Ecological scarcity 2013: Overview and main elements of the update and its implications

Rolf Frischknecht, Sybille Büsser Knöpfel
treeze Ltd., Uster
DF 54, 5.12.2013

Eco-factor Carbon dioxide (CO_2):

460 UBP/kg

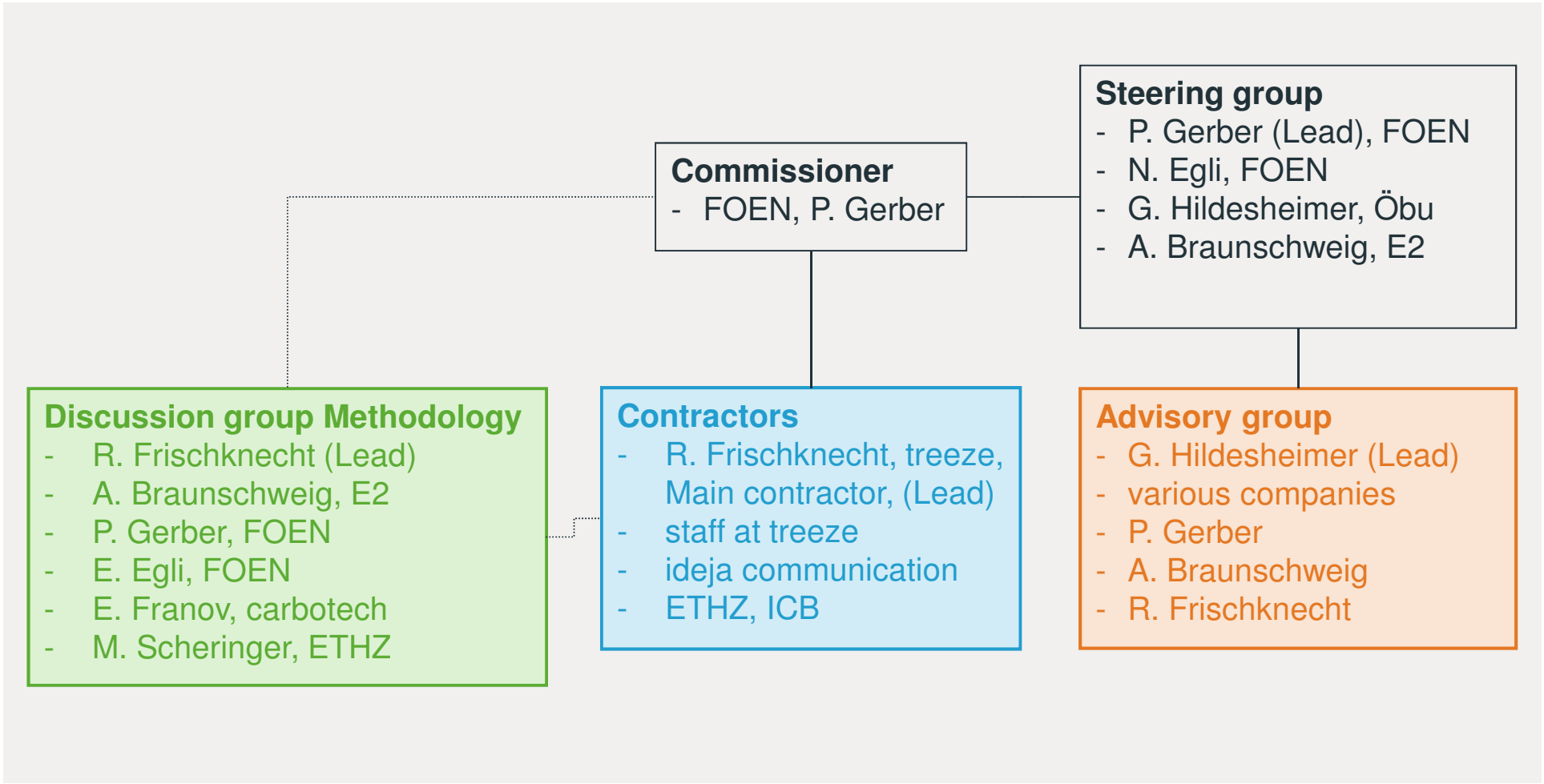
Contents

- Project outline
- Methodology and main elements of the update
- Focus: greenhouse gases, nuclear wastes
- Eco-factor time series
- Synthesis

Project goal

- Update of Swiss eco-factors 2006
- Track
  - Swiss environmental legislation
  - Swiss emission situation
- Expand to new/emerging environmental impacts
- Provide
  - ready to use eco-factors Switzerland 2013
  - method applicable in other countries/regions

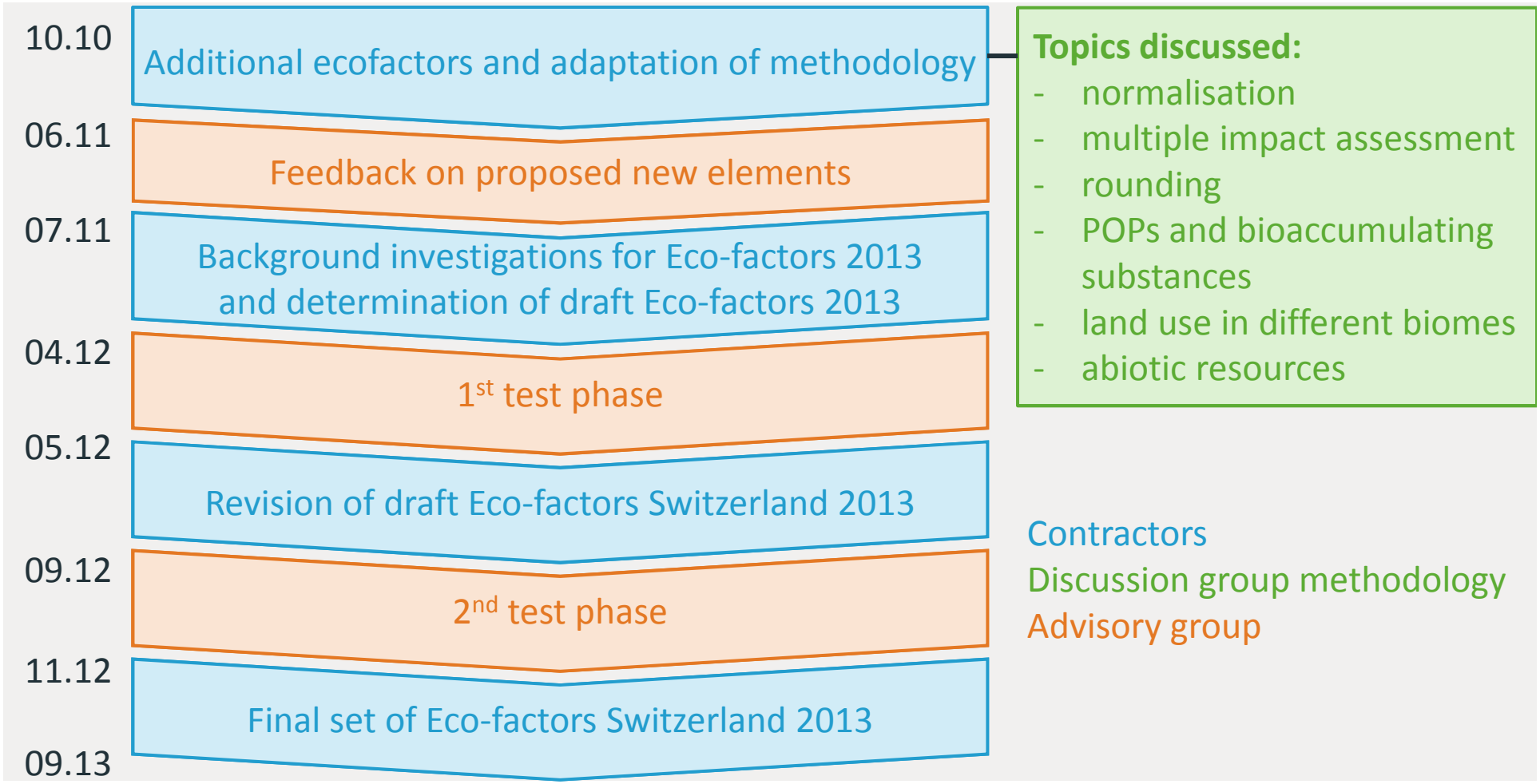
Project organisation



Advisory group

- Christian Brütsch, RePower AG
- Patrik Burri, Credit Suisse
- Roland Högger, Geberit International AG
- Elisabeth Huber, Geberit International AG (until 12. 2012)
- Martin Kilga, Sinum AG
- Peter Müller, Knecht und Müller AG
- Paul Schnabl, Die Schweizerische Post
- Jörg Schwille, Schweizer Metallbau AG
- Marcel Sutter, BWK-FMB AG
- Patrik Walser, Migros Genossenschaft
- Anne Wolf, Die Schweizerisch Post

Project phases



The ecological scarcity formula

$$\text{Eco - factor} = \underbrace{K}_{\substack{\text{Characterization} \\ \text{(if applicable)}}} \cdot \underbrace{\frac{1 \cdot \text{UBP}}{F_n}}_{\text{Normalization}} \cdot \underbrace{\left(\frac{F}{F_k}\right)^2}_{\text{Weighting}} \cdot \underbrace{c}_{\text{constant}}$$

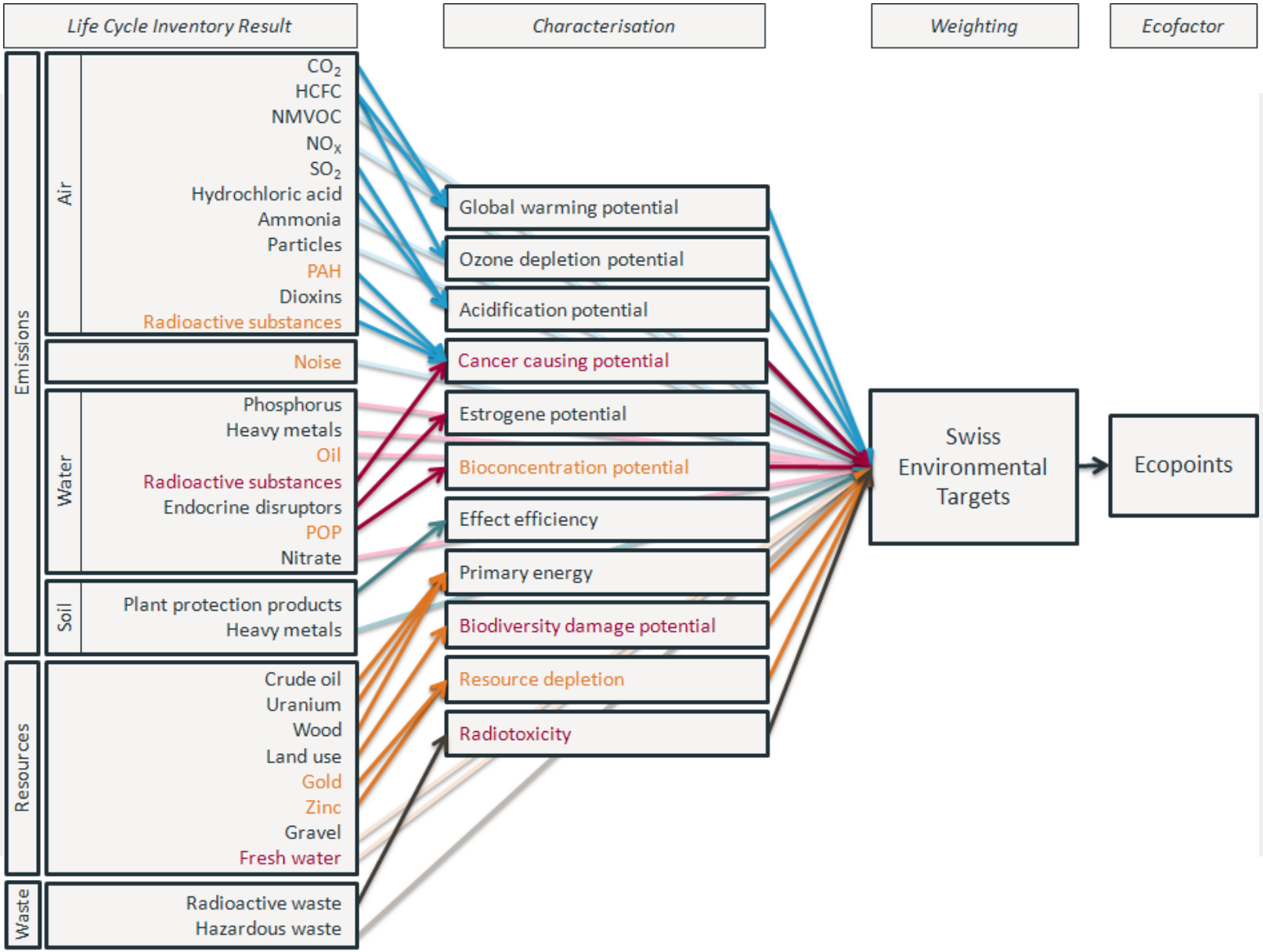
K	=	Characterization factor of a pollutant or a resource
Flow	=	Load of a pollutant, quantity of a resource consumed or level of a characterized environmental pressure
F_n	=	Normalization flow: Current annual flow with Switzerland as the system boundary
F	=	Current flow: Current annual flow in the reference area
F_k	=	Critical flow: Critical annual flow in the reference area
c	=	Constant (10^{12}/a)
UBP	=	Eco-point: the unit of the assessed result

The regionalised ecological scarcity formula

$$Eco-factor^{Region\ 1} = K \cdot \frac{1 \cdot UBP}{F_n^{CH}} \cdot \left(\frac{F^{Region\ 1}}{F_k^{Region\ 1}} \right)^2 \cdot c$$

K	=	Characterization factor of a pollutant or a resource
Flow	=	Load of a pollutant, quantity of a resource consumed or level of a characterized environmental pressure
F_n^{CH}	=	Normalization flow: current annual flow with Switzerland as the system boundary
$F^{Region\ 1}$	=	Current flow: current annual flow within Region 1
$F_k^{Region\ 1}$	=	Critical flow: critical annual flow within Region 1
c	=	Constant (10^{12}/a)
UBP	=	Eco-point: the unit of the assessed result

Basic scheme Swiss ecofactors ‘13



Final report:
Structure and new elements

- Part I: Life cycle assessment in short
  - Basic information for decision makers
  - Questions and answers concerning Life Cycle Assessment (FAQ)
- Part II: Method fundamentals
  - The ecological scarcity method
  - Derivation principles
  - Application principles
  - Characterisation and grouping by environmental issues
- Part III: Eco-factors for Switzerland

New grouping

Environmental topic	1 tier grouping	2 tier grouping
Water resources	Water resources	Water resources
Energy resources	Energy resources	Abiotic resources
Mineral primary resources	Mineral resources	
Land use	Land use	Soil
Non radioactive waste to deposit	Non radioactive waste	
Radioactive waste to deposit	Radioactive waste	
Climate change	Climate change	Climate change
Ozone layer depletion	Ozone depletion	Ozone depletion
Main pollutants and PM	Air quality	Air quality
Carcinogenic substances into air		
Heavy metals into air		
Radioactive substances into air		
Water pollutants	Water quality	Water quality
Heavy metals into water		
POP into water		
Radioactive substances into water		
Pesticides into soil	Soil quality	Soil quality
Heavy metals into soil		
Noise	Noise	Noise

Climate change: Target and characterisation

- Two targets
  - Act on the reduction of CO_2-Emissions (CO_2-Gesetz): minus 20 % (relative to 1990) by 2020
  - Sustainable Development Strategy 2012-2015: minus 50 to 85 % reduction by 2050
- Target (agreed by FOEN): minus 80 %
- Characterisation:
  - GWP of 4th IPCC assessment report 2007
  - no adjustments for emissions of greenhouse gases in lower stratosphere (by airplanes)

greenhouse gases, ecofactors

	2013		2006	remarks
normalisation flow	53’040	1’000 t CO_2-eq	53’034	emissions 2009
actual flow	53’040	1’000 t CO_2-eq	45’436	
critical flow	10’766	1’000 t CO_2-eq	11’183	80 % reduction relative to 1990
weighting factor	24.3		16.5	
ecofactor	**460**	**UBP/kg CO_2-eq**	**310**	

- Increase of CO_2 ecofactor by 50 % compared to 2006

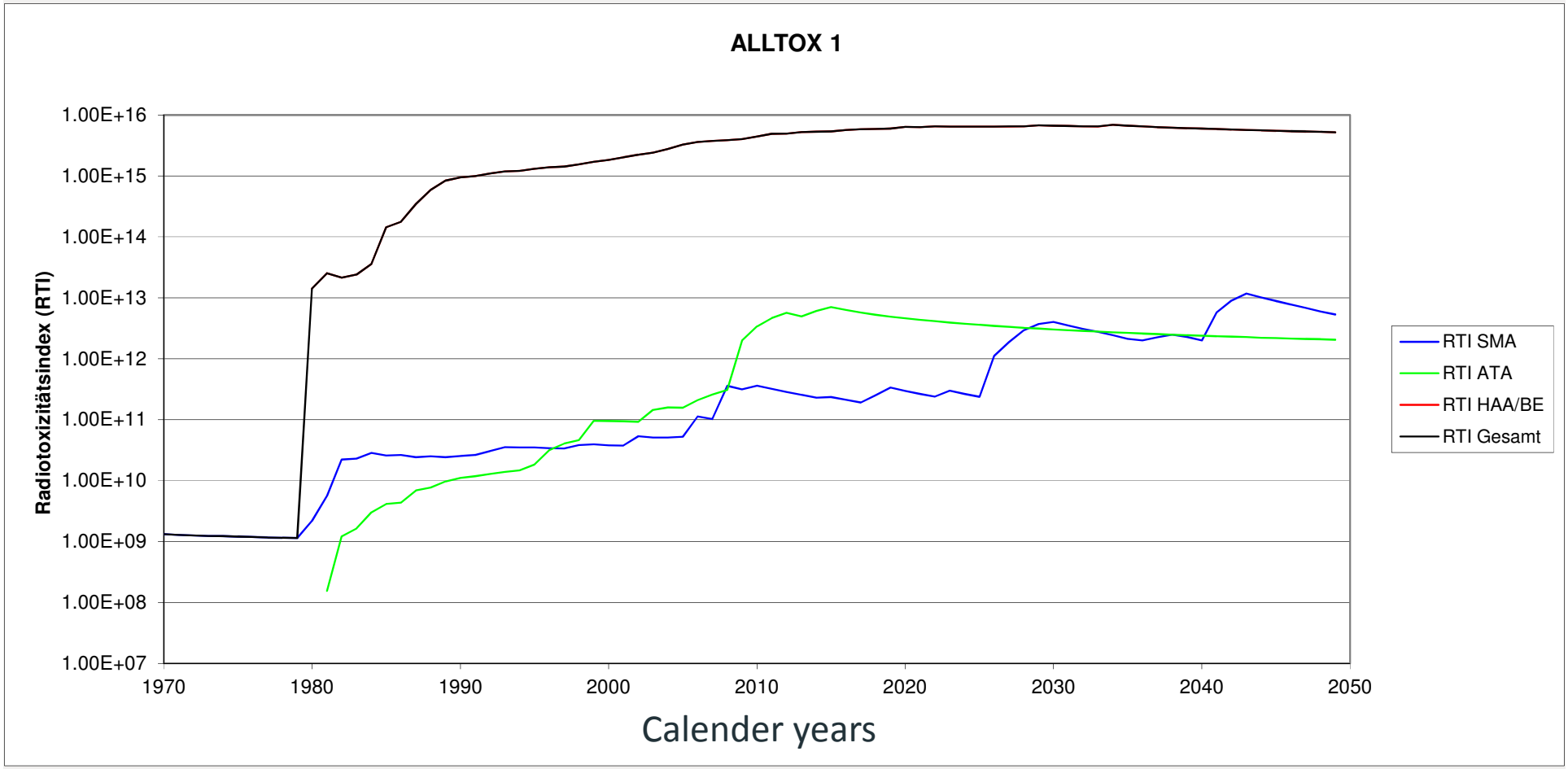
Radioactive wastes, new concept

- damage potential instead of «(political) acceptance»
- Radiotoxicity Index (RTI), dependent on
  - activity of radionuclide
  - dose factor of radionuclide
  - limit value of dose
  - international measure used by NAGRA (National Cooperative for the Disposal of Radioactive Waste)

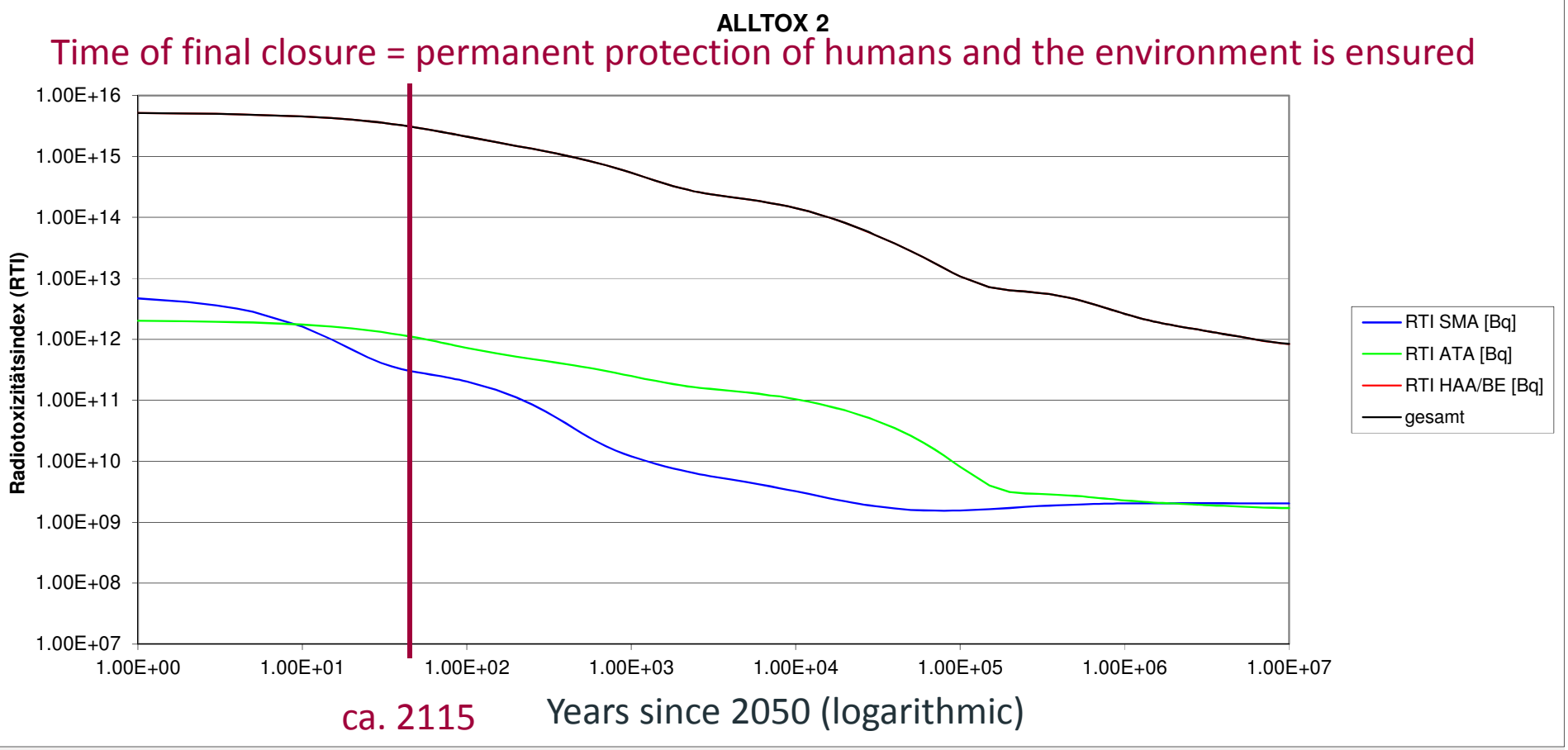
radioactive wastes, actual and critical flow

- actual flow (Data source: NAGRA):
  Maximum value RTI inventory Switzerland
- critical flow (Data source: NAGRA):
  RTI at time of final closure of deposit: presumably 2115
  - Ordinance of Closedown and Waste disposal funds for nuclear installations (Stilllegungs- und Entsorgungsfondsverordnung)
  - Nuclear Energy Act (Kernenergiegesetz (KEG)), § 39, cypher 2: «... the Federal Council shall order the closure of the repository, if **the permanent protection of humans and the environment is ensured**."

Radiotoxicity inventory -2050 of radioactive wastes in Switzerland



Radiotoxicity inventory 2050+ of radioactive wastes in Switzerland



radioactive wastes, characterisation

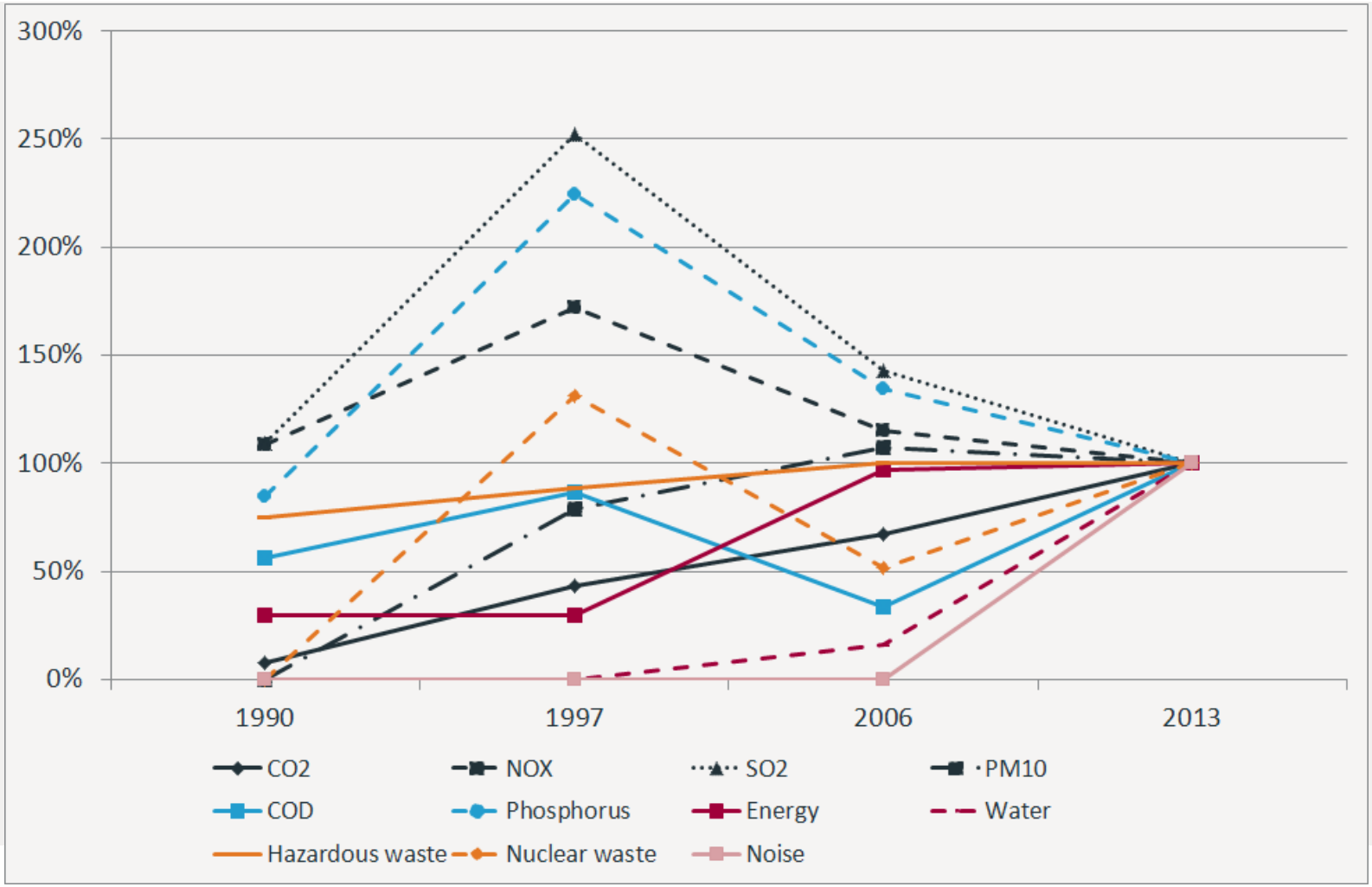
- Basis: Radiotoxicity index (RTI)
- Reference«substance»: high active waste (HAA)
- Characterisation factors — cm^3 HAA-eq/cm^3
  - low and medium active wastes — 0.000045
  - alpha toxic wastes — 0.0015
  - high active wastes (incl. spent fuel) — 1
- High active wastes are important
- Low active wastes from hospitals etc. are marginal

radioactive wastes, ecofactors

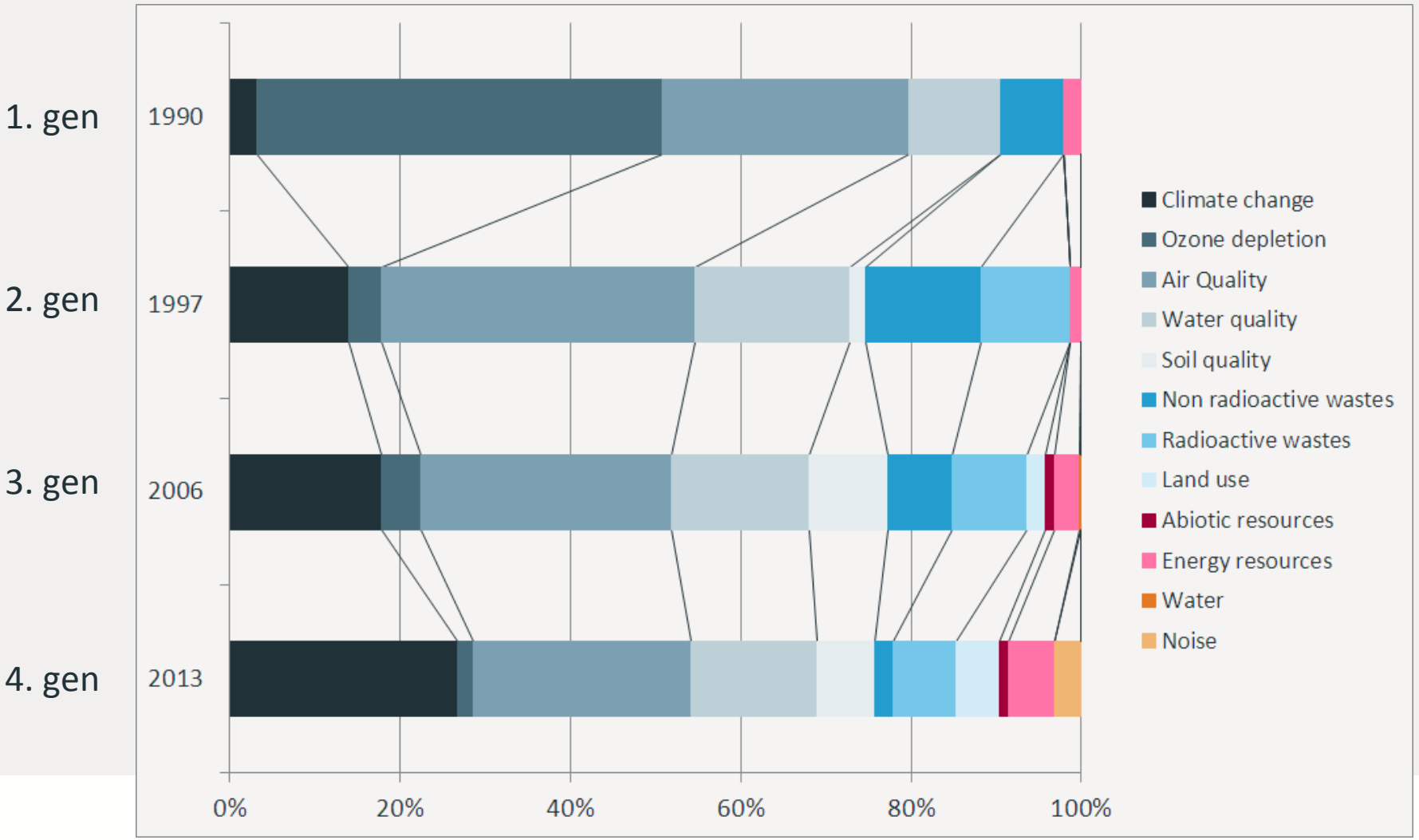
	2013		2006
low and medium active wastes	2.1	UBP/cm^3	3’300
Spent fuels, high active wastes, alpha toxic wastes	35’000	UBP/cm^3	18’000
High active wastes (including spent fuel)	46’000	UBP/cm^3	
Alphatoxic wastes	69	UBP/cm^3	

- EF low and medium active wastes much lower
- EF high active waste approx. doubled
- In total, very similar assessment like in 2006

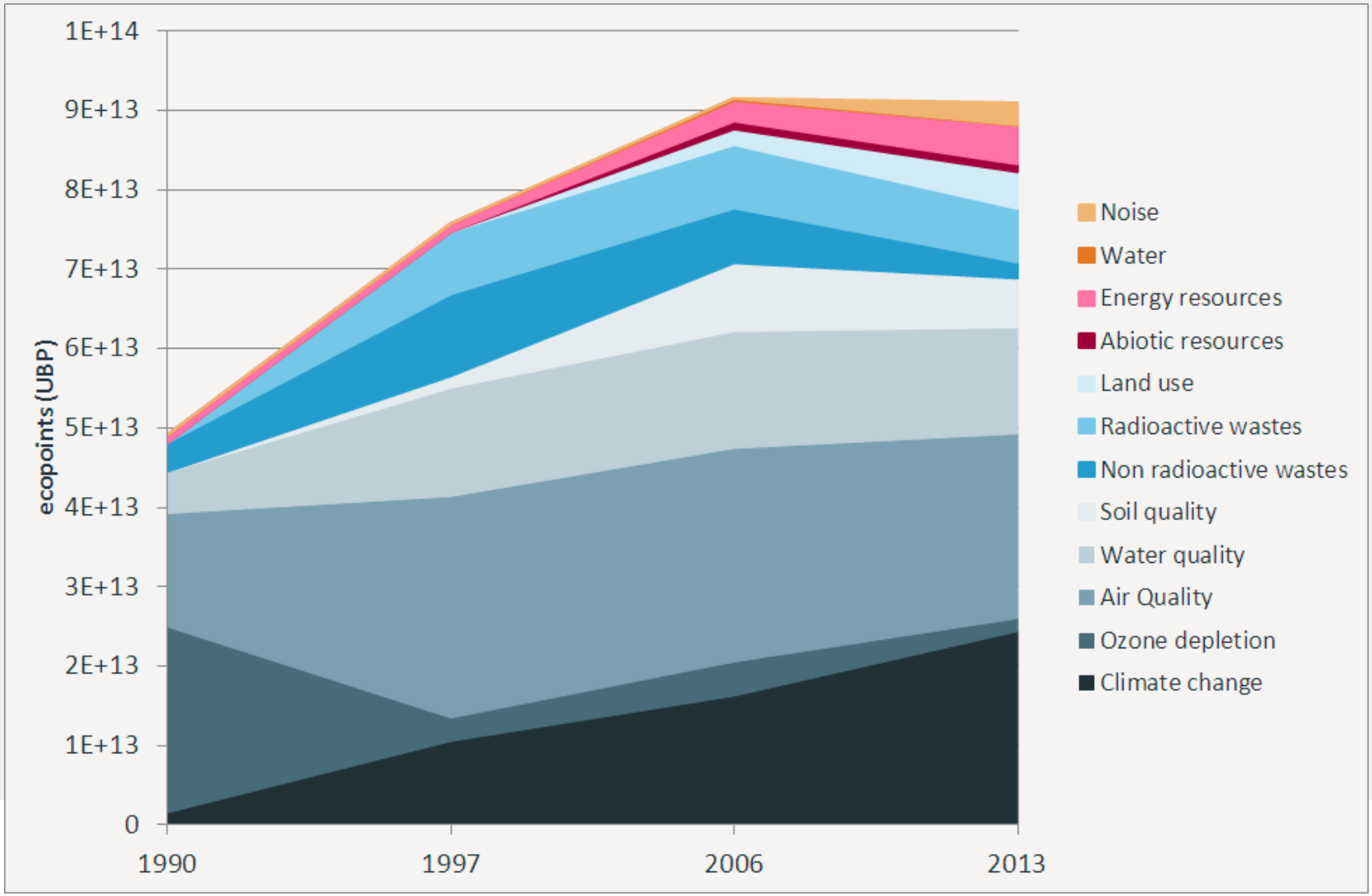
Evolution of ecofactors of selected pollutants/resources



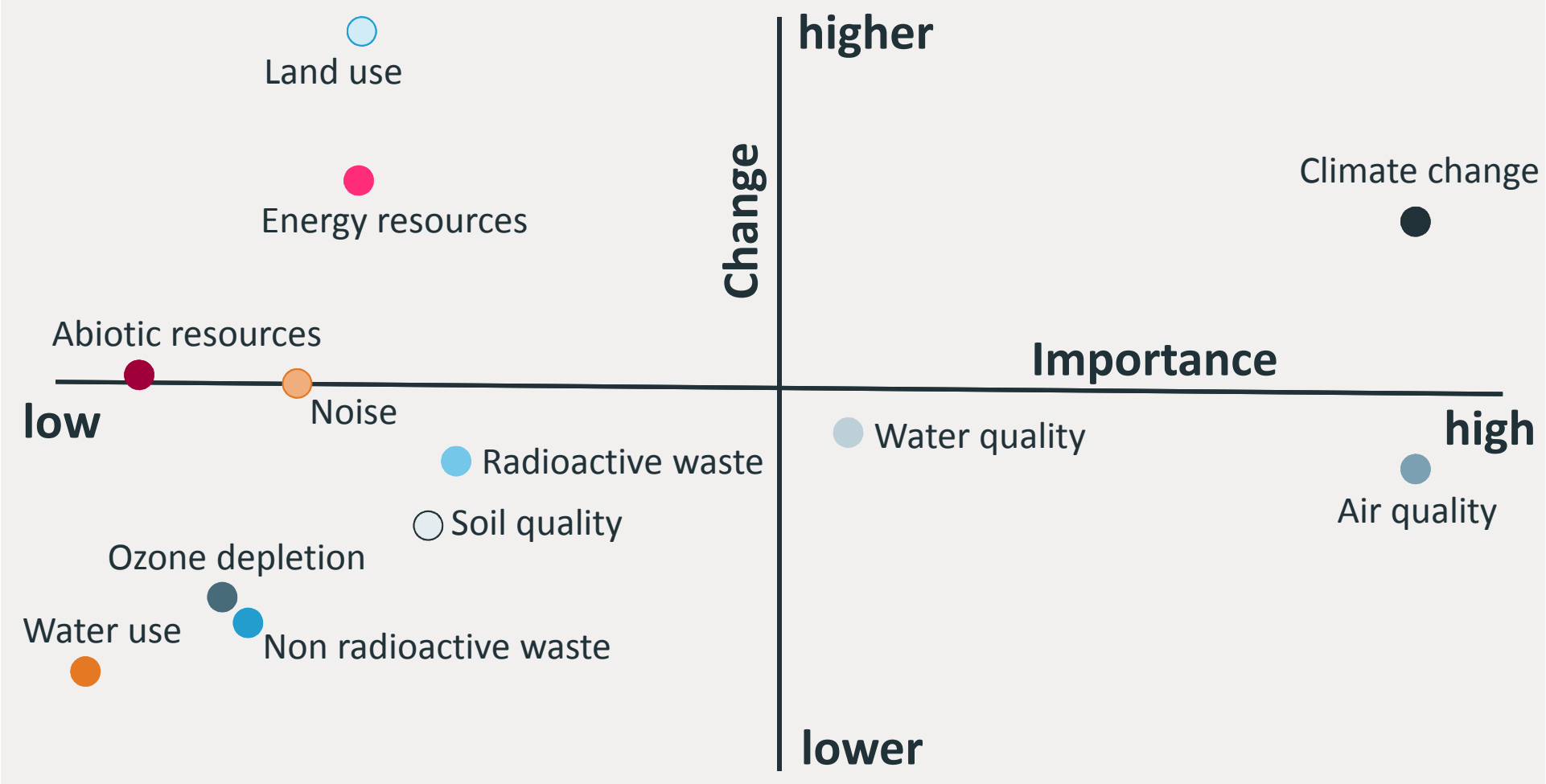
Evolution of the shares of Swiss environmental impacts (UBP)



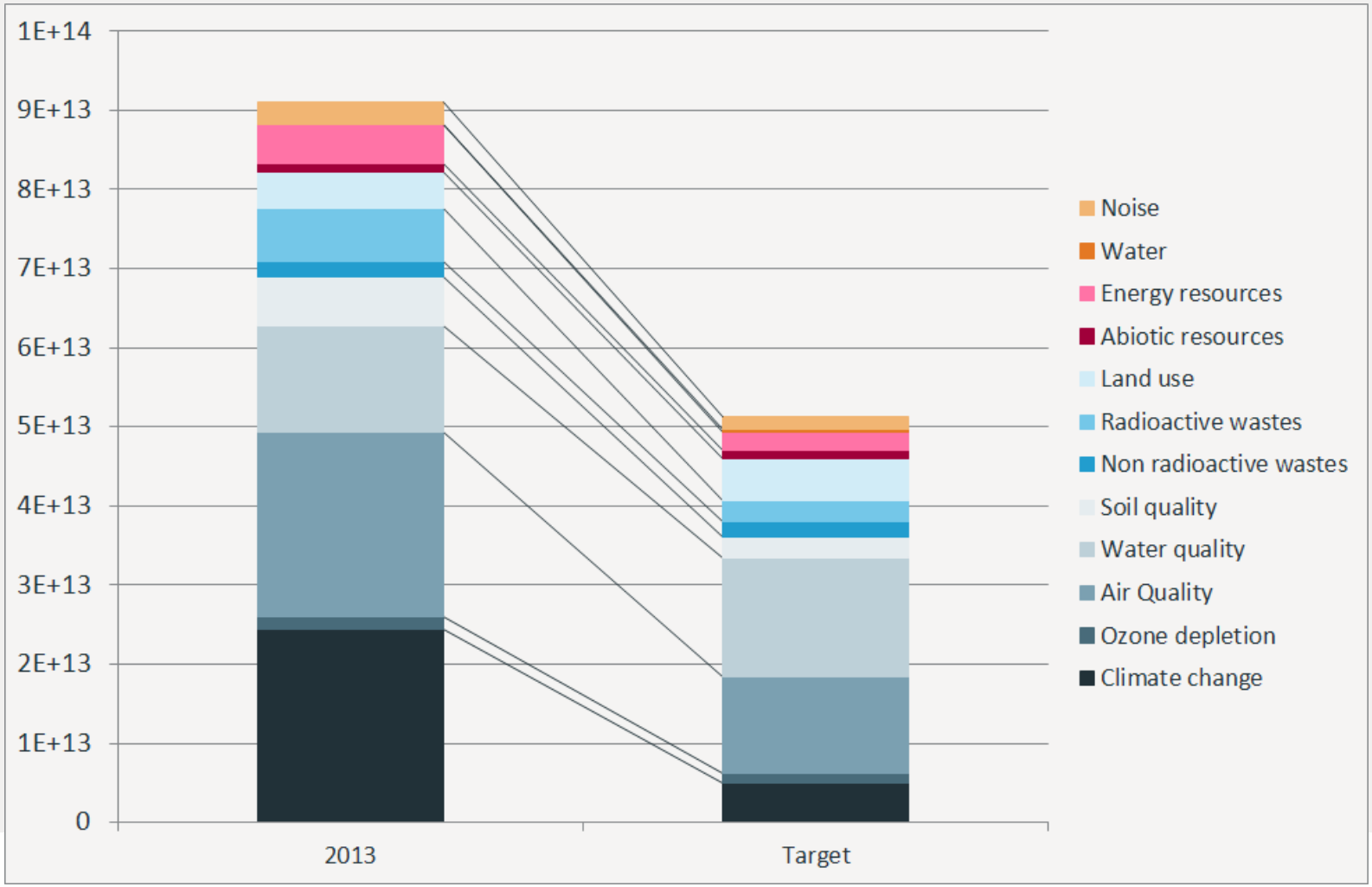
Evolution of Switzerland's ecopoints (UBP)



Actual impacts Switzerland: Relative importance and change



Actual situation and environmental target (in UBP'13)



Synthesis: «UBP-view» on Swiss environmental situation

- Climate change: more and more important
- Air and water quality: slightly less important
- Ozone depletion and non radioactive wastes significantly less important
- Overall reduction of environmental impacts (in UBP) by about 50% to reach Swiss environmental targets

4th generation ecofactors Switzerland brings you

- up to date Swiss ecofactors
- approach ready to be implemented in other countries/regions
- ecofactors covering new impacts such as resource dispersion, noise and persistent organic pollutants
- broadened regionalised ecofactors for land use and water use
- no revolution but evolution

Thank you very much for your attention!

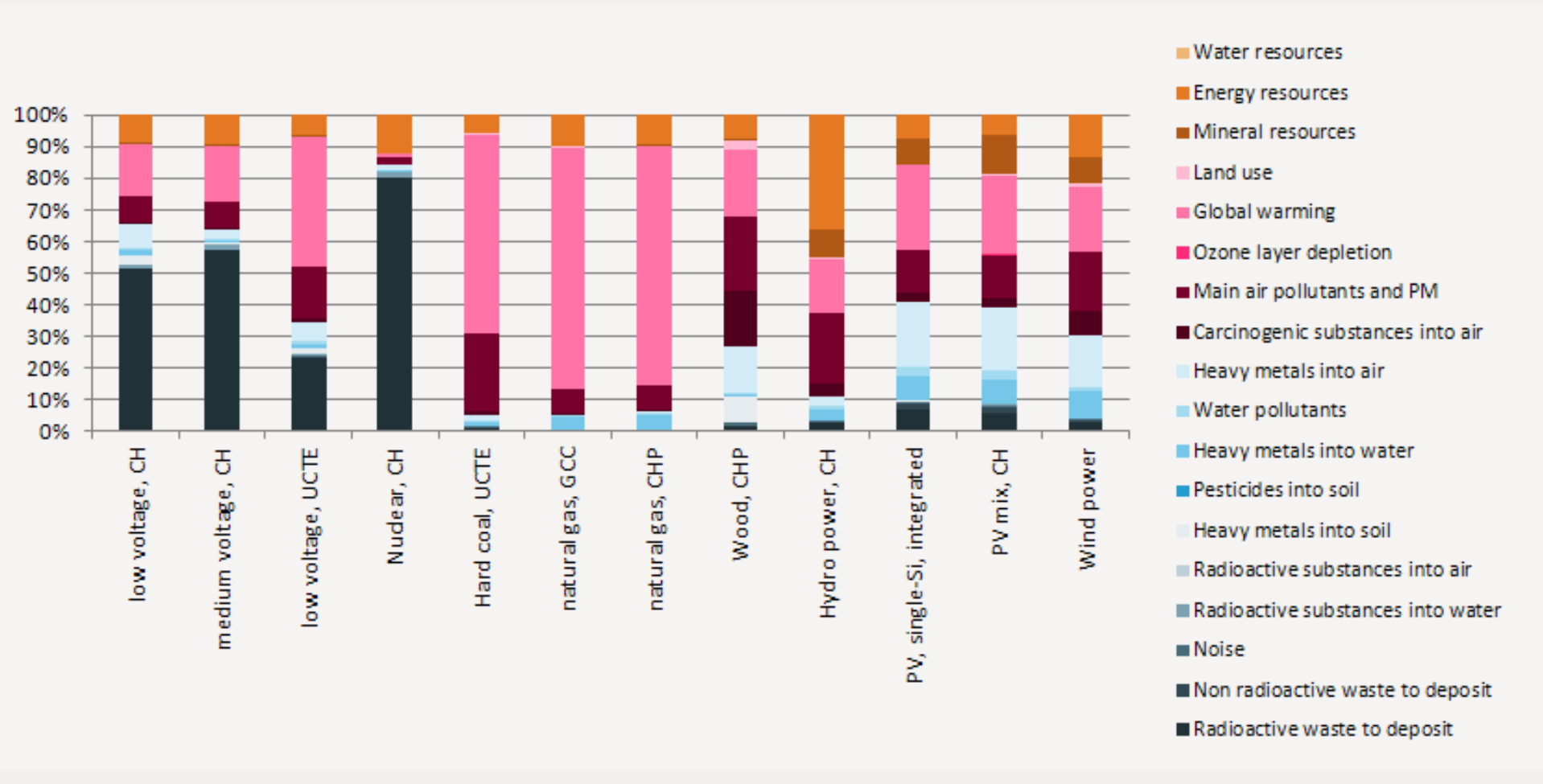
treeze
fair life cycle thinking

Contact:
frischknecht@treeze.ch
Website:
www.treeze.ch

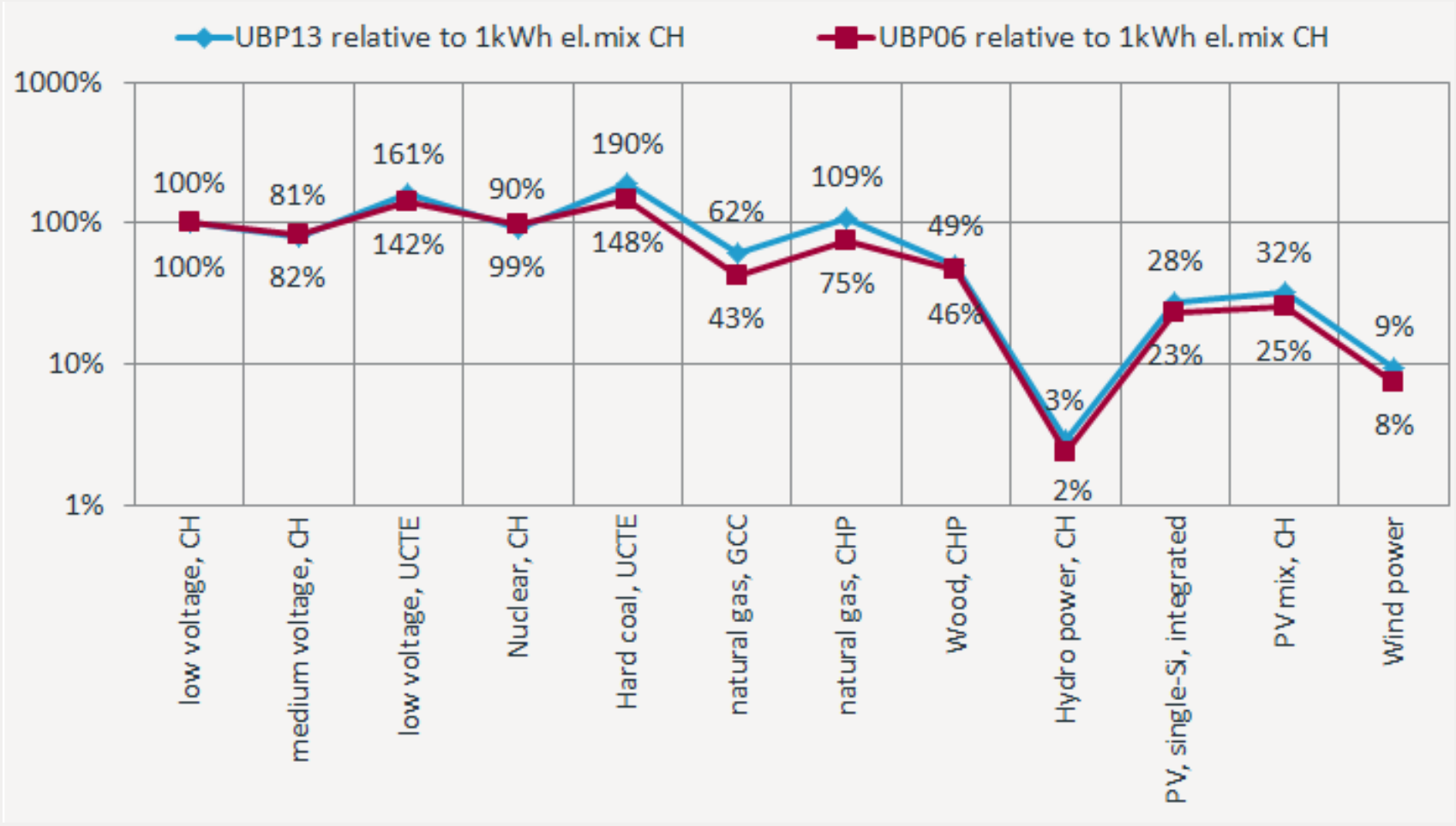
Acknowledgement:
Funding: Swiss Federal Office for the Environment FOEN, Öbu
Co-operation (until 10.2012): Karin Flury, Matthias Stucki
Suggestions, preparatory work and practical tests:
Peter Gerber, Arthur Braunschweig, Gabi Hildesheimer, Norbert Egli
Members of the advisory group, and
Hans Bögli, Laura de Baan, Fredy Dinkel, Emil Franov, Paul Filliger, Ernst Furrer, Daniel Hartmann, Bettina Hitzfeld, Blaise Horisberger, Michael Hügi, Harald Jenk, Sybille Kilchmann, Martin Kilga, Thomas Köllner, Nina Mahler, Sandy Ruiz Mendoza, Reto Muralt, Beat Müller, Carla Ng, Christian Pillonel, Robin Quartier, Monika Schaffner, Kaarina Schenk, Martin Scheringer, Ulrich Sieber, Peter Straehl, Josef Tremp, Roland von Arx

Appendix

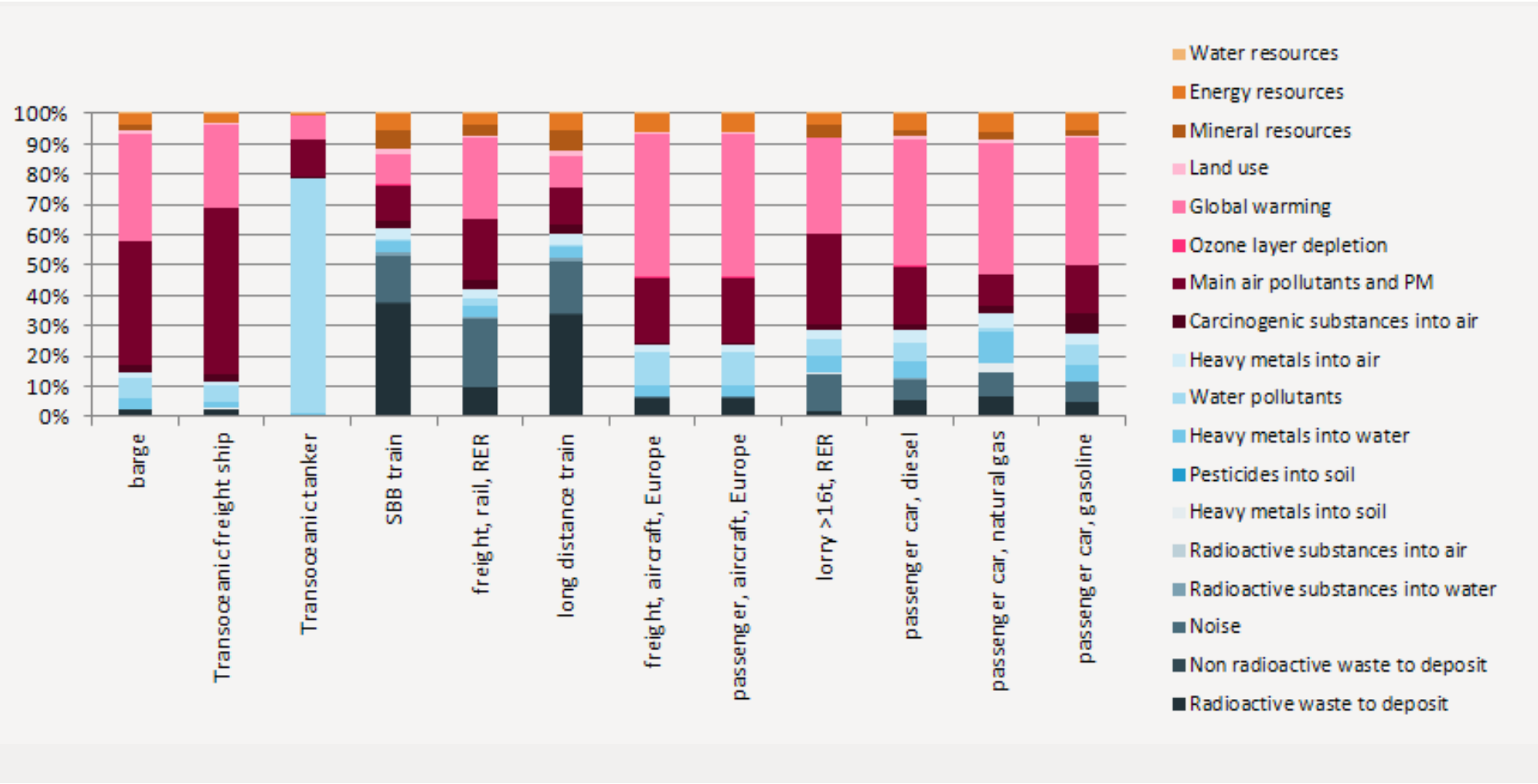
Electricity supply systems



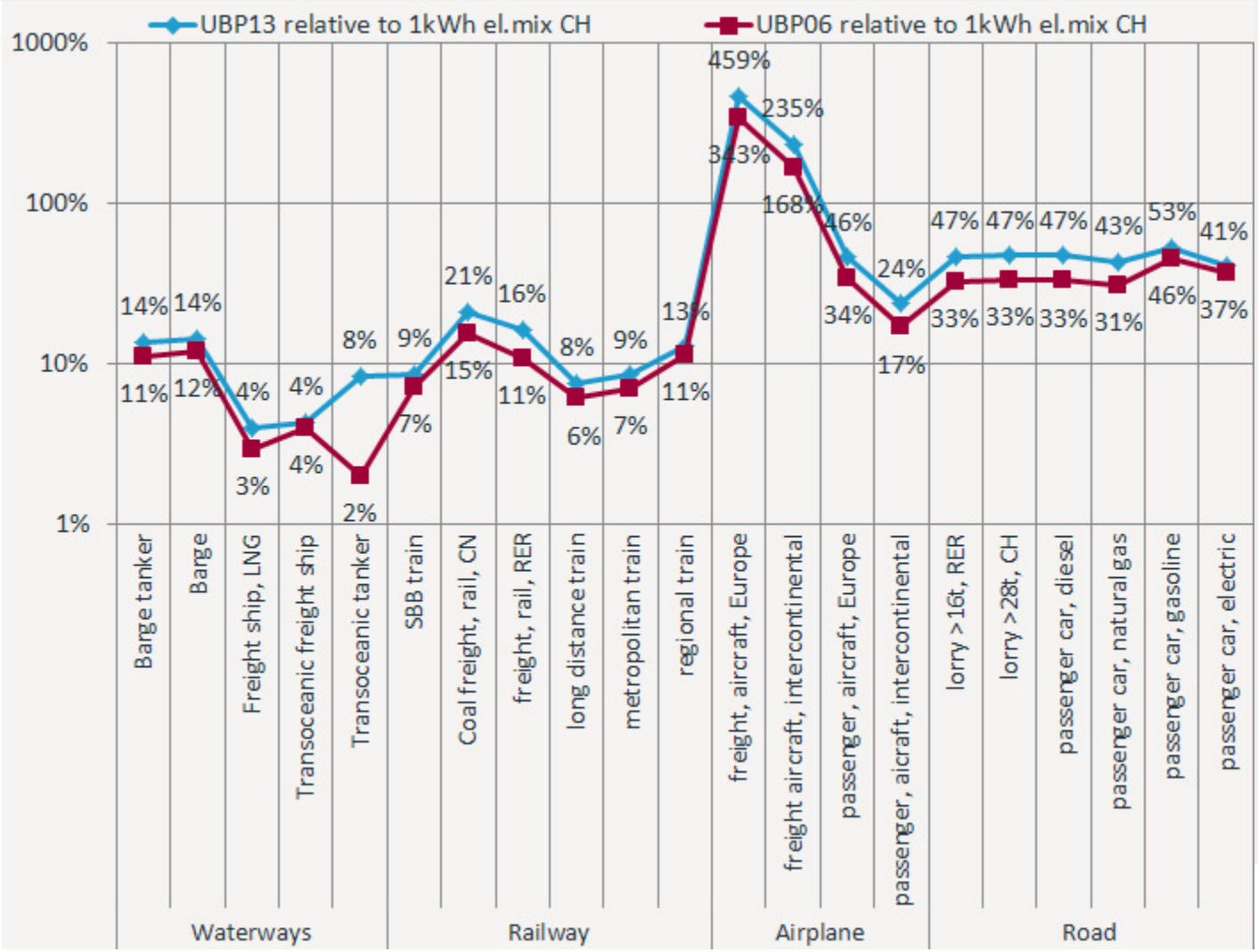
Electricity supply systems



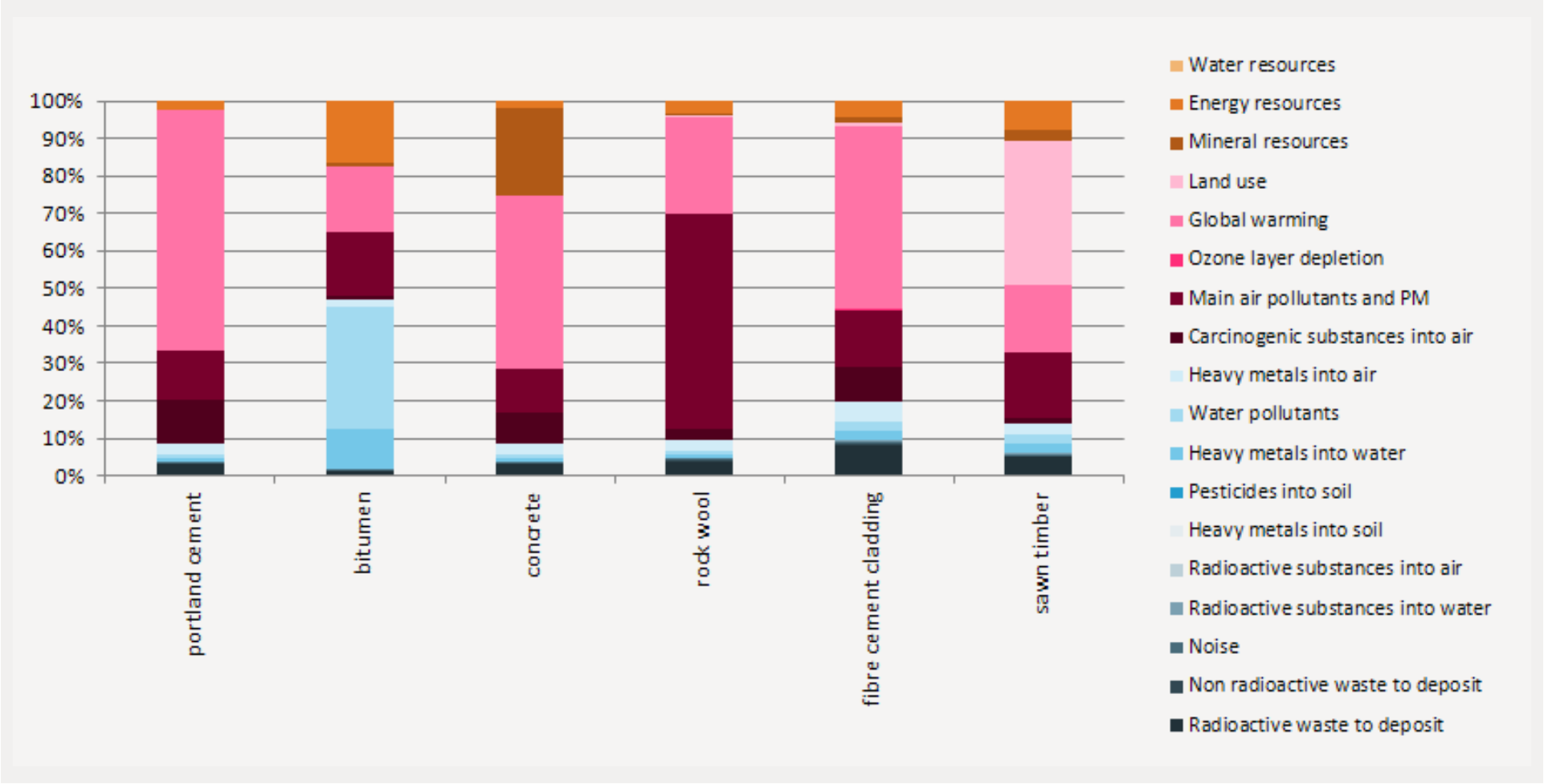
Transport services



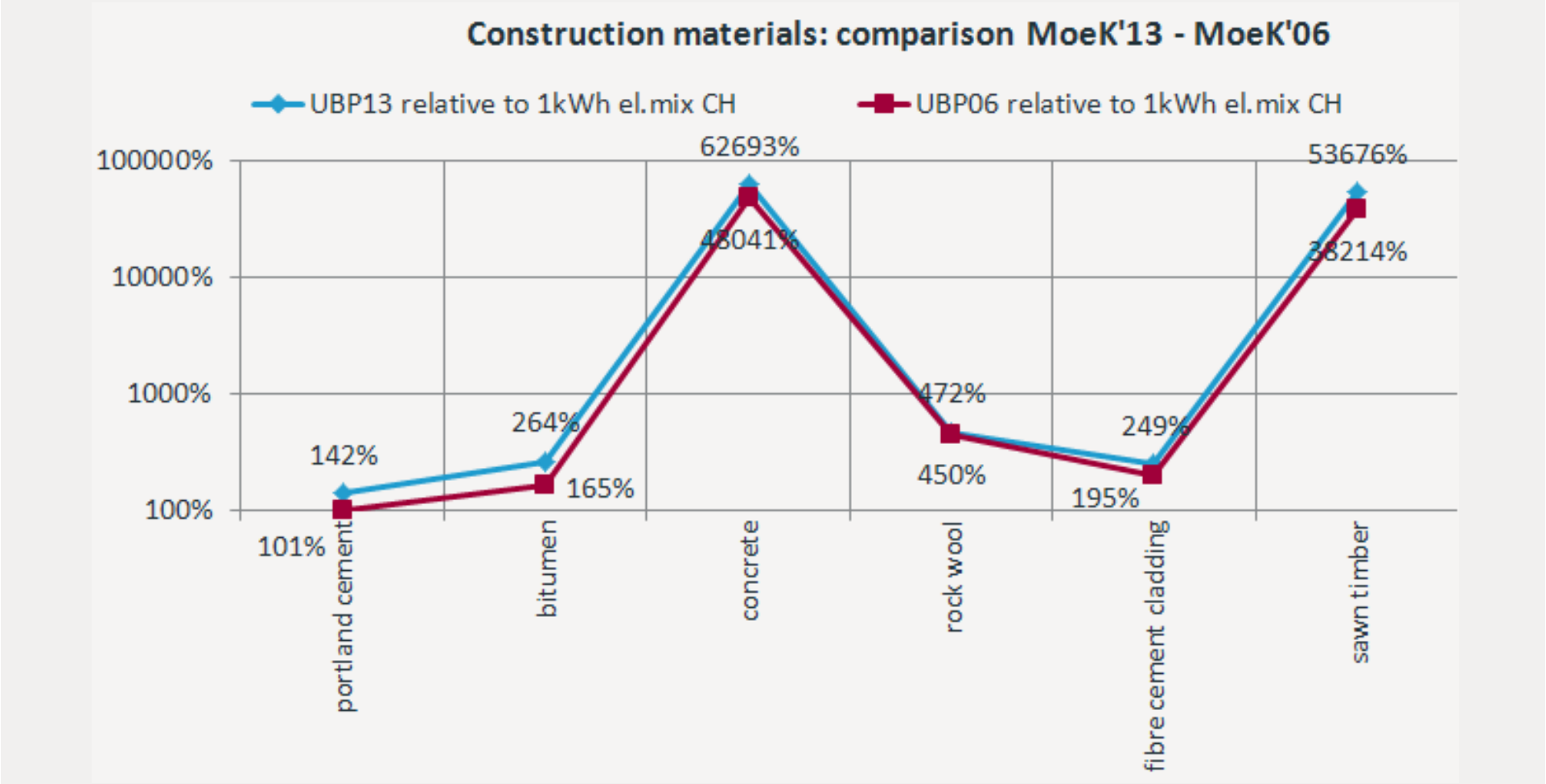
Transport services



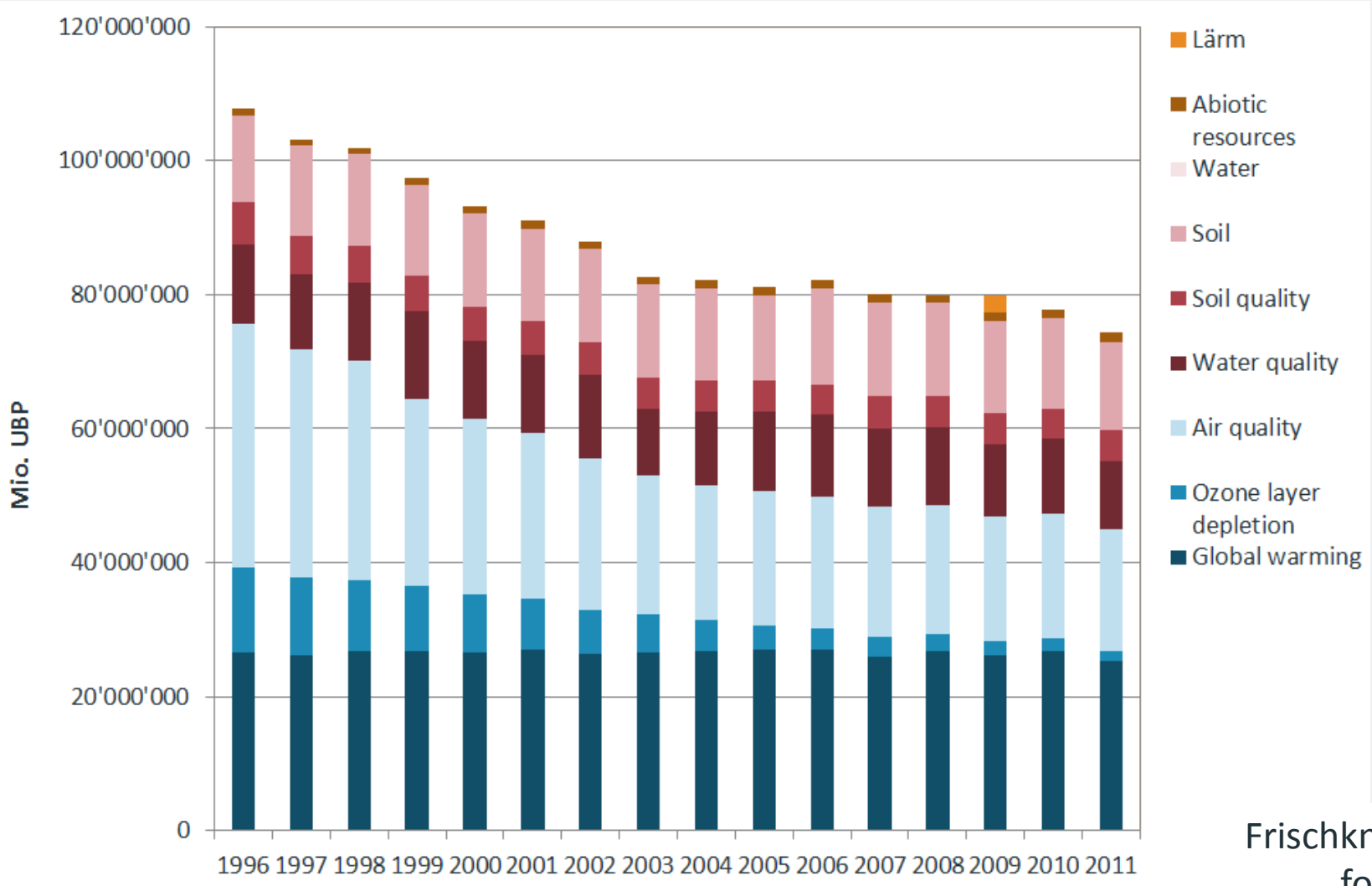
construction materials



construction materials



Environmental impacts in Switzerland (UBP'13)



Frischknecht et al. forthcoming