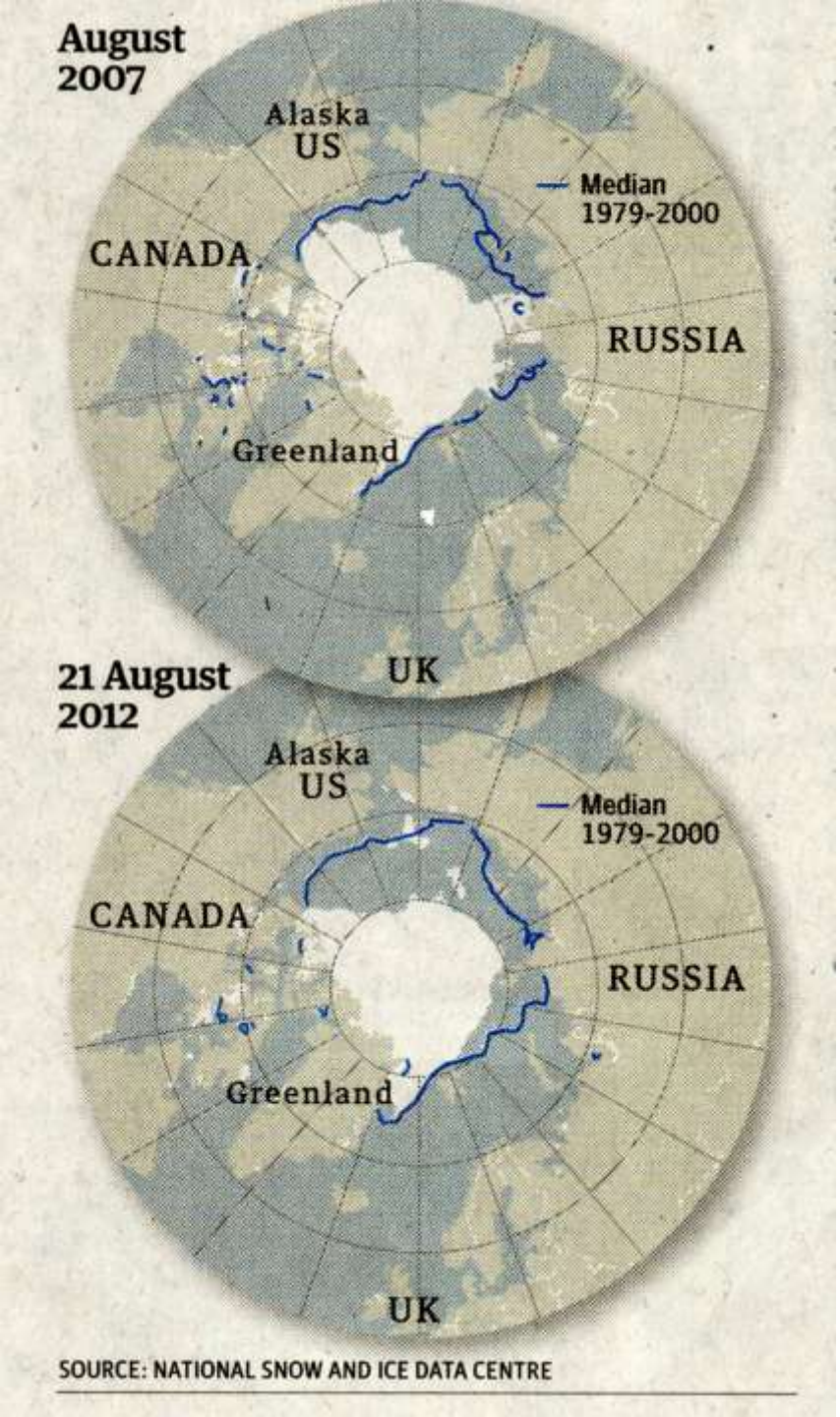
CLIMATE CHANGE & ENERGY

Latest Climate Change Evidence – The Double Whammy!

Arctic sea ice shrunk 18% 700,000 sq kms below 2007 previous minimum.

Source: US National Snow & Ice Data Centre Boulder Colorado, Sept 2012.

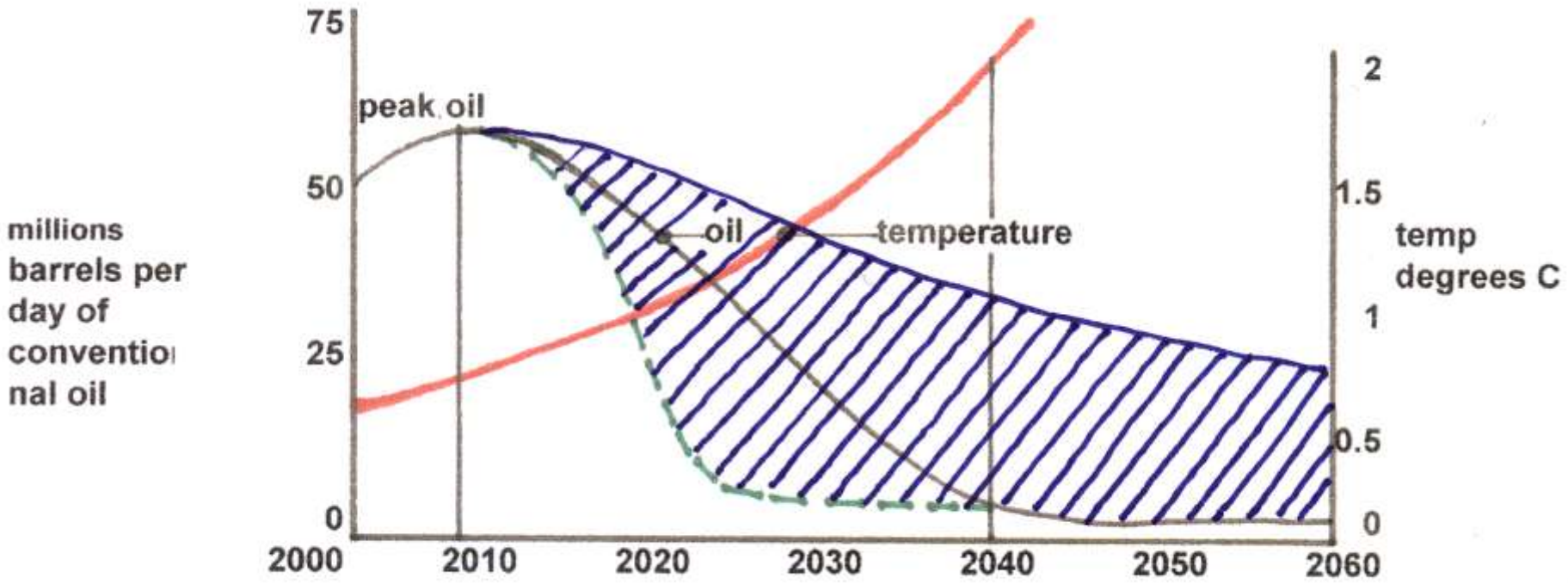


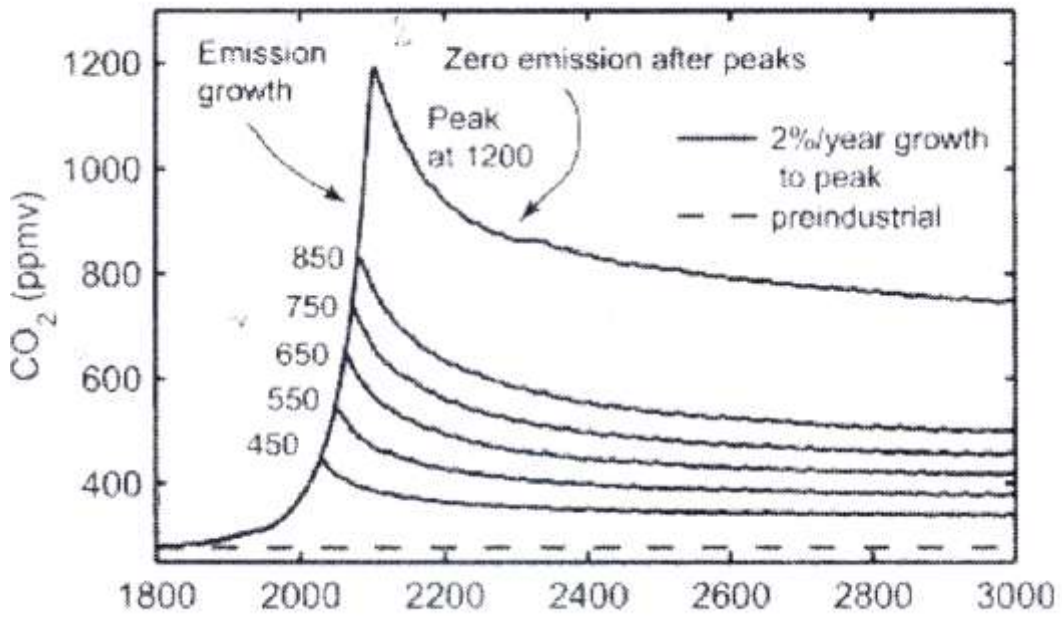
Arctic Sea Ice Melt, 2007 – 2012

World seems unwilling to cut down on fossil fuels.

Tyndall Centre shows scale of challenge.

Fossil fuels left in the ground





US National Academy of Sciences

Atmospheric rate of decline in CO2 concentration expected over millennium and assumes:

- **manmade emissions cease immediately.**
- **non-human emissions increase at 2% per year due mainly to feedback systems, AND**

Warns peak rate temperatures sustained to end of millennium at least.

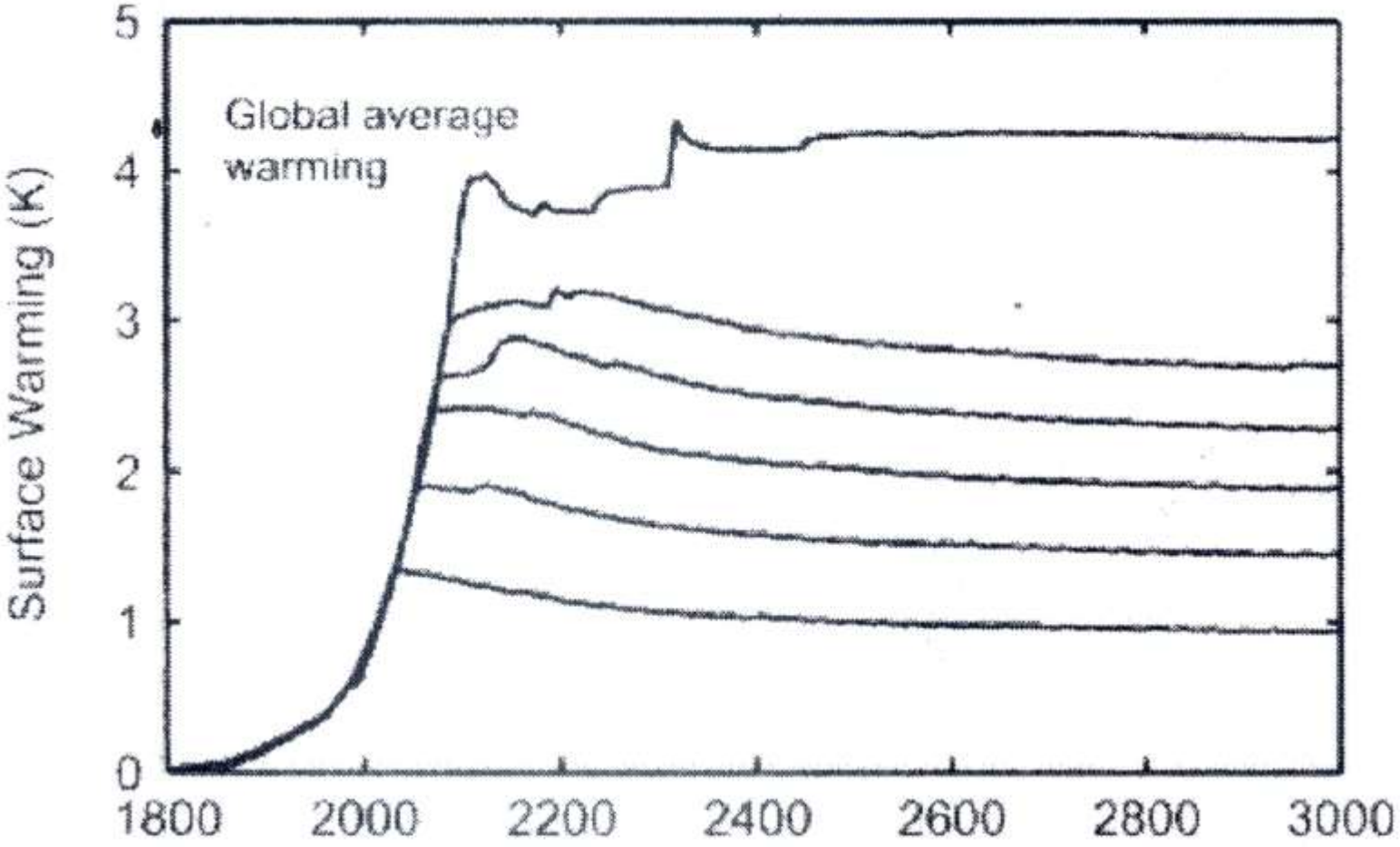
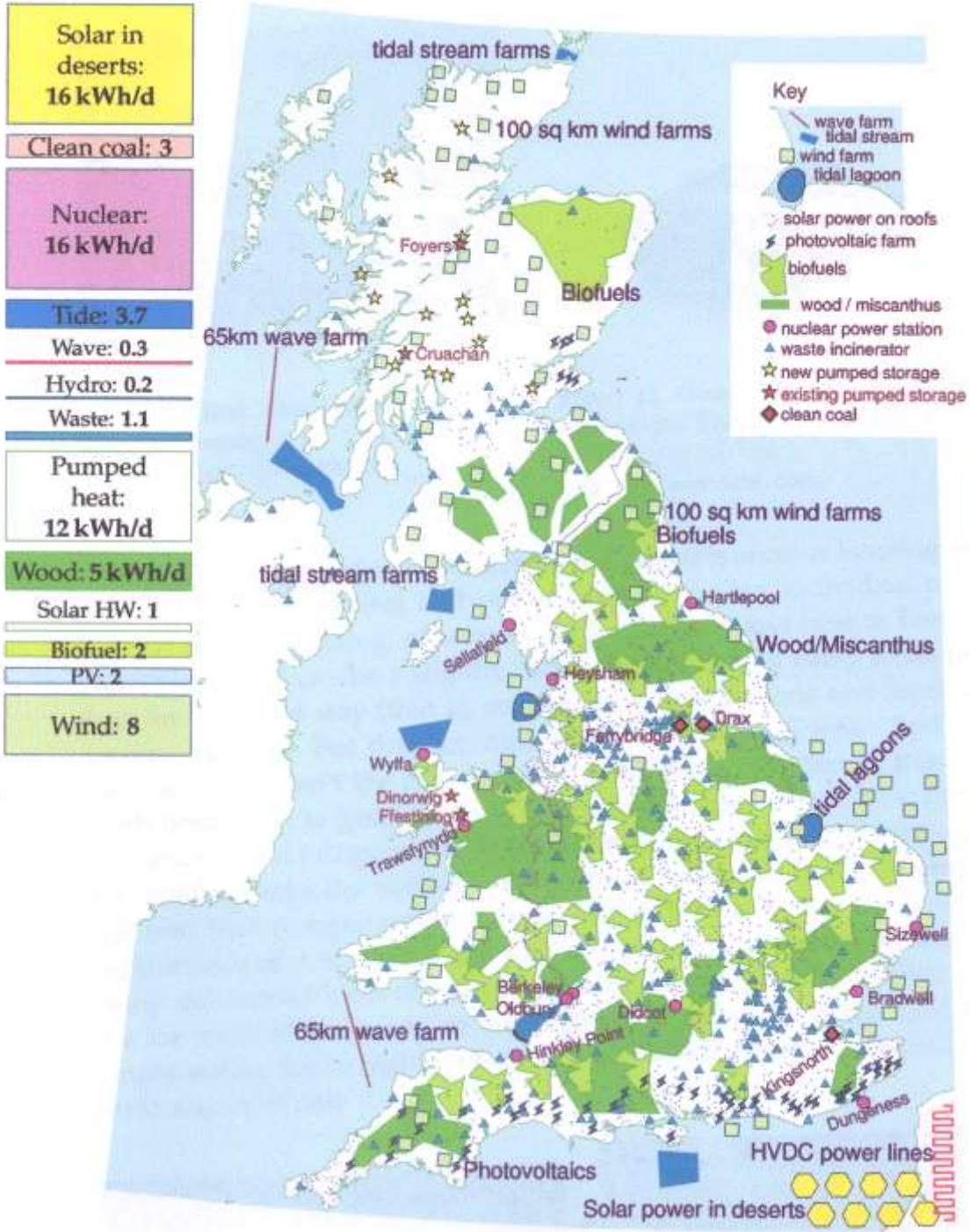


Figure 20.1 Mean climate system changes in emissions and warming to 3000. Courtesy of the US National Academy of Sciences

The Energy Dilemma

- UK one of most favoured countries for access to renewable energy due to:
  - tidal rise and fall,
  - tidal currents
  - offshore wind patterns
- Estimates UK could not accommodate peak saturation of renewable technologies
- Concludes could not support current lifestyles.

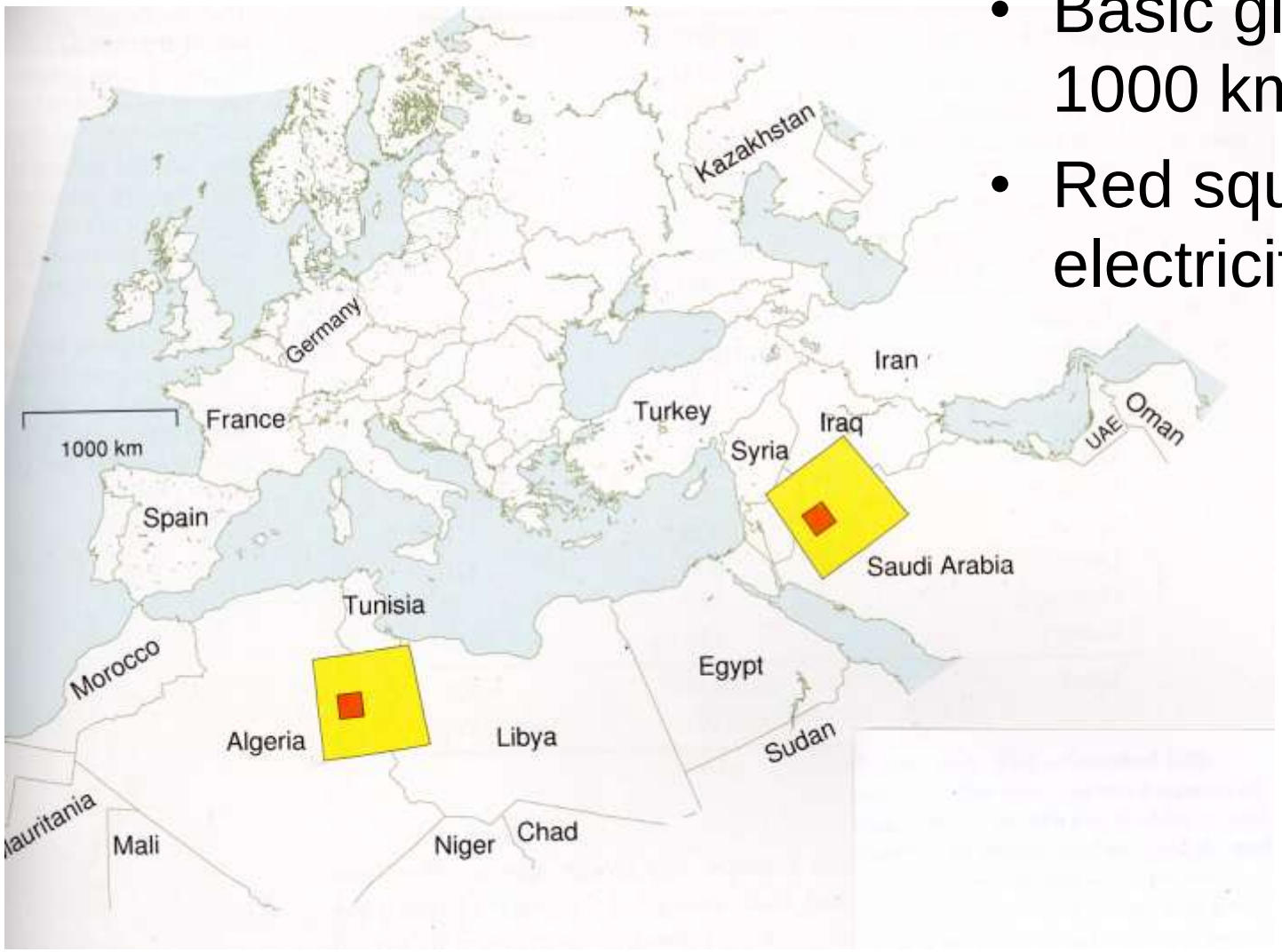
Source: David MacKay, HMG Chief Adviser on Climate Change, (*Sustainable energy – without the hot air)*



The UK's Saturation Renewables

MacKay indicates desert area for solar energy options:

- Basic global needs - 1000 kms2
- Red squares for UK electricity needs



Renewable Energy Systems

- Intermittent
- Often un-predictable.
- Energy storage critical for viability.
- Recent answer is Highview Power Storage
- Latest advance: cryogenic liquefaction of air
- Wrong-time or off-peak electricity used to chill air to -190 C turns to liquid and stores energy.
- Liquid warmed to ambient temperature drives turbine as it vaporises
- Potential to be grid-scale.

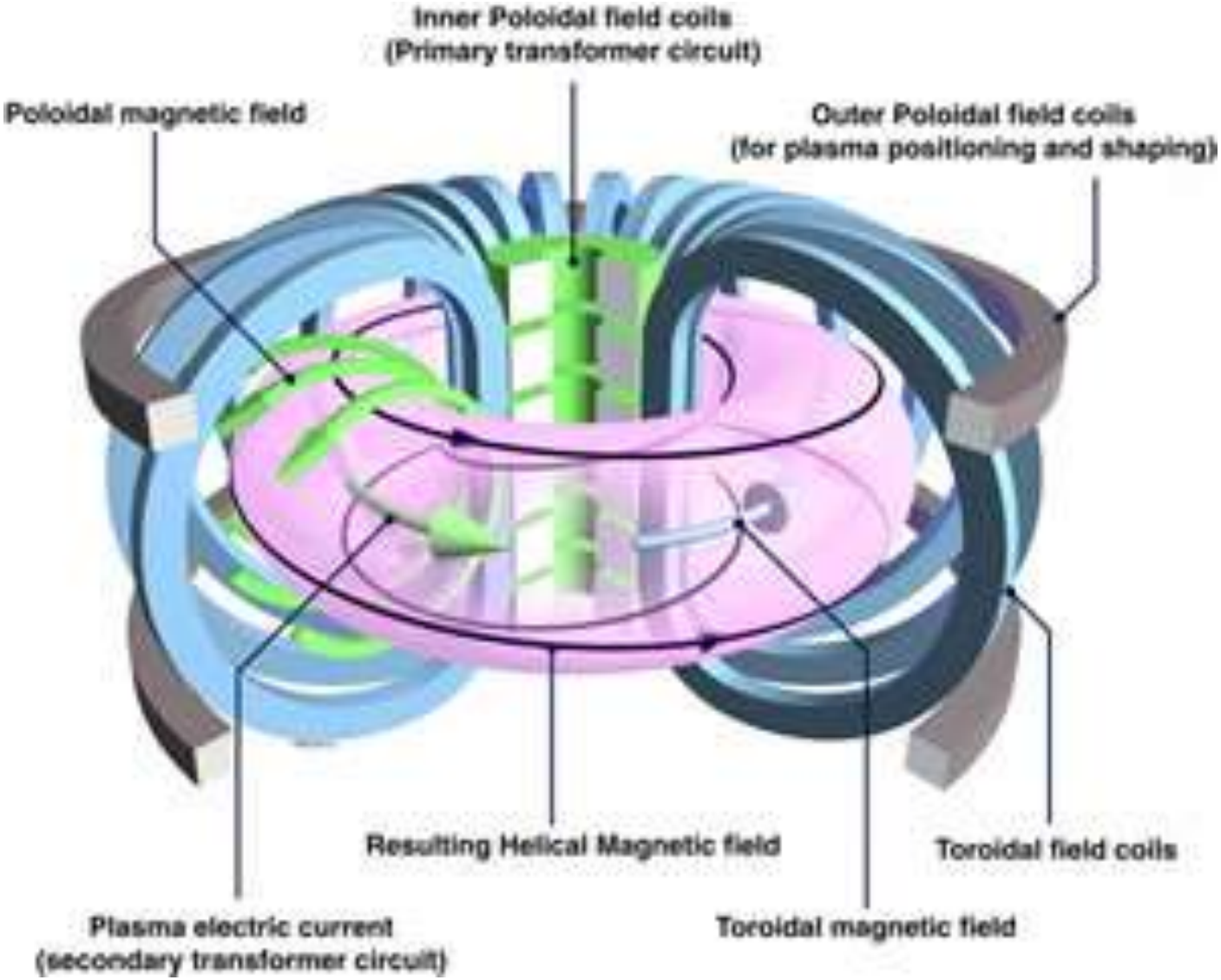
Liquid fluoride thorium reactor (LFTR)
Nuclear fuel for mid-term future

- Similar to uranium reactors
- Much less radio-active
- Fuel almost completely burnt,
- No waste problem.
- Switched on and off rapidly
- Ideal to backup intermittent renewables.
- ‘accelerator-driven’ system, needs external source of uranium for self-sustaining chain reaction.
- Consumes 20MW of electricity to generate 600 MW.

Nuclear Fusion – our future hope?

- Favoured long-term option for energy
- Involves fusion between two heavy nuclei isotopes of hydrogen: deuterium & tritium
- opposite polarities therefore repel.
- Repulsion only overcome within high pressure plasma at ~100,000 C
- Process releases 1.8 megajoules of energy.
- Tokamak - most promising fusion device a toroidal chamber with magnetic coils to confine the hot plasma.

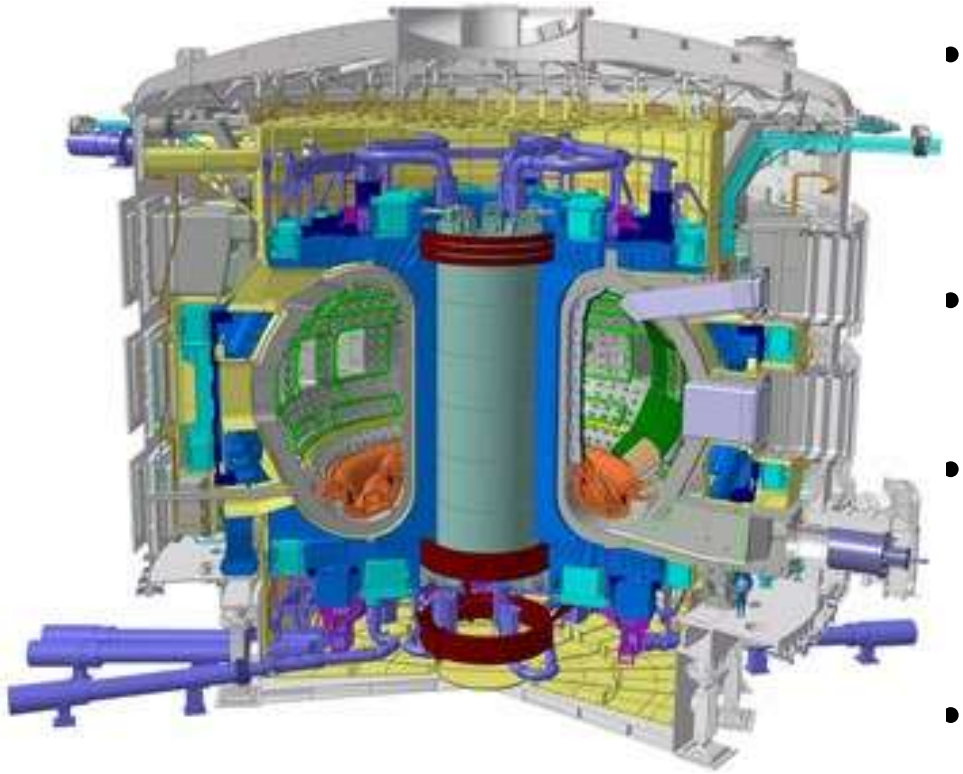
Tokamak schematic



Tokamak's Magnetic Coils: Benefits

- Coils create high temperature and pressure plasma
- Deuterium and tritium fuse to produce helium, high-speed neutrons to release energy.

ITER Tokamak



- Next development stage International Thermo-nuclear Experimental Reactor: ITER
- Joint European Torus (JET), Culham Centre for Fusion Energy near Oxford
- 50:500 megawatts ratio of input to output power.
- World’s largest magnetic confinement plasma physics experiment.
- Completion 2019

ITER platform, Cadarache, France

Conclusions

- **David Mackay: NUCLEAR UNAVOIDABLE PROBABLY - but not based on Uranium**

- **Mark Lynas: Without nuclear, the battle against global warming is as good as lost, The Guardian 15.09.012**