

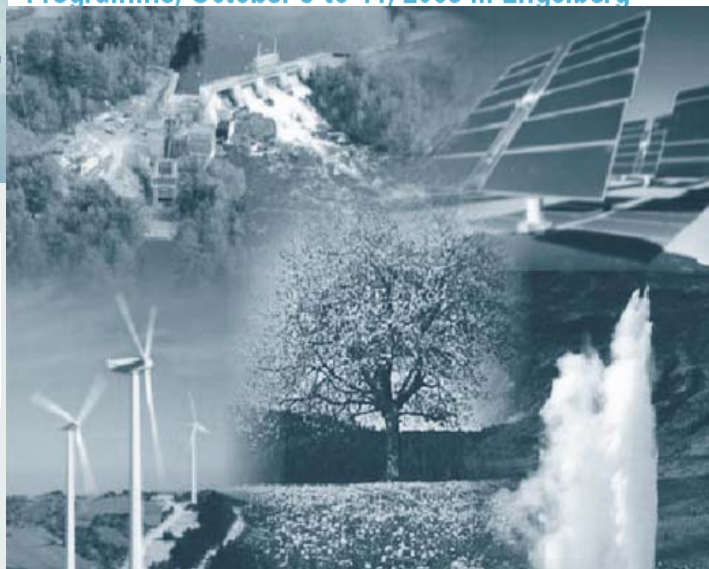
# OUR Global Future



## Rethinking our Energy Future

Smart, sustainable and secure

Programme, October 9 to 11, 2006 in Engelberg



### Contribution of Science

Ernst von Weizsäcker, Donald Bren School for Environmental Science and Management, Santa Barbara, CA

### Energy and Sustainable Development

MP Borge Brende, Oslo Norway

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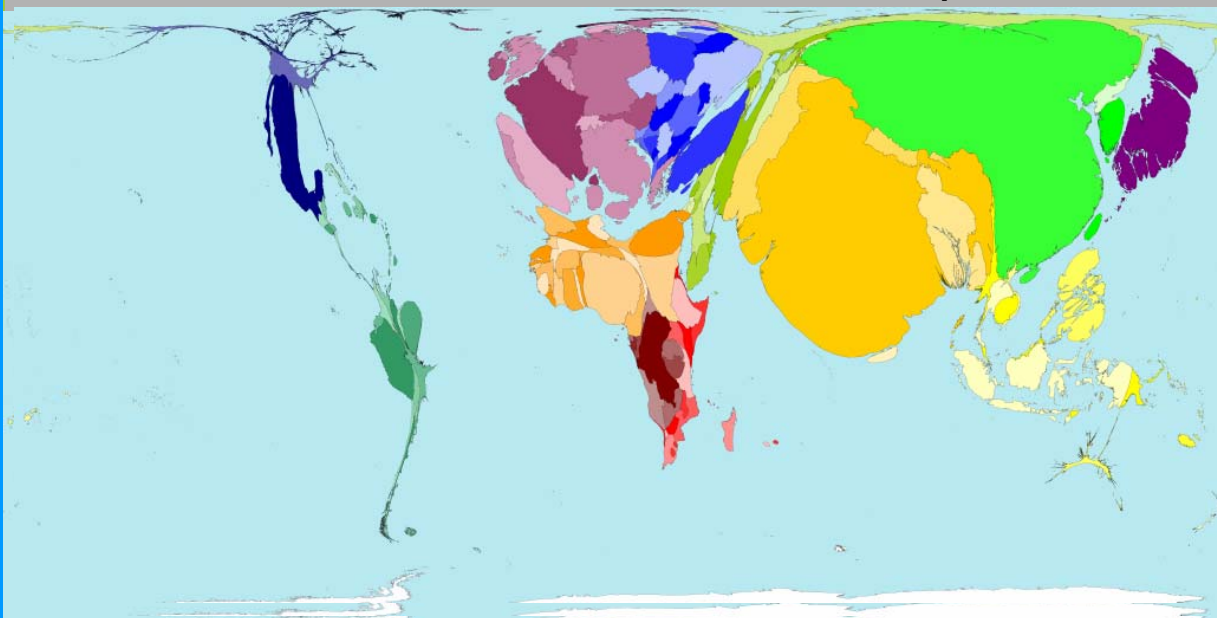
Land areas

Population 2005

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Population 2050

Population 1500

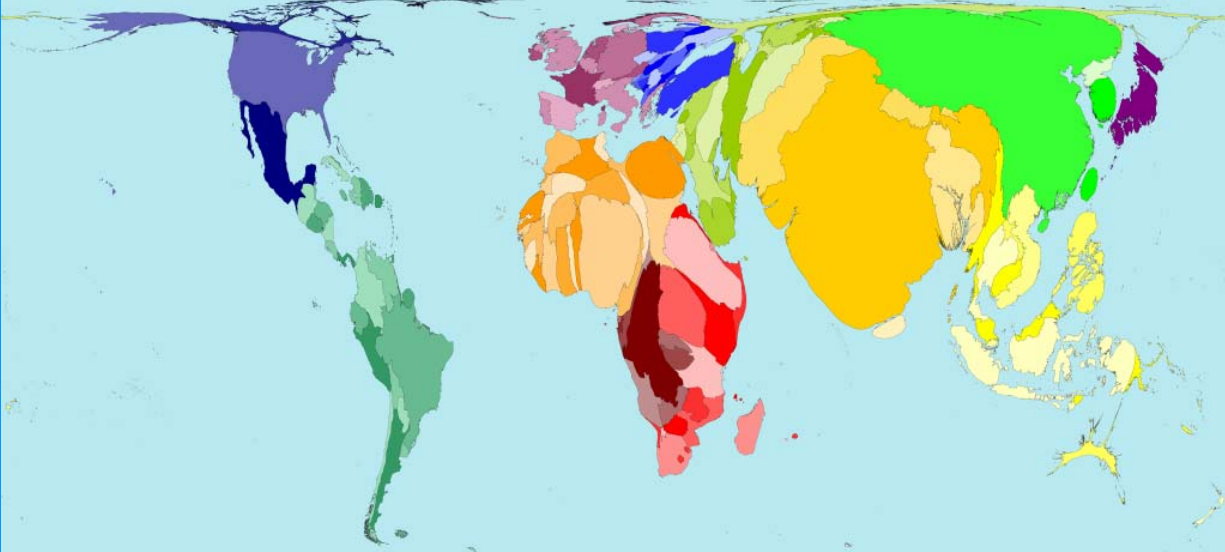


<http://www.sasi.group.shef.ac.uk/worldmapper/>

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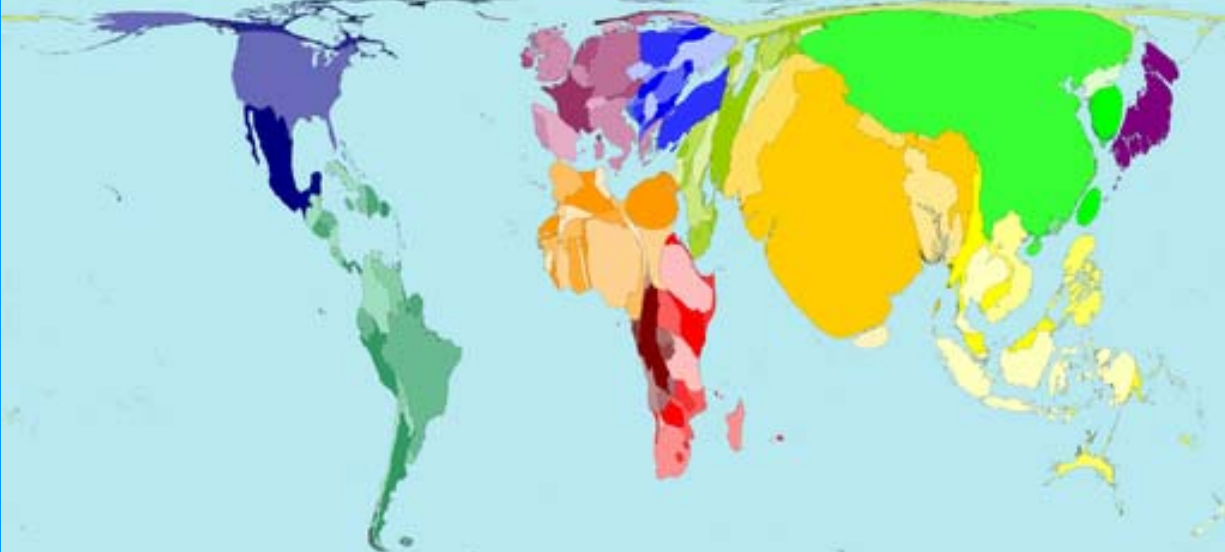


By 2050 it is estimated that the earth's human population will be 9.07 billion. 62% of the people will live in Africa, Southern Asia and Eastern Asia - numerically this is the same as if all the world's current population lived just in these regions. In addition another 3000 000 000 will be spread across the rest of the world.

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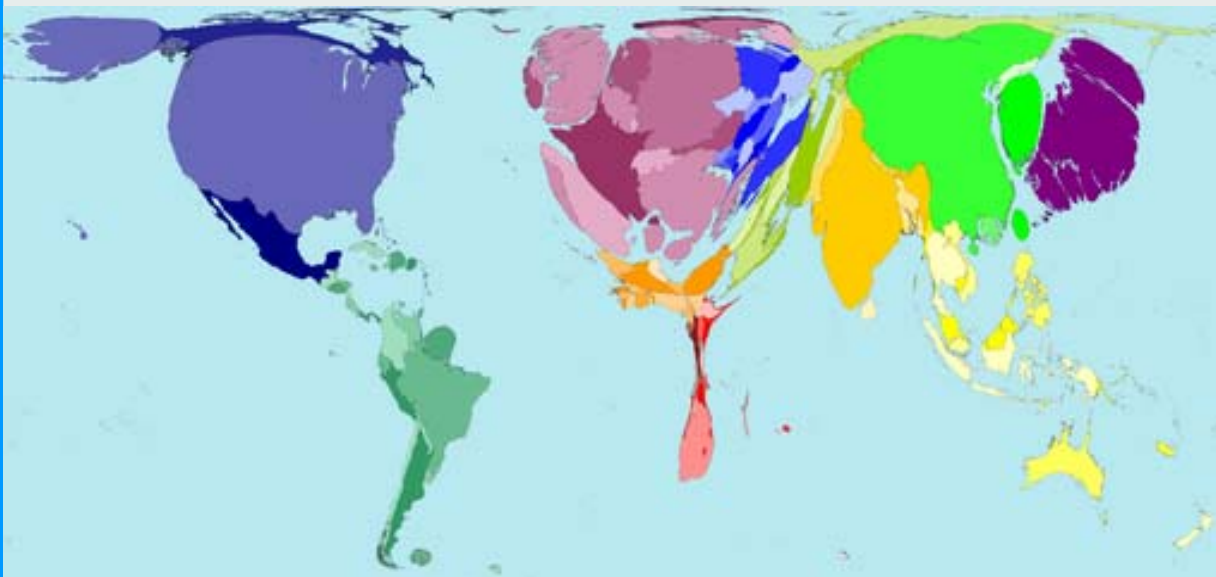
*"Out of every 100 persons added to the population in the coming decade, 97 will live in developing countries." Hania Zlotnik, 2005*

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### Purchasing Power



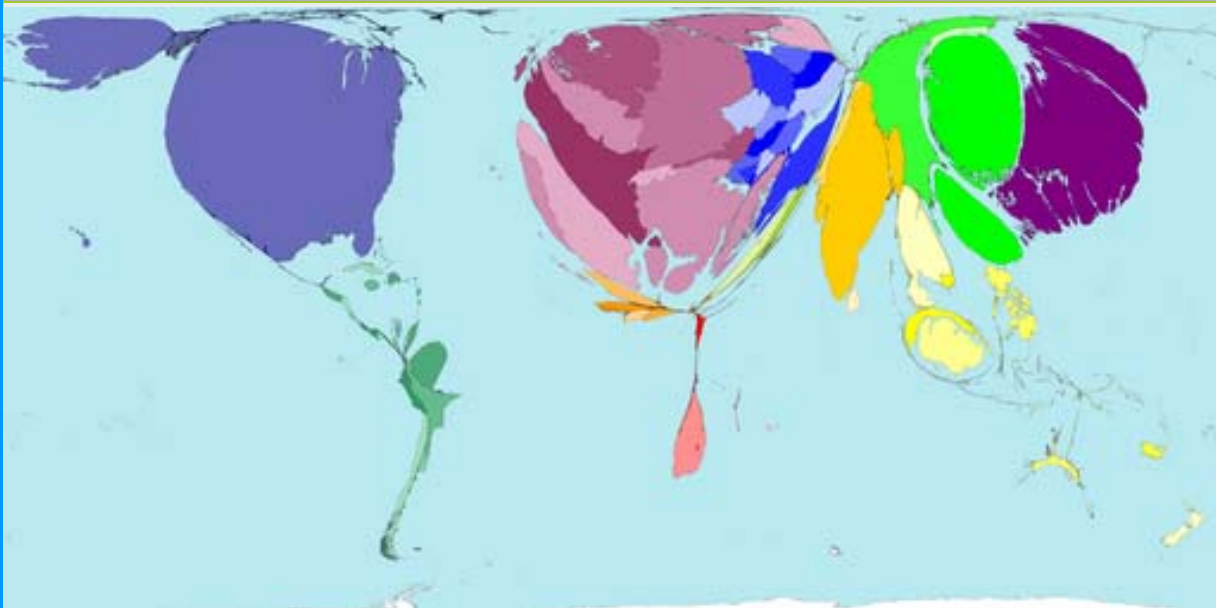
Taking differences in local costs into consideration, this map shows that 46% of world wealth adjusted for purchasing power is in North America and Western Europe.

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### Crude Petroleum Imports



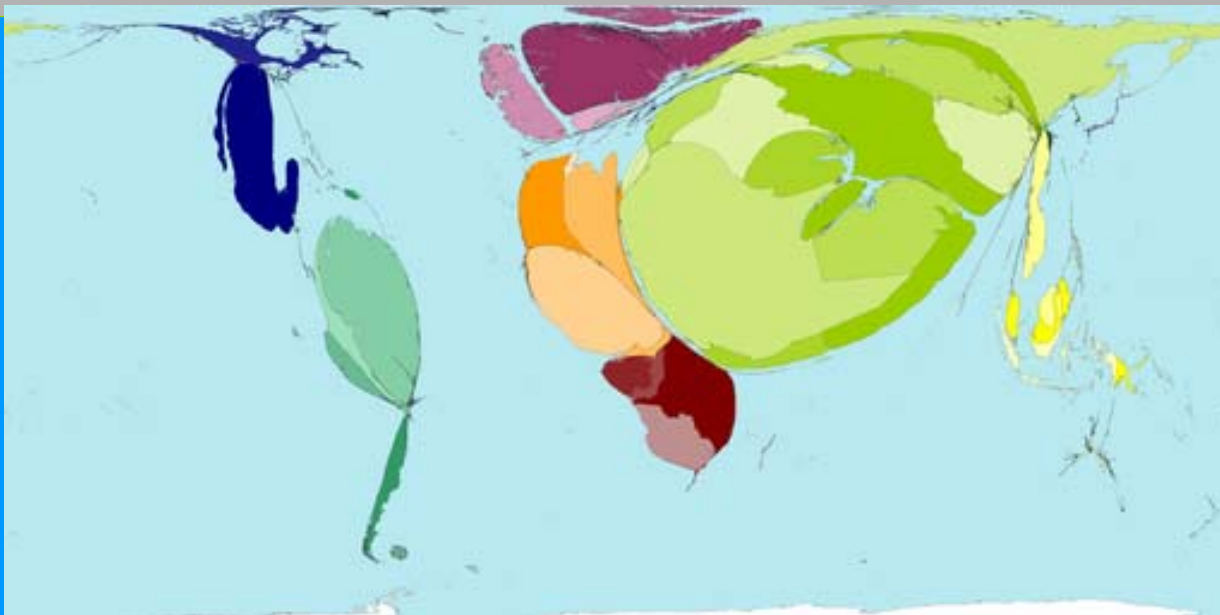
*"Aside from the effects of high oil prices, growth in imports in general can be interpreted as a sign that domestic demand is robust, another reason to say that the Japanese economy is on the right track ..."* Koji Kobayashi, 2006

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### Crude Petroleum Exports



Territories in the Middle East export 58% of all crude petroleum. Saudi Arabia exports over twice the US dollar value of any other territory, measured in net terms.

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### Gas And Coal Exports



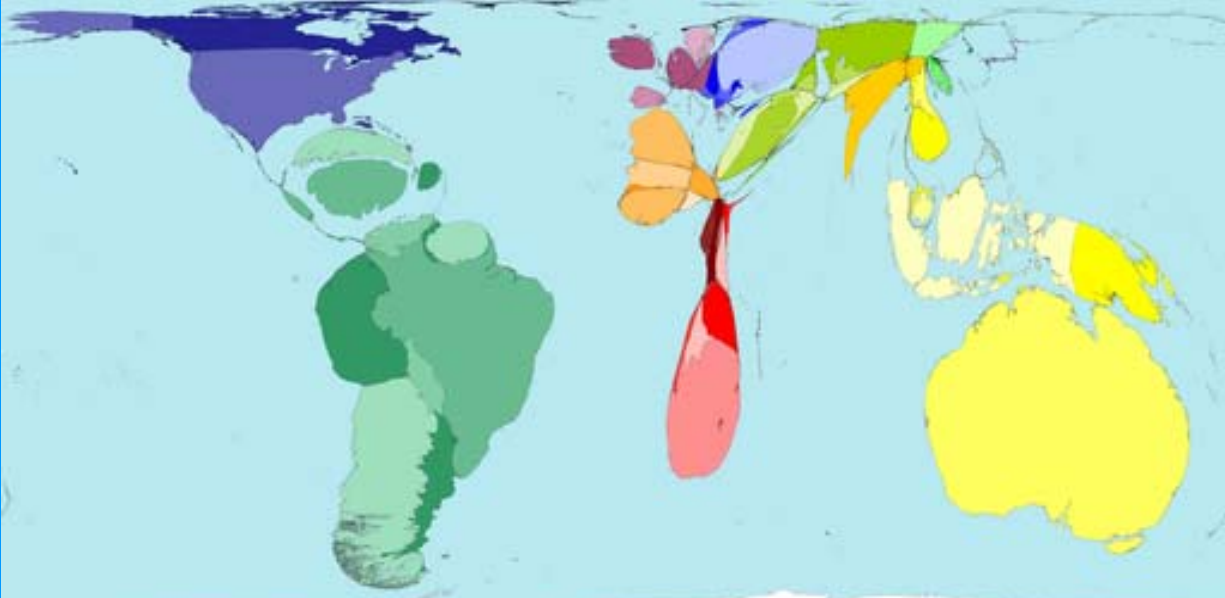
The Middle East and Asia Pacific are the main net exporting regions for coal and gas. The territories in these regions export up to 60% of all gas and coal exports in the world (US\$ net).

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### Ores Exports



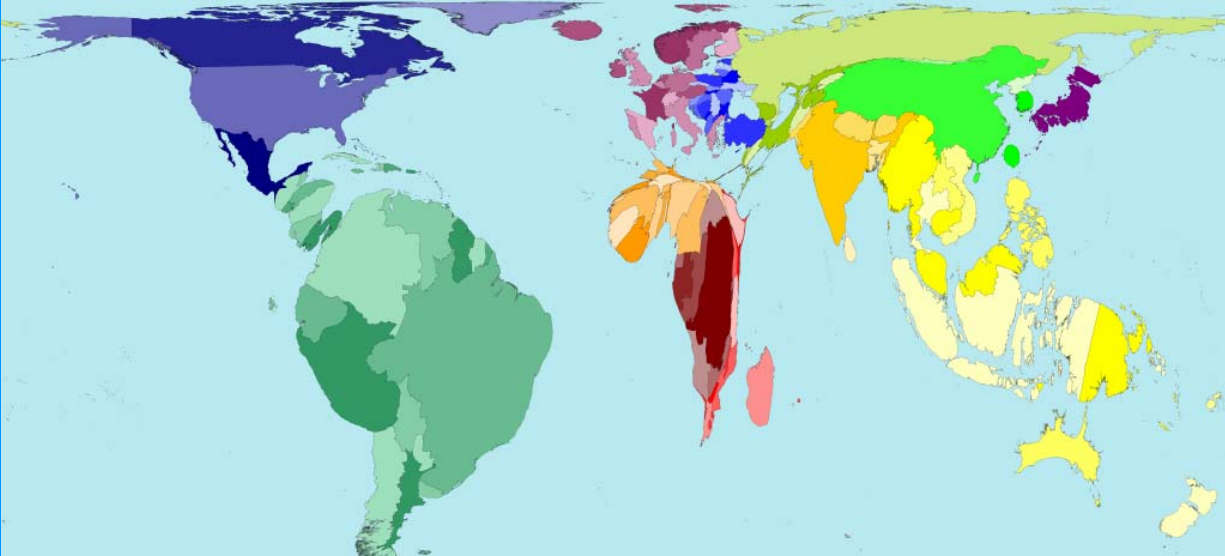
Taking differences in local costs into consideration, this map shows that 46% of world wealth adjusted for purchasing power is in North America and Western Europe.

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### Water resources

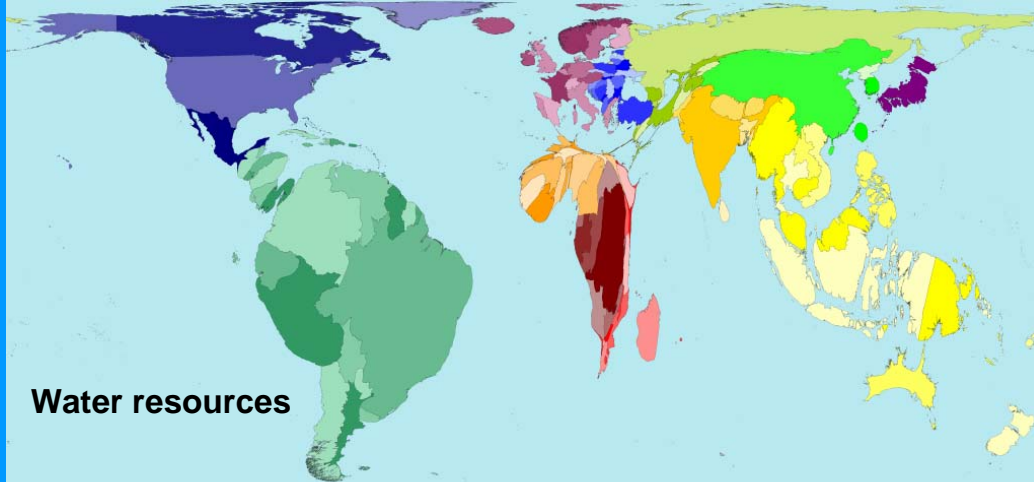


Only 43 600 cubic kilometres of freshwater is available as a resource each year, despite more than twice this amount falling as precipitation (rain and snow). Much is lost through evaporation. Those countries with higher rainfall often have larger water resources. Of all the water available, the regions of South America and Asia Pacific have the most.

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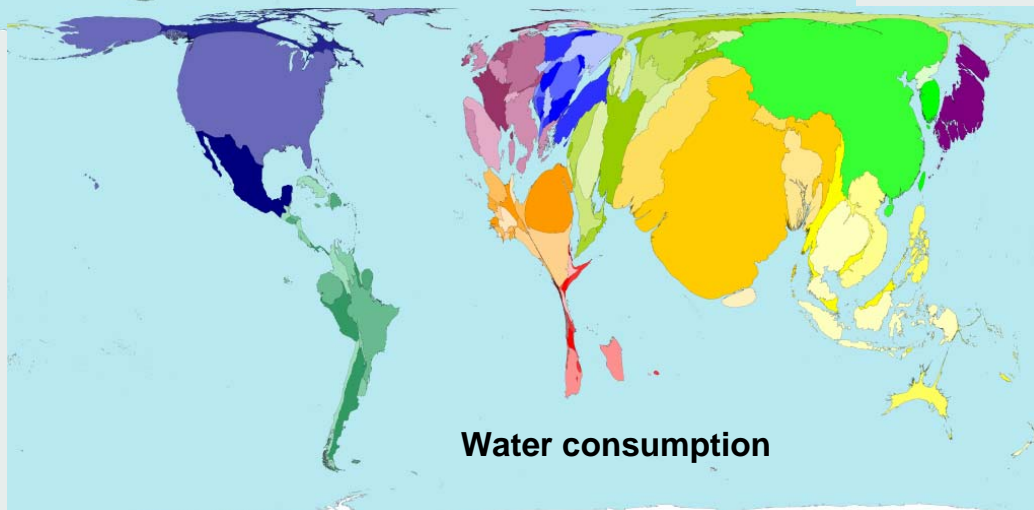
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### Water resources



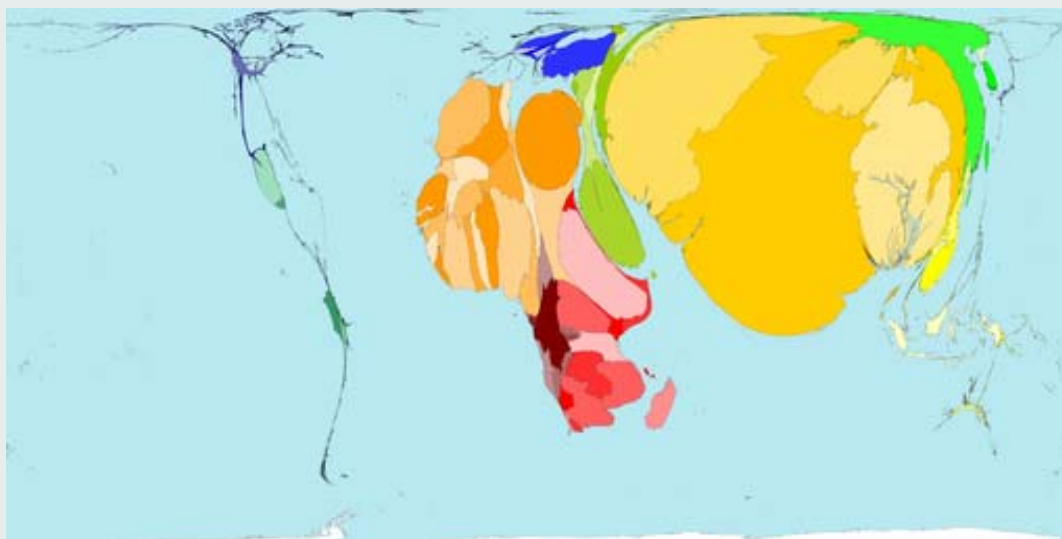
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### Water consumption



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### Illiterate Young Women

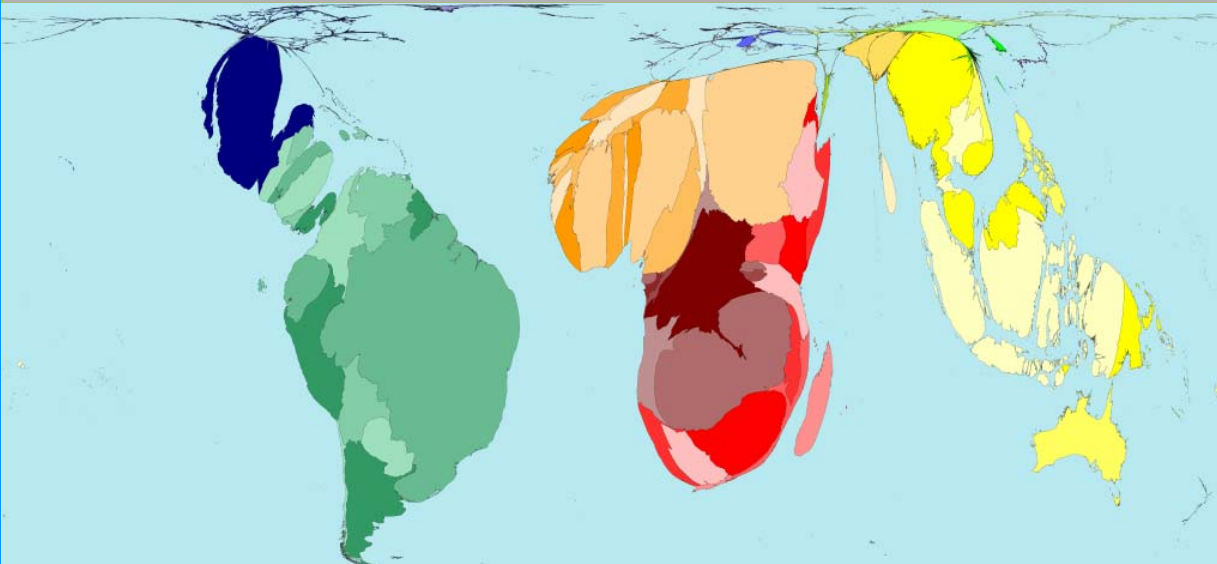


The most 'extra' female illiteracy in the Middle East is in Yemen; in Eastern Europe it is in Turkey; in Asia Pacific it is in Indonesia; in South America it is in Guatemala; and in North America it is in the United States.

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## Forest Loss



Net forest losses of all territories between 1990 and 2000 are, 31% in South America, and 21% in Asia Pacific. Worldwide, territories with net forest loss lost 1.33 million km<sup>2</sup> of forest over this ten year period. Despite this, South America was the region with the largest forested area in the world in 2000.

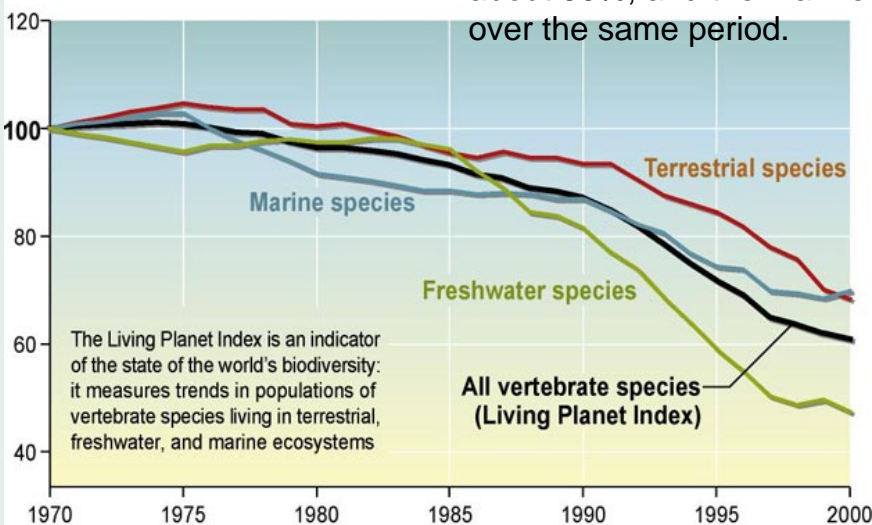
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## Biodiversity

The index currently incorporates data on the abundance of 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. While the index fell by some 40% between 1970 and 2000, the terrestrial index fell by about 30%, the freshwater index by about 50%, and the marine index by around 30% over the same period.

Population Index = 100 in 1970



The Living Planet Index is an indicator of the state of the world's biodiversity: it measures trends in populations of vertebrate species living in terrestrial, freshwater, and marine ecosystems

Source: WWF, UNEP-WCMC

Source & © : [Millennium Ecosystem Assessment](#)

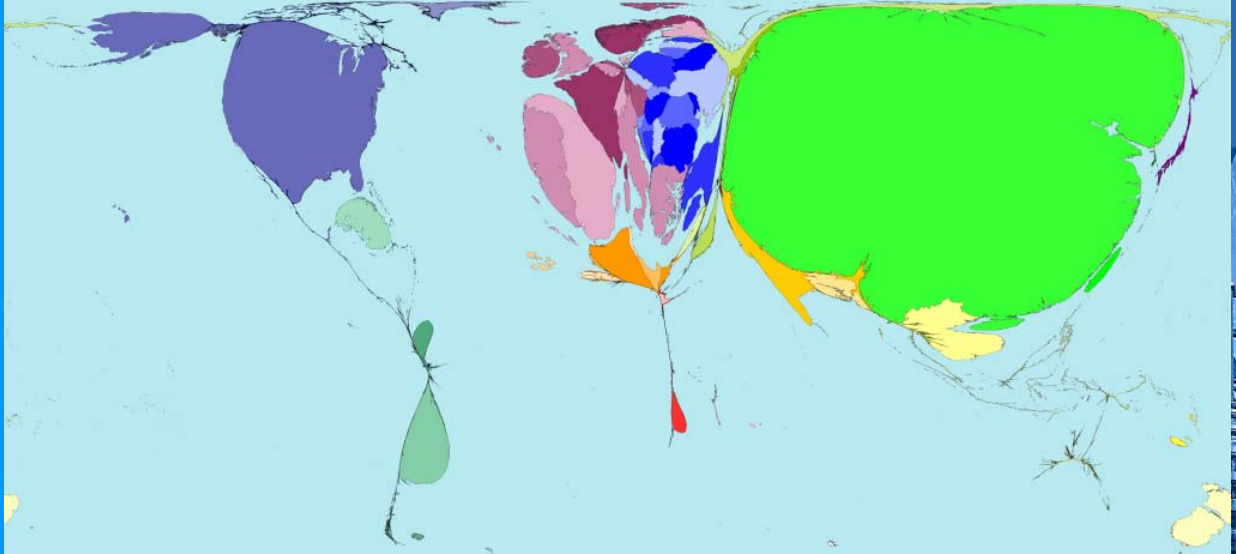
– [Ecosystems and Human Well-being: Biodiversity Synthesis \(2005\)](#), p.47

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### Forest Growth



The territory with the most forest expansion between 1990 and 2000 was China, which gained 181 000 km<sup>2</sup> over the ten year period.

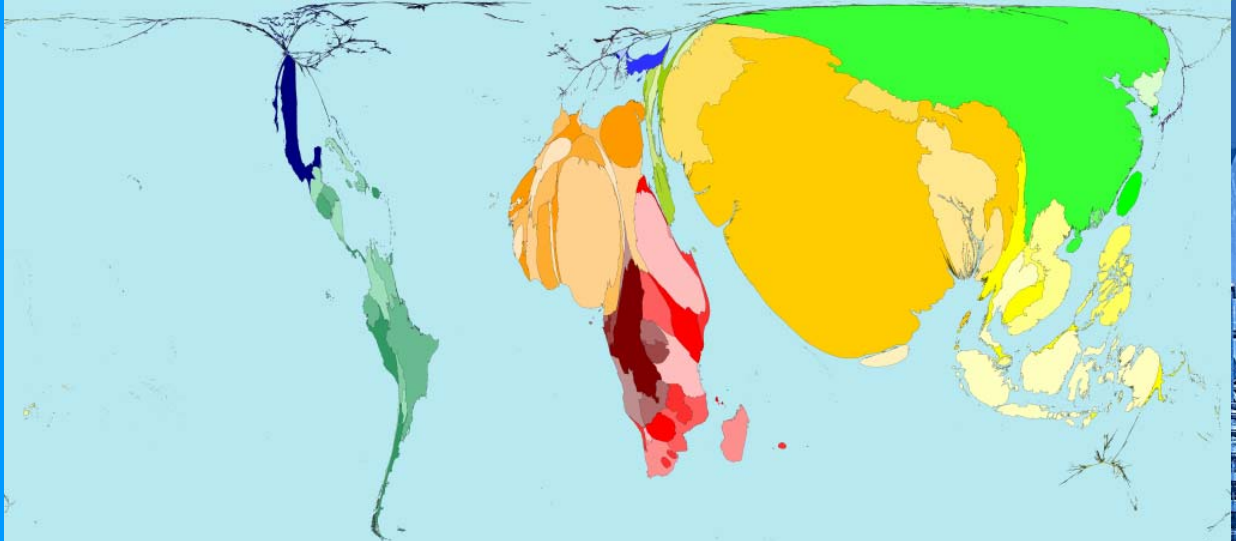
The forest growth in the United States was the second largest increase, but this was only a fraction of the increase in China, at 39 000 km<sup>2</sup>.

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### Poverty 2\$ pd



Absolute poverty is defined as living on the equivalent of US\$2 a day or less. In 2002, 43% of the world population lived on this little. This money has to cover the basics of food, shelter and water. Medicines, new clothing, and school books would not be on the priority list.

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### Medicines exports



Territories in Western Europe receive 74% of all earnings from exports of medicines. These territories account for 91% of net medicine exports (US\$). Ireland has the highest value of exports (US\$ net). Much of the Ireland trade is the export of imports.

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## Global Limitations

**Saudi saying:**

**"My father rode a camel.**

**I drive a car.**

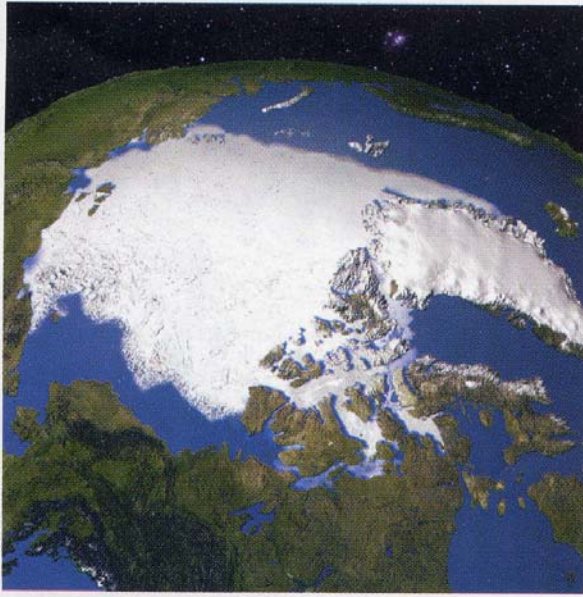
**My son flies a jet airplane.**

**His son will ride a camel."**

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# Arctic Ice Shield



1979



2005

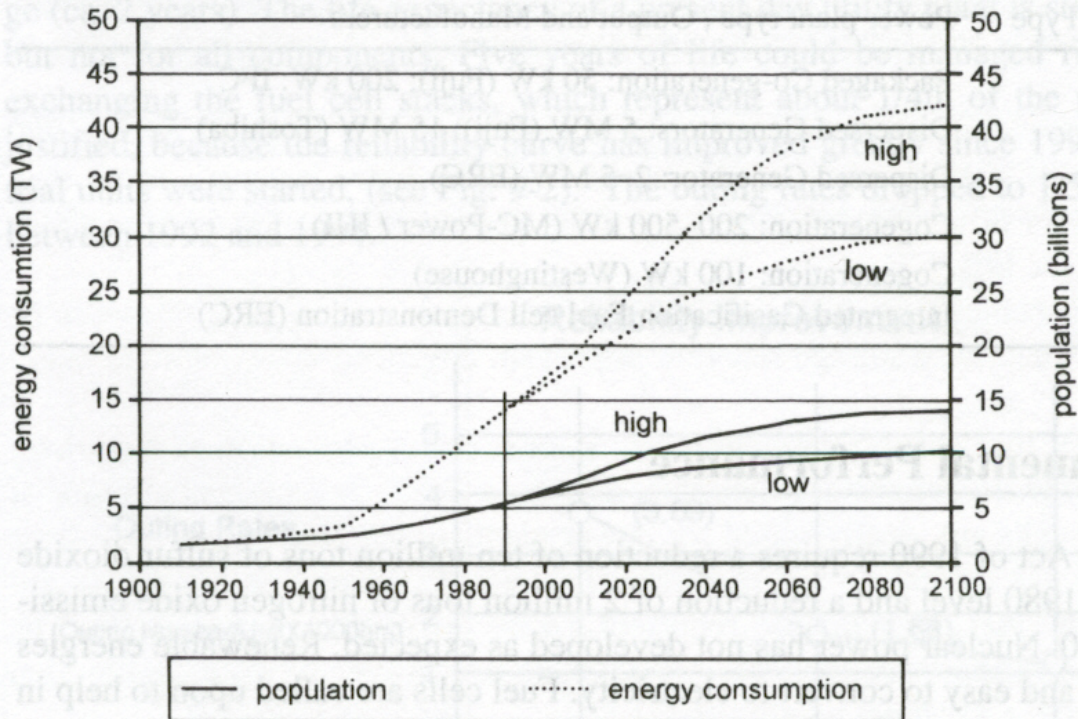


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# Prognoses of World Development

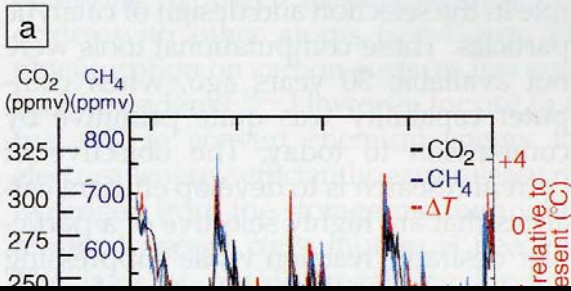


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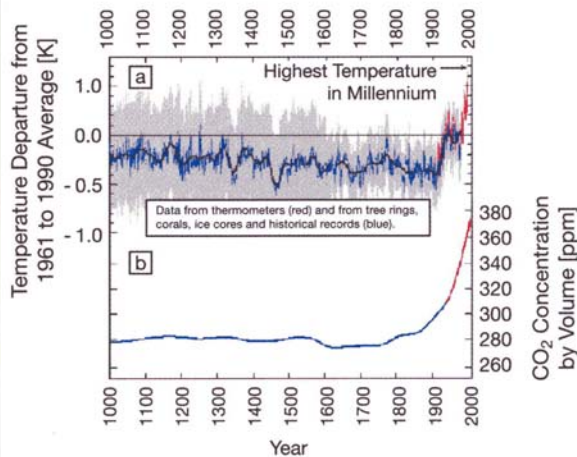
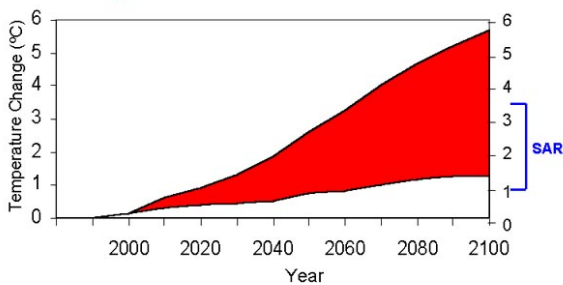
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# Atmospheric CO<sub>2</sub> & Temperature



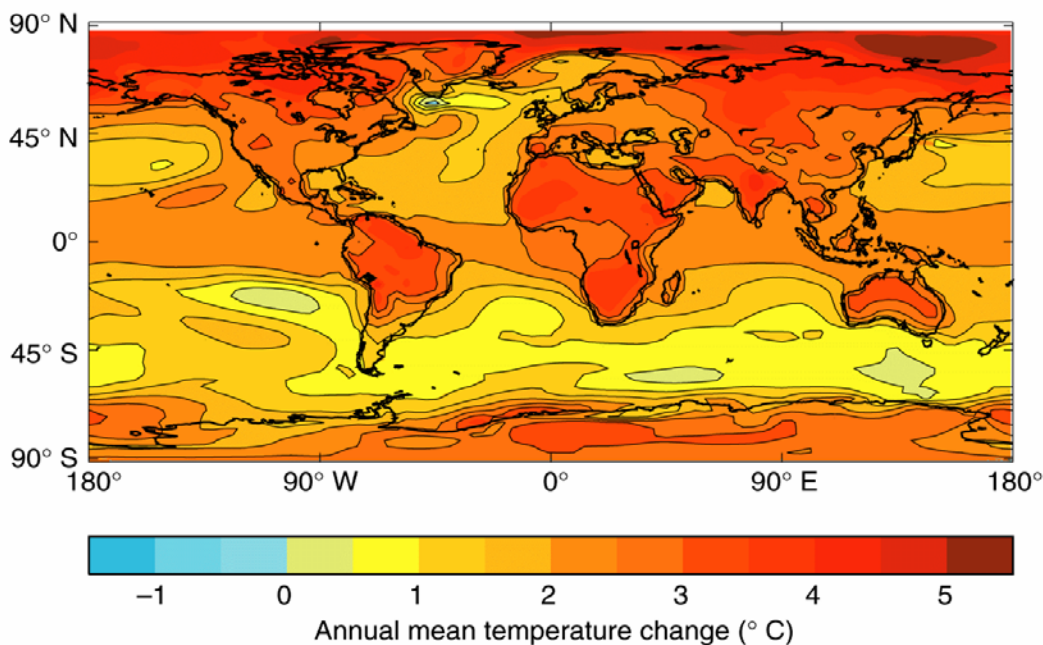
**Figure 10: Projected Change in Global Mean Surface Temperature from Models using the SRES Emissions Scenarios**



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## Projected Changes in Annual Temperatures for the 2050s

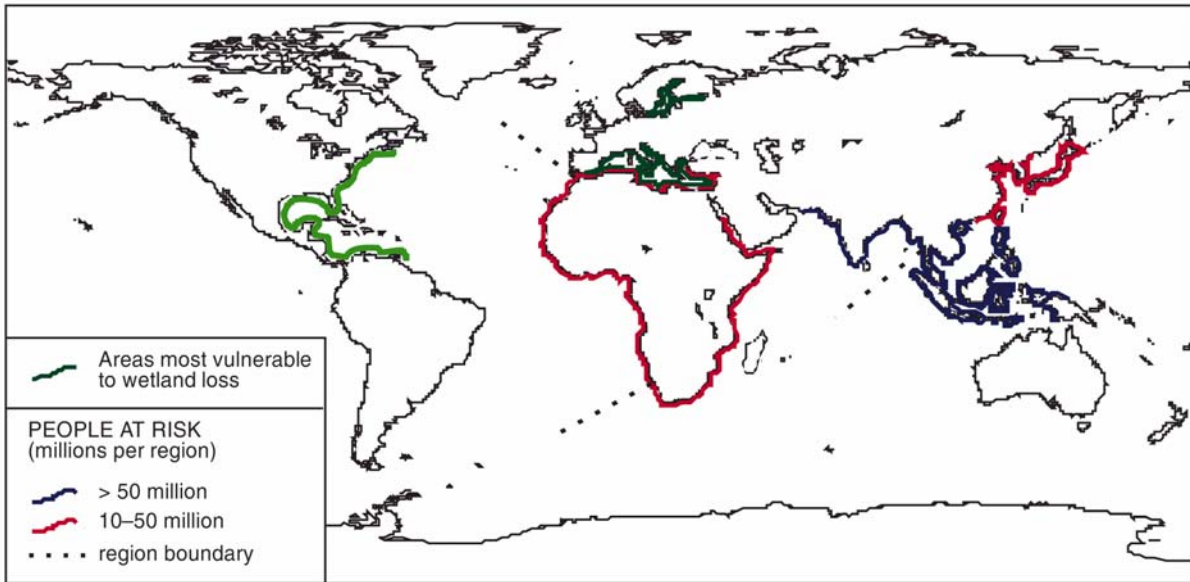


The projected change in annual temperatures for the 2050s compared with the present day, when the climate model is driven with an increase in greenhouse gas concentrations equivalent to about a 1% increase per year in CO<sub>2</sub>.

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# People at Risk from a 44 cm sea-level rise by the 2080s



When the Labrador Ice shield melted about 8000 years ago, there was a sea level rise by 6-8m !

Complete melting of the Greenland ice shield is expected to lead to + 6m!

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## Distinctions Among Four Social Conditions



Source: Chauncey Starr

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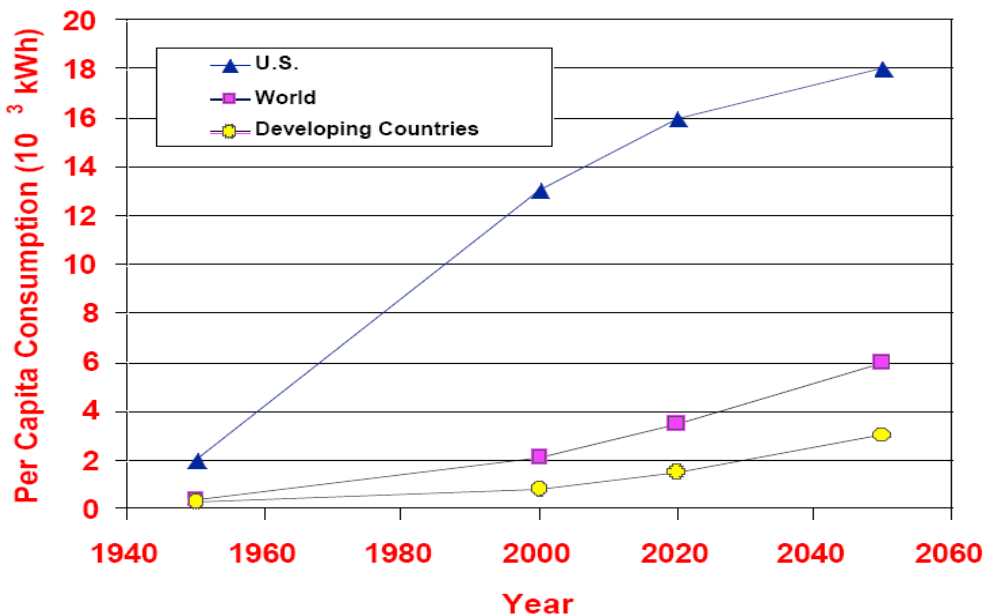
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# Global Electricity

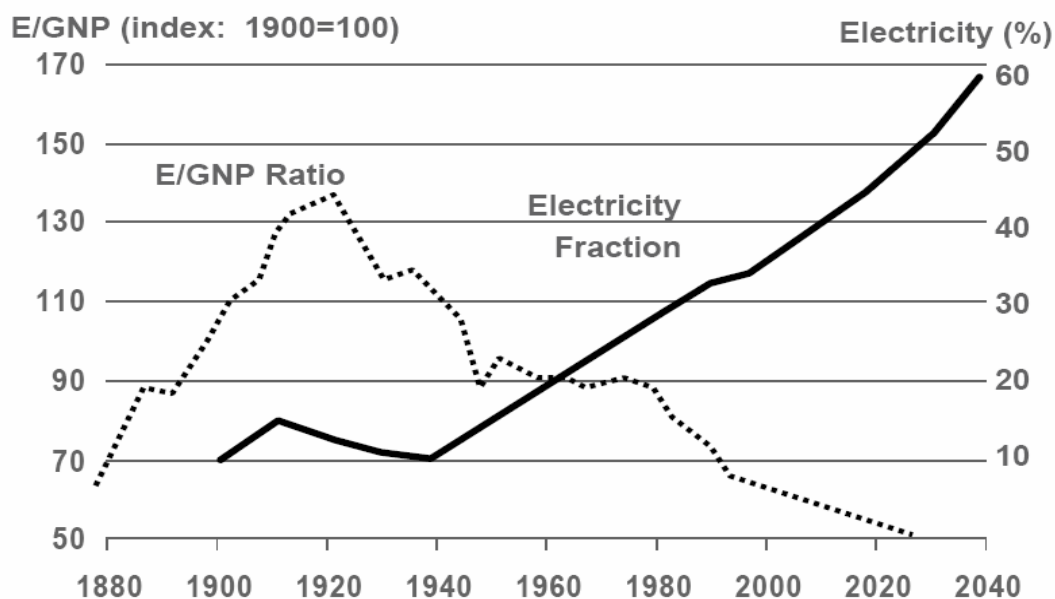
## Trends in Per Capita Electricity Consumption



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EPRI

## Increasing Energy Efficiency



Source: *Electricity in the American Economy*, Sam H. Schurr, et. Al., 1990

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EPRI

# Efficiency of Power Delivery

- The issue of Transmission Line losses and reliability is related to the limits of the conductor itself.
- The power that can be carried is related to the temperature of the conductor.
- It sags as its temperature rises; the limit is determined by the possibility of its arcing to ground.
- **This is a nanotechnology opportunity**

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# Efficiency of End Use

- This is a much more difficult topic, because the efficiencies are very specific to the end use.
- Two major uses are refrigeration and lighting.
- Refrigeration. In 1975, a typical refrigerator used about 1750 kWh/year; in 2000 the figure was 500 kWh/year
- Lighting consumes some 20% of the U.S. electricity output. Incandescent lights have an efficiency of 5 – 6%. Fluorescent lights achieve perhaps 25%. LEDs may achieve 50%.

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# Efficiency of End Use

- Both of these examples of improvements have been going on for years, with largely conventional evolutionary developments.
- However, nanotechnology is now presenting us with the possibility of major leaps forward: the developments in quantum dot LEDs for lighting, and the potential improvement in thermoelectric devices as a result of quantum effects on the transport properties.

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## Technological Limitations

### Cars at the limits

Max. efficiency  
tank to wheel:

Otto car 14%

Diesel car 18%

Hybrid car 32%



At the Ladoux circuit in June 2005, PAC-Car II beat its own world record using just 1.02g of hydrogen for the 21km.

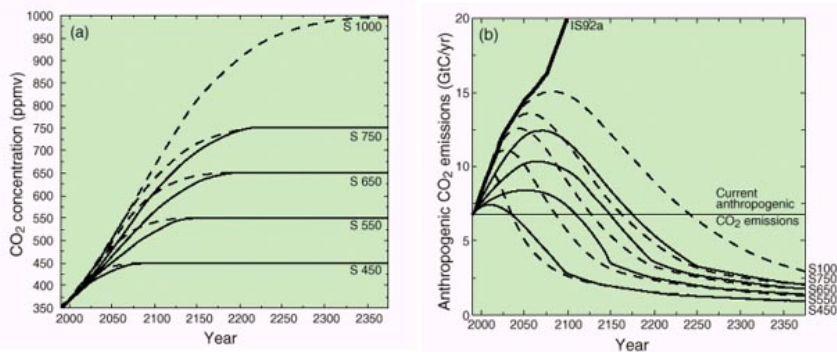
**This is equivalent to 5385km/l of gasoline.**

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# CO<sub>2</sub> - Models

**Figure 19: Energy Emission Pathways and Stabilization Concentrations**



Source: IPCC, 1995. Second Assessment Report. Working Group I. Cambridge.

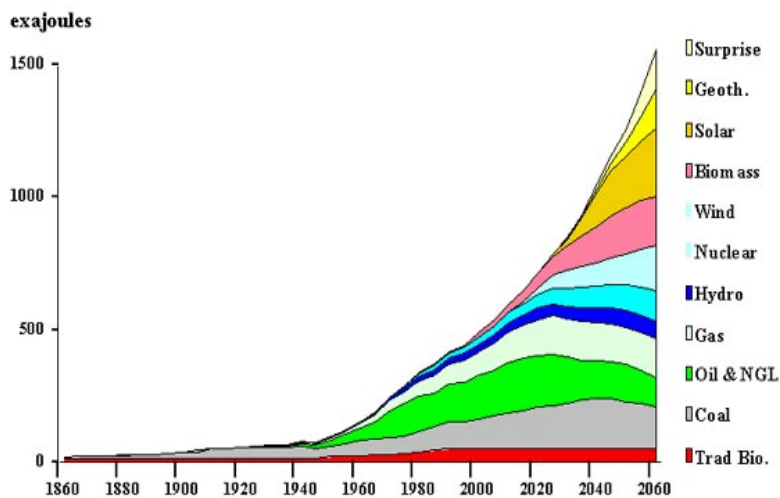
two different pathways for stabilizing carbon dioxide concentrations for each stabilization level between 450ppm and 750ppm and one for 1000ppm. The figure clearly shows that for any of these stabilization levels emissions must be lower than IS92a (often called the business-as-usual scenario) within the next few decades.

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# Sustainable Energy Sources

**Figure 22: Energy Supply Sustained Growth Scenario**



Source: Shell International Limited.

Non-fossil energy sources (solar, wind, modern biomass, hydropower, geothermal and nuclear) could account for as much as half of all energy produced by the middle of this century

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