



International
Resource
Panel

Global Resource Use and Decoupling

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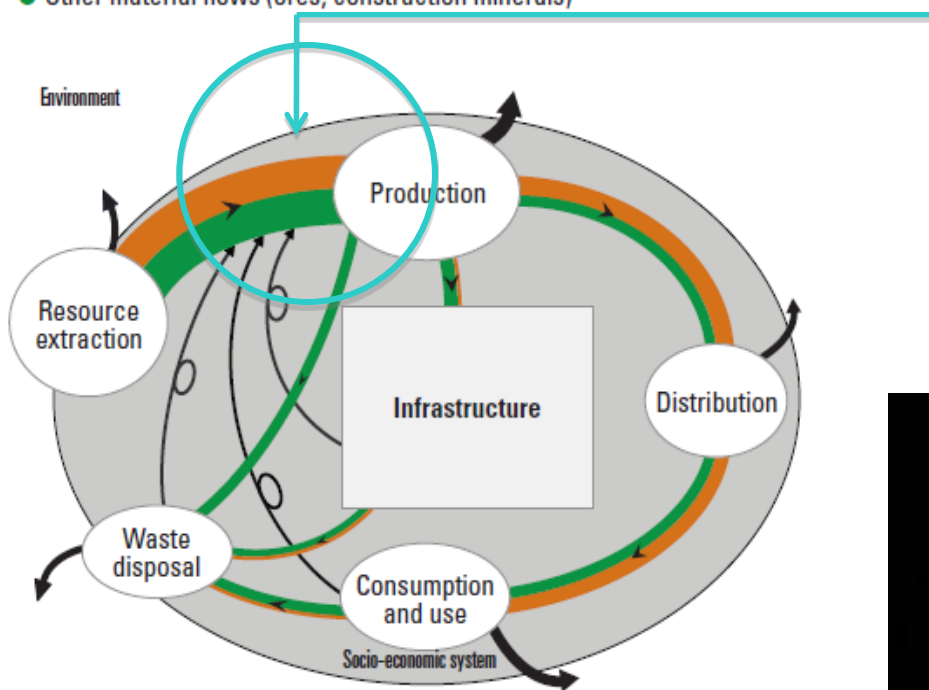
www.ntnu.edu/indecol

www.unep.org/resourcepanel

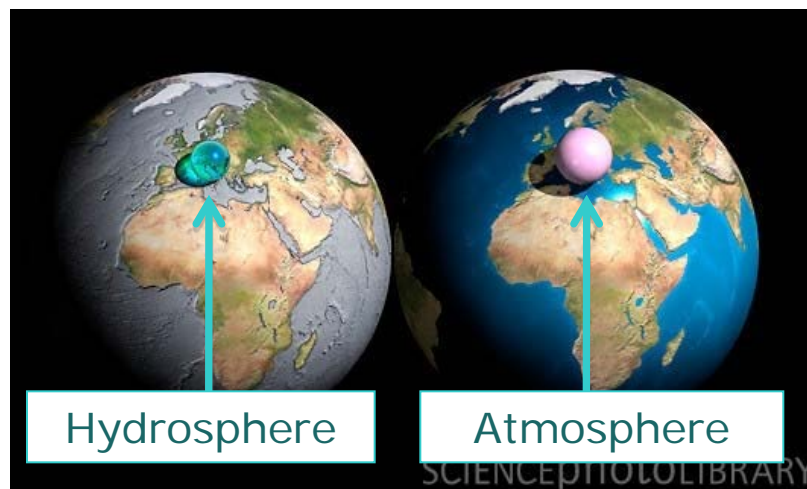
The inconvenient truth (about resources)

- Recycling flows
- Emissions (mainly CO₂)
- Flows of energy carriers (biomass and fossil fuels)
- Other material flows (ores, construction minerals)

'Hidden' resources flows are large and cause significant environmental impacts...

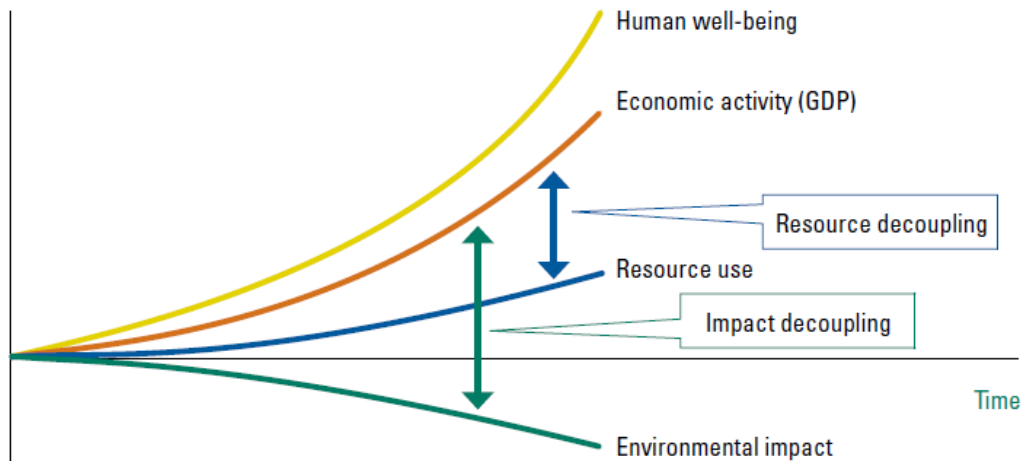


...and the **receiving environments for emissions** are smaller than some might think.



The promise of resource efficiency

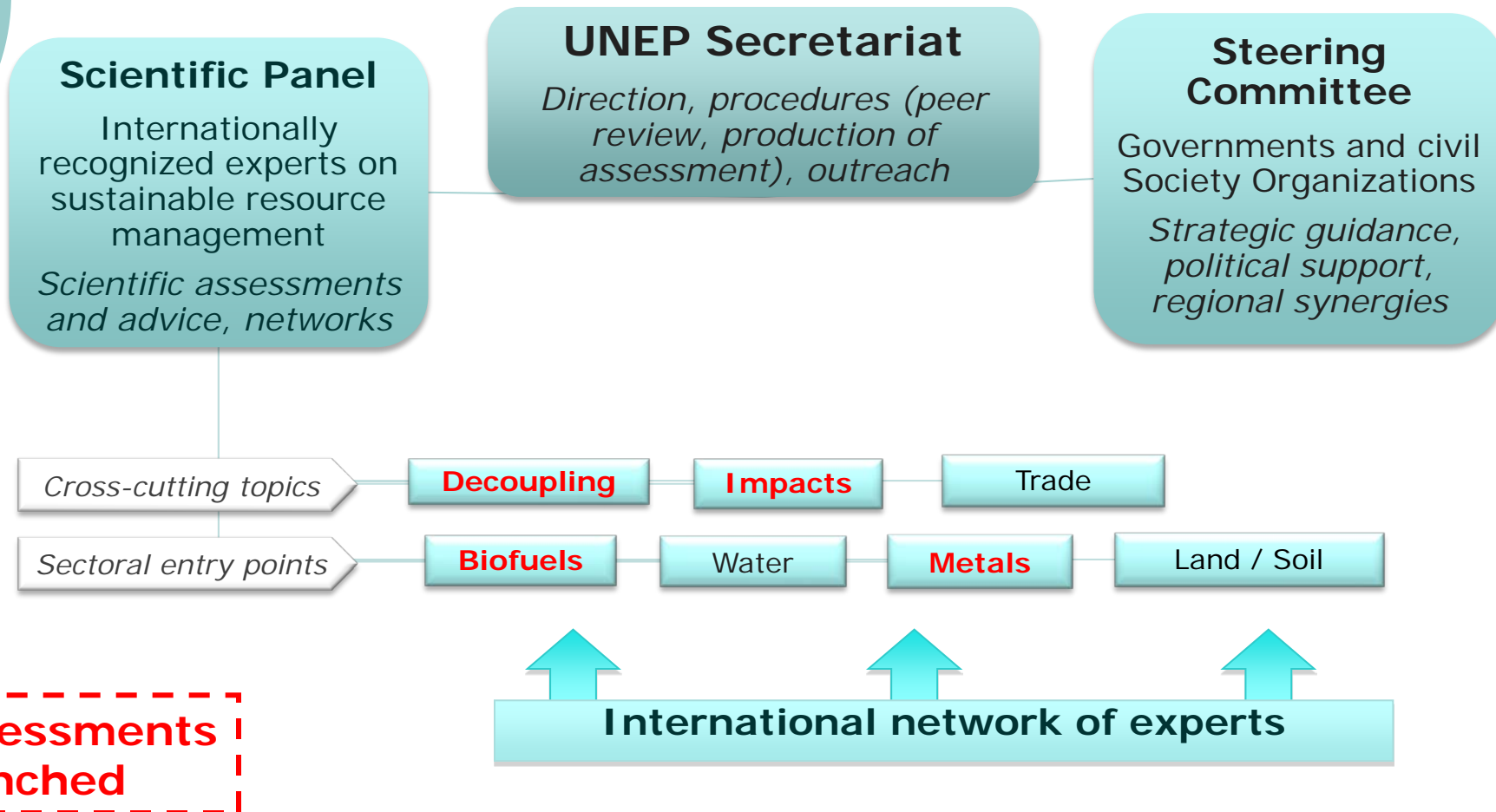
There may be ways **decouple environmental impacts** and resource use from **economic growth**...



... while **avoiding burden shifting** between countries, generations, and **trade-offs** between impact categories and life cycle stages.



International Resource Panel Structure

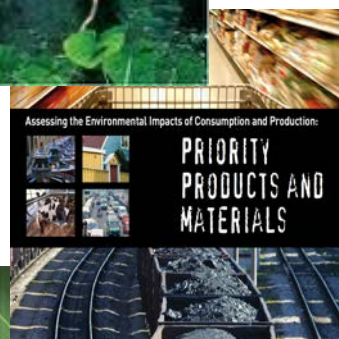
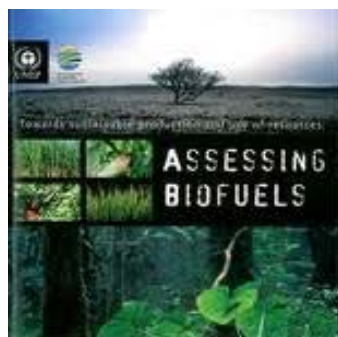


Steering Committee – a broad partnership



- **Government and IGOs:** Canada, China, Chile, Denmark, EC, Egypt, Finland, France, Germany, Hungary, Indonesia, India, Italy, Japan, Kazakhstan, Mexico, Netherlands, Norway, Russia, South Africa, Switzerland, Tanzania and USA, OECD
- **Civil Society Organisations:** ICSU, IUCN, and WBCSD
- **Observers:** UK

Achievements



Five Assessment Reports launched

Oct 2009: Assessing Biofuels

May 2010: Metals Stocks in Society

June 2010: Priority Products and Materials

May 2011: Decoupling

May 2011: Recycling Rates of Metals

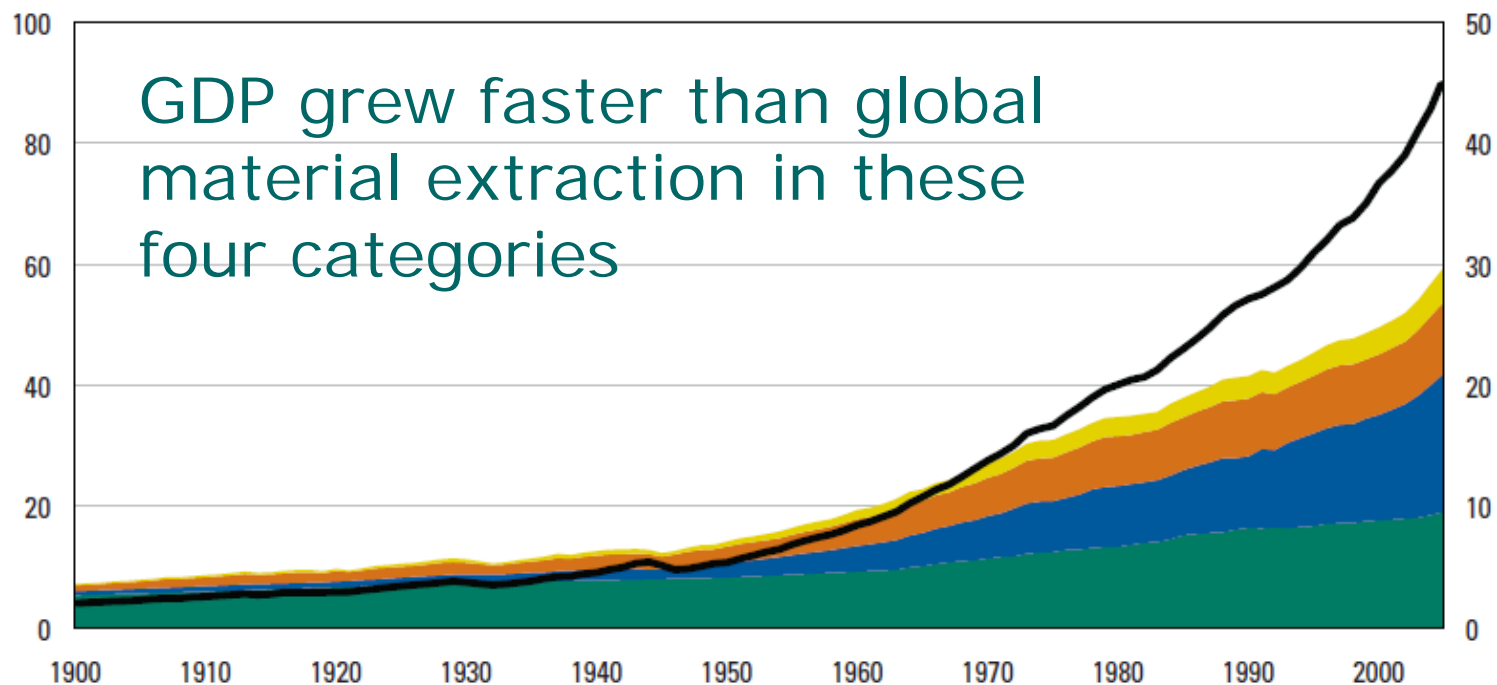
Key findings on resource use and economic growth

Figure 1. Global material extraction in billion tons, 1900–2005

Material extraction
Billion tons

- Ores and industrial minerals
- Fossil energy carriers
- Construction minerals
- Biomass
- GDP

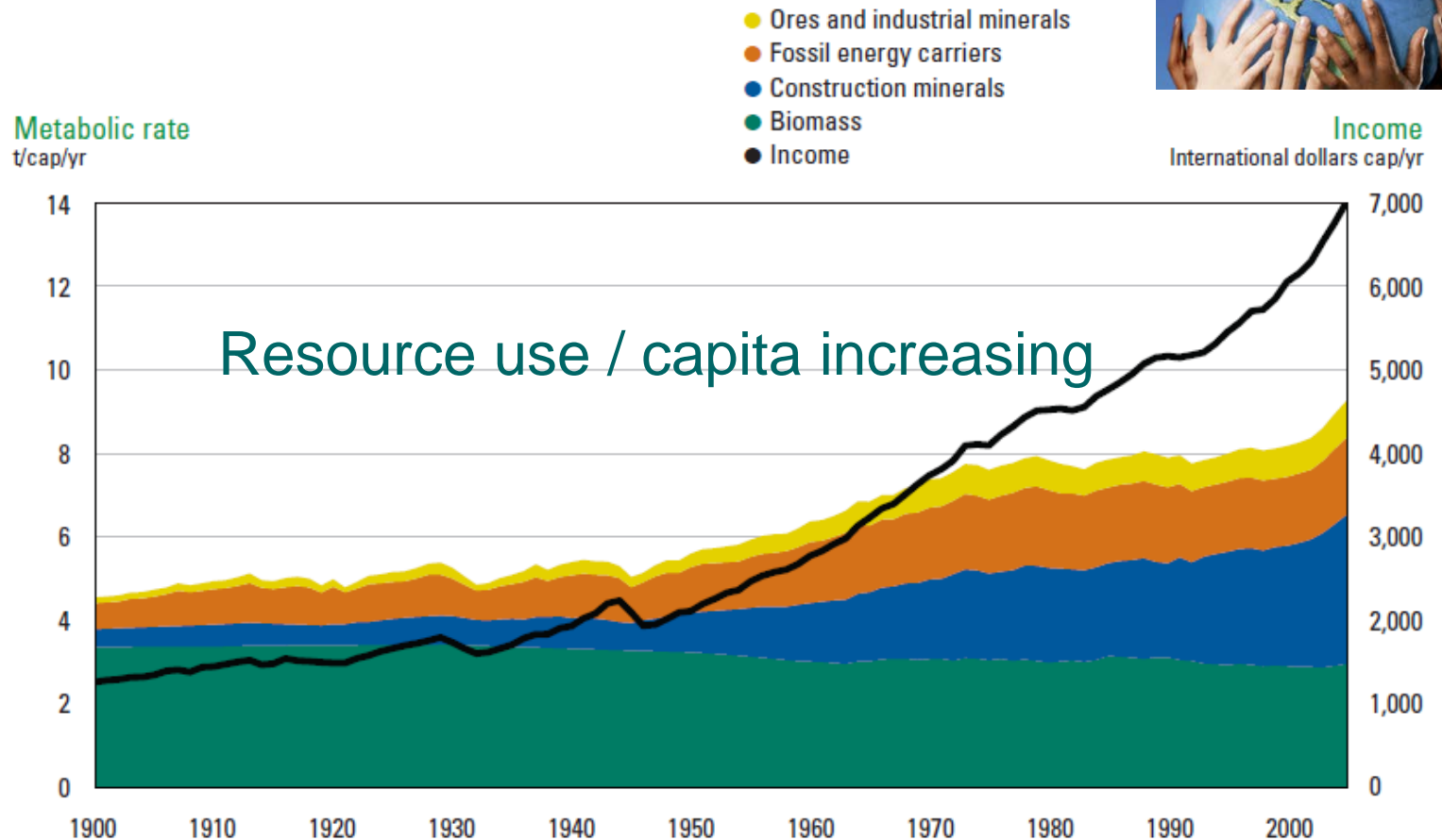
GDP
trillion (10¹²) international dollars



Key findings on resource use and economic growth

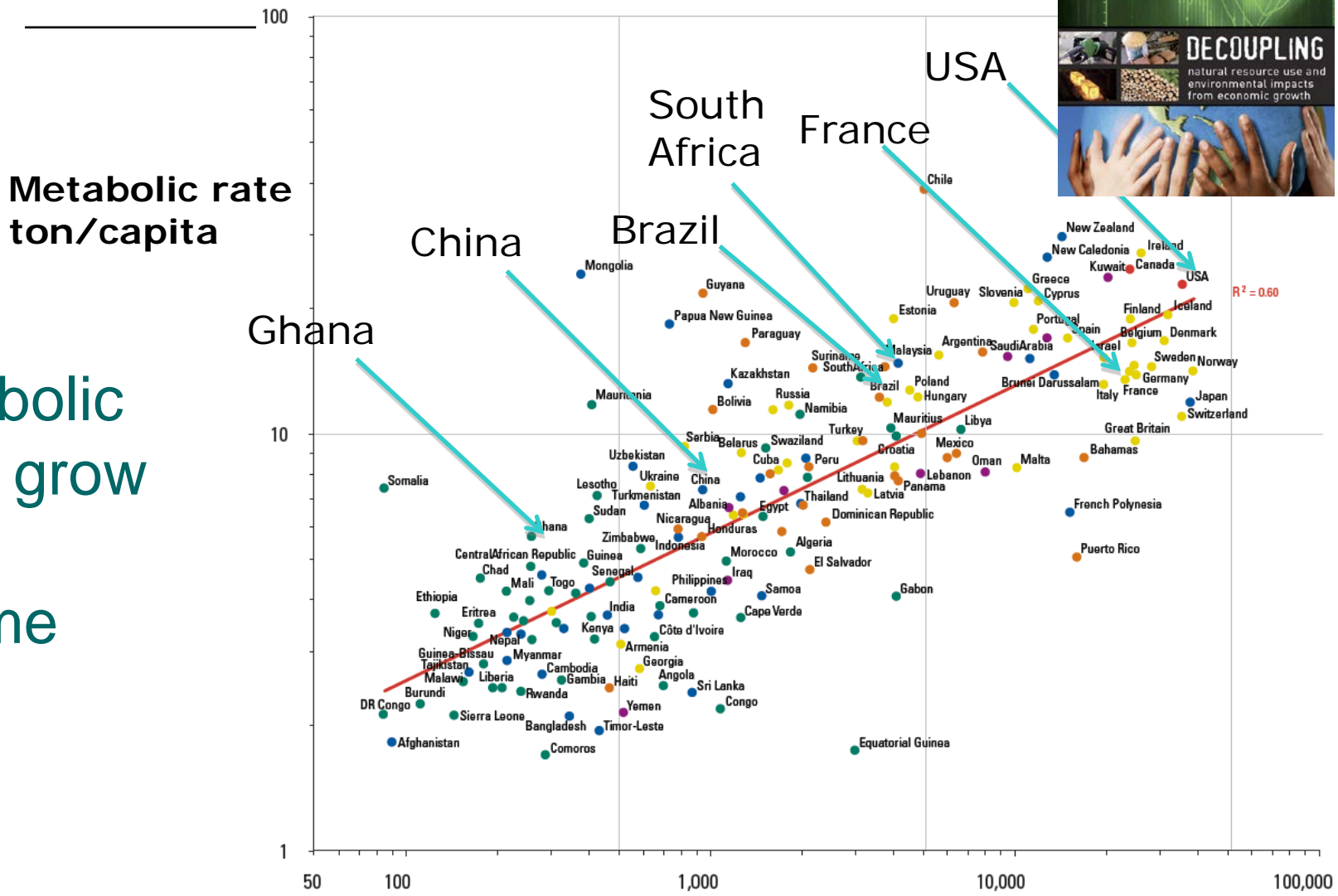


Figure 4. Global metabolic rates 1900–2005, and income



Source: Krausmann *et al.*, 2009; based on Sec Database "Growth in global materials use, GDP and population during the 20th century", Version 1.0 (June 2009): <http://uni-klu.ac.at/socec/inhalt/3133.htm>

Key findings on resource use and economic growth



Metabolic rates grow with income

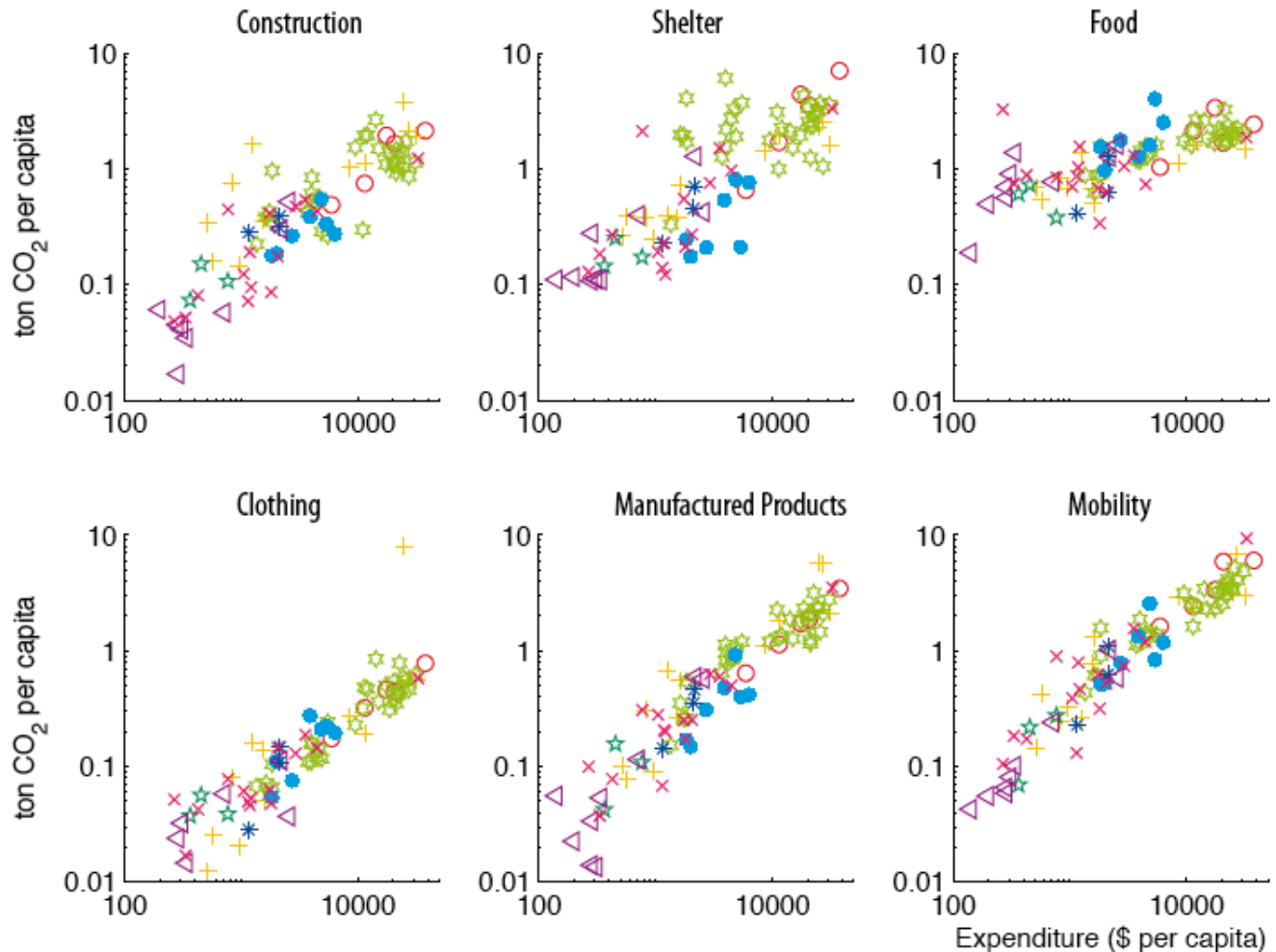
Metabolic rate ton/capita

GDP per capita
Constant year 2000 US\$

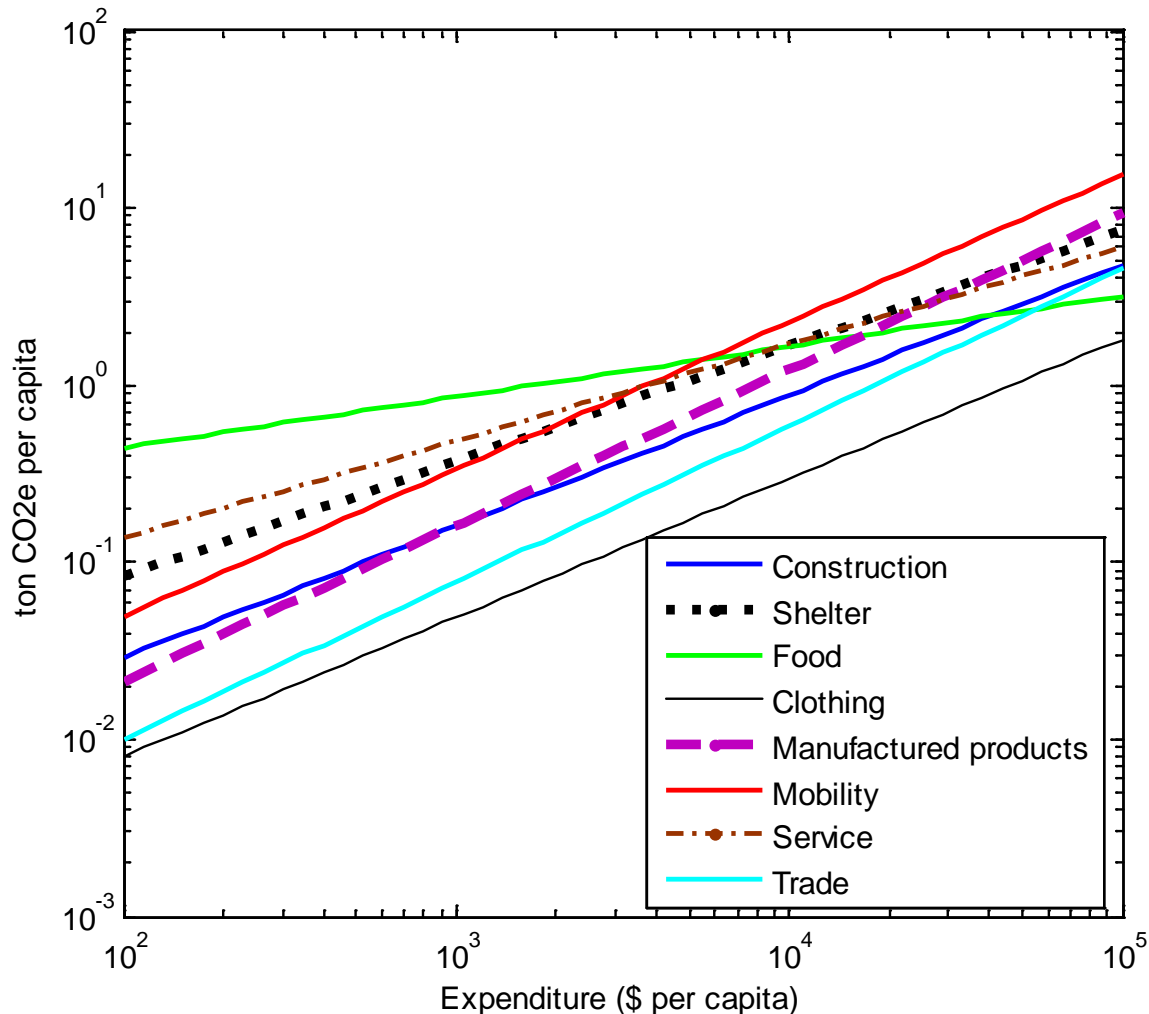
Increasing trend holds across expenditure categories



Carbon footprint also increases with income



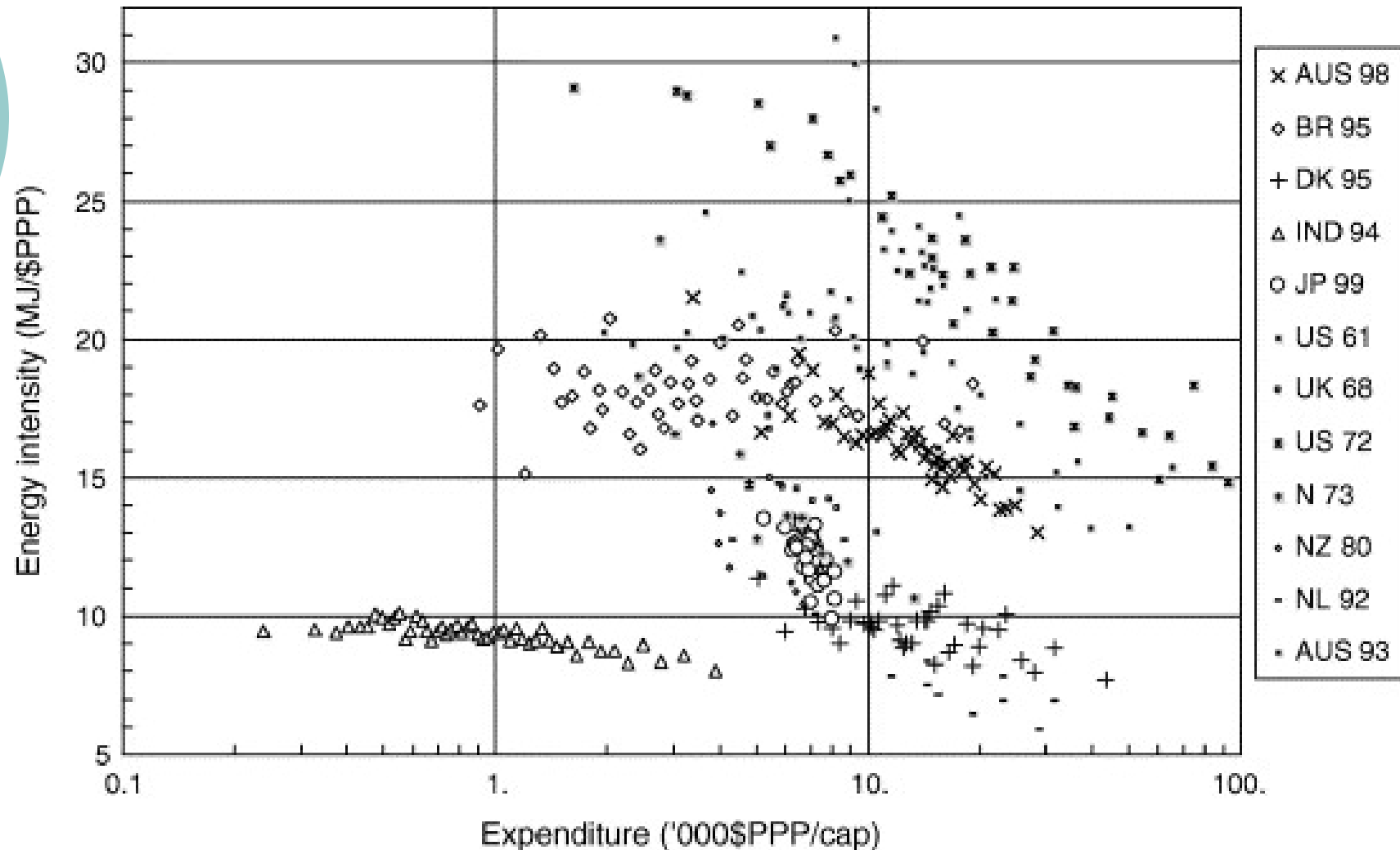
Cross-sectional analysis of carbon footprints: $0 < \varepsilon < 1$



	GHG footprint elasticity
Construction	0.74
Shelter	0.65
Food	0.29
Clothing	0.79
Manufactures	0.88
Mobility	0.83
Service	0.55
Trade	0.88

Elasticity of 0.73 implies that if income increases with 100%, GHG emissions increase with 73%

Energy use across household income groups also shows relative decoupling





Key empirical finding: relative but not absolute decoupling

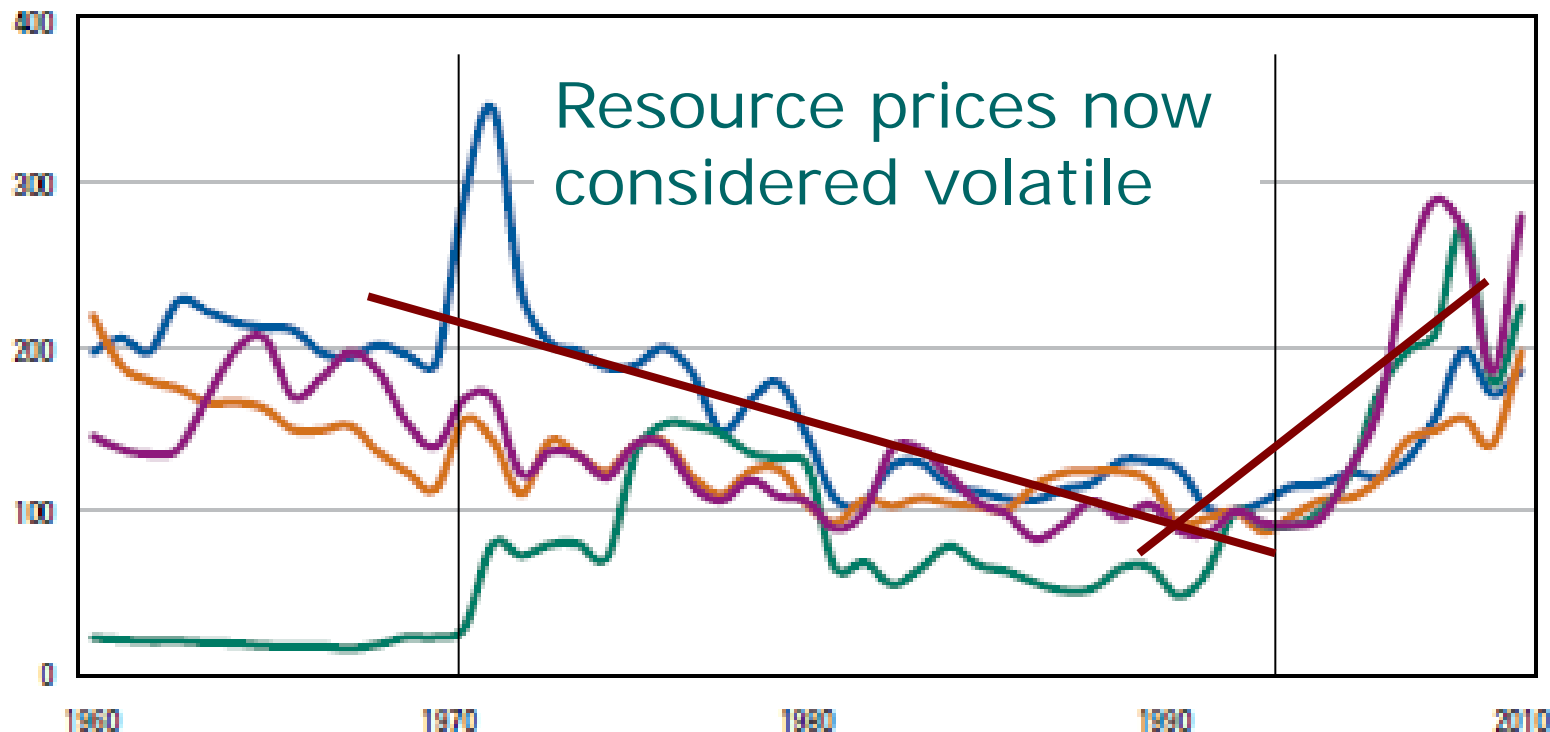
- We see a relative decoupling: resource use grows, but slower than GDP
- Many studies support this finding: across countries, within countries, longitudinal and cross sectional studies
- There is no demonstration of absolute decoupling: growth has always required increased resource inputs

Key findings on resource use and economic growth

Figure 2.5. Commodity price indices

Price index (real year 2000 US\$)
2000=100

- Food
- Raw materials
- Energy
- Metals and minerals (j)

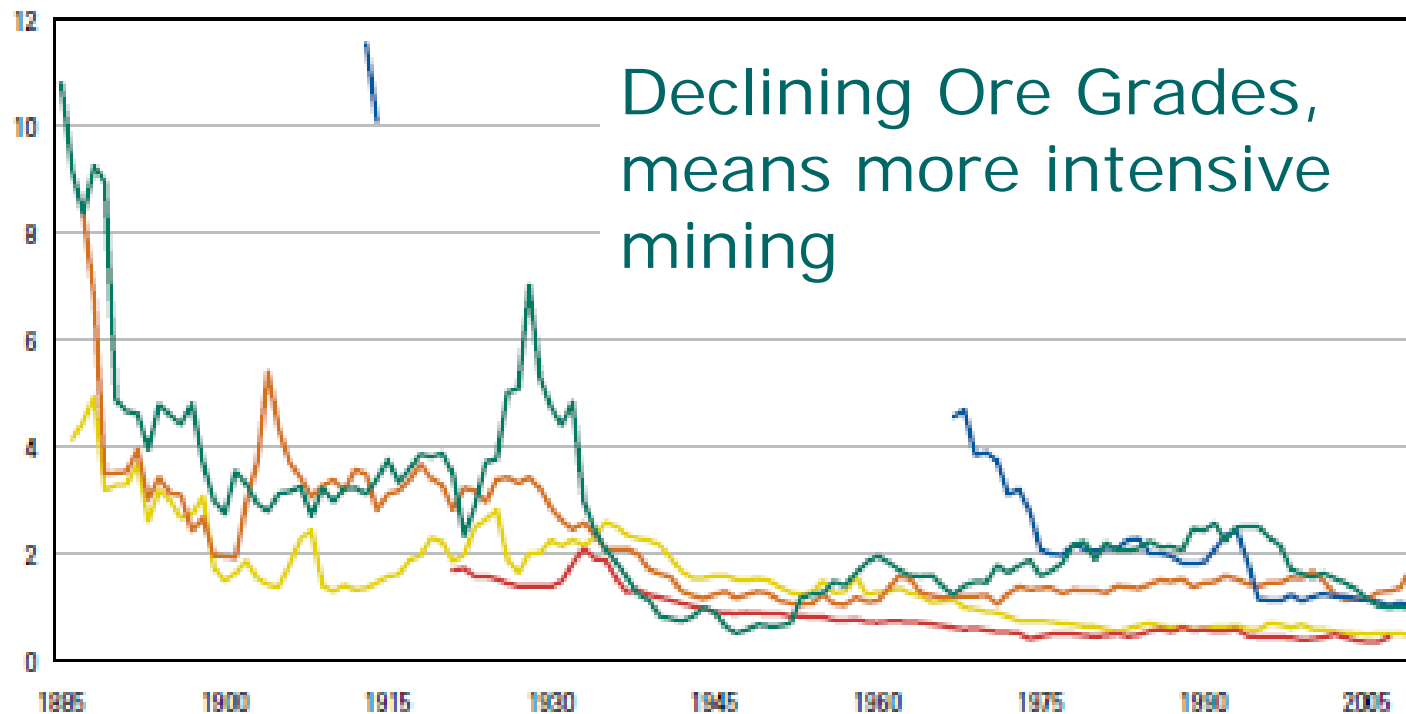


Source: World Bank Commodity Price Data (Pink Sheet), historical price data, available from <http://blogs.worldbank.org/prospects/global-commodity-watch-march-2011>

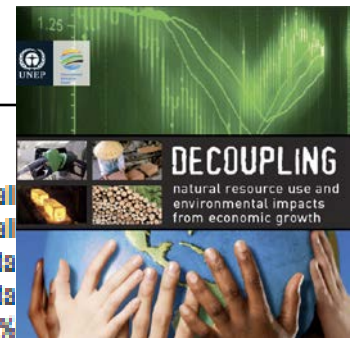
Key findings on resource use and economic growth

Figure 2.14. Ore grades of nickel and copper mines, 1885–2010

Metal ore grade
%Cu, %Ni

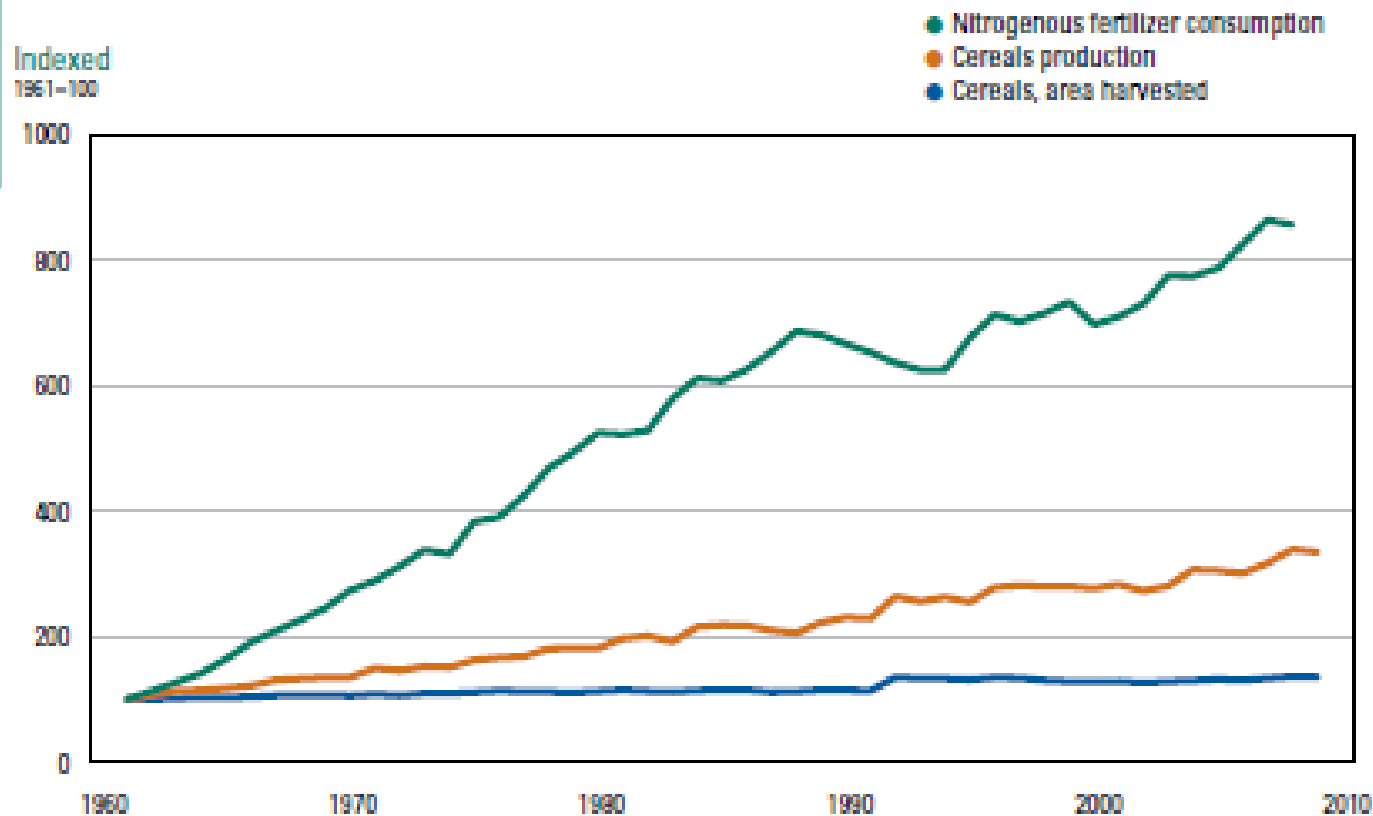


Source: Giunto *et al.*, 2010



Decoupling of cereal production from land area – but at the expense of more fertilizer use

Figure 2.9. Global growth of cereals production and fertilizer consumption



Note: Global growth in the production of cereals since 1961 almost exclusively depended on intensification (nitrogen input, tractors, yields and many other factors not shown on this graph), whereas the expansion of harvested area played an insignificant role.

Source: UNEP GEO Portal, as compiled from FAOSTAT database, Food and Agriculture Organization of the United Nations (FAO), <http://geodata.grid.unep.ch>

Key findings on metals: Opportunities for recycling



The majority of specialty metals have recycling rates lower than 1%!

1 H																	He
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg Magnesium											13 Al Aluminum	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br	36 Kr
37 Rb	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I	54 Xe
55 Cs	56 Ba Barium	57-71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismut	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103	104 Rf	105 Db	106 Sg	107 Sg	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113 Uut	114 Uug	115 Uup	116 Uuh	117 Uus	118 Uuo

- > 50%
- > 25-50%
- > 10-25%
- 1-10%
- < 1%

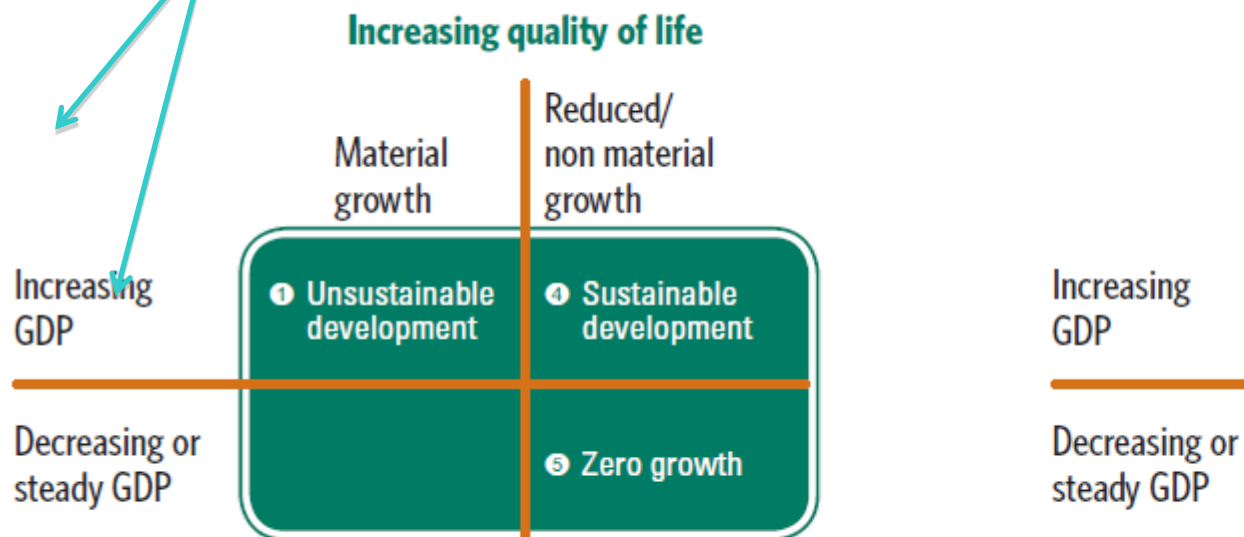
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Key findings on resource use and economic growth

Rethinking growth to include materials might help



only possible
with decoupling





Key findings

- At present, consumption growth outstrips decoupling, leading to an increase in absolute resource consumption
- There are substantial opportunities for increases in resource efficiency
- There is often a trade-off between different resources and environmental impacts => Long-term efficiency limits?
- Focus on decoupling well-being from resource consumption