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Different visions on abiotic resource depletion

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Problem statement and Objectives

- Different methods to address resource depletion:
 - Does it matter which one we use?
- How do these methods fit into the cultural perspective theory?
- Does the ranking of materials/processes change?



Area of Protection “Natural resources”: definition

ILCD handbook:

“The concern of natural resources is the removal of resources from the environment (and their use) which results in a decrease in the availability of the total resource stock, as non-renewable (usually abiotic) resources are finite ”

In this study only non-renewable resources are considered



Non-renewable resource depletion (ILCD handbook)

- Exergy
- Ecoscarcity
- CML 2000 → Based on ultimate reserves
- EDIP 2003 → Based on econom. exploitable reserves
- Eco-indicator 99 → Surplus energy for future extraction, change in available grade, substitution
- IMPACT 2002+
- ReCiPe 2008 → Surplus cost for future extraction, change in available grade
- EPS 2000

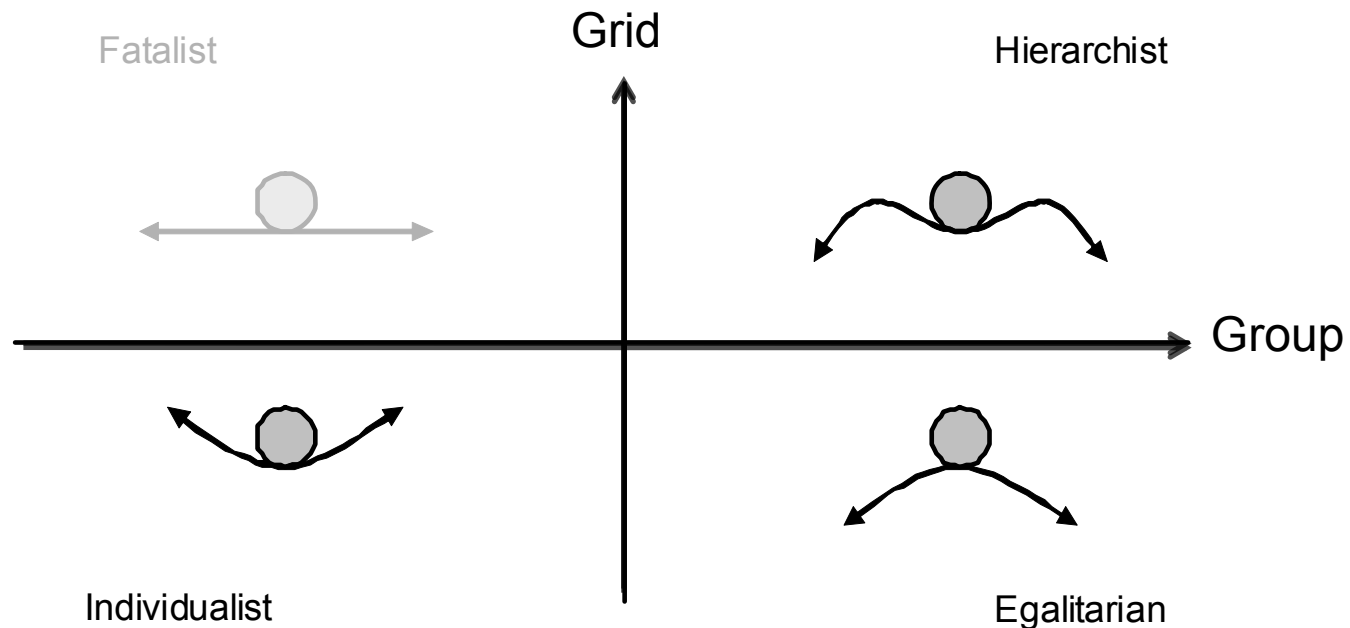


Different visions on abiotic resource depletion

Cultural perspective theory: Aggregates different moral beliefs, attitudes, and views on nature and society to only a few perspectives.

Vision on nature

Vision on society





Different visions on abiotic resource depletion

Proposed visions on resource depletion

	Individualist	Hierarchist	Egalitarian
Level of proof	Ultimate reserve	Economically available	Economically available
Timeframe	20 years	100 years	Infinite
Manageability	High technol developments	Medium technol developments	Low/little developments
	Substitution	Substitution	No substitution



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Proposed visions on resource depletion

How do the methods fit into the cultural perspective theory?

	Individualist	Hierarchist	Egalitarian
Level of proof	Ultimate reserve CML	Economically available	Economically available EDIP
Timeframe	20 years ReCiPe I	100 years ReCiPe H ReCiPe E	Infinite ReCiPe F
Manageability	High technol developments ReCiPe I	Medium technol developments ReCiPe H EI 99 H	Low/little developments ReCiPe F
	Substitution	Substitution	No substitution

Different implementation of Perspectives in EI99



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Resource depletion in ReCiPe 2008

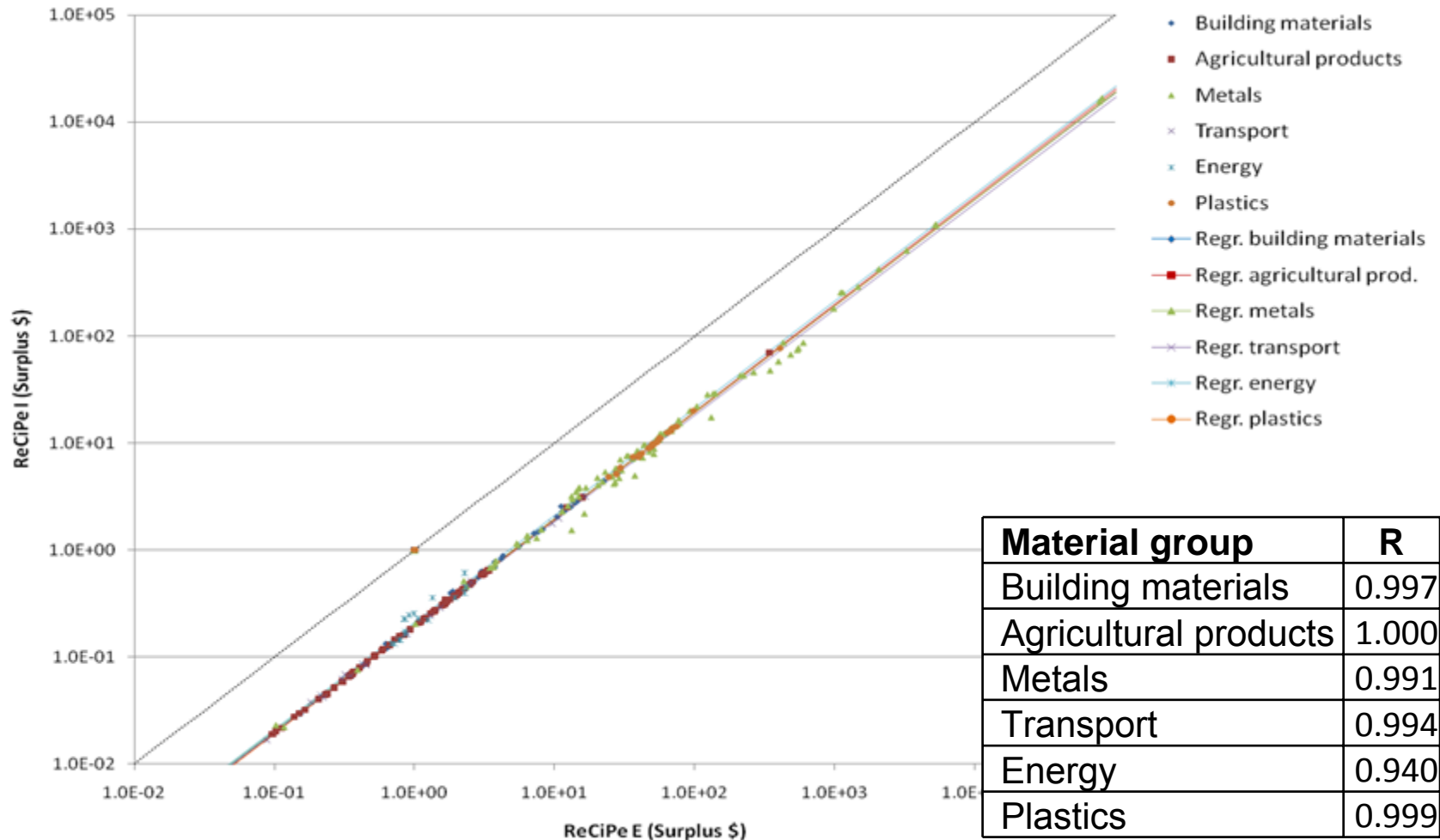
Possible choices	Individualist	Hierarchist	Egalitarian
Inflation	5%	3%	2%
Fossil fuels			
Heating value	Upper	Upper	Lower
Timeframe: production costs	<30 years	> 30 years	Infinite
Resource grade	Highest	Mostly used	Lowest grade
Minerals			
Production cost	High technol developments	Medium technol developments	No technol developments

For coal



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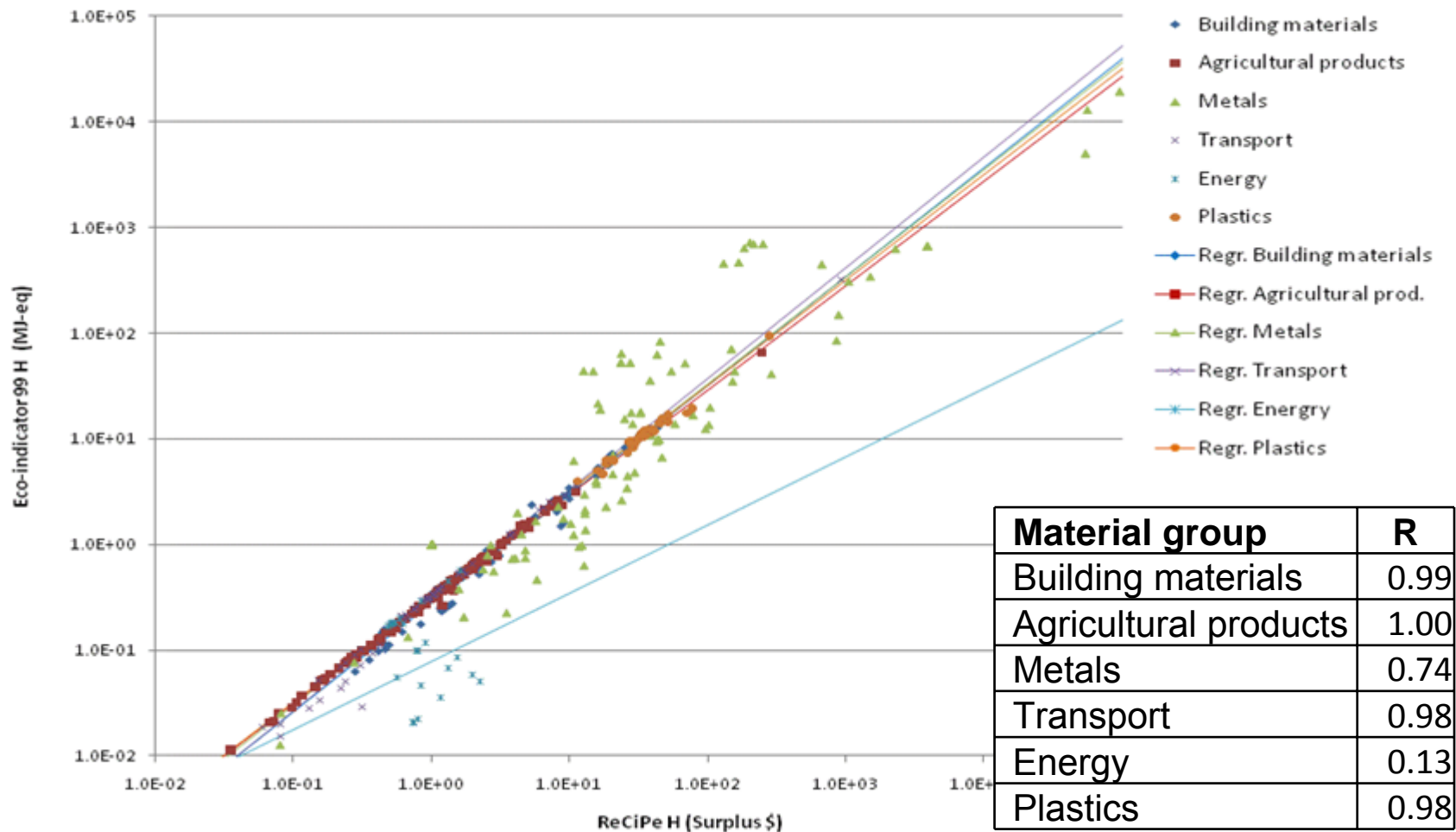
ReCiPe I – ReCiPe E





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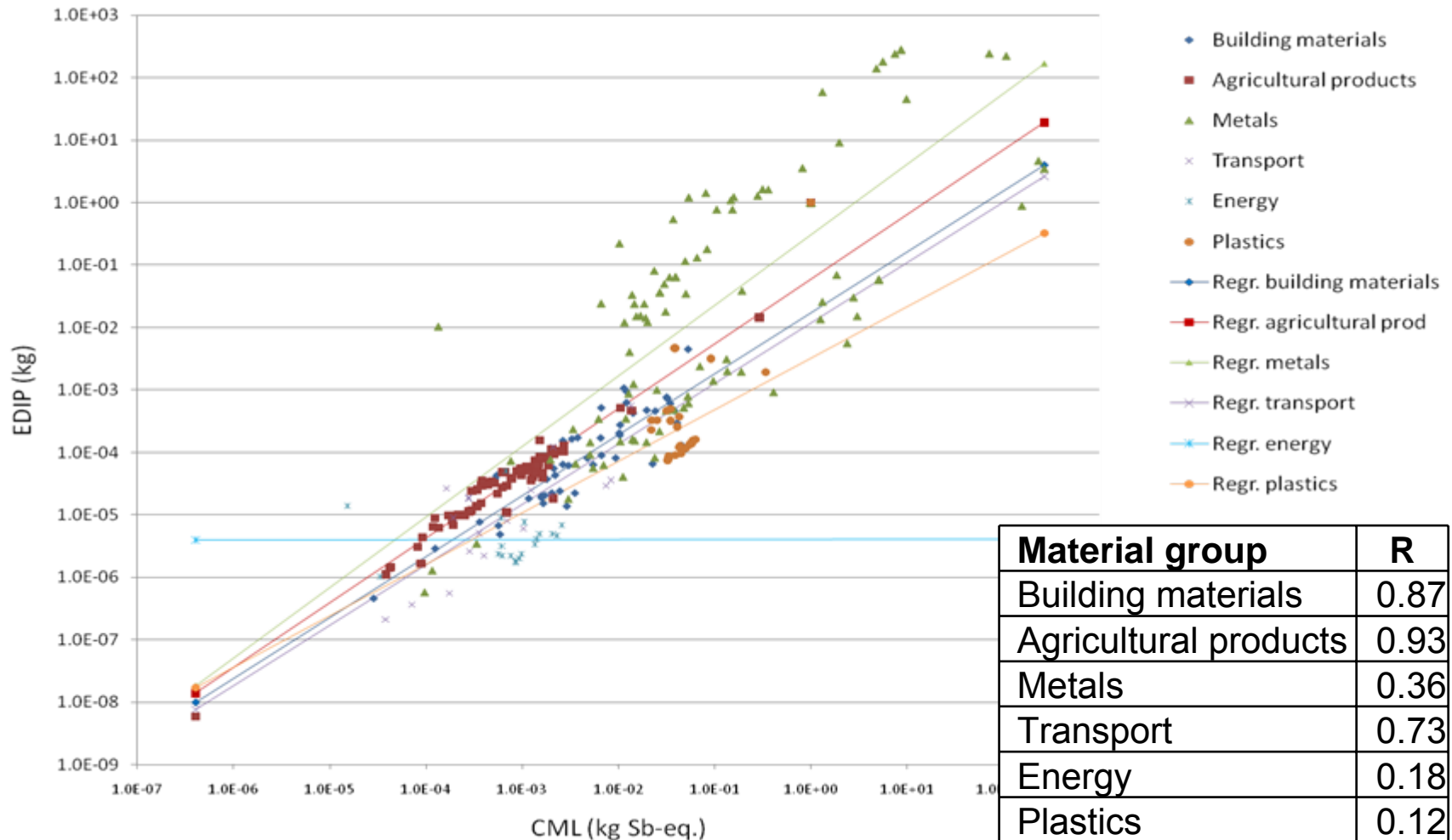
ReCiPe H – EI 99 H





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EDIP - CML





Results comparison:

- ReCiPe I - ReCiPe E
 - Ranking coefficients are high (0.9 to 1.0)
 - Minimal difference between product groups
 - Absolute values can differ up to a factor of 8, due to choices
- ReCiPe – EI99

ReCiPe has a 70x higher CF for coal extraction than EI99

 - EI99: low CF for coal, compared to oil and gas (substitution)
 - ReCiPe: same extraction costs for coal, oil and gas
- CML-EDIP
 - CML: fossil fuels driven (Oil, coal, gas)
 - EDIP: minerals driven (Manganese, nickel)
 - Missing substances in EDIP



Conclusions and recommendations

- Different methods have different visions
- When analyzing ReCiPe, differences in results are maximum a factor 8 among perspectives, what can influence weighting
- Ranking among methods and visions?
 - Among different methods, ranking can be influenced
 - Among visions for the same method, ranking is minimal influenced



Future research questions

Methodology improvements of ReCiPe 2008:

- Specific costs for coal extraction
- Mineral specific / mine specific mining
- Perspectives: Substitution to be included
 - Consistent time horizon
 - Future predictions for technology/costs

Perspectives:

- Discussion concerning value choices in resource depletion
- Better alignment between inventory and impact assessment
 - Individualist-Egalitarian HHV ↔ LHV
 - Coal and oil grades to be included (only coal included here)

Inventory
problem?



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Questions?



Different visions in LCA

	Individualist	Hierarchist	Egalitarian
Vision on nature	Robust	Tolerant	Vulnerable
Level of proof	Proven effects	Accepted effects	All effects
Timeframe	Present generations	A balance	Future generations
Vision on society	Economic output: market driven	Developments within limits of nature: authorities	Equality: Social driven
Manageability	Adapting	Controlling	Preventing



Grades of coal

- Antracite 34.1 - 33.3 MJ eq / kg
- Bitumous 30.11 - 28.8 MJ eq / kg
- Subbitumunous 22 - 20 MJ eq / kg
- Lignite 19 - 16 MJ eq / kg

Sources:

- Christopher Higman, Maarten van der Burgt (2008) Gasification, 435p.
- Nikolaï Vasilievich Kharchenko (1997) Advanced energy systems, 285p.



Costs of coal extraction

- Mining costs
- 20-30 \$/ton coal
- Transport costs
- 8-10 \$/ton coal

Source:

- Energy Information Administration: Statistical agency of U.S. Department of Energy, created in 1977
- www.eia.doe.gov



Mining costs

- Codelco: copper mines
 - 0,03 to 0,16 \$/kg (2004)



ReCiPe: Ranking coefficients

Ranking coefficients	ReCiPe I-H	ReCiPe I-E	ReCiPe H-E
Building materials	0.981	0.999	0.985
Agricultural products	0.995	1.000	0.996
Metals	0.995	0.998	0.994
Transport	0.991	1.000	0.991
Energy	0.903	0.986	0.930
Plastics	0.979	0.999	0.982



Product groups

Product group	Nr. processes
Building materials	49
Agricultural products	72
Metals	93
Transport	18
Energy	19
Plastics	24