Energy and Climate

Rude Awakening Tour
Falmouth,
July 2008

http://wwwfraw.org.uk/ebo/

An illustration of the problem...

Source:
NASA

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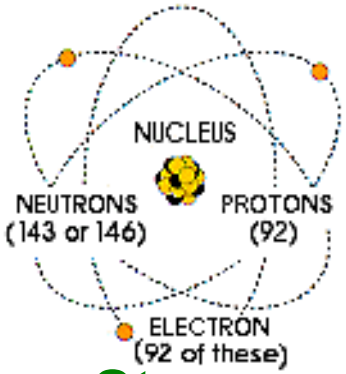
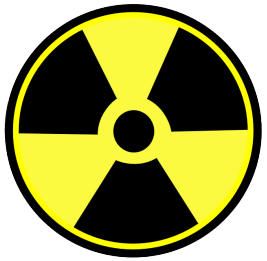
Source:
NASA

Fundamental Forces

All forms of energy are based upon one of four “fundamental forces”

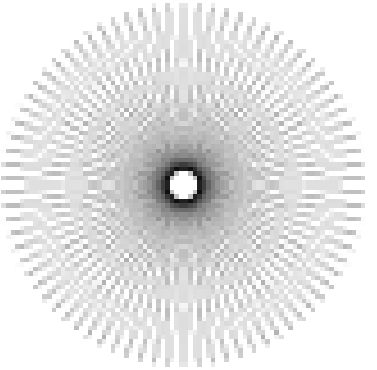


Strong nuclear



Weak nuclear

Electro-magnetic



Gravity

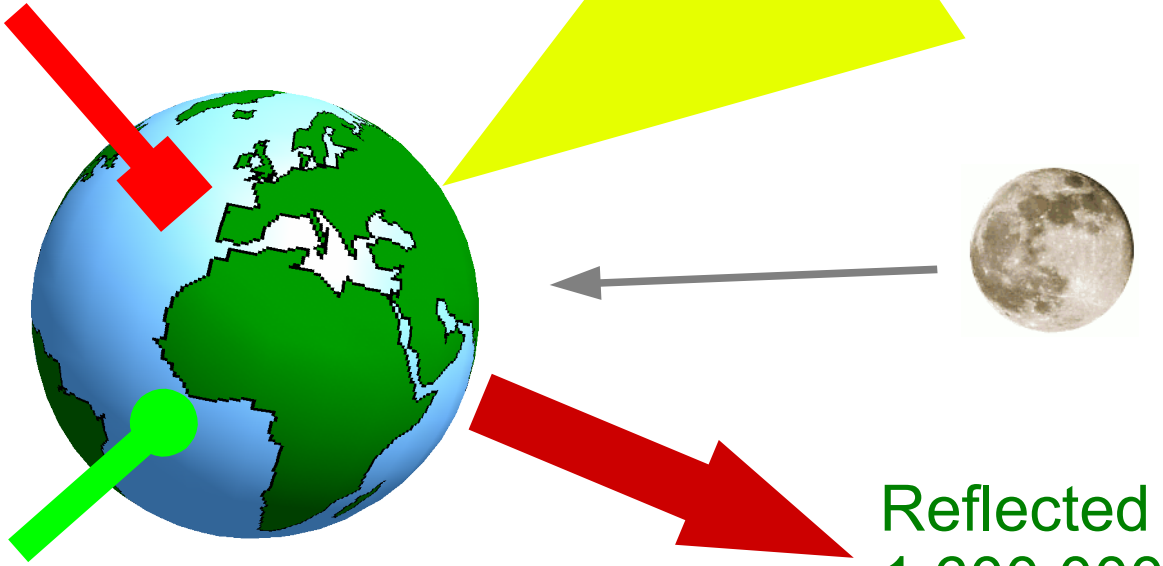
The rules:

- Energy and matter are constant (Law of Conservation)
- The activity within any system is proportional to the energy flowing through it (First Law of Thermodynamics)
- Energy only flows “downhill” – once utilised it takes more energy to restore its “quality” to its original state (Second Law of Th.)

Global Energy Inputs

Solar input,
5,400,000EJ
per year

Climate cycles
(wind/currents)
2,500,000EJ (46%)



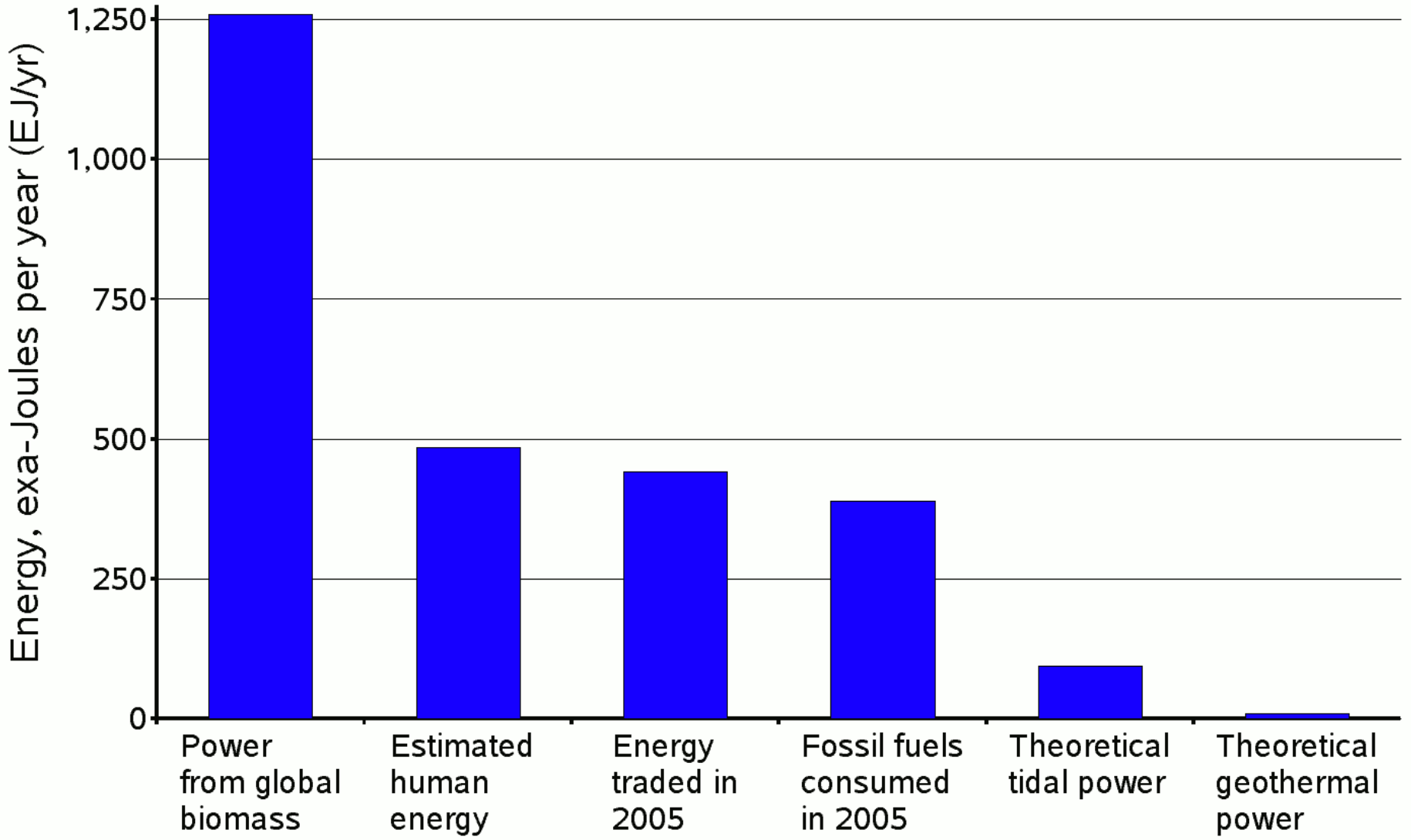
Moon's gravity
(creates tides)
94EJ per year

Reflected to space,
1,600,000EJ (30%)

Hydrological cycle
(evaporating water)
1,300,000EJ (24%)

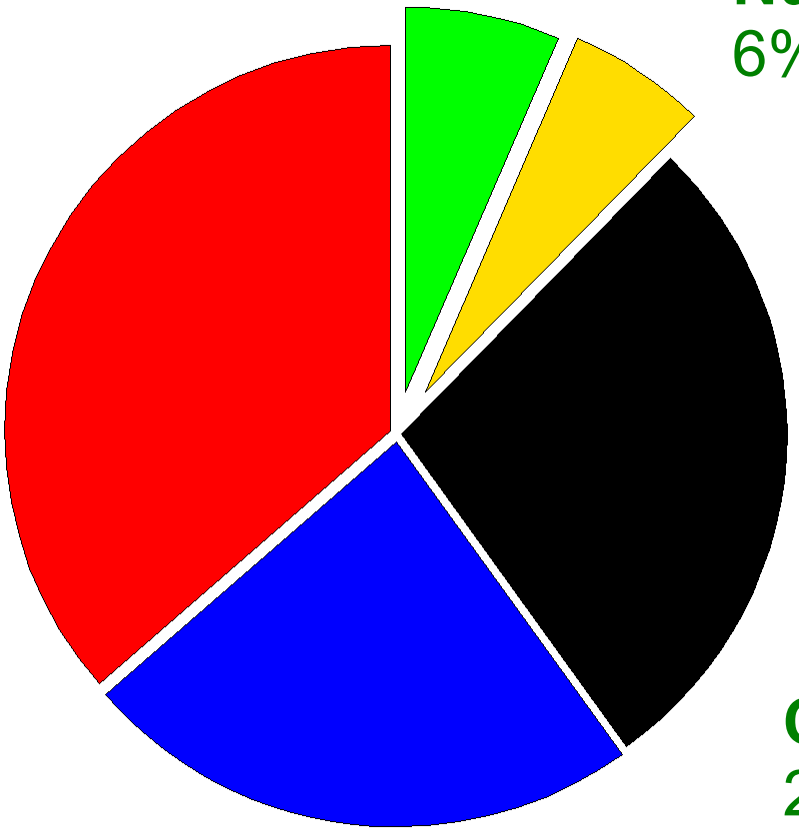
Source:
Open University

The Scale of Human Energy Use



Source:
BP/Open University

Globally Traded Energy, 2005

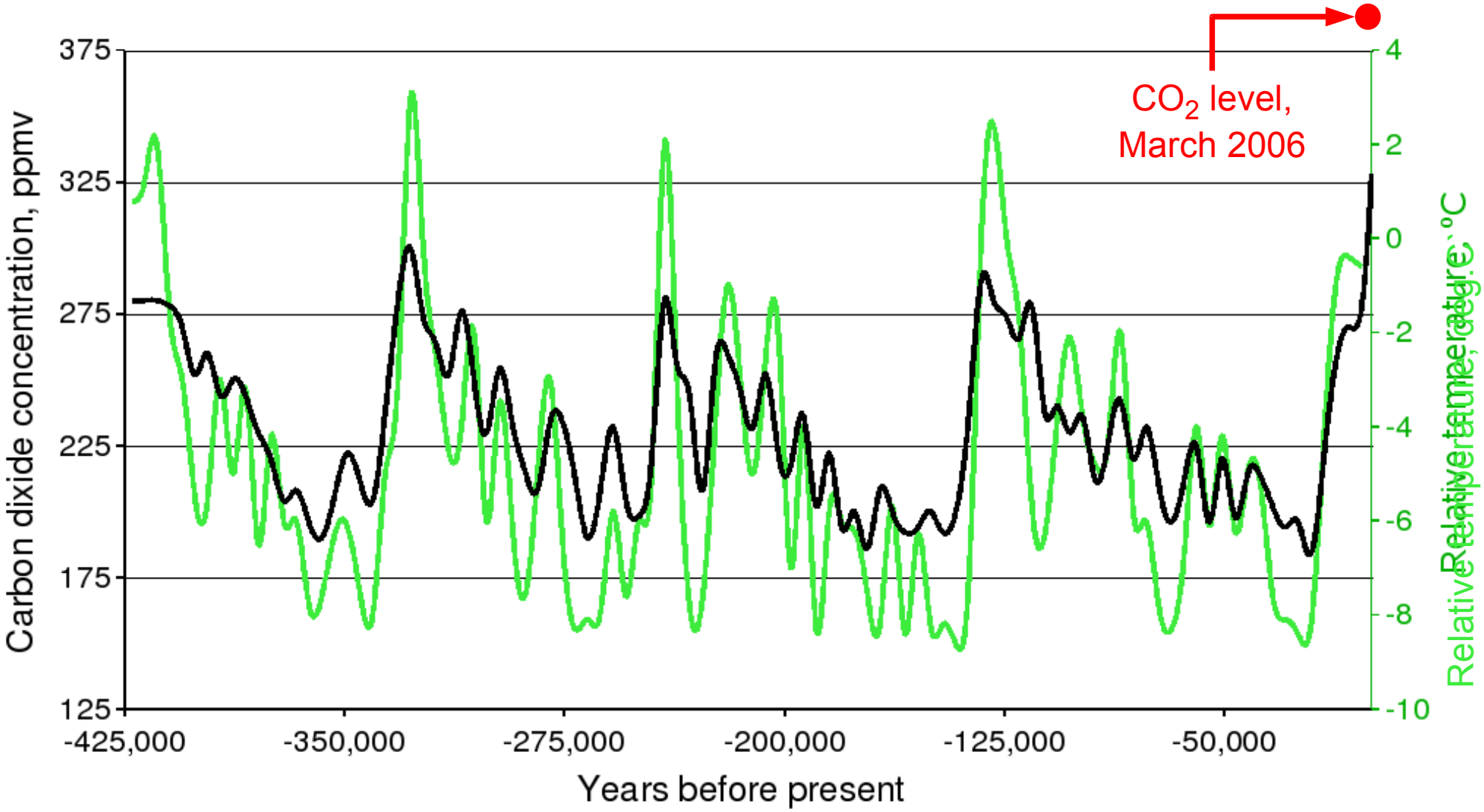


Consumption:	EJ
Oil	161
Natural Gas	104
Coal	123
Nuclear	26
Hydro	28
Total	**442**

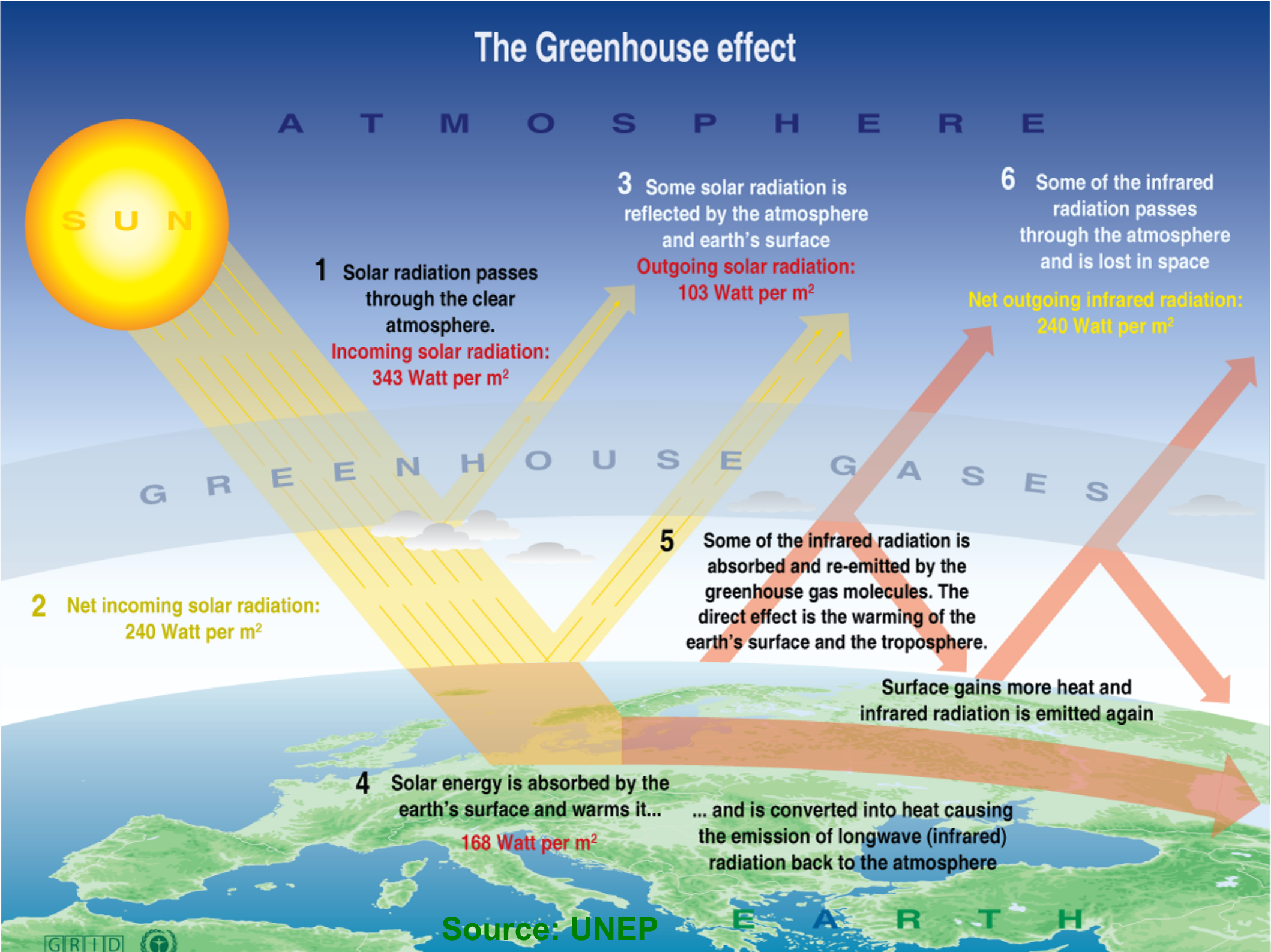
88% fossil fuels!

Source:
BP

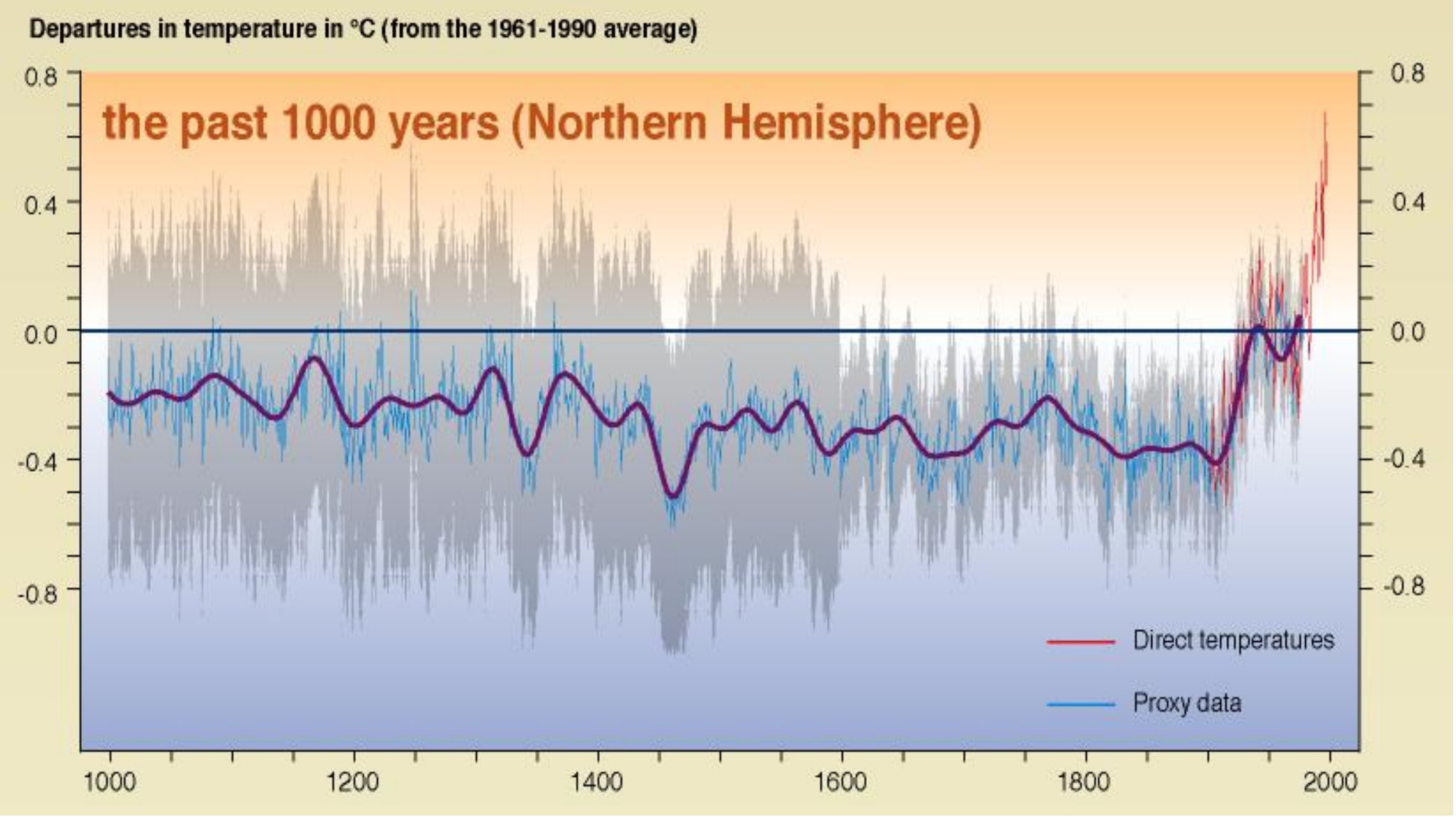
Carbon and the Historical Climate



Source:
RCEP/Hadley Centre

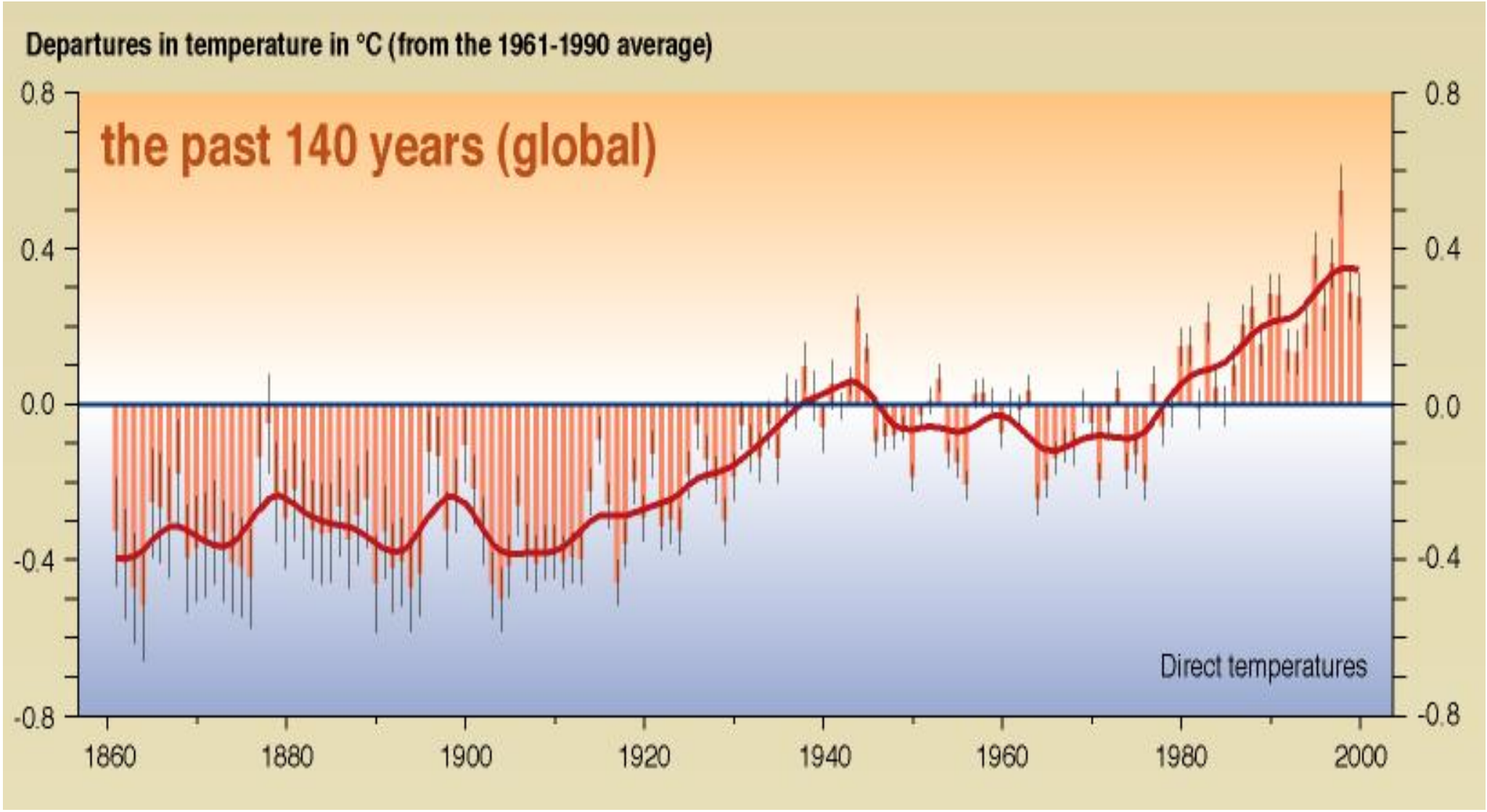

The Greenhouse effect
A T M O S P H E R E
S U N
1 Solar radiation passes through the clear atmosphere.
Incoming solar radiation:
343 Watt per m²
3 Some solar radiation is reflected by the atmosphere and earth's surface
Outgoing solar radiation:
103 Watt per m²
6 Some of the infrared radiation passes through the atmosphere and is lost in space
Net outgoing infrared radiation:
240 Watt per m²
G R E E N H O U S E G A S E S
2 Net incoming solar radiation:
240 Watt per m²
5 Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.
Surface gains more heat and infrared radiation is emitted again
4 Solar energy is absorbed by the earth's surface and warms it...
168 Watt per m²
... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere
E A R T H
Source: UNEP
GRID

Last 1,000 years (Northern Hemisphere)



Source: IPCC

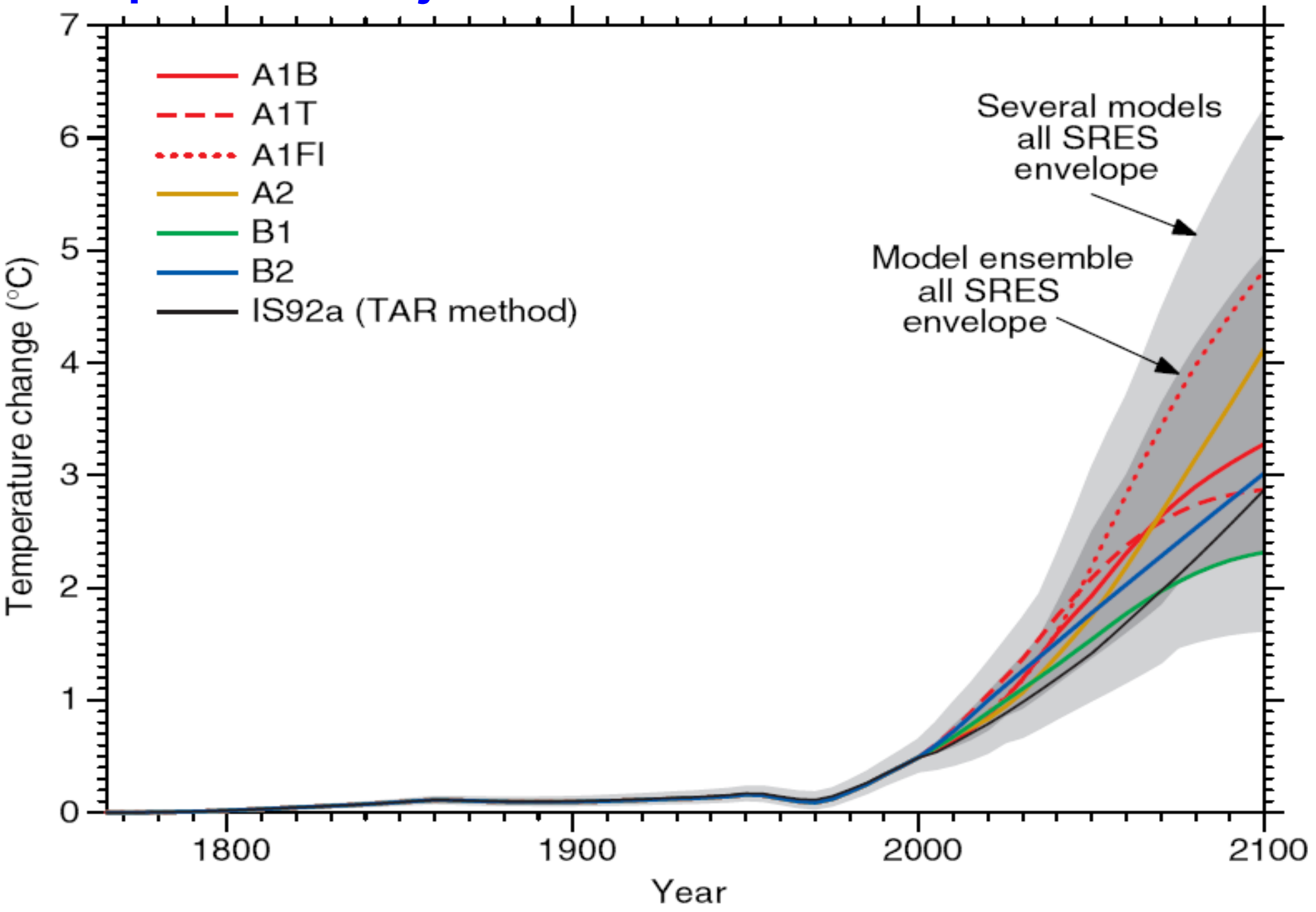
Recent temperature



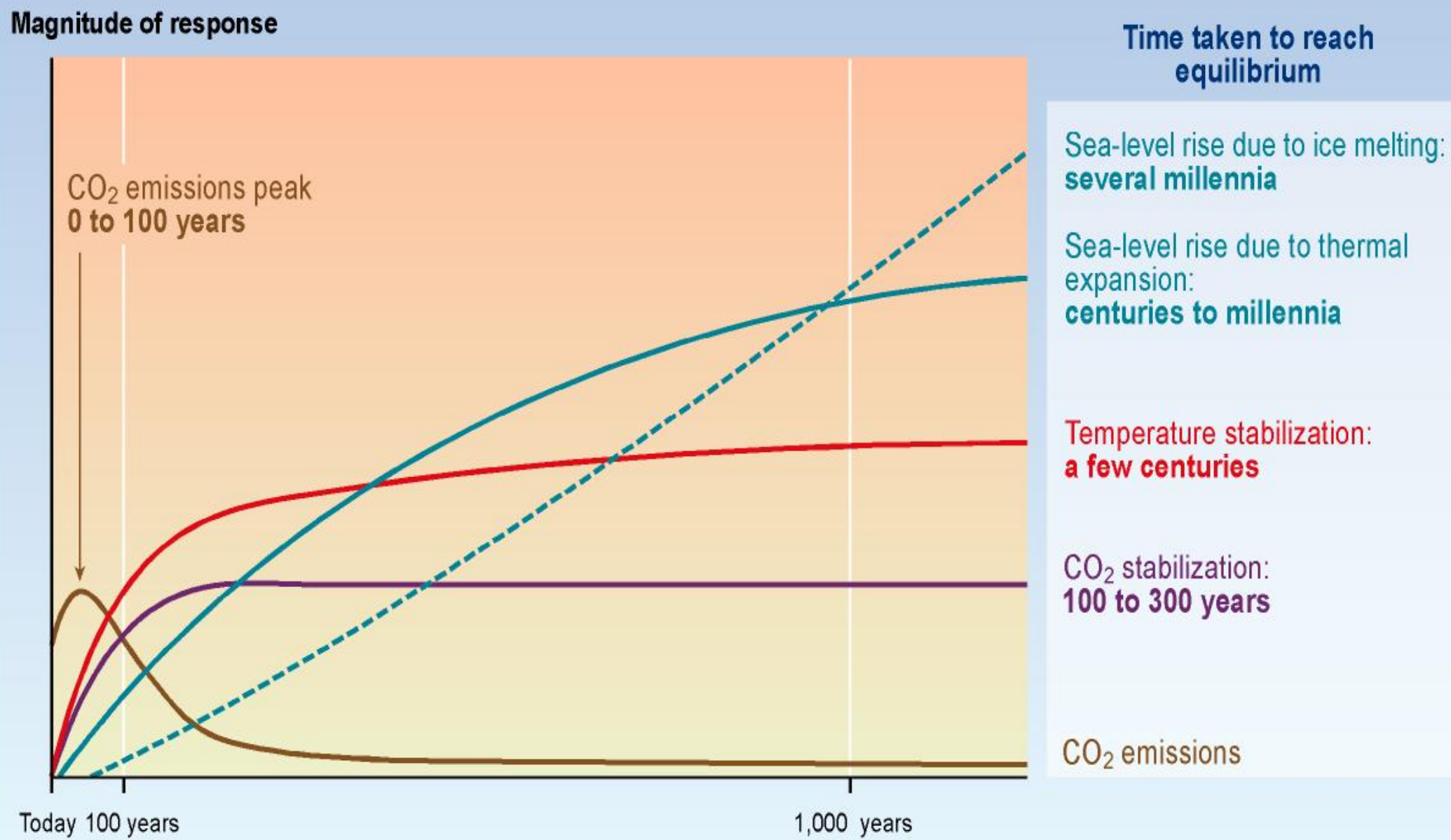
Source: IPCC

Temperature Projections

Source: IPCC

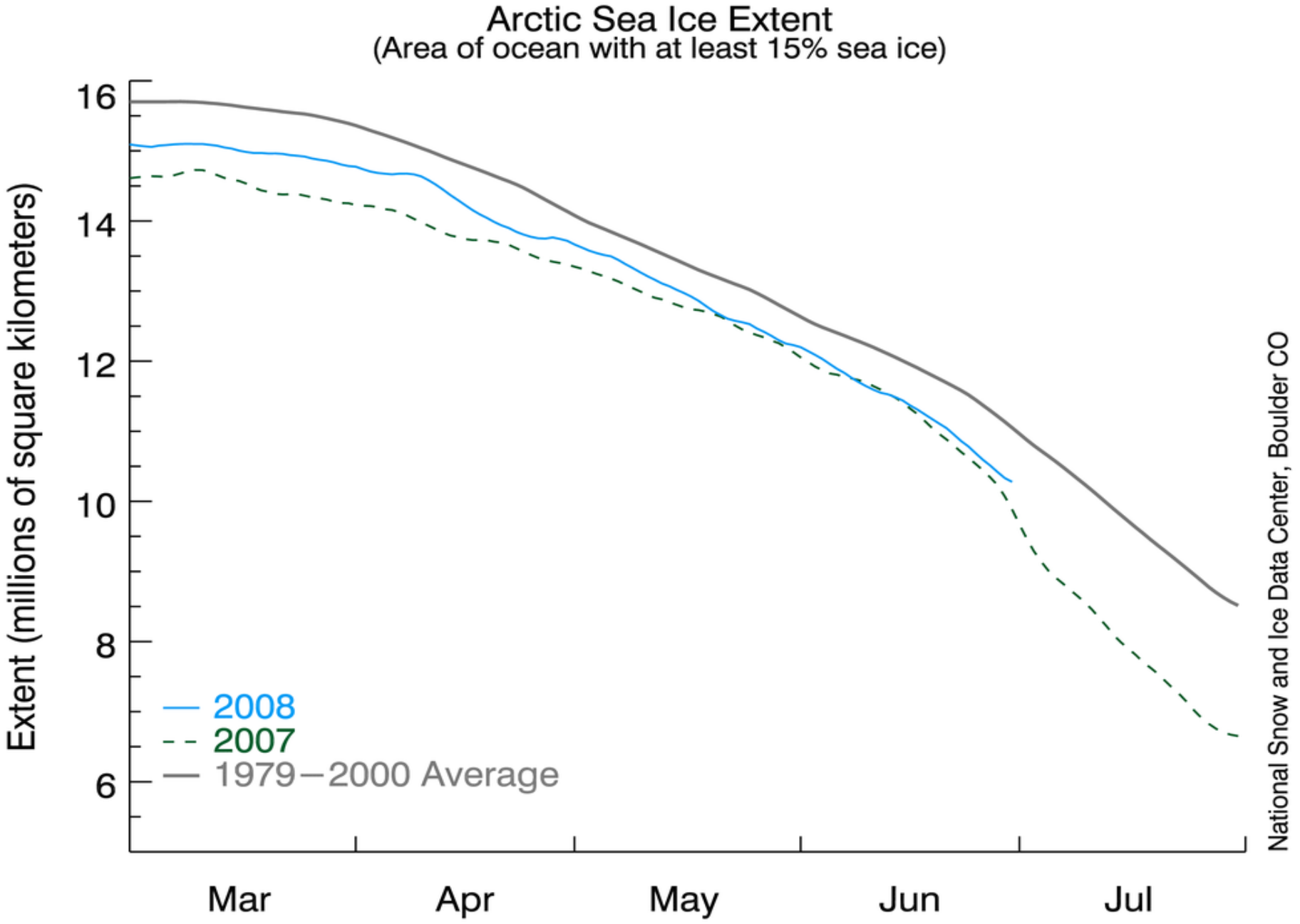


CO_2 concentration, temperature, and sea level continue to rise long after emissions are reduced

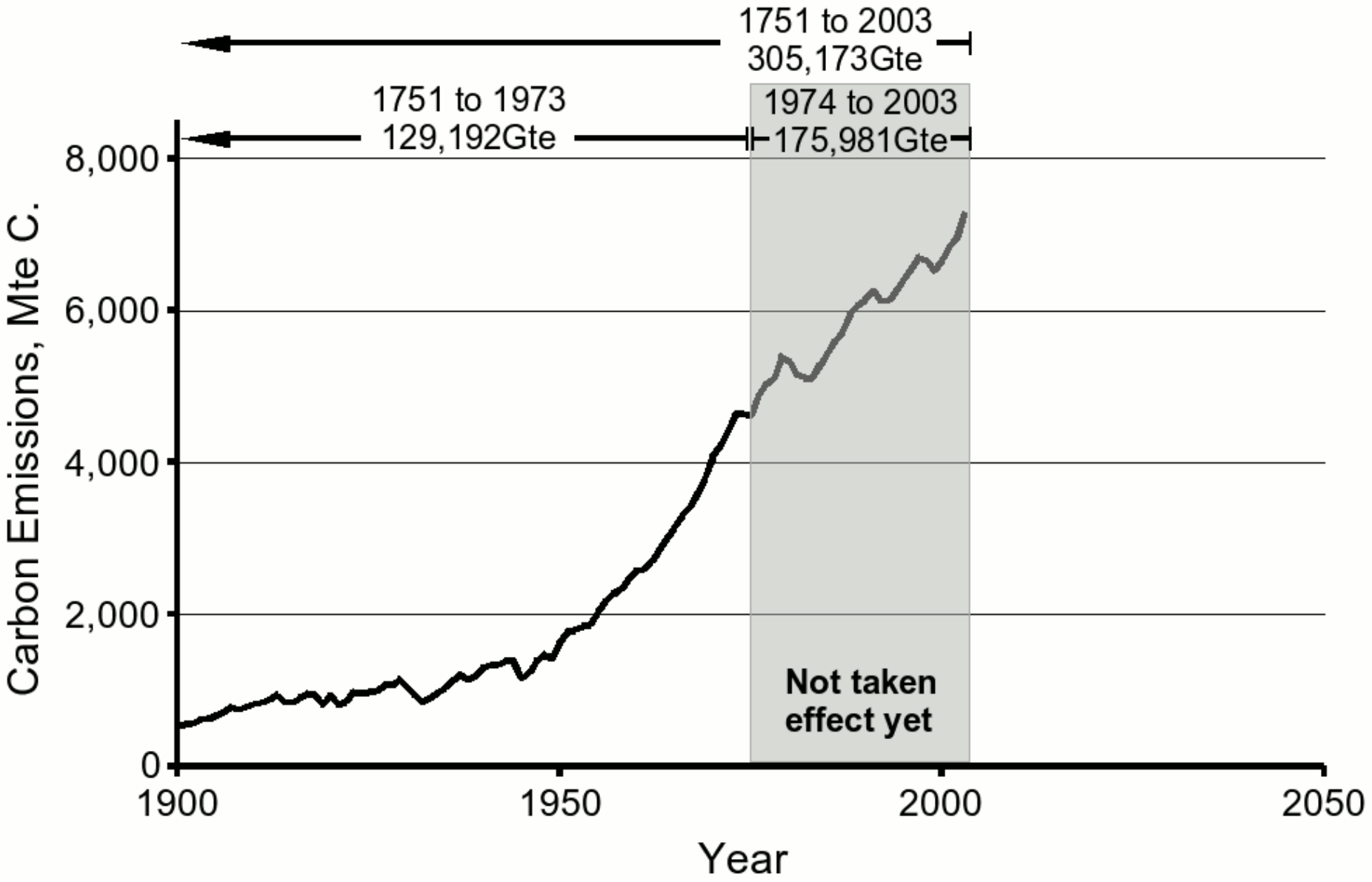


Source: IPCC

Positive Feedback?



How Much Carbon?



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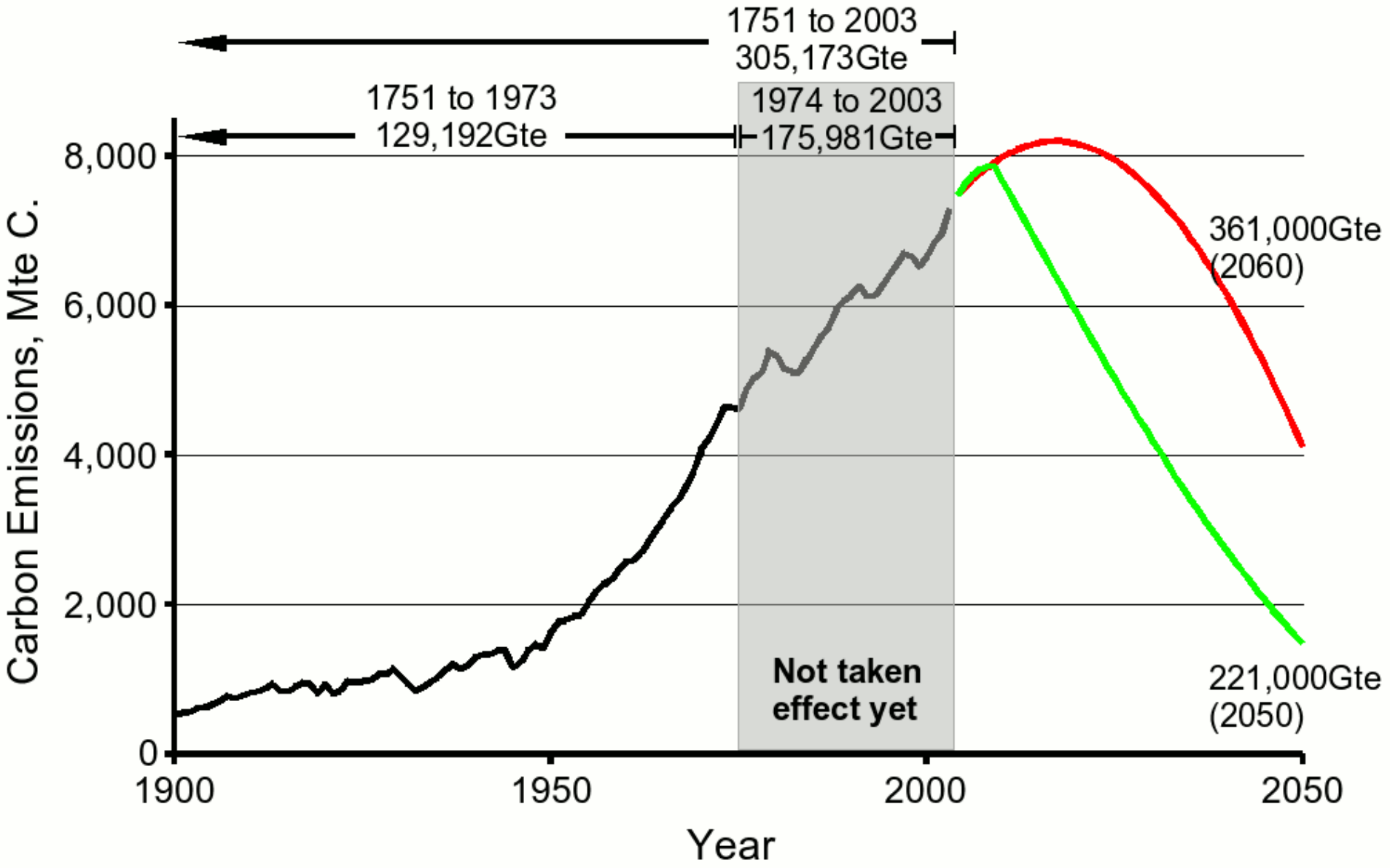

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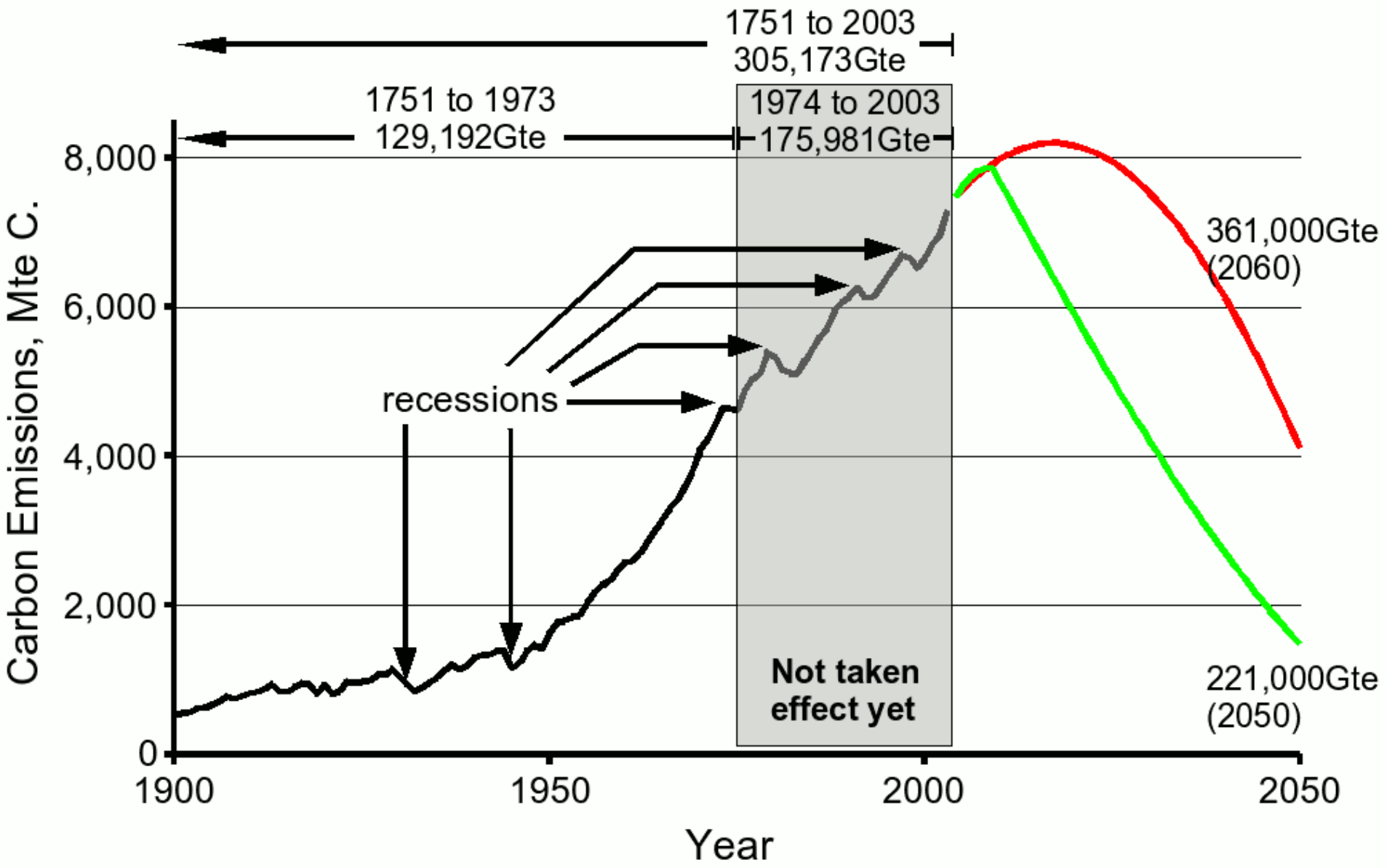
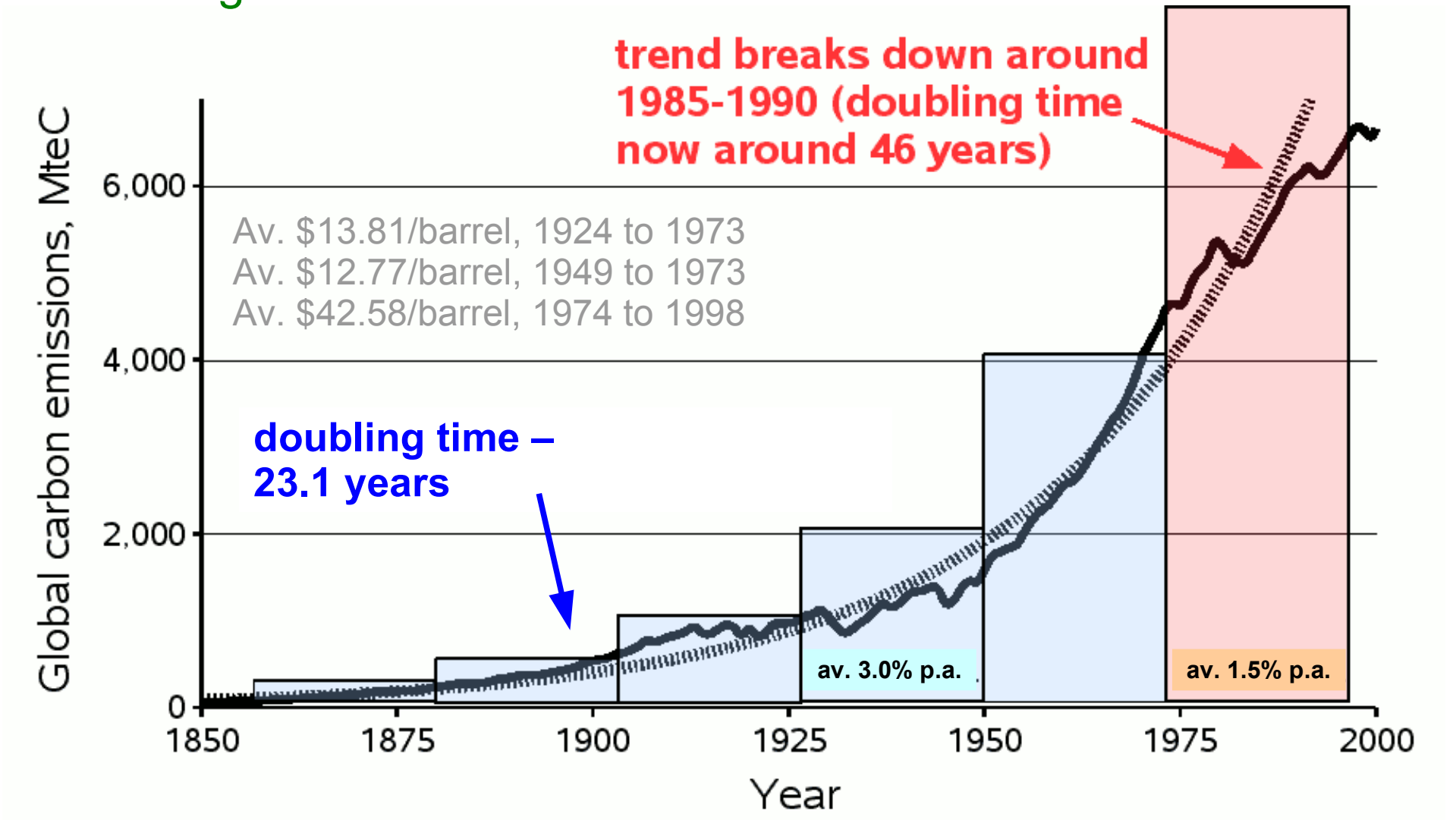
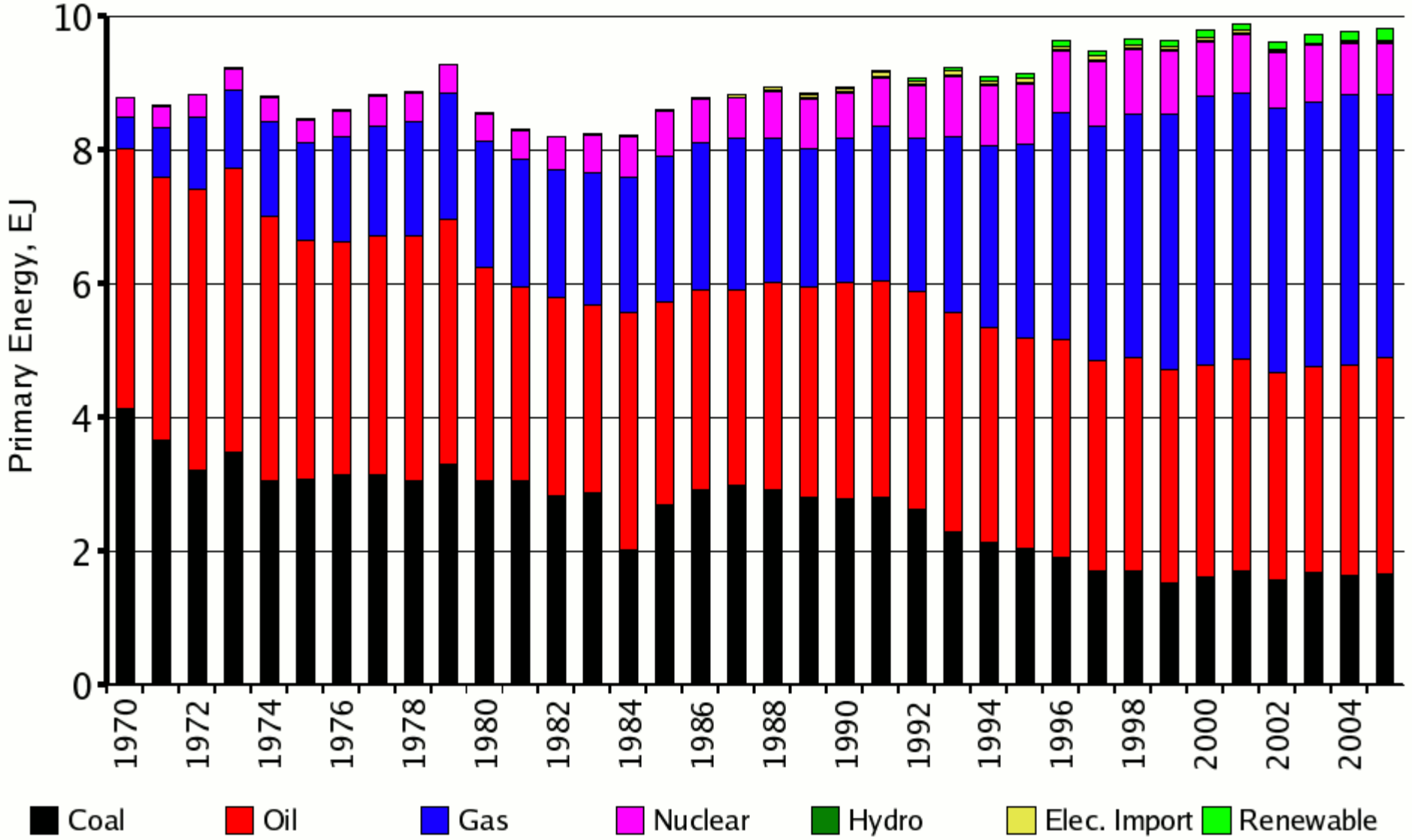


Doubling Time and Growth

Where growth is exponential, the value will double over a fixed period of time – the "doubling time". This can be estimated by dividing 70 by the rate of growth.

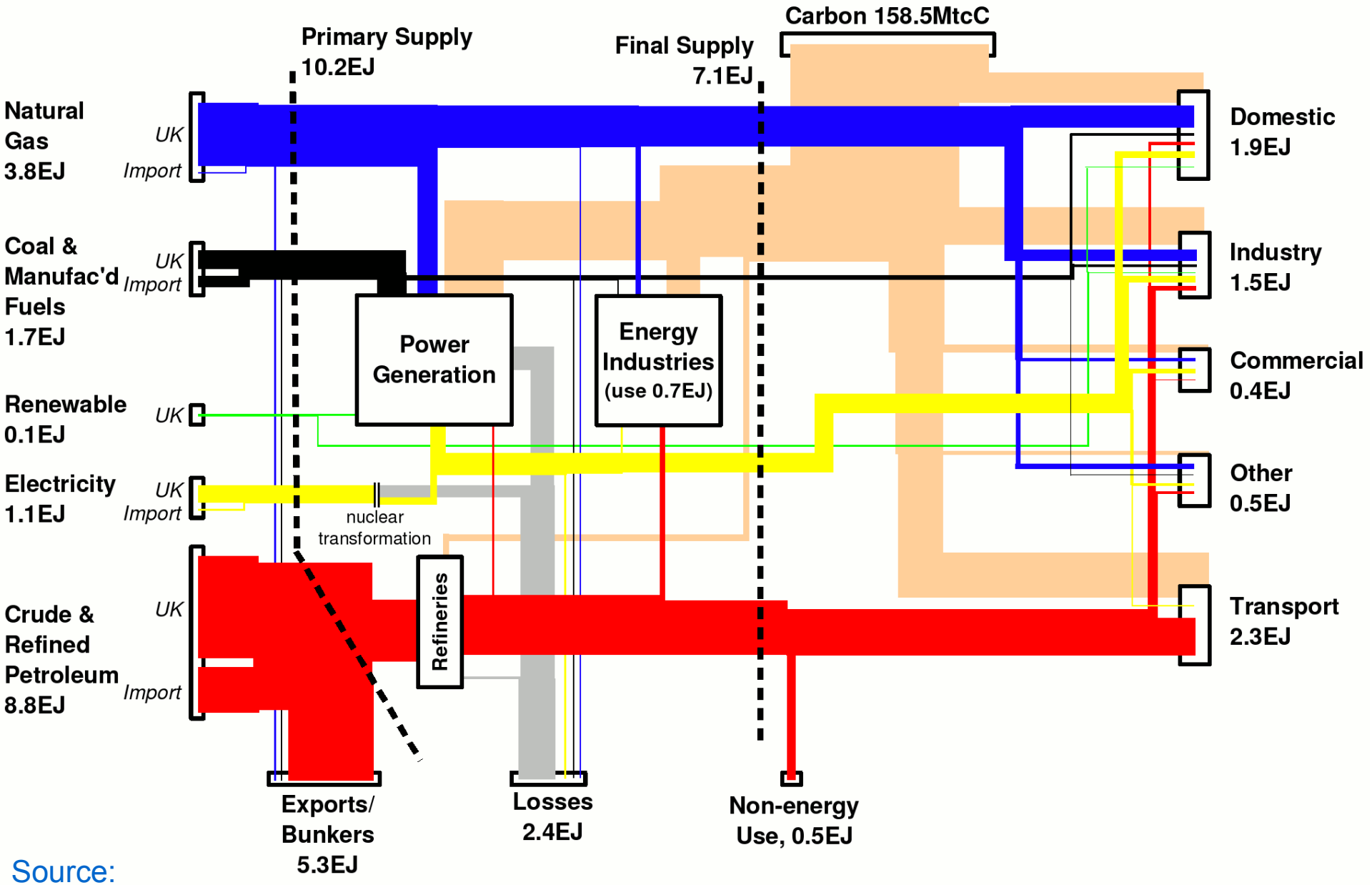


UK Primary Energy Supply, 1970-2005



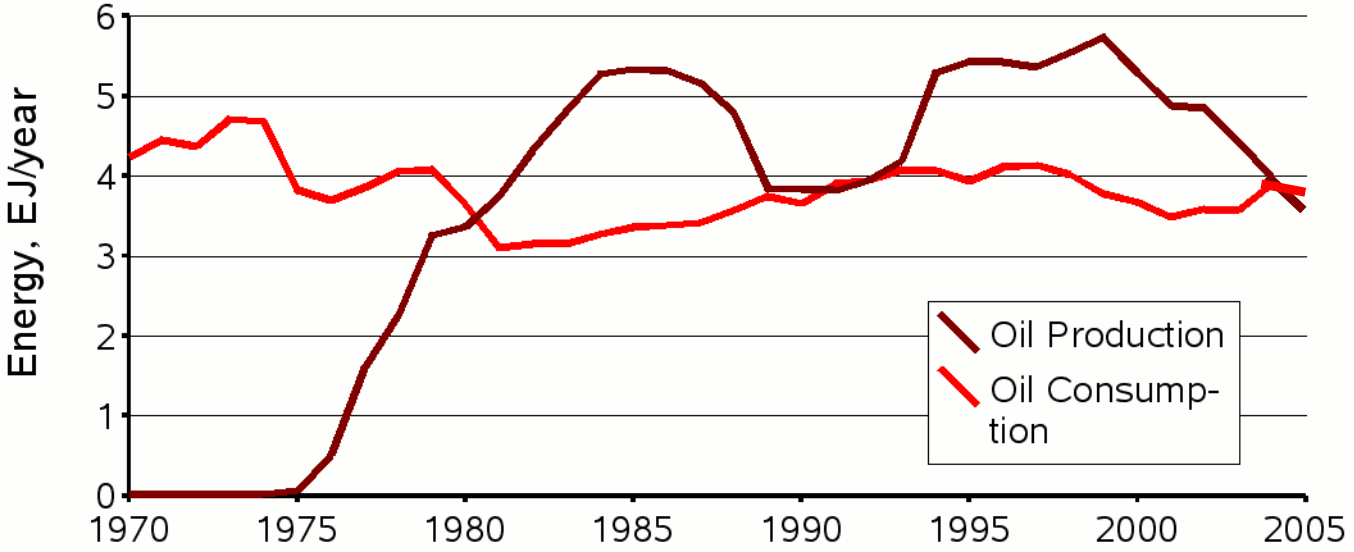
Source:
Digest of UK Energy Statistics 2006, DTI

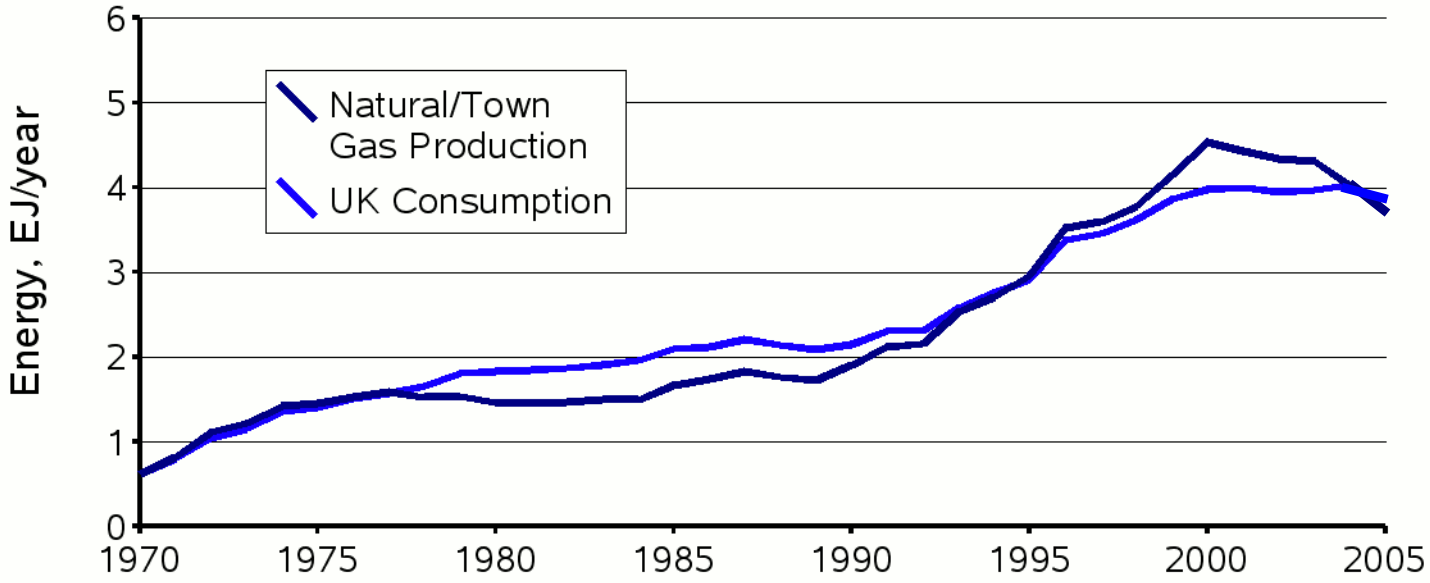
UK Energy and Carbon Flowchart, 2004



Source:
Compiled from Digest of UK Energy Statistics (2005) data

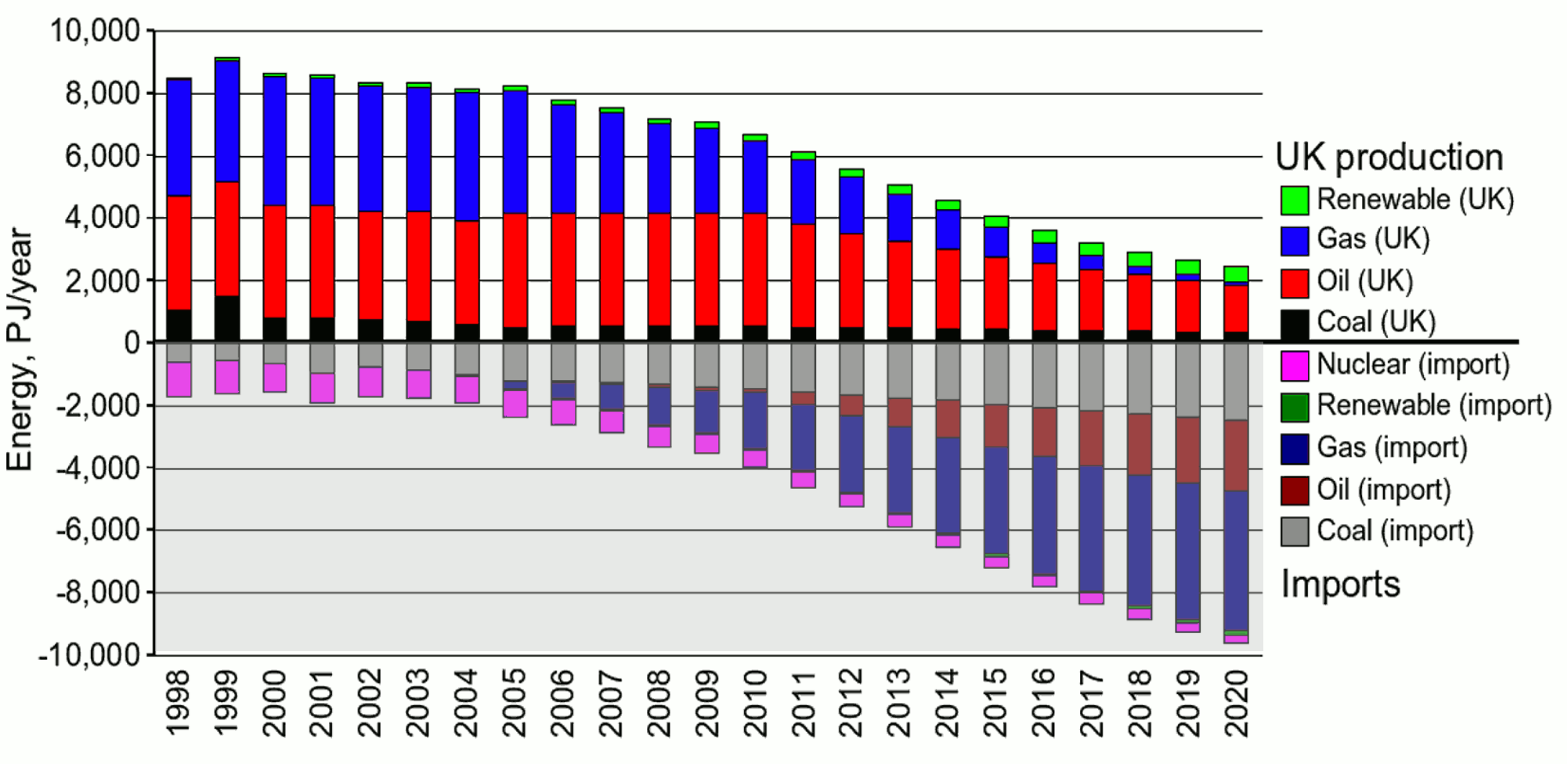
UK Oil and Gas Production, 1970 to 2005





Source:
Digest of UK Energy Statistics 2005, DTI

Projected Change in Imports



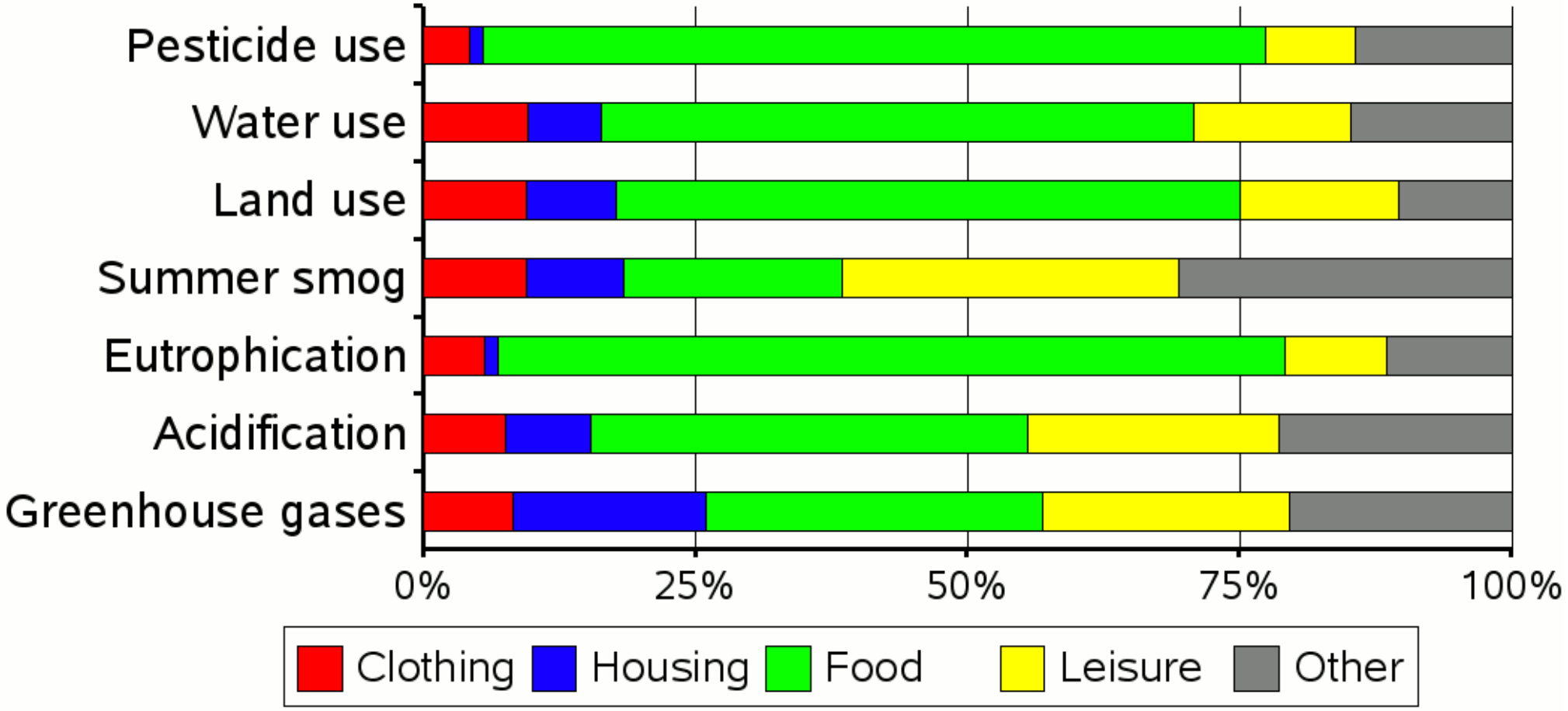
Source:
UK Joint Energy Security of Supply (JESS) Committee

The Simple Solution...

Why n  t just HAVE LESS?

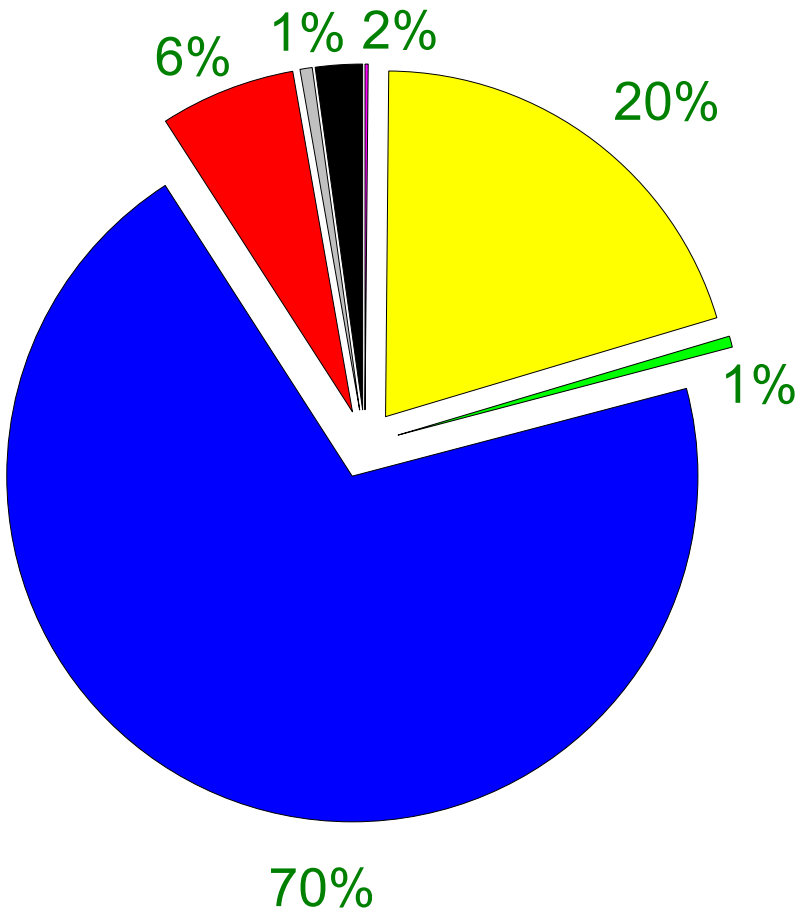
The Impacts of Consumption

Dutch consumption provides a good analogy for the UK:



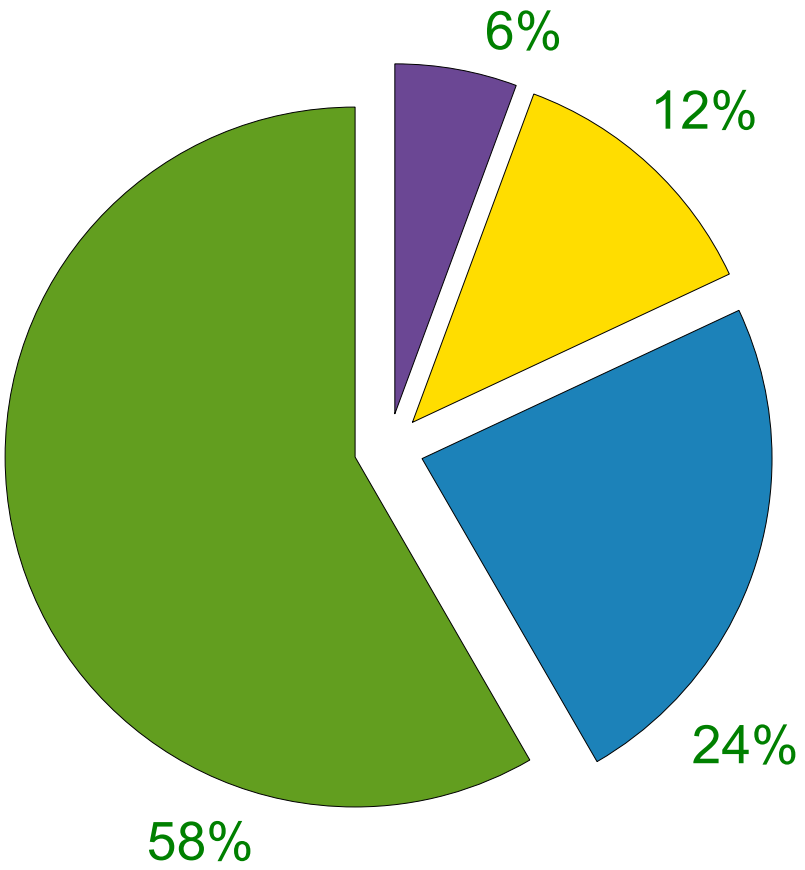
Source: Share of Consumption Environmental Load from Dutch Private Consumption, Nijdam et. al., Journal of Industrial Ecology 9(1-2), 2005

Domestic Energy Use



- Coal
- Manufac-tured fuels
- Petroleum products
- Natural gas
- Renewable
- Electricity
- Heat sold

So, if standby devices use 10% of your lighting/ appliance consumption, that's 10% of 12% = 1.2%! (not a lot compared to the space heating load)



- Space heat-ing
- Water heat-ing
- Lighting/appli ances
- Cooking

Source:
DTI

The Likely Future

We don't need to produce more energy, we need to use less!

- Petroleum will become very expensive within 10 years and will be in short supply within 20.
- Gas will become expensive. Just as more people are switching to gas, this too will begin to run short around 2030.
- Coal creates problems because of climate change, and nuclear has problems because the uranium won't last long.
- Renewables can't fill the gap – wind needs back-up/storage, biomass needs massive land area that it would affect agriculture, and other options have a low power density.

In short, renewables might supply 30% to 40% of the UK's current energy use. That means cutting use by 60% to 70% over 60 to 70 years.

Finally, read the book!

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