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Introduction to climate change and energy

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Structure

- Climate Change – overview:
 - What is it?
 - What are Greenhouse gases?
 - What's the impact?
 - What are the solutions?

Note: the following presentation is partly based on Al Gore's book 'An inconvenient truth' (Paperback, 2006)

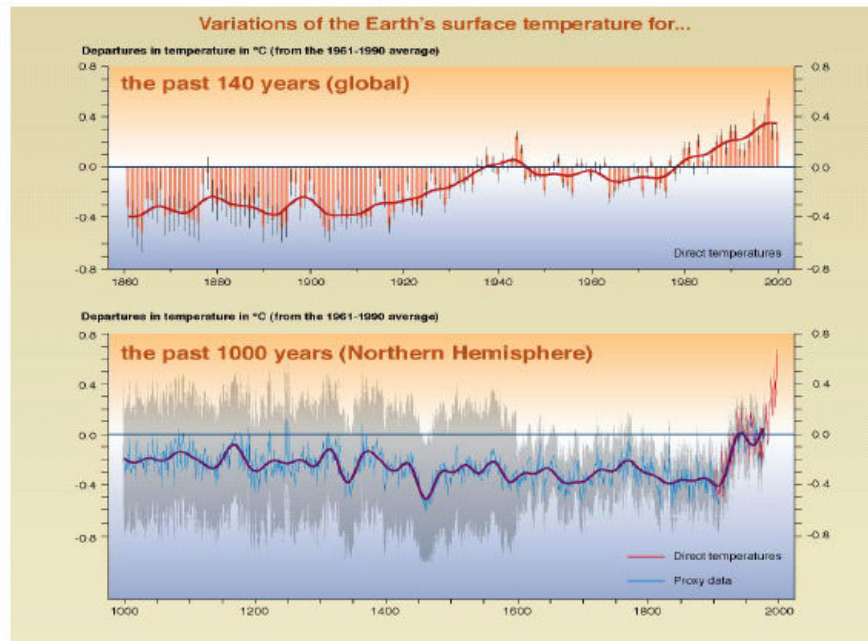


What is climate change

- The climate has always been changing
- However, climate change (or “global warming”) refers to unusual changes observed in the 20th century
- Mainly a result of man-made increase in emissions

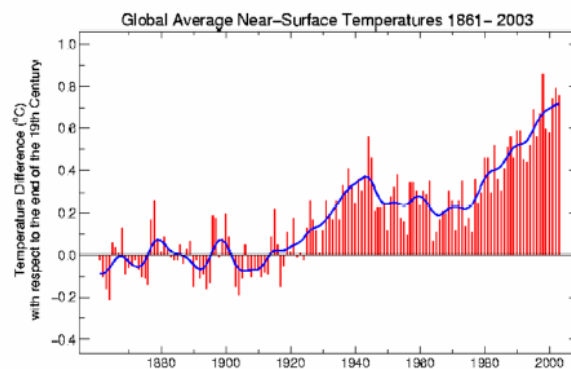


Global mean surface temperatures have increased



Globally temperatures grew by 0.7 degree Celsius since 1861

Figure 1 Observed temperatures for the globe since 1861 (Hadley Centre)



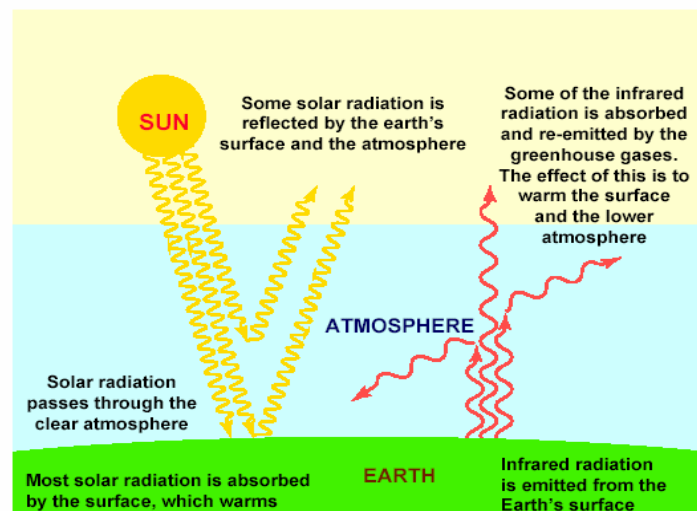


What is climate change

- Atmosphere vulnerable part of our ecological system.
- So thin that we can change it's composition
- Atmosphere 'traps' GHG → greenhouse effect which keeps the temperature of the earth comfortable for its inhabitants
- The amount of GHG (in particular CO₂) has drastically increased
- **Too many GHG thicken the atmosphere**, which becomes **warmer**
- The addition to the atmosphere of certain gases (radioactively active) forces the climate away from its natural equilibrium
- **This causes Climate Change (or global warming)**



The greenhouse effect



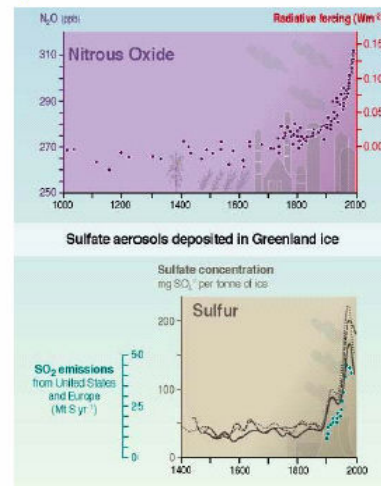
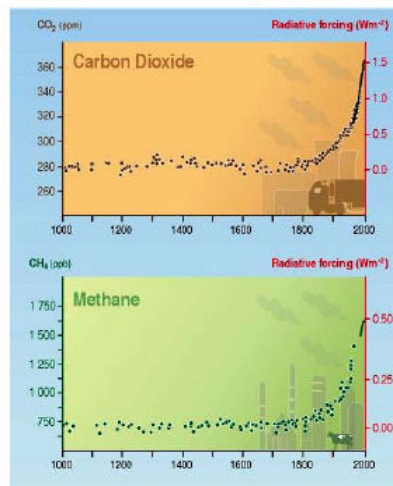


What are Greenhouse Gases (GHG)?

- Carbon dioxide (CO₂) – energy & transport
- Methane (60% by humans)
- Nitrous oxide (N₂O) – increased by 17% during industrial age (fertilizers, fossil fuels, forest burning)
- SF₆ and HFCs which are produced only by human activity
- PFC produced by human activities like aluminium smelting, electricity grids etc
- Water vapors which magnify the impact of artificial GHG



Human activities have changed the composition of the atmosphere since the preindustrial era





Carbon Dioxide – the main culprit

- CO₂ concentration increased at high rate in last 40 years
- CO₂ accounts for 80% of total GHG emissions, currently responsible for 60% of the 'enhanced greenhouse effect'
- Pre-industrial concentration 280 ppm
- 2005 → 381 ppm
- 400 ppm threshold
- IPCC forecast 450-500ppm



Carbon Dioxide - CO₂

- Most of the CO₂ was removed from the atmosphere as early organisms evolved photosynthesis. This locked away carbon dioxide as carbonate minerals, oil shale and coal, and petroleum in the Earth's crust when the organisms died. This left 0.03% in the atmosphere today.

The natural carbon dioxide cycle:

- Atmospheric carbon dioxide comes from a number of natural sources, mainly the decay of plants, volcanic eruptions and as a waste product of animal respiration.
- It is removed from the atmosphere by photosynthesis in plants and by dissolving in water, especially on the surface of oceans.





Carbon Dioxide CO₂

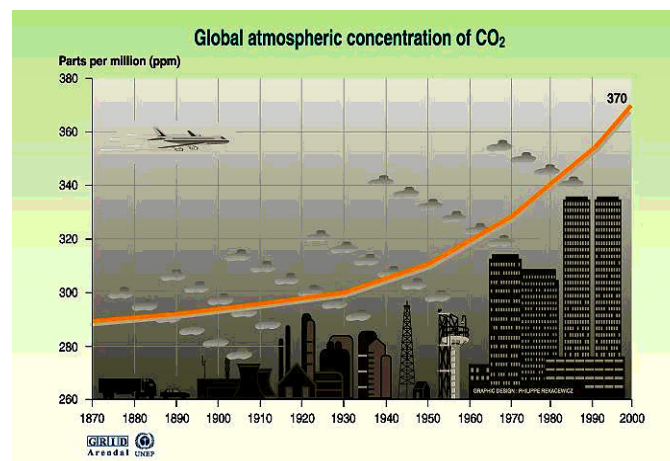
- It stays in the atmosphere for approximately 100 years.
- The amount of CO₂ taken out of the atmosphere by plants is almost perfectly balanced with the amount put back into the atmosphere by respiration and decay. Small changes as a result of human activities can have a large impact on this delicate balance.

CO₂ & Human activities

- Burning fossil fuels releases the carbon dioxide stored millions of years ago. We use fossil fuels to run vehicles (petrol, diesel and kerosene), heat homes, businesses and power factories. Deforestation releases the carbon stored in trees and also results in less carbon dioxide being removed from the atmosphere.



Atmosphere over the last 130 years





What's the impact?

- Glacier melting all over the world (from Patagonia to Himalaya) is one of most visible impact
- Risk: 40% of world's population exposed at water shortages
- 20/21 hottest years occurred within the last 25 years
- Warmer temperature = increasing ocean's temperature above natural variability = stronger storms (in duration and intensity), more destructive → 27 in America in 2005, incl. Katrina
- Heavy rains & floods (i.e. Europe and Asia 2005)
- Sever droughts + desertification



Impacts (2)

- Why are the impacts so different?
Global warming increases the precipitations and RELOCATE some of them
- Arctic and Antarctic are the most vulnerable and affected by climate change
- Arctic is particularly vulnerable (thin ice cap) to temperature increase and is experiencing **ACCELERATED MELTING**
→ **Danger for many species like polar bears**





Impacts (3)

- The world climate redistributes heat from equator to the poles & drives wind and ocean currents like the Gulf Stream
- A change in average temperature is unequally distributed, $+2^{\circ}\text{C} = +4/5^{\circ}\text{C}$ in the Arctic

FAST MELTING → CHANGE IN OCEANS TEMPERATURE & WATER SALINITY = OCEAN CHEMISTRY CHANGES

- Coral reefs bleach & eventually die
- Season changes & unpredictability
- Many species at RISK, some extinct



What impacts for us?

- **Collision** between Earth eco-system & human civilisation
- Change in temperature → new diseases and bacteria
- Rising seas → **millions likely to be displaced**
 - Tuvalu & Maldives to disappear
 - Relocation

We need to change the trend!



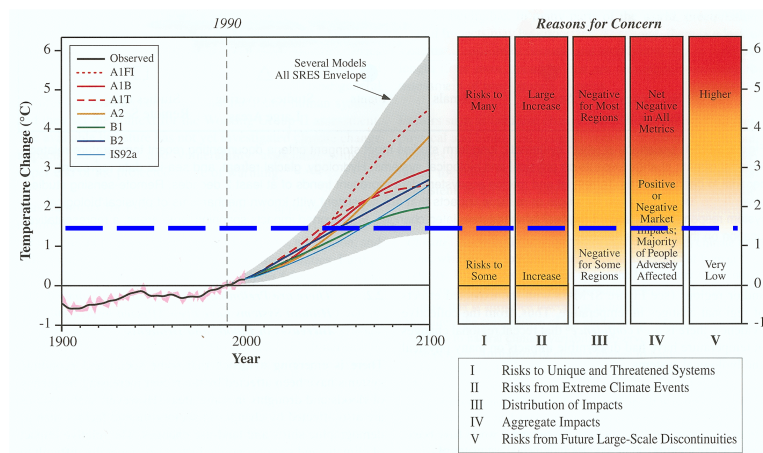


How much warmer can we get?

- Keep global temperature growth **below 2° C** to prevent disastrous climate change
- Some scientists today question this threshold → too low, too little time



t° increase and risks to ecosystems





Why human activities are harmful?

- Increased population (mostly in developing countries) + Urbanisation = rocketing demand of food/water/energy
- Forest destruction + wildfires (30% CO₂ results from burning forests for agriculture & wood fires for cooking)
- New technologies + old habits = altered consequences (unexpected and out of control)
- Humans have become a real force of nature, having heavy impacts on Earth's system
- Denial



Is there a solution?

YES!

but we need to take action now:

- **Change the way we produce & consume energy**
- **Change our transport system**
- **Change the way we produce& consume food**
- **Change the way we THINK&ACT**

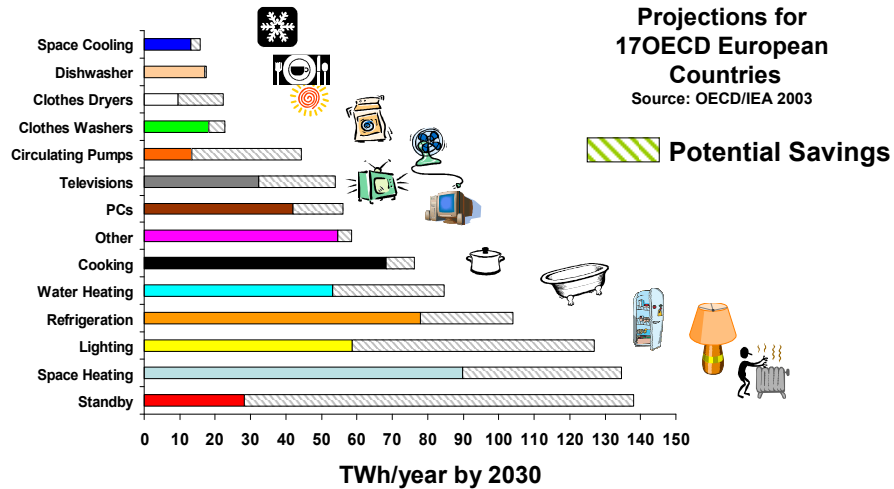




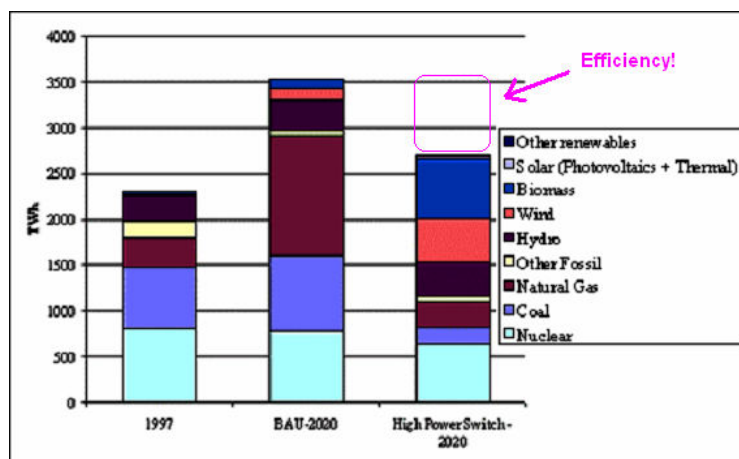
Potential Electricity Savings in OECD Europe by Major End-Uses

Projections for
17OECD European
Countries

Source: OECD/IEA 2003



EU Energy Supply in 2020 PowerSwitch! Scenario





Thank you!

