



Brussels 24th November, 2009

About Factor Five

Prof. Ernst Ulrich von Weizsäcker

Co-Chair



**International Panel
for Sustainable
Resource Management**



Factor Five is the new Report to the Club of Rome . It shows that we can become 5 times more efficient.

(But it also shows that eventually there are still limits to growth. *Factor Five* can only buy time.)

**Factor Five is also the sequel to “Factor Four”
(1995), which offered fifty examples of
quadrupling resource productivity**



Factor Four, however, was a bit naive.

It assumed that demonstrating the technical availability of a fourfold increase of resource productivity would suffice to make it all happen.

It did not account for the rebound effect either.

What is the rebound effect?

It is sometimes also called “Jevons Paradox”, after **William S. Jevons** who in his 1865 book, **The Coal Question** observed that England's consumption of coal *soared* after James Watt introduced his highly efficient coal-fired steam engine .

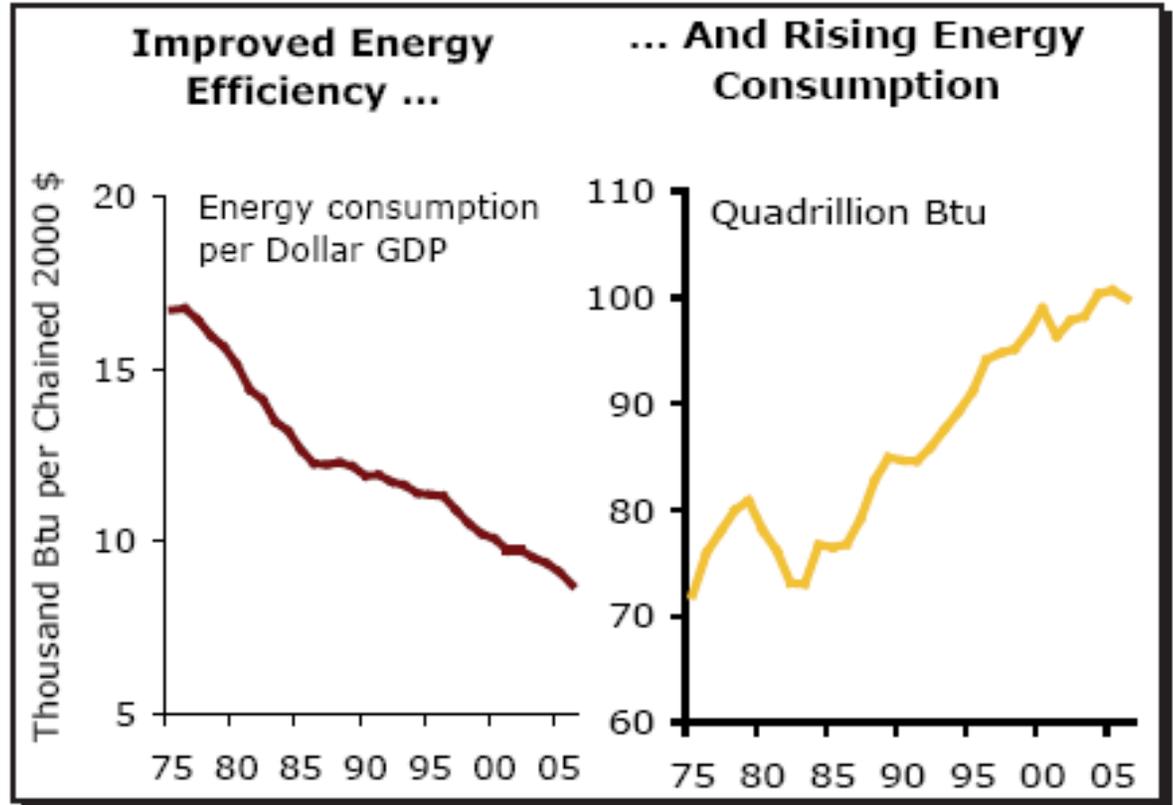
The rebound effect means that efficiency gains tend to be eaten up by additional consumption. Today, the effect is often called the **Khazzoom-Brookes Postulate**.



Rebound effect in the USA:

Energy intensity down, total energy consumption up.

SUV's, urban sprawl, electronics boom.



Source: EIA

**This rebound effect (or growth of consumption)
in a sense also was at the roots of the
2008 financial meltdown.**

It was not only banking blunders!

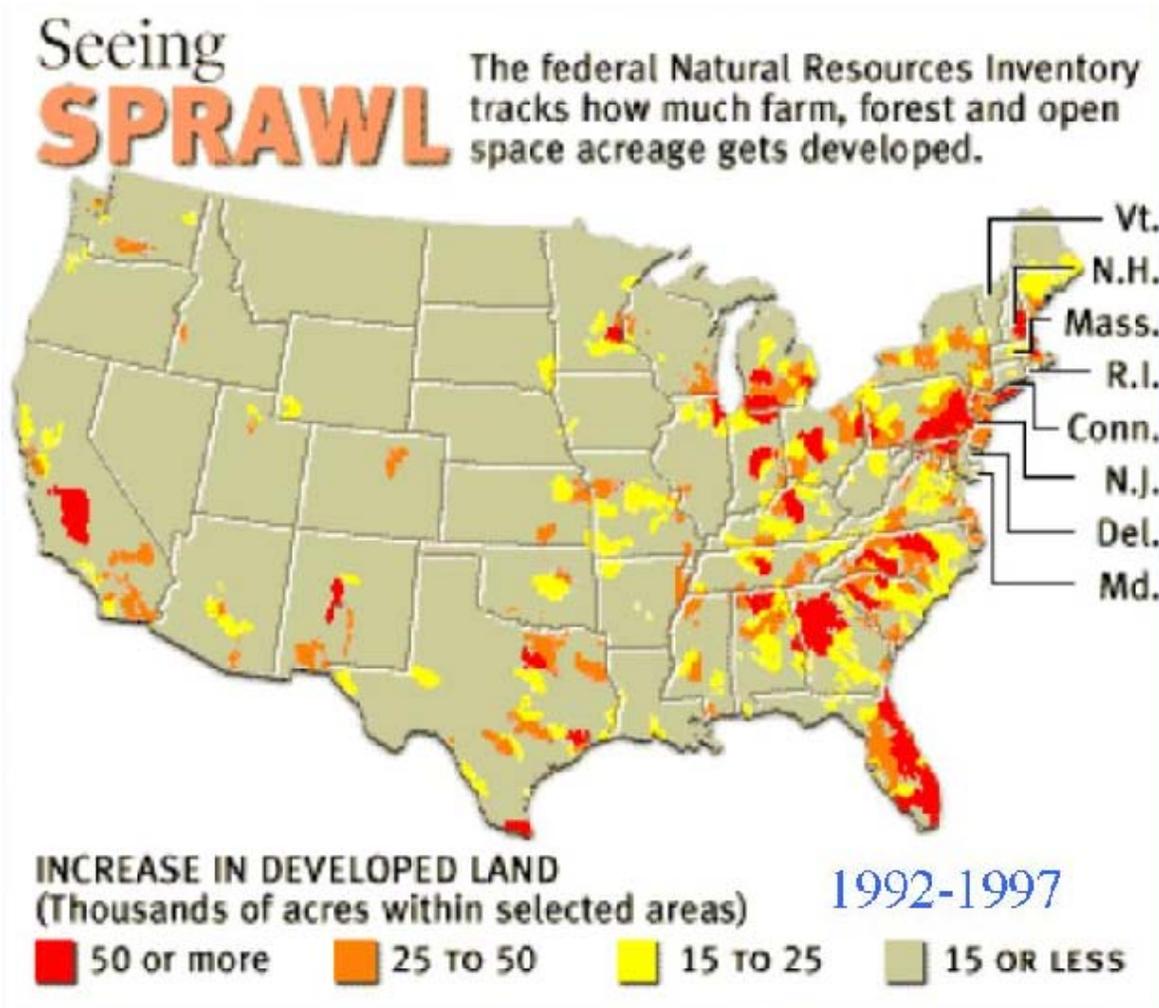
Since 1982 **tumbling oil prices** and strict opposition in the USA to gasoline taxes created an optimistic feeling of ,cheap gas forever‘, - leading to

- the creation of a new car fleet, the gas guzzling SUV‘s, and Hummers;
- accelerated urban sprawl and a near doubling of typical commuter distances.



**The Hummer H1,
a fortress on wheels,
and a gas guzzler**

Urban sprawl madly increased in the USA



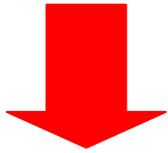
Source: Anand Prasad, US Forest Service, 2002
aprasad@fs.fed.us

And then, in 2007,

oil prices skyrocketed



Long distance commuting became a nightmare



Houses lost value



Mortgage loans above home values got non-performing



Collapse of Fannie Mae, Freddie Mac, Countrywide and later Bear Stearns, Lehman Bros., Merryll Lynch, General Motors etc.



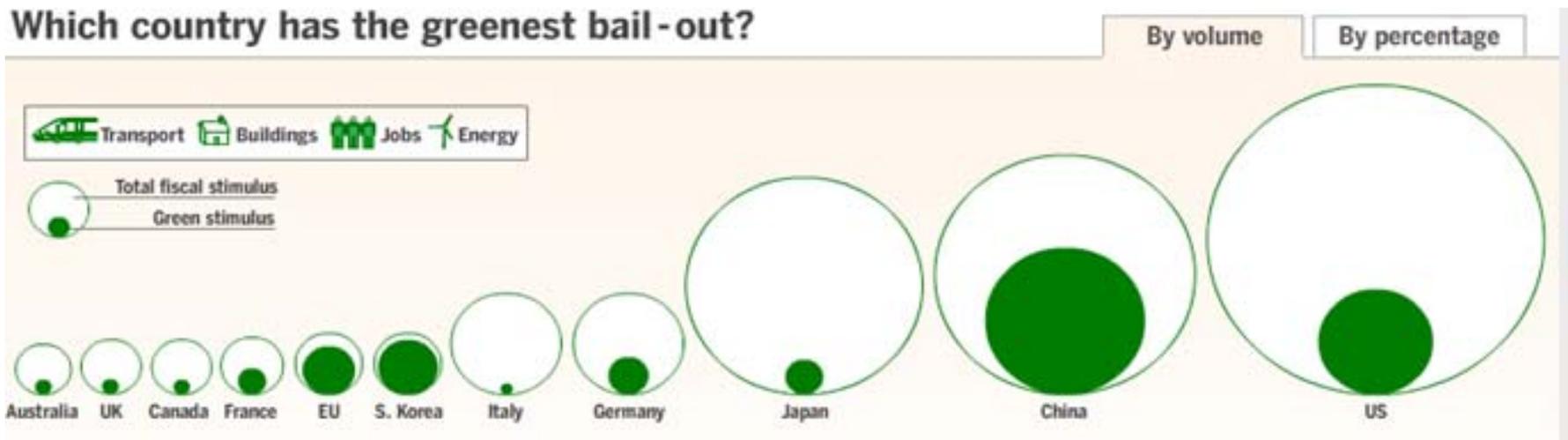
Achim Steiner, UNEP's Executive Director. He is calling for a

Green Economy Initiative

Strongest support comes from WBCSD, UNIDO, and several Asian countries, including China

Two Asian countries made their stimulus package very green

Which country has the greenest bail-out?



Source: DIE, German Institute for Development

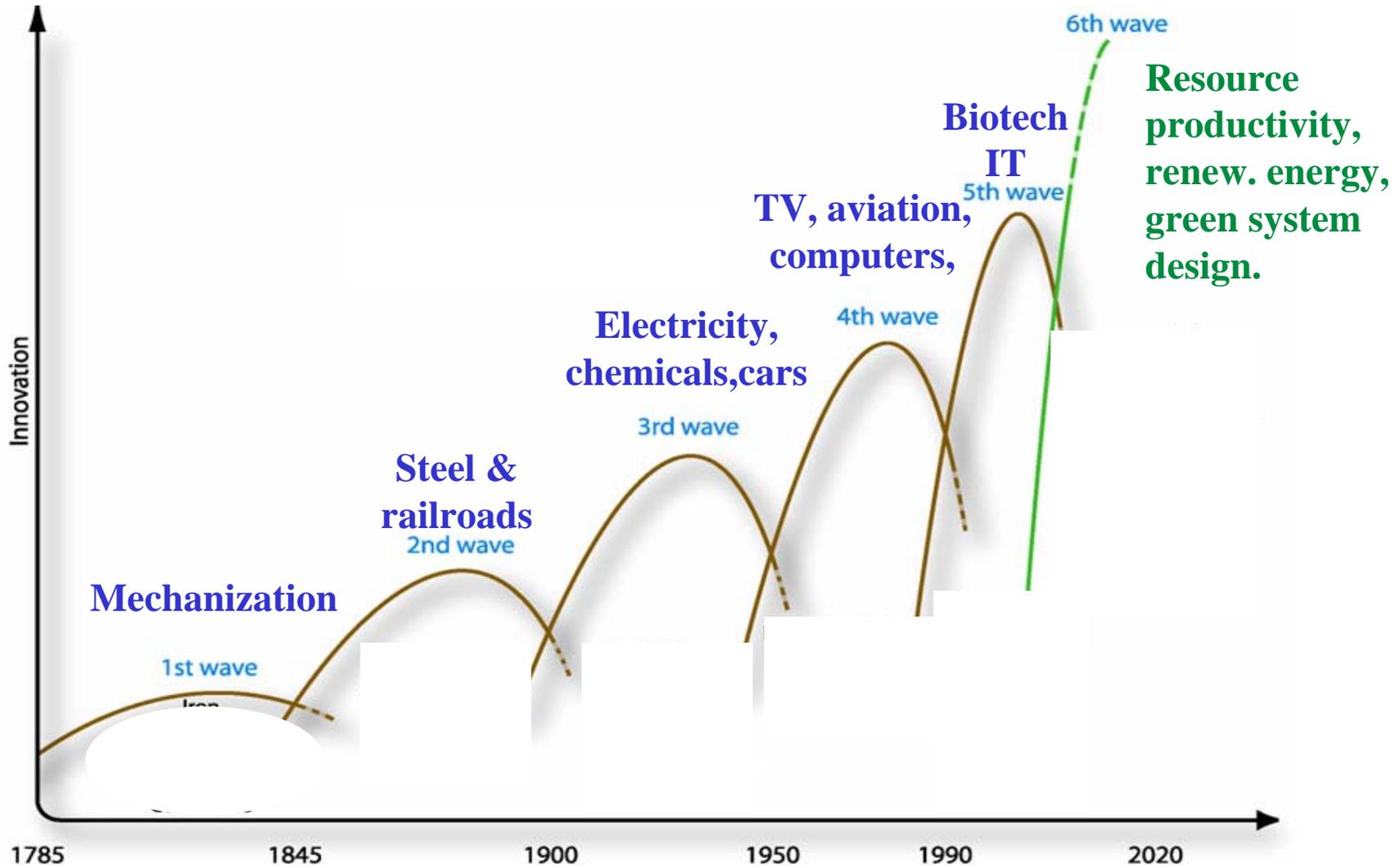


**George Soros, perhaps
the most successful
money wizard, last month
invested 1 billion dollars
into the green economy**

Source: Environmental Leader 10.10.09

The next Kondratieff Cycle should be “green”

(after Charlie Hargroves, Brisbane, Australia, co-author of Factor Five)



Why should it be green?

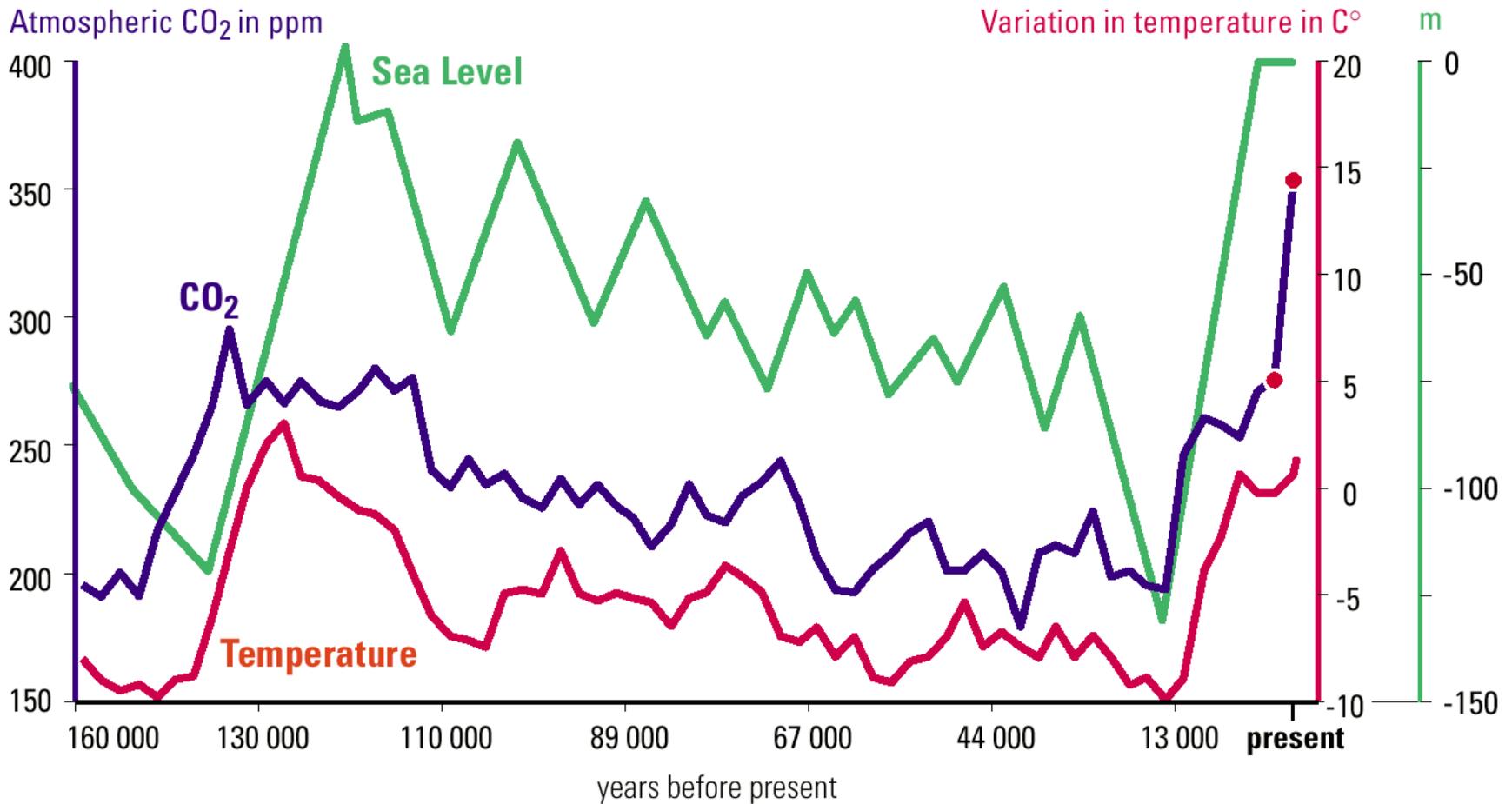
7 billion people want decent life styles

Today's lifestyles are far too resource (and carbon) intensive

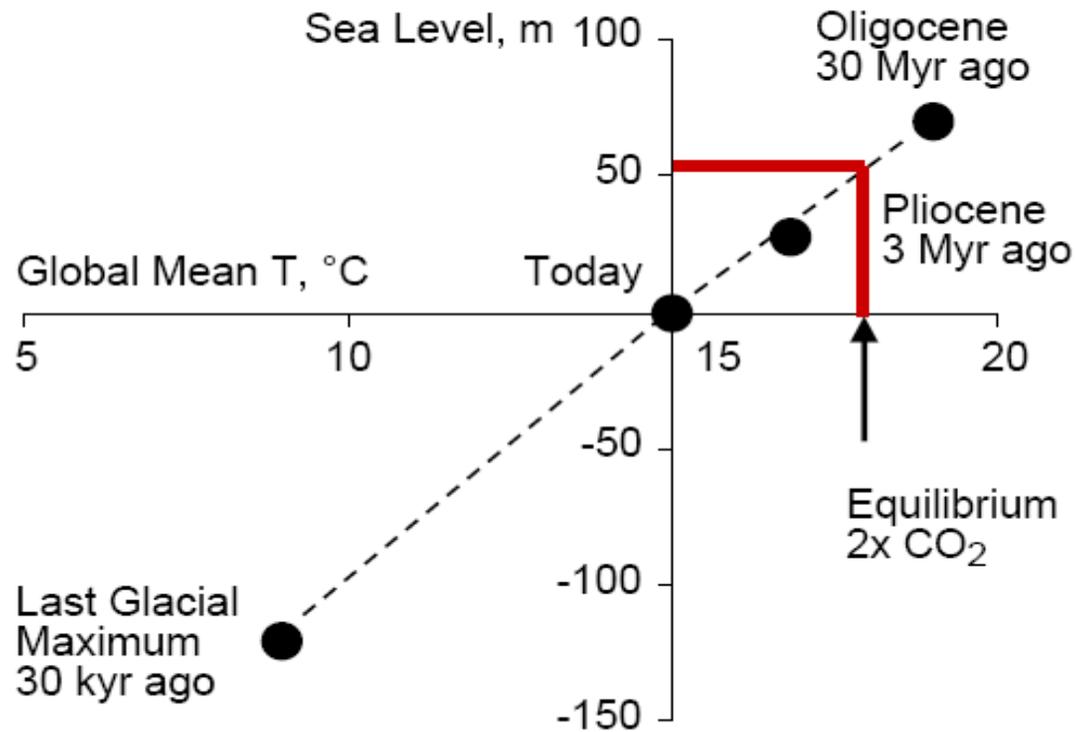
Providing enough energy and material resources for 7 billion people is not sustainable **at US lifestyles.**

**Let us briefly look at the nature of
the climate challenge**

The most alarming feature of global warming is the potential sea level rise



Doubling CO₂ concentrations could lead to 50m sea level rise

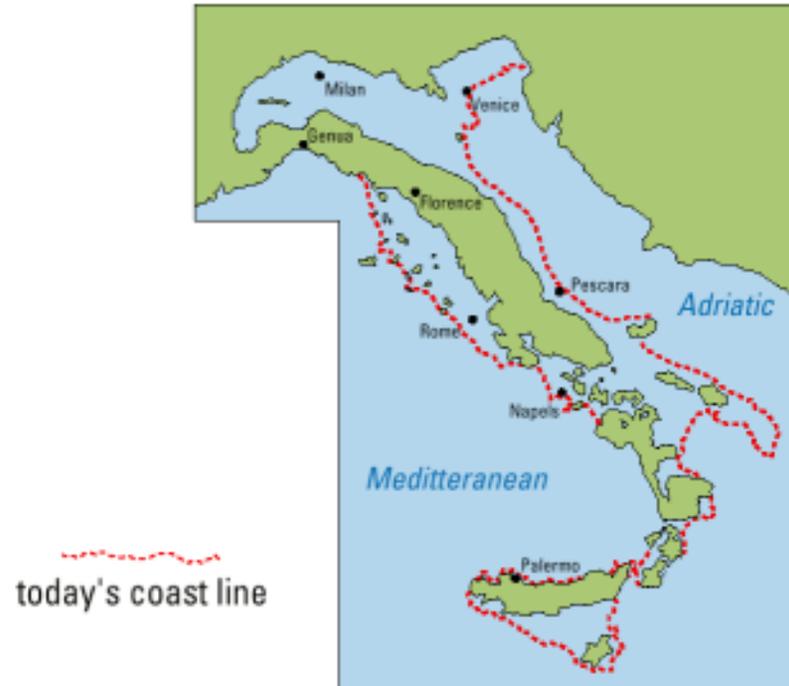


David Archer

Italy during the last Ice Age (20 000 years ago)

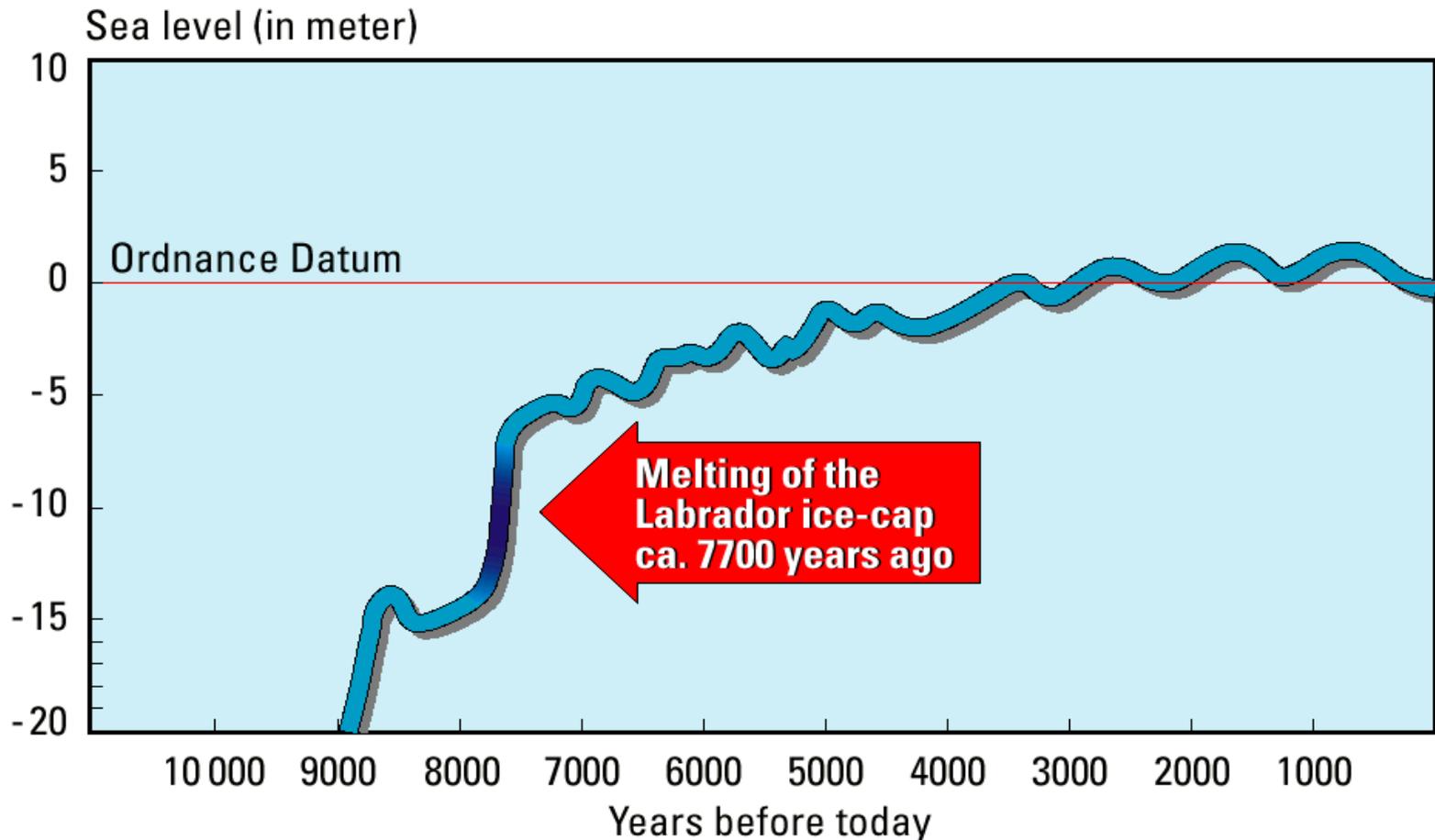


.... and during the last Hot Age (2 million years ago)

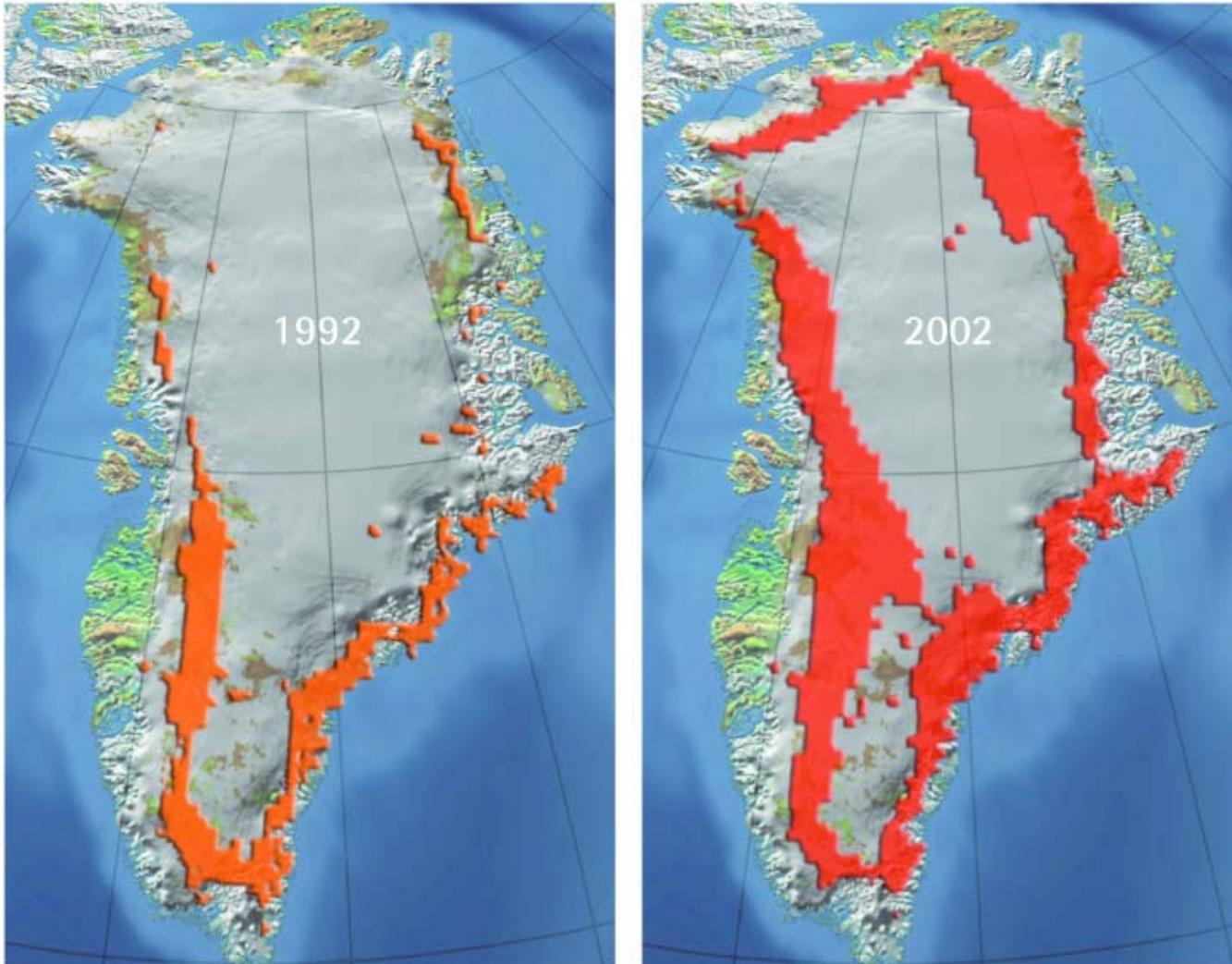


Sea level rise can take catastrophic speed!

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

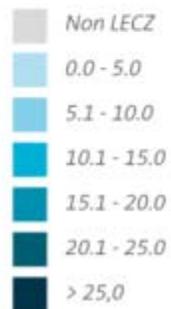


Presently we are **destabilizing** Greenland!
(Freshwater coverage during Summers 1992 and 2002)

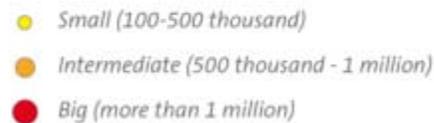


East and South Asia's agglomerations are mostly at the sea shore

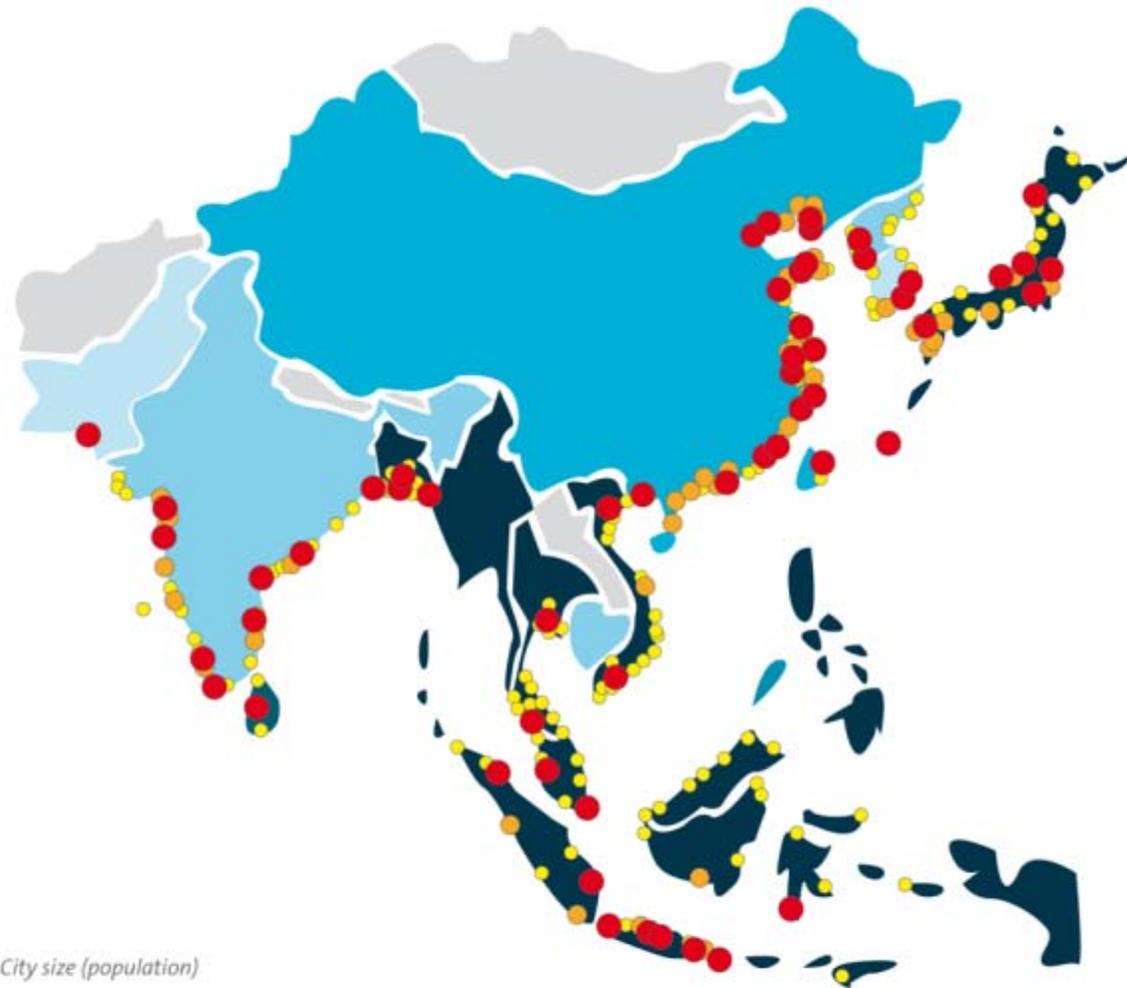
Per cent of national urban population in low elevation coastal zones in Asia



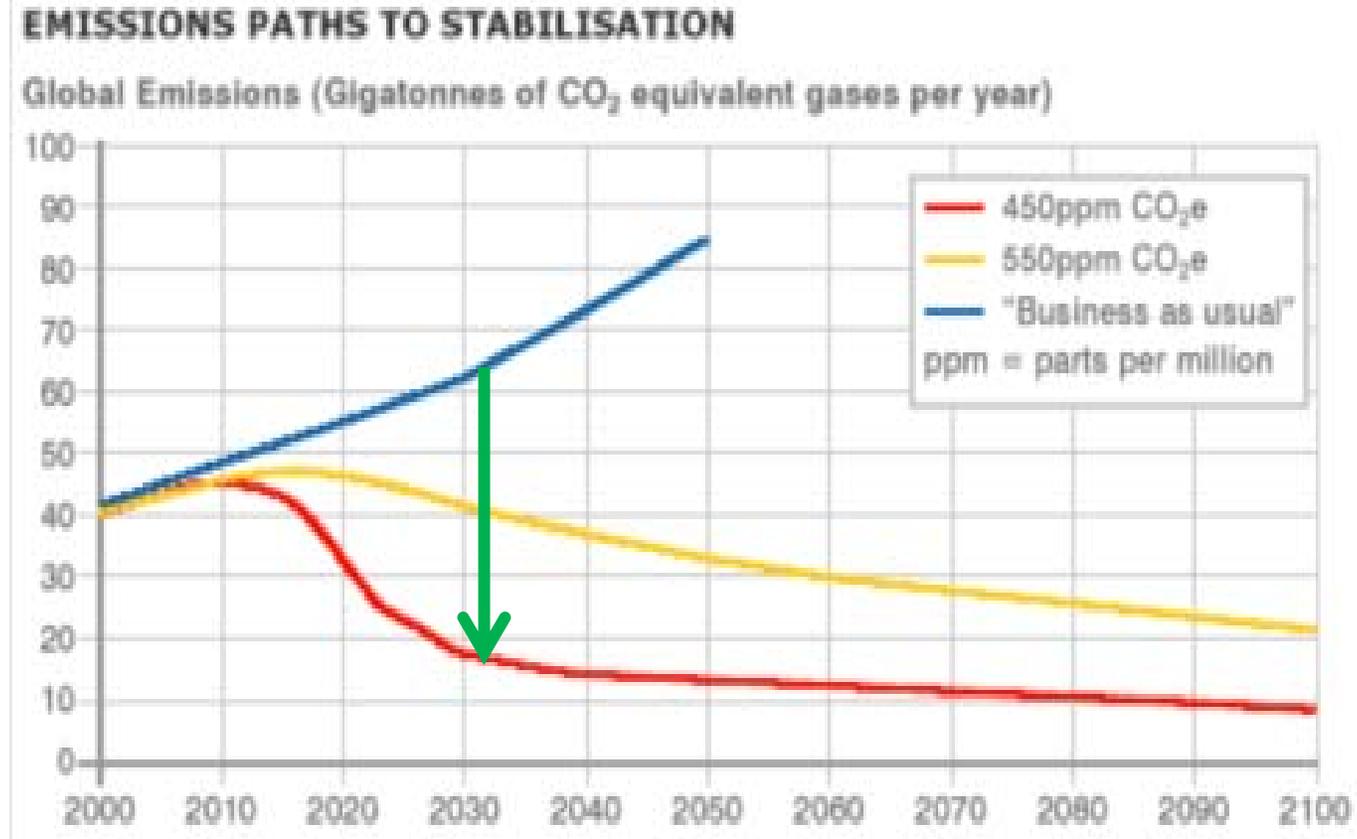
City size (population)



LE CZ: Low Elevation Coastal Zones are land areas that are contiguous with the coast and ten metres or less in elevation

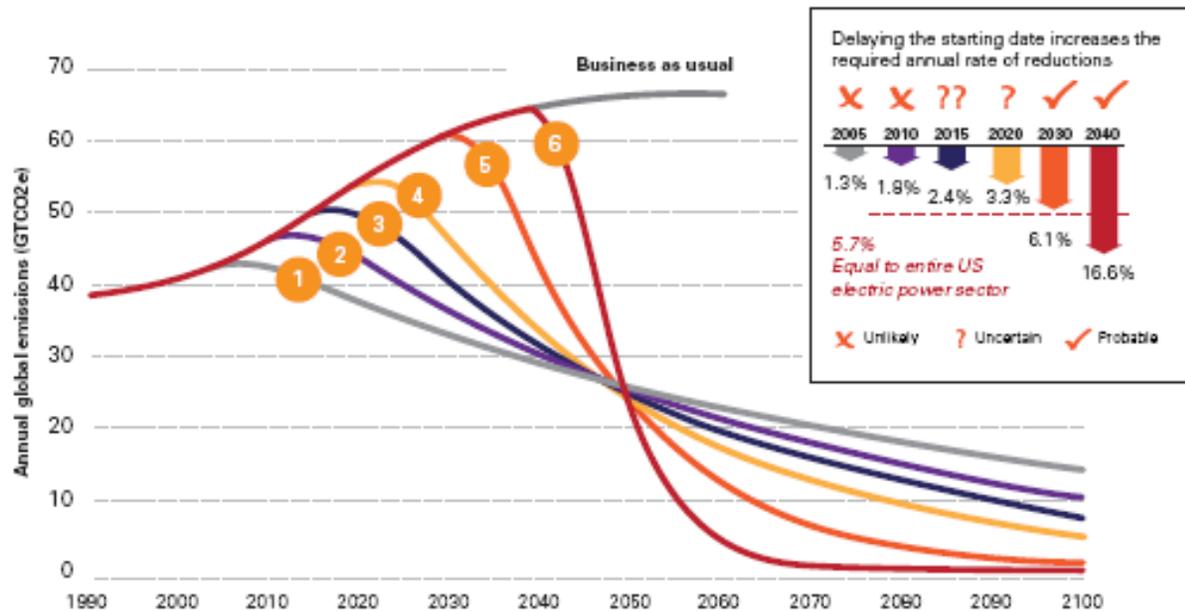


Stern Review: BAU (blue) vs. stabilising at 450 ppm CO₂ (red)



The longer we wait, the more radical changes are needed

Pathways for global emissions consistent with long-term stabilization at 450 ppm

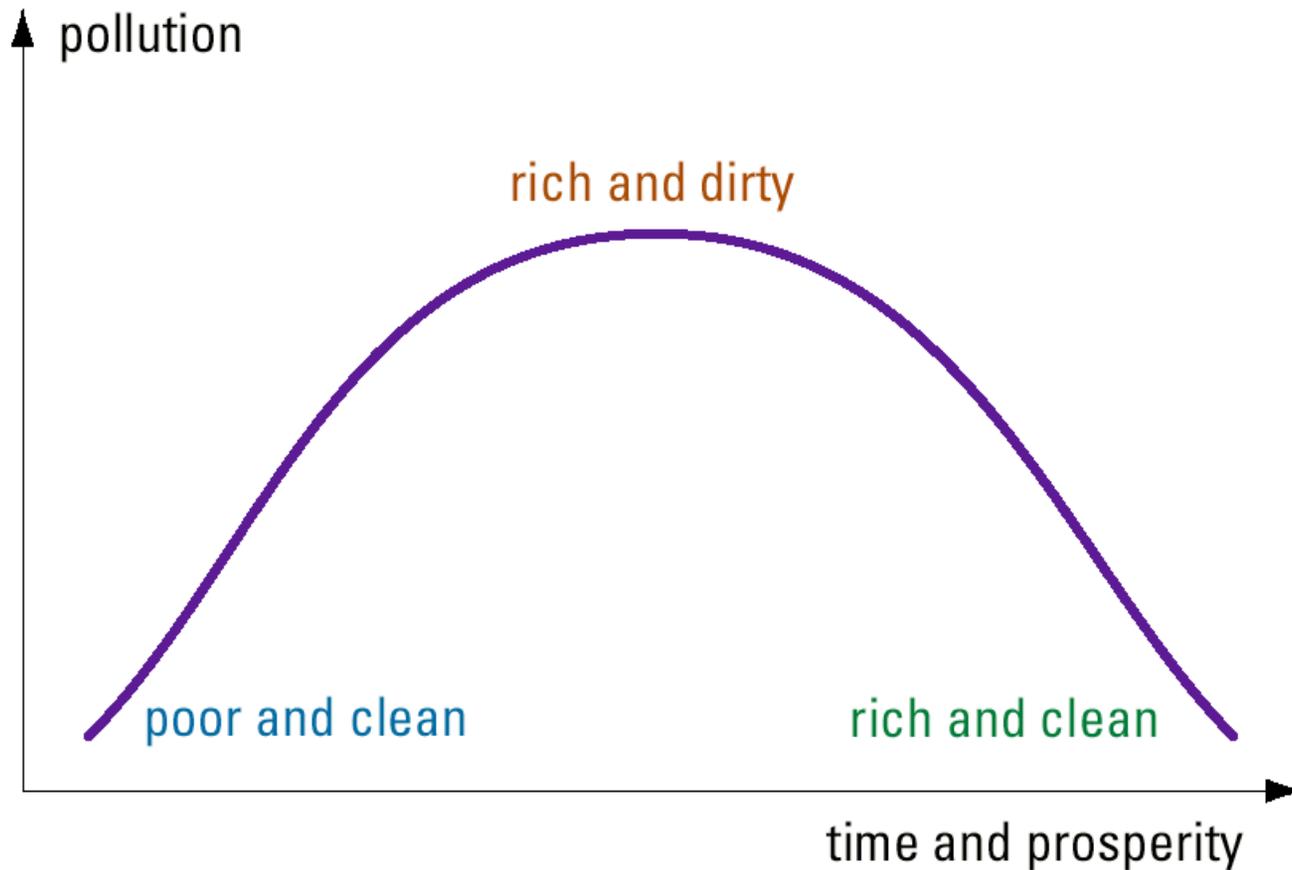


Source: EDF calculations using the MAGICC climate model and IPCC assumptions, published in Keohane & Goldmark (2008) "What Will it Cost to Protect Ourselves from Global Warming? The Impact on the U.S. Economy of a Cap-and-Trade Policy for Greenhouse Gas Emissions", Environmental Defense Fund report.

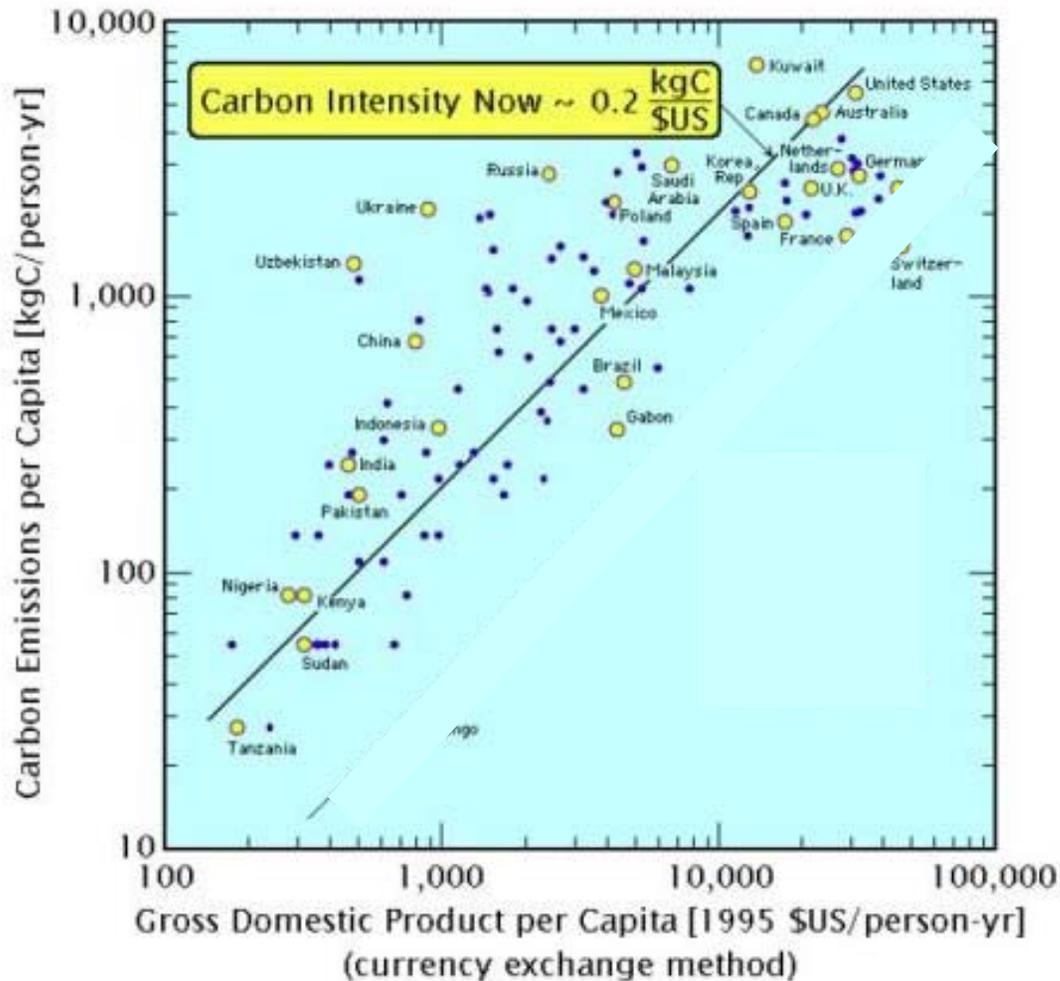
*More than 200 international climate scientists issued a declaration in December 2007 urging politicians at the United Nations Climate Change Conference in Bali to agree on strong targets for tackling climate change.

*Based on CO₂-equivalent volumes (CO₂, methane, N₂O, HFCs, PFCs and SF₆)

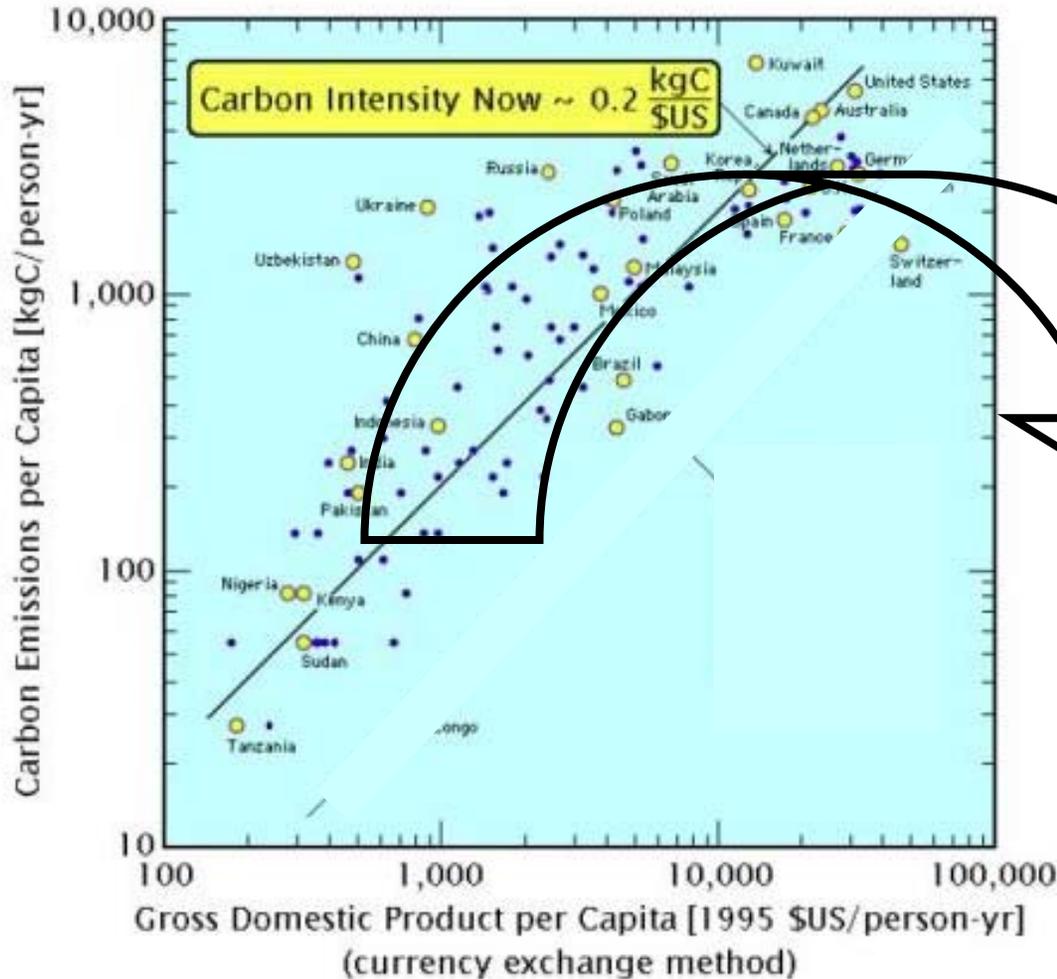
Why are so many people thinking we should first become rich and deal with climate problems later? It is the convenient paradigm of the Kuznets curve of pollution



Well, empirically wealth does go with carbon intensity

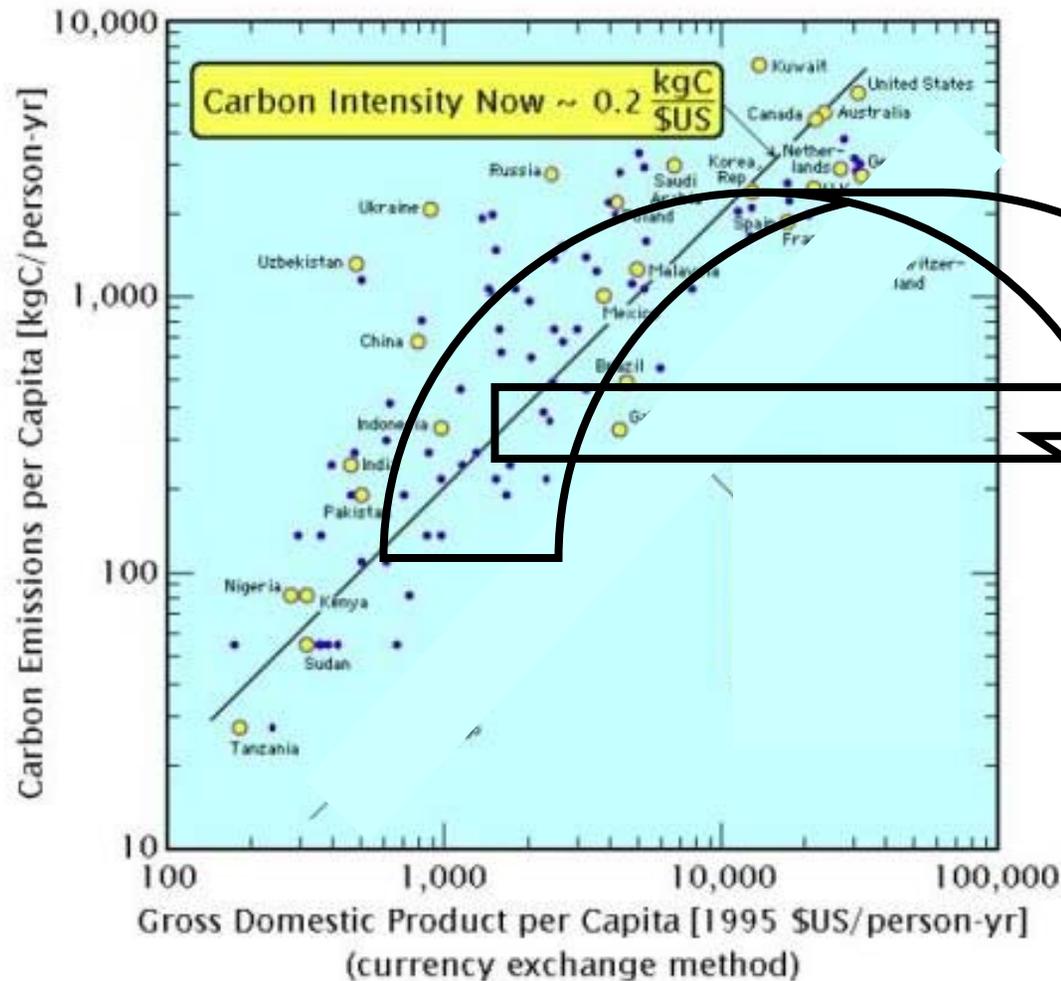


Escaping from this mindset means we need a „Kuznets Curve“ of decarbonization!



„rich and carbon free“

And then make China, India etc.
„tunnel through that curve!“



„rich and
carbon free“

The only solution leading to a quick moderation of CO₂ emissions in China, India, Brazil etc. is per capita equal CO₂ emission rights



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



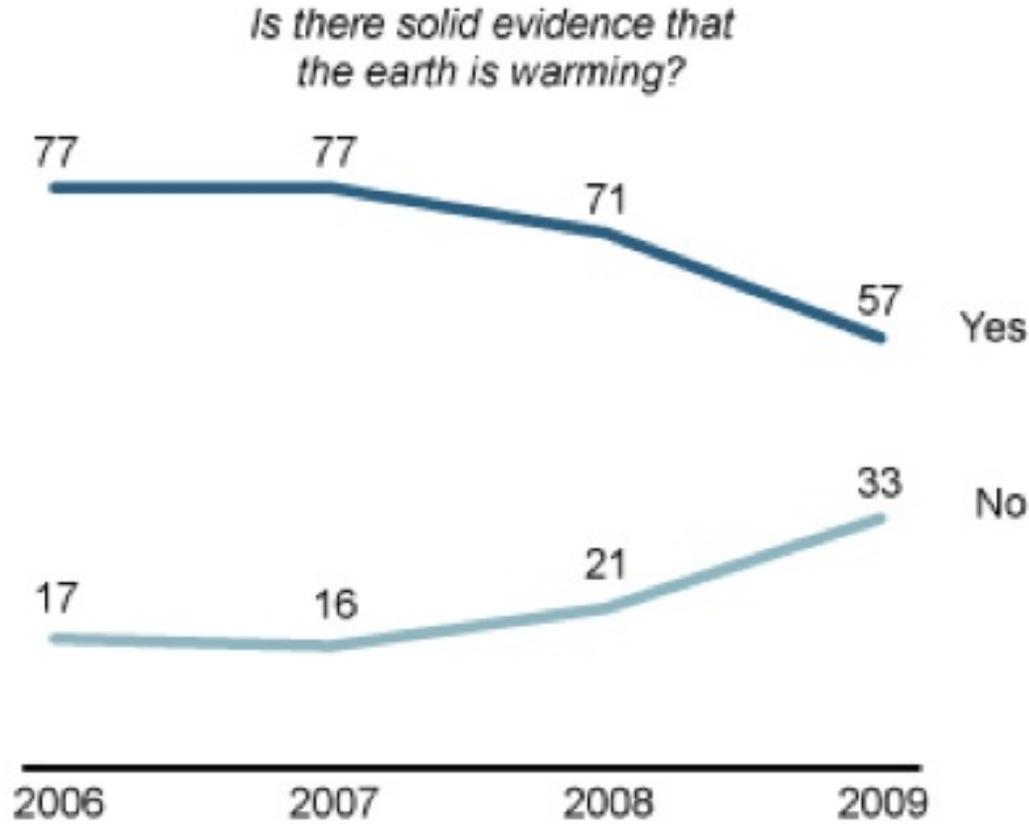
German Chancellor Angela Merkel, on 30.8.07, at the Nikkei Symposium in Tokyo, and later in New Delhi supported the idea! In the USA, this will be a hard sell!

A somewhat shocking trend I saw last month in „Environmental Leader“

OCTOBER 22, 2009

Fewer Americans View Global Warming as a Problem

**„De-learning“
in America
2009**



If minus 80% CO₂ emissions is required, how do we get there?

Three options exist:

- Reduce carbon intensity of energy**
- Reduce energy intensity of wealth**
- Reduce wealth**

Conventional thinking suggests

- **70% Reduce carbon intensity of energy**

(renewable energies, nuclear, CCS)

- **15% Reduce energy intensity of wealth**

- **15% Reduce wealth (“we all have to pay a painful price”)**

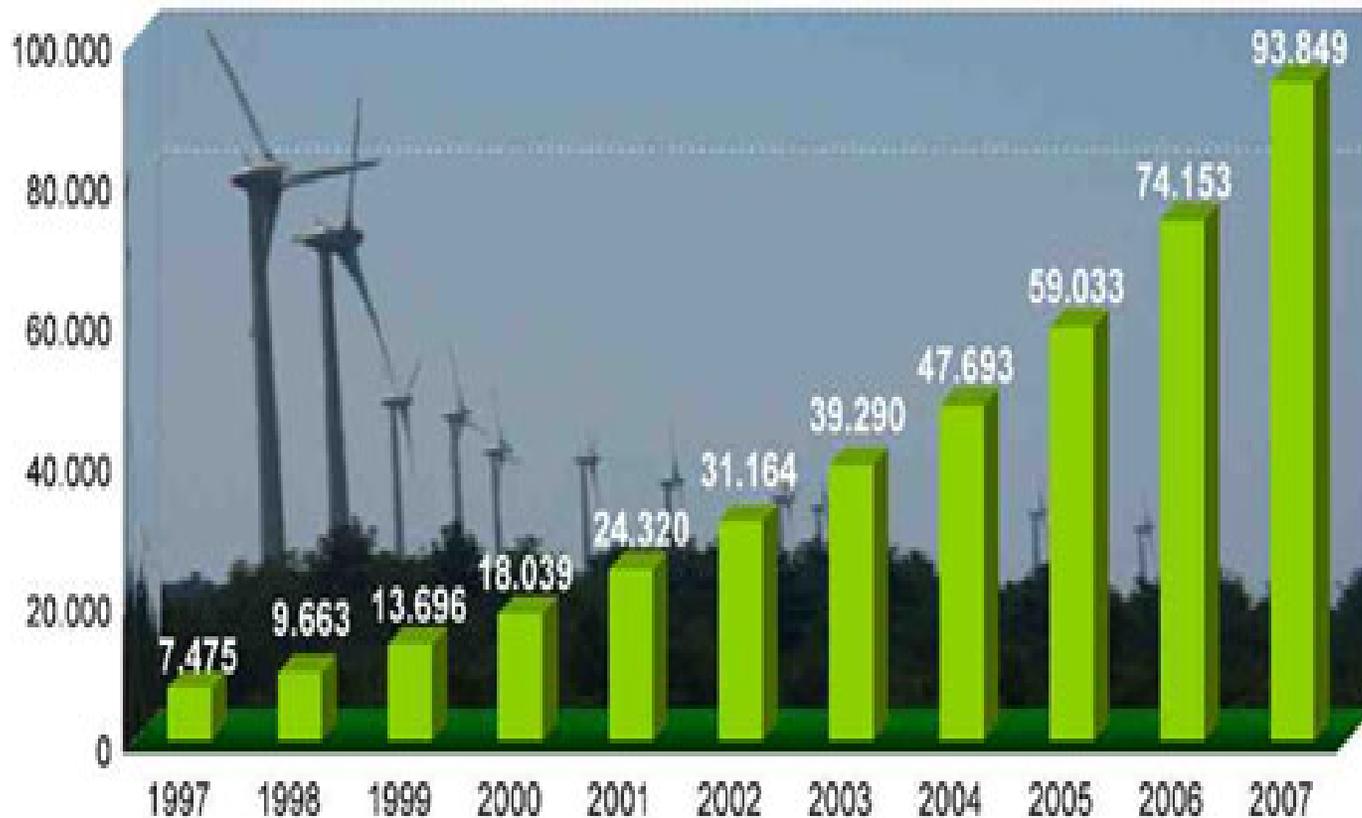
By contrast, I suggest this distribution:

- 30% Reduce carbon intensity of energy**
- 65% Reduce energy intensity of wealth**
- 5% Reduce wealth (such as weekend hopping to Teneriffa or Bahamas)**

Success story wind energy



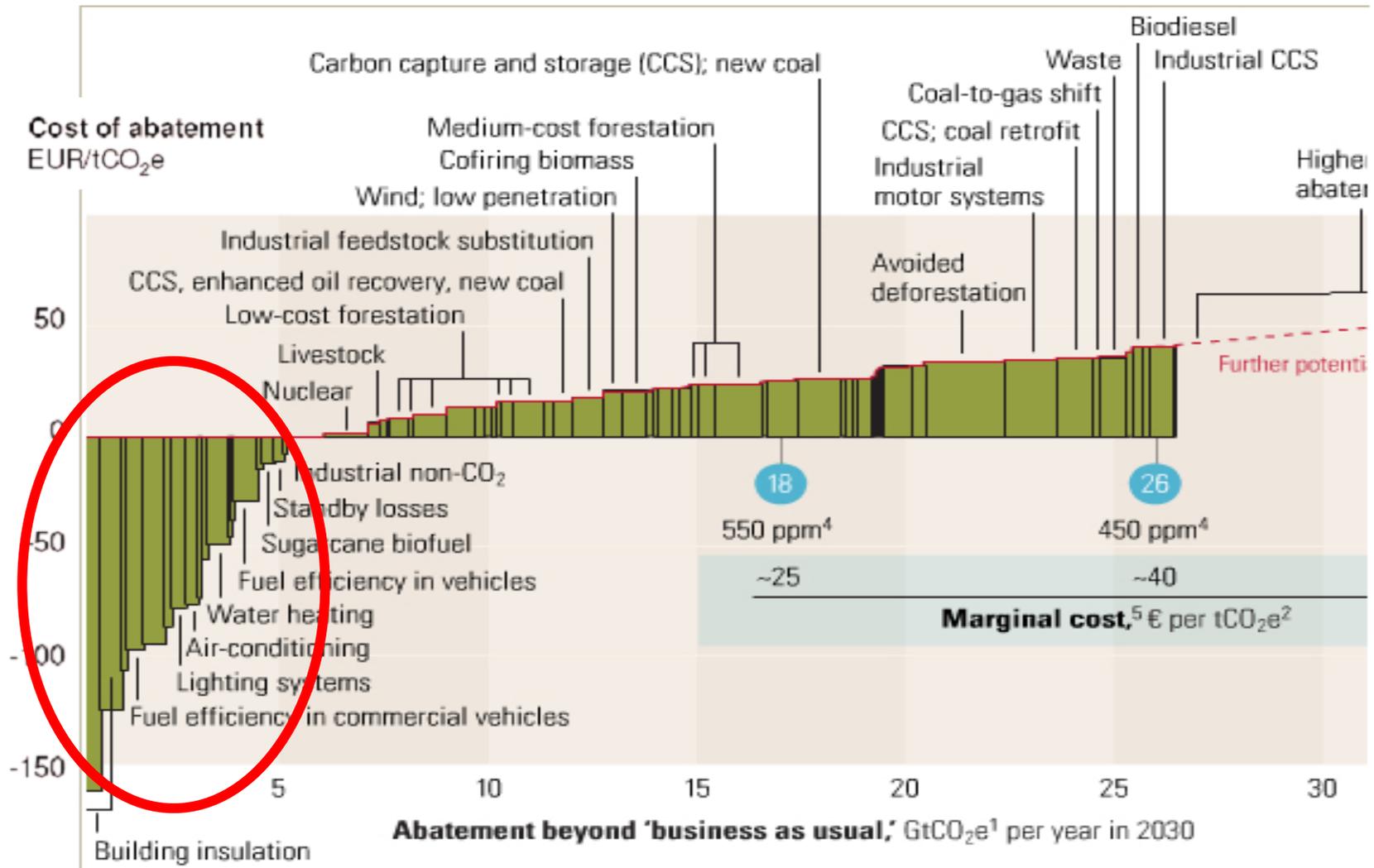
World Wind Energy - Total Installed Capacity [MW] 1997-2007



Offshore wind could become routine for the construction industry



However, the win-win options relate to efficiency, not renewables, and not to CCS



Source: MacKinsey & Vattenfall 2007

**And now let's go a bold step
further**

**Let's imagine climbing
Mt. Everest**



Imagine a bucket
of water weighing
twenty pounds.

**How many
kilowatt-
hours**

would you need to
lift that bucket
from sea level
up to the top of
Mount Everest?



Knowing that one Watt-second (Ws) is equivalent to one Newton-meter, (1 Joule)

the answer is:

One quarter of a kilowatt-hour!
(= 900.000 Ws)

1 kwh

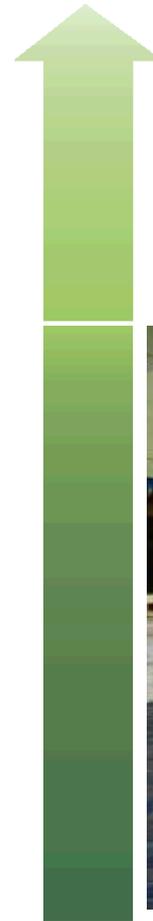




Becoming 5 times more efficient now doesn't sound too outlandish any longer.

Amory Lovins' Hypercar is up to seven times more fuel efficient than today's cars

Today's cars
6-10 l/100km



Hypercar
1,2 l/100km

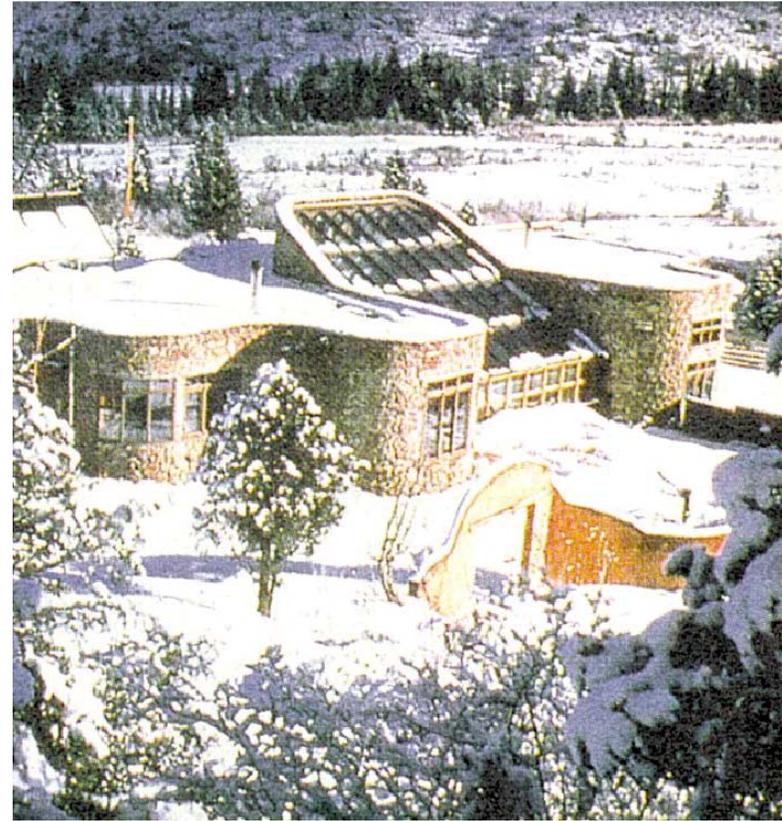


Energy efficiency

House in the Alps

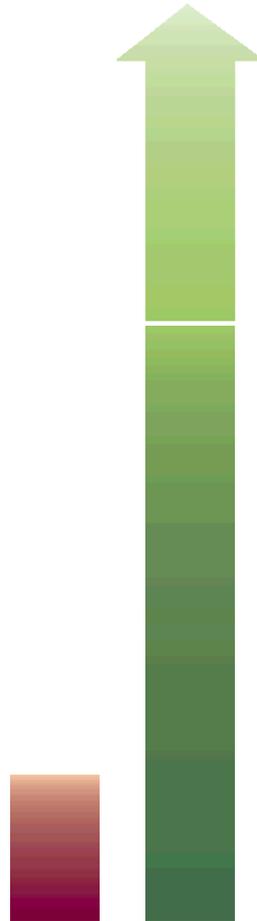


Amory Lovins' Rocky Mountain Institute



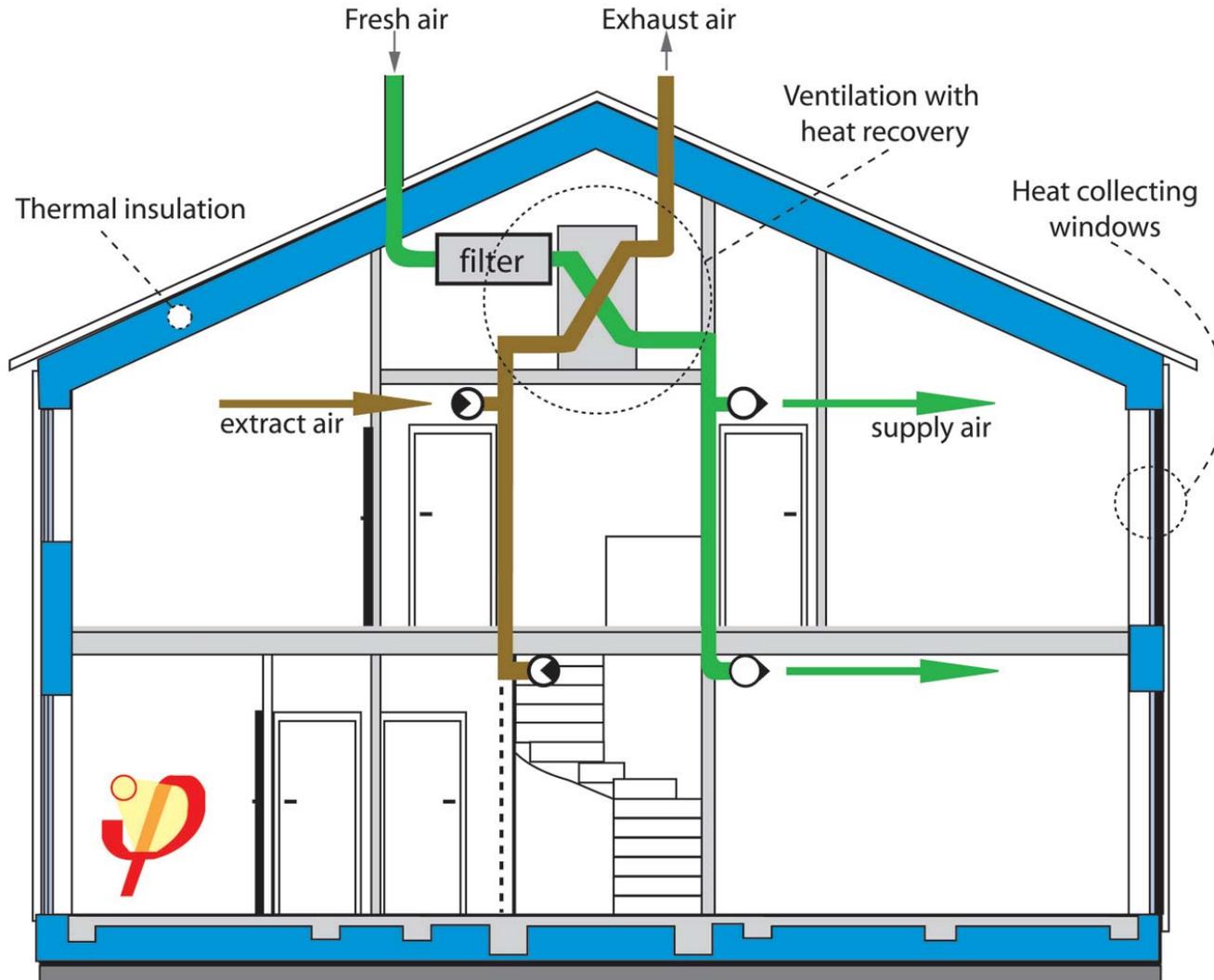
Heating efficiency

Solar „passive houses“ save 90% of heating costs

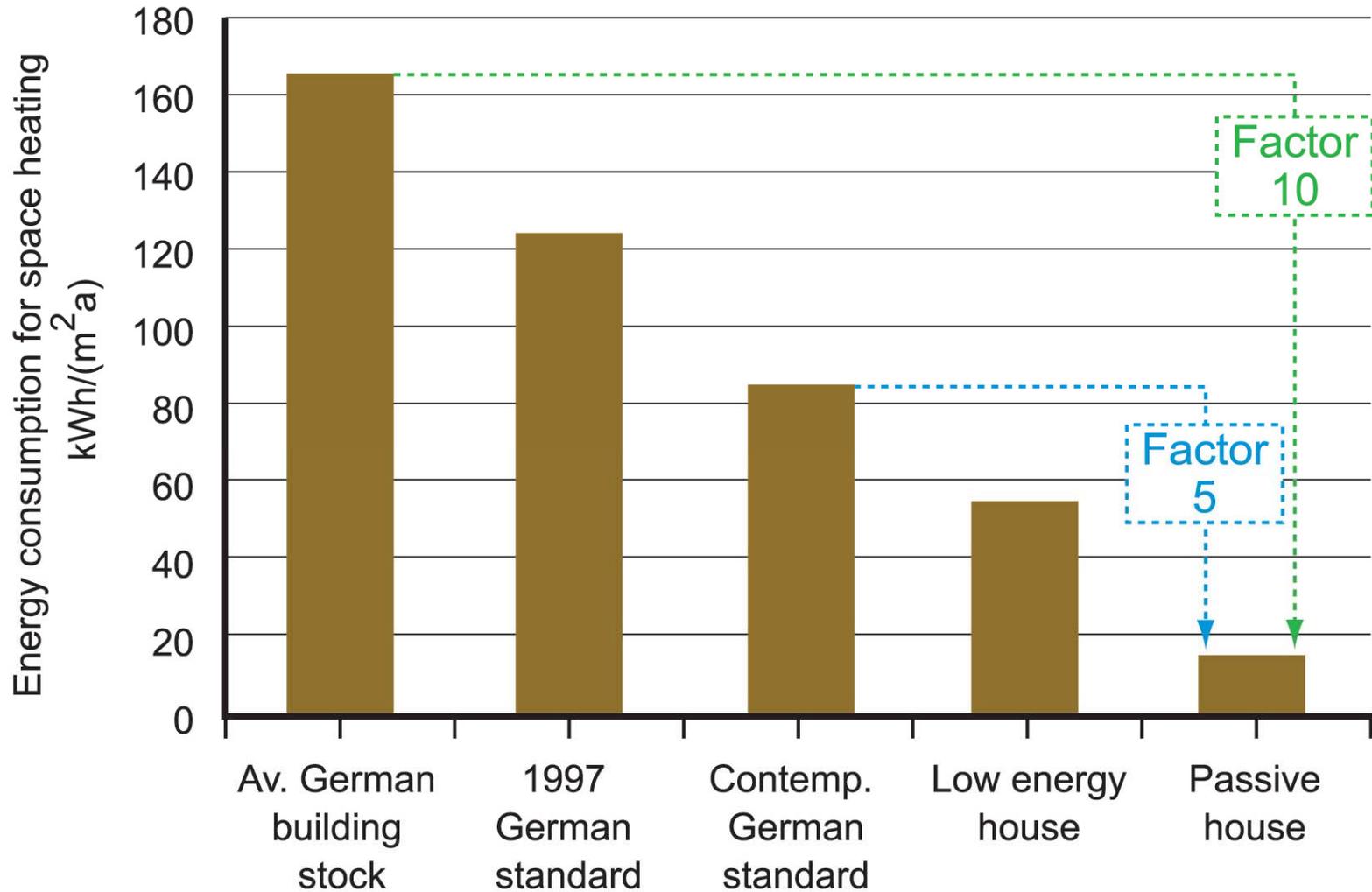


**Energy and
material efficiency**

Passive house: 90% less energy, through good insulation and heat exchange ventilation



Ladder of progress towards the Passive House



Passive house kindergarten in Dresden



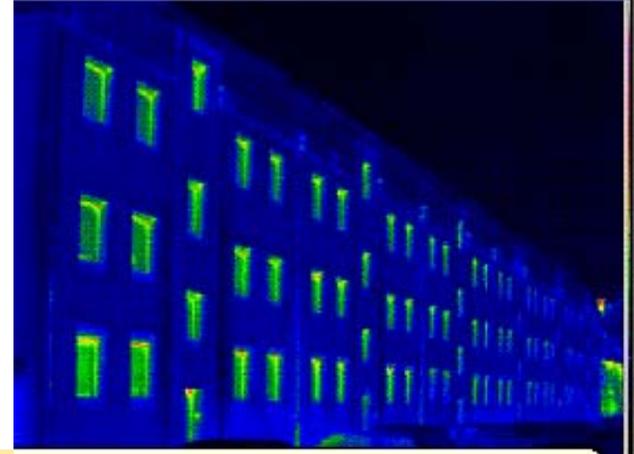
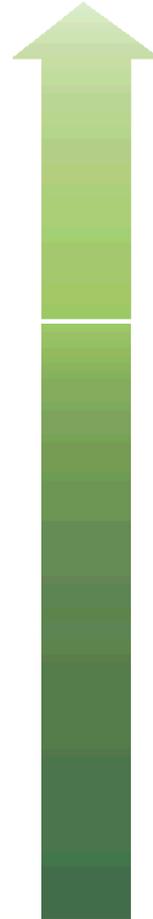
Passive houses in Illinois and Minnesota, USA



Refurbishing : the new frontier.



Refurbishing existing buildings



Upper row: Photographs
Lower: Thermograms

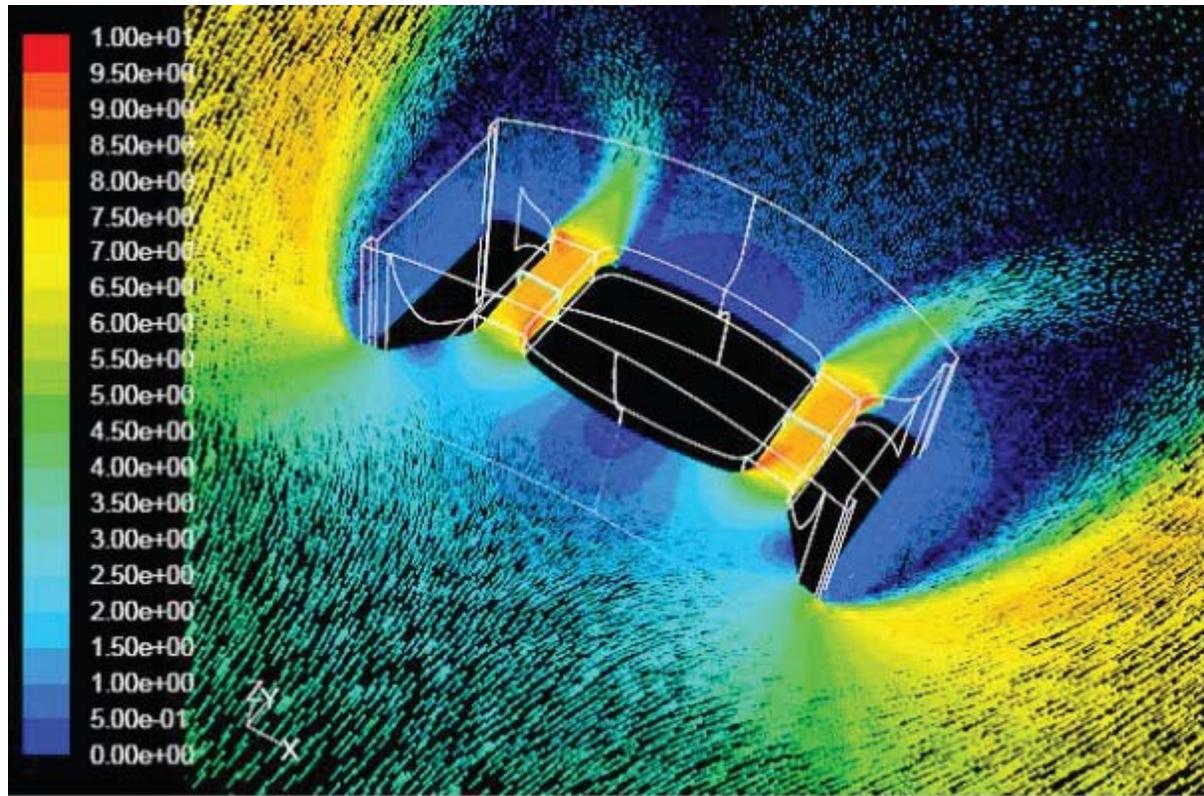


The Pearl River Tower in Guangzhou (Canton) in the South of China could become the first „zero energy“ skyscraper in the world (310m tall), using solar, wind, and needs 60% less energy than usual.

Architects: Skidmore, Owings, and Merrill (SOM)

Wind channels make for wind power conditions and reduce mechanical wind pressure on the flat tower

Wind velocity



Velocity Vectors Colored By Velocity Magnitude (m/s)

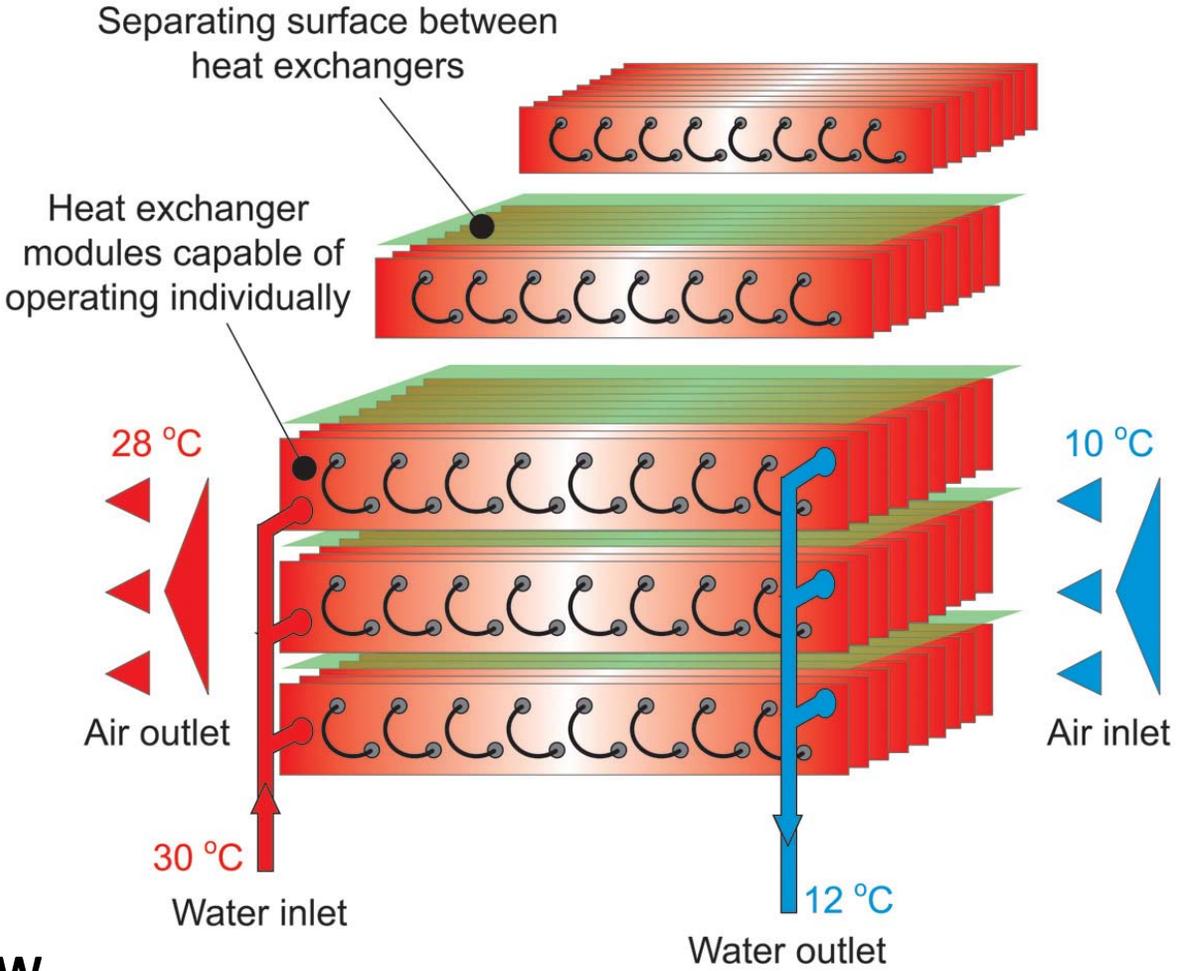
Dec 01, 2006

Let's assume that Züblin's „Dancing Towers“, planned for 2011 in Hamburg will also be extremely energy efficient



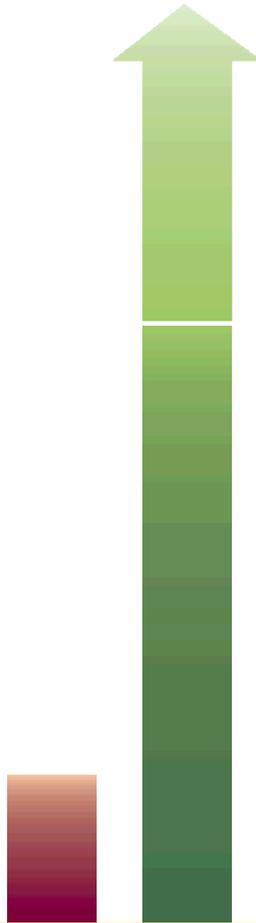
(concept)

Combined air and water cooling/heating system has a 90% efficiency of heat /coolth recovery. In dry-hot climate, nights tend to be cool. This can be used to ,harvest‘ coolth at night for airconditioning during the day. Design: H. Schilling, SEW



Design: H. Schilling, SEW

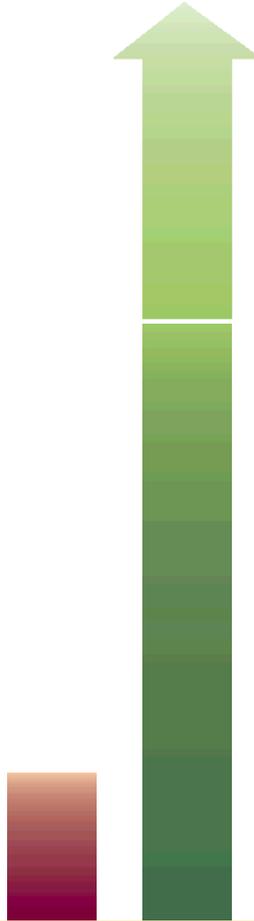
LED replacing incandescent bulbs: a factor of 10



Philips 7W Master LED

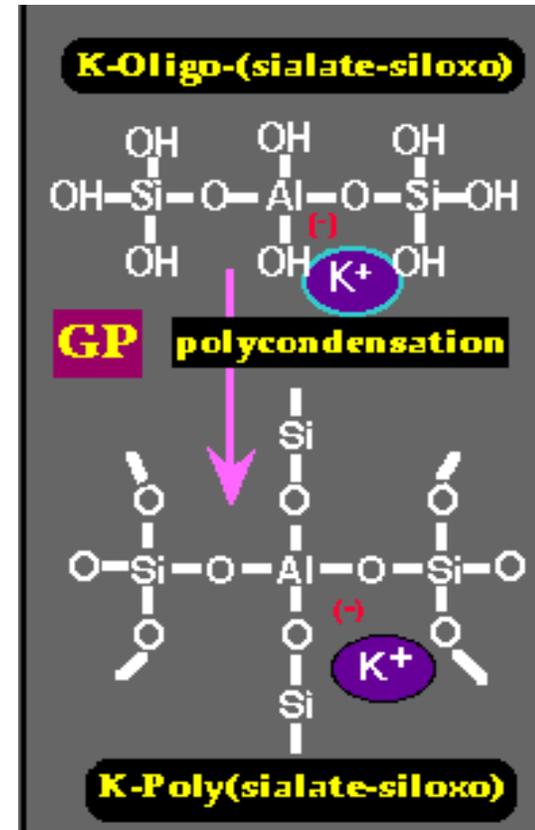
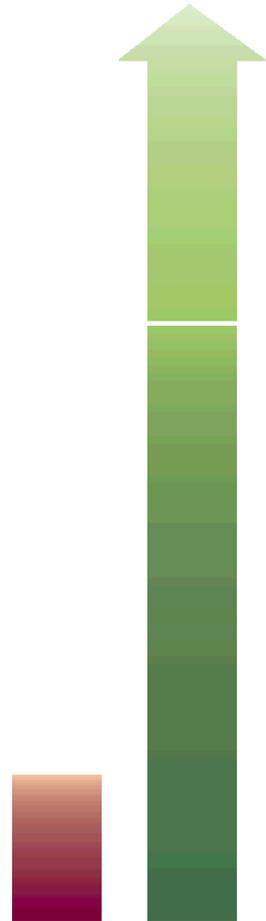
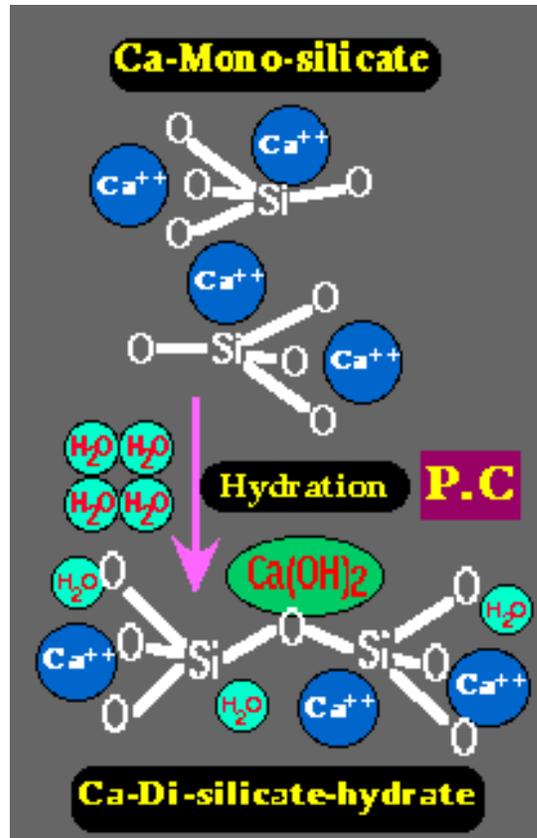
Energy efficiency

Modern Japanese steel can be 4 –10 times as resource efficient



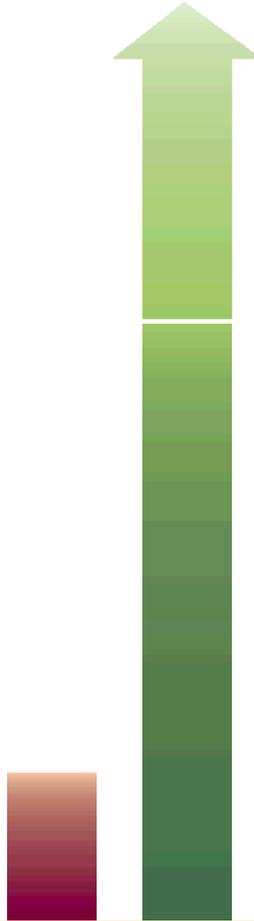
**Energy and
material efficiency**

From Portland cement to geopolymers



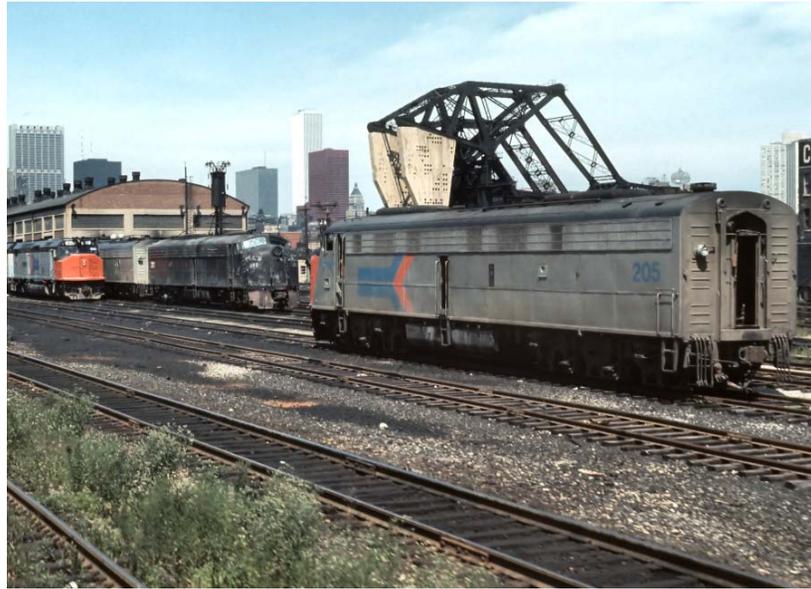
Carbon efficiency

From urban sprawl to high density cities (this is essentially USA vs Japan)

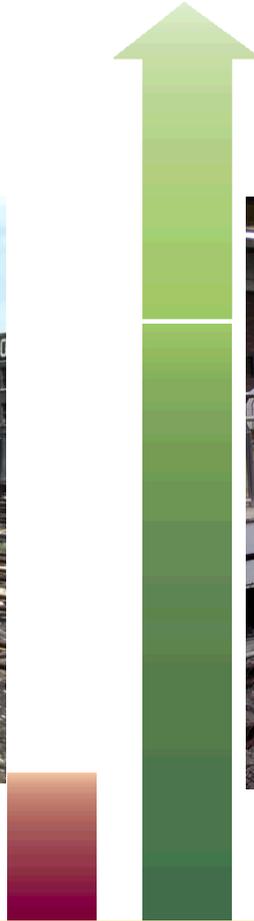


Space and energy efficiency

From 12 lane highways and rotten trains to 4 lane highways and high speed trains



Fuel prices are low



Fuel prices are high

Telepresence rooms replacing business travel



Energy & material efficiency



A European Infrastructure of Living Labs – Fostering sustainable innovations around the home
www.livinglabproject.org



POLITÉCNICA



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich



I was very happy learning that my earlier institute, the Wuppertal Institute is co-creating a European network into sustainable innovations around the home.

Changing technological paradigms

Old:

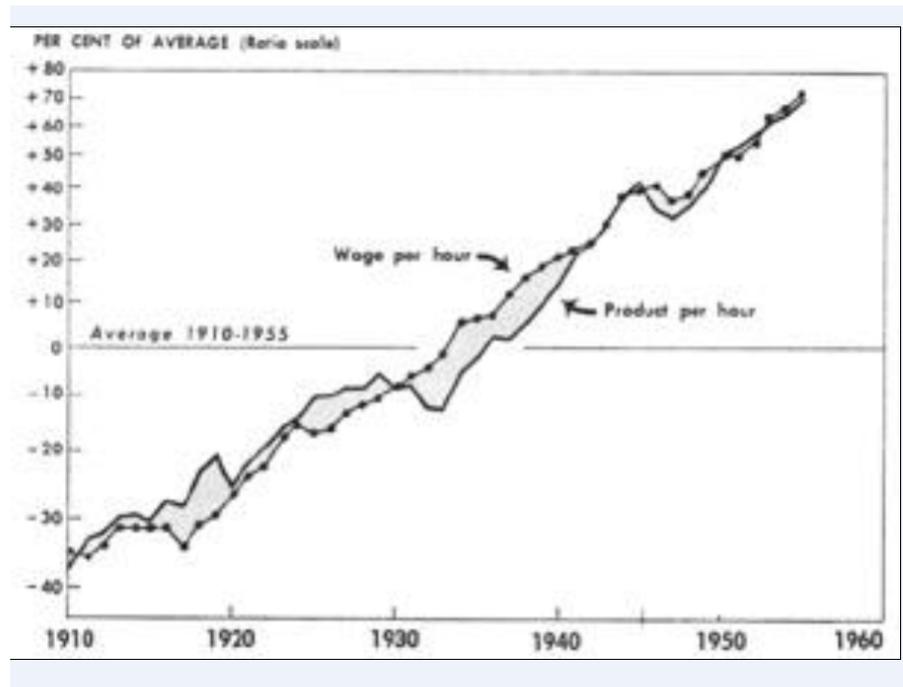
**Increasing
labour
productivity**

New:

**Increasing
resource
productivity**

If labour productivity has increased
twentyfold since 1850, it is not utopian
to think of **resource productivity**
increasing tenfold in 100 years and
fivefold in 50 years!

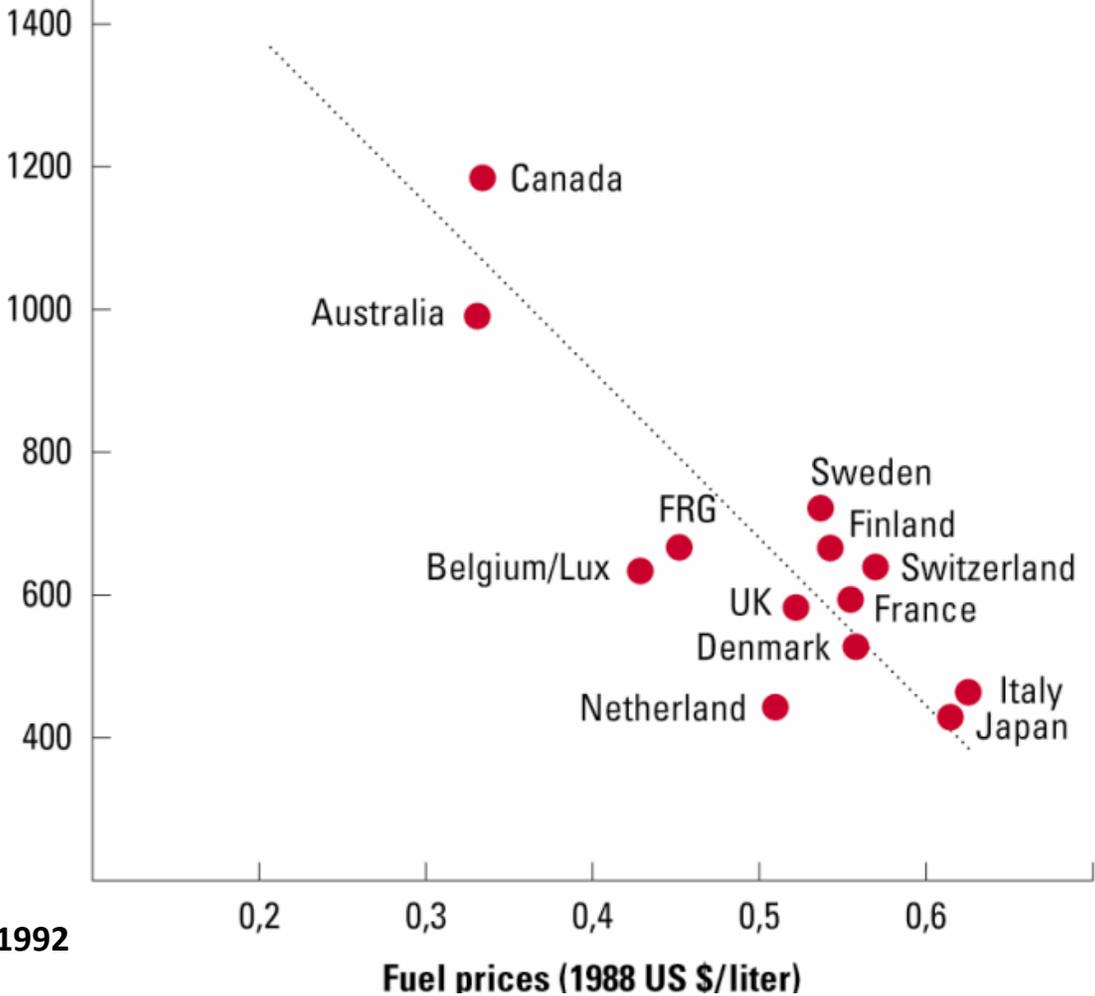
Labour productivity rose in parallel with labour costs



This suggests a strategy of actively elevating energy prices in parallel with energy productivity increases

High price elasticity for petrol

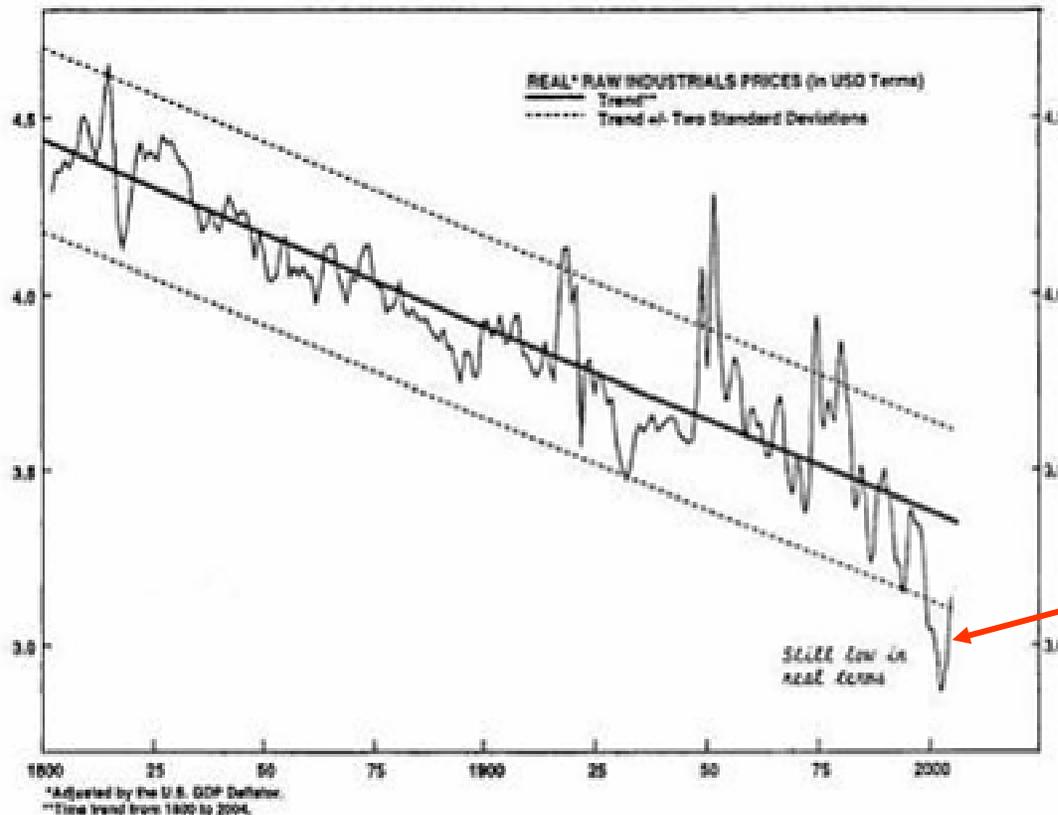
per capita and year fuel consumption in kg



Source: J.Jesinghaus, 1992

However, for 200 years **resource prices were falling**. Recent price hikes just brought us back into the **lower** confidence interval!

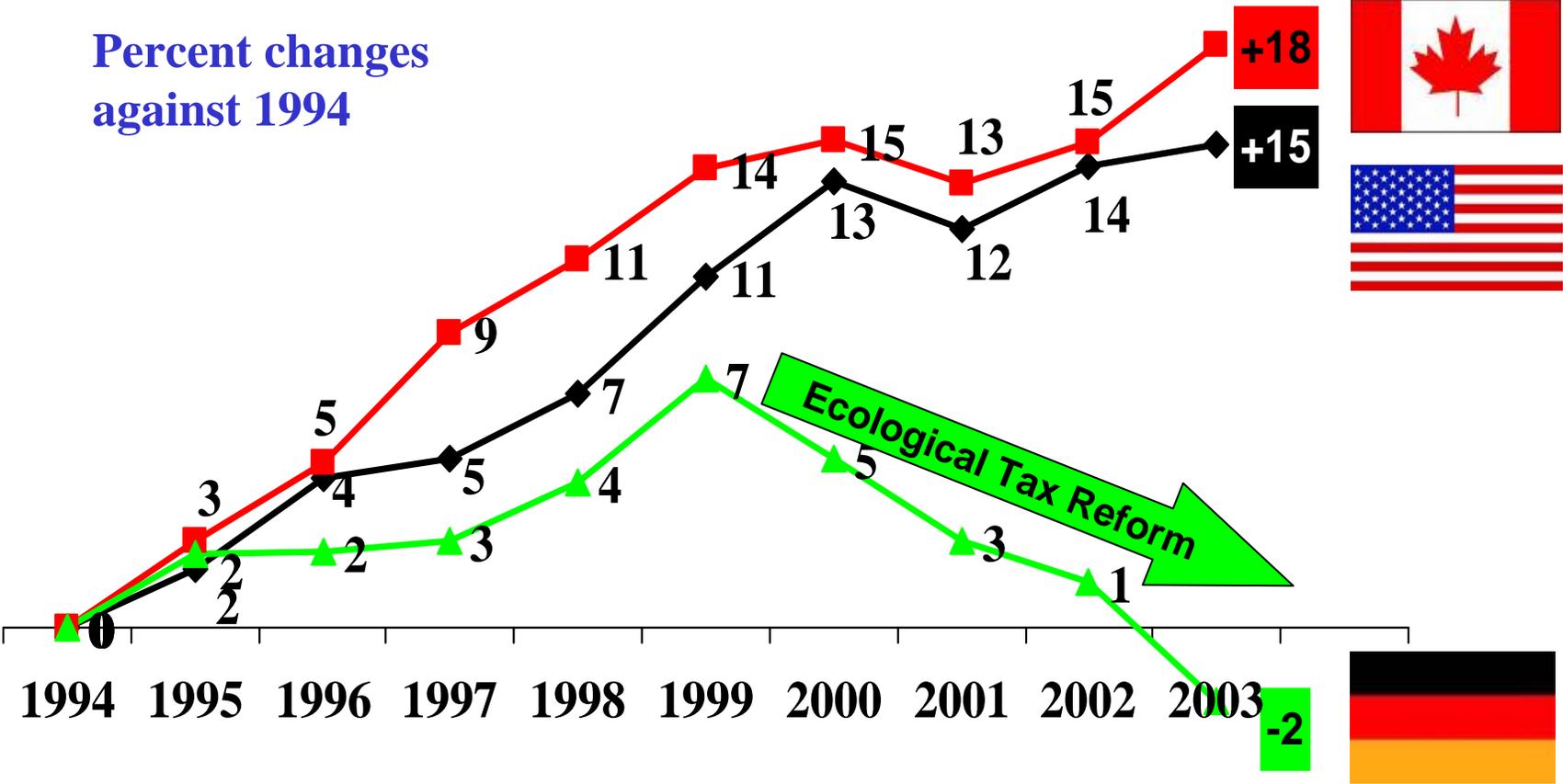
Prices of industrial commodities & energy, in constant dollars



Source: The Bank Credit Analyst

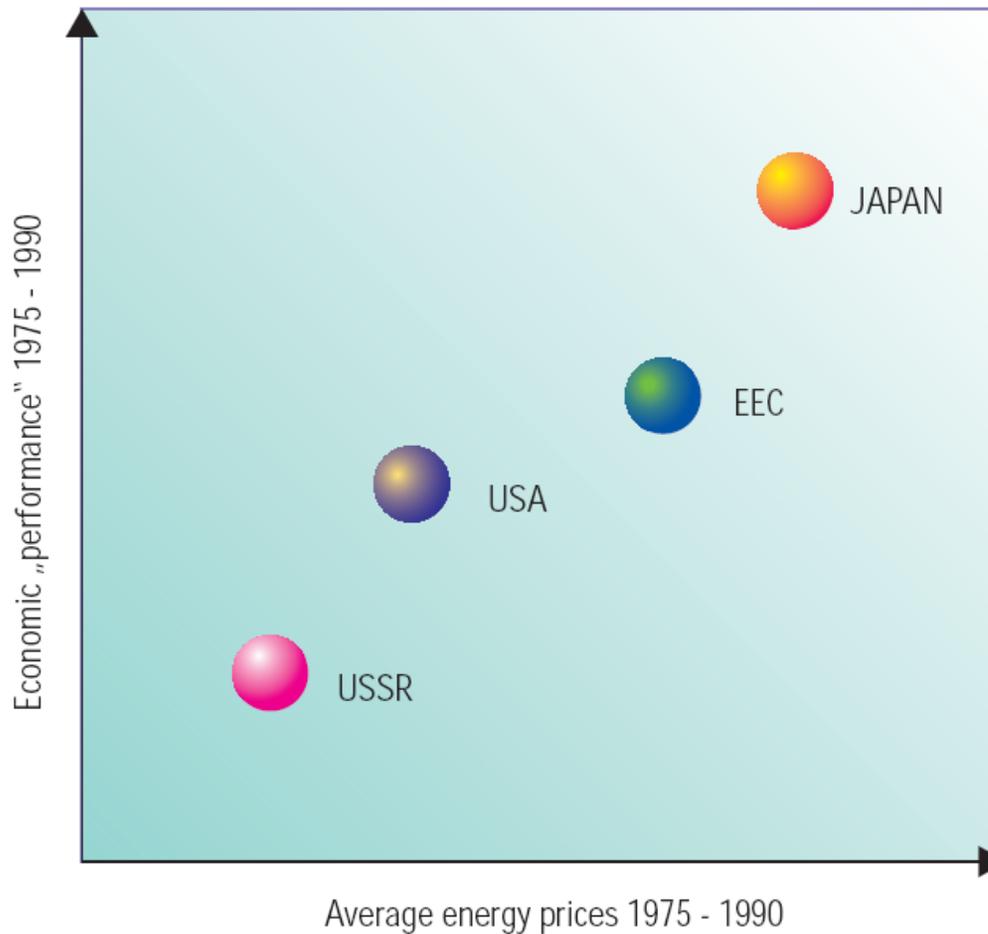
Ecotaxes can reverse the trend in fuel consumption

Percent changes against 1994



Reference: UNFCC 2005

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



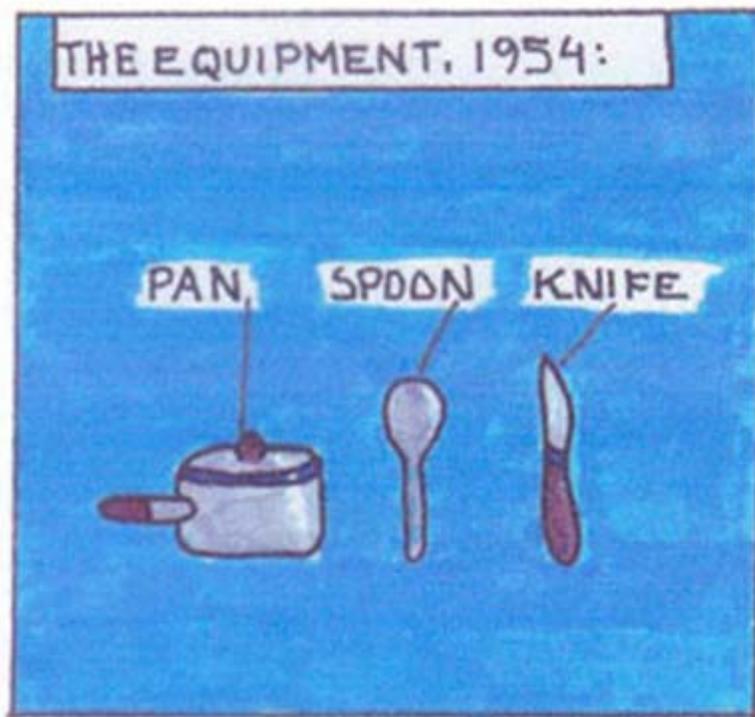
I suggest that entering a new technological growth cycle will require all branches of industry to become much more innovation (R&D) oriented.

This definitely applies to the construction industry and its partners.

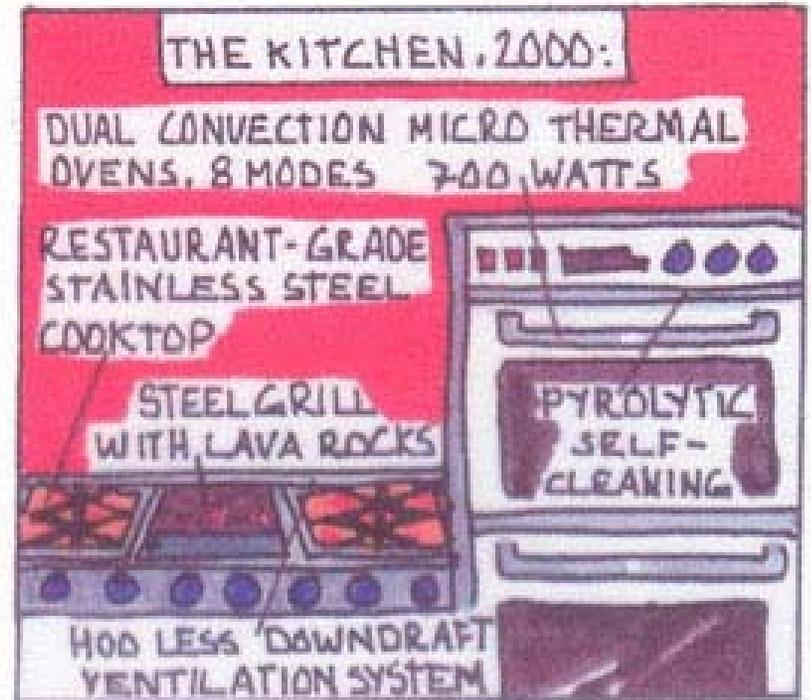
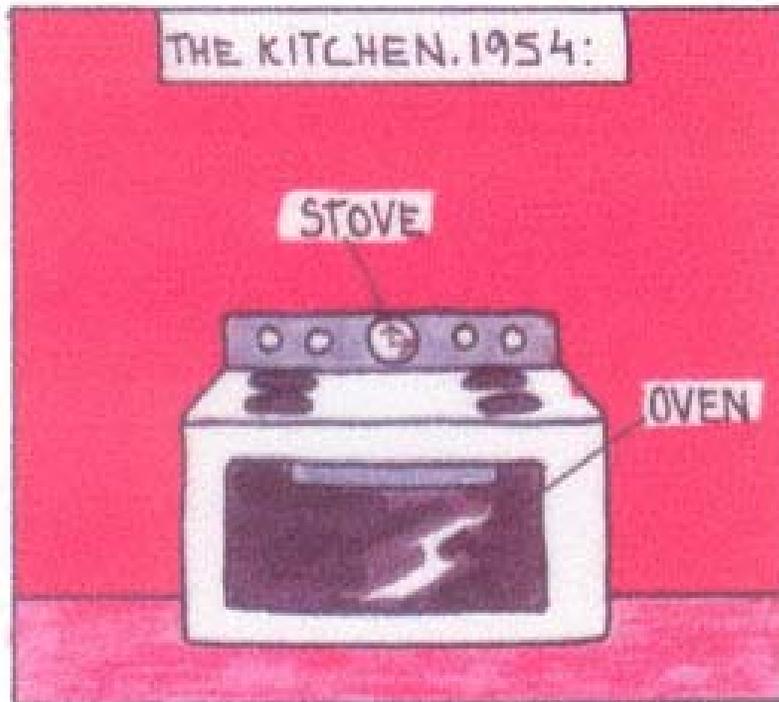
**Innovation and efficiency are great. But
there is also scope for**

sufficiency

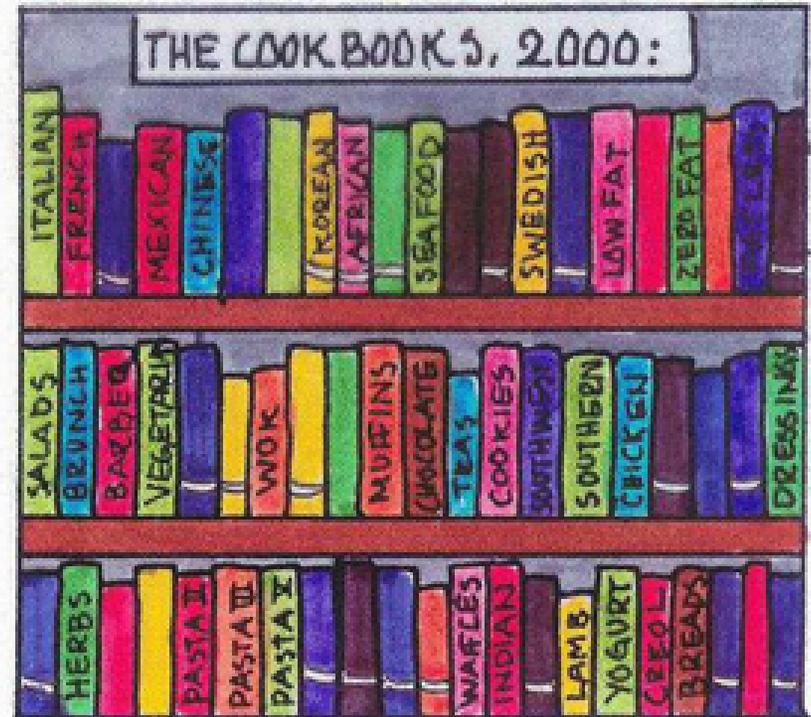
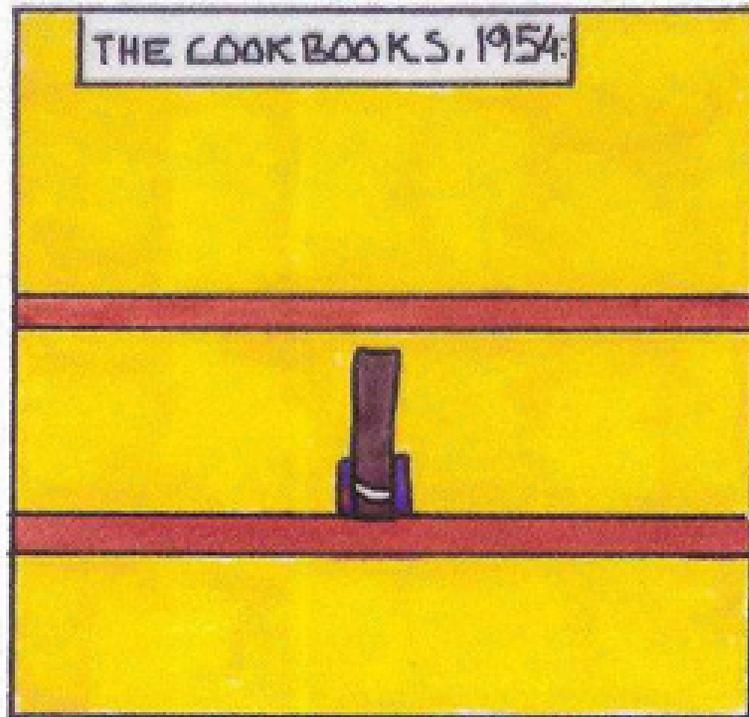
Economic growth in the kitchen



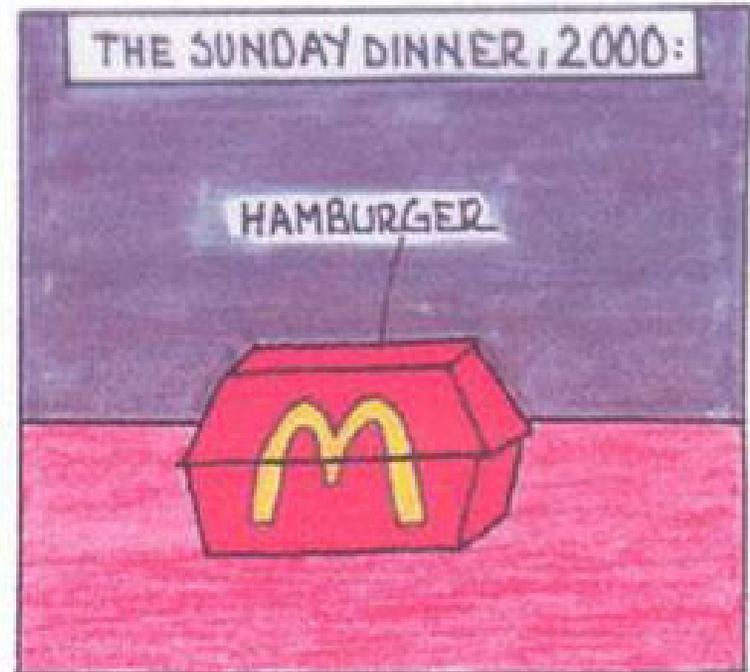
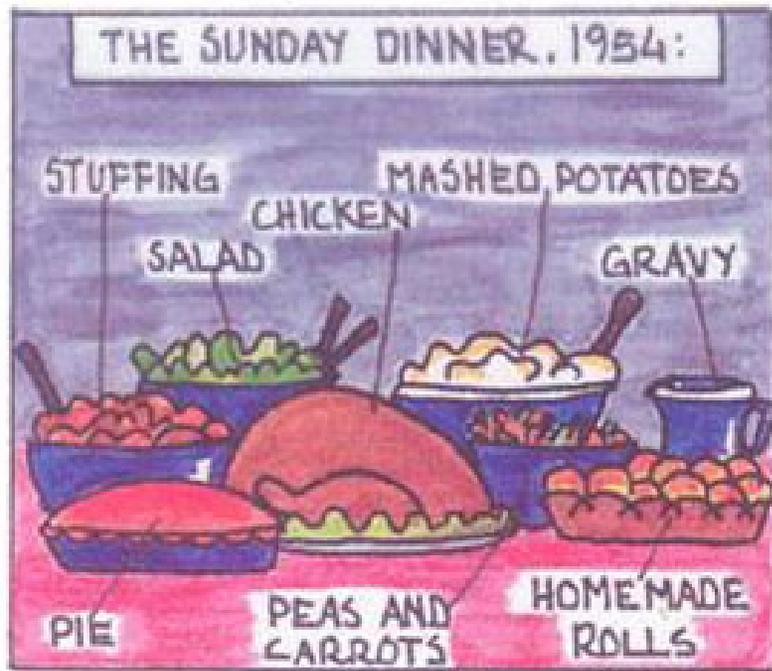
Economic growth in the kitchen



Economic growth in the kitchen



And now the Sunday dinner!



Source: John Holmberg