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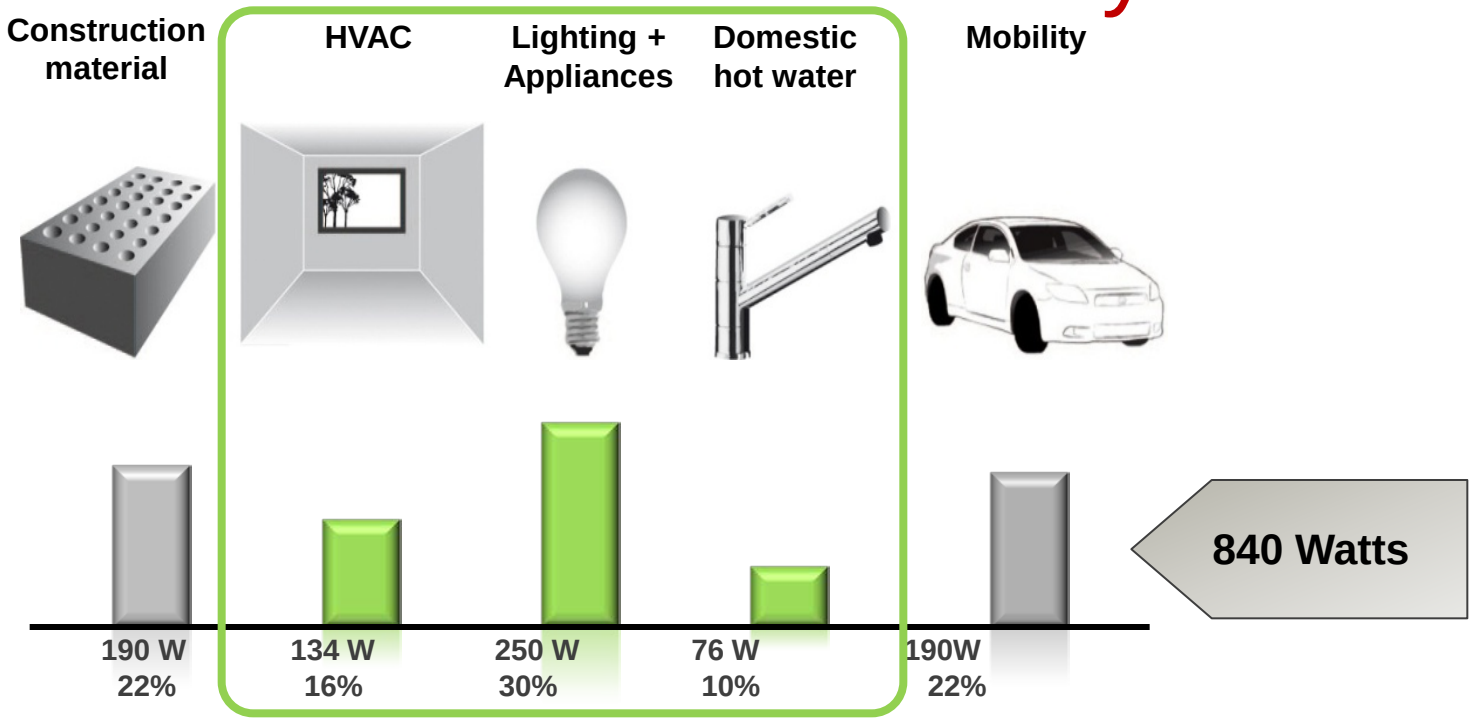
SS4: Targets, indicators, and benchmarks for resource use

Applicability of environmental impact assessment indicators on the use of natural resources In the built environment

Prof. Dr.-Ing. Holger Wallbaum[1], Ass.-Prof. Dr.-Ing. Alexander Passer[2], Prof. Dr. habil. Stefan Bringezu[3], Jun Kono[1]

[1]Chalmers University of Technology, Sweden
[2]Graz University of Technology; Austria
[3]Wuppertal Institute for Climate Environment Energy, Germany

Ambitious goals of the 2000 W-society



Switzerland	Status 2005	Goal 2050	2050 / 2005
Primary energy, overall [W/P]	6300	3500	-44%
Primary energy, non-renewable [W/P]	5800	2000	-66%
GHG-emissions t [CO_2-eq./P]	8.7	2.0	-77%

Embodied energy

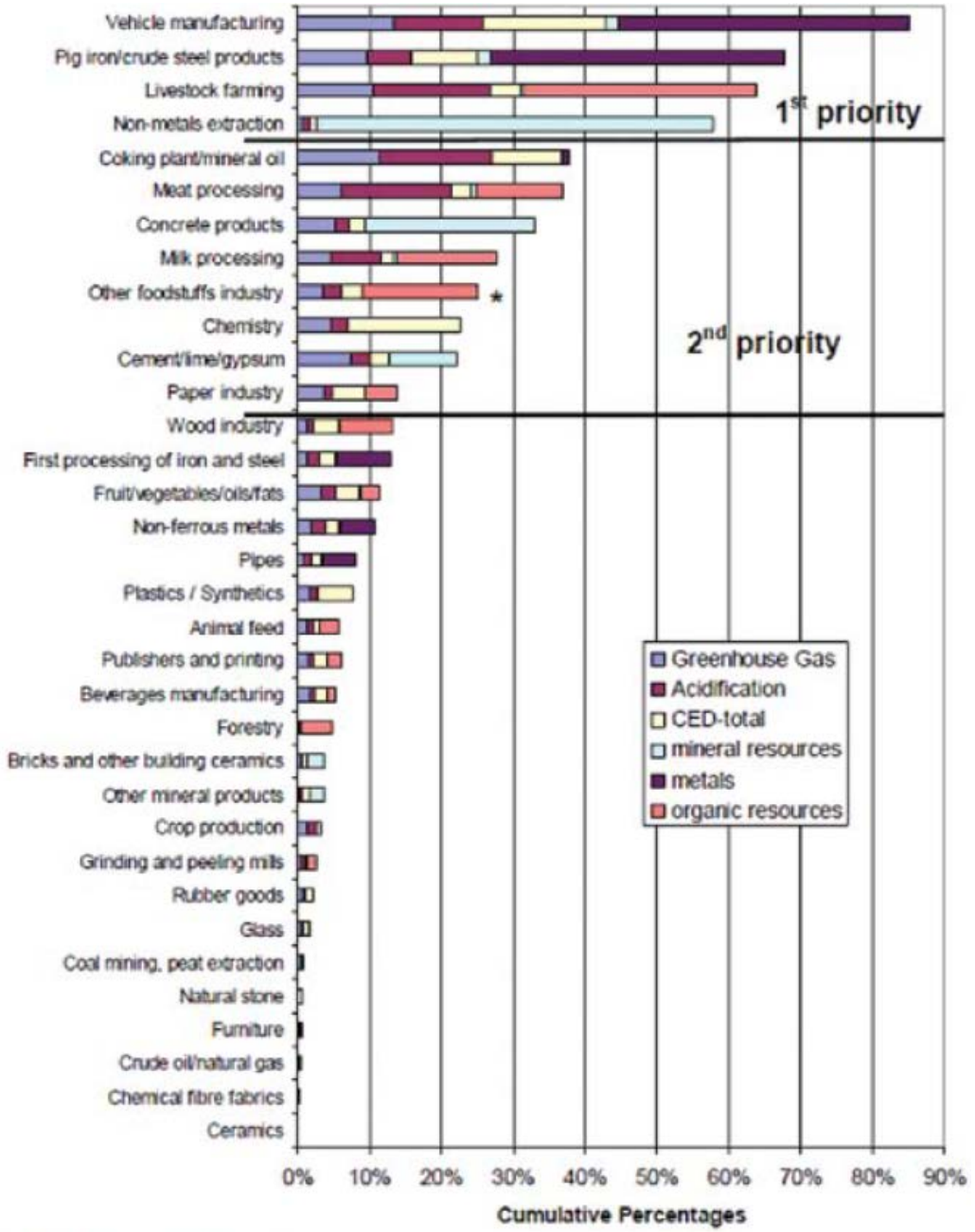
- The embodied energy in Zurich building stock by building new construction and renovation cumulates to TJ 1’796 (Reference scenario), TJ 2’270 (Efficiency scenario) and TJ 2’304 (Eco-efficiency scenario) in 2050.
- Around 190 watts per person (or already appr. 10% of the target value of 2000 watts per capita in the year 2050) and 0.48 tonnes of CO_2 per person in 2050 for the efficiency scenario.
- “Grey greenhouse gas emissions” amount to almost 90% of greenhouse gas emissions from the operation in 2050.

Source: Jakob M., Martius G., Ostermeyer Y., Wallbaum H. (2014): Graue Energie und Graue Treibhausgasemissionen der Neubau- und Erneuerungstätigkeit im Gebäudepark in der Stadt Zürich bis 2050 - Eine ergänzende Abschätzung auf Grundlage des Gebäudeparkmodells und des Konzepts Energieversorgung 2050, City of Zurich, Switzerland

Resource use and environmental impacts

- Although the large amount of resources used by the construction industry, **several studies stated that the size of the mass of the various building materials and products are not a sufficient indicator to express the environmental effects**.
  - For example, the study by van der Voet et al. 2005 concluded that **the environmental effects assessed by the "Environmentally Weighted Material Consumption" (EMC) method of the mass-wise relevant materials are of minor importance**.
- A report on behalf of the UNEP International Resource Panel came to the conclusion ***"that both small material flows with a very high environmental impacts as well as large material flows with low environmental impacts are classified as minor challenge."***

Source: UNEP International Resource Panel. Responsible Resource Management for a Sustainable World: Findings from the International Resource Panel. Paris, France : UNEP, 2012. 978-92-807-3278-8



Source: Hertwich, Edgar G., et al., et al. Assessing the Environmental Impacts of Consumption and Production - Priority Products and Materials. Paris, France : UNEP, 2010. 978-92-807-3084-5.

The role of buildings

"Buildings are the most important end-user of energy and many materials. They lead to substantial direct and indirect emissions of greenhouse gases, particulate matter and its precursor. Indoor air pollution from uncontrolled combustion is a major concern of health in Developing Countries. For most impacts, the combustion of fuels or the use of fossil fuel-based electricity causes the largest contribution to the total impacts from housing. For wealthier countries, construction and the production of construction materials is the largest source of particulate matter.“

Source: Hertwich, Edgar G., et al. Assessing the Environmental Impacts of Consumption and Production - Priority Products and Materials. Paris, France: UNEP, 2010: 79, ISBN 978-92-807-3084-5.

Goals of the study

To evaluate the currently used environmental assessment methods that claim to consider natural resources in their assessment and impact framework combining both energetic and natural resources

→ Draw conclusions on the strengths and weaknesses of the methods to be evaluated

→ Identify the most appropriate methods

→ Define requirements for an improved environmental assessment method if it turns out that the evaluated methods are not sufficient

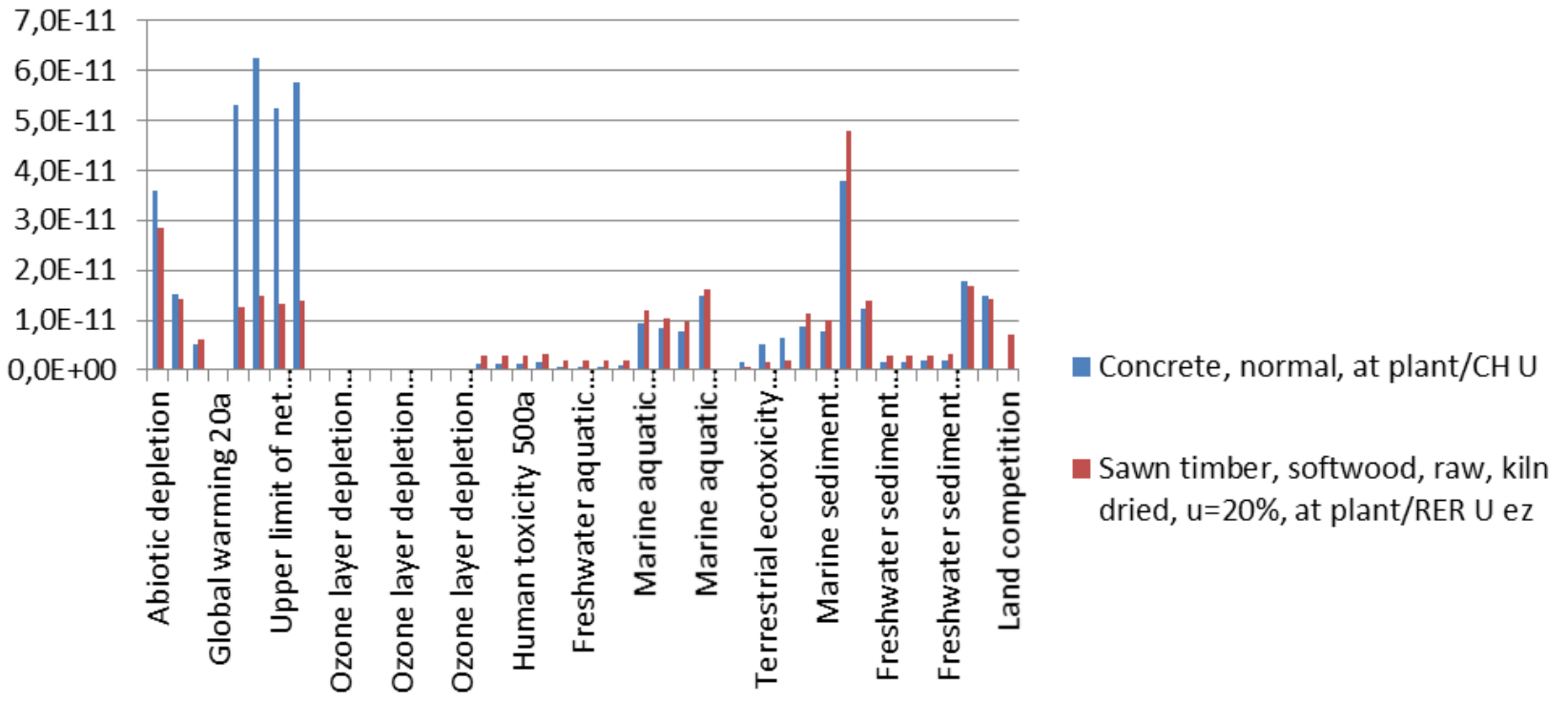
Approach

- The currently applied Life cycle assessment methods have been assessed against the study goals
- Material Input per Service unit (MIPS) from the Wuppertal Institute and the Ecological Scarcity from the FOEN in Switzerland have been added
- The most qualified methods have been applied on three levels:
  1. Building materials
  2. Construction element
  3. Whole building
- Software SimaPro has been used and the Ecoinvent database version 3.1
- An Advisory Board consisting of representatives from Public authorities, academia, and businesses have been established

Evaluated methods

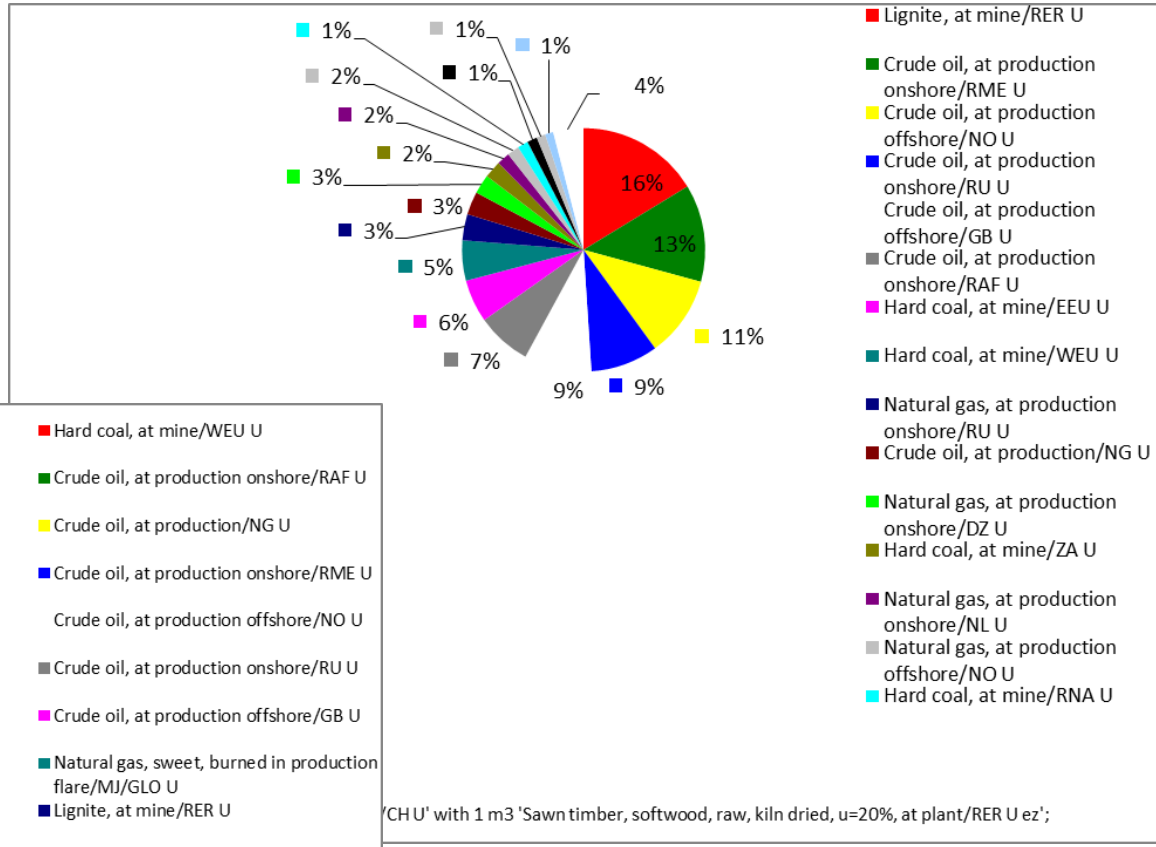
1. CML 2001
2. EPS 2000
3. Ecological Scarcity 2006 – 2011
4. Material Input per Service Unit (MIPS)
5. Impact 2002+
6. Recipe 2008
7. Eco-indicator 99
8. Environmental Design of Industrial Products (EDIP)
9. Ecological Footprint
10. Cumulative Energy Demand (CED)
11. Cumulative Exergy Demand (CExD)
12. Carbon Footprint (GWP)

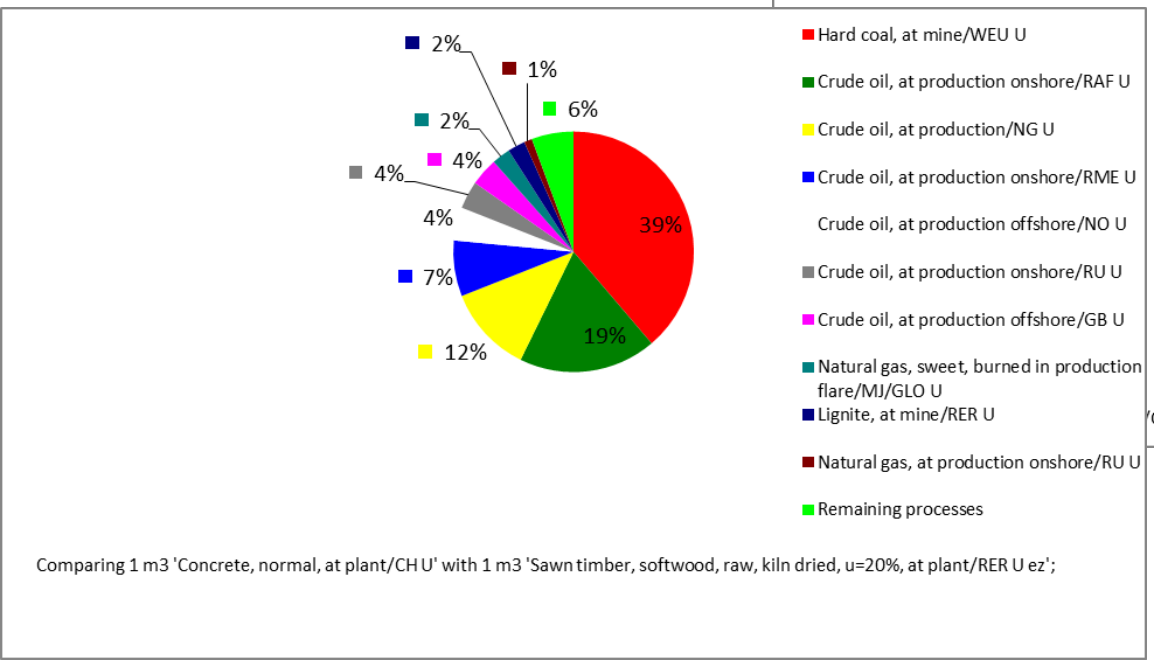
Results



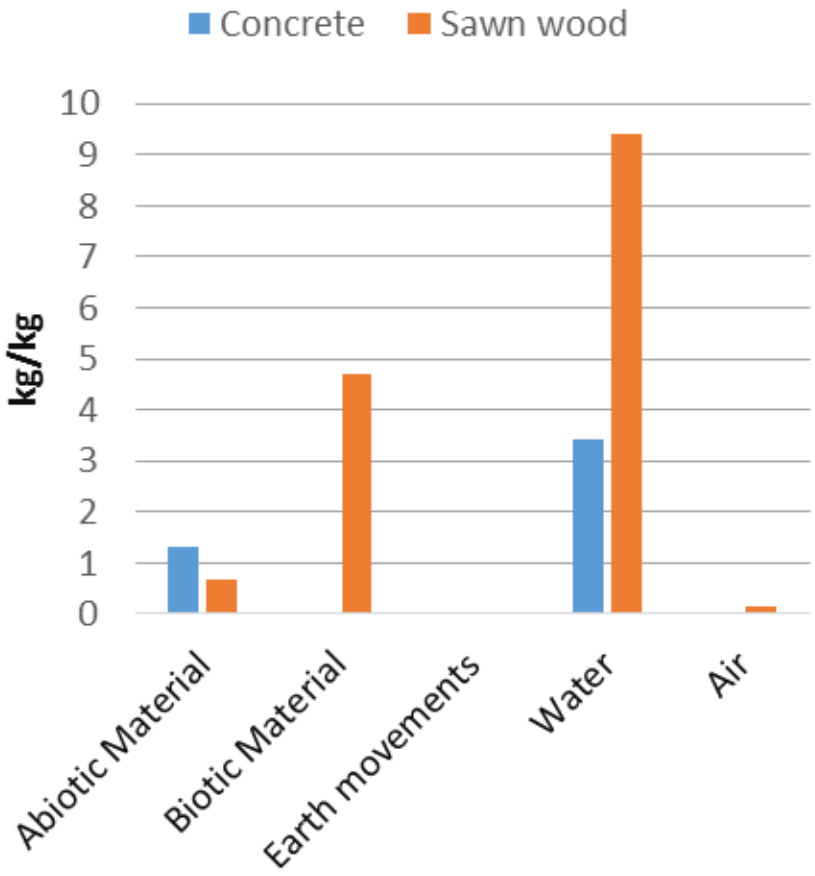
Comparing 1 m3 'Concrete, normal, at plant/CH U' with 1 m3 'Sawn timber, softwood, raw, kiln dried, u=20%, at plant/RER U ez';
Method: CML 2001 (all impact categories) V2.05 / West Europe, 1995 / Normalization / Excluding infrastructure processes / Exclud

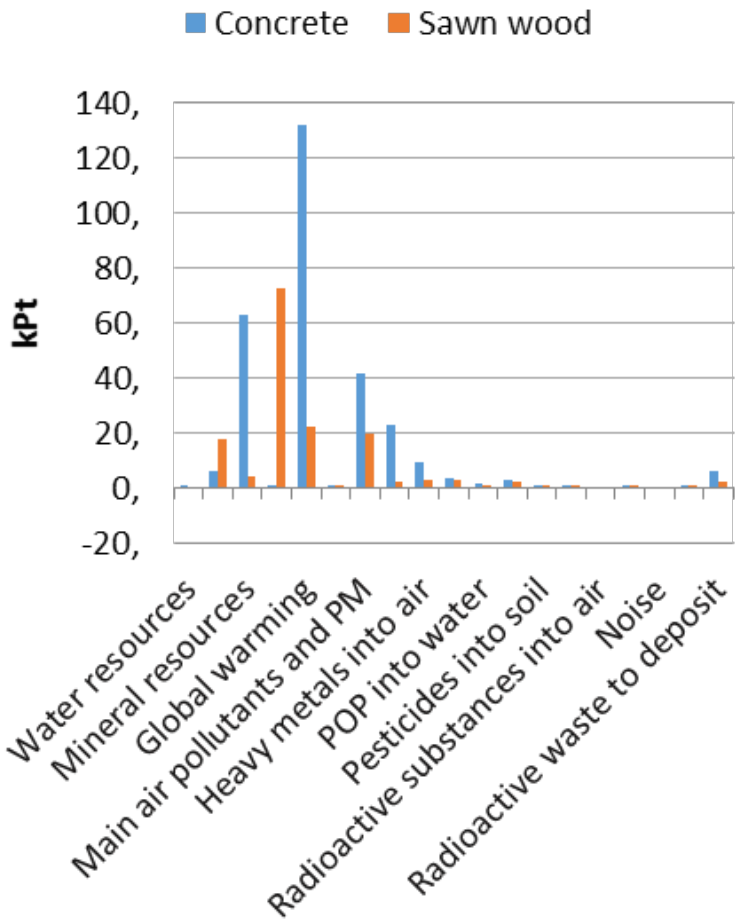
Processes contributing to the category ADP



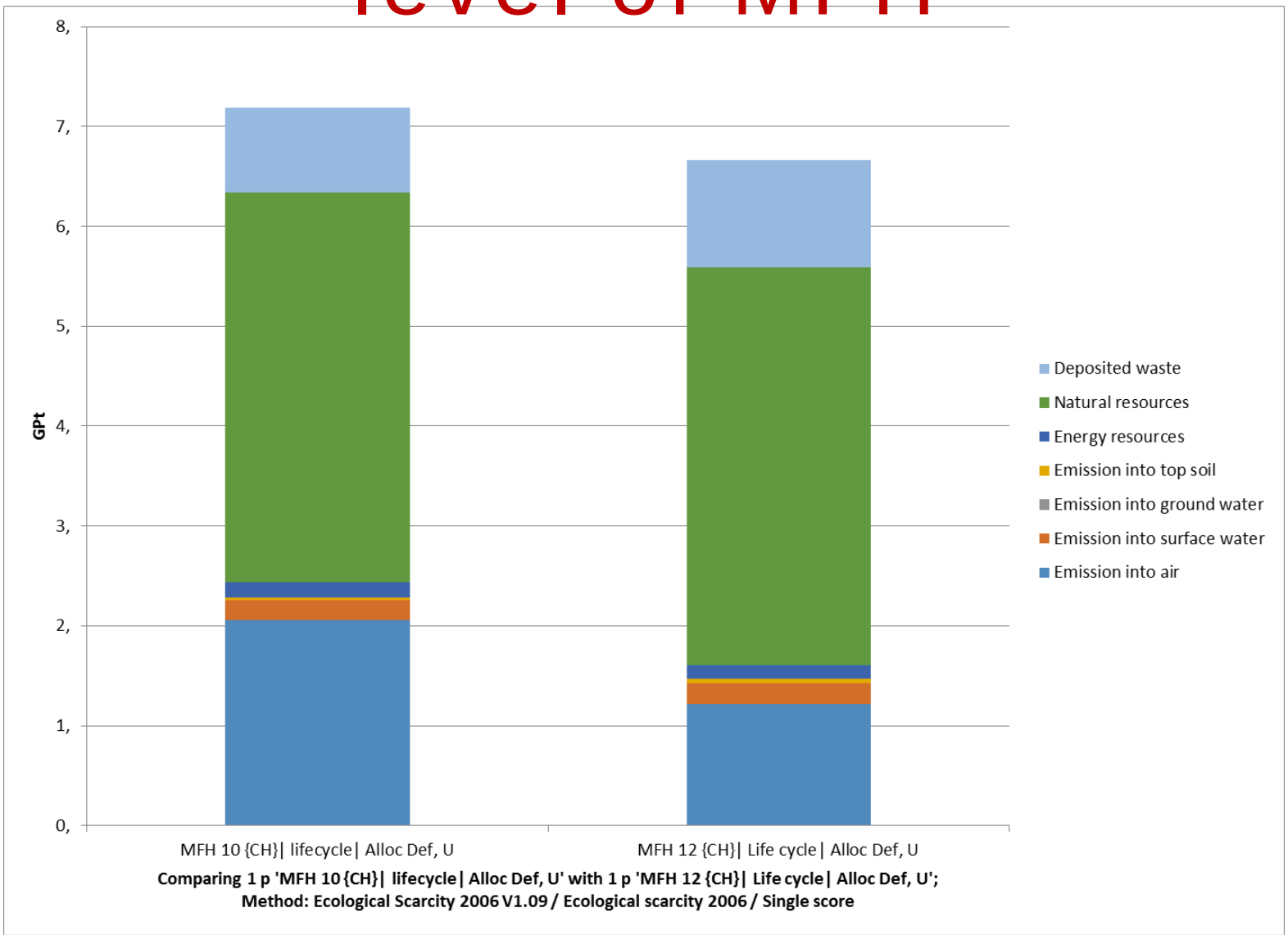


MIPS concept and Ecological scarcity on the material level

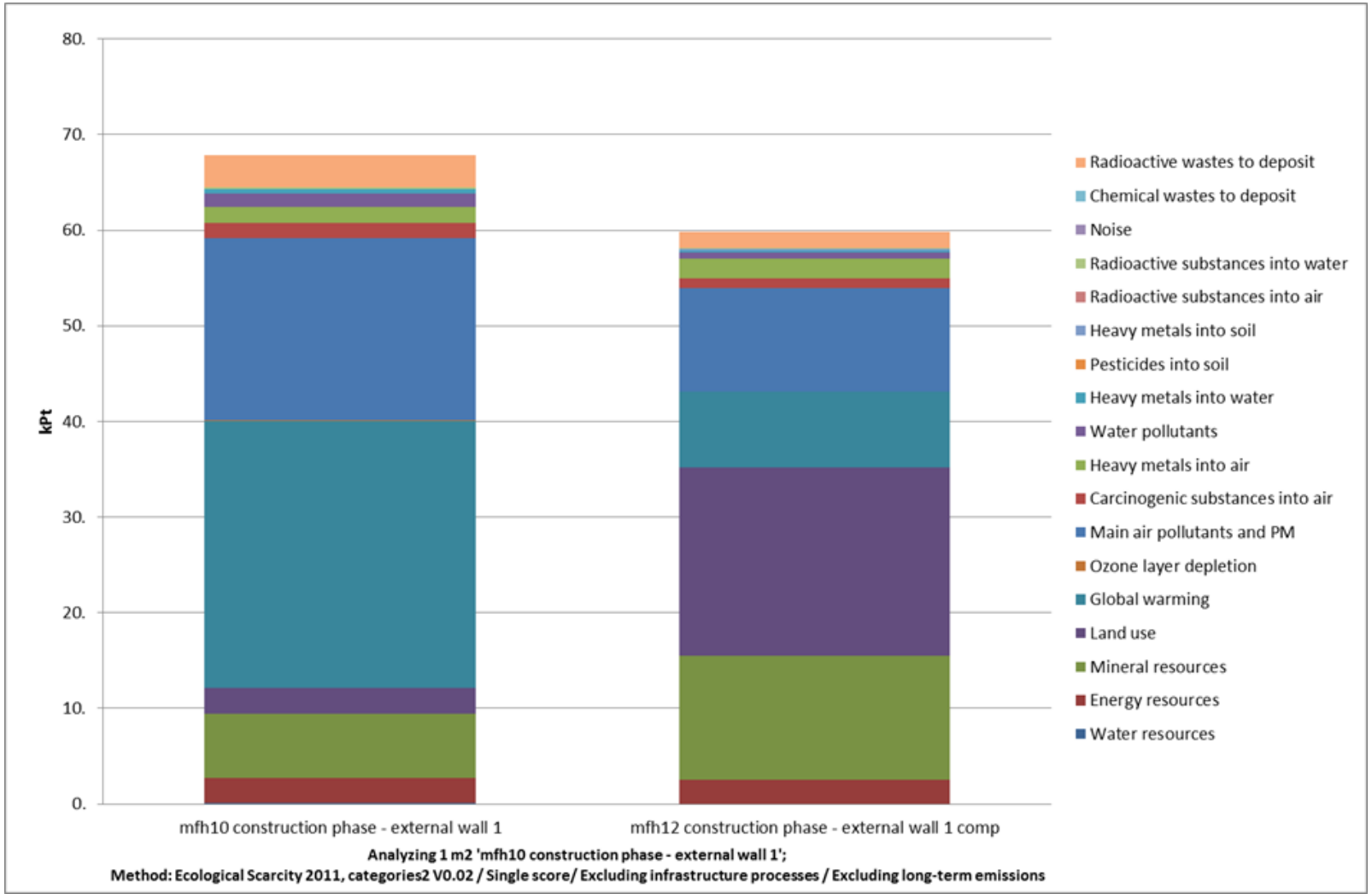




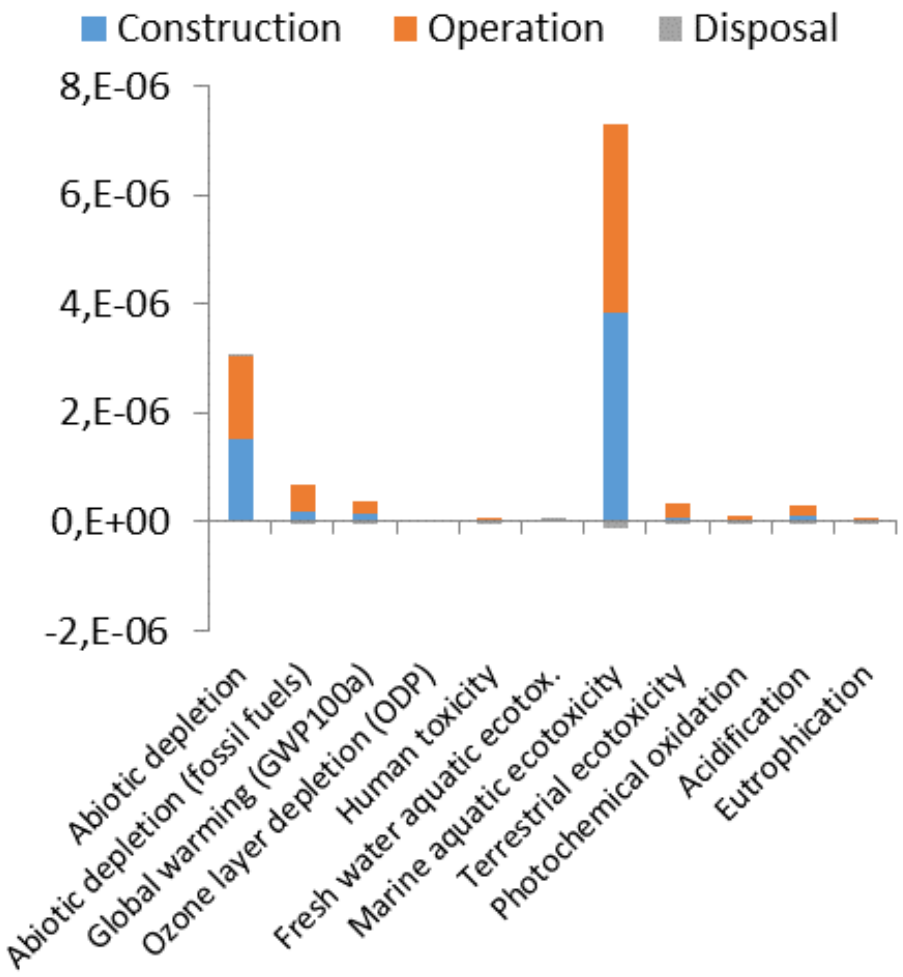
Ecological scarcity on the level of MFH

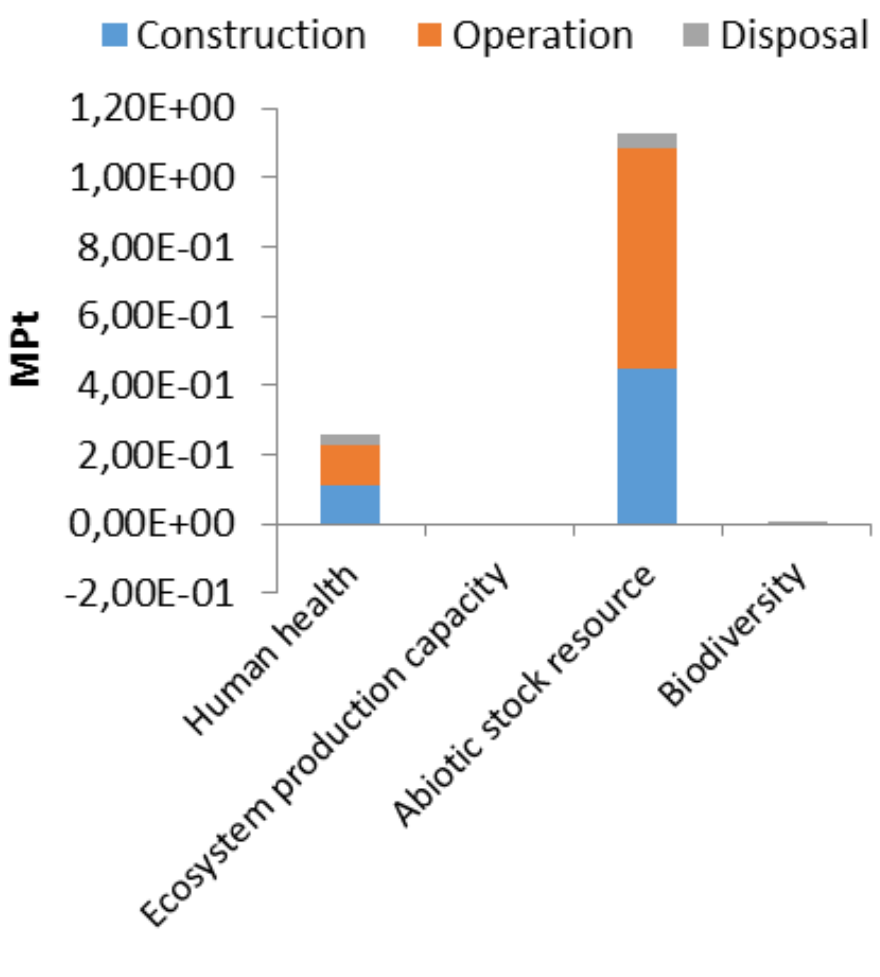


External wall make-ups; Ecological Scarcity 2011



Multifamily houses; CML (MFH10) and EPS (MFH12)





Conclusions I

- Only two of the assessment methods commonly used in the LCA (e.g. CML 2001 and EPS 2000) evaluate the use of non-energy resources explicitly.
- Only the MIPS concept provides explicitly the use of resources classified by abiotic, biotic, water, soil and air. Both renewable as well as non-renewable materials can be displayed graphically with their resource requirements. Earth moving non-used resource extraction is also covered.
- The method of ecological scarcity summarize the input as the output side in one assessment methods. In ecological scarcity 2011, a division of resource assessment in the form of a separate presentation for the mineral raw material usages was introduced as opposed to the version of 2006. Renewable resources are mapped on the assessment of the size of land occupancy.

Conclusions II

- None of the environmental assessment methods neither explicitly discriminate a building material neither prefer a specific type of construction.
- It also became clear that the objectives and the chosen assessment method of the individual methods differ and to date, no common understanding exists that the use of natural resources should be assessed.

Conclusions III

Assessment factors	What is covered?	Goal
Resource availability/-scarcity	The available „reserves“ and their utilization rate	Ensuring a sustainable/cross-generational availability of material resources
Resource use related environmental impacts	• A mass related use of resources	The reduction of the mass related use of material resources with the same or even increased functionality that implies the reduction of the resource use related environmental impacts
	• The resource use related environmental impacts (emissions into soil, water and air)	Reduction or avoidance of eco- and human-toxic emissions
Dilution potential	The loss or the recovery rate of the resource use	Reduction or avoidance of dissipative losses

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AREAS OF ADVANCE

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