Framing decision support for SME

Trends and perspectives of resource use

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The presentation

- Historical learning and actual policies on resource efficiency
- Global trends of resource use
- Goals and Strategies for sustainable resource management
- What governments and companies do
- Conclusions

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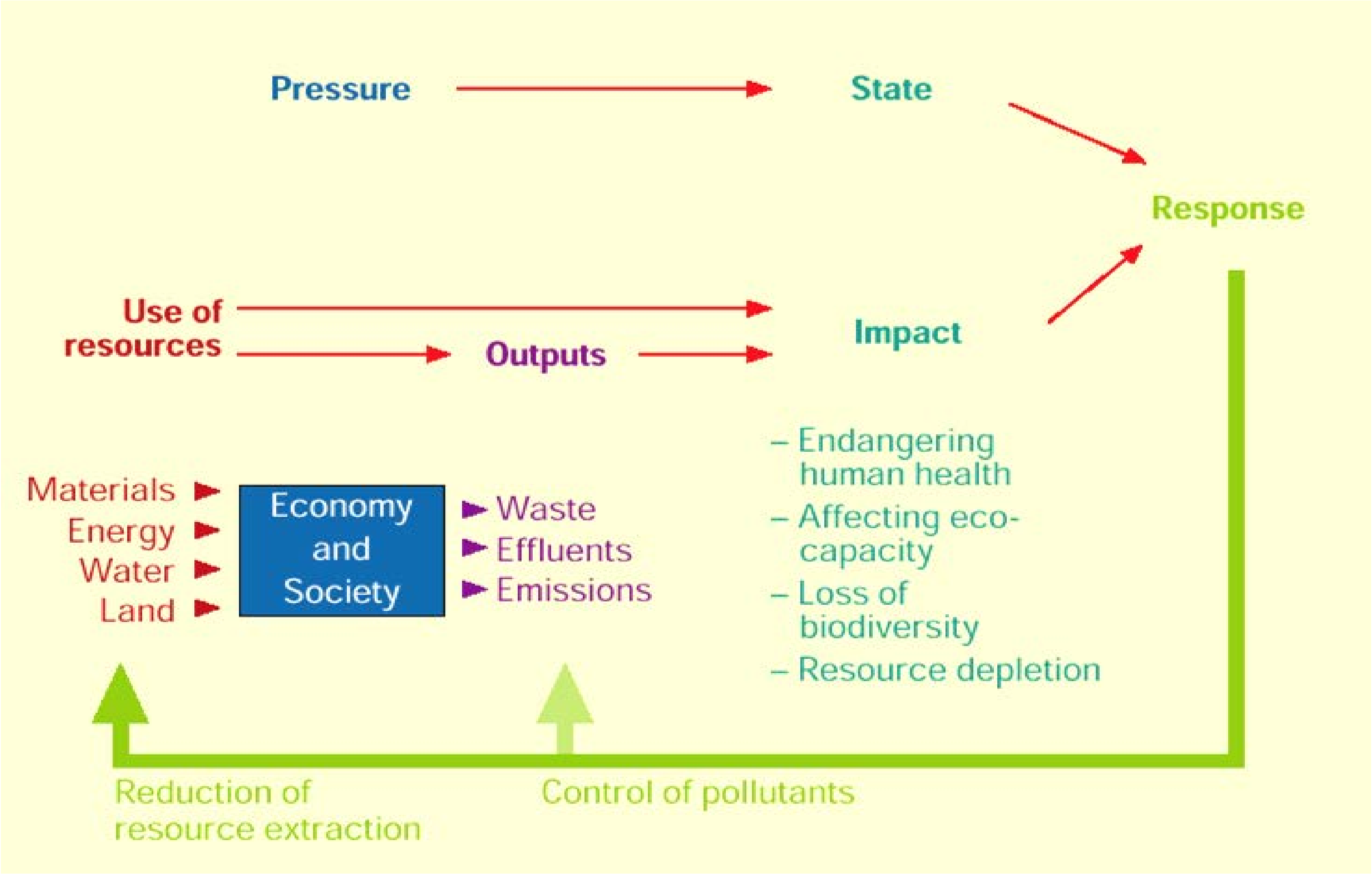
Background: Development of environmental policy in Europe

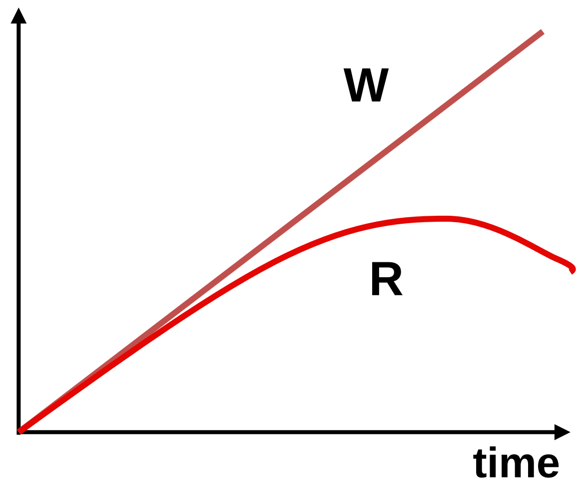
A History of learning and a widening perspective



Source: Loske et al. 1996

Decoupling of wealth generation and resource use

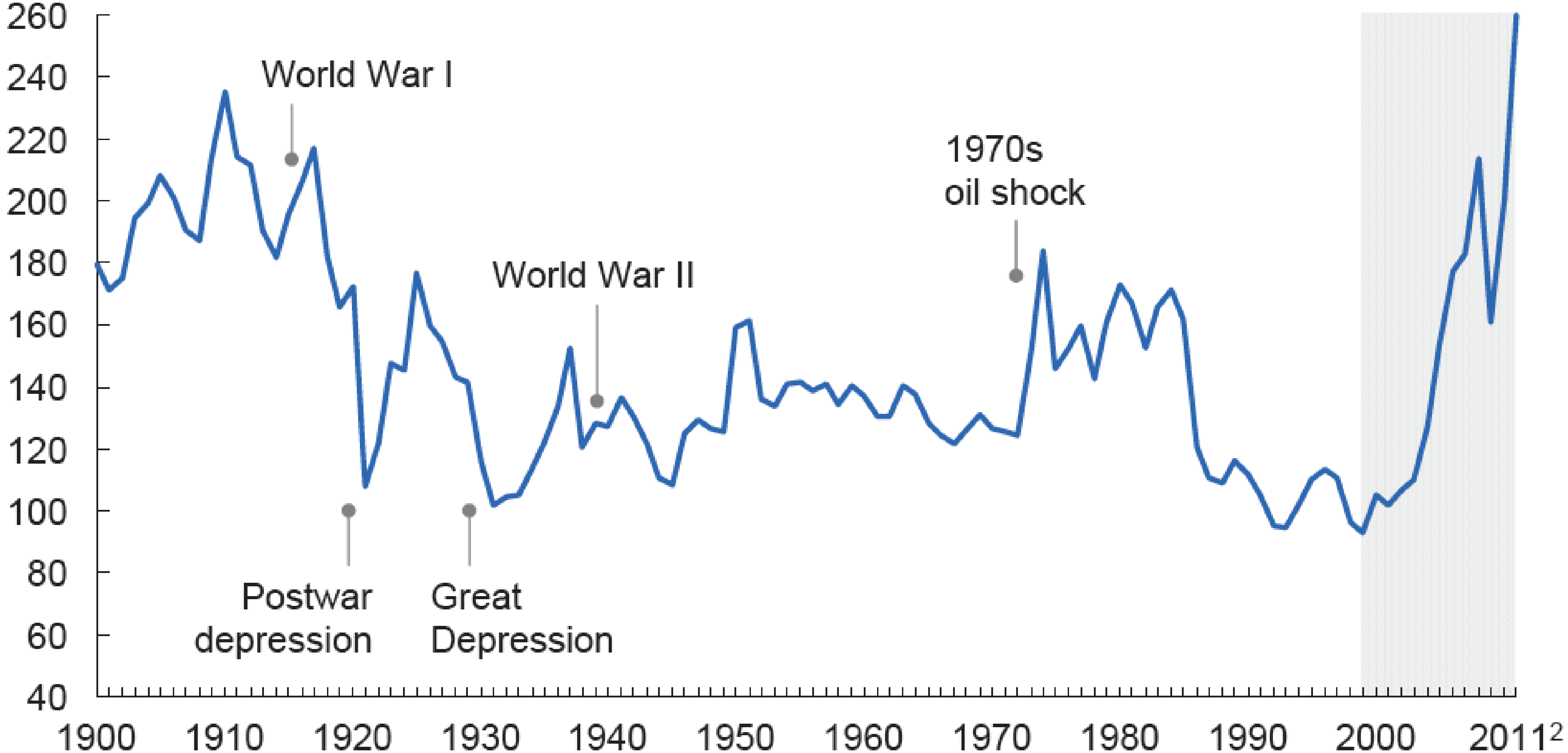
Policy goals and targets



- Factor X: Targets to increase resource productivity by factor 4-10 (Schmidt-Bleek 1992, von Weizsäcker 1995)
- Quantitative targets and measures:
  AT, D, DK, EST, FL, I, Japan, ROM, S, SLO, HUN, UK, China
- EU Commission: 3rd pillar of Raw Material Initiative (2008)
  Flagship Initiative for Resource Efficient Europe 2020 (2011)
  Roadmap for Resource Efficiency (2011)

Prices of raw materials increased with higher volatility

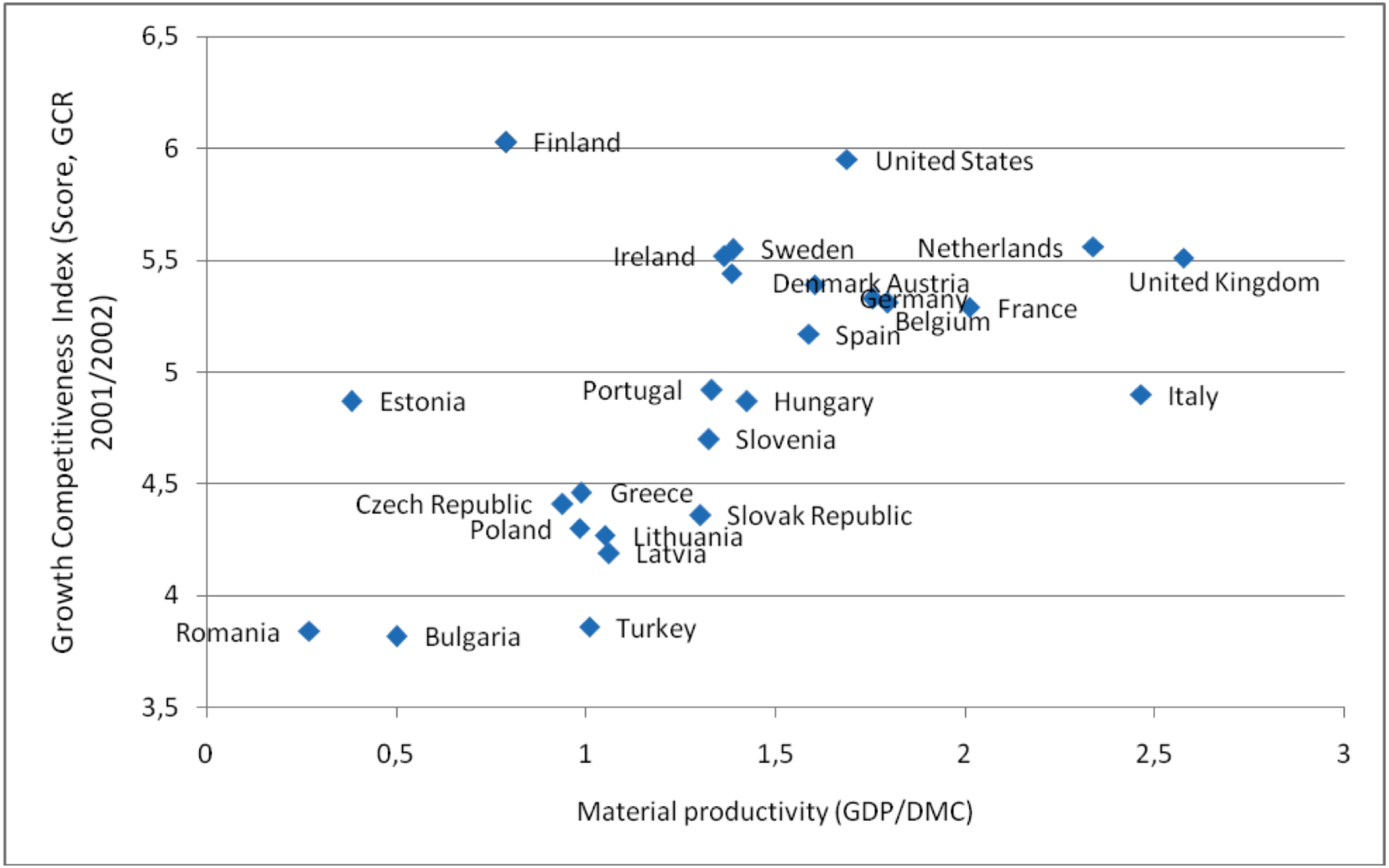
Commodity Price Index (1999-2001 = 100)



1 See the methodology appendix for details of the MGI Commodity Price Index.
2 2011 prices are based on average of the first eight months of 2011.

Quelle: McKinsey (2011) „Resource Revolution: Meeting the world´s energy, materials, food and water needs“

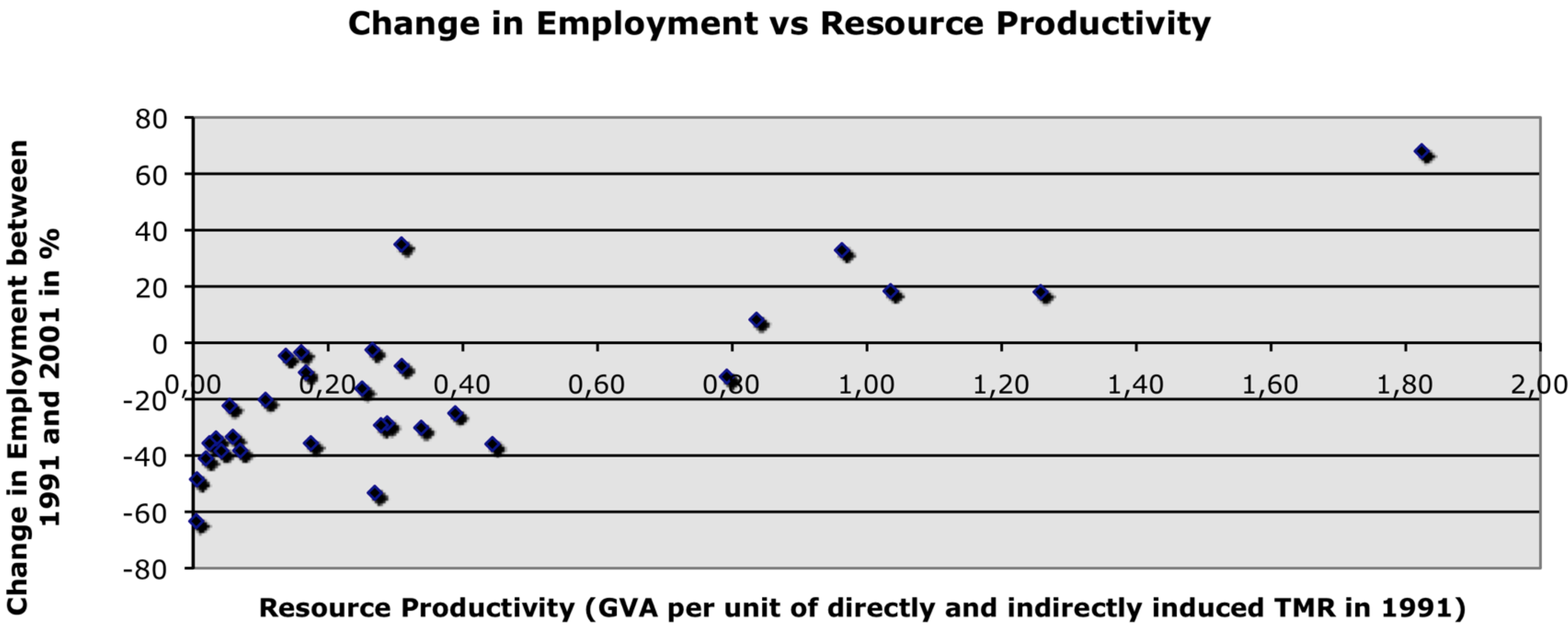
International competitiveness grows with material productivity



Note: GDP in PPP U.S. $; t-statistics and F-statistics significant with $p<0.05$; Source: Bringezu and Bleischwitz (2009)

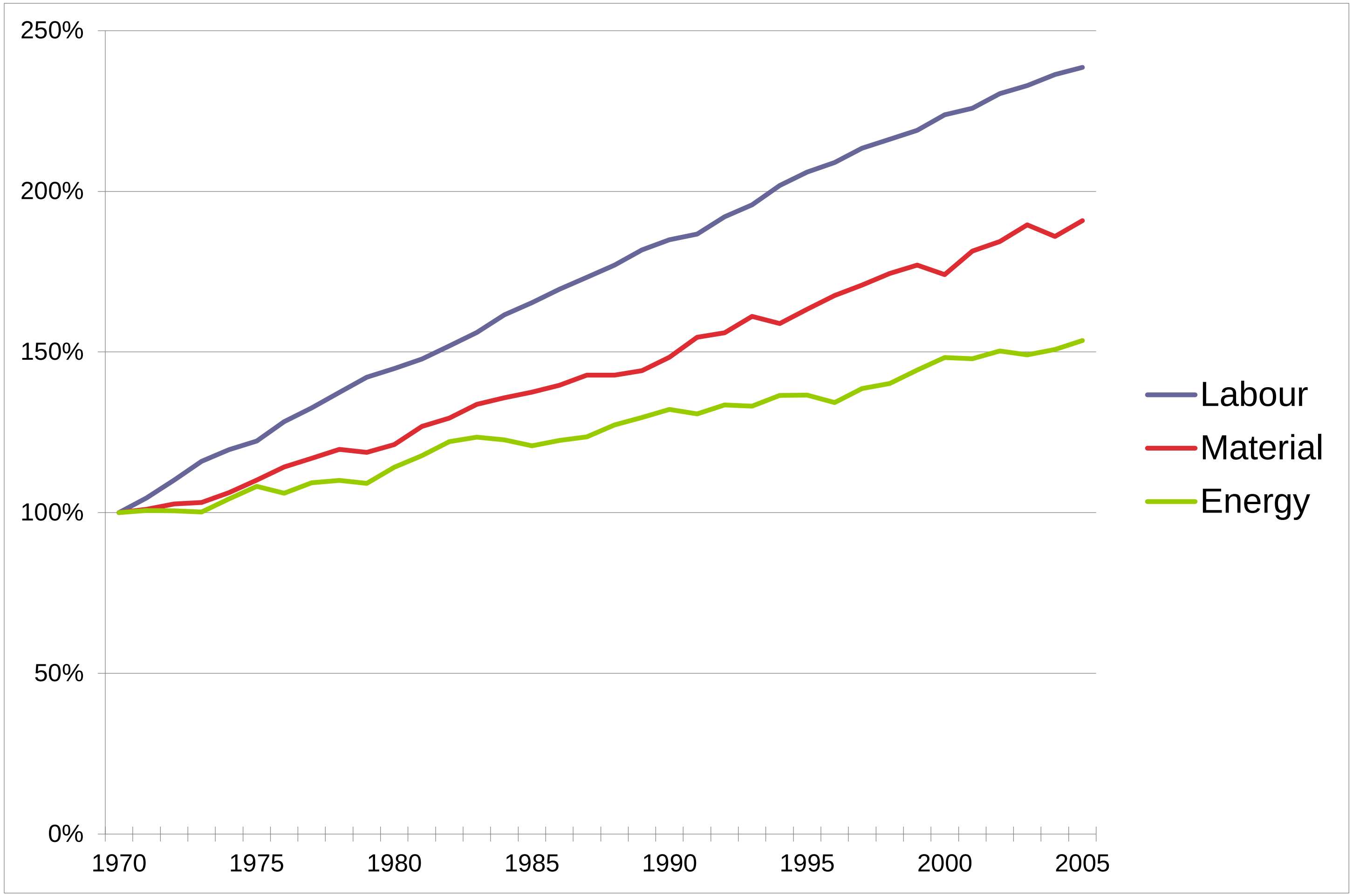
Employment chances rise with resource productivity of branches

Example of Germany



Note: Spearman rank correlation highly significant: $r_s = 0.6756$, $p<0.001$. Source: Bringezu et al. 2009

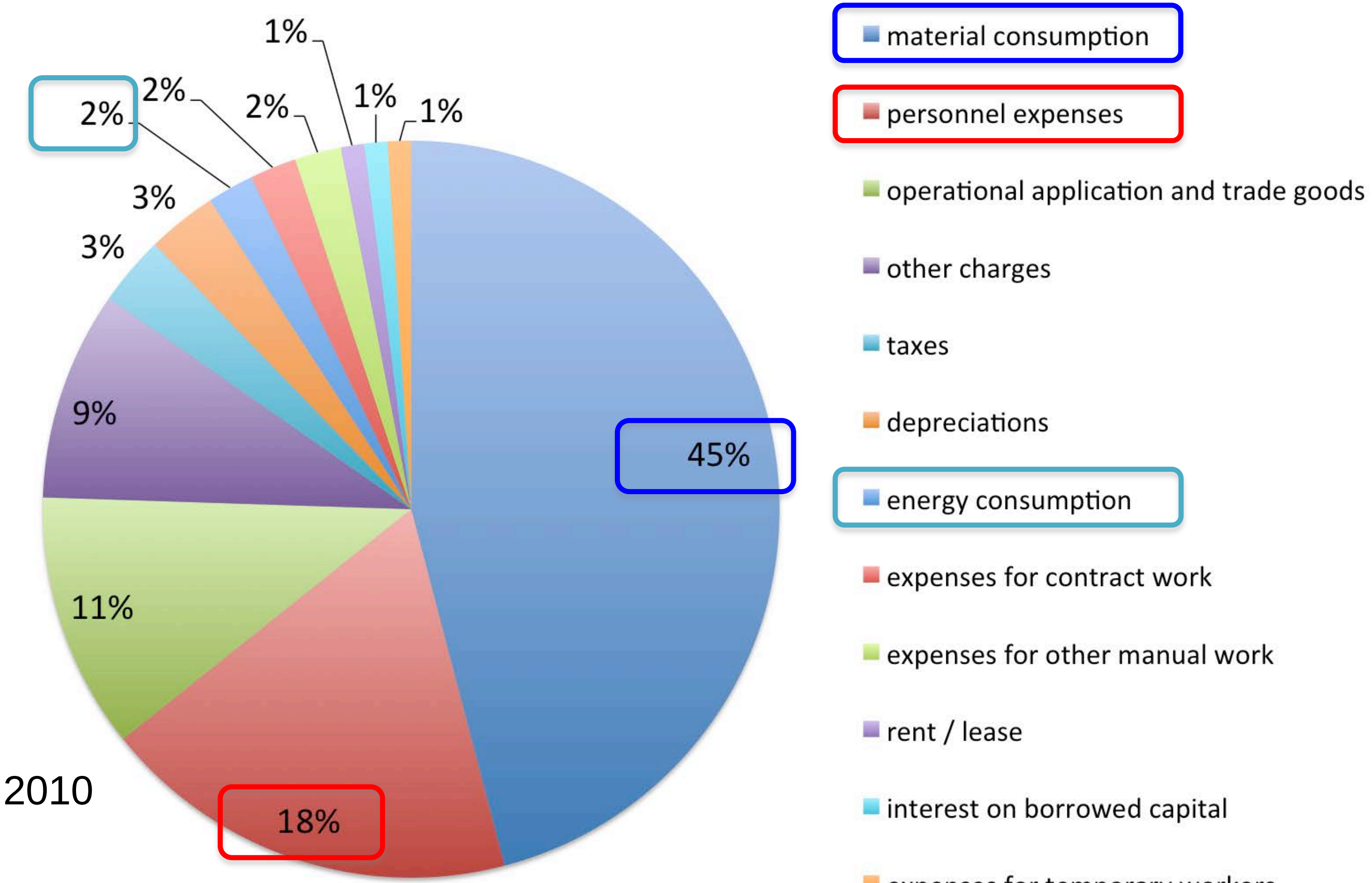
Labour, material and energy productivity have grown differently (EU-15)



Source: GDP + working hours: Conference Board and Groningen Growth and Development Centre, Total Economy Database, June 2009; Material: Eurostat statistics; Energy: International Energy Agency.

Cost structure of the manufacturing industry in Germany

Material costs dominating



Quelle: destatis 2012

Material efficiency measures in manufacturing

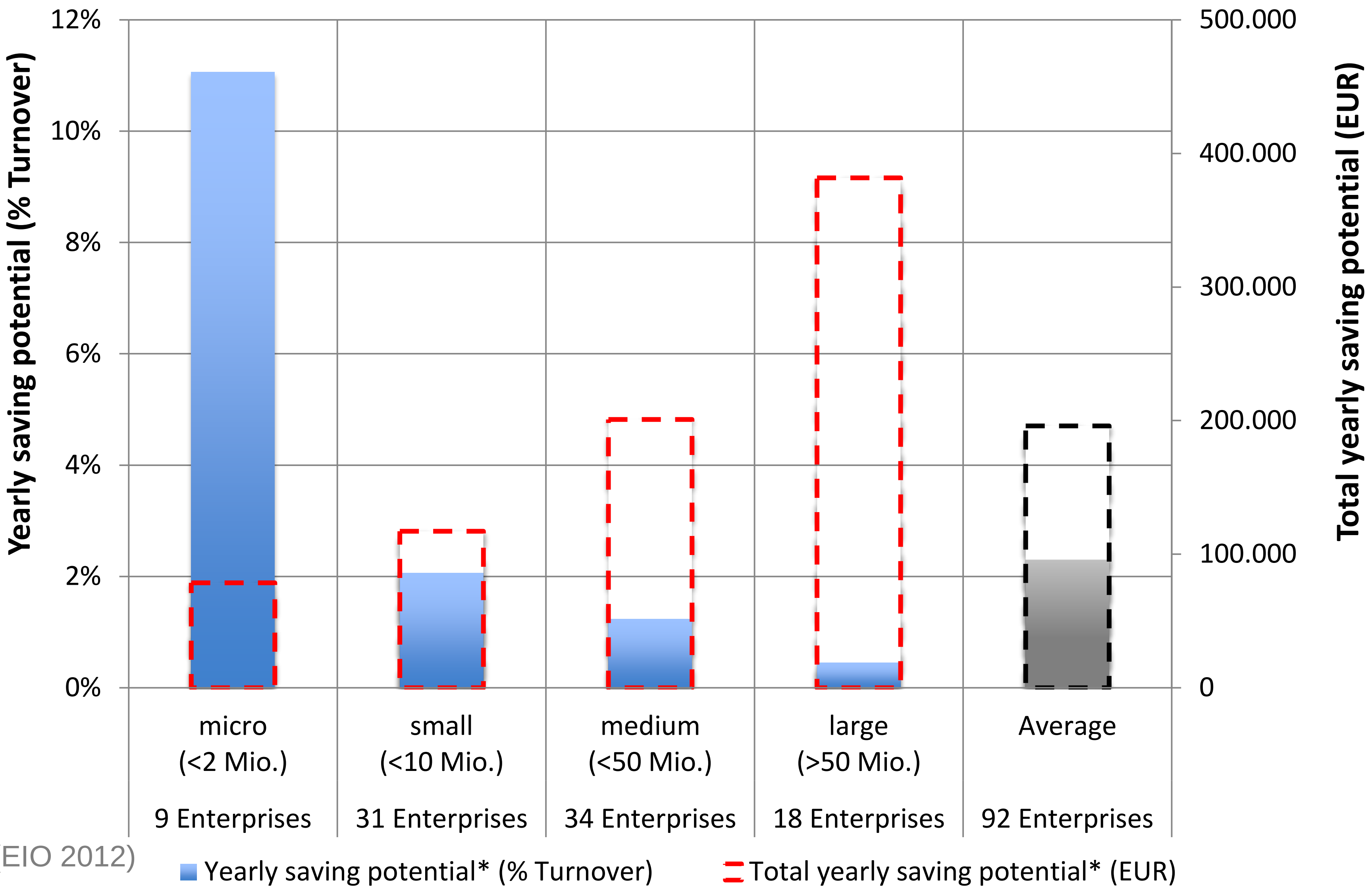
Cost saving potentials

Study	Yearly saving potential	Sample size, source, branches, country
Követ (2012)	**134.000 € to 412.000 €**	N=56, „Money back through the window“, Manufacturing, Hungary
BIS (2010)	**19.000 £ to 52.000 £**	N=403, ENWORKS, 8 sectors,, UK
Schmidt u. Schneider (2010)	**210.000 €**	N=569, demea, manufacturing; Germany
Schröter (2012)	**7 % of material purchases**	N=1,484, „MidP“, manufacturing; Germany
EIO (2012)	**196.000 €**	N=92, demea, 5 sectors of manufacturing; Germany

Quelle: Eco Innovation Observatory (2012)

Material efficiency measures in manufacturing

Potential savings (demea)



(EIO 2012)

Material efficiency measures in manufacturing

Investments and saving potential

(demea)

- **Average by company**:
  - **129,000 €** one-off investments
  - **196,000 €** yearly saving potential

Investments and Saving Potential	Sample size	One-off Investments		Yearly Saving Potential	
		EUR	% Turnover	EUR	% Turnover
Fabricated metal products, except machinery and equipment	28	85,000	3.6%	120,000	3.9%
Furniture and other manufacturing	14	79,000	0.3%	327,000	1.6%
Food products and beverages	13	429.000*	2.8%	247,000	1.2%
Machinery and equipment n.e.c.	27	81,000	0.7%	207,000	1.9%
Rubber and plastic products	10	53,000	0.5%	132,000	1.5%
<2 Mio.	9	43,000	9.3%	78,000	11.1%
<10 Mio.	31	103,000	1.8%	117,000	2.1%
<50 Mio.	34	129,000	0.5%	201,000	1.2%
>50 Mio.	18	216,000	0.3%	382,000	0.4%
<10 Employees	5	49,000	12.5%	87,000	11.2%
<50 Employees	27	55,000	1.9%	108,000	3.3%
<250 Employees	44	153,000	1.0%	203,000	1.4%
>250 Employees	16	214,000	0.3%	358,000	0.4%
Sum / Average	**92**	**129,000**	**1.8%**	**196,000**	**2.3%**

Source: EIO 2012

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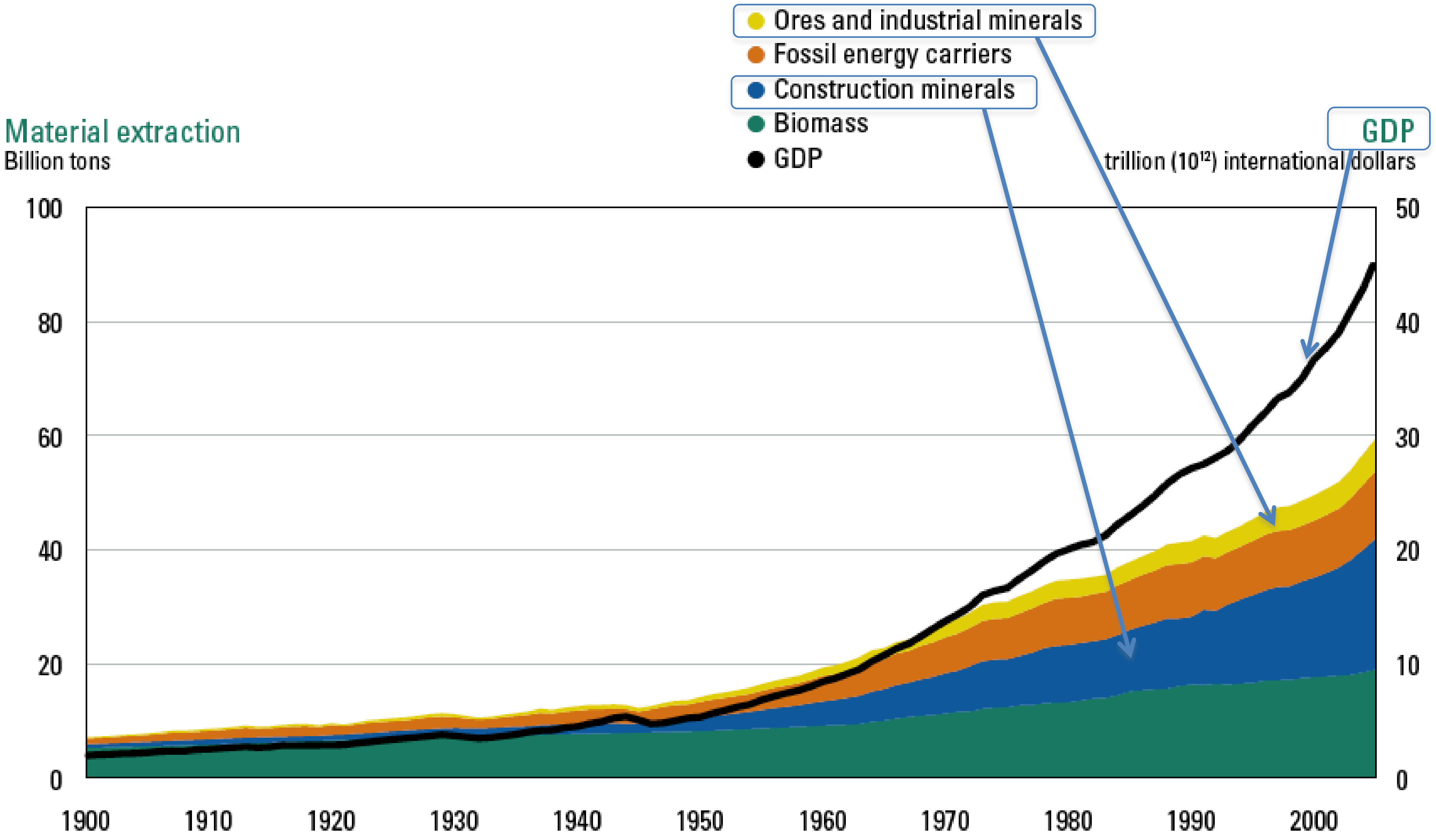
World GDP decouples from resource use

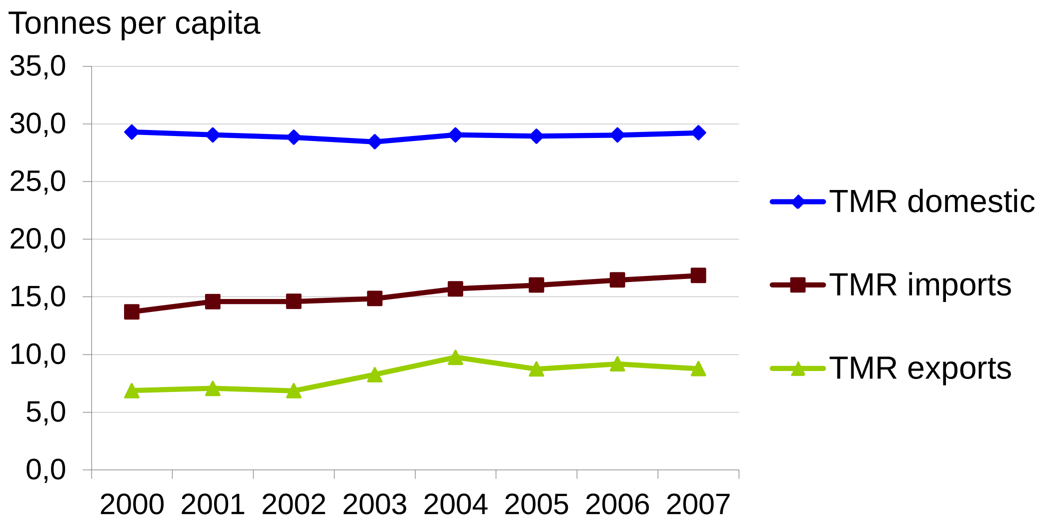
Global material extraction used 1900-2008



Source: UNEP (2011) after Krausmann et al. 2009

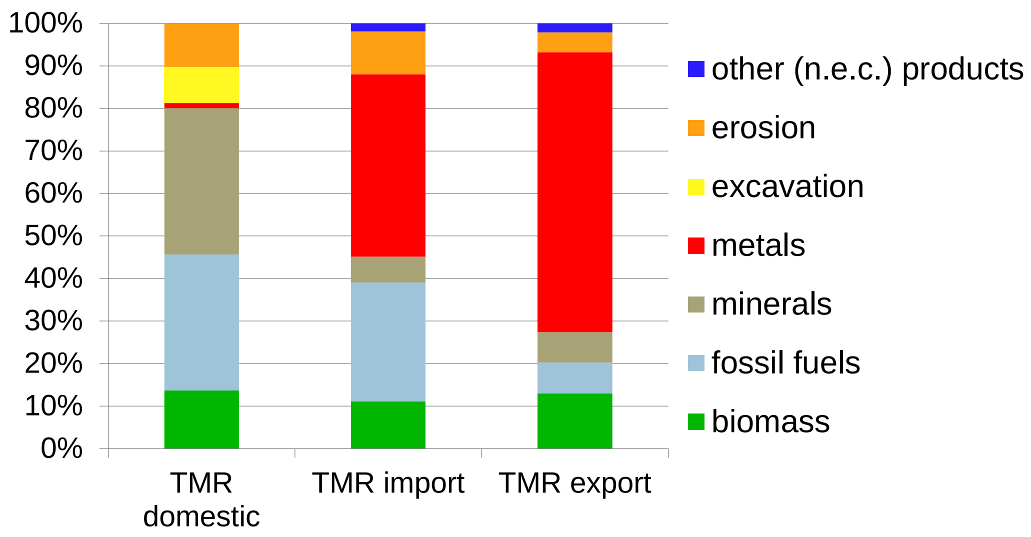
Global resource use of the EU is growing

Total Material Requirement TMR



- EU increasingly uses resources outside

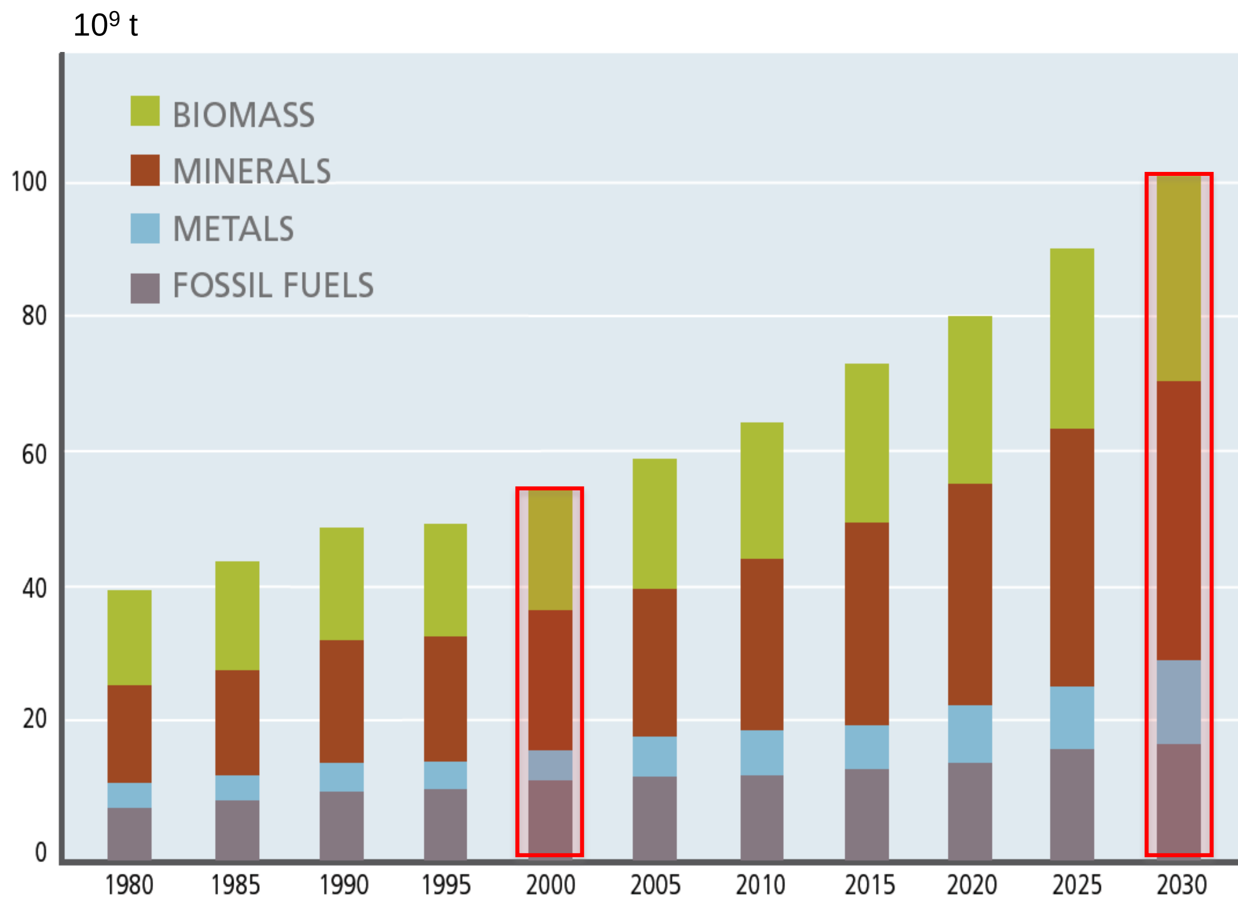
- Metal minerals determine TMR of imports and exports



Sources: Schütz/Bringezu, Eurostat

Growing global resource use

- Projected **doubling of used extraction** from 2000 to 2030
- Unused extraction adds double to triple amount*

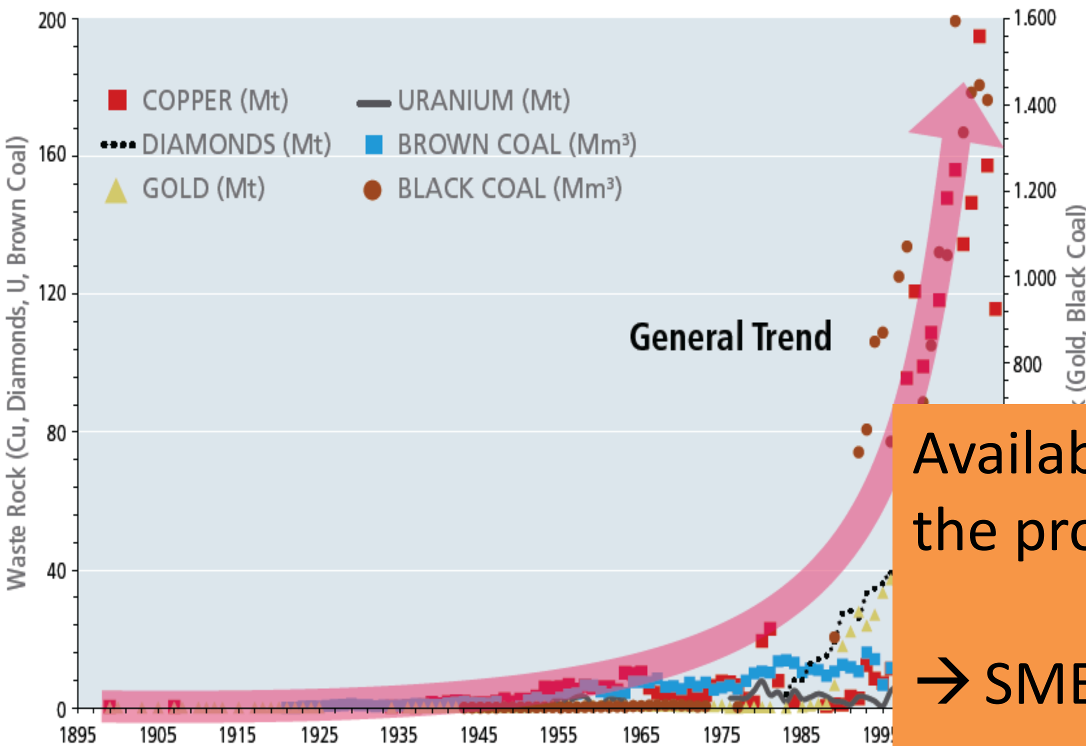


Source: Aachen Foundations based on SERI/FoE 2009

***not shown: e.g. in 2000: 50 bill t used plus 95 – 130 bill t unused extraction**

Growing environmental impacts by mineral extraction:

Purposeful excavation which remains per se unused



Source: Mudd 2009, Australia

Availability of resources is not the problem but conflicts on land use

→ SMEs should check low risk sourcing strategies

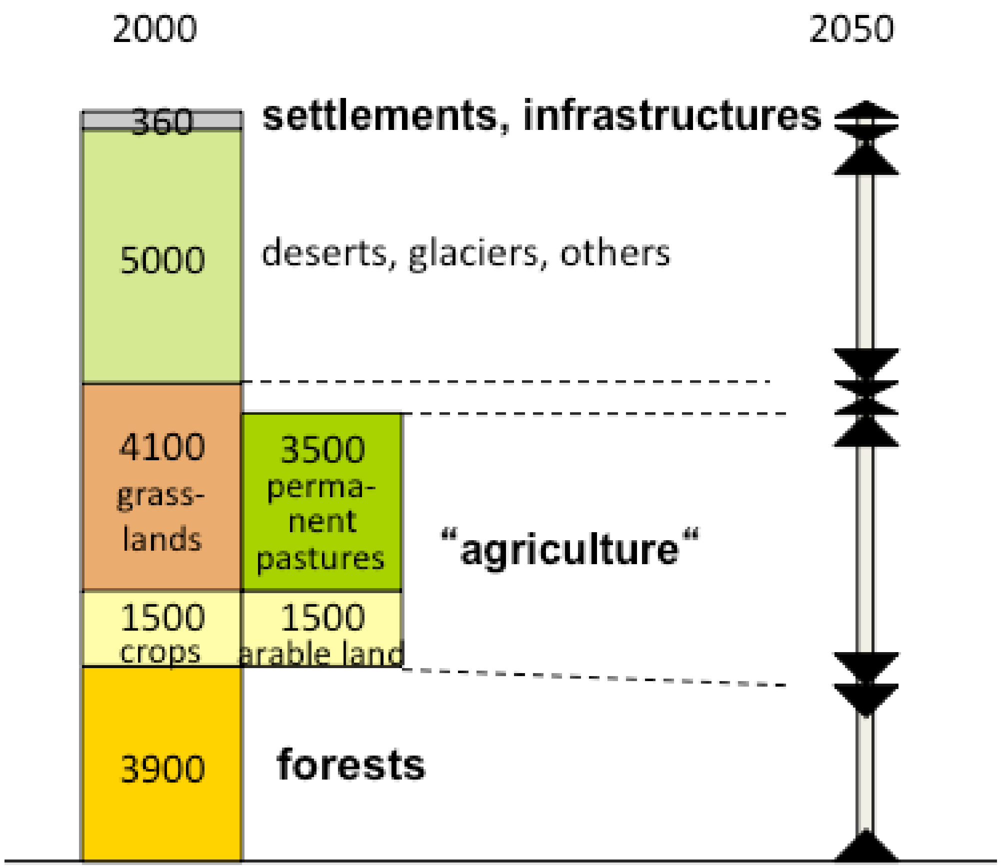
Foto Edgar Llamoca

- "Unused extraction" grows
  - ➢ more waste, water distraction, landscape change

Global trends

Dynamics of land use change

- Around 15 billion ha of land worldwide
- Around 30 % used for agriculture
- Built-up land expands (often at the expense of agriculture)
- Agriculture expands at the expense of forests and savannahs, especially in the tropics
- Around 13 Mha of forests per year were lost over the last 5 decades



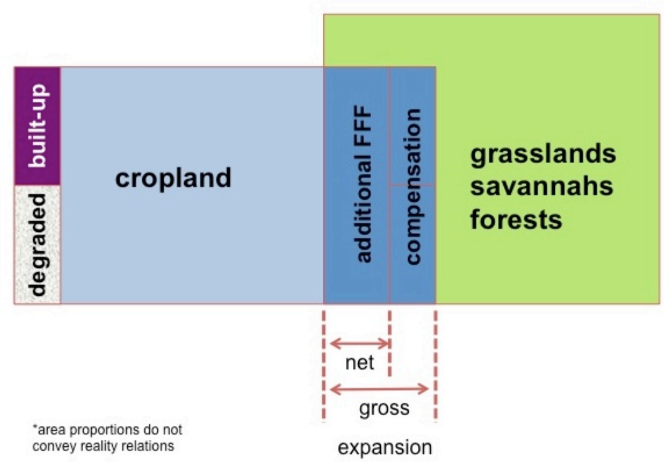
Major types and trends of global land use and land cover (Mha)

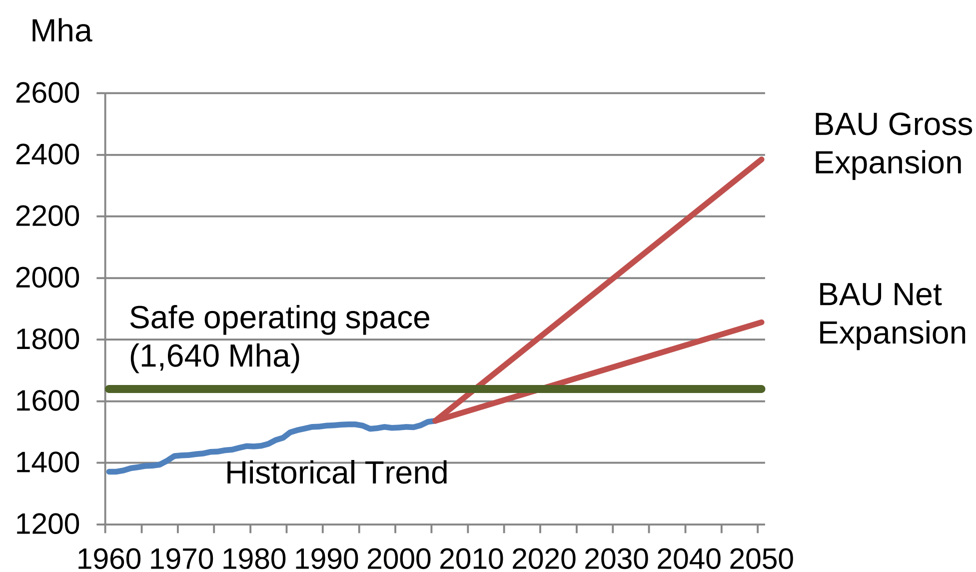
Source: Bringezu and Bleischwitz 2009

Global land use change: growing pressure by demand for crops

- Demand for food and non-food biomass from cropland boosts
- Fertile soils are lost
- Expansion of cropland mainly in the tropics into grasslands and forests
- Result in more GHG emissions and losses of biodiversity
- Safe Operating Space value of 0.20 ha/person exceeded by BAU

Net and gross expansion of cropland





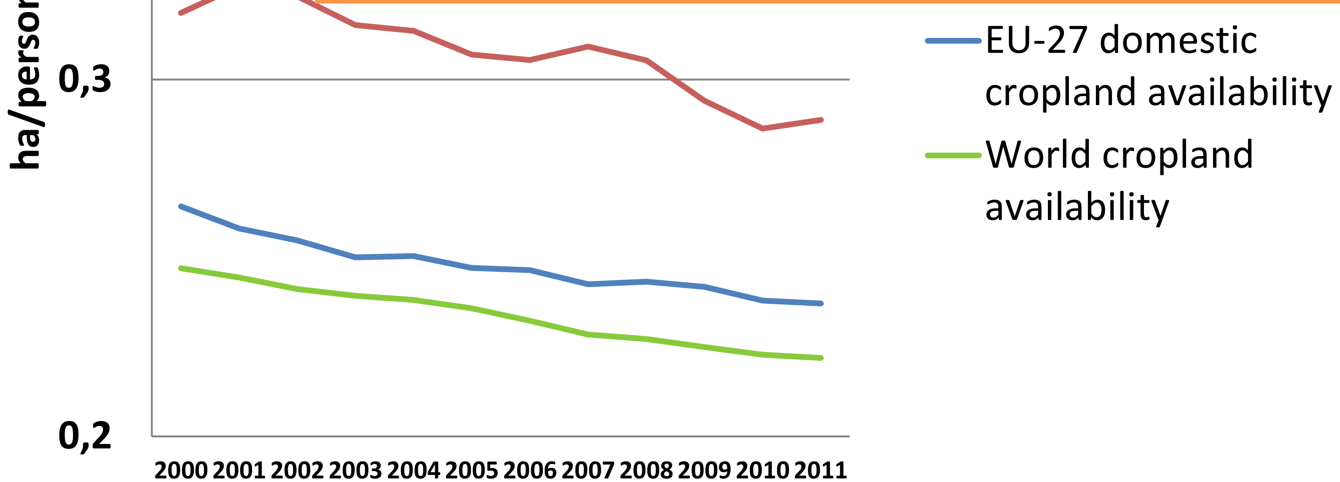
EU net importer of cropland

Consumption exceeds SOS

Certification of biofuels cannot prevent land use change

→ SMEs should avoid non-food biomass supply from crops (1st gen "bio"fuels, "bio-"materials)

- EU-27 used 22% more cropland than domestic cropland area in 2011
- EU-27 used 30% more cropland than the globally available per person cropland of the world population in 2011
- The consumption exceeds 0.20 ha/person



Use of global cropland by the EU-27 for the consumption of agricultural goods

Source: H. Schütz – Wuppertal Institute, based on Bringezu et al. 2012

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Goal of Sustainable Resource Management

Suggestions for SDG by a think piece of the International Resource Panel

Possible Goal

Efficient use of natural resources in an equitable and environmentally benign manner for human well-being in current and future generations.

Possible Targets

Double the rate of yearly productivity increase

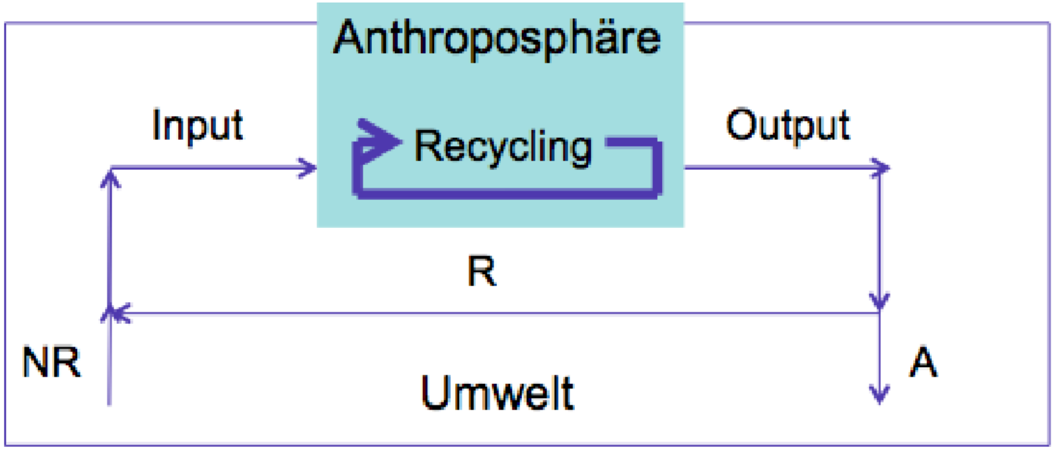
Keep resource consumption within Safe Operating Space

Possible Indicators

the Four Footprints and relations to GDP

- ***Materials***
- ***Land***
- ***Water***
- ***GHG emissions***

The goal from a systemic perspective
Criteria for a sustainable socio-industrial metabolismus



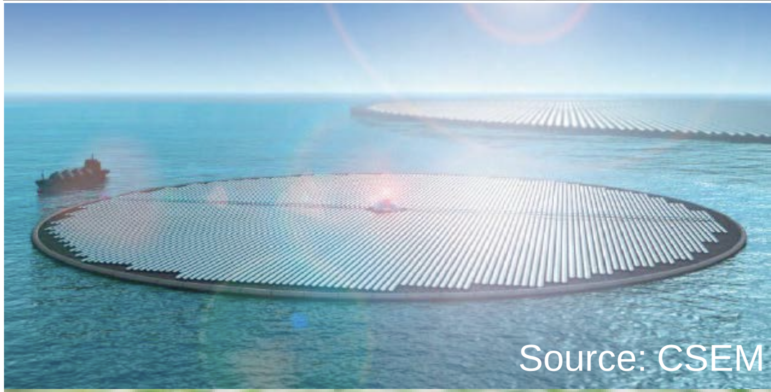
1. Material supply is largely based on recycling within the anthroposphere
2. Energy supply comes from renewable sources (solar, wind etc.)
3. Material Input and Output stay within safe levels
4. The anthroposphere must not oust the bio-geo-sphere (controlled growth)

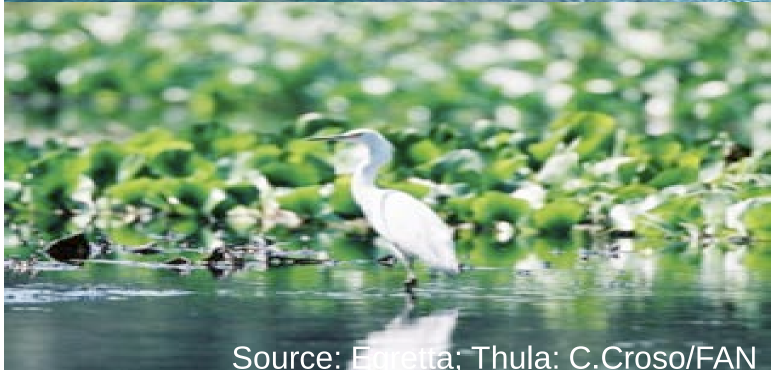
Four key strategies for a sustainable resource management

- **Resource efficient and recycling based industries**
- **Steady stocks societies**
- **Solarized infrastructures**
- **Balanced bio-economy**

Source: Bringezu 2009

Source: ETH

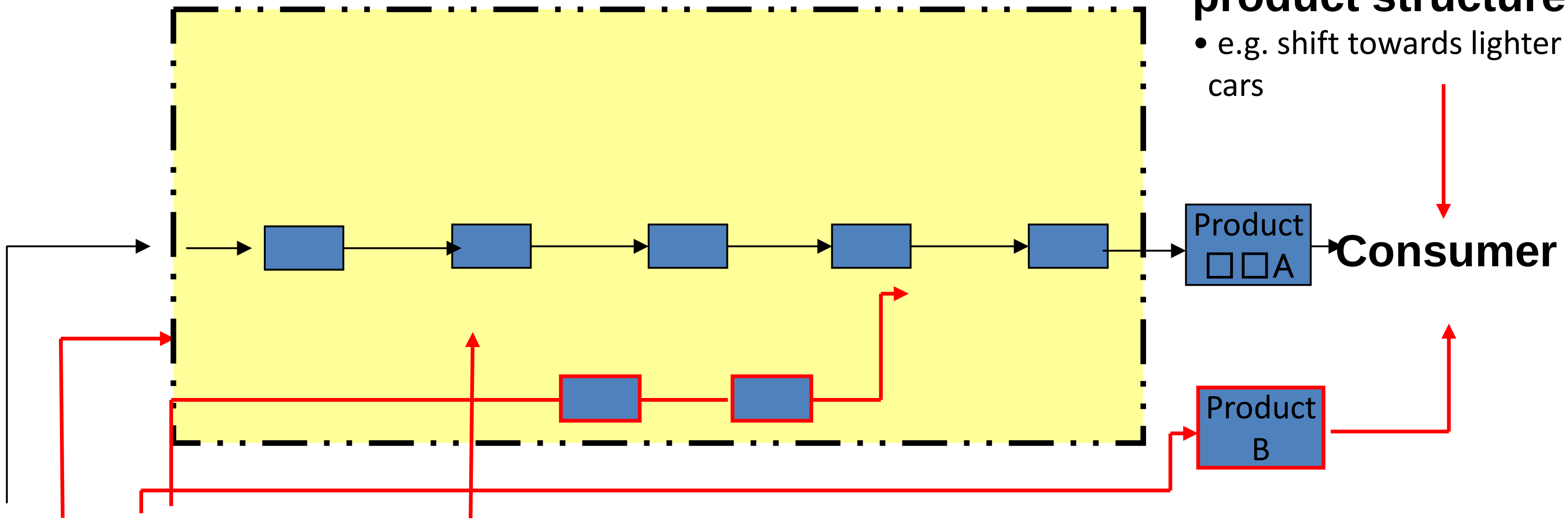

Source: CSEM


Source: Egretta; Thula: C.Croso/FAN

Where are the greatest potentials for resource efficiency along the production chain? The case of automobiles

4b.Changes in product structure

- e.g. shift towards lighter cars



1. Extraction

- **depends on location and technologies of extraction**

2. Material Efficiency

- **10-15% reduction**

3. Substitution

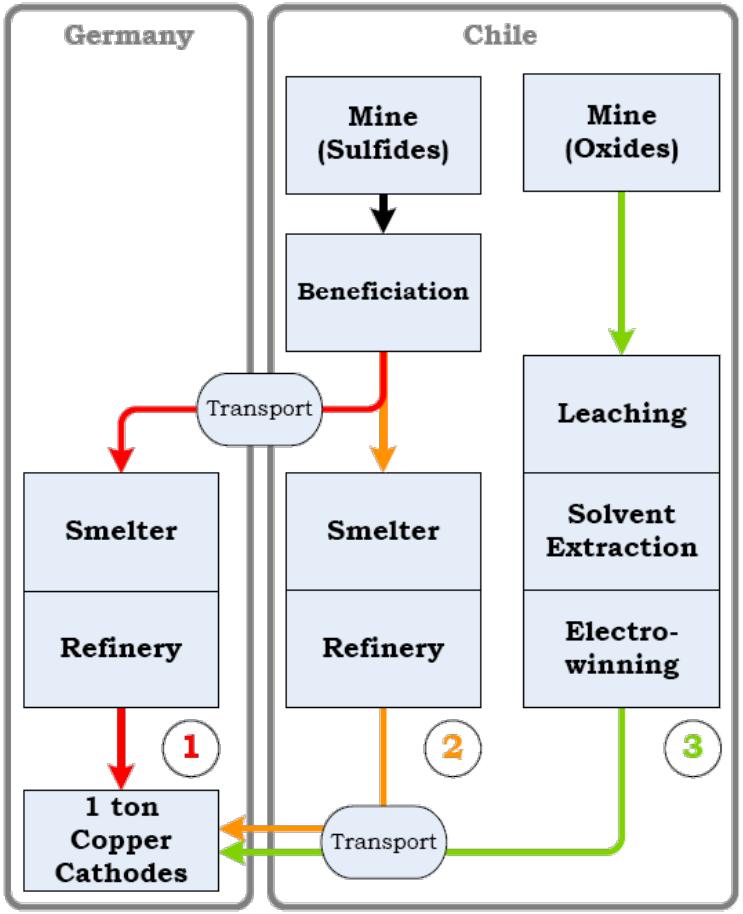
- **e.g. aluminium vs steel**
- **burden shifting?**

4a. Changes in product design

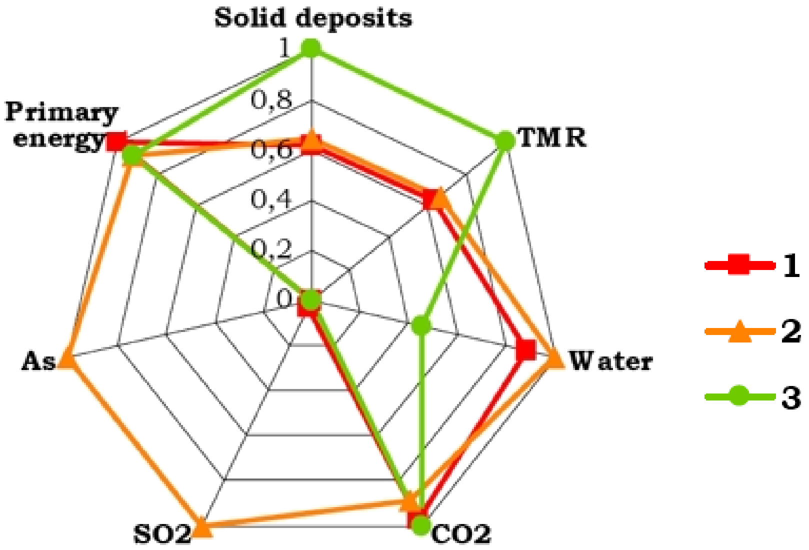
- **e.g. new forms of car design**
- **Greater potentials?**

Options to improve the environmental profile of raw materials

The example of copper in Chile and Germany



Source: Schüller, Estrada, Bringezu 2008



→ Existing mining, smelting and refinery processes can be improved

→ EU refineries and manufacturing can source from supply chains and regions with low environmental burden

Efficiency increase in production and logistics

Examples of material, waster and fuel savings

Upholstery
Paint use: - 20%
while enhancing quality

Production (
Cleaning wa

Scoure: Efficienc
Material Efficien

Beverages
Cleaning water: ca -40%

Pipe production Re
cutings +20%

→ When companies check

- all inputs:
  - materials
  - water
  - energy
- outputs:
  - waste
  - waste water
  - emissions to air

→ They will find options for savings

Where are the highest potentials for resource savings?

Substitution: Example of car manufacturing

Golf A4

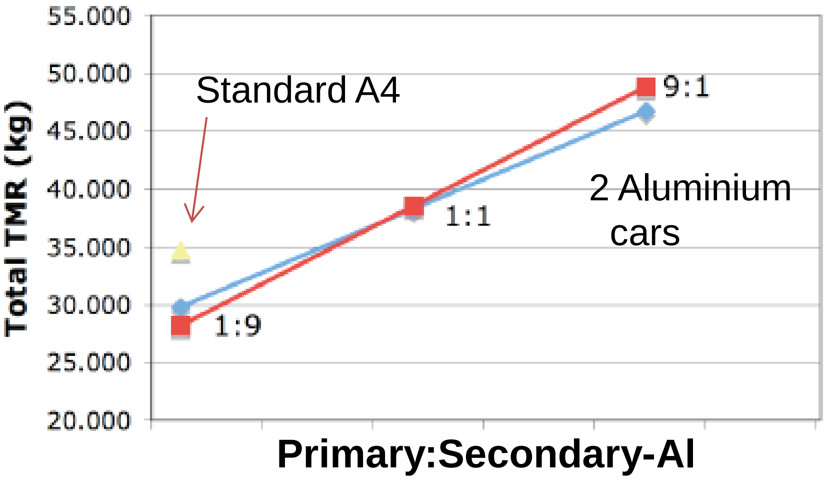
Aluminium vs Steel

Depends on relation of ore vs. recycling based Aluminium

1:9 15-19% savings of TMR

1:1 -9% to – 11%

9:1 -34% to – 41%



v.d. Sand et al. / WI 2007

- Only recycled aluminium requires less resources

- Problem:

a) RC Aluminium for cars only suitable for cast parts

b) No economy-wide savings as long as material input higher than total waste output

→ Material substitution may lead to problem shifting

Changing product design offers greatest potential for resource savings

TMR savings related to current German fleet production

Source: Wikimedia – Sven Storbeck

100% Lupo → **31%** savings

Source: Wikimedia – LSDSL

100% Loremo → **54%** savings

Source: ETH

100% Pac Car → **Up to 89%** savings
(technological extreme)

→ Profound changes towards dematerialized design would offer significant potentials for resource and climate protection

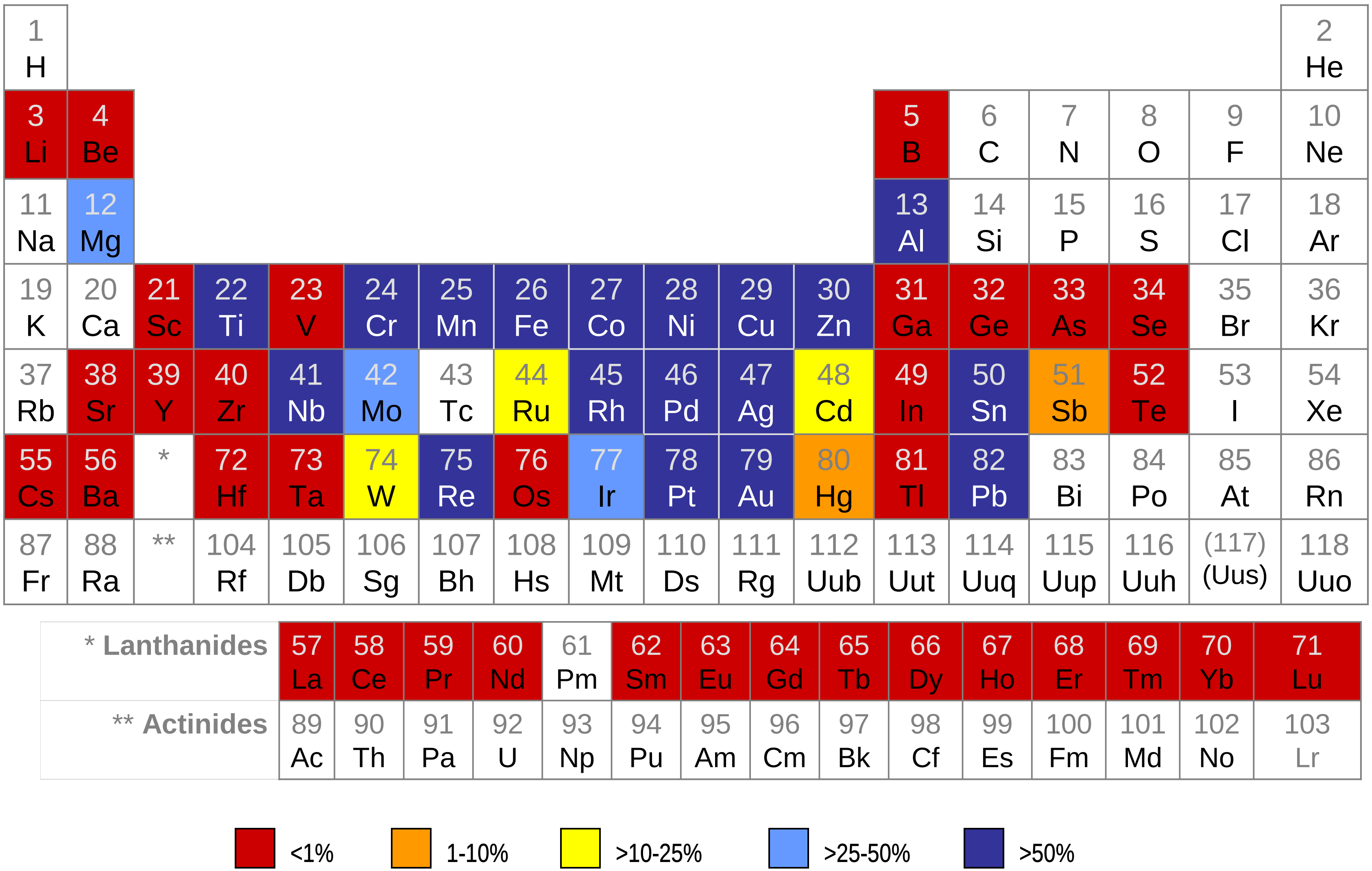
Europe imports most of the ores used from other regions

The example of iron ore from Brasil

Primary material (TMR)
per tonne of steel:
8.1 t/t blast furnace
1.5 t/t recycling

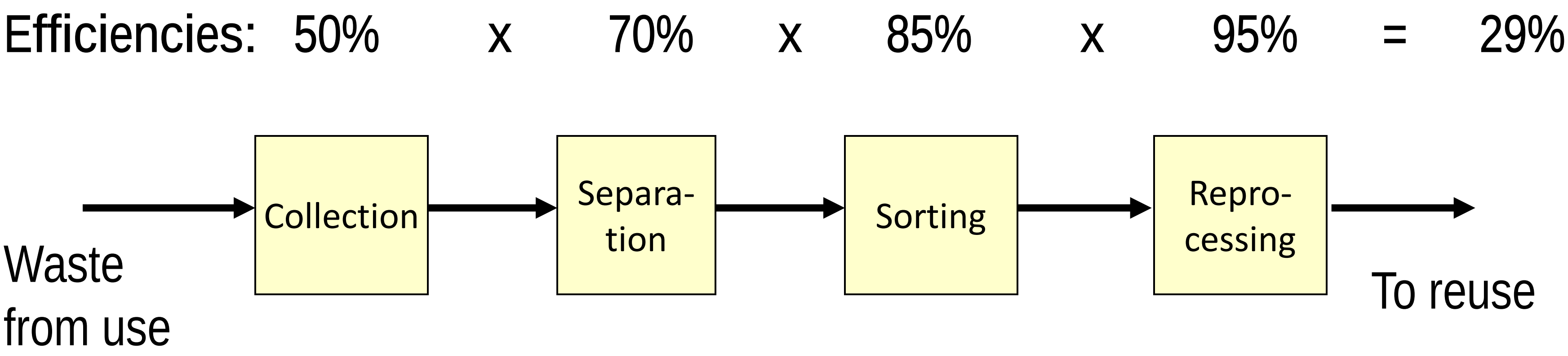
→ Recycling can reduce the ecological rucksack significantly

Global Post-Consumer Recycling Rates are still rather low



Source: Graedel et al., 2011

Example of why End-of-Life Recycling Rates are often low

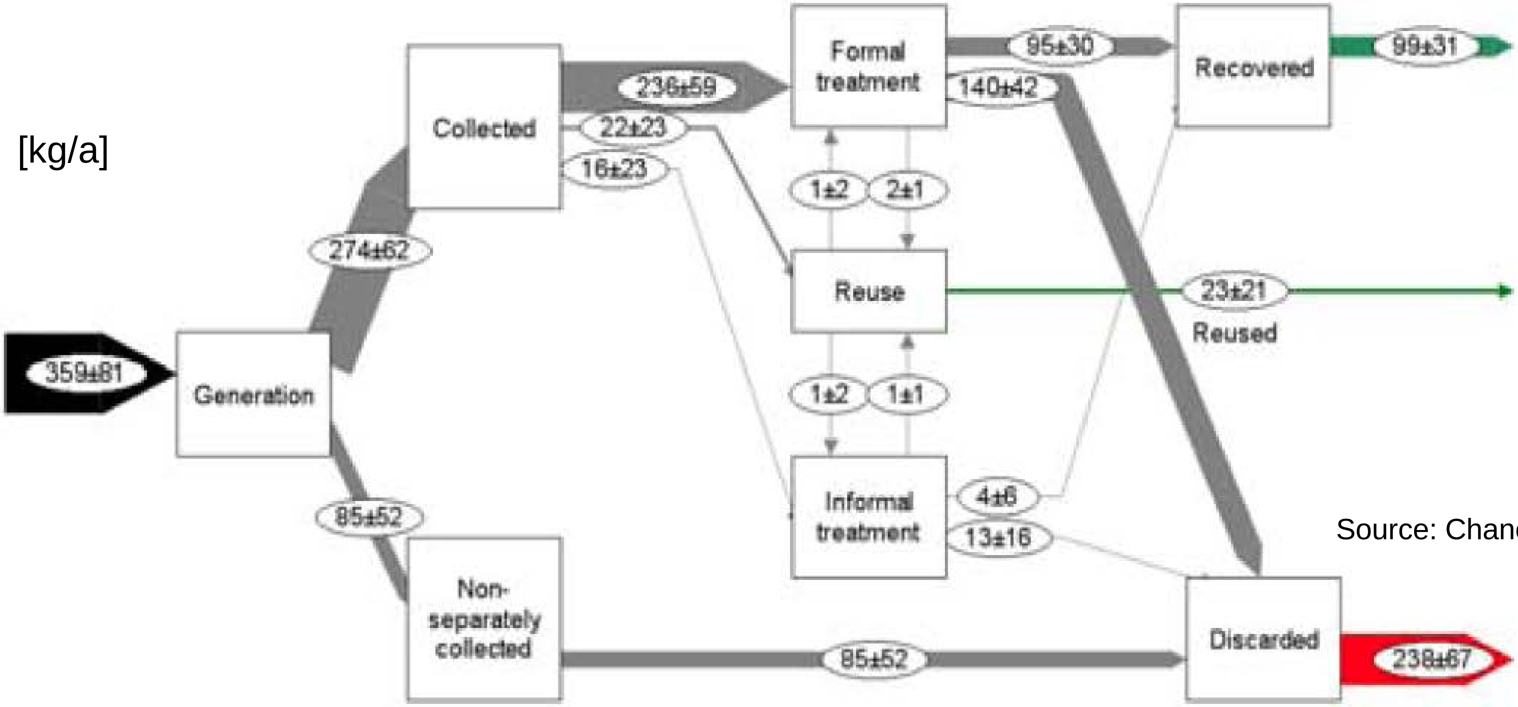


While technologies for recycling may be advanced, institutions managing waste to resources are often poor

Gold from WEEE: PCs and Laptops

Germany 2007

[kg/a]



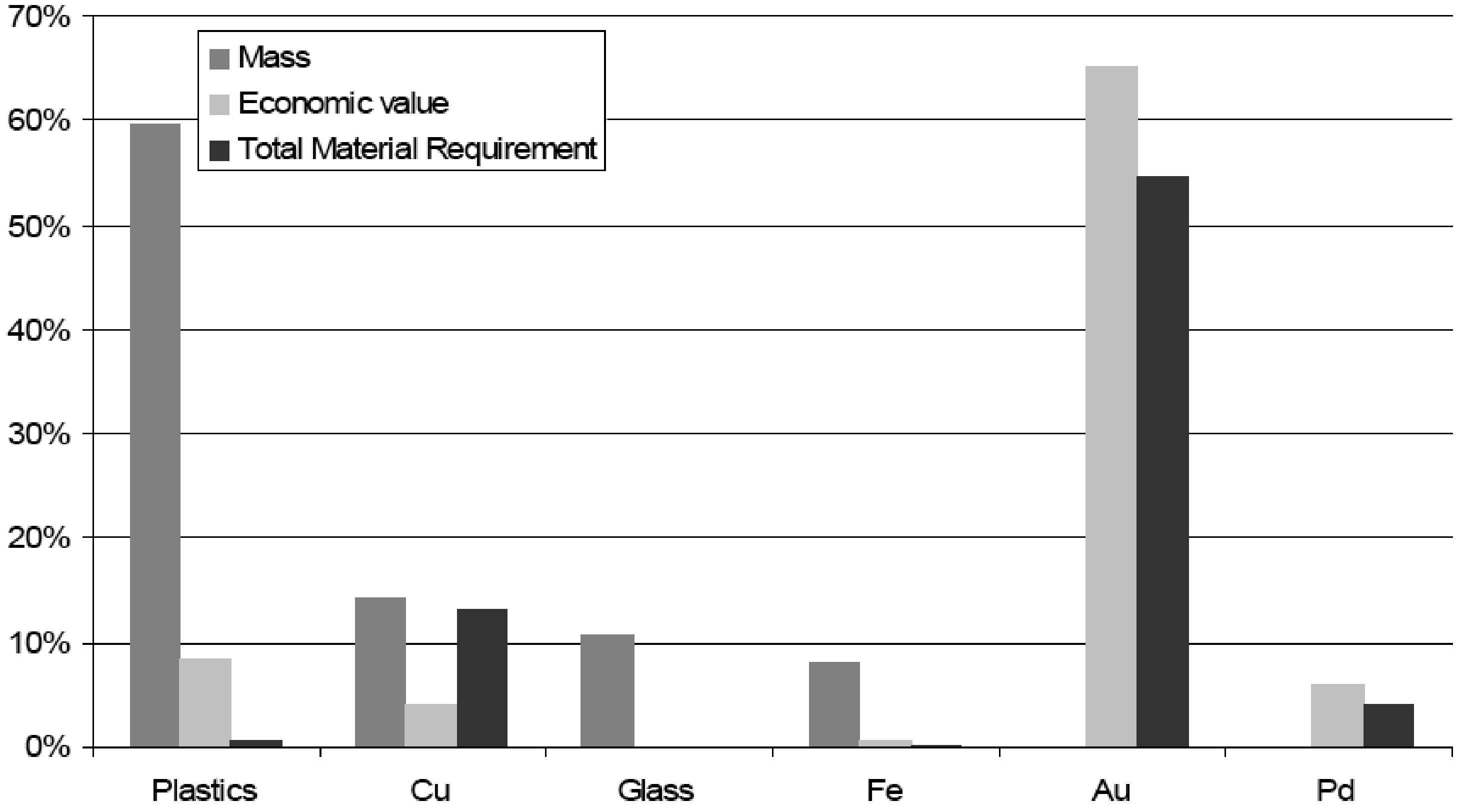
Source: Chancerel and Rotter 2009

- Separate collection and sorting still poor
- While recovery from sorted waste was nearly 100%, the overall recycling rate was 28%
- In particular SMEs still dispose their computers as normal household waste, due to data security concerns

→ a business case

Waste regulations still based on direct mass

The example of mobile phones shows that this may be misleading

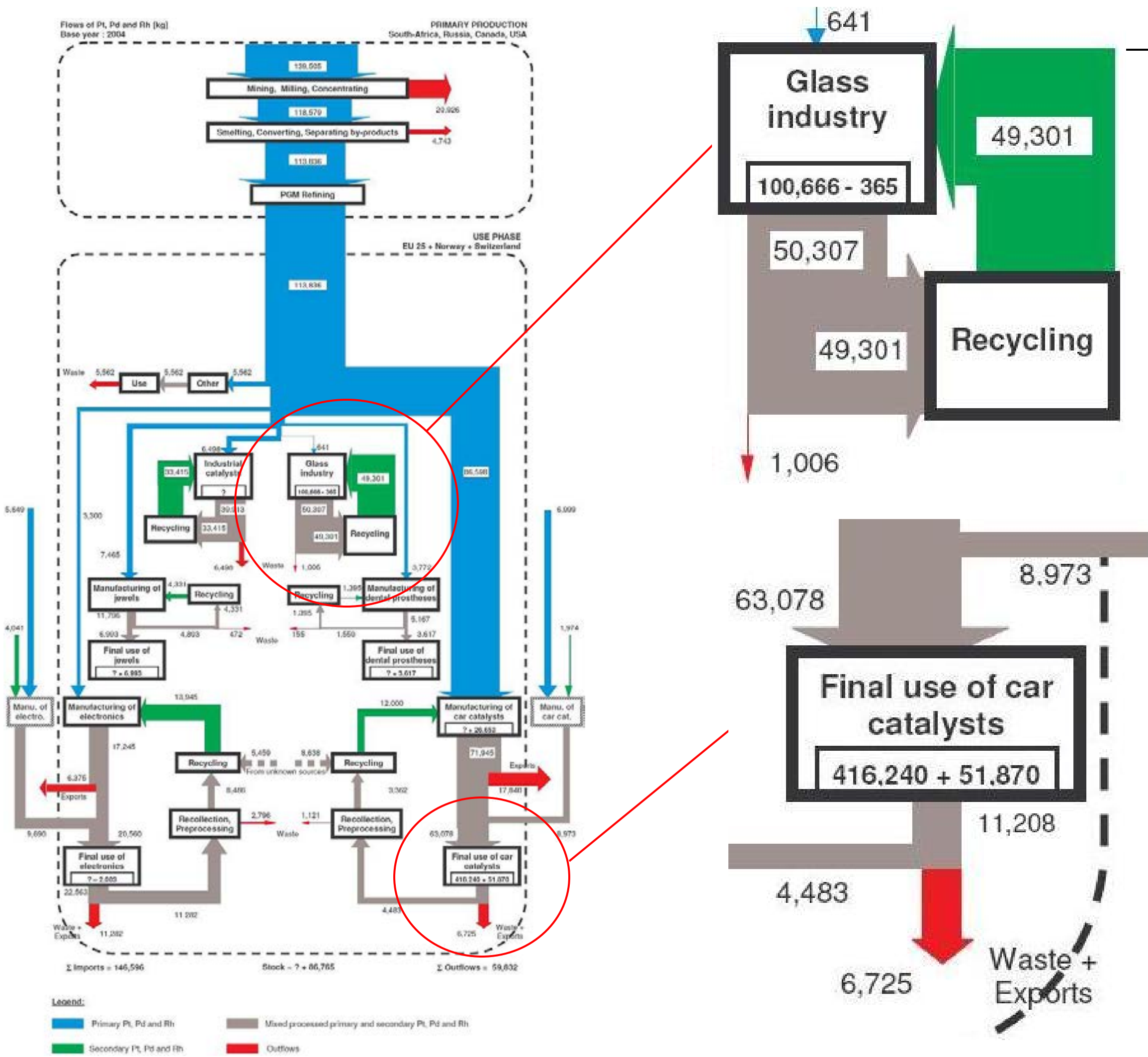


Source: Chancerel and Rotter 2009

→ Performance indicators of recycling need to consider (savings of) total resource requirements

Managing Metal Flows

The example of Platinum-Group-Metal flows for European industry



PGM flows in EU 25 + Norway + Switzerland in 2004
Source: Mathieu Saurat and Stefan Bringezu

PGMs in glass industry:

organized in nearly closed cycle

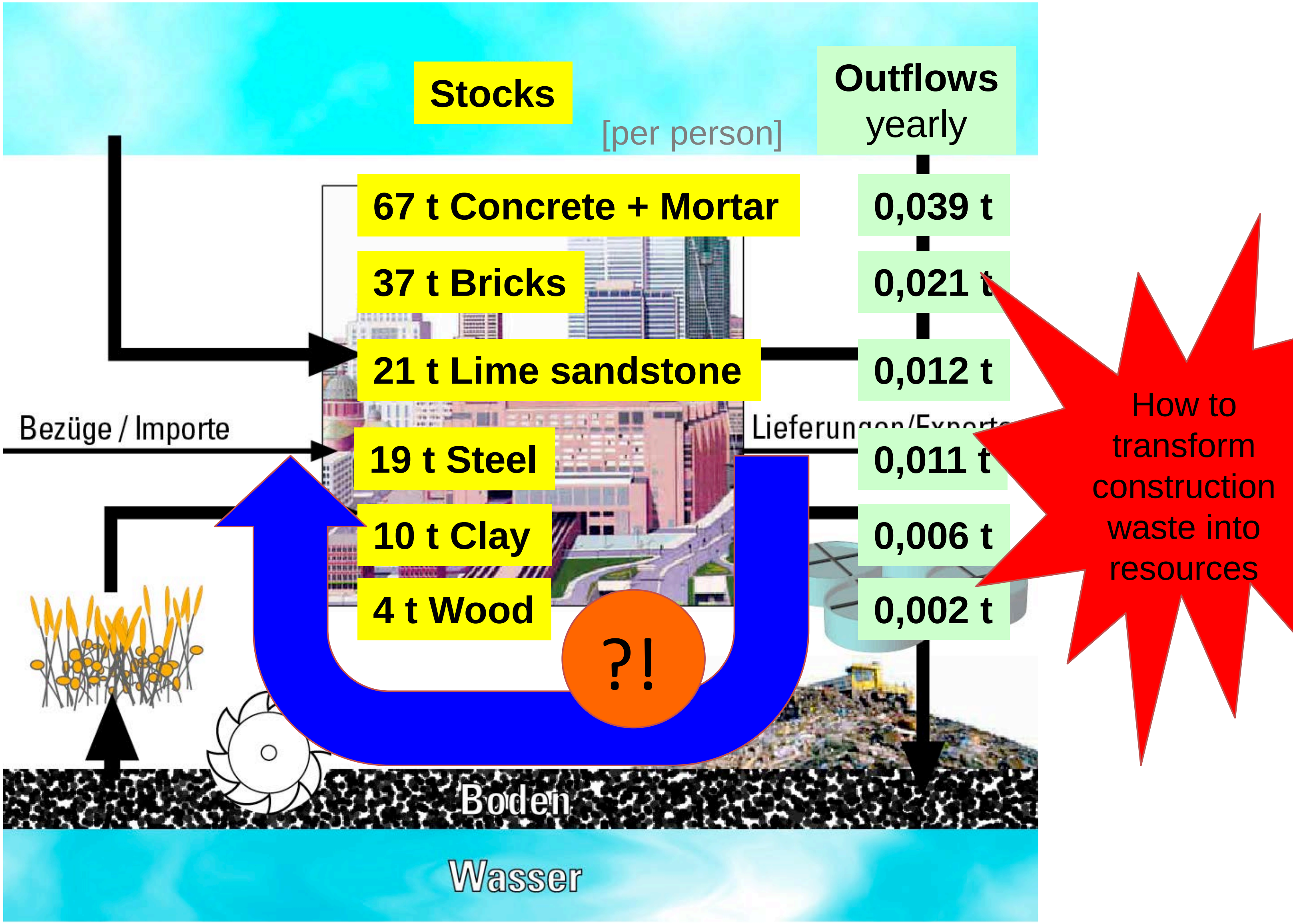
PGMs in car catalysts: low recycling rate (~30 %), mainly due to exports

The automotive industry requires 76 % of PGM primary input to Europe

→ Trans-European recycling schemes also important

Buildings and infrastructures are the mines of the future

Stocks and construction waste flows in Wuppertal (residential buildings)



Quelle: Wuppertal Institut/FG3 M. Ritthoff

Urban Mining Potential – Stocks of engineering metals in the technosphere

[kg/person](2000-2006)

to be expected in the EU

Metal	Number of estimates	Percent of all estimates	Global per capita stock	MDC per capita stock[b]	LDC per capita stock[c]
Aluminum	9	7.4	80	350 – 500	35
Copper	34	27.0	35 – 55	140 – 300	30 – 40
Iron	13	10.7	2200	7000 – 14000	2000
Lead	20	16.4	8	20 – 150	1 – 4
Steel	1	0.8		7085	
Stainless steel	5	4.1		80 – 180	15
Zinc	14	11.5		80 – 200	20 – 40

MDC: more developed countries
LDC: less developed countries

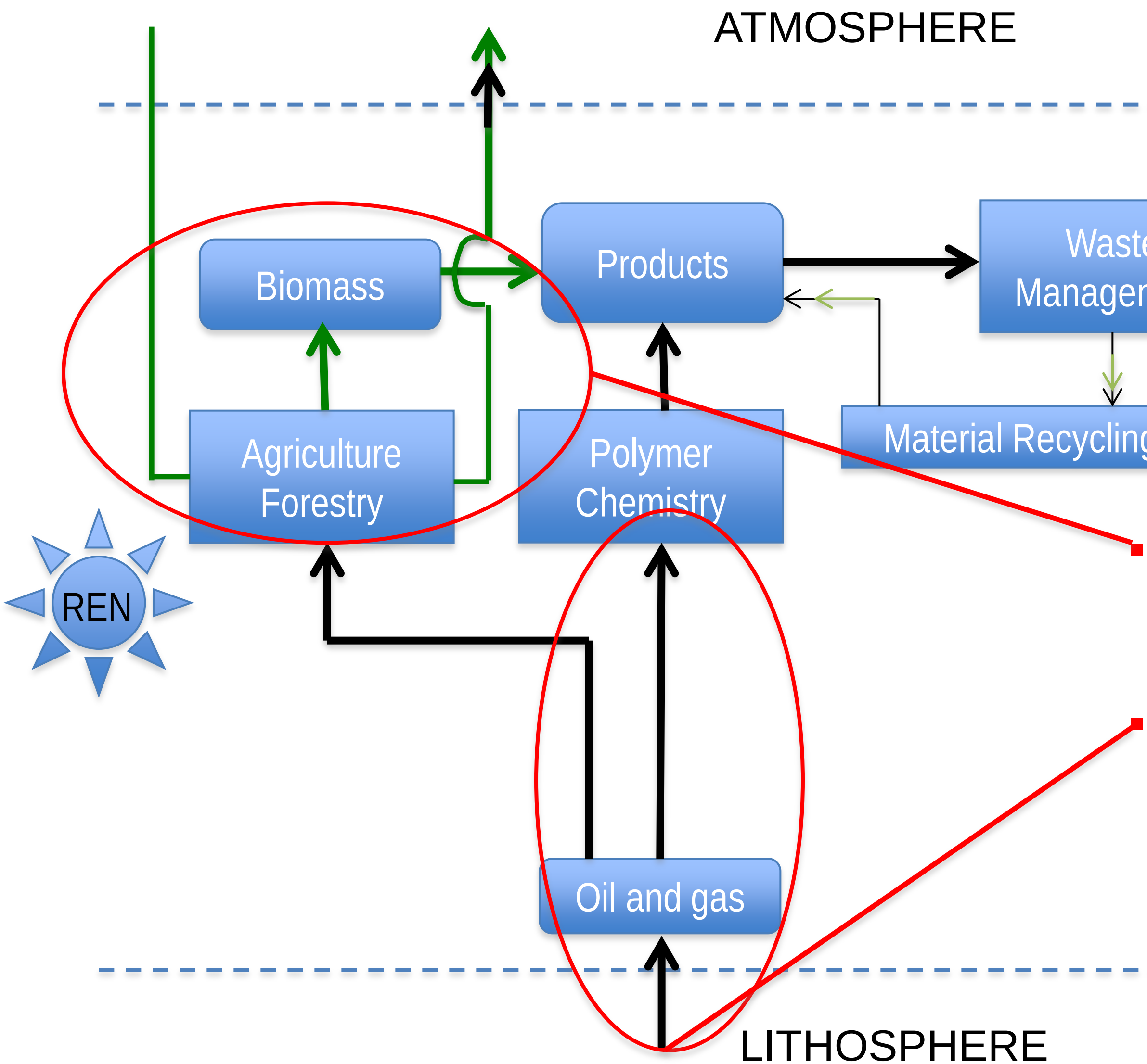
Source: Graedel et al. 2010

Urban Mining has started ...

... but information systems on how much materials, when and which quality may be expected as potential RC input are still in an early phase

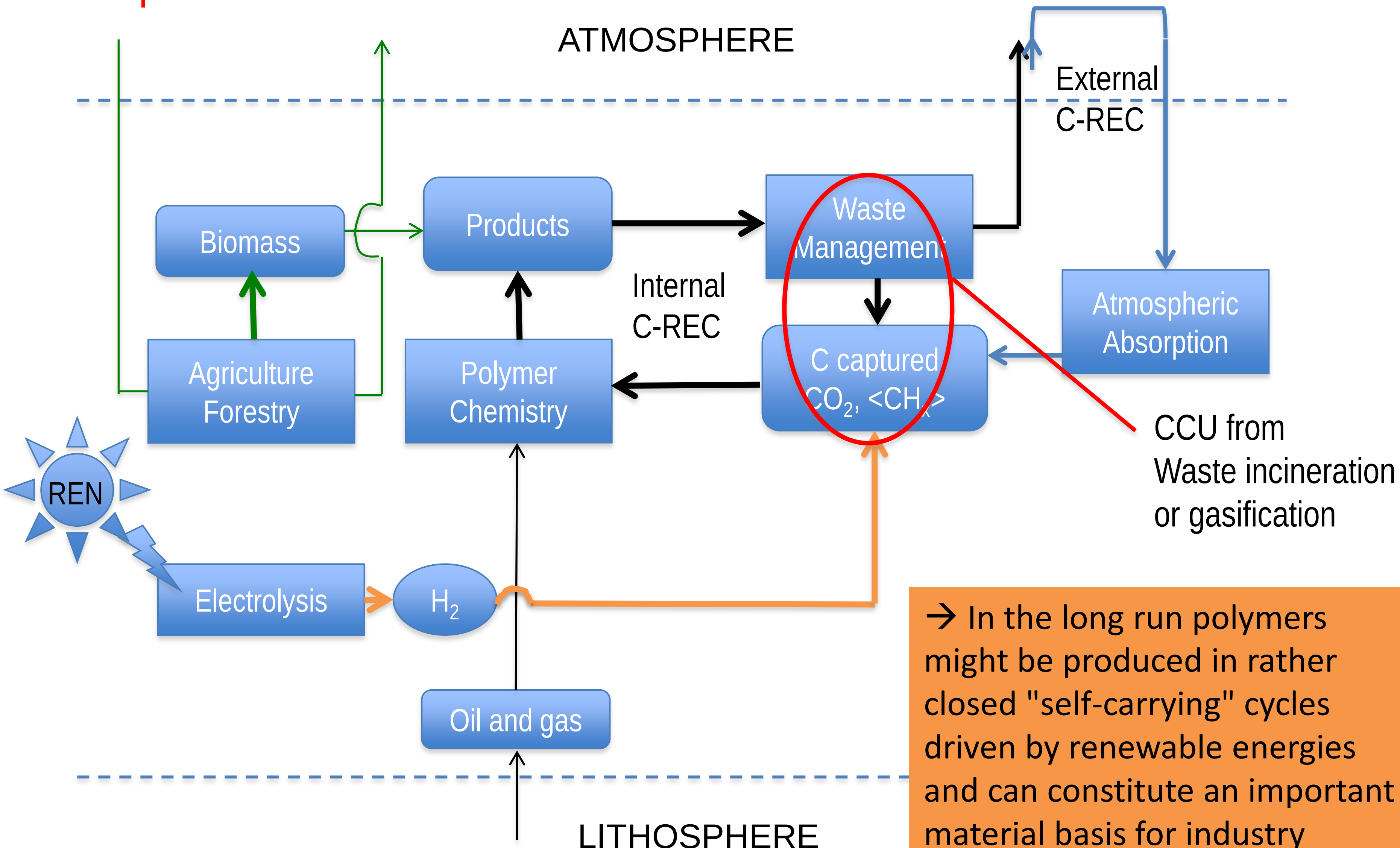
→ a business case

Current carbon flows for consumable and durable products



- biomass supply limited due to competition on land, esp. cropland
- fossil based supply not sustainable on the long run due to final GHG emissions and growing scarcity

Polymer production can develop recycling routes to become independent from fossil and biomass resources



→ In the long run polymers might be produced in rather closed "self-carrying" cycles driven by renewable energies and can constitute an important material basis for industry

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The triangle of progress in the transition cycle

Orientation, motivation and information

Goals (e.g. Dematerialisiation), objectives (e.g. decoupling), targets (e.g. Factor 4/10)
- *broad discussion*
- indicators for orientation and monitoring

Applicable across scales: country, branch, company

Information
- EU, national, regional, communities, firms, households (status quo + trends)
- institutional + technological potentials for improvement
- good-practice examples
- education and training

Incentives
- prices, costs, premiums (subsidies, tariffs, awards etc.)
- planning (e.g. extraction licenses)
- progressive production standards (e.g. material intensity, energy efficiency)
- black list of materials (e.g. Hg, U, non-food biomass from crops)

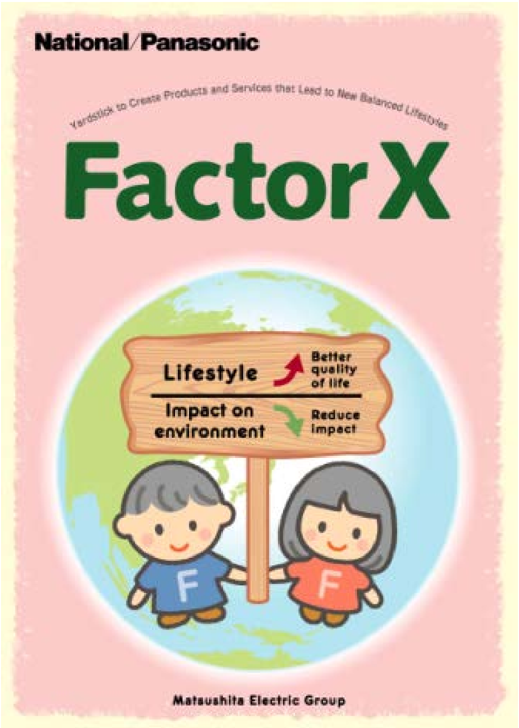
Source : Stefan Bringezu

Resource innovations in companies
The factor X approach was tested in Japanese electronics industries

Panasonic

Panasonic tests new products against older ones

New products need to be more efficient than older ones by a defined factor

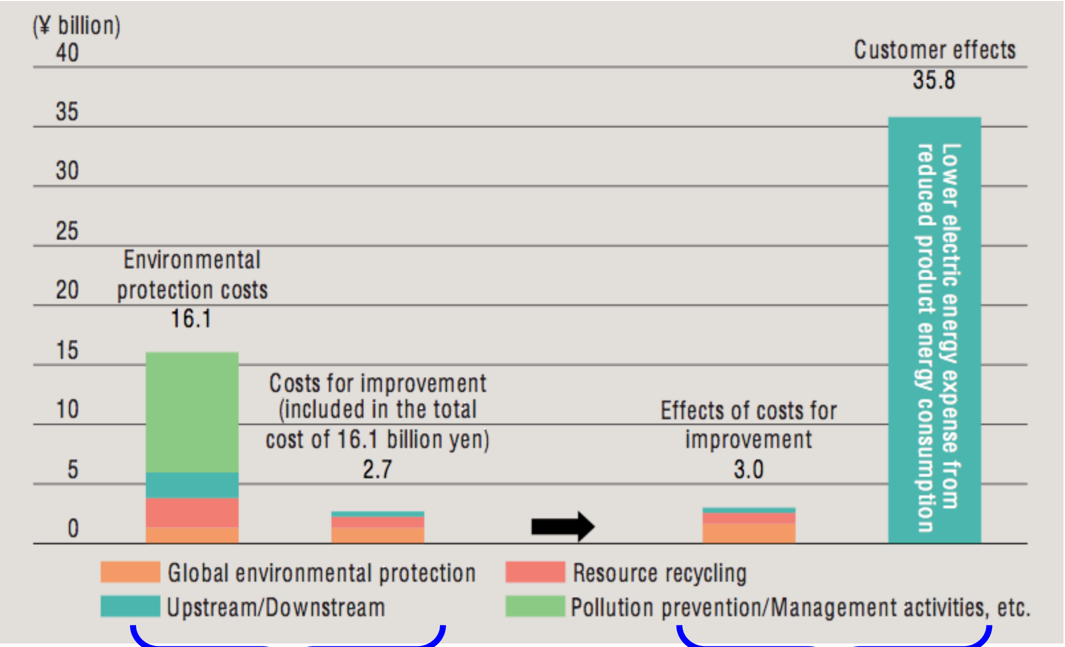


Goals and targets in companies

The example

Factor 2

Resource efficiency pays dividends

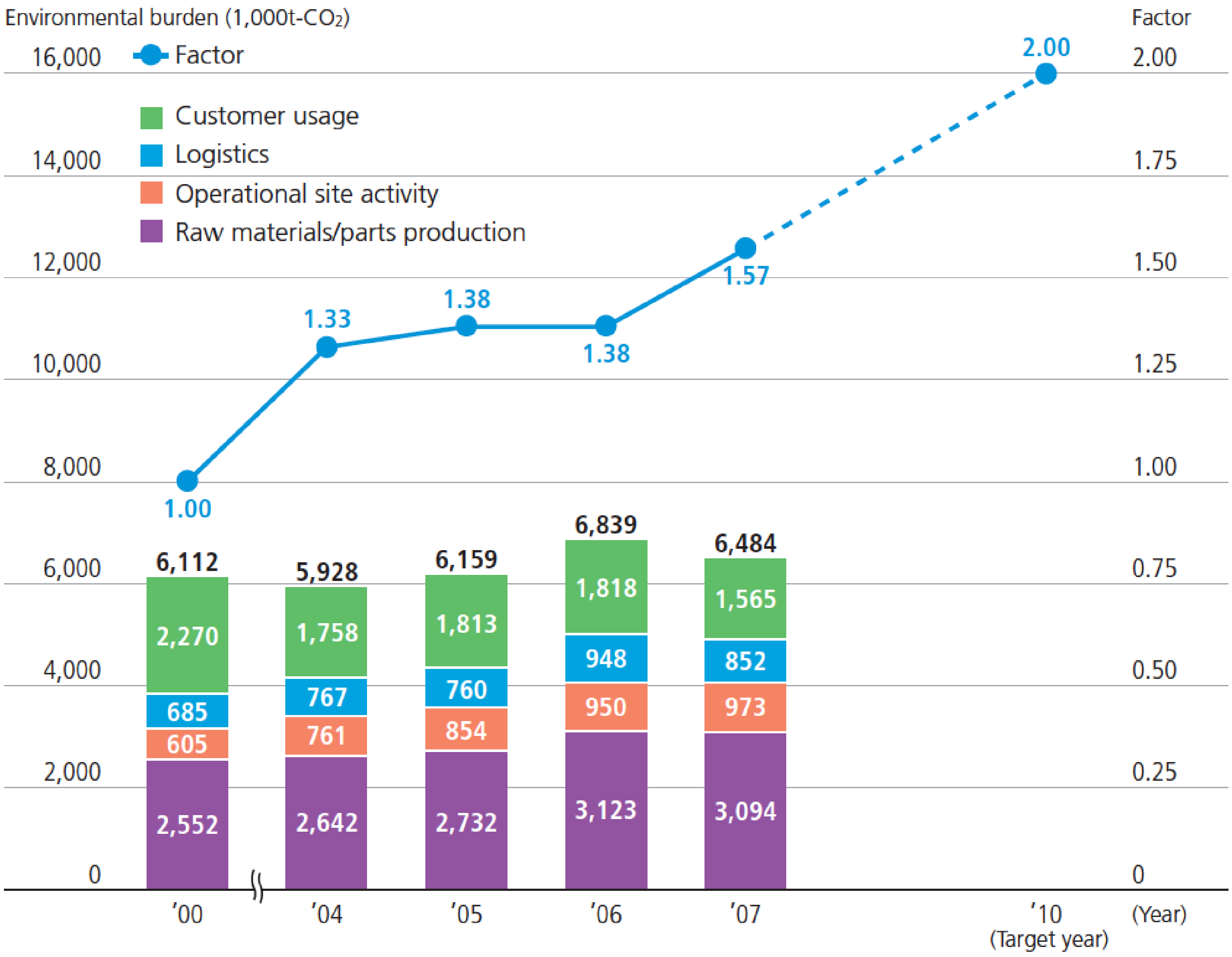


Costs   Benefits

- Canon set a target to reduce CO_2 emissions by a factor 2
- The company expected that this paid for itself if costs are considered over the whole production and use chain

Example of Target Setting at company level

Canon´s sustainability report



Policy targets on resource use and productivity
Selected examples

- European Resource Efficiency Platform (EREP)
  Increase of resource productivity "well over 30% until 2030" (from pre-crisis level)
- Germany: doubling raw materials productivity until 2020 (from 1994)
- Japan: increase material productivity by 50% until 2015 (from 2000)
- China: increase material efficiency by 15% (2011-2015)

target values and indicators differ, but direction is clear

Progress will be measured by headline indicators

Environmental performance: the Four Footprints

Material Productivity
GDP/DMI (GDP/DMC)

Raw Materials Productivity
GDP/RMI (GDP/RMC)

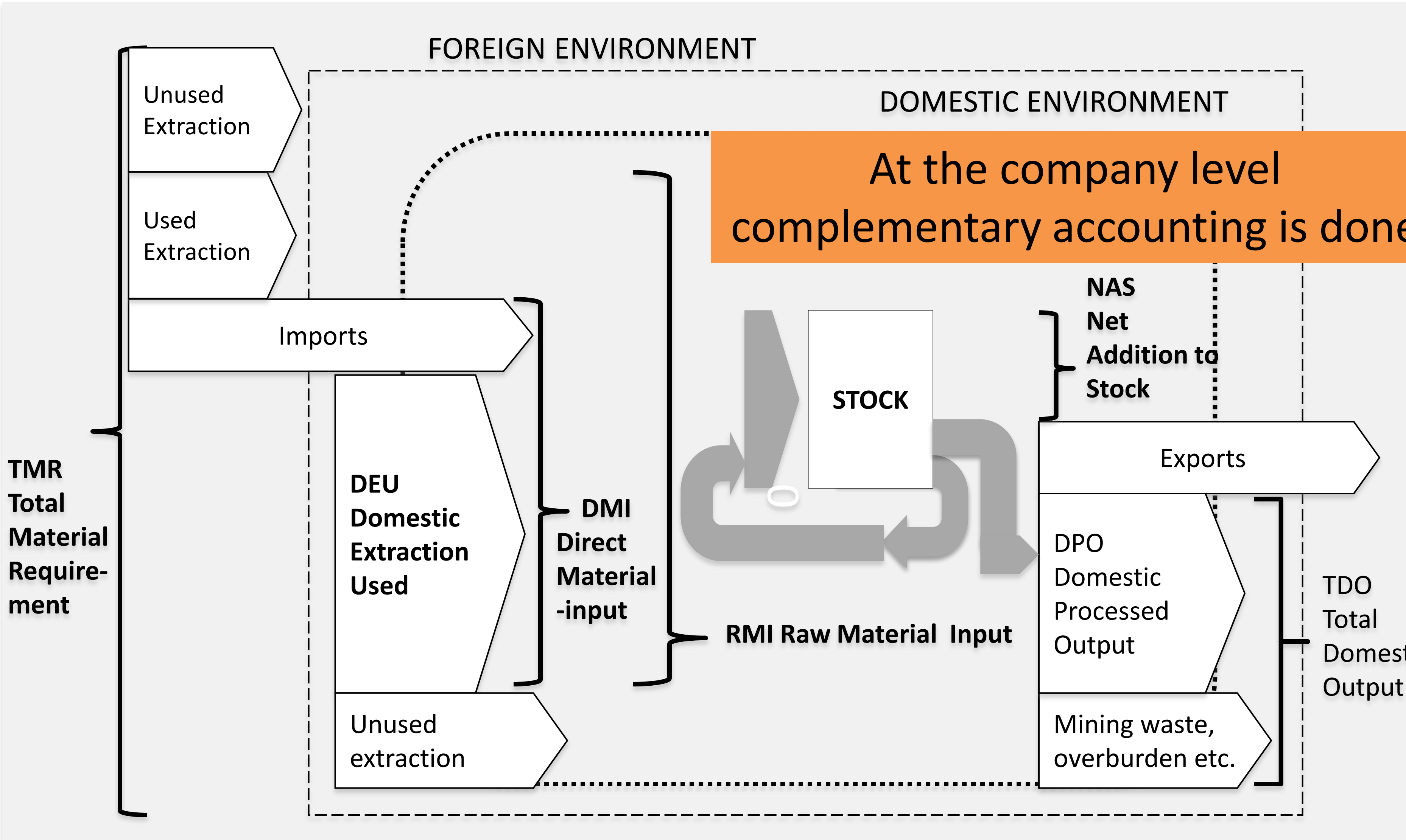
Total Resource Productivity
GDP/TMR

Key indicators for monitoring natural resource use

	Territory or national perspective	Global supply chain or international perspective
Materials	Domestic extraction - abiotic - biotic - used - unused, DMI, DMC*	Total primary material resource requirements - direct (domestic) - indirect (foreign) TMR and TMC RMI and RMC
Land	Artificial land or built-up area	Direct and indirect land use for consumption of biomass-based products focussing on cropland
Water	Water exploitation index	Direct and indirect water consumption (e.g. Water footprint)
Air	GHG emissions (t)	Direct and indirect GHG emissions (both carbon and non-carbon emissions)

Economy-wide MFA and Resource productivity indicators:
- method guides Eurostat, OECD;
- applications in many IC and DCs;
- statistical offices in charge

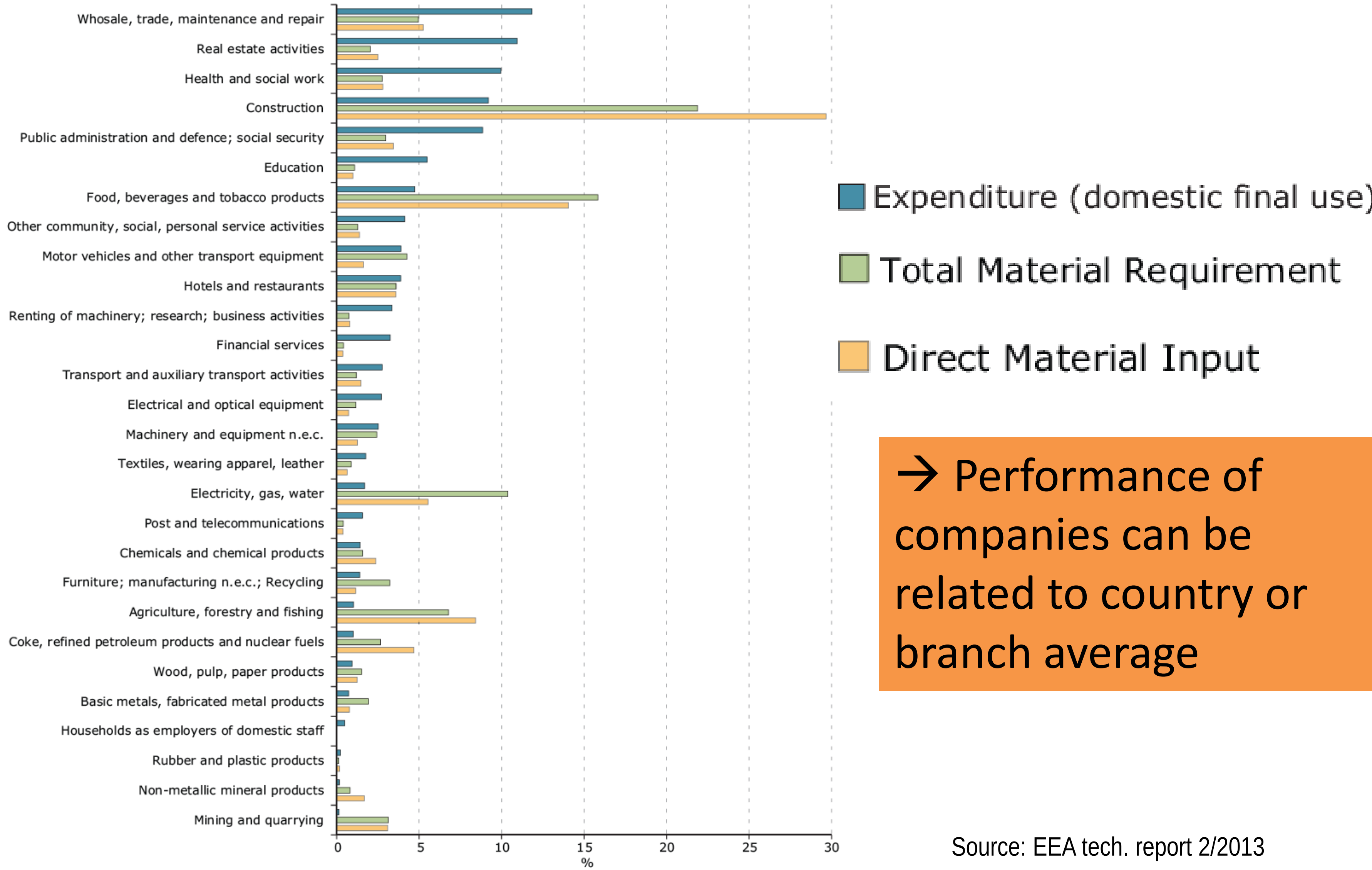
Overview of economy-wide material flow indicators



At the company level complementary accounting is done

Material Input and Total Material Requirement of branches

Product groups,EU-9, 2005



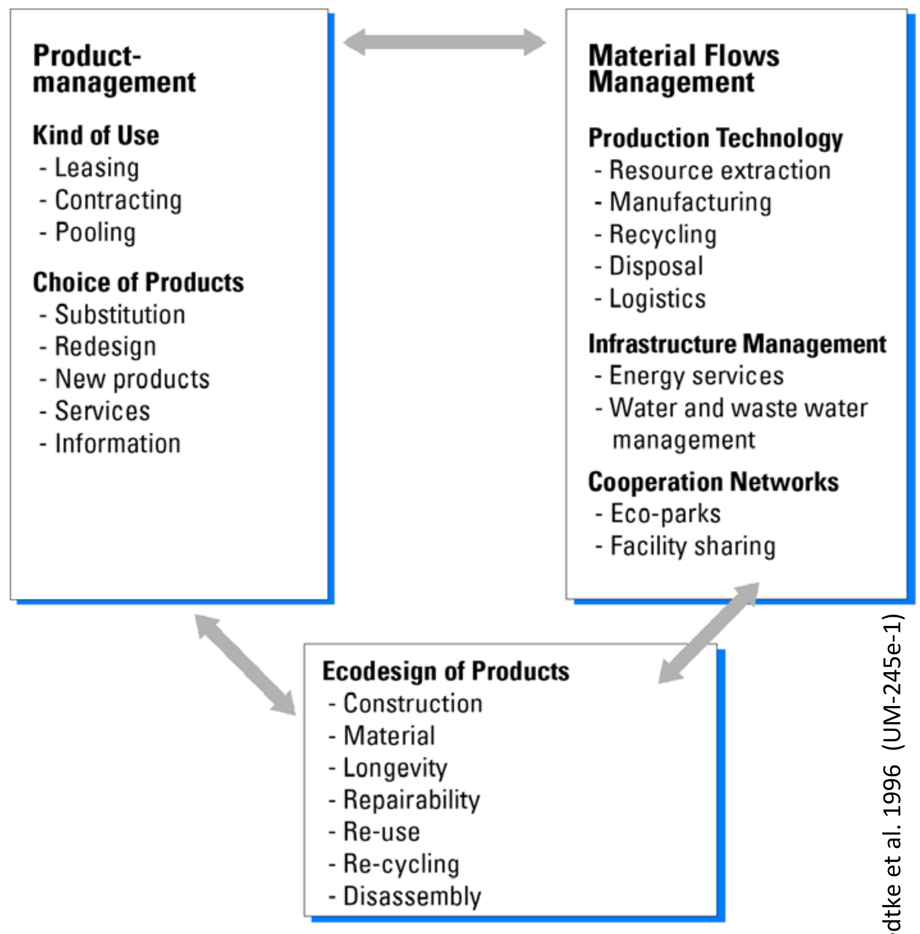
→ Performance of companies can be related to country or branch average

Source: EEA tech. report 2/2013

What companies can do to increase their resource productivity

Examples from Germany

- Resource checks are available online and offline
  - for specific branches,
  - as basic and advanced modules
- VDI-ZRE: http://www.ressource-deutschland.de/instrumente/ressourcenchecks/
- Resource Efficiency Agency (efa) in Northrhine-Westphalia: english Website: http://www.ressourceneffizienz.de/en/startpage.html



Source: Liedtke et al. 1996 (UM-245e-1)

The presentation

- Historical learning and actual policies on resource efficiency
- Global trends of resource use
- Goals and Strategies for sustainable resource management
- What governments and companies do
- Conclusions

Conclusion

- A relative decoupling of economic growth and natural resource use is ongoing. Thus, markets already favour increased resource efficiency
- For industry and SMEs still huge potentials are untapped to save costs for purchasing, storing and waste managing materials. Efficiency agencies such as in Germany can play an important assisting role.
- SMEs may set their goals and check
  - inhouse potentials for material and energy efficiency;
  - risks associated with their purchases (minerals, biomass);
  - business opportunities in waste prevention and recycling;
  - options for dematerialized design of their products;
  - strategic innovation potential to enhance their competitiveness

International Resource Panel

CESR Center for Environmental Systems Research

Wuppertal Institute for Climate, Environment and Energy

Many thanks for your attention !

If you need assistance, let us know

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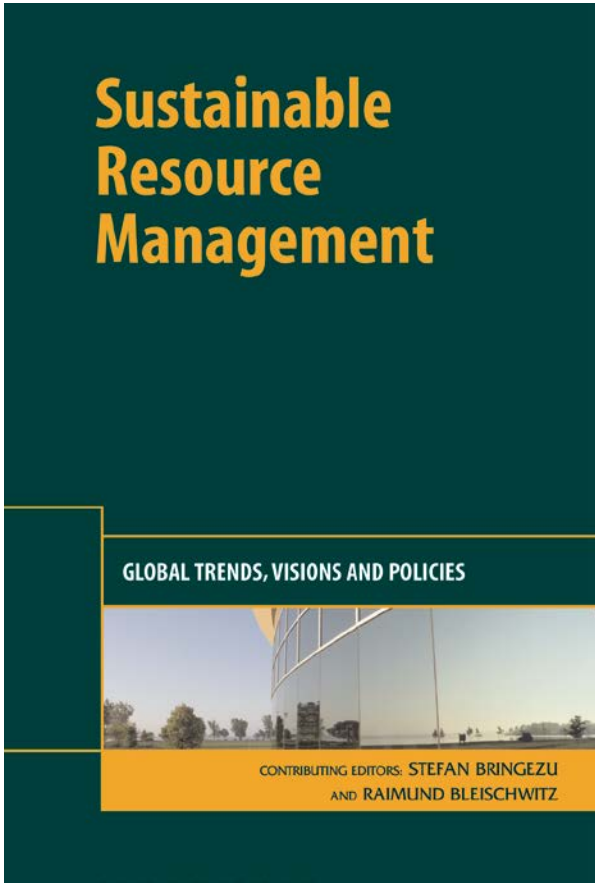

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