

OUR Global Future



Contribution of Science

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Energy and Sustainable Development

MP Borge Brende, Oslo Norway

20.10.2008

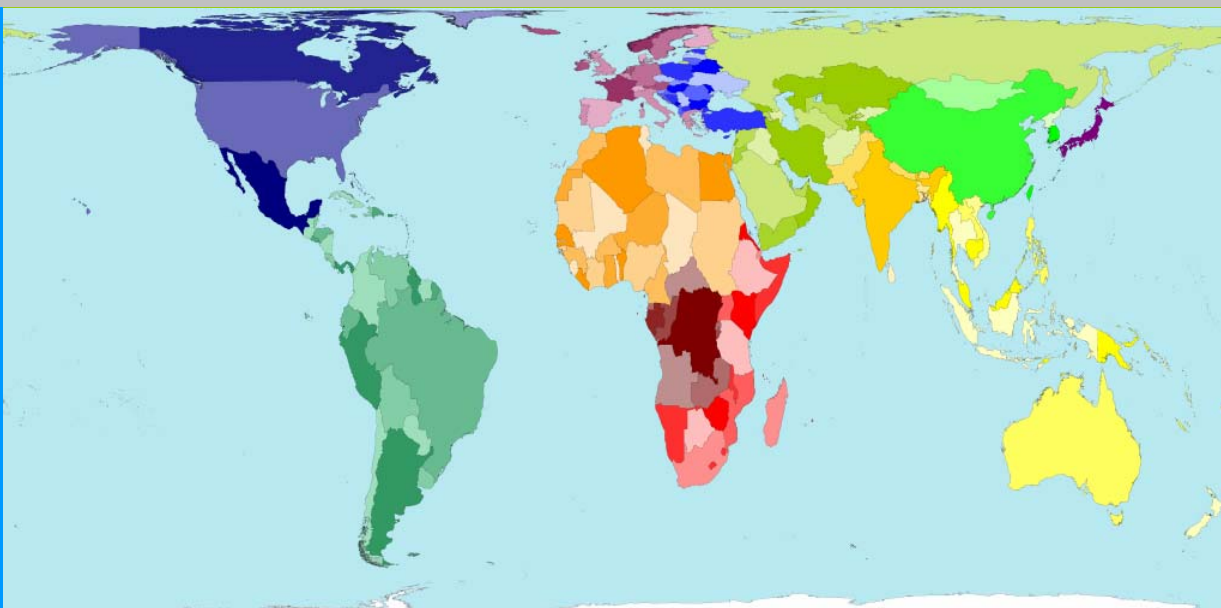
Rethinking our Energy Future Smart, sustainable and secure

Programme, October 9 to 11, 2006 in Engelberg



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Global Issues

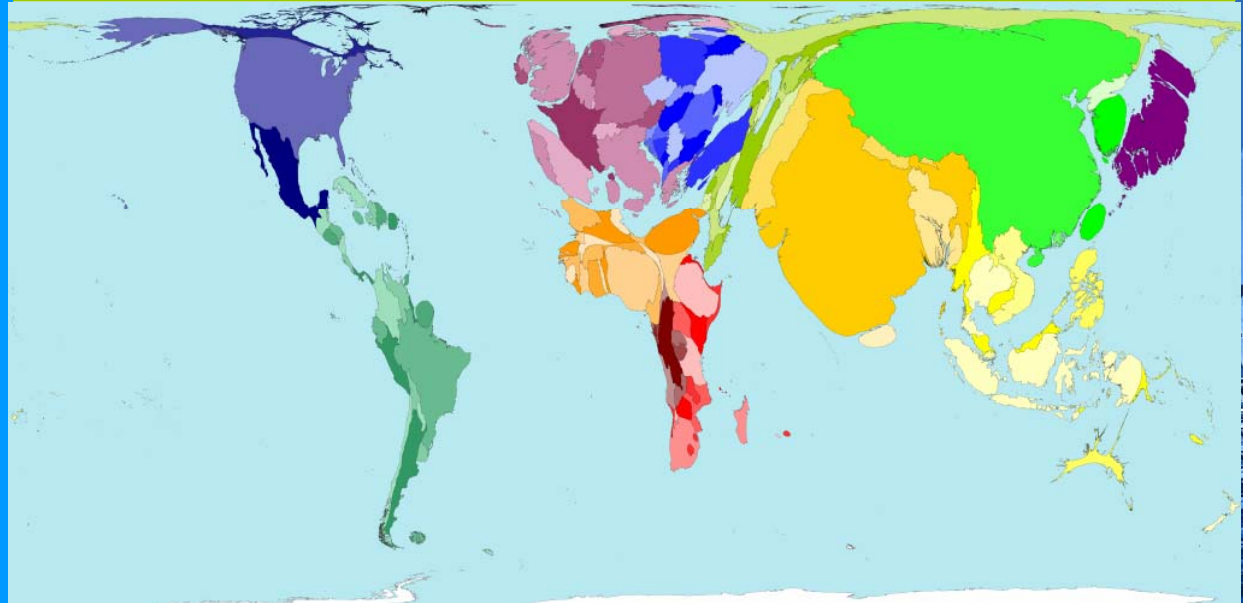


<http://www.sasi.group.shef.ac.uk/worldmapper/>

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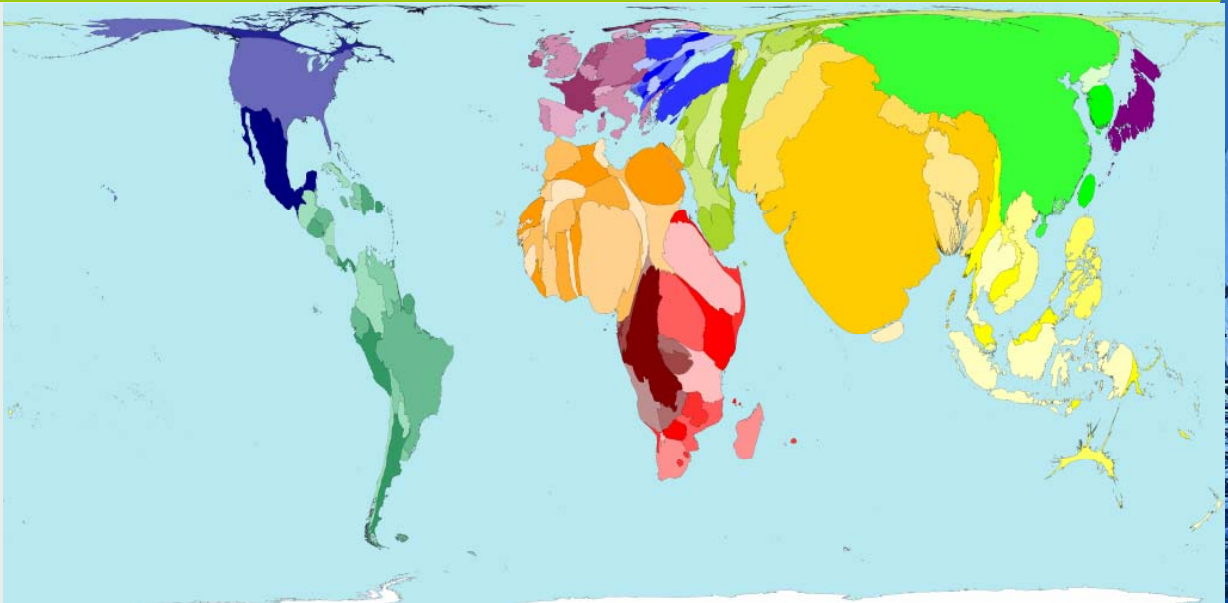


Population 1500

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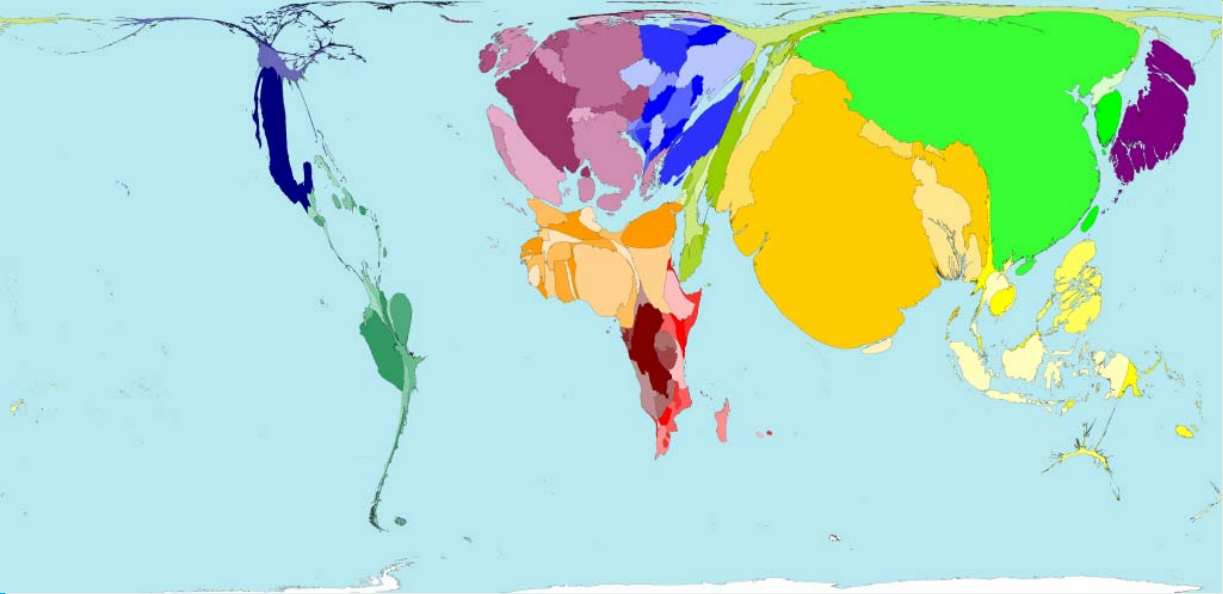


Population 2005

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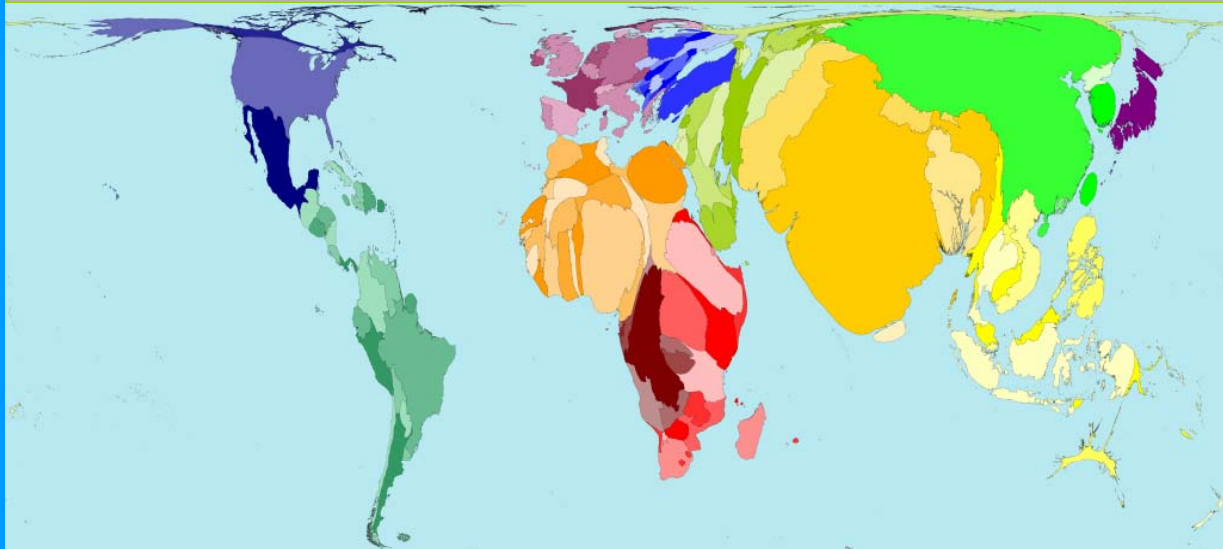


Population 2300

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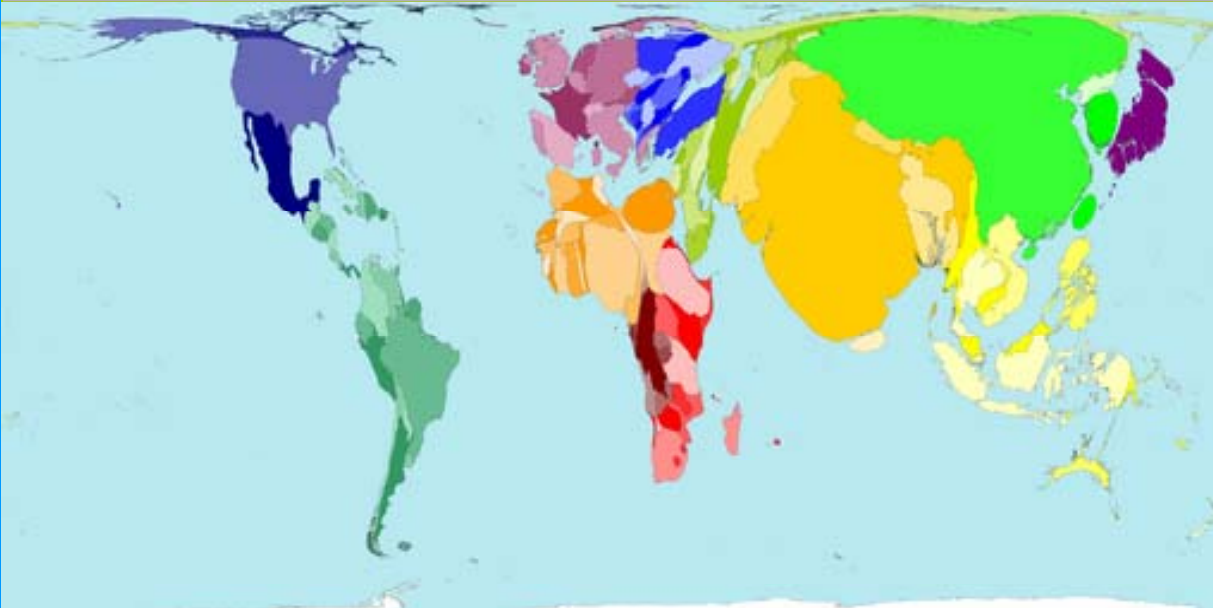


By 2050 it is estimated that the earth's human population will be 9.07 billion. 62% of the people will live in Africa, Southern Asia and Eastern Asia - numerically this is the same as if all the world's current population lived just in these regions. In addition another 3000 000 000 will be spread accross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

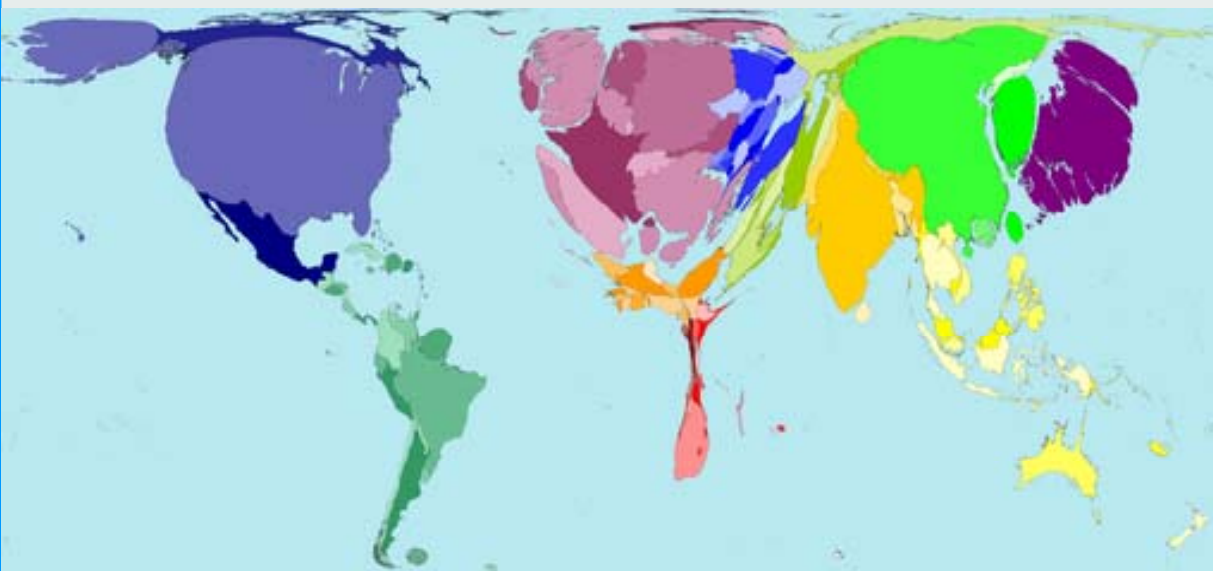
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Global Issues

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.

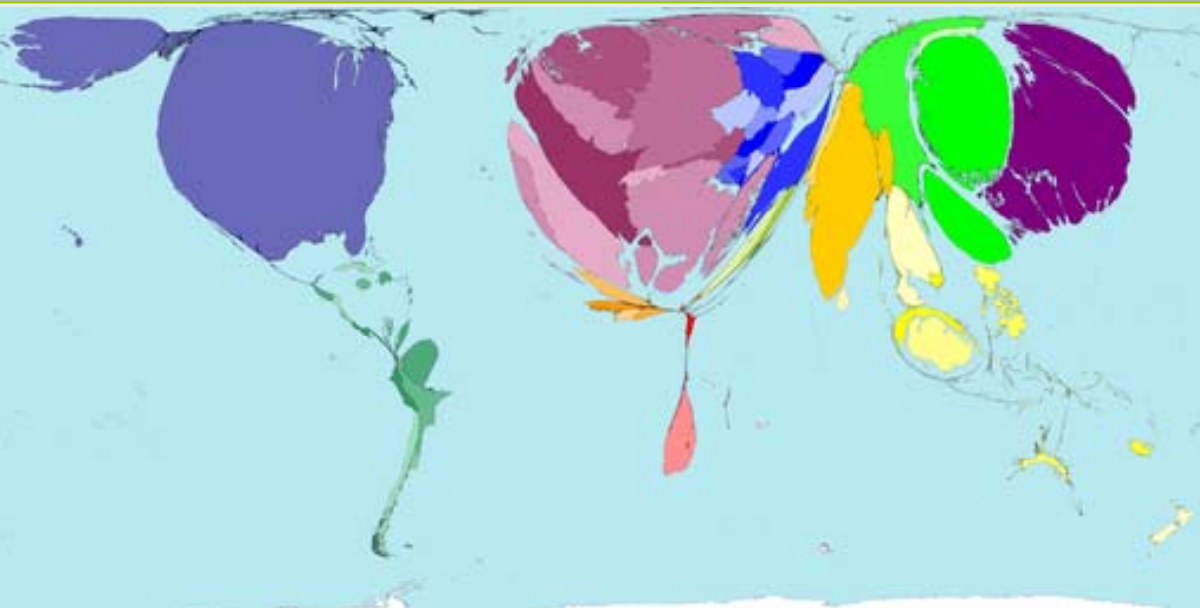
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Global Energies

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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Global Energies

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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Global Energies

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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Global Ores

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.

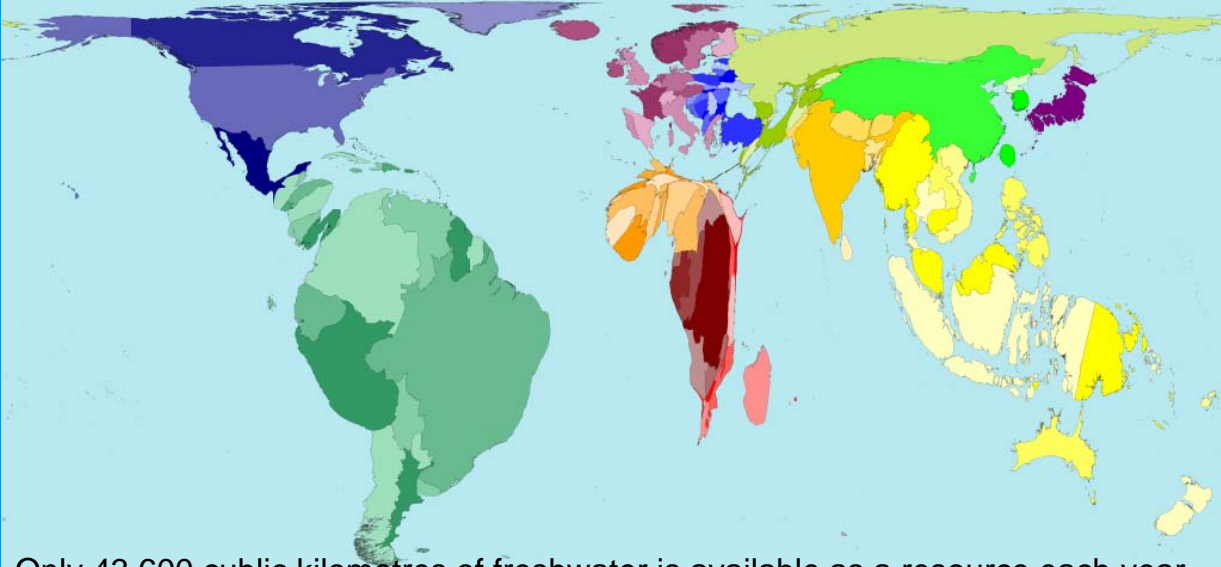
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Global Water

Water resources

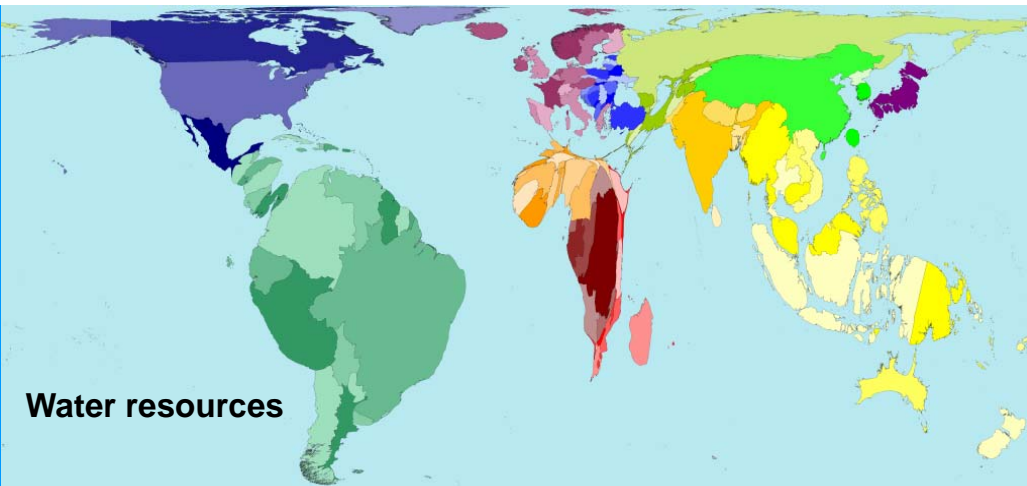


Only 43 600 cubic kilometres of freshwater is available as a resource each year, despite more than twice this amount falling as precipitation (rain and snow). Much is lost through evaporation. Those countries with higher rainfall often have larger water resources. Of all the water available, the regions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

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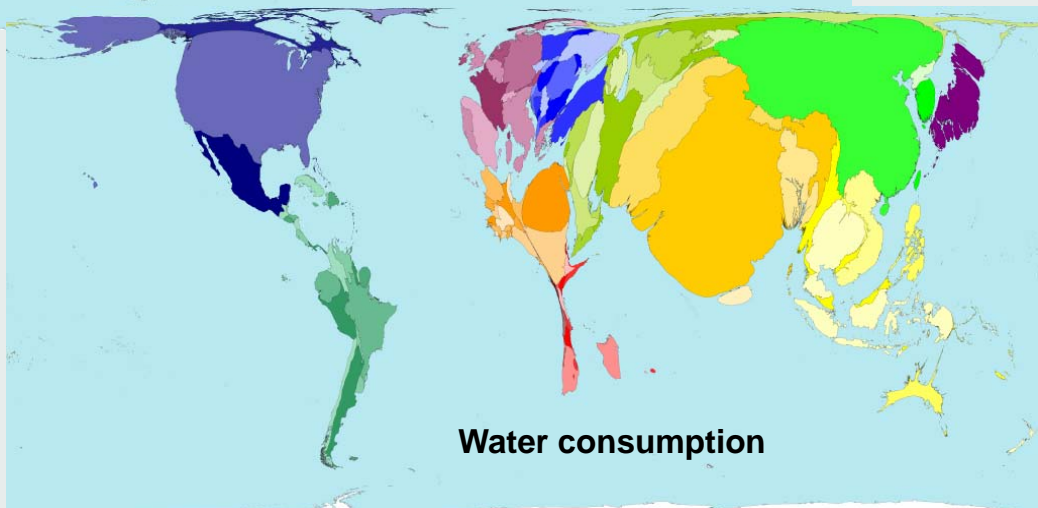
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Water resources



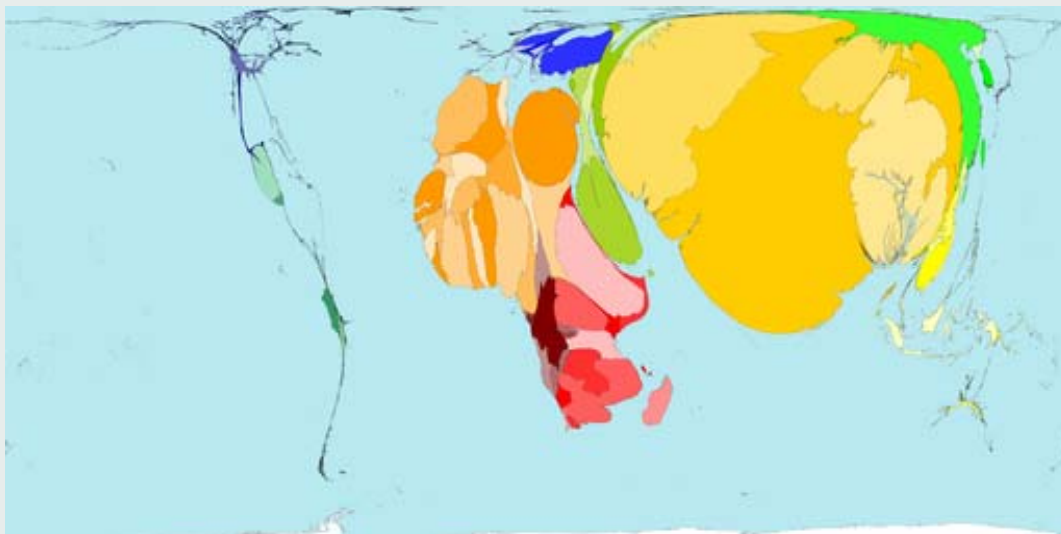
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Water consumption



Global Education

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.

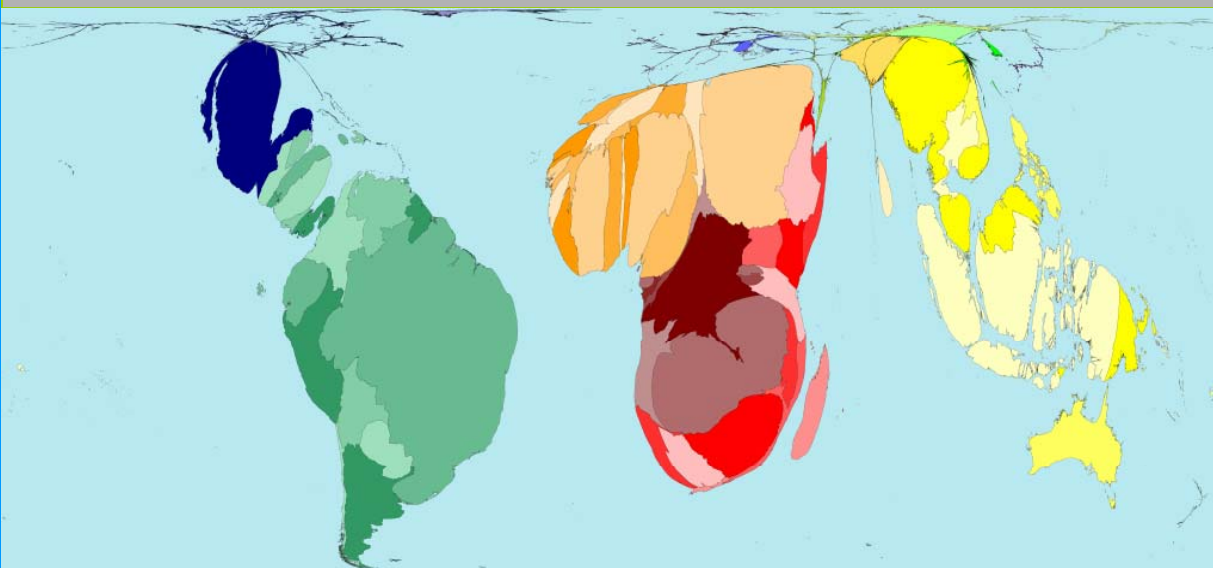
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Forest Loss



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 km² 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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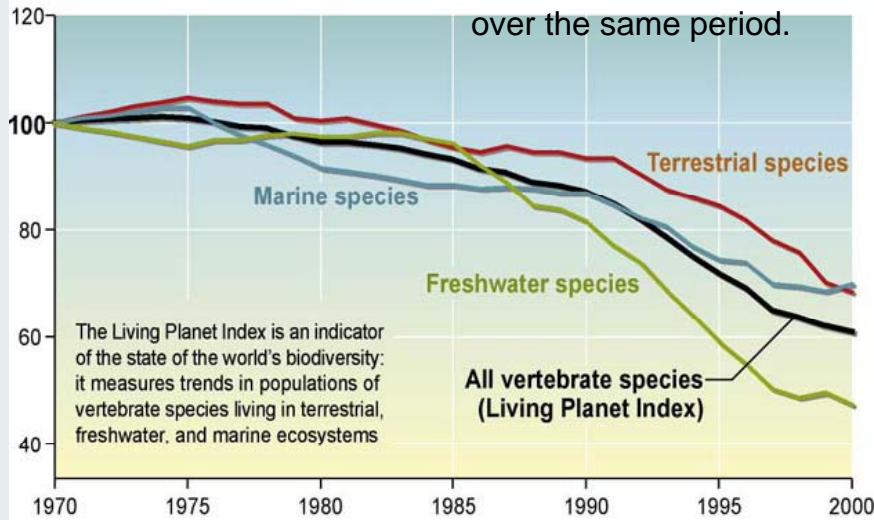
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Biodiversity

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



Source: WWF, UNEP-WCMC

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

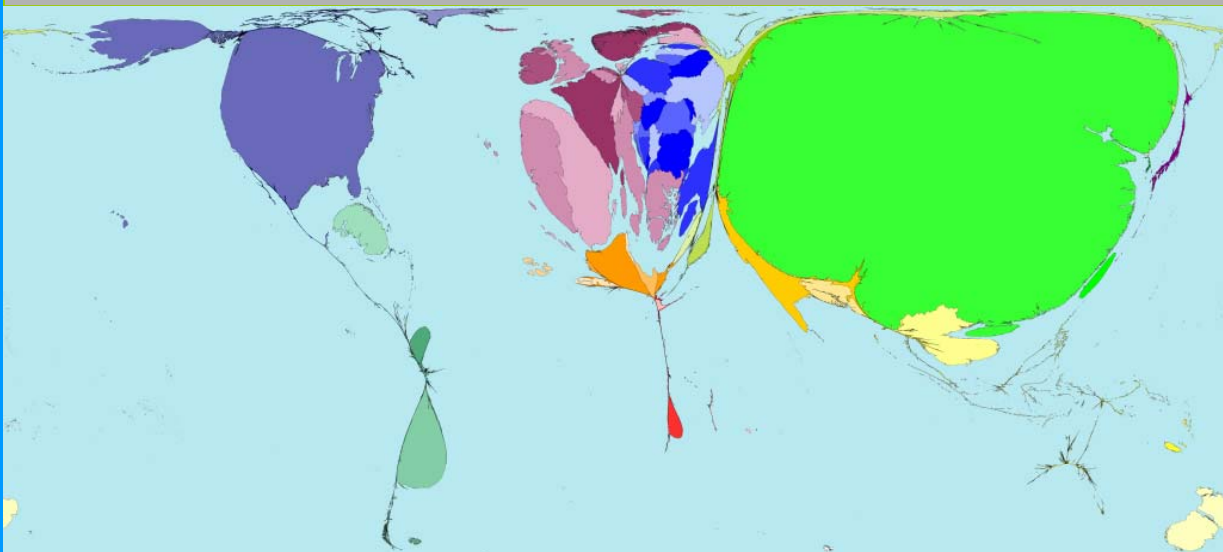
— [Ecosystems and Human Well-being: Biodiversity Synthesis](#) (2005), p.47

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Forest Growth



The territory with the most forest expansion between 1990 and 2000 was China, which gained 181 000 km² over the ten year period.

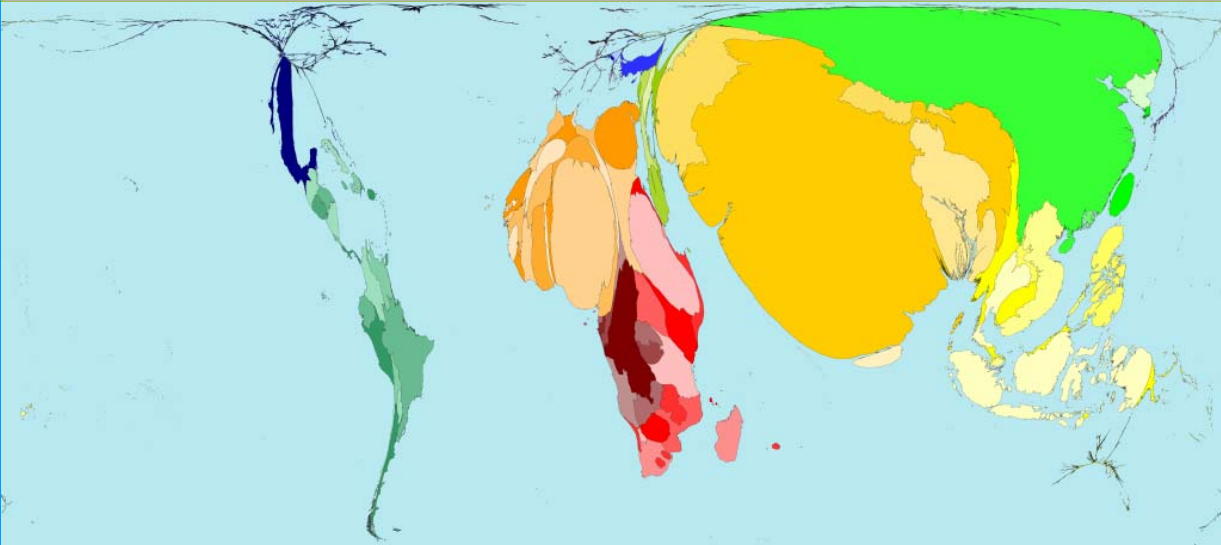
The forest growth in the United States was the second largest increase, but this was only a fraction of the increase in China, at 39 000 km².

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Global Income

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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Global Economy

Medicines exports



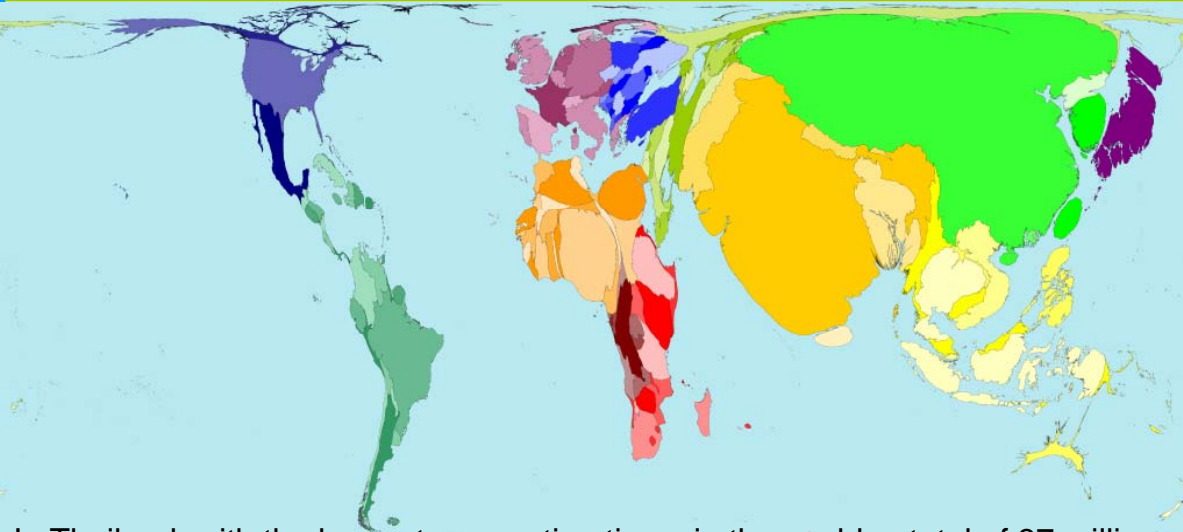
Territories in Western Europe receive 74% of all earnings from exports of medicines. These territories account for 91% of net medicine exports (US\$). Ireland has the highest value of exports (US\$ net). Much of the Ireland trade is the export of imports.

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Global Working

Commuting Time



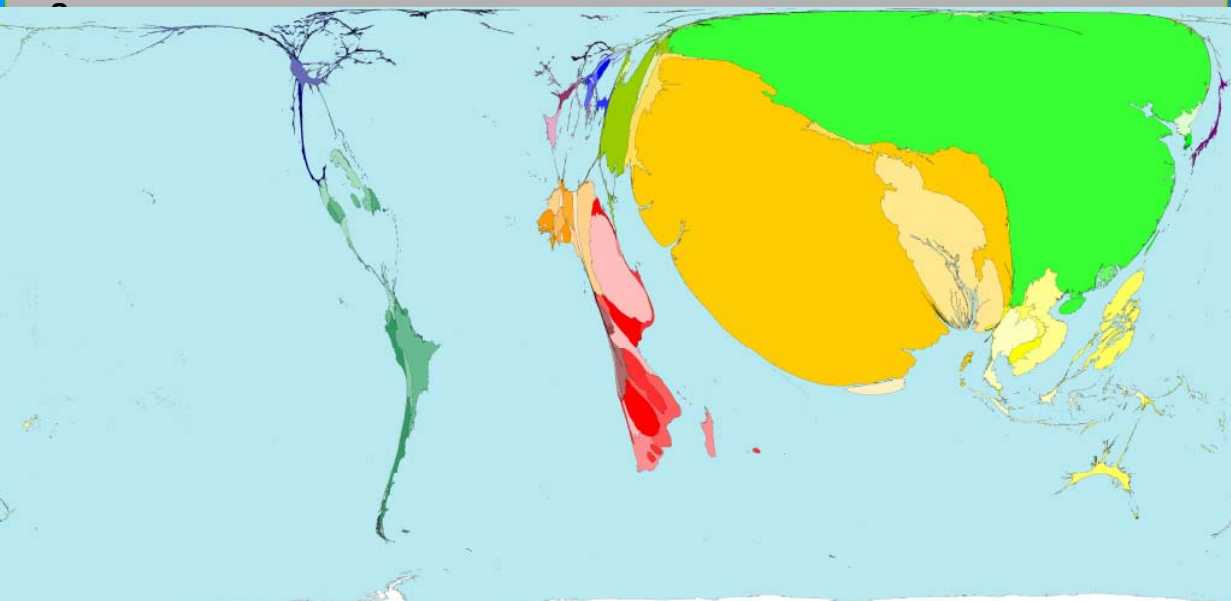
In Thailand, with the longest commuting times in the world, a total of 37 million hours is spent travelling to work everyday. If this number is doubled the total time commuting each day in Thailand can be calculated. The average working person living in Thailand spends 2 hours everyday travelling to and from work. The shortest journeys to work are in Malawi, taking just 2 minutes.

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Global Dangers

Affected by Disasters



Of all people affected by disasters between 1975 and 2004, 43% live in Southern Asia, 41% live in Eastern Asia, and 5% live in Southeastern Africa.

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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**

Wie weit ist der Klimawandel
fortgeschritten?
**Das Polareis
gibt Antworten.**



1979

2005

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CLIMATE CHANGE

Greenland glacier sol

TUESDAY 23 SEPTEMBER 2008

The gigantic Ilulissat has become a clog of global warming boulders are break evidence of a dramatic rate of ice melting.

Greenland melt 'speeding up'

The meltdown of Greenland's ice sheet is speeding up, satellite measurements show.

Data from a US space agency (Nasa) satellite show that the melting rate has accelerated since 2004.



This Greenland glacier is now one of the fastest moving in the world

Climate change: Uncharted waters?



By Alex Kirby
BBC News Online environment correspondent

As part of *Planet Under Pressure*, a BBC News series looking at some of the biggest environmental problems facing humanity, Alex Kirby explores the implications of climate change.

If the ice cap were to

Sea rise could be 'catastrophic'

By Paul Rincon
BBC News science reporter

Earth could be headed for catastrophic sea level rise in the next few centuries if greenhouse gases continue



Greenland ice-melt 'speeding up'



By David Shukman
BBC environment and science correspondent in Greenland

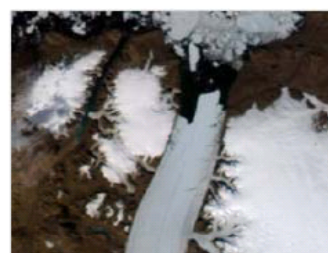
First you hear a savage cracking sound, next the rolling of thunder.

Then as the icebergs rip away from the margin of the ice sheet they plunge into the grey waters of the Atlantic with a roar that echoes around the mountains.

Associated Press
updated 7:31 p.m. ET Aug. 21, 2008

WASHINGTON - In northern Greenland, a part of the Arctic that had seemed immune from global warming, new satellite images show a growing giant crack and an 11-square-mile chunk of ice hemorrhaging off a major glacier, scientists said Thursday.

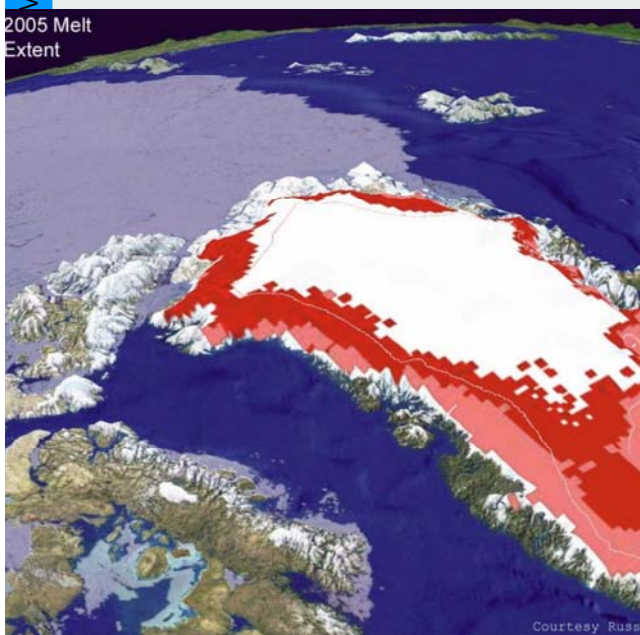
And that's led the university professor who spotted the wounds in the massive Petermann



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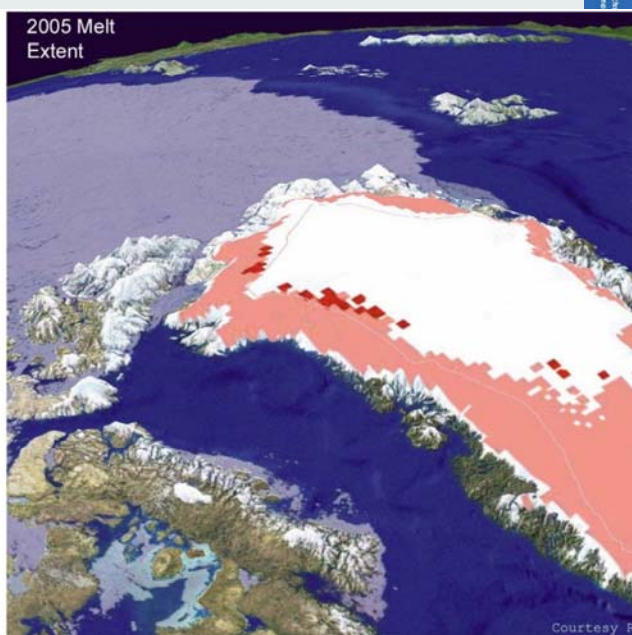
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2005 Melt Extent



Courtesy Russ

2005 Melt Extent



Courtesy Ru

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Atmospheric CO₂ & Temperature

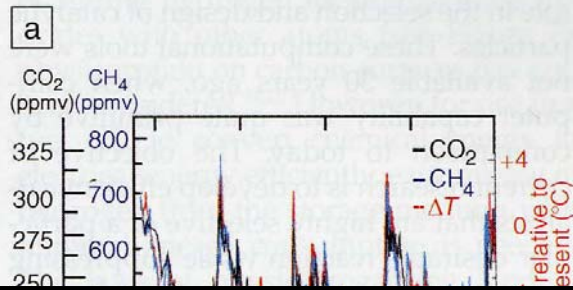
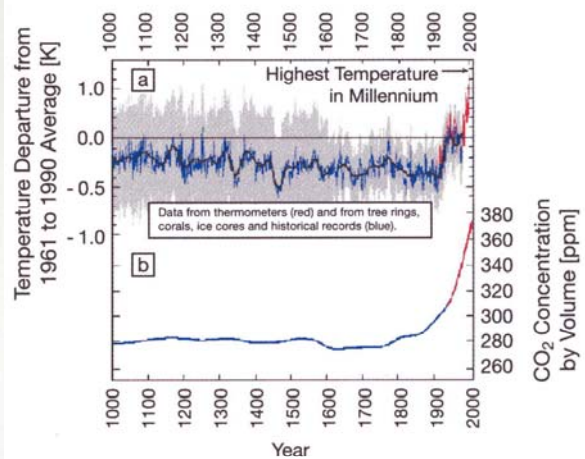
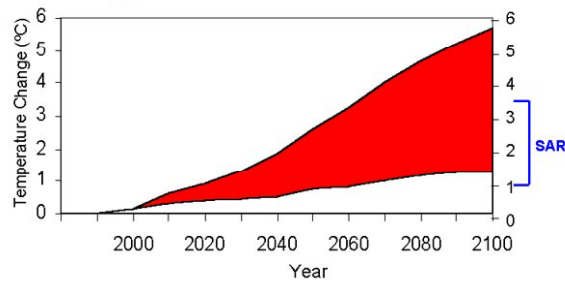


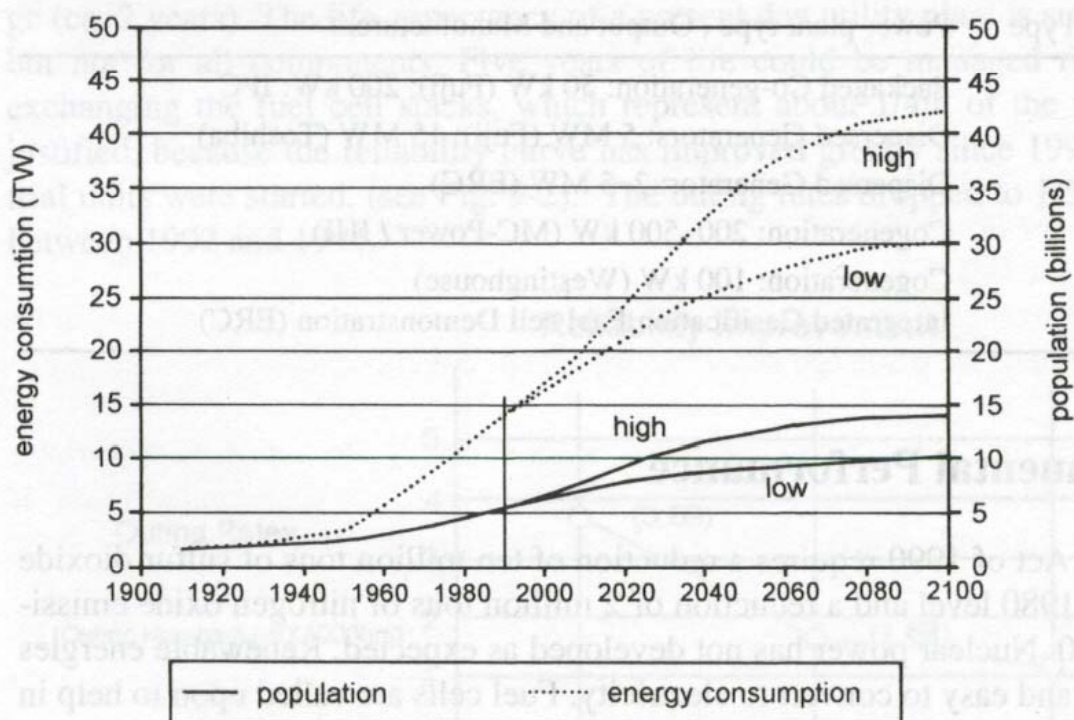
Figure 10: Projected Change in Global Mean Surface Temperature from Models using the SRES Emissions Scenarios



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Prognoses of World Development

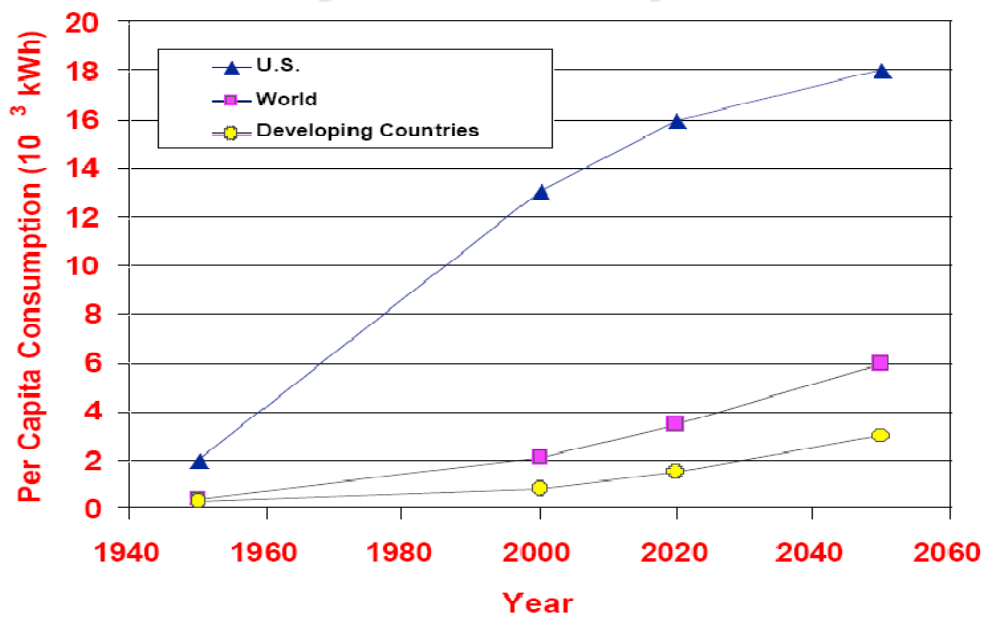


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Global Electricity

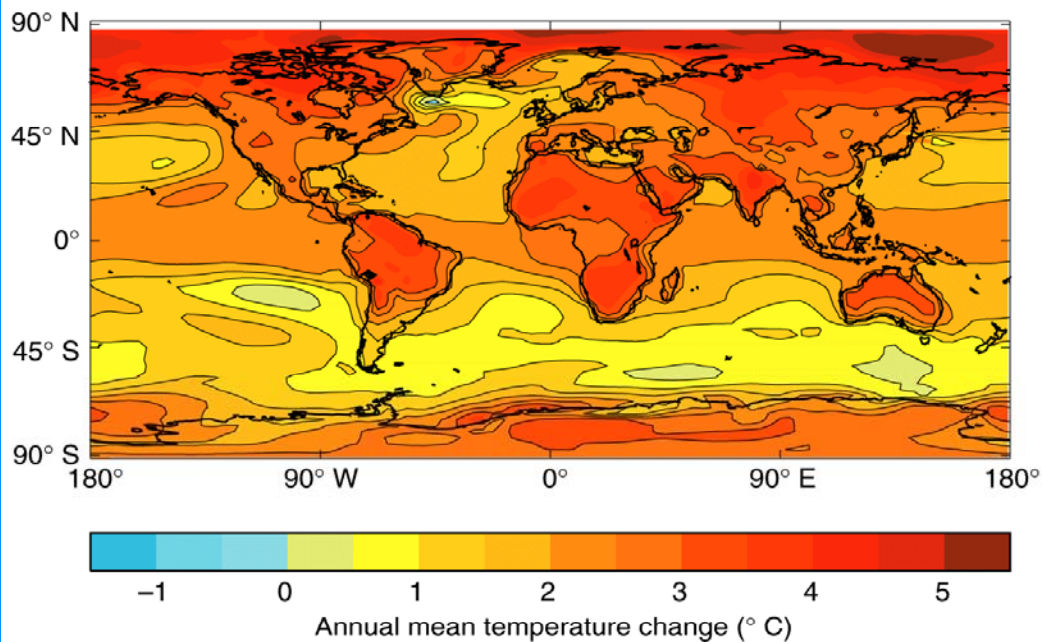
Trends in Per Capita Electricity Consumption



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EPRI

Projected Changes in Annual Temperatures for the 2050s

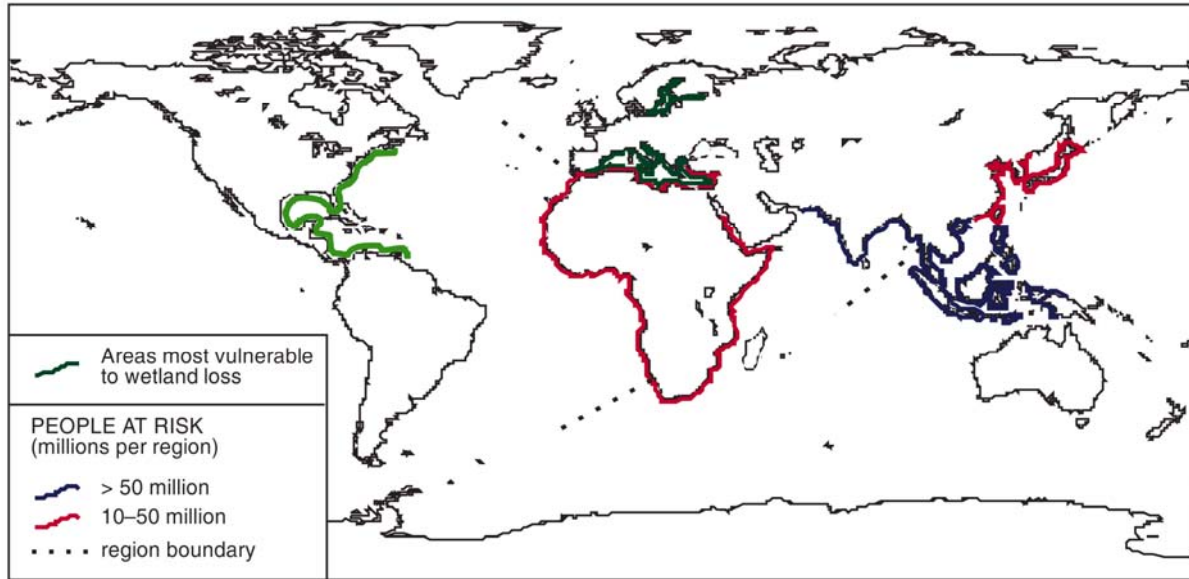


The projected change in annual temperatures for the 2050s compared with the present day, when the climate model is driven with an increase in greenhouse gas concentrations equivalent to about a 1% increase per year in CO_2 .

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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

Annual
GNP/capita
 10^5

International Collaboration
Global R&D, global investment,
global peace, global technologies

10^4

10^4

Amenities
Education, recreation, the environment,
intergenerational investment

10^3

10^3

Basic Quality of Life
Literacy, life expectancy, sanitation, infant
mortality, physical security, social security

10^2

Survival
Food, water, shelter, minimal
health services

Annual
kWh/capita

Source: Chauncey Starr

EPRI

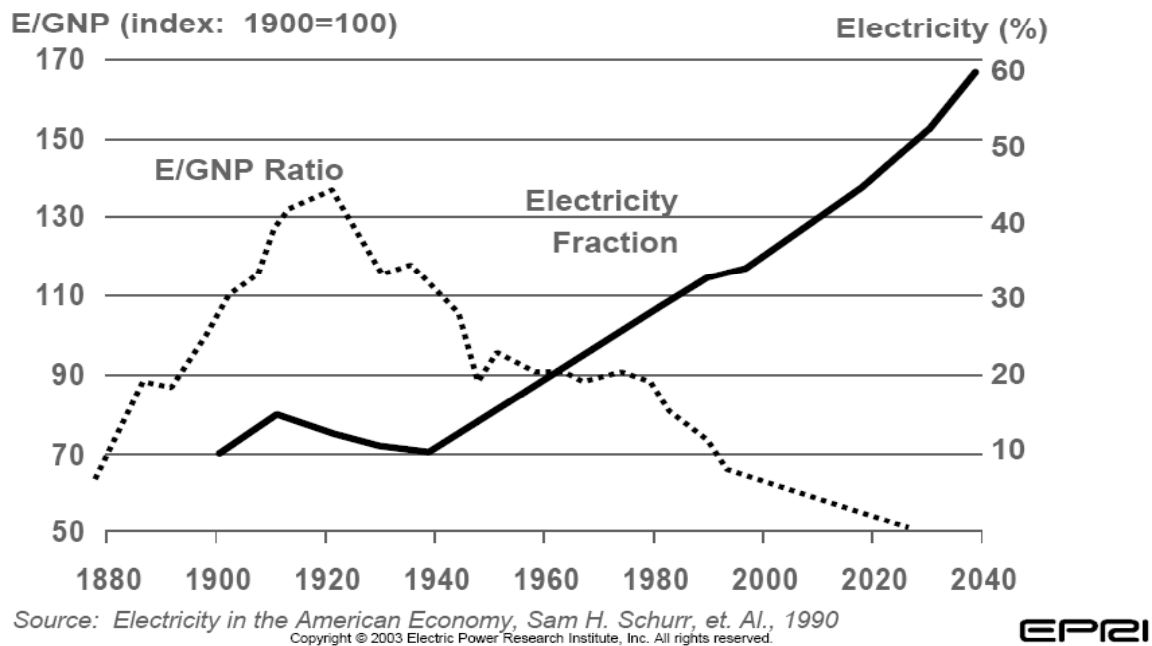
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Increasing Energy Efficiency



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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 & Progresses

Cars at the limits

Max. efficiency
tank to wheel:

Otto car 14%

Diesel car 18%

Hyd

This is equivalent to 5385km per 1l of diesel.

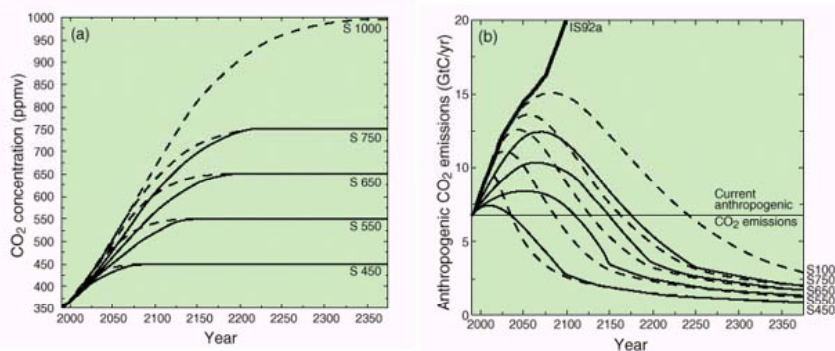
At the Ladoux circuit in June 2005, PAC-Car II beat its own world record using just 1.02g of hydrogen for the 21km.

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CO₂ - Models

Figure 19: Energy Emission Pathways and Stabilization Concentrations



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

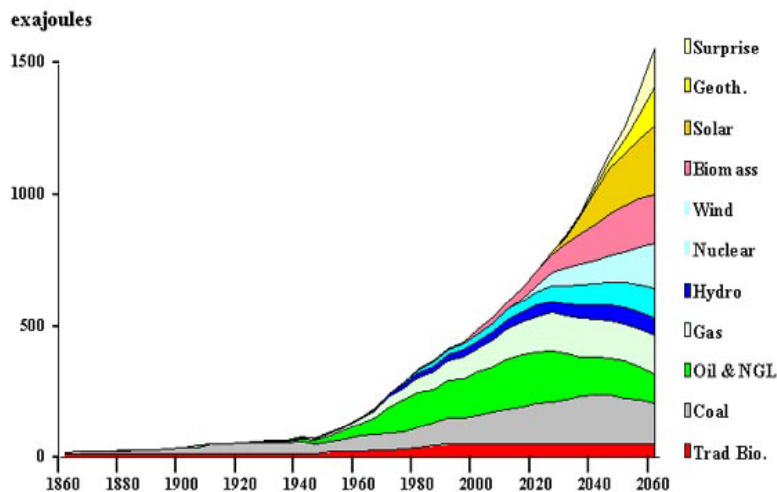
two different pathways for stabilizing carbon dioxide concentrations for each stabilization level between 450ppm and 750ppm and one for 1000ppm. The figure clearly shows that for any of these stabilization levels emissions must be lower than IS92a (often called the business-as-usual scenario) within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

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Sustainable Energy Sources

Figure 22: Energy Supply
Sustained Growth Scenario



Source: Shell International Limited.

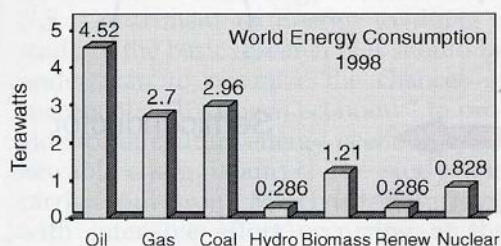
Non-fossil energy sources (solar, wind, modern biomass, hydropower, geothermal and nuclear) could account for as much as half of all energy produced by the middle of this century

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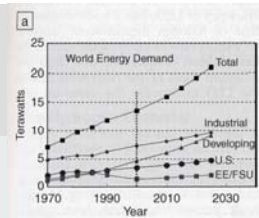
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The Energy Problem Energy, Atmosphere and Climate

b



"At some point, almost certainly within this decade, we will peak in the amount of oil that is produced worldwide."



"To give all 10 billion people on the planet the level of energy prosperity we in the developed world are used to, a couple of kilowatt-hours per person, we would need to generate 60 terawatts around the planet—the equivalent of 900 million barrels of oil per day."

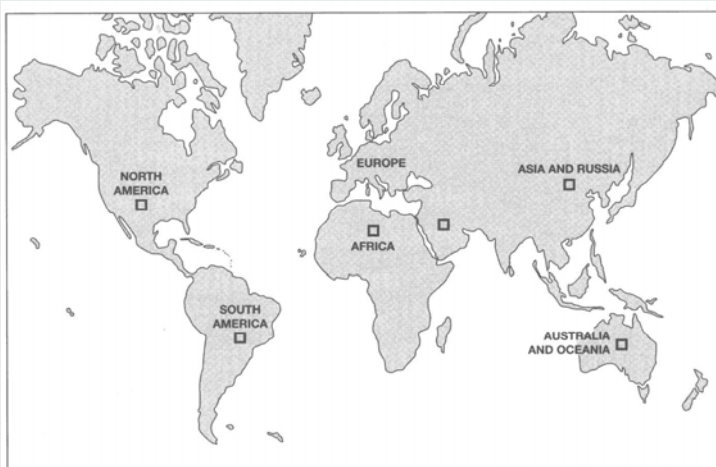


Figure 3. Solar cell land area requirements in which the six boxes (100 km on a side), located in areas of high solar radiation, can each provide 3.3 terawatts of electrical power to a total of ~20 terawatts of electrical power. Courtesy of Nate Lewis of the California Institute of Technology.

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Anorganische Chemie VI

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