council's cleantech strategy)
- The Swiss federal government is promoting actions within the current "Measure 4b" (integrated product policy) to close material cycles

Characterization

- Approach: Annual depletion of reserves
  → scarcity of a specific resource
- ——————— (Guinée et al. 2001)
- Updated based on Mineral Commodity Summaries 2010, U.S. Geological Survey
- Reference substance: Antimony

Eco-factor abiotic resources

	Edition 2013
Normalization (t Sb-eq)	904
Current Flow (t Sb-eq)	904
Critical Flow (t Sb-eq)	904
Weighting (-)	1.0
Eco-factor (EP/t Sb-eq)	**1'100**

- Current flow: per capita world production of metals and minerals, multiplied with Swiss population
- Critical flow: Status quo (no increase)

Resulting Eco-factors

Substance	Specification	Characterization (kg/kg Sb-eq.)	Eco-factor (UBP/kg)
Metals			
Copper	1.18% in sulfide, Cu 0.39% and Mo 8.2E-3% in crude ore	0.0010	**1'100**
Chromium	25.5% in chromite, 11.6% in crude ore	0.0043	**4'800**
Lead	5.0% in sulfide, Pb 3.0%, Zn, Ag, Cd, In	0.015	**17'000**
Tantalum	81.9% in tantalum, 1.6E-4% in crude ore	1.33	**1'500'000**
Silver	3.2 ppm in sulfide, Ag 1.2 ppm, Cu and Te, in crude ore	2.05	**2'300'000**
Gold	4.9E-5% in ore	23.1	**26'000'000**
Minerals			
Gypsum		0.00001	**6.30**
Phosphorus	18% in apatite, 4% in crude ore	0.00006	**62.0**
Sulfur		0.00007	**72.0**

Application

- Based on the target the eco-factors should not address the extraction of a resource but the **dissipative use** only
- Dissipative use = materials are degraded, dispersed and lost in the course of usage and no longer available for future usage
- Remaining portion is only «on loan»

→ Eco-factors are applied to the difference between resource extraction and recycled resources

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Calculation of environmental impact of consumptive resource use

$$EIR = R_{ex} \times ef_R - R_{rec} \times ef_R = R_{diss} \times ef_R + R_{landf} \times ef_R$$

EIR: environmental impact of the resource

R_{ex}: amount of resource extracted

R_{rec}: amount of resource recycled

R_{diss}: amount of resource dissipated to nature (emitted to air, water, soil)

R_{landf}: amount of resource landfilled

ef_R: eco-factor of the resource ("resource depletion" only, not including environmental impacts caused during mining etc).

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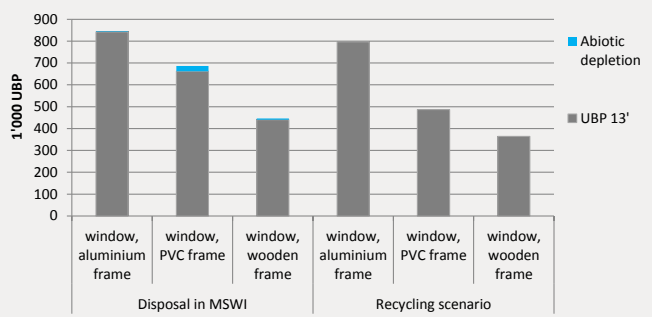
Example window frame



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Download

- as .csv for import in SimaPro
- as .xml for import in other softwares
- read instructions !!

www.treeze.ch/projects/methodology-development/life-cycle-impact-assessment/ecological-scarcity-method-2013/

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Thank you very much for your attention!

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