Downsizing Industrial Metabolism

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Introduction

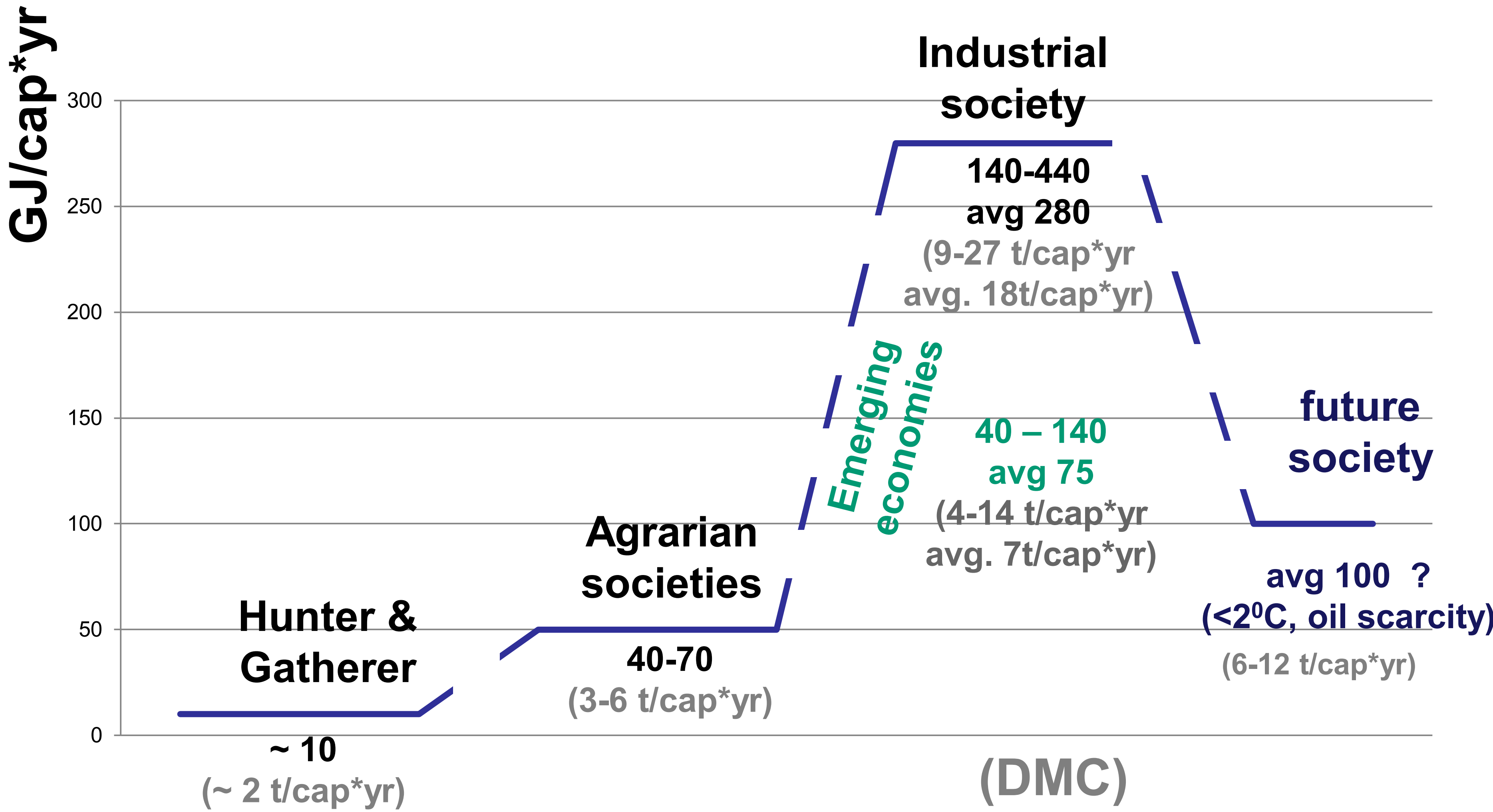
- Existing discourse about „degrowth“: widespread efforts to disclose economic mechanisms that allow a departure from growth without harming human welfare.
- Another version: Keep aspiring to „growth“, but instead of growing GDP, strive for growing human quality of life, or welfare. (OECD, Sarkozy…)
- Still another version: *Green Growth:* grow economically, but in an environmentally friendly way.
- Instead, I will talk about the physical economy: about downsizing industrial metabolism – about physical degrowth.

Downsizing Industrial Metabolism:

1. Why should this happen?
2. How can this happen?
3. Why will this happen?

1. Why should this happen?

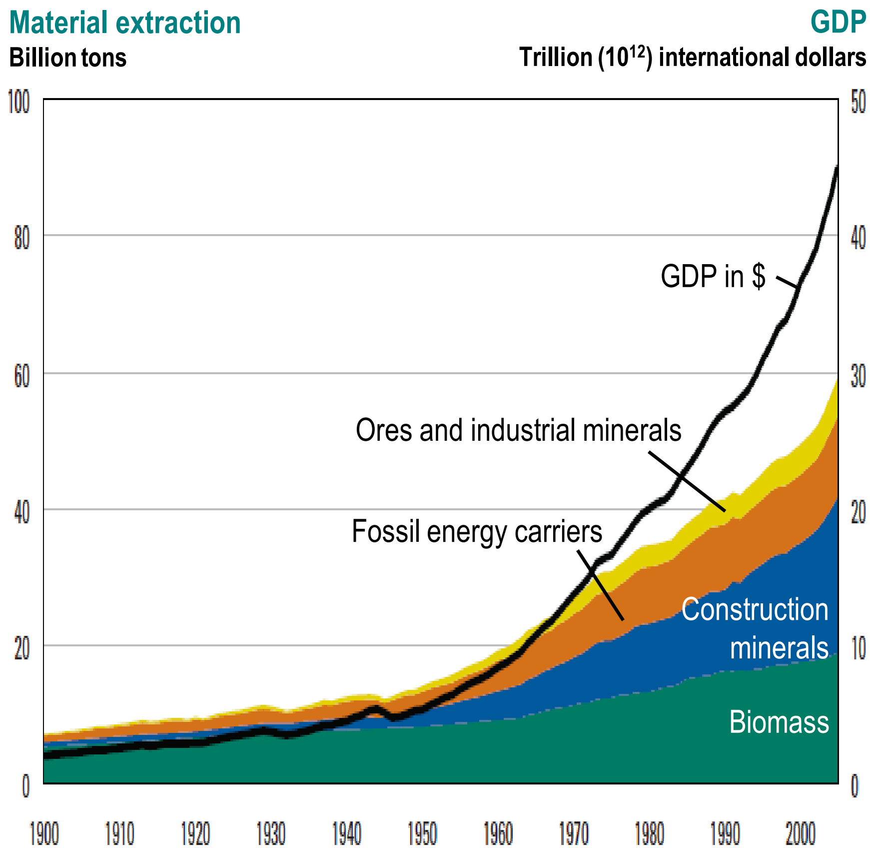
Energy and material consumption per capita by sociometabolic regime



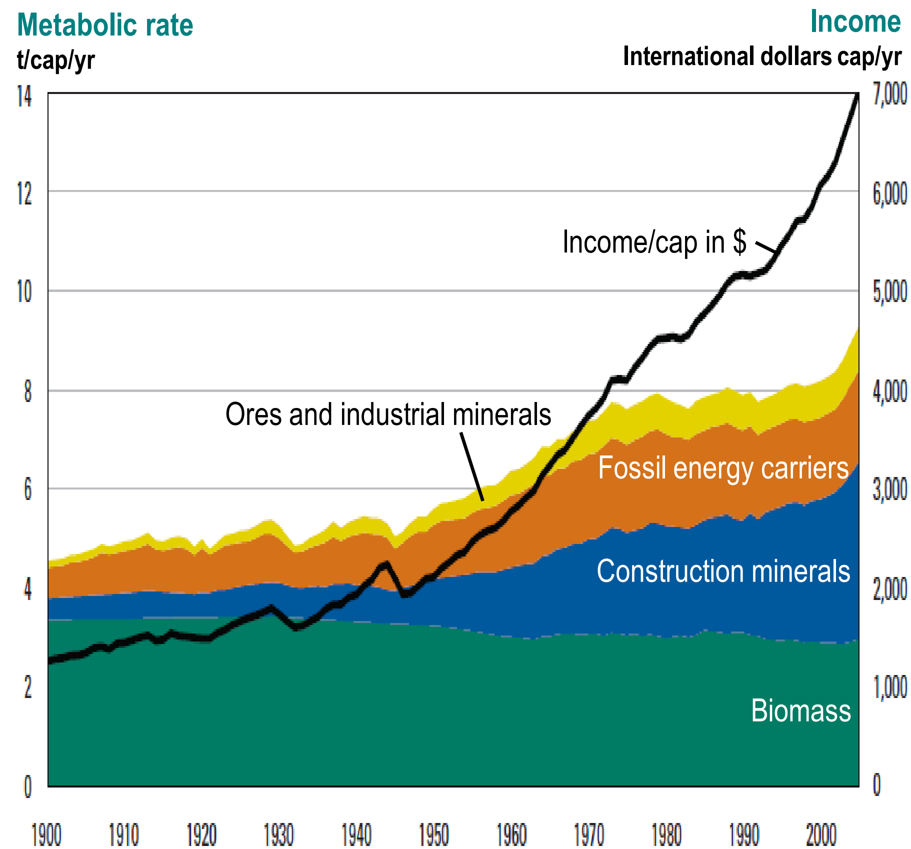
Source: after Sieferle et al. 2006, Schandl et al. 2008

During the 20th century

Global material extraction
1900-2005



Global metabolic rates
1900-2005

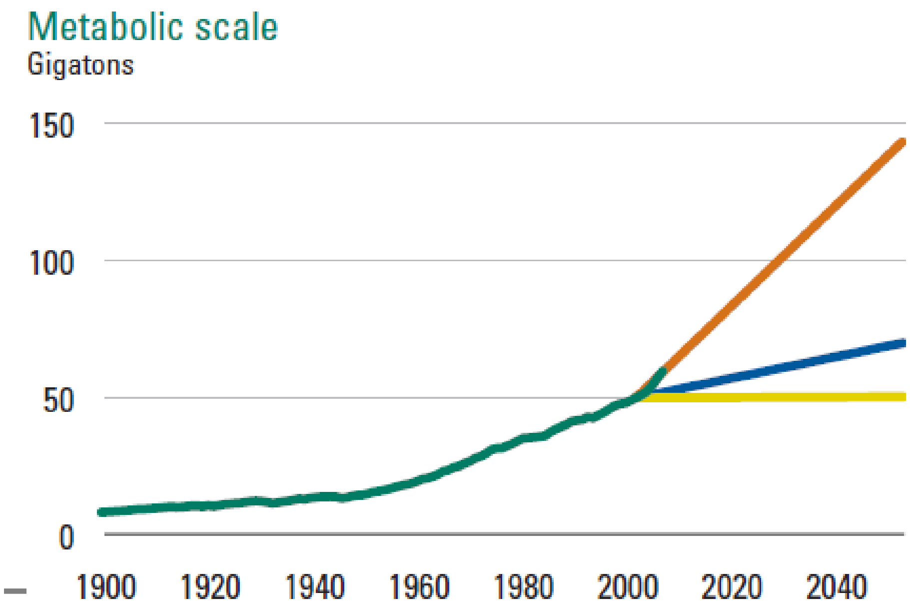


Source: UNEP International Resource Panel, Decoupling Report 2011

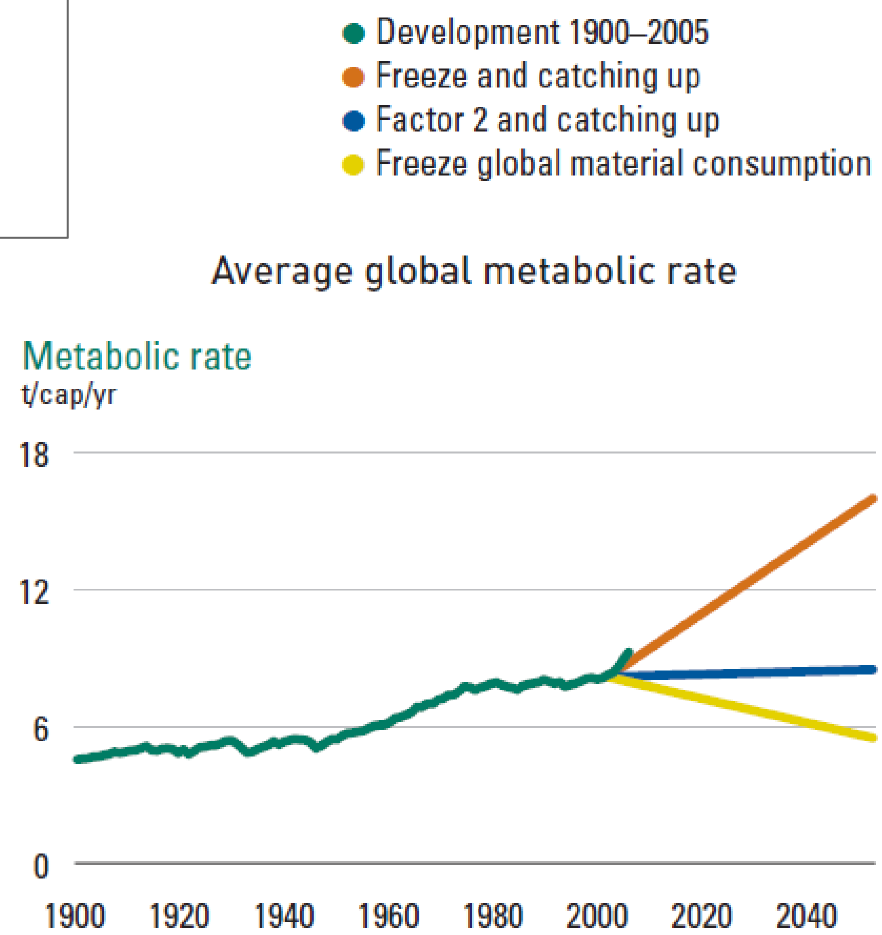
Trend scenario: tripling of annual global resource extraction by 2050

Alternative: per capita resource consumption of industrial economies declines (50%), rest of the world can converge to same level

Global metabolic scale



Average global metabolic rate



Source: UNEP International Resource Panel, Decoupling Report 2011

This BAU growth dynamics must not be sustained on a limited planet

- Limits to non-renewable resources
- Limits to renewable resources and biocapacity
- Limits to the absorption capacity for human wastes and emissions
- Limits to our right to plunder the planet at the expense of future human generations and all other living beings

The current industrial metabolism is detrimental in two ways:

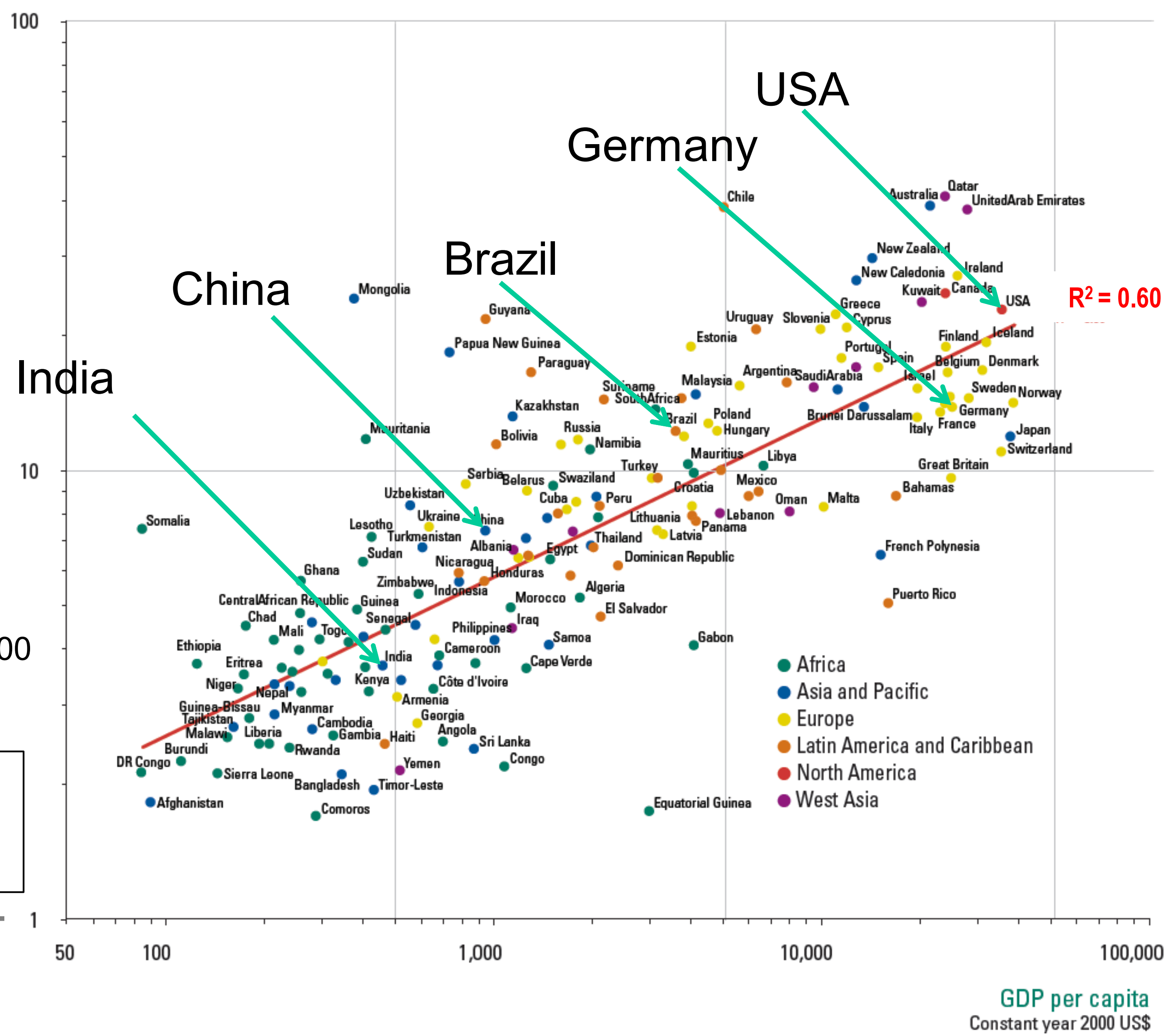
1. By using the majority of the world‘s resources for the benefit of 20% of its (current) population
2. By providing a model that the rest of the world is quickly trying to emulate (and is actively induced to emulate for the sake of global markets)

2. How can downsizing of industrial metabolism happen?

Drivers of the scale of industrial metabolism

- **Population**: population is the strongest driver of the scale of social metabolism (elasticity ~ 1). Population growth in mature industrial countries is low (fed mainly by immigration) and may turn negative in this century.
- **Income**: is a somewhat weaker driver (elasticity ~ 0,7), there is „decoupling". During the 20th century, av. global income increased 5,4 fold, while material use per capita increased just 3,2 fold. „Degrowth" in per capita income would presumably reduce metabolic rates.
- **Energy availability**: Energy and materials use are directly causally related. A „dematerialization" of energy (e.g. solar instead of fossil fuels) will directly reduce materials use. A decline in available primary energy (scarcity, cost barriers) would strongly lower metabolic scale.
- **Material efficiency**: in contrast to arguments based on selected technical cases („Factor 5", „Factor 10"), on a macro level, material efficiency gains contribute only marginally to keeping material use at bay and are to a large degree compensated for by rebound effects.
- **Structural change**: structural change from a biomass-based (agrarian) social metabolism to a fossil-fuel-based industrial metabolism induces technology change *increasing* material consumption (see Kaya analysis in UNEP-CSIRO 2010), structural change from fossil fuel based to renewables (*Energiewende*) would drive dematerialization.

Sociometabolic rates: A log-log-linear function of per capita income



Data for the year 2000

Source: UNEP Decoupling Report 2011.

Raising material efficiency I: J. Allwood‘s et al. *White Paper (2011)*

Extensive meta-analysis of literature illustrates:

- Plausible material efficiency improvements in production and processing of steel, cement, plastic, paper & alluminium will not amount to the CO^2 reductions required by IPCC targets
- There are strong economic and business barriers to adopting material efficiency strategies (lock-in with production systems based on cheap energy; business models oriented at growing sales motivate towards *planned obsolescence…*)
- There are strong social barriers (fashion and lack of emotional attachment to *things*, convenience creating overcapacities, no moral disapproval of wasting any more, pervasive idealized life styles…)
- Mechanisms promoting material efficiency are comparatively weak (business opportunities for second-hand and leasehold, resource and waste taxes, voluntary simplicity on the consumer side…)

J.Allwood, M.F. Ashby, T.G.Gutowski & E.Worrell, Material Efficiency: A white paper. Resources, Conservation and Recycling 55(2011), 362-381

Raising material efficiency II: „Closing the Eco-Innovation Gap in Europe“

- Survey of 600 000 companies in all European countries found 320 000 „innovators“, but only 80 000 companies trying to reduce material use
- DEMEA analyzed 100 case studies in Germany for financial impact of resource savings, arriving at estimates between 1% - 2,3% of output annually (much lower with large, higher with small companies)

EIO (2012), Closing the Eco-Innovation Gap. An economic opportunity for business. Brussels (DG Environment)

Resource use reduction targets for EU 27

	Ambitious	Moderate	Conservative
GHG emissions (baseline 1990)	-30% by 2020 -95% by 2050	-20% by 2020 -80% by 2050	-20% by 2020 -50% by 2050
Energy consumption (GIEC) (baseline 2005)	-20% by 2020 -40% by 2050	-15% by 2020 -30% by 2050	-10% by 2020 -20% by 2050
Material use (DMC) (baseline 2005)	-30% by 2020 -70% by 2050	-10% by 2020 -30% by 2050	-5% by 2020 -20% by 2050
Land use	Zero net demand of foreign land by 2020	Zero net take of artificial land by 2020	Limit annual net increase of artificial land to 200 km^2 by 2020
Water use Water Exploitation Index (WEI)	<20% WEI by 2020 <10% WEI by 2050	<25% WEI by 2020 <20% WEI by 2050	<30% WEI by 2020 <25% WEI by 2050
Legend for feasibility:	Possibility to achieve targets with significant changes in levels of activity and significant advancement from known and future technologies	Possibility to achieve targets with slight changes in levels of activity and greater investments in known technologies	Possibility to achieve targets while maintaining current levels of activity and cost effective investments in known technologies

Source: BIOIS, SEC & SERI (2012), Assessment of Resource Use Indicators, report to DG Environment, p. 96

Multi-Return strategies for resource use reduction

- **Changing the human diet** towards a lower share of animal based food. Tackling this will have several effects:
  - Positive effects on human health (less obesity, less cardiovascular diseases, lower risk of livestock-related epidemics)
  - Decreasing livestock and thus lowering pressure on land because less land area is needed for agricultural production (i.e. market fodder for livestock)
  - Lowering pressures on groundwater (nitrification)
  - Savings of energy (cooling, transportation)
  - Decreasing GHG emissions from ruminants
  - Savings on water use

- **Steady stocks of built-up infrastructure and densification of settlements**, reducing urban sprawl
  - decreasing material use, i.e. construction minerals, metals use in infrastructure,
  - facilitating a continuous recycling of construction materials
  - decreasing energy use for the construction of infrastructure, in transport and in the use phase (more efficient heating, shorter distances)
  - decreasing use of land area and sealing of land

Source: BIOIS, SEC & SERI (2012), Assessment of Resource Use Indicators. Report to DG Environment, p. 81

Question 2: Conclusion

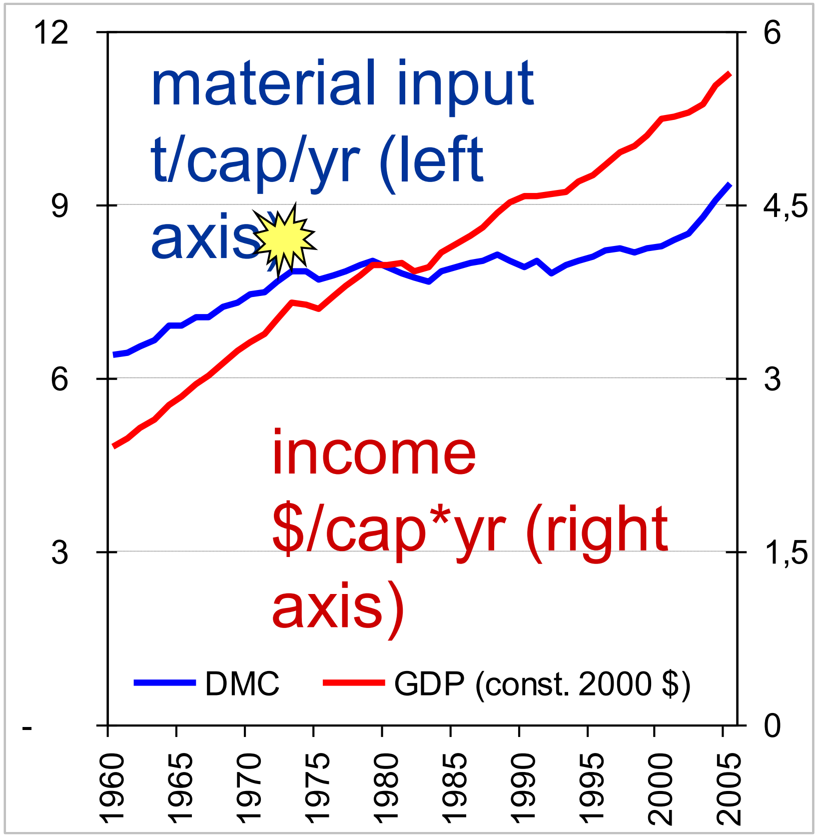
- Under the structural conditions prevailing in the past decades – emphasis on economic growth, emphasis on private rather than public goods, emphasis on increasing profits in the financial sector – efforts at climate protection, saving of natural resources and driving material efficiency towards dematerialization proved relatively futile.
- In particular, increases in material efficiency = resource productivity = *decoupling* did generally not decrease resource use; (over)compensation by economic growth
- Can we detect signs of new structural conditions that would offer better framework conditions?

3. Why will a downsizing of industrial metabolism indeed happen?

A sociometabolic transformation is currently ongoing …

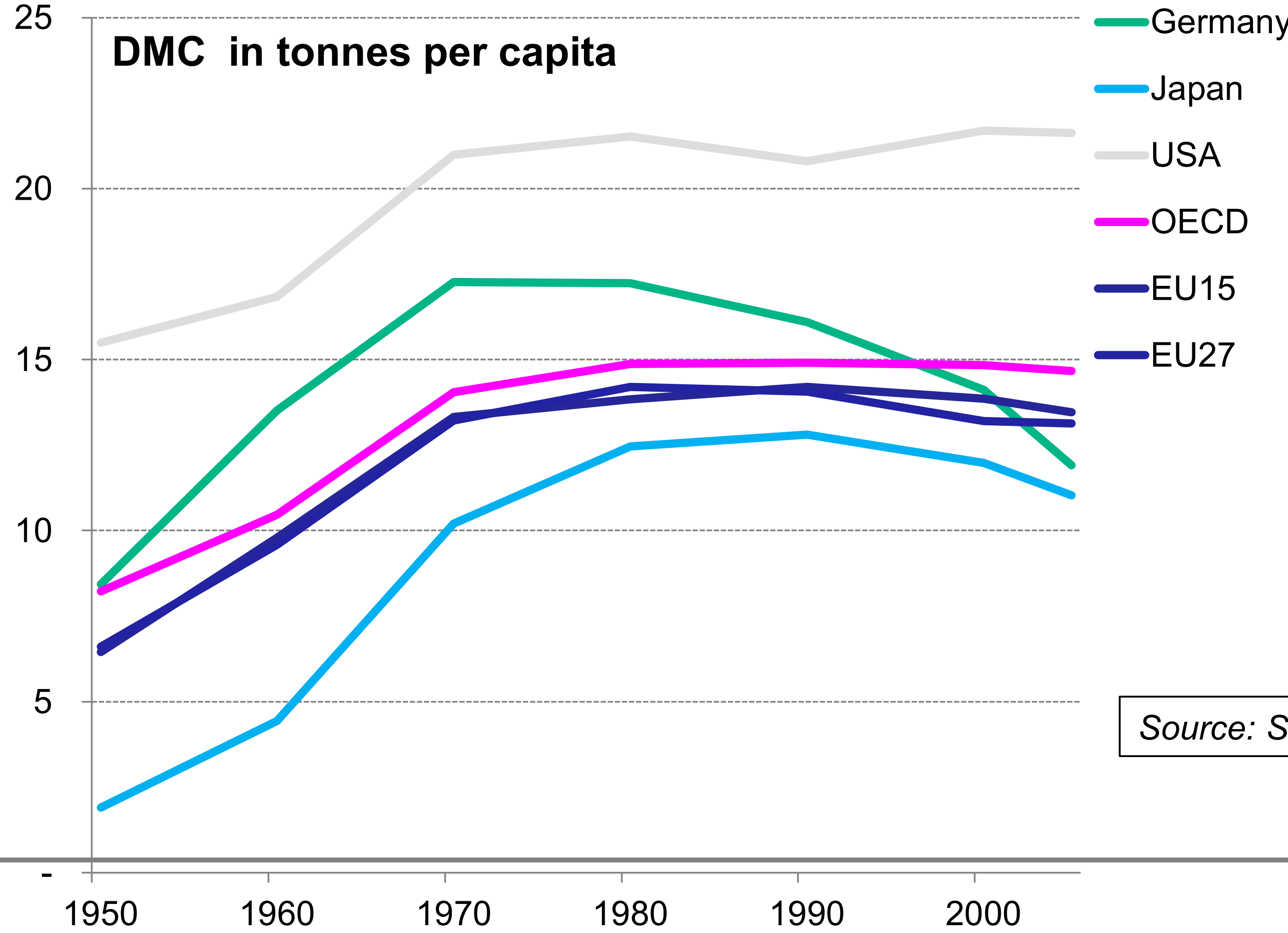
- Since the early 1970s the mature industrial countries worldwide showed indications of biophysical saturation on a high level of resource consumption, while the economies kept growing.

Global metabolic rates grow slower than income, in particular since the first oil crisis



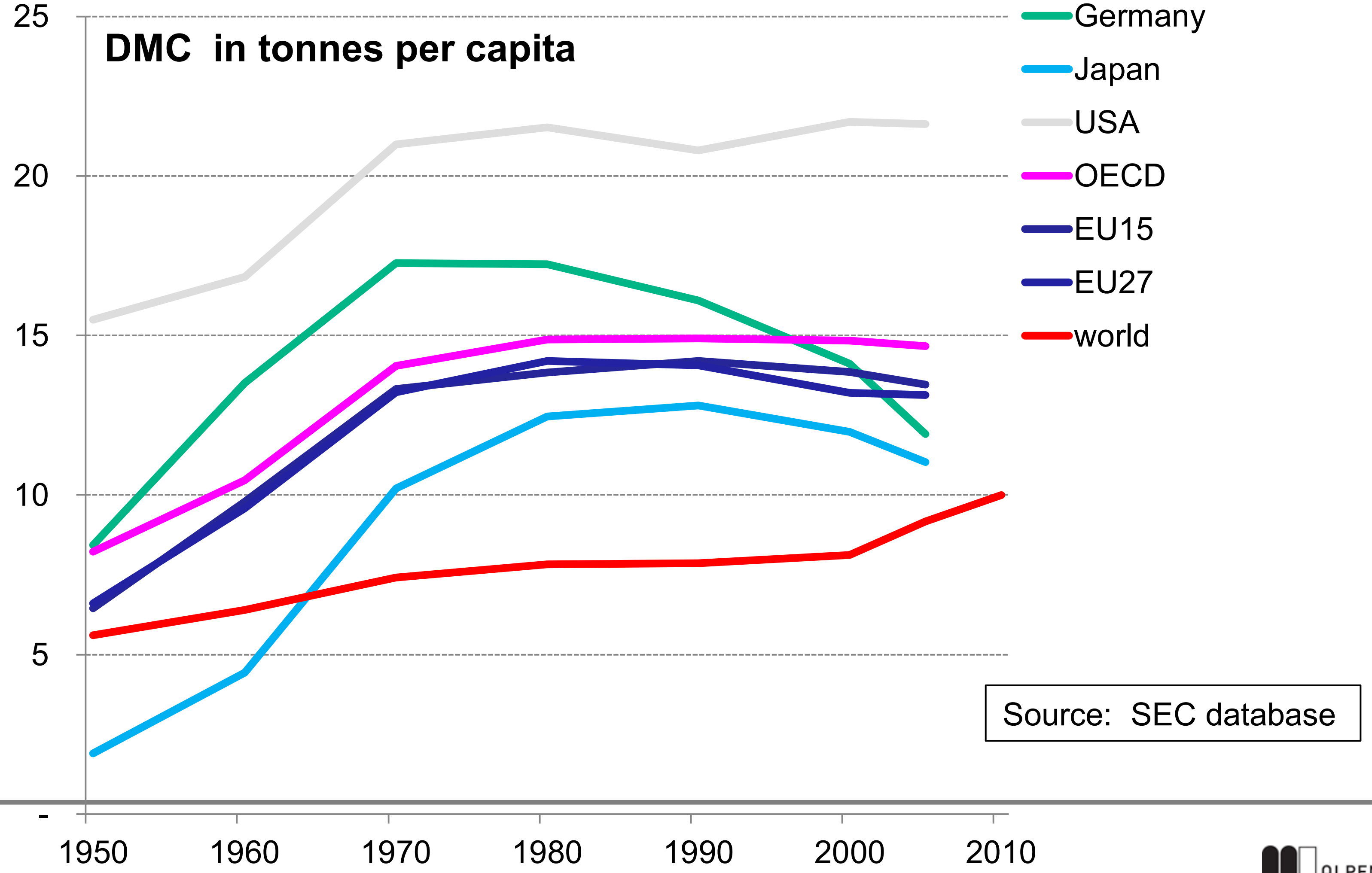
Source: after Krausmann et al. 2009

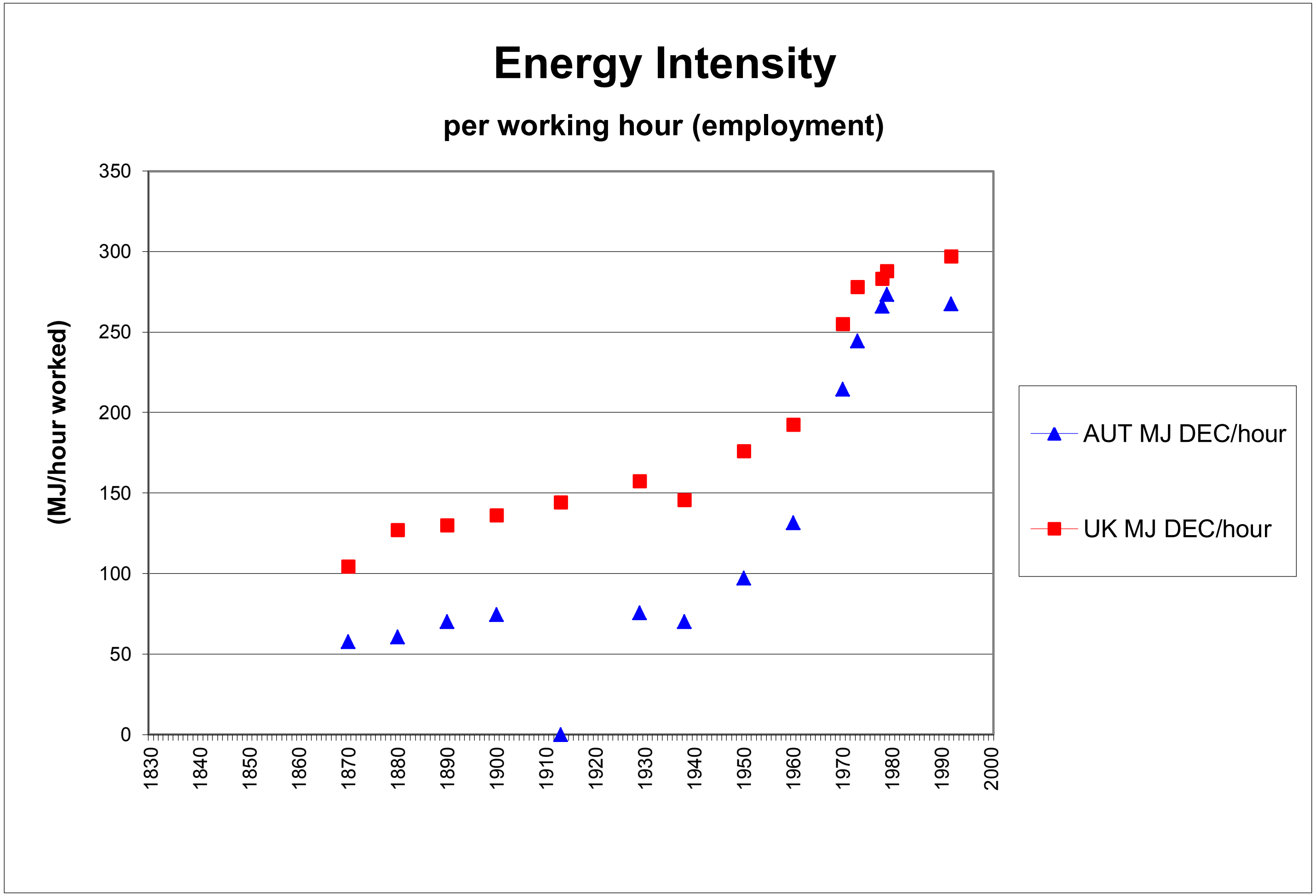
Mature industrial countries: stagnation of resource use since the early 1970s, despite income growth



Source: SEC database

Mature industrial countries: stagnation of resource use since the early 1970s, despite economic growth





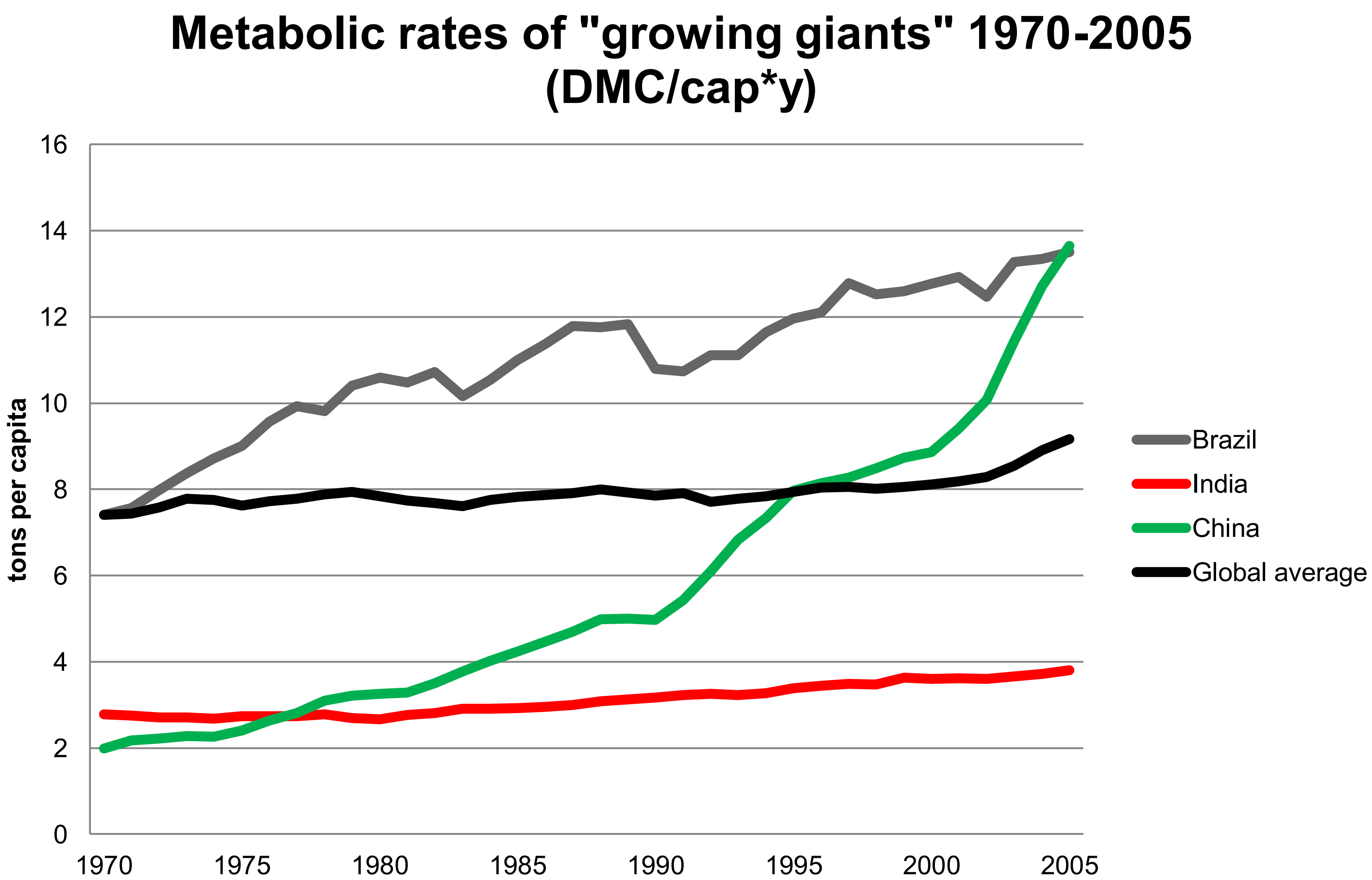
based on Krausmann 2001 and Maddison 2008, SEC data base
(ongoing project: „Arbeit und Energie: Österreich“, funded by BMLFUW)

A sociometabolic transformation is currently ongoing …

- Since the early 1970s the mature industrial countries worldwide show indications of biophysical saturation on a high level of resource consumption, while the economy keeps growing: „decoupling“

- At the same time, the „historic“ Great Transformation happens in many emerging economies: they transit from agrarian to fossil-fuel based industrial. Their population size is much larger that that of the mature industrial economies. They emulate the industrial countries model of welfare by high resource consumption.

Emerging economies: take off and accelleration in the transition to high resource use



Sources: UNEP Asia & Pacific 2011, SEC database

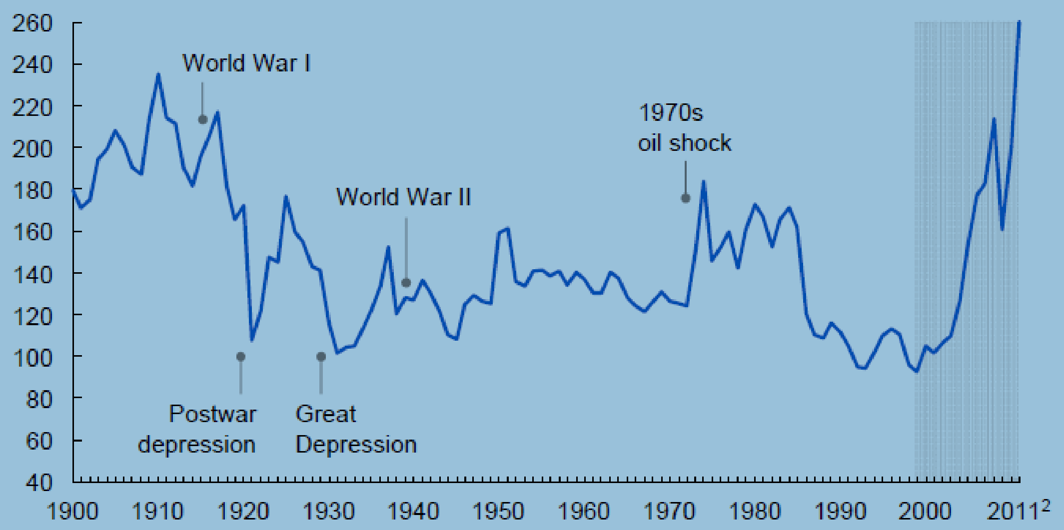
HOWEVER:
Downsizing is no more just a moral appeal:
new forces are at work…

Unprecedented rise in commodity prices

Exhibit E1

Commodity prices have increased sharply since 2000, erasing all the declines of the 20th century

MGI Commodity Price Index (years 1999–2001 = 100)[1]



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.

SOURCE: Grilli and Yang; Stephan Pfaffenzeller; World Bank; International Monetary Fund (IMF); Organisation for Economic Co-operation and Development (OECD); UN Food and Agriculture Organization (FAO); UN Comtrade; McKinsey analysis

Source: **McKinsey** Global Institute. 2011. Resource Revolution: Meeting the world's energy, materials, food and water needs. www.iwar.tu-Darmstadt.de

Exhaustion of the mineral resource base?

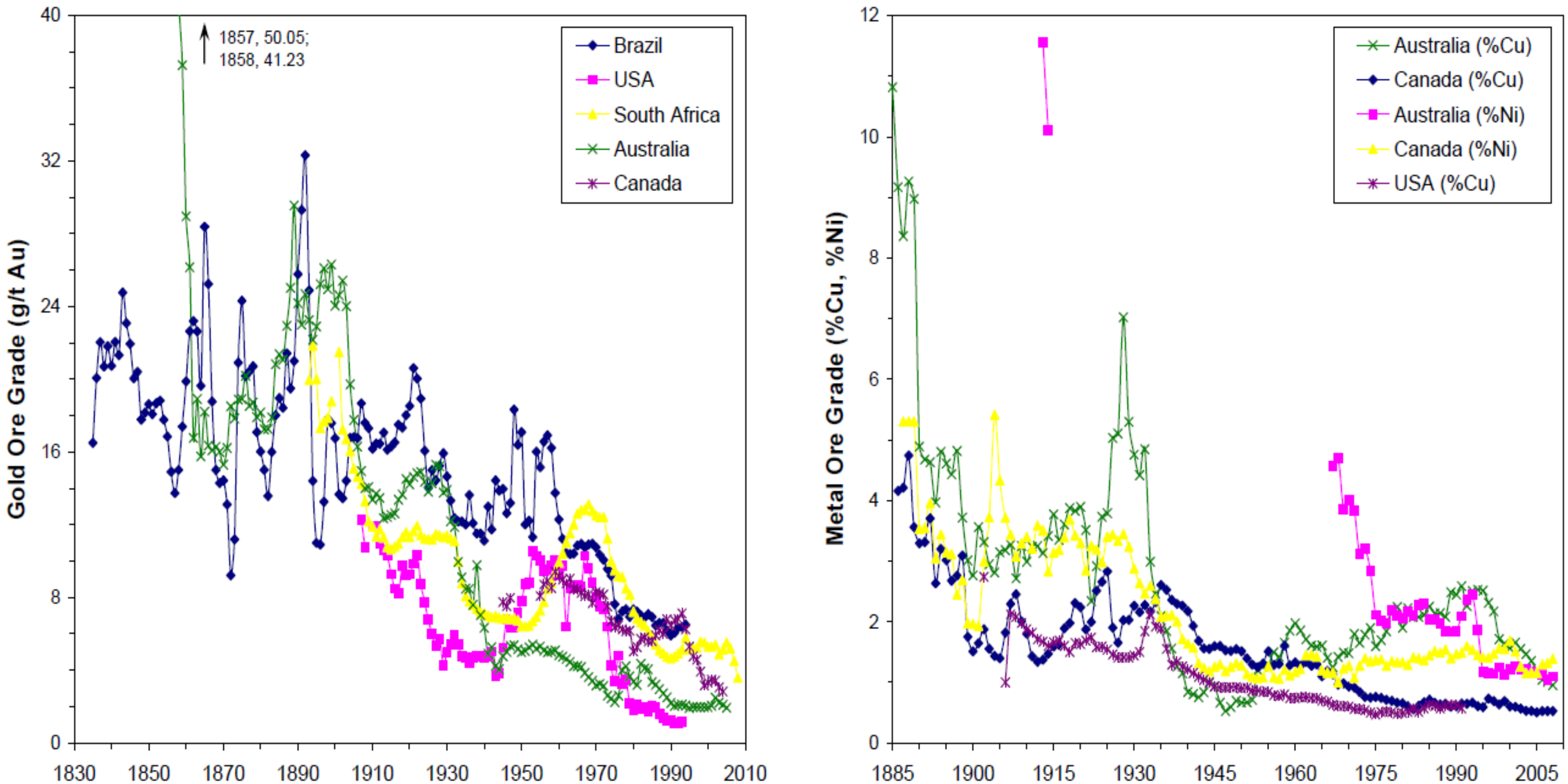


Figure A2.1: Declining ore grades in the major producing countries

Source: Giurco et al, 2010, p.28: based on Mudd 2010, 2009, 2007

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Key messages from McKinsey's (2011) *Resource Revolution*

- Over the past century, progressively cheaper resource prices have underpinned economic growth.
- Has changed: prices have risen since the turn of the century (+147% real commodity prices, 100% increase in av cost to bring a new oil well on line since 2000). Resource price inflation and volatility could further increase.
- At least $ 1 trillion more investment in the resource system (1/3 more than currently) is needed per year to meet future demands
- Need to achieve a resource productivity revolution comparable to the labour productivity revolution of the 20th century
- Supply of oil and natural gas could fall by approx. 6% per year, supply of coal by 3%
- Growing concern about inequality might require action

Ch 1: „*The resource intensive growth model of the past*" … needs to be abandoned (that is what they say *p.21ff)*

Randers‘ „2052“ Club of Rome Projection (2012): core assumptions about global dynamics that make a difference:

- Population will peak much earlier than current UN projections, because of reduced family size in increasingly urban populations (emulating the case of the EU 1950-2010, p.366). Peak assumed at about 2035 (63)

- Labour productivity will grow ever more slowly, because of a shift of work towards caretaking of an aging population (that is difficult to rationalize) and because of social conflicts and tensions that make fine-tuning difficult (emulating the case of the US 1950-2010, p.367)

- An increasing share of GDP will have to be invested to solve the emerging problems of depletion, pollution and inequity, prevention and adaptation. This will reduce the share available for consumption (55).

Increasing investment …throwing money at problems…

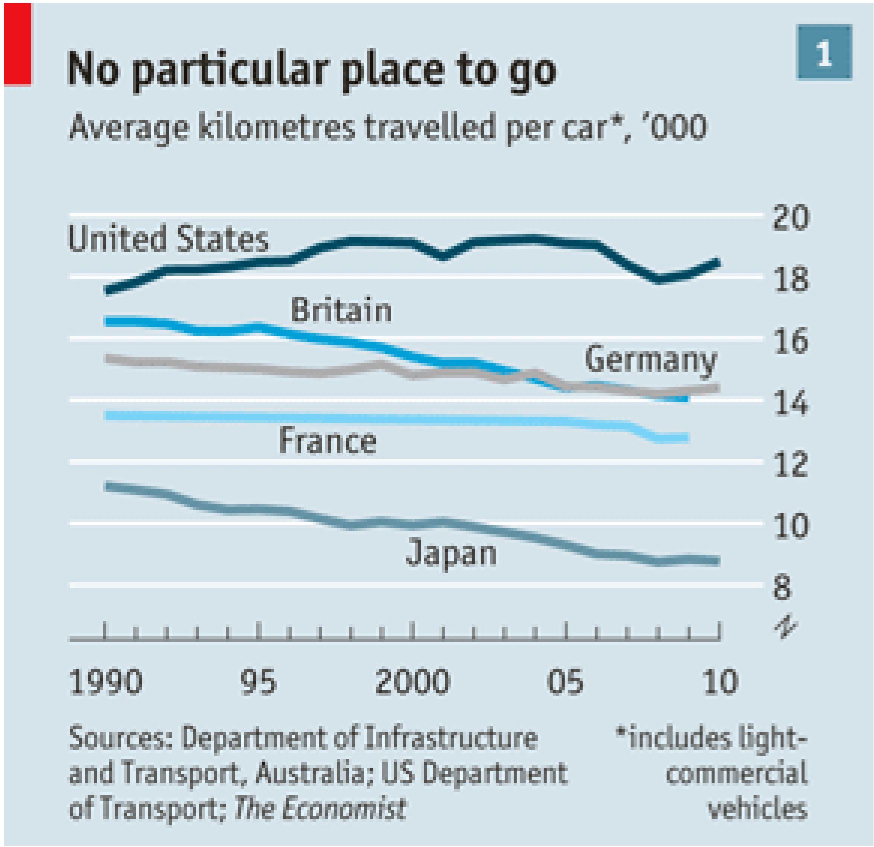
"…increasing scarcity of various resources, unpleasant accumulation of various pollutants, imminent loss of selected species and ecosystems, growing needs to defend our buildings against new and scary weather patterns, time consuming problems associated to congestions… (will initially not) lead to a decision to pull back, … instead (to) a decision to throw money at the problem."(76)

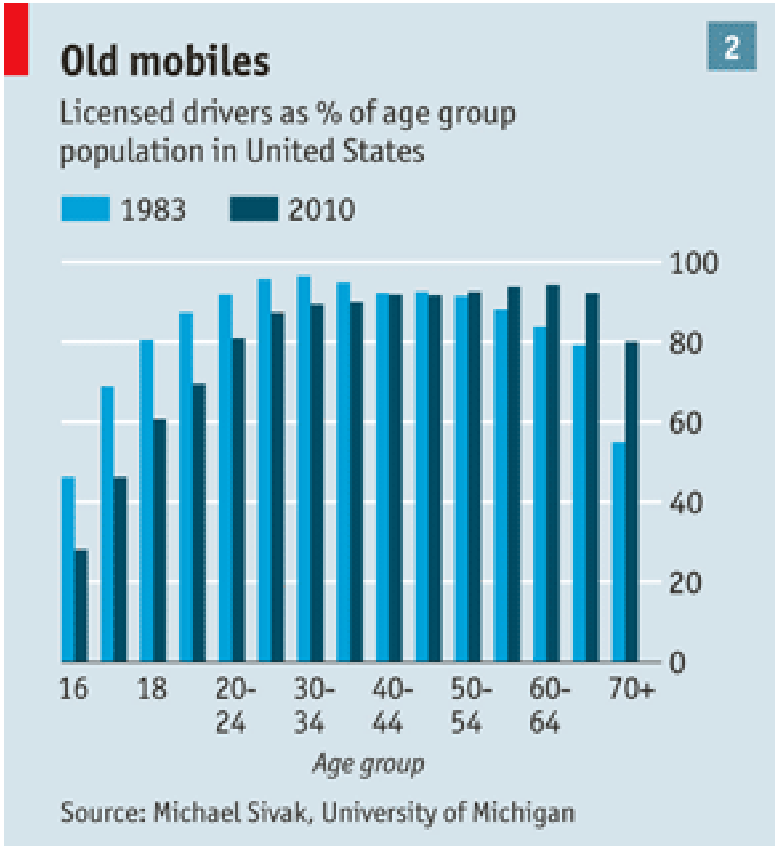
The increasing investment may be *forced* (ex post, as after a hurricane) or *voluntary* (ex ante as with developing new low carbon energy sources).

New structural framework conditions ahead

- Basically Randers says: structural change, and an end to consumption growth, will be forced upon humanity. But global society won‘t do its job properly, at least not in time to escape disaster 2050-2100.
- In the coming decades, the mature industrial countries will face slow economic growth, if growth at all. Slow economic growth will first hurt the low income groups, and this will create political conflicts – which are in part necessary to stimulate change.
- I also believe that the convincing response to this are not futile efforts at recapturing economic growth, but to focus on a more equal distribution of human wellbeing and how this can be achieved at lower environmental cost.
- Talking in complex systems‘ terms, we might be at the take-off point to a new sociometabolic regime – all of a sudden, things could start moving much faster.

The *Economist's* final kick: Peak Car?





The Future of Driving. Seeing the Back of the Car? The Economist Sept. 22nd, 2012. http://www.economist.com/node/21563280

Major recent global sustainability reports

- **McKinsey** Global Institute. 2011. Resource Revolution: Meeting the world's energy, materials, food and water needs. www.iwar.tu-Darmstadt.de
- **Randers, J**. 2012. 2052. A Global Forecast for the Next Forty Years. A Report to the Club of Rome. White River Junction, Vermont: Chelsea Green Publishing.
- **Raskin, P. D.,** C. Electris, R. A. Rosen. 2010. The Century Ahead: Searching for Sustainability. Sustainability. 2: 2626-2651.
- The **Royal Society**. 2012. People and the Planet. London: The Royal Society.
- **UNEP,** International Resource Panel. 2011. Decoupling Resource use and Environmental Impacts from Economic Growth. Paris: UNEP
- **WBGU** (German Advisory Council on Global Change) 2011. World in Transition. A Social Contract for Sustainability. Flagship Report. Berlin: WBGU.