GREEN GROWTH
knowledge platform

Green Growth Knowledge Platform
Conference January 12-13, 2012
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Parallel Session 1b. Infrastructures and Urban Development

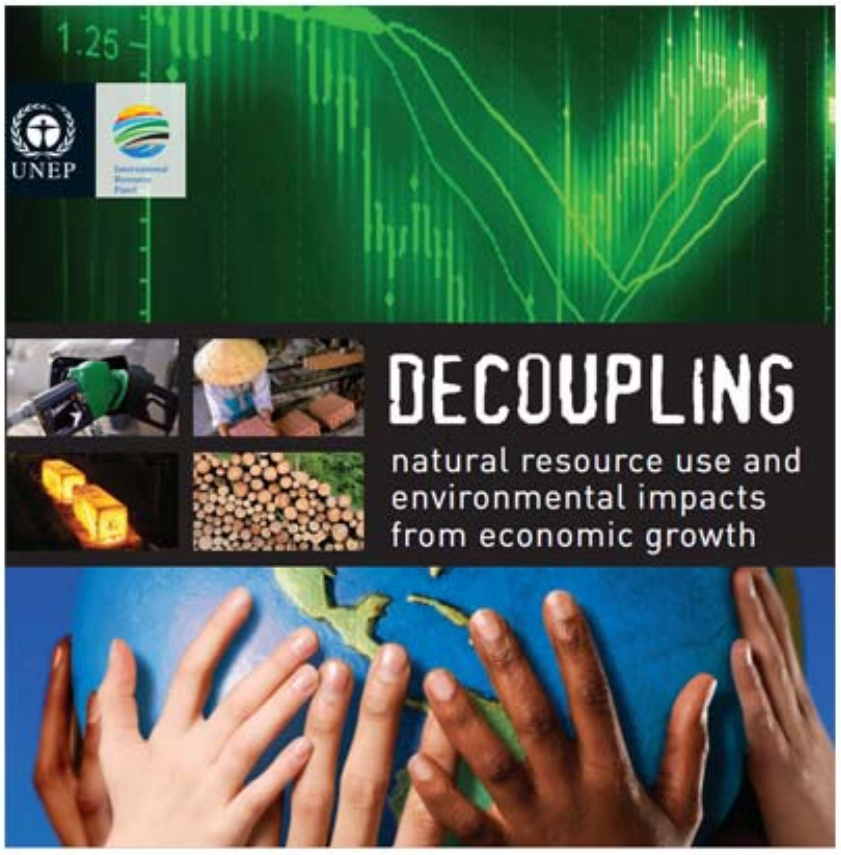
Decoupling infrastructures from resource consumption

Prof. Ernst Ulrich von Weizsäcker
Co-Chair

UNEP

International Resource Panel

‚Decoupling‘ is at the core of *Sustainable Development.*



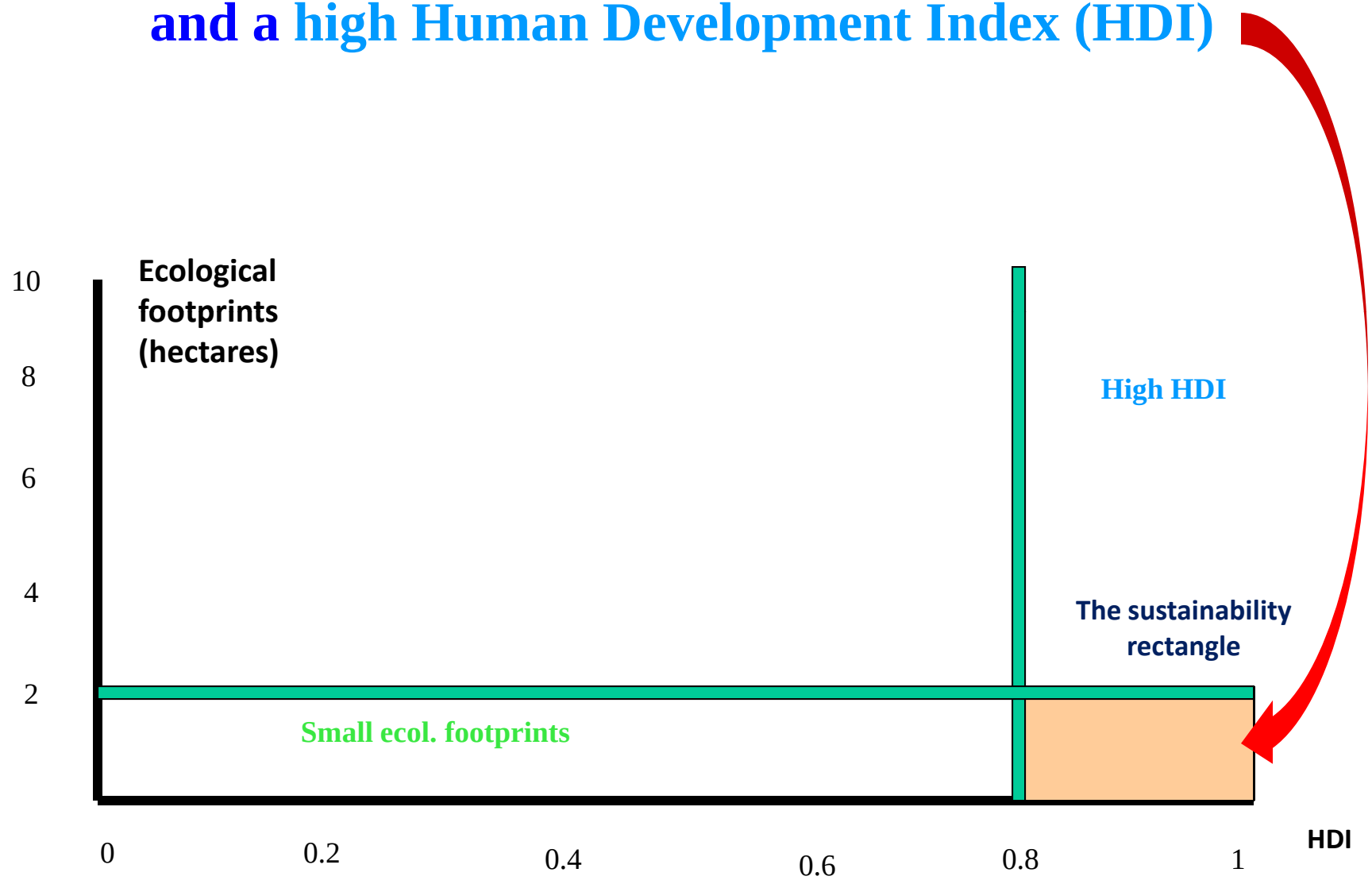
And it‘s at the heart of the agenda of the International Resource Panel

UNEP

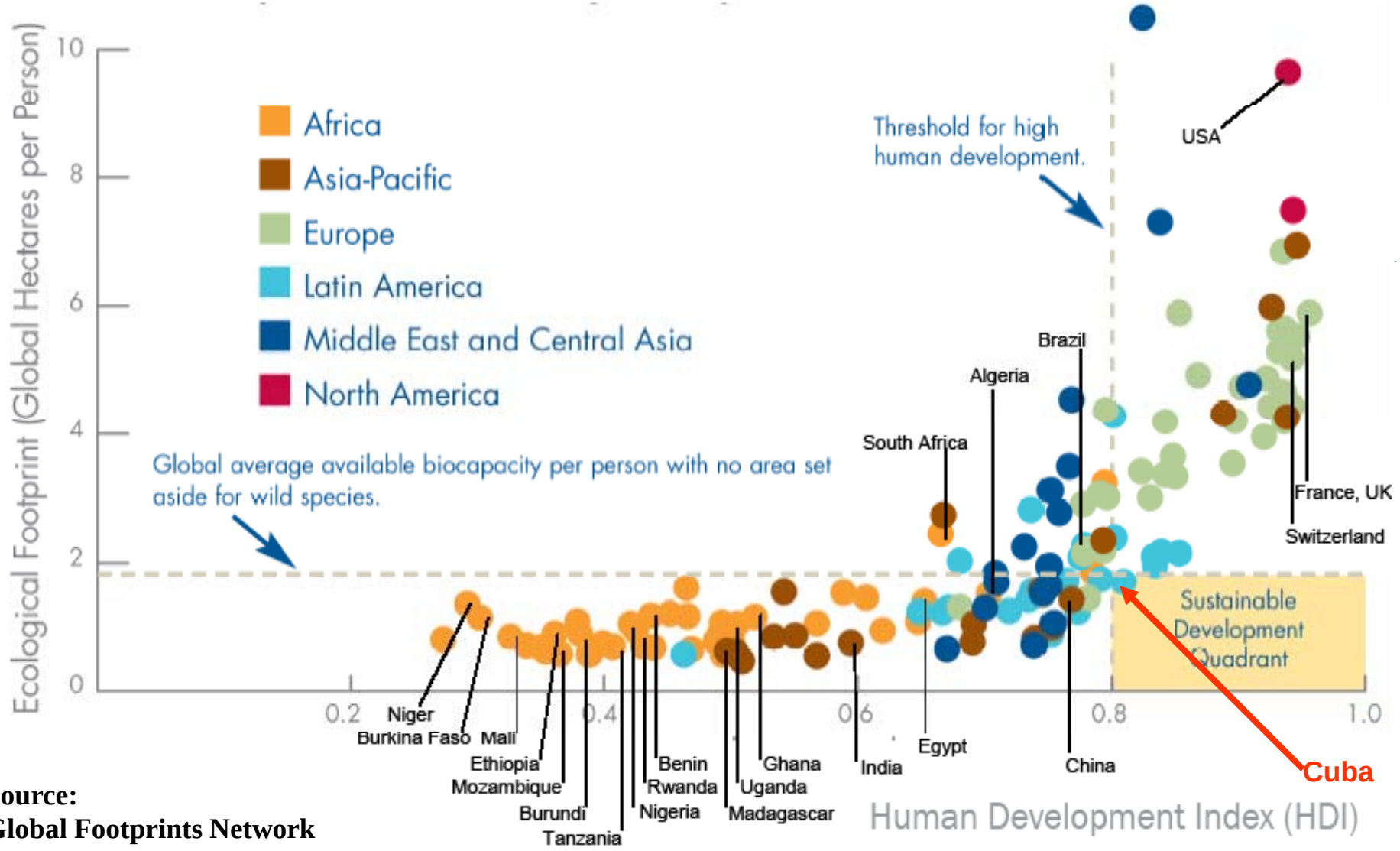
International Resource Panel

How can we conceptualize Sustainable Development?

Sustainable development means small ecological footprints and a high Human Development Index (HDI)

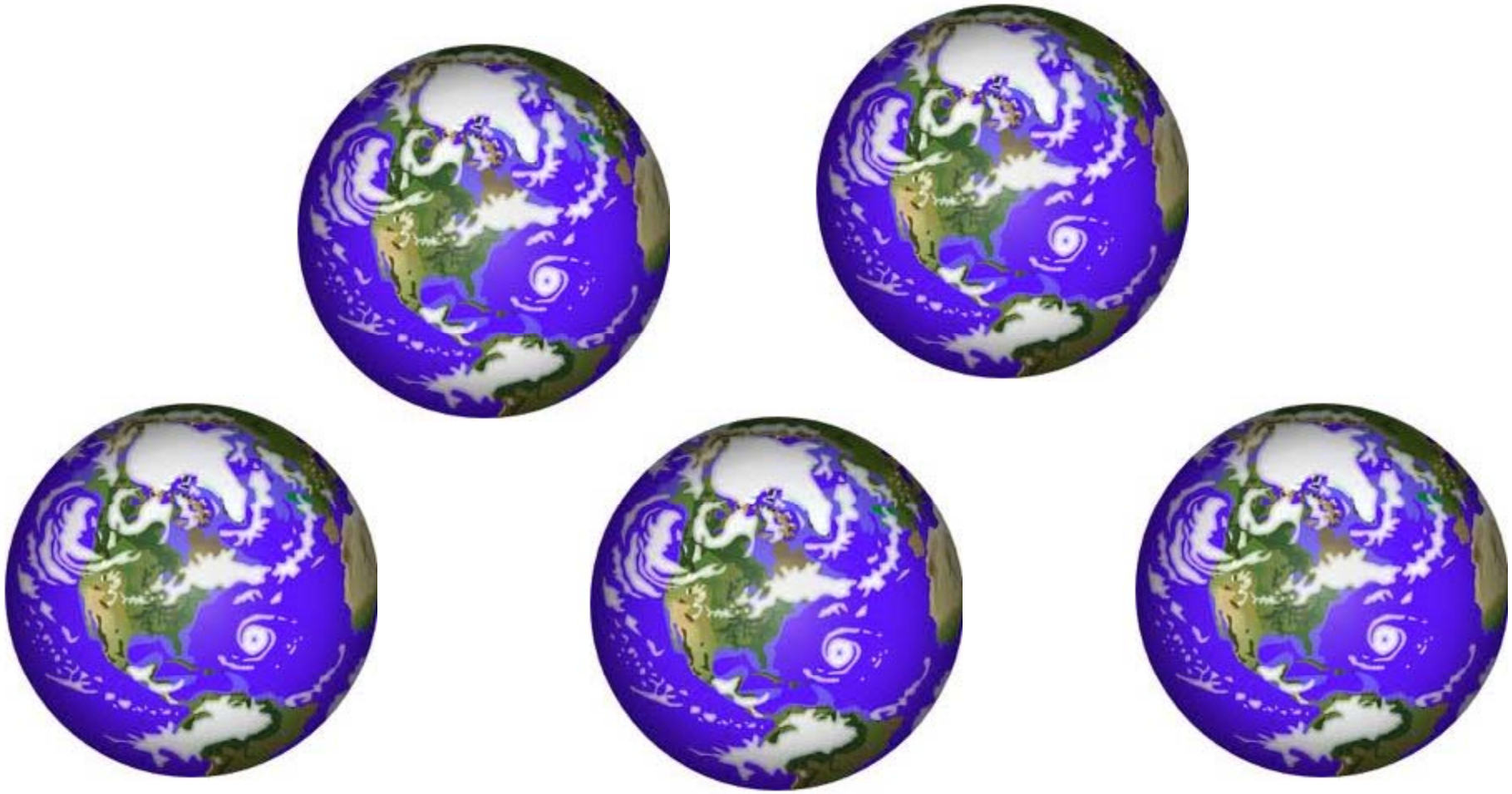


Alas, only one country currently populates the sustainability rectangle

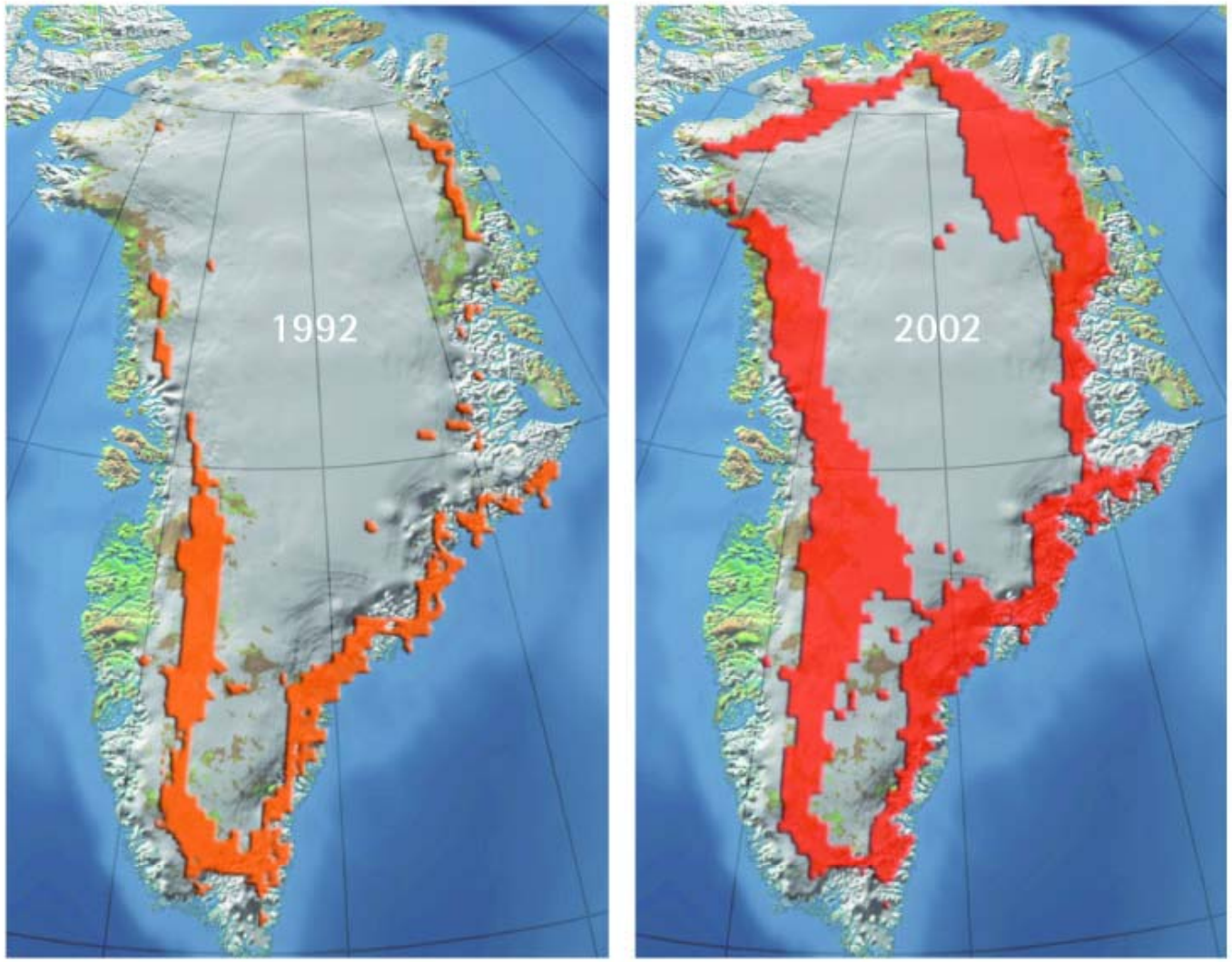


Source:
Global Footprints Network

If 7 b people had US American footprints, we would need 5 planets Earth

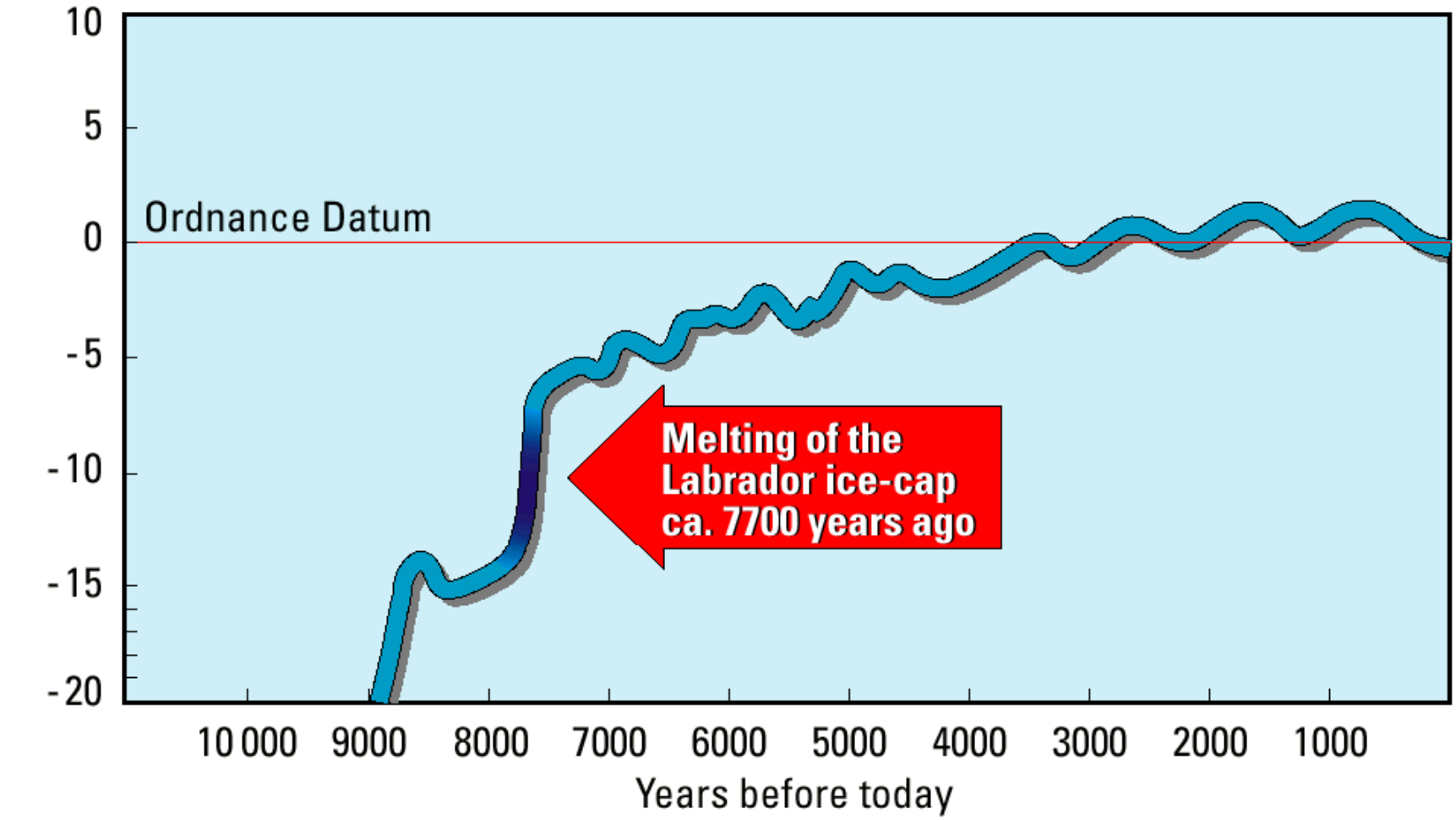


We seem to be destabilizing Greenland. (Freshwater coverage during Summers 1992 and 2002)



Sea level rise can take catastrophic speed!

(after Michael Tooley. Global sea-levels: floodwaters mark sudden rise. Nature 342 (6245), p 20 - 21 1989)



If the Greenland ice breaks off, a billion people are in danger of losing their homes, mostly in Asian agglomerations.

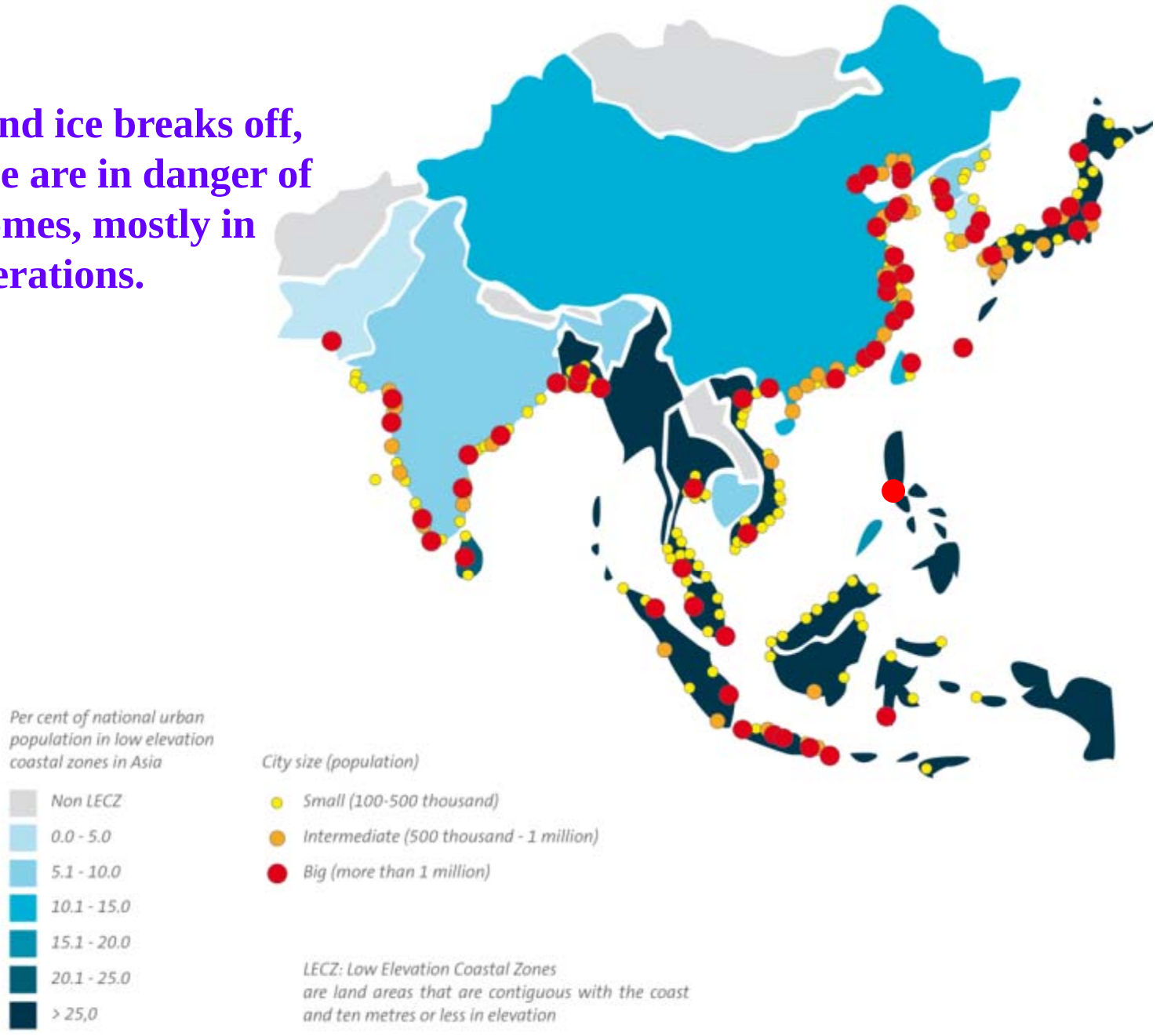
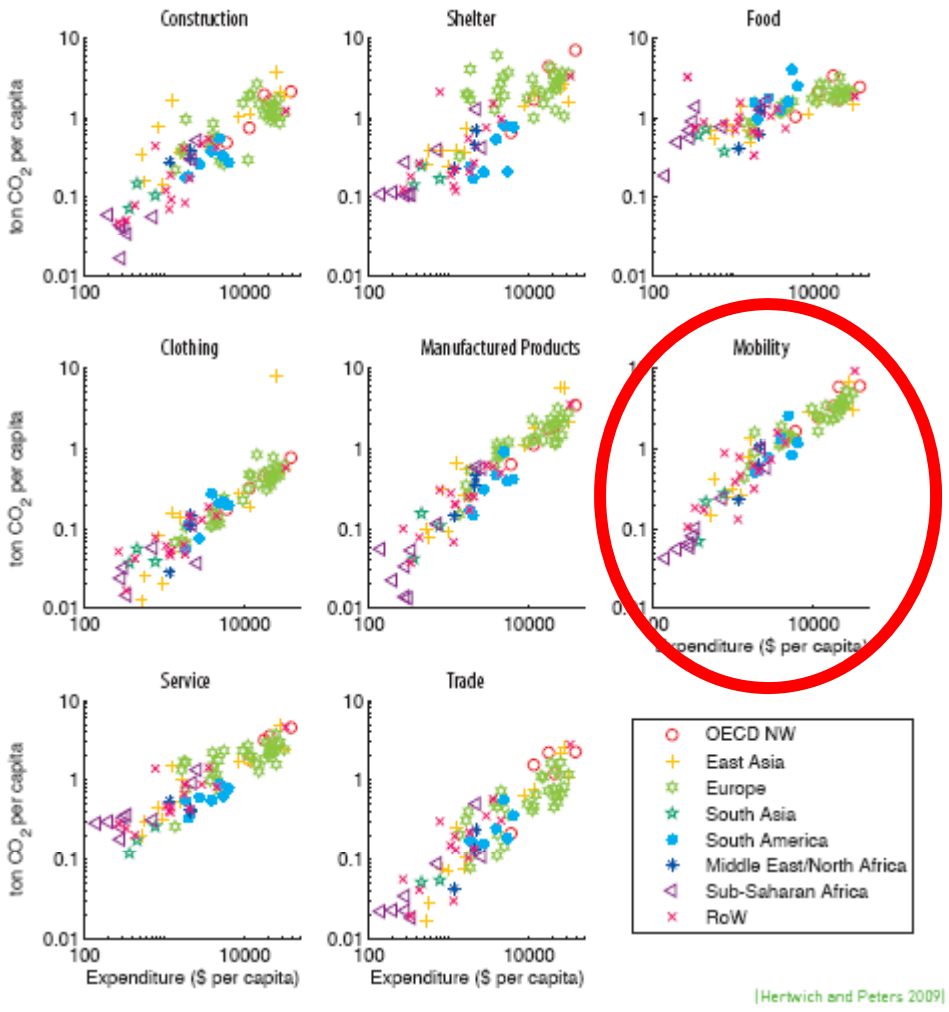


Figure 4.6: Carbon footprint (tonnes of CO_2 equivalents per capita in 2001) of different consumption categories in 87 countries/regions as a function of expenditure ($ per capita)



(Hertwich and Peters 2009)

Note: OECD NW stands for the "New World" countries in the OECD, i.e. Australia, Canada, Mexico, New Zealand and the US. "RoW" represents various aggregate regions.

So far, carbon footprints grow in all sectors, including mobility.

Source: Priority Products and Materials. UNEP Resorce Panel, Nairobi, 2010, p24.

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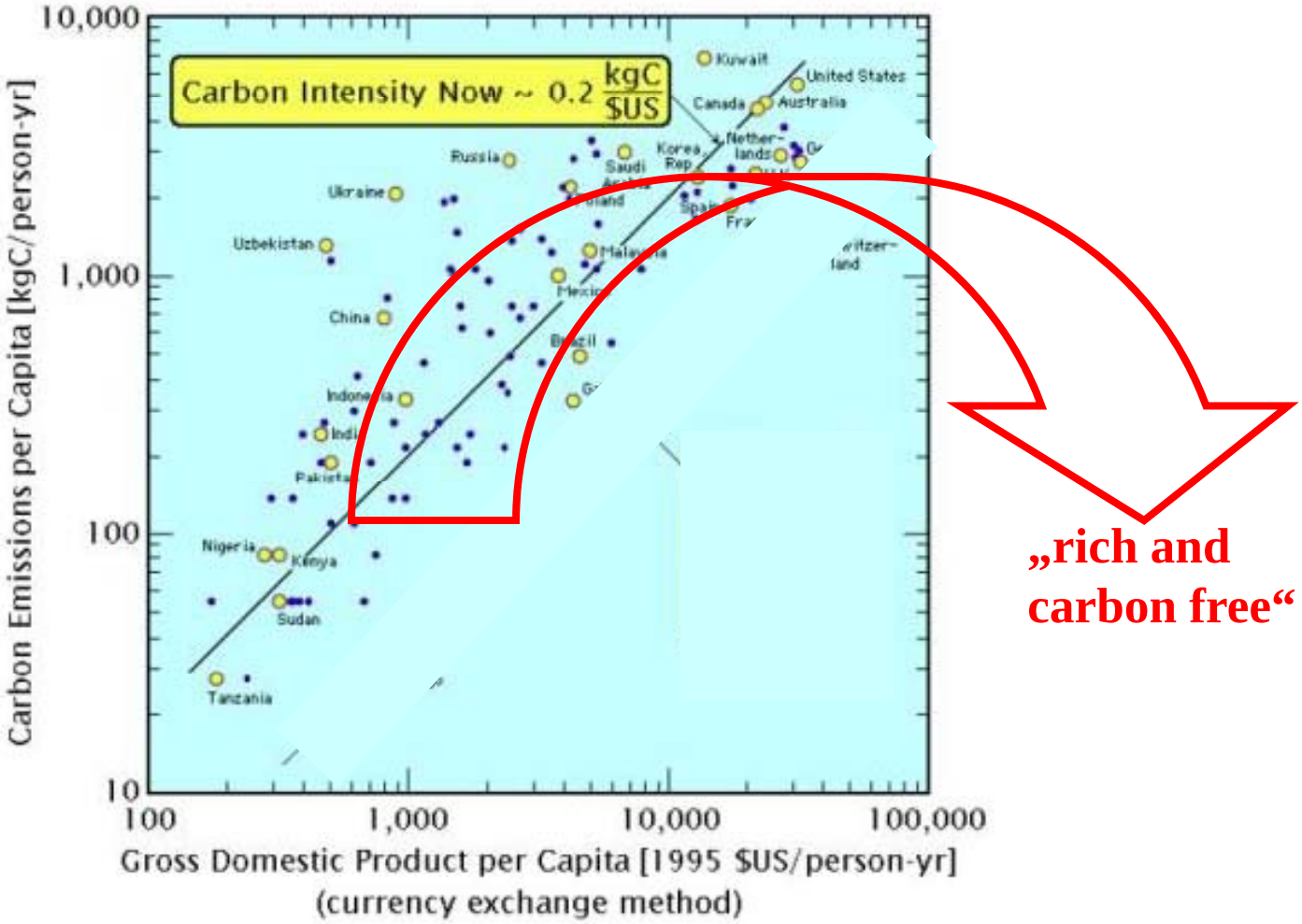
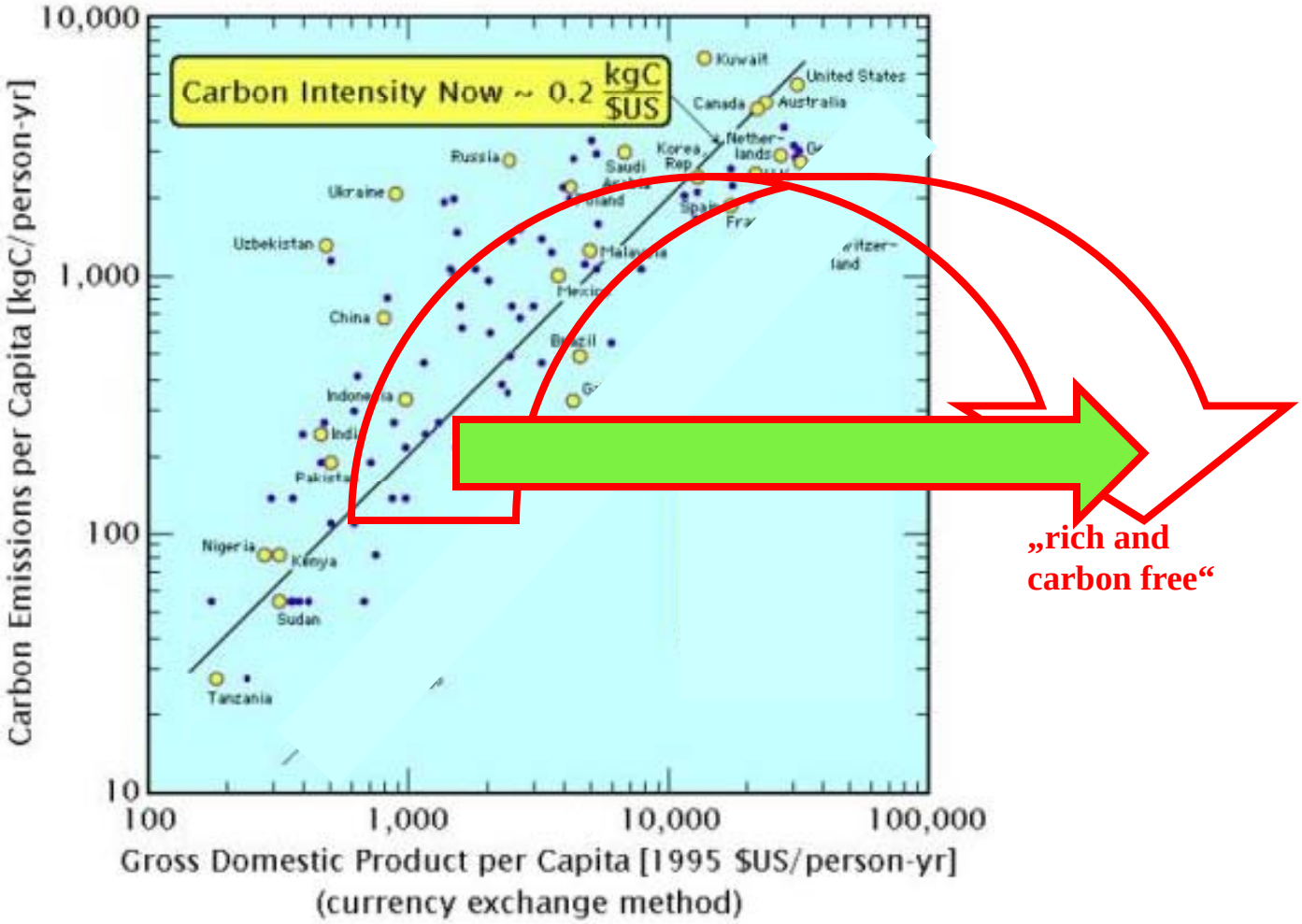
Generally, GDP goes with CO_2 intensity. We have to break this correlation, i.e. create a Kuznets Curve of decarbonization.



„rich and carbon free“

And help poorer countries tunneling through it.



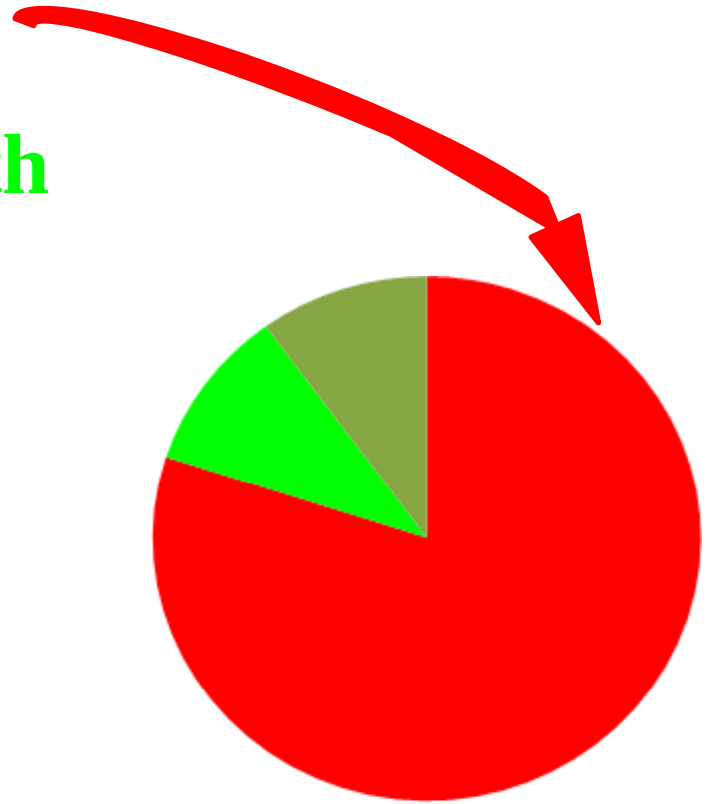
Three methods of decarbonization:

- **Less CO_2 in energy**
- **Less energy in wealth**
- **Less wealth**

Conventional thinking suggests:

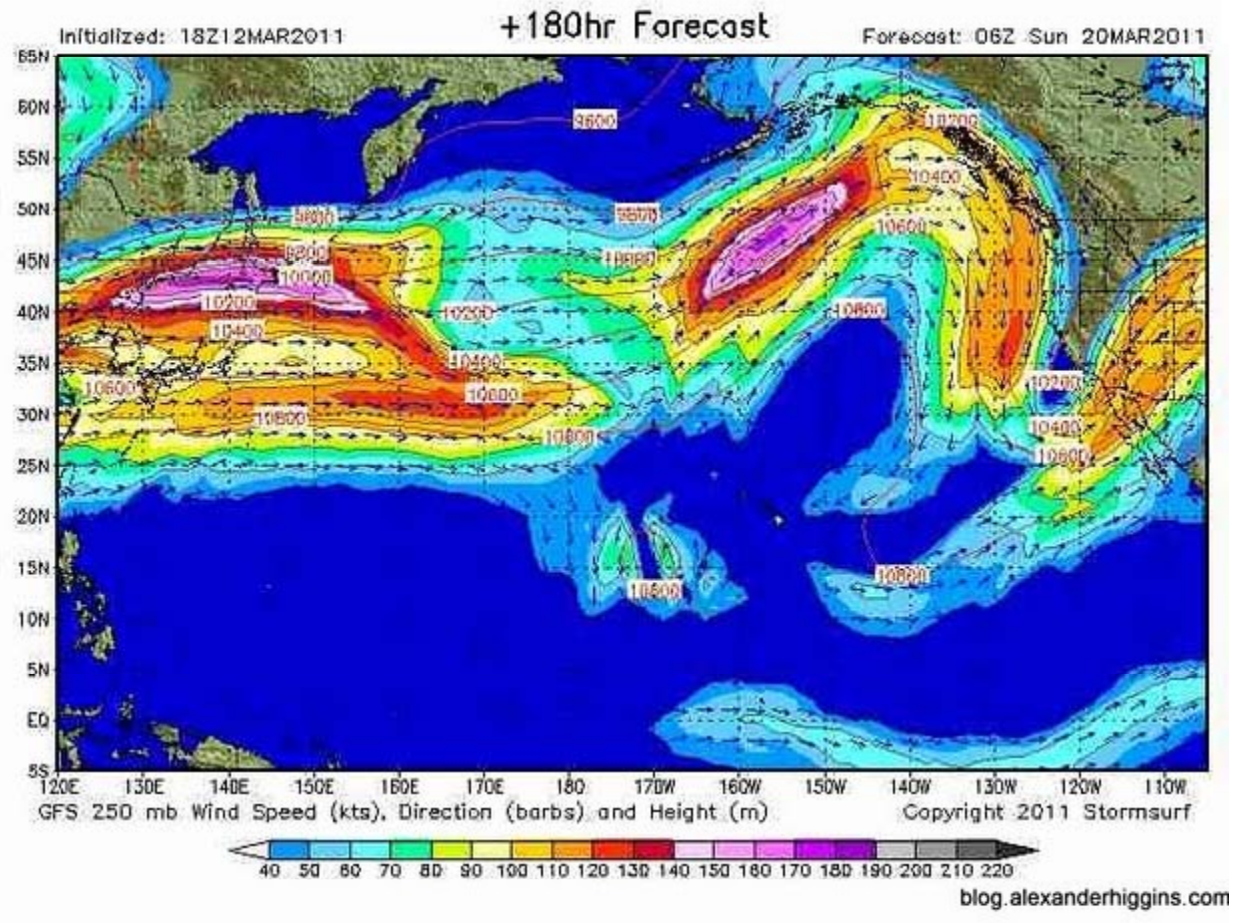
- **80%: Less CO_2 in energy**
- **10%: Less energy in wealth**
- **10%: Less wealth**

100%



Less carbon in energy? Such as nuclear?
Not after Fukushima!

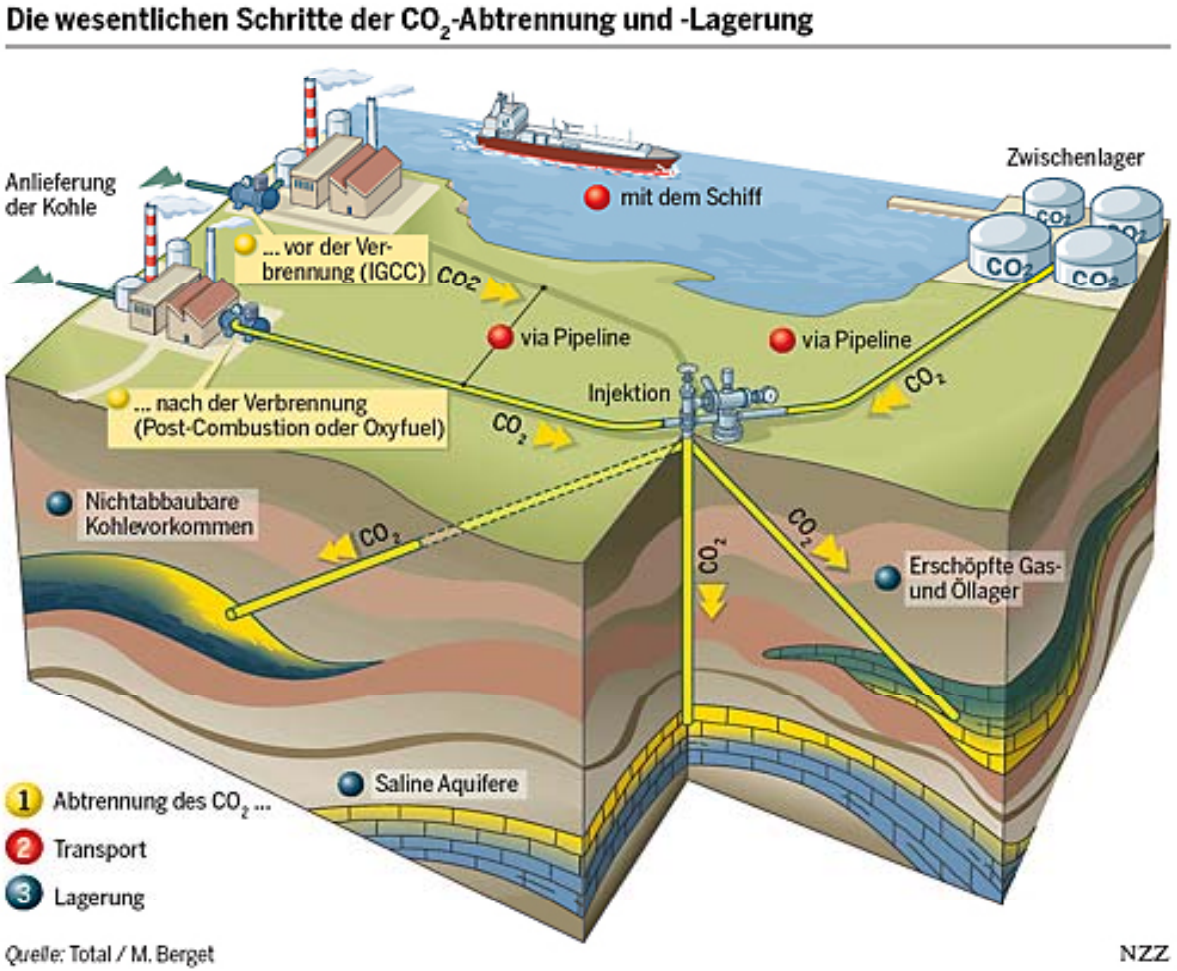
The Tsunami causes a nuclear desaster
(NTV Japan)



The radioactive cloud after 7 days
(Blog alexanderhiggins.com)

… or carbon capture and storage (CCS)?

That means sinking a lot of money!



Endless maize fields

Endless palmoil plantations

… how about „bio-fuels“:

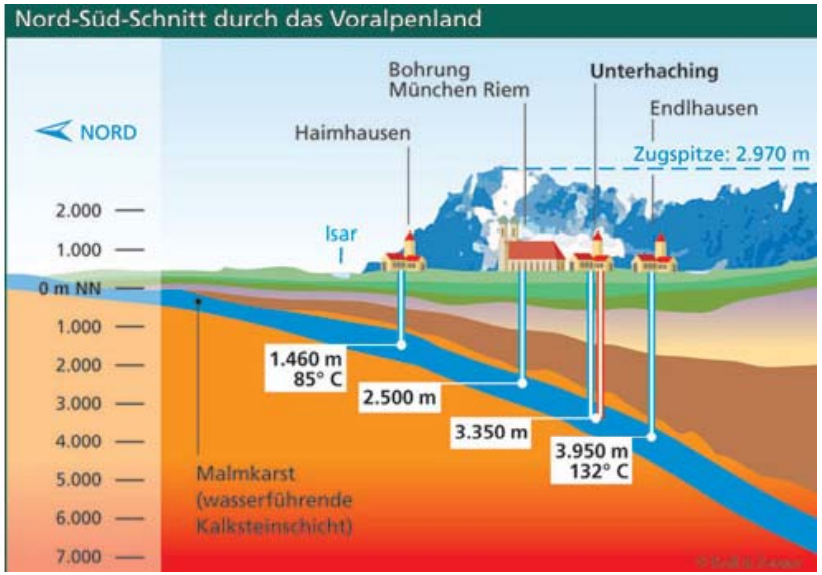
- **an ecological nightmare!**

…how about solar, wind, hydro or geothermal? They are fine in moderate sizes but can be nasty in very large quantities.

PV as large as airports? (Saxony, Germany)

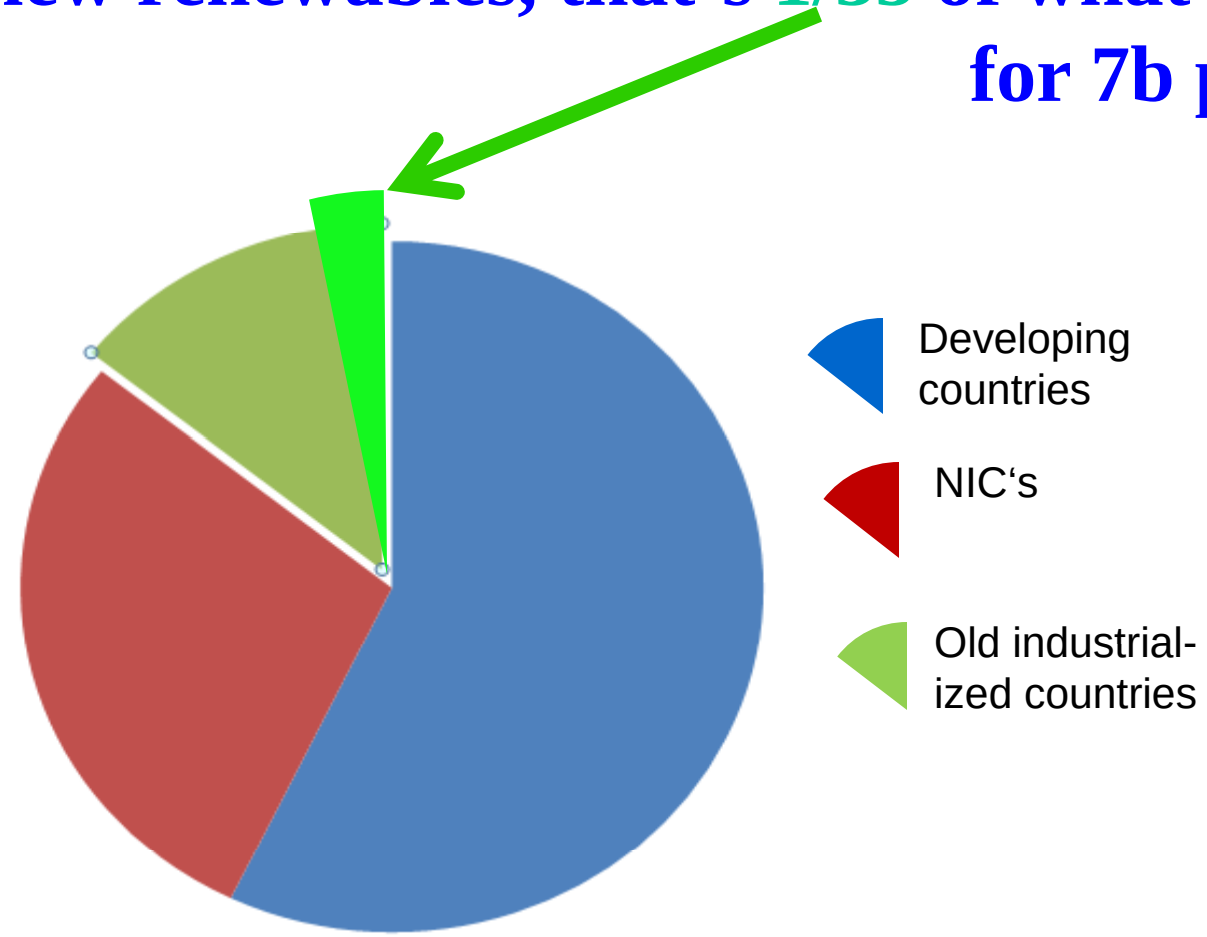
Wind turbines,- do you want such neighbours?

Hydrodams? Always big conflicts .



Geothermal? As deep as the Alps are high…

Let‘s calculate: if 1b people (the rich) achieve 20% new renewables, that‘s 1/35 of what you would need for 7b people on earth.

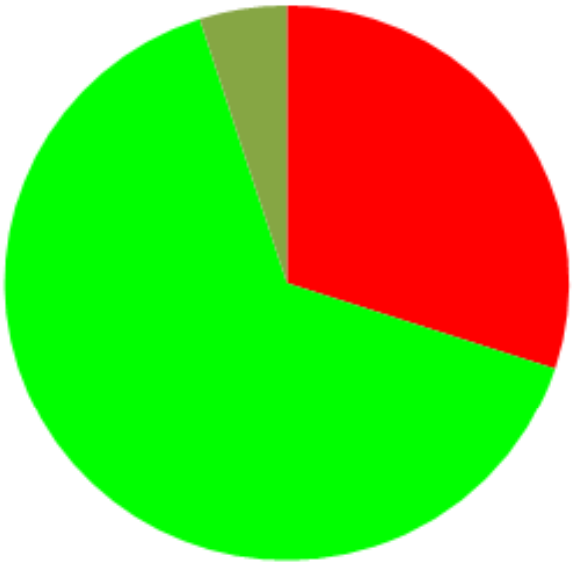


And now imagine a 35fold increase of today‘s biofuels plantations, wind power, hydopower, solar power. It‘s an ecological nightmare!

To avoid that nightmare, we better opt for this one:

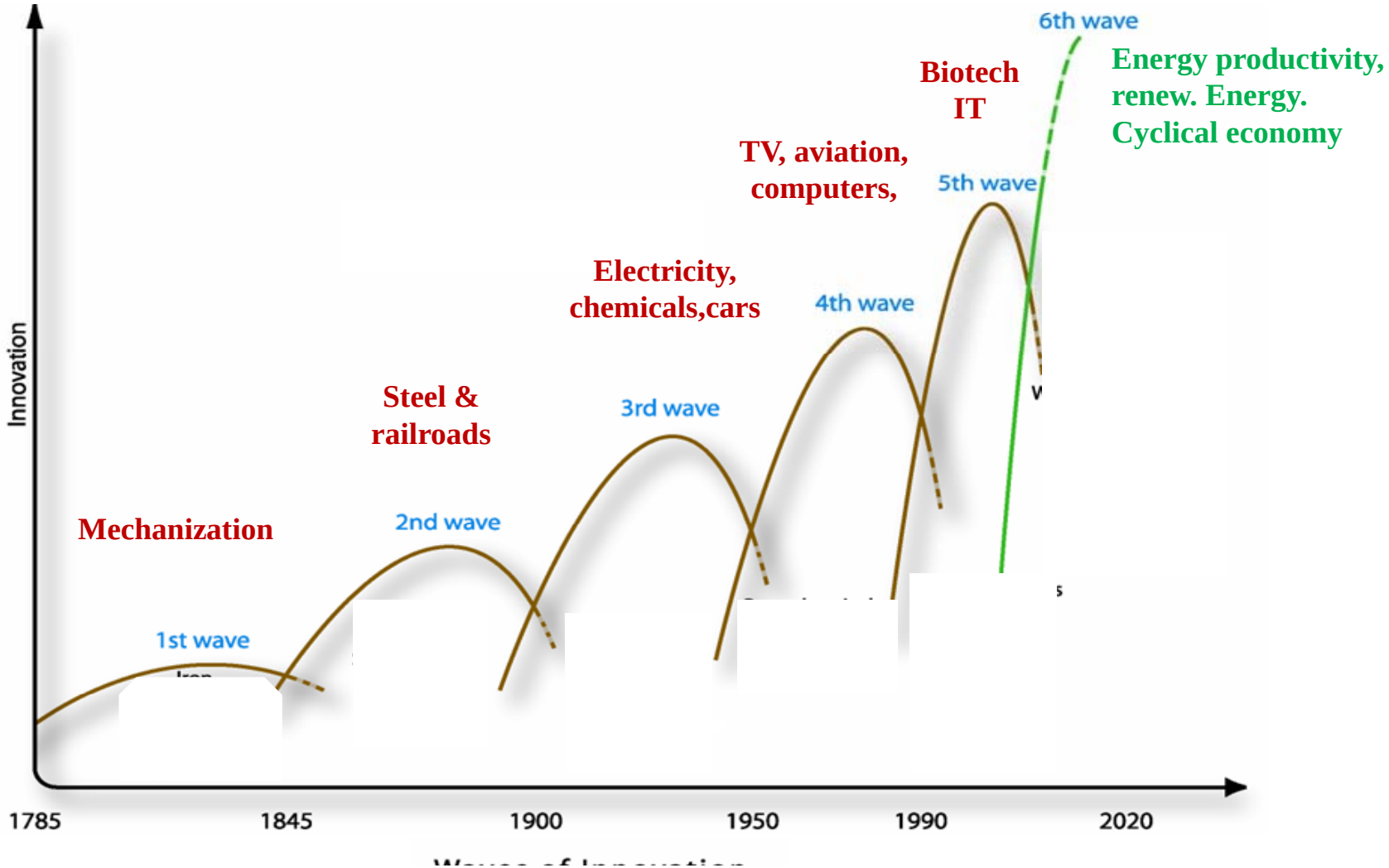
- **30% Less CO_2 in energy**
- **65%: Less energy in wealth**
- **5%: Less wealth**

100%



That is still a 5 – 10-fold increase of renewables, but at the core it's a new technological revolution! That's what we should go for!

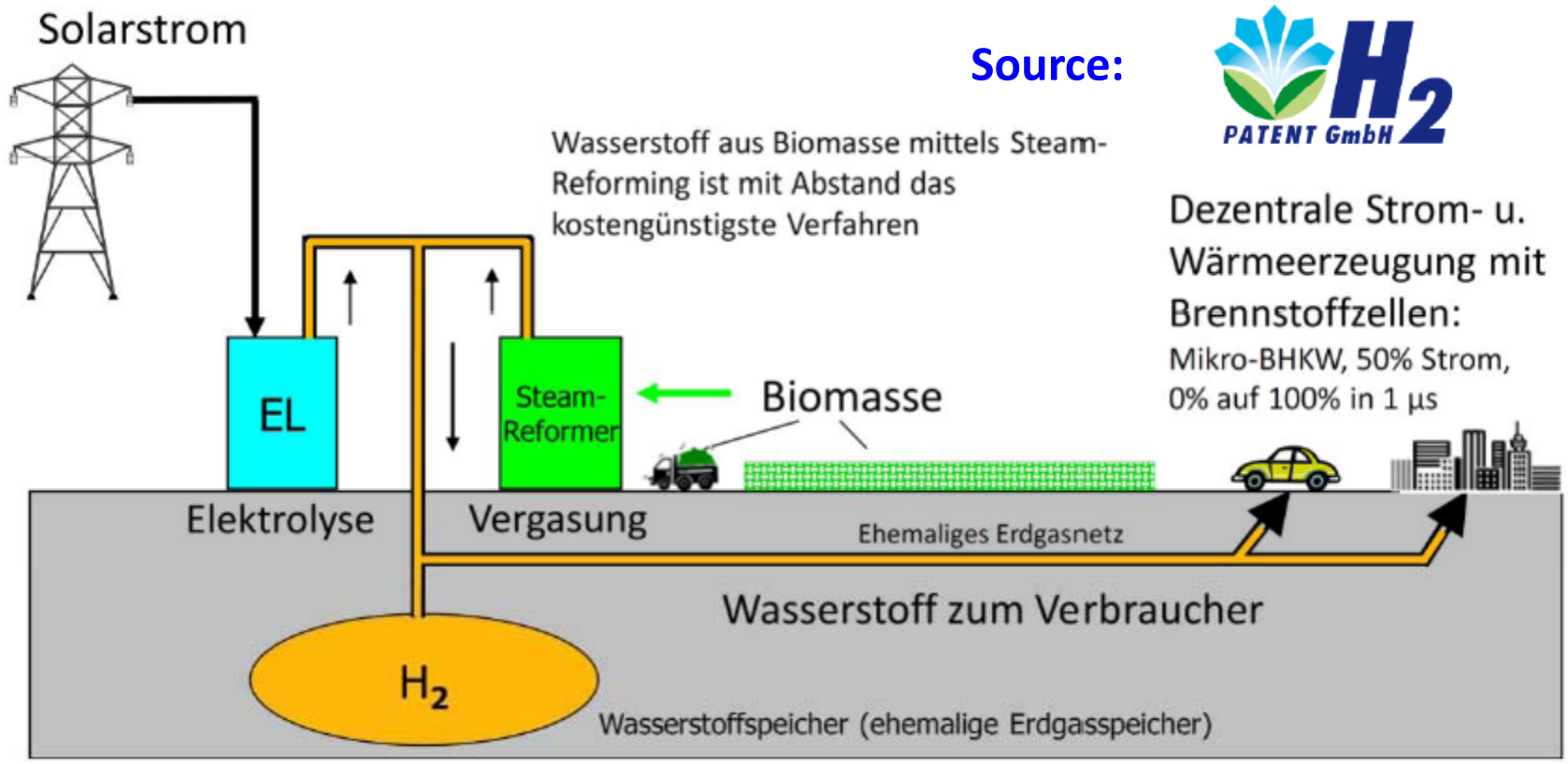
... meaning nothing short of a Green Kondratiev Cycle, - after five brown Cycles.



Infrastructures will be backbones of the new Cycle.

One example now: H_2 grid instead of coal, gas, oil, electrical power.

Energy infrastructures. H_2-grids fed by wind & solar power + electrolysis and steam reformed biomass.

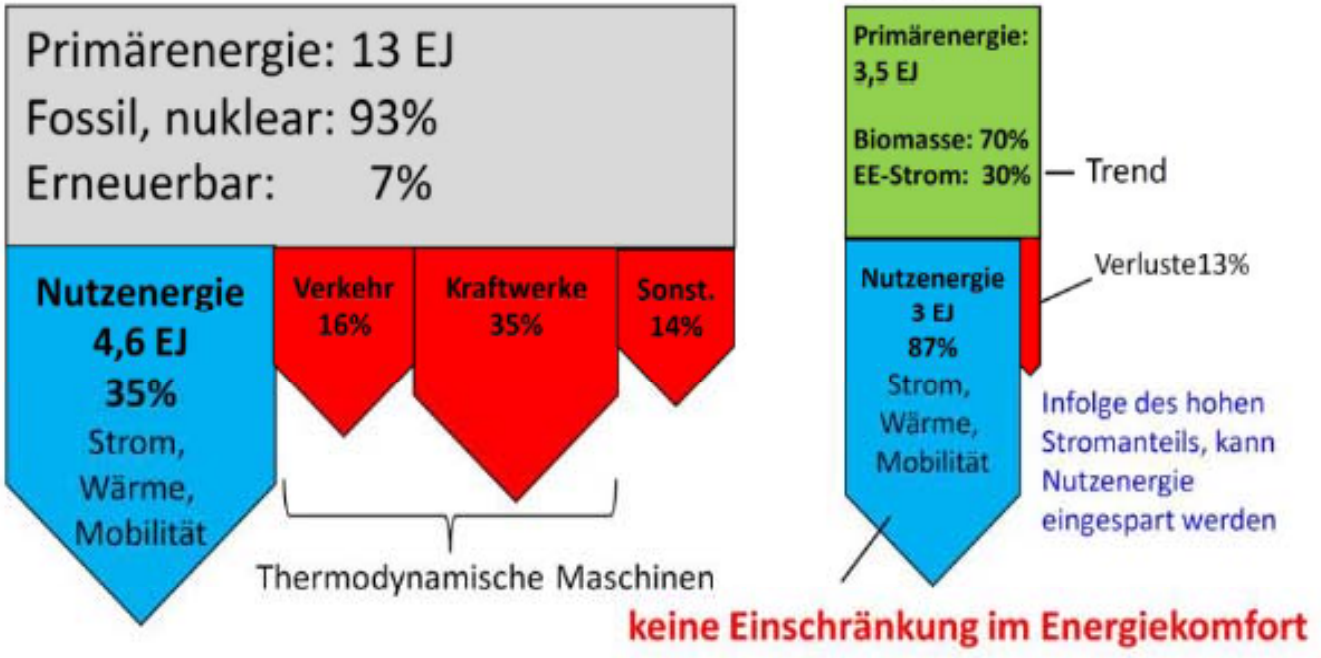


H_2 grids: Fourfold efficiency increases on the supply side.

Source: PATENT GmbH H_2

Today: primary energy 13 EJ — **65%**

Tomorrow 3.5 EJ — **13% losses**



keine Einschränkung im Energiekomfort

Efficiency is an exciting arena.

Let me encourage you to think bold about efficiency!

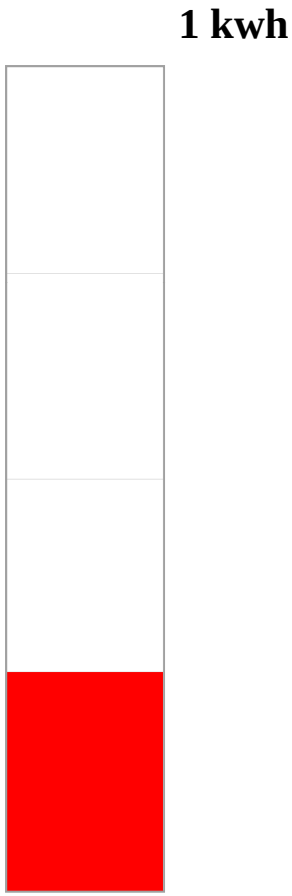
Imagine a bucket of water of 10 kg weight

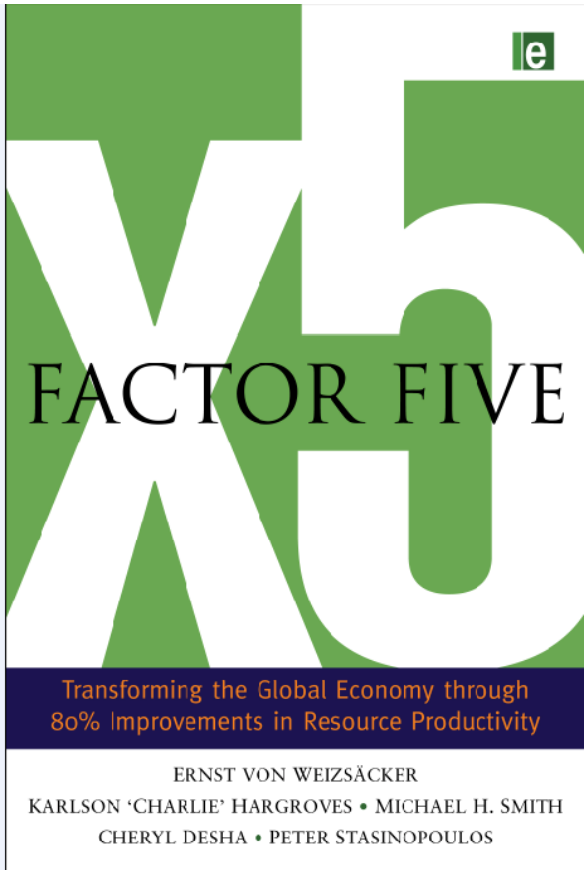
How many Kilowatt-hours

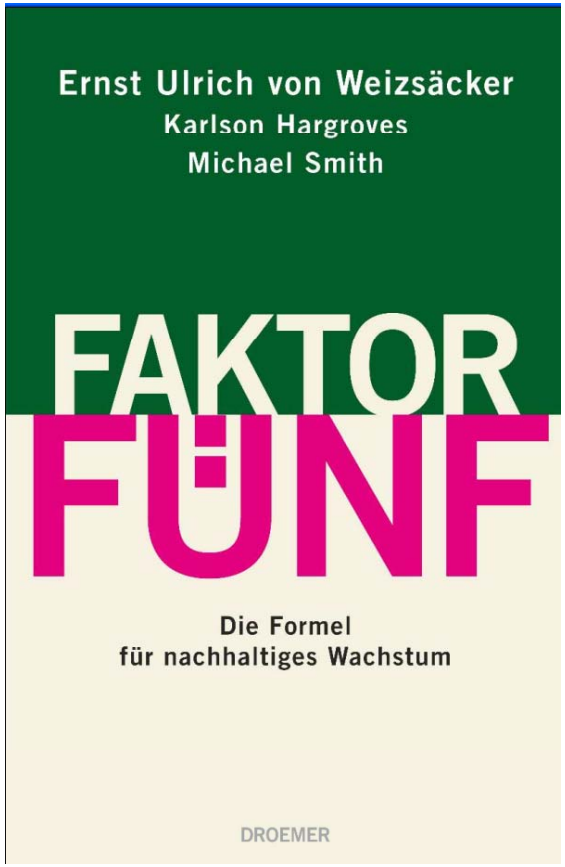
do you need to lift it from sea level to the top of Mount Everest?

The answer is:
One quarter of a kilowatthour!

(knowing that one watt-second is one Joule or one Newton-meter; ¼ kwh is 900.000 watt-seconds)



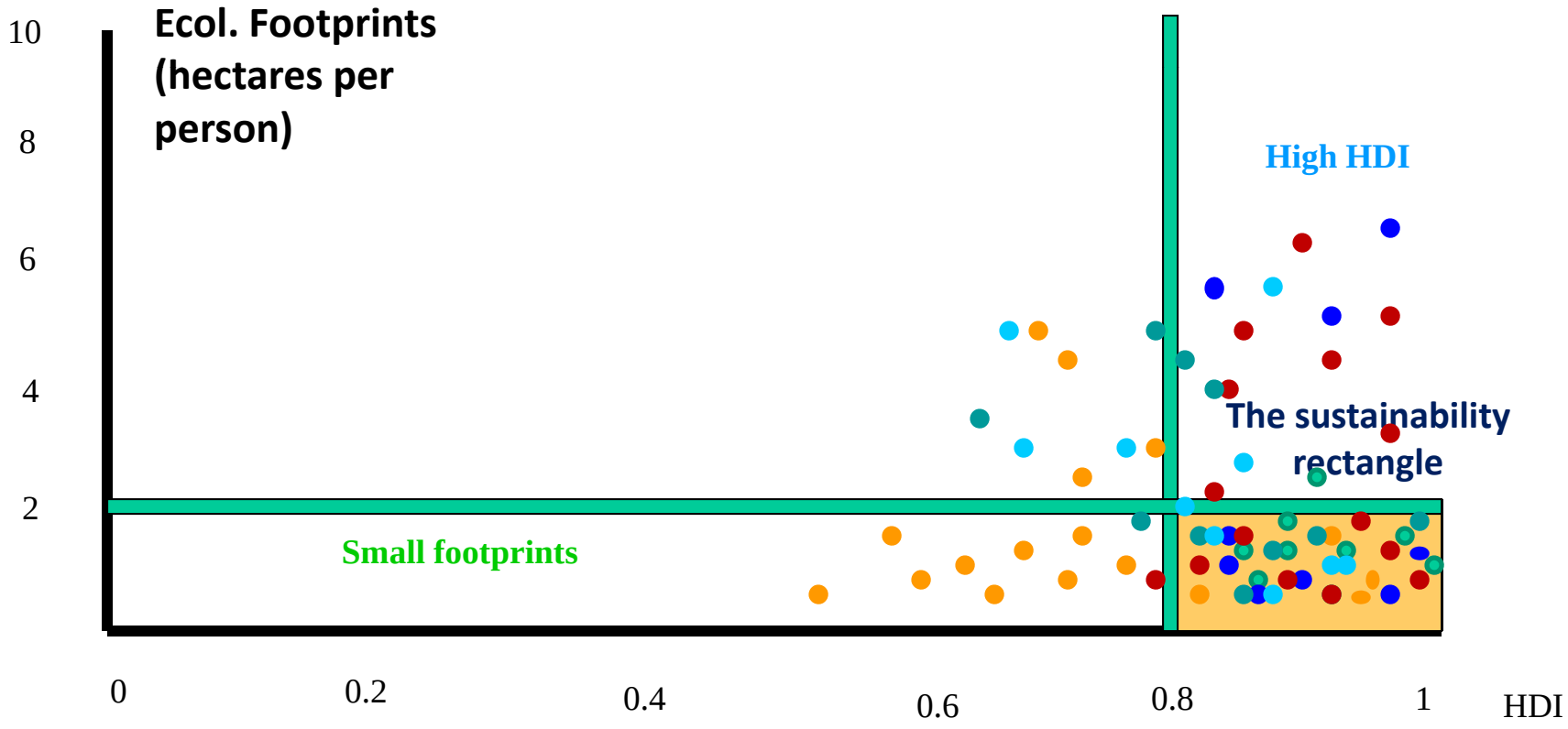




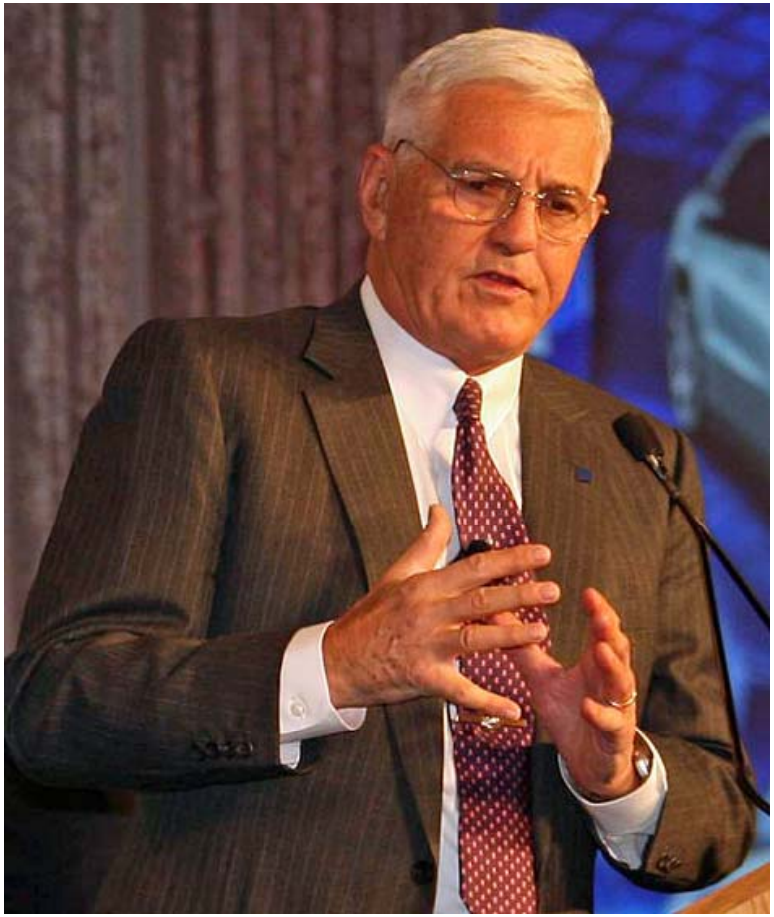
December, 2009 **March, 2010** **October, 2010**

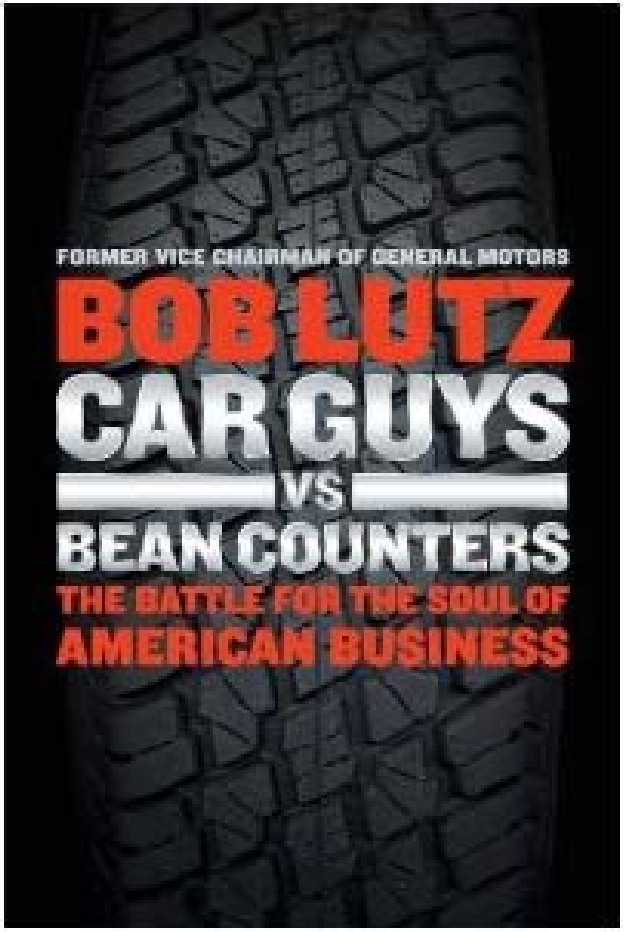
Bold efficiency thinking is at the heart of *Factor Five*

A factor of five in the increase of resource productivity could pull or push most countries into sustainability!



Bob Lutz: let engineers run the show, not MBA‘s.





Source: Rana Foroohar, TIME July 18, 2011, p 16

Let‘s now look at some of the technologies that are relevant for infrastructures.

Here we are mostly talking about the demand side.

Superefficient cars

Amory Lovins' "Hyper-car", or "Revolution": Carbon fibre; fuel cell or hybrid; < 1,5 l/100km

Today's fleet
6-12 l/100km

CO_2-reduction: electric cars fueled by wind power.

CO_2-Efficiency

…or use „pedelecs“ for city transport

(like Tübingen‘s Lord Mayor Boris Palmer does)

Energy and space
efficiency

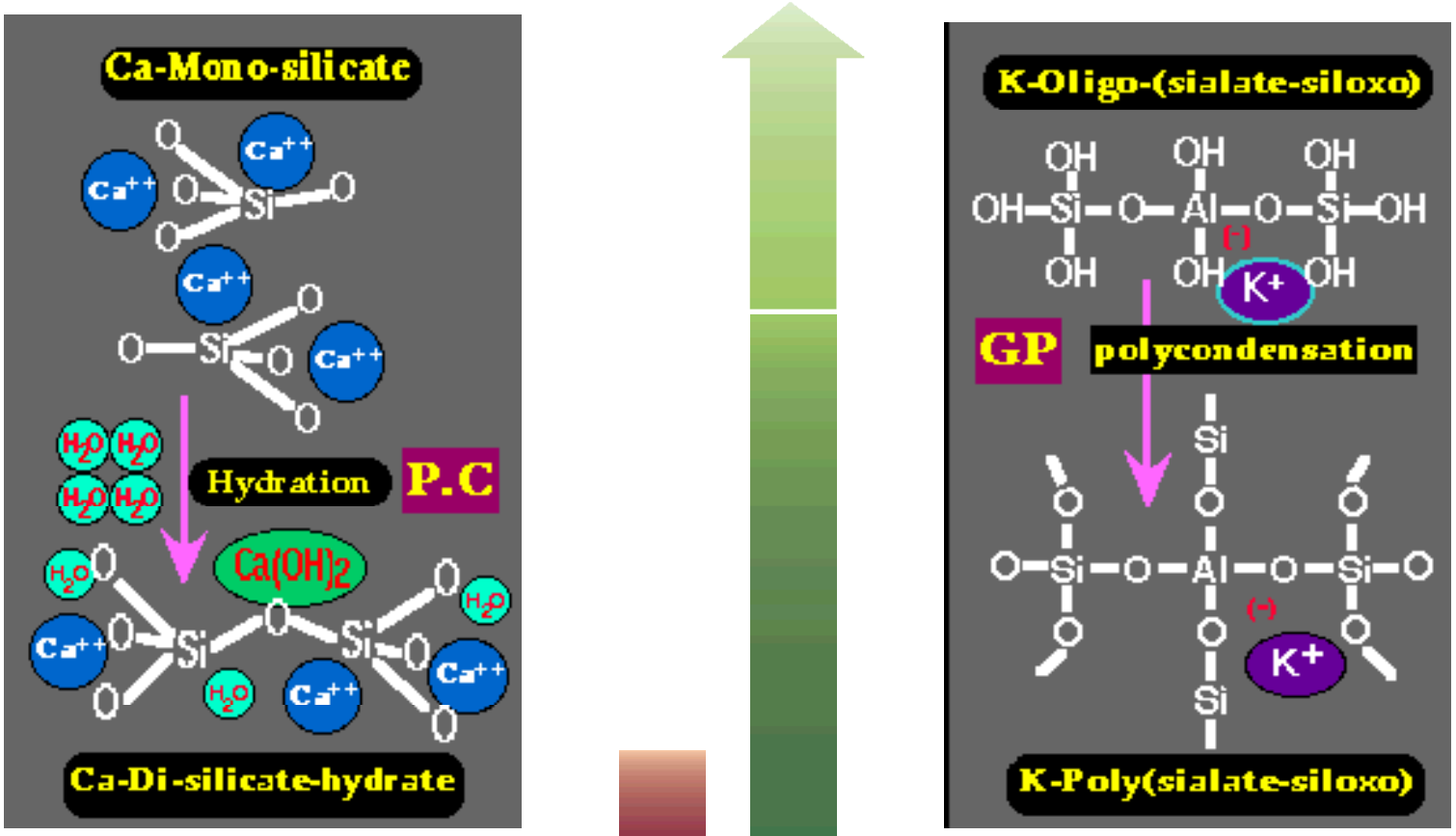
“Passive houses”: a factor of ten more heat efficient

LED replacing incandescent bulbs: a factor of 10.

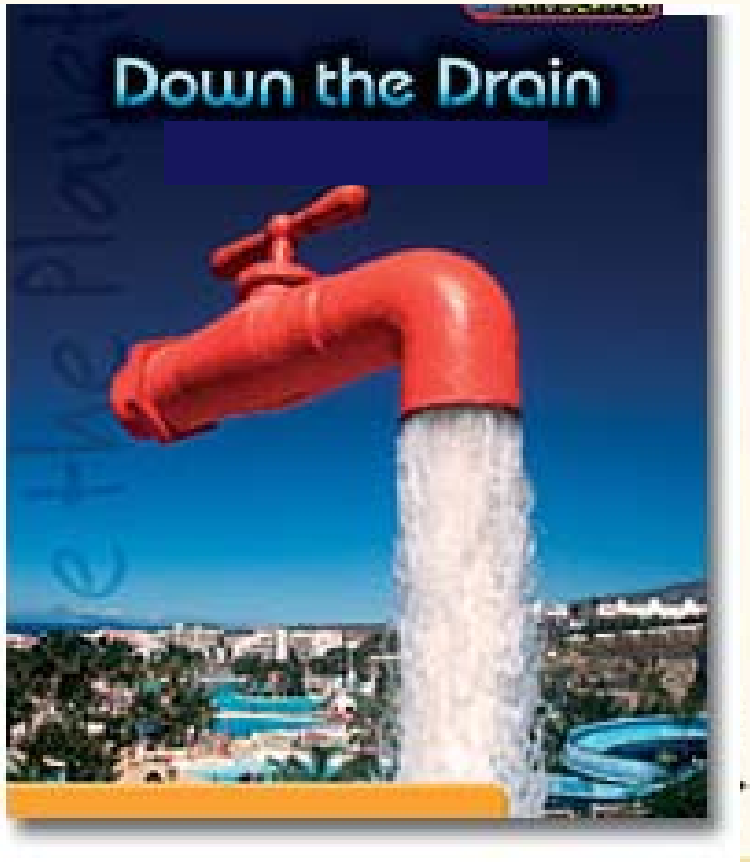
Philips 7W Master LED

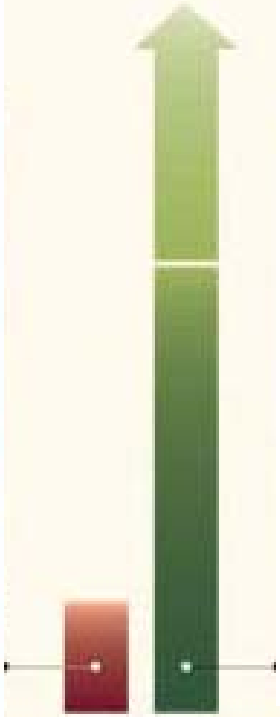
Energy efficiency

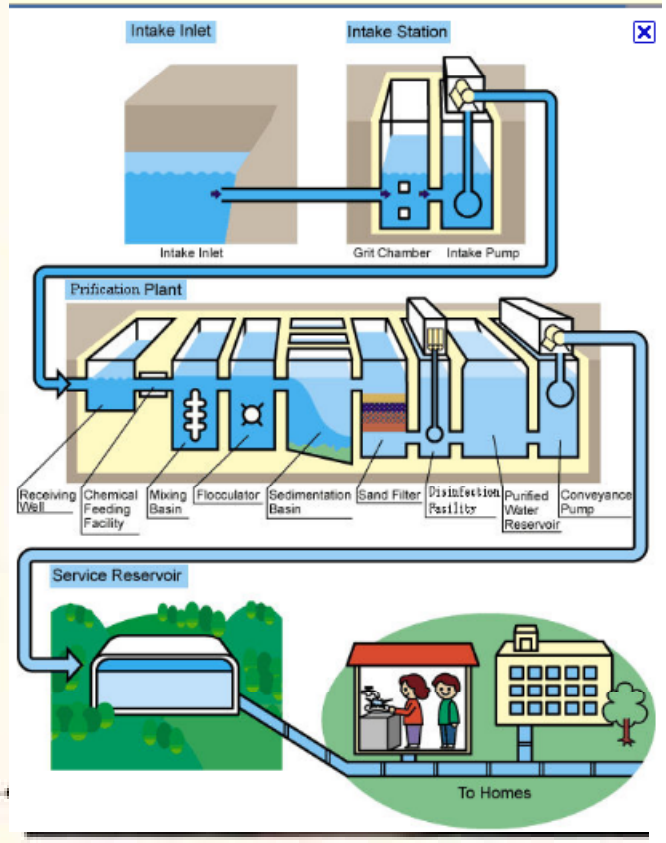
From Portland cement to geopolymer cement (e.g. fly ashes from coal power plants).



From using water once to purifying (recycling) it. This one of the biggest infrastructure challenges!

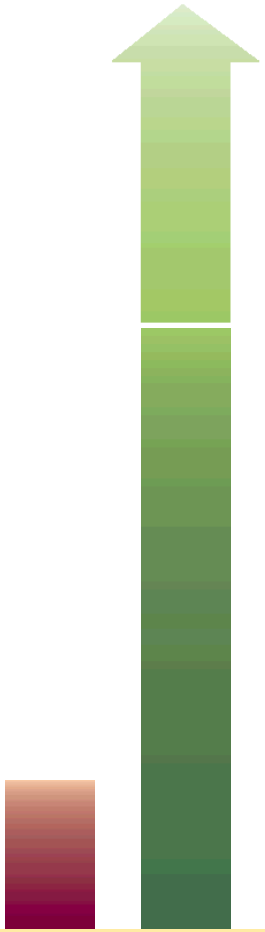






Water efficiency

City structure, - infrastructure again



USA

Energy and space efficiency

Copenhagen (above)
Freiburg , Vauban (below)

Train infrastructures. China will soon have the biggest high speed rail system.

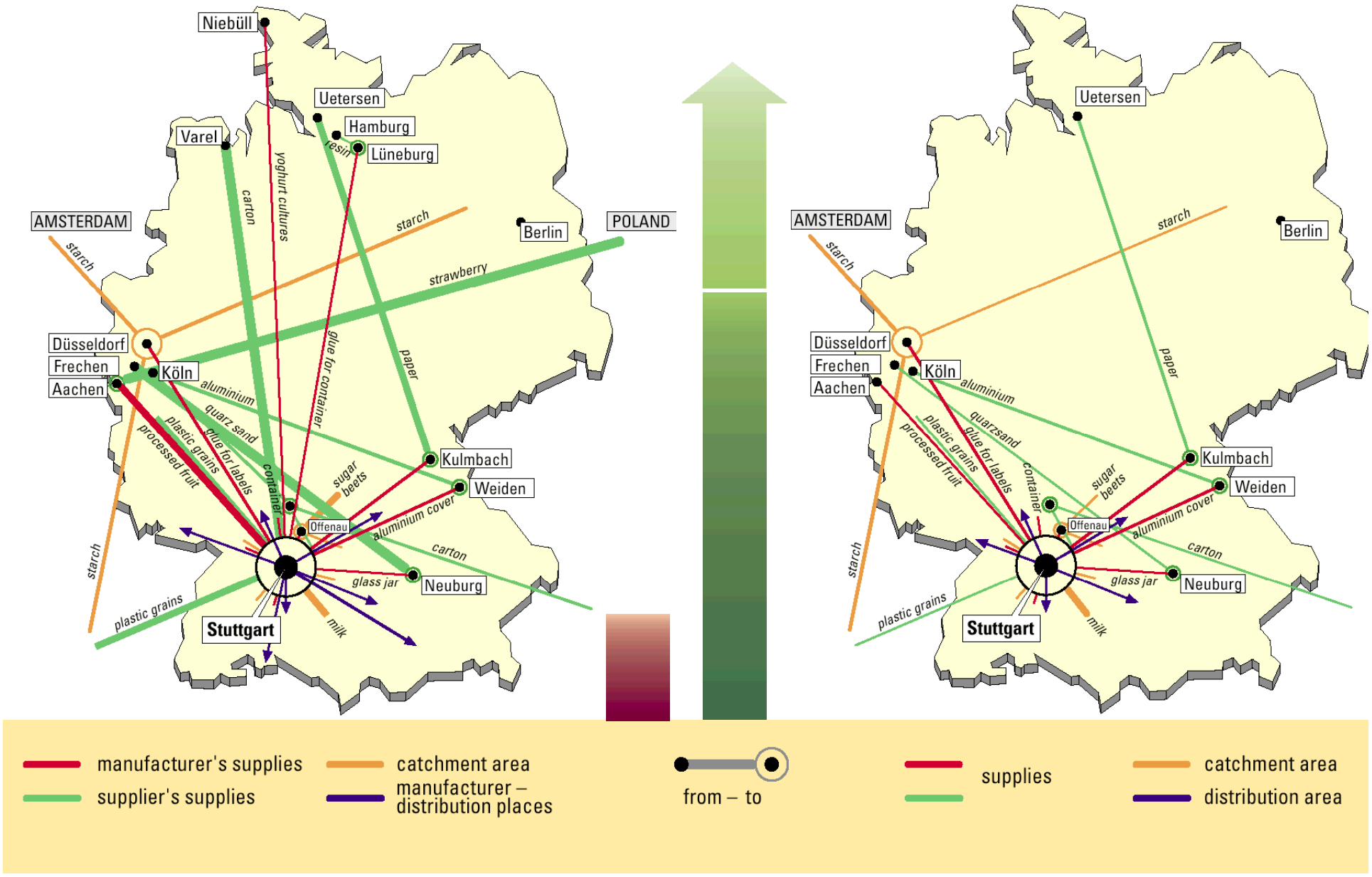
Amtrak

Shinkansen

Time and resource efficiency

From endless business travel to telepresence meetings

Overcoming crazy logistics (e.g. for strawberry yoghurt)

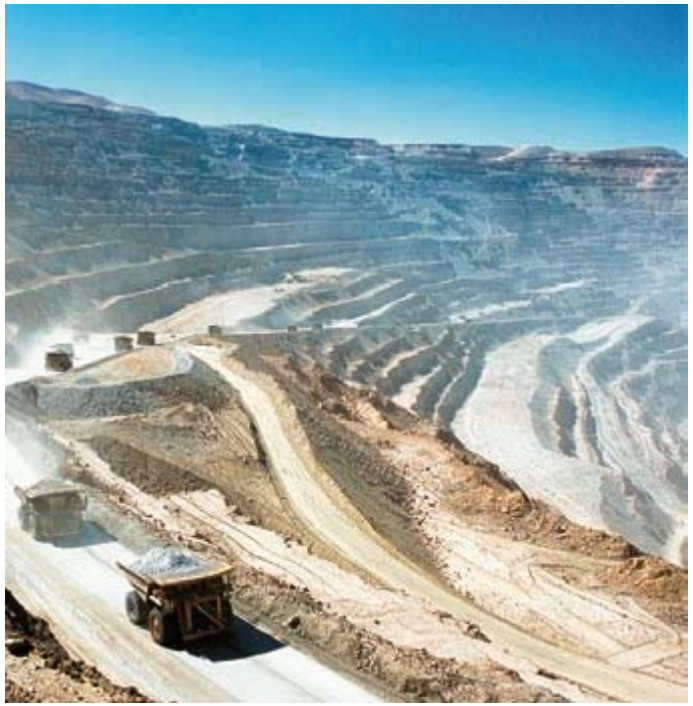


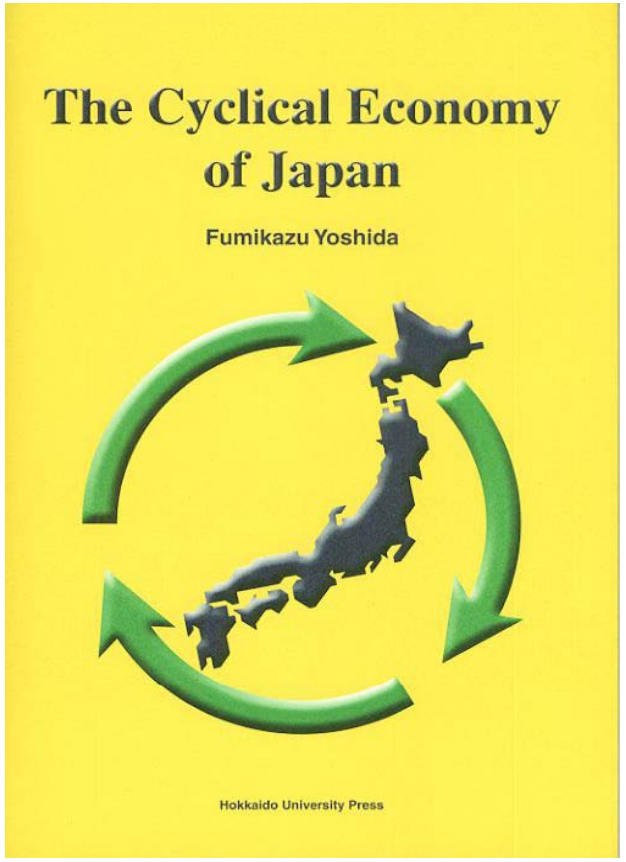
Aluminium recycled instead of from bauxite

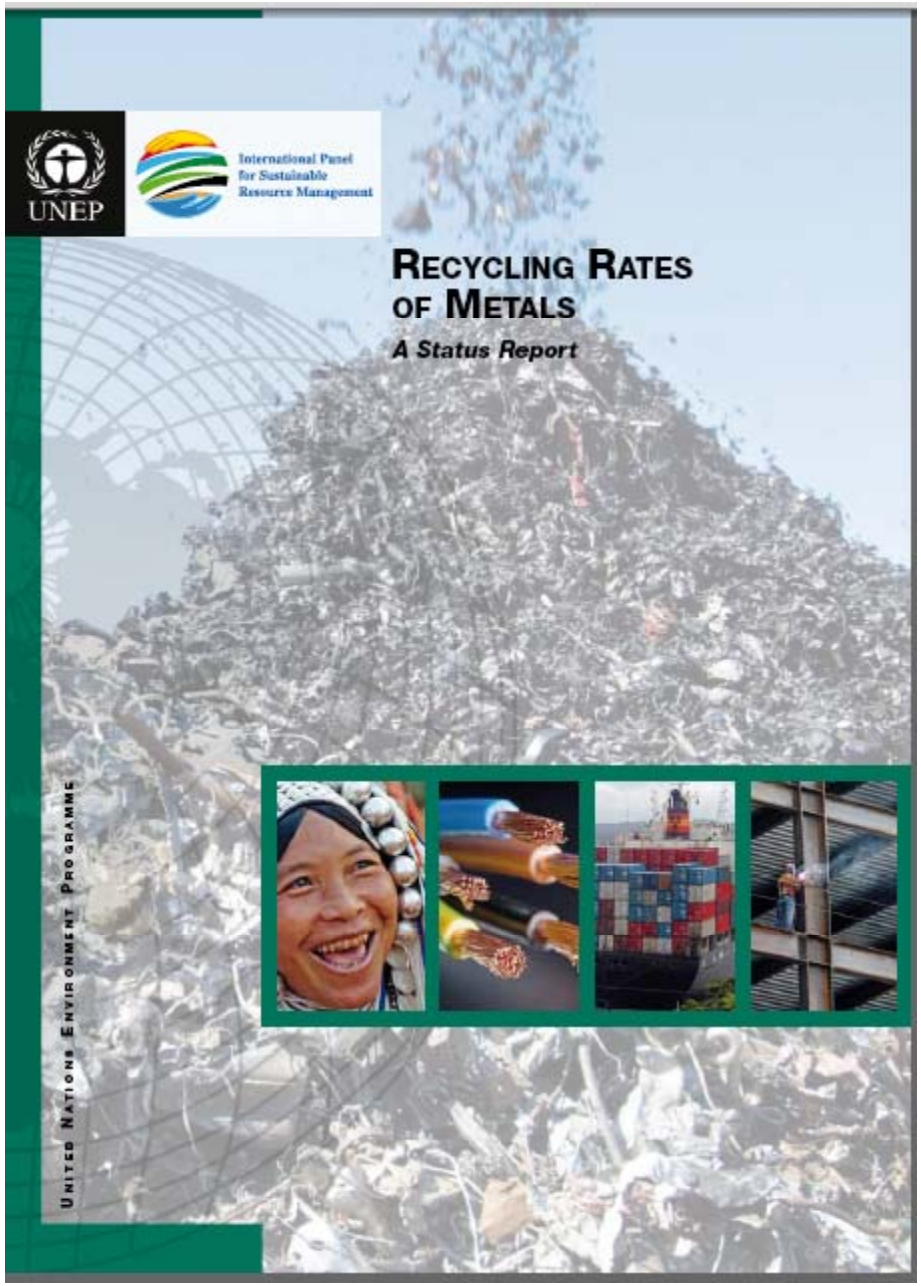
Source: www.pitoipa.de

Energy & material efficiency

From excessive mining to the Cyclical Economy.







Metals recycling. Huge surprises ….

UNEP

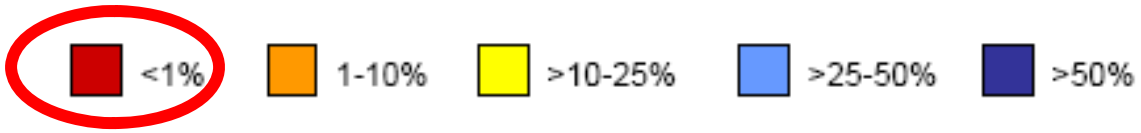
International Resource Panel

Specialty metals recycling rates are below 1%!!

(Int. Resource Panel: Graedel et al, 2011)

1 H																2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	**	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh	(117) (Uus)	118 Uuo

* Lanthanides	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
** Actinides	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



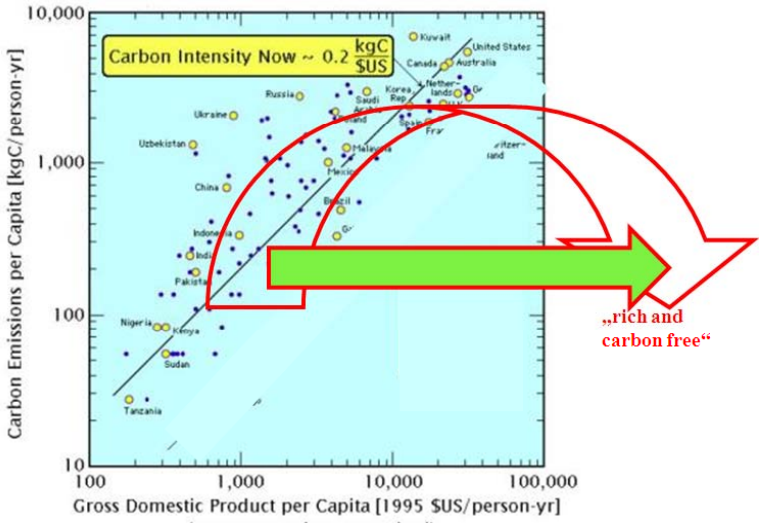
What does this mean in terms of infrastructures?

First class waste recovery systems; and product design facilitating the recovery of valuable metals.

Next question:

Is the efficiency revolution coming from alone?
Or do we need to intervene?
And if so, in which way?

If we want developing countries tunnel through the decarboization curve, the best solution is per capita equal CO_2 emission rights worldwide.



It was proposed in 2007 by the Indian PM Manmohan Singh. It means the North would have to go shopping for emission rights in the South.

This „carbon justice“ approach would make it profitable *in developing countries* to become very energy efficient and to turn to renewable energies.

Efficiency technology would rapidly migrate to the South. And hundreds of plans for new coal power plants could be scrapped.

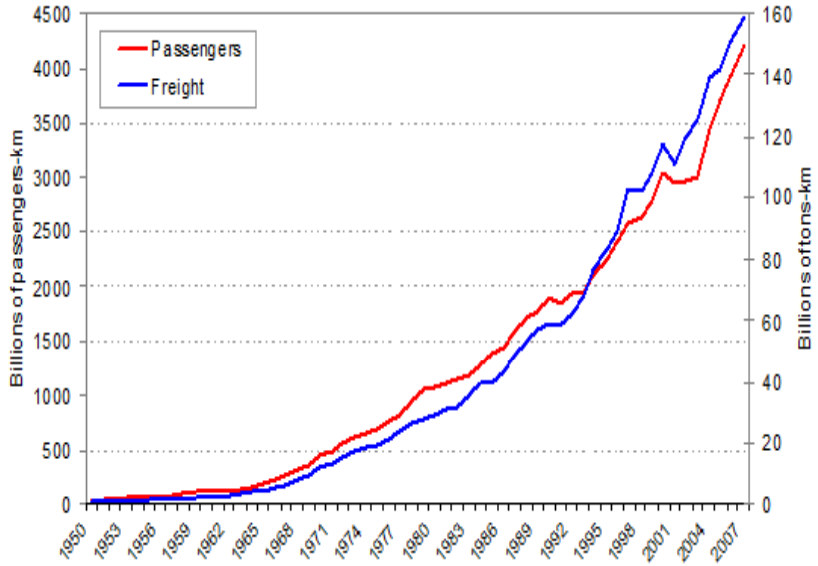
Domestic regulation: Avoid super-bureaucratic systems.

Let prices steer the direction and let engineers and investors do the details.

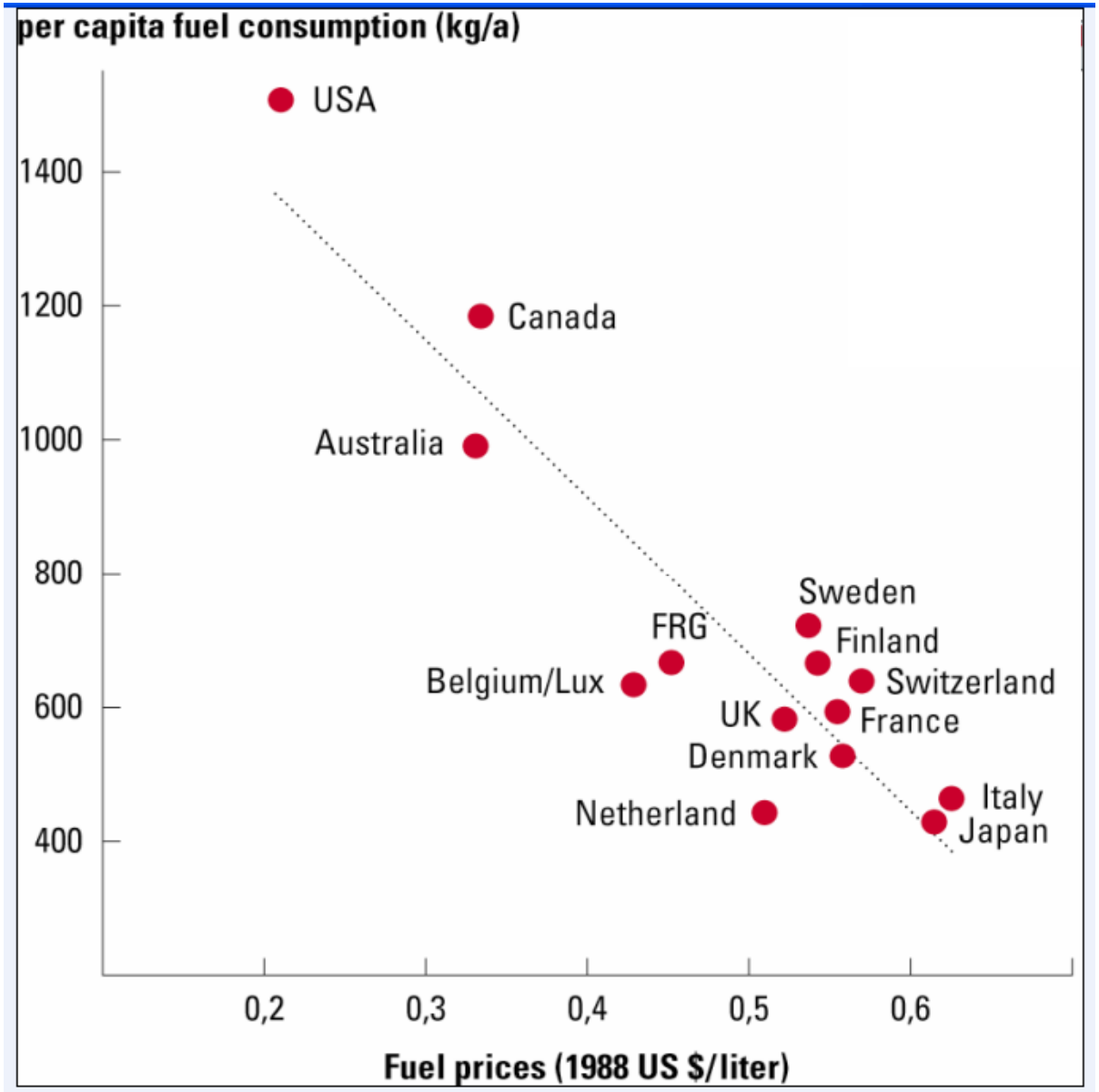
Prices do matter. Here are collapsing prices (left) and corresponding explosion of air traffic (right)

Note: Yields of US airlines in international traffic. Domestic figures show similar trends.

(EEA, 2005)



Long term price elasticity of fuel consumption is very high!



Source: Jesinghaus, in Weizsäcker & Jesinghaus, 1992

Let us try and understand the dynamics of the Industrial Revolution. And learn from it.

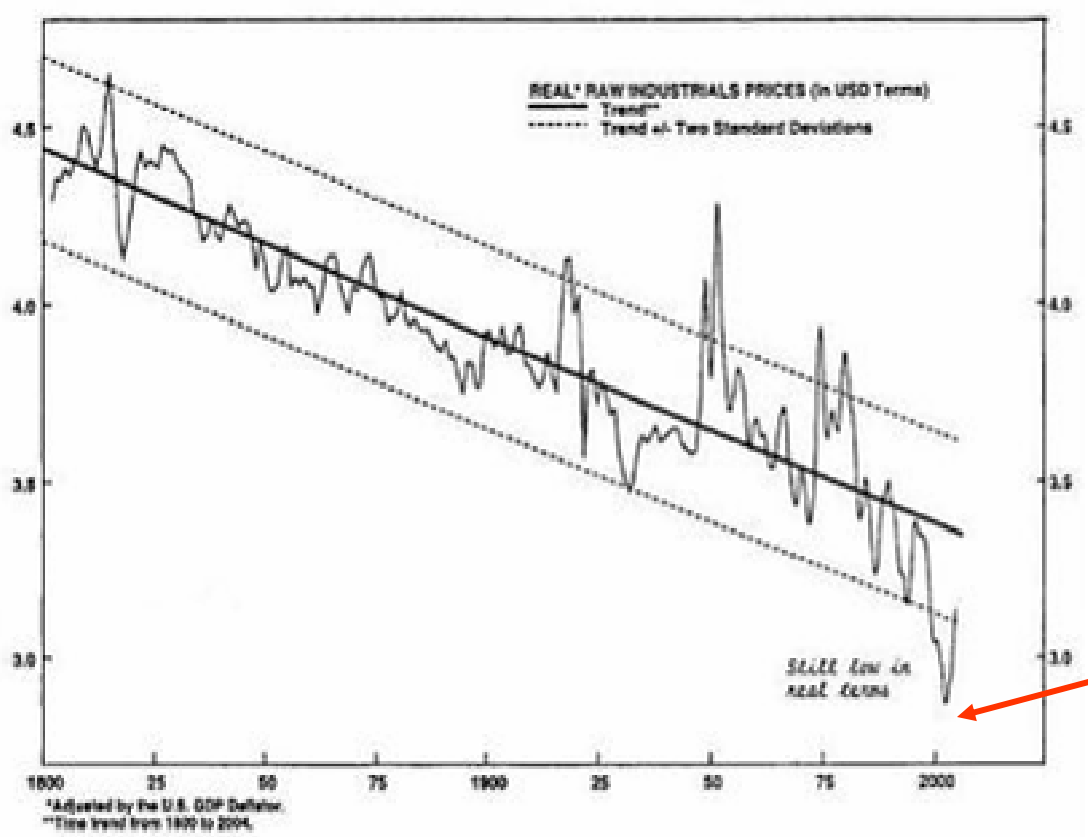
Labour productivity rose twentyfold since 1850. It did so in parallel with wages!!

Labour productivity and wages rose in parallel.

This is a fifty years time-window from the United States

Resource prices, conversely, were falling over 200 years, encouraging wasteful use of resources.

Prices of industrial commodities & energy, in constant dollars

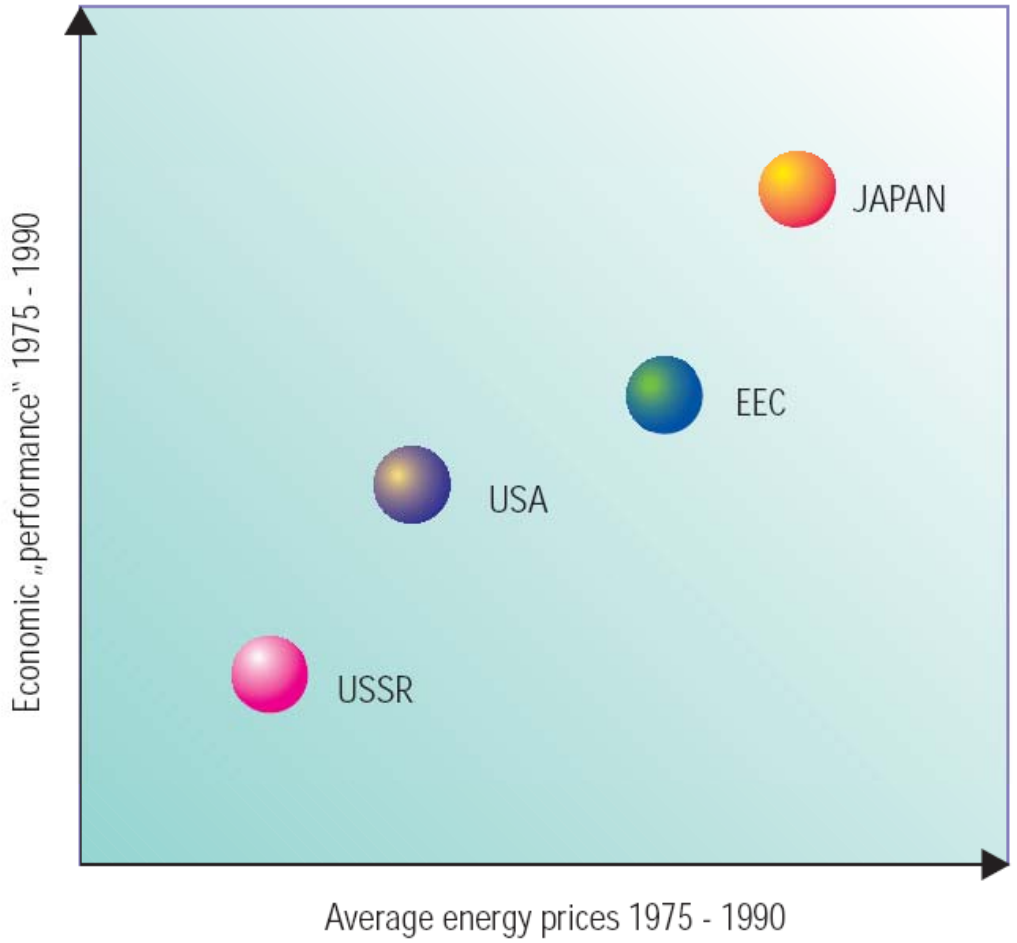


2000-2004

Source: The Bank Credit Analyst

Therefore we shall need a political decision to artificially raise energy prices. And do that in parallel with documented efficiency increases, so that average expenses for energy services would remain stable.
(Some low „life-line“ prices should be accepted for the poor.)

High energy prices need not hurt the economy. Japan blossomed during the 15 years of highest energy prices!



One lesson from this is: pioneers need not wait for the slow ones. I therefore suggest creating an alliance of the speedy ones, of the game winners.

Who would win, who would lose?
(1. inside countries)

Winning: high tech; crafts; science; education; green busines; railroads; maintenance; culture; high quality.

Losing: lorries, aircraft industry, heavy industry, urban sprawl, wasteful consumers.

Who would win, who would lose?
(2. *among* countries)

Winning: Europe, East Asia, developing countries poor in natural resources. That is some 90% of the world population!

Losing: USA, Canada, Australia, Russia, commodity exporting developing countries. But they all can become winners too!

Four take home messages:

- **An efficiency Kondratiev is in the making.**
- **Infrastructure are at the core of it.**
- **A long term price signal is the best condition for letting sustainable infrastructures grow.**
- **Alliances of winners domestically and internationally can kick it off.**