UK Nuclear and Low Carbon Energy

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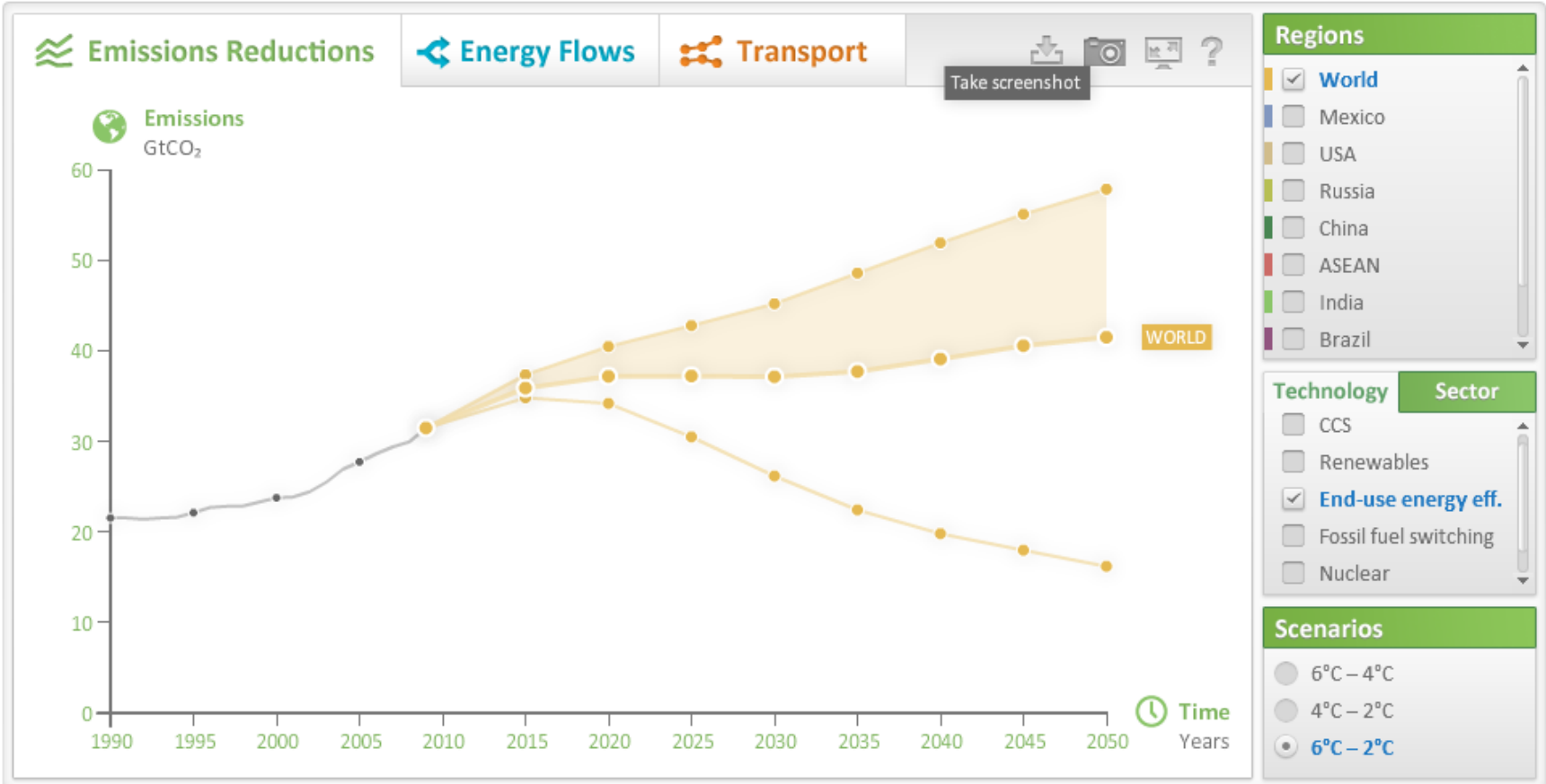
Outline

- The Energy Transition
- UK as an example – 2020
- Energy from biomass
- UK 2050
- The Future of Nuclear
- Conclusions.

Energy Provides Essential Services

- As the world population approaches 10 Billion, what level of energy services is required and what are the associated energy needs?
- Food energy – **1TW** of steady power is needed just to feed people. **Abject poverty**.
- Stable food and water supply, including transport, cooking, purification – **10TW** of steady power is needed. **Survival**.
- Wide range of goods and services – **50-100TW** of steady power is required. **Industrialisation**.
- Where does the world lie on this scale today. Where will it be in 50 year's time. How can we supply this need? How can we do better? Use the UK as an example.

IEA Energy Technology Perspectives

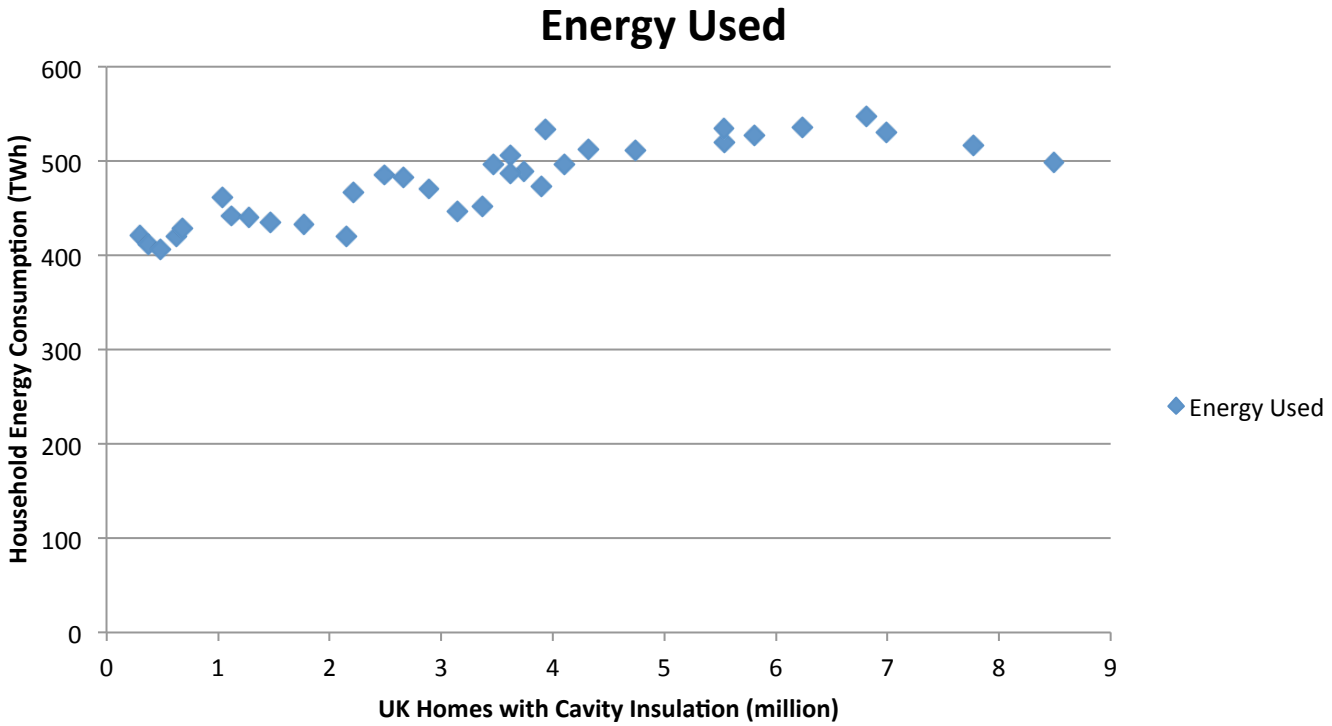


Example of IEA Scenarios, suggests that end use efficiency can prevent global increase in carbon emissions, beyond 2020. Is this true?

Reducing emissions projected to require massive investment in renewables, nuclear, carbon capture and storage etc.

How does this work out in a country like the UK?

Does Energy Efficiency Always Reduce Energy Demand?



As insulation of UK homes has increased, domestic energy consumption has increased. Why?

More houses, more heating, higher temperature homes. Increasing wealth can overcome increasing efficiency.

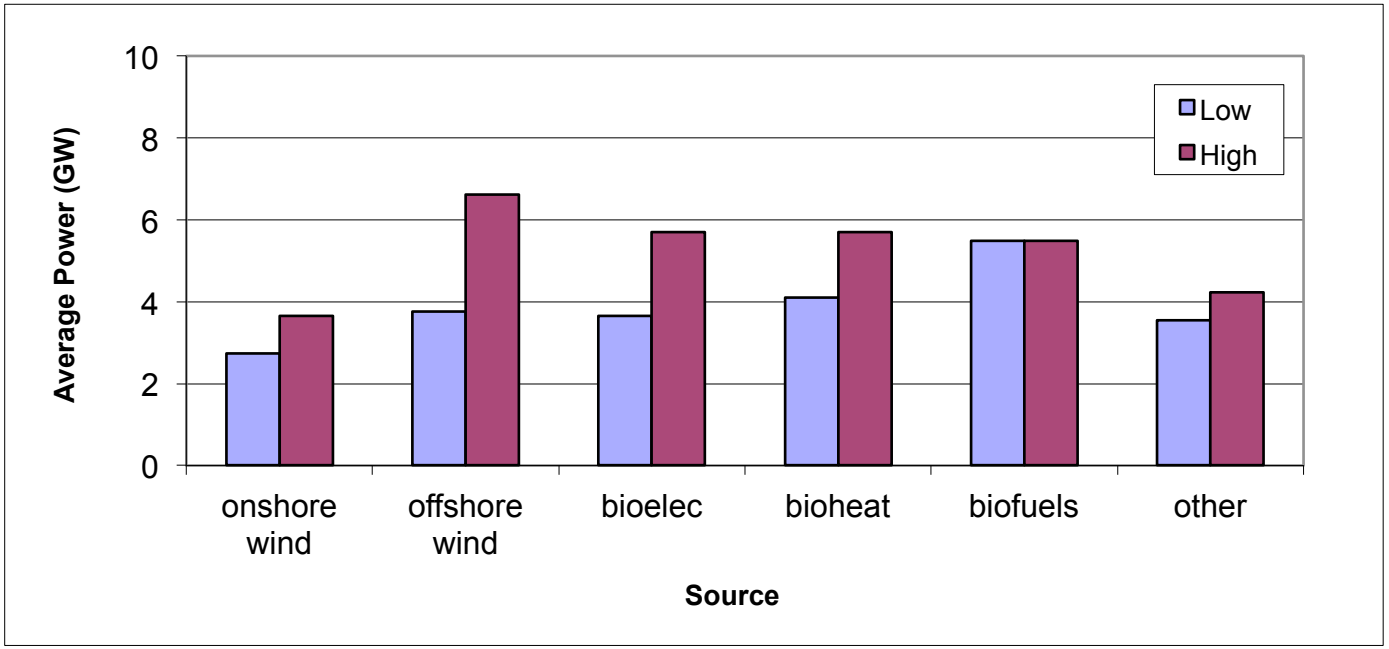
Without the efficiency improvements, energy use would have doubled.

IEA target of preventing increase in energy use in spite of increase in wealth seems a good one. But what policies will be needed?

Technical, Social and Economic issues

- The energy debate incorporates multiple aspects of the same problem, for instance:
  - Nuclear safety: a technical, social or economic problem?
- Post-Fukushima,
  - German reaction: *"nuclear power can be completely phased out within one decade".*
  - UK reaction: "*we see no reason for curtailing the operation of nuclear power plants".*

UK 2020 – 15% Renewables



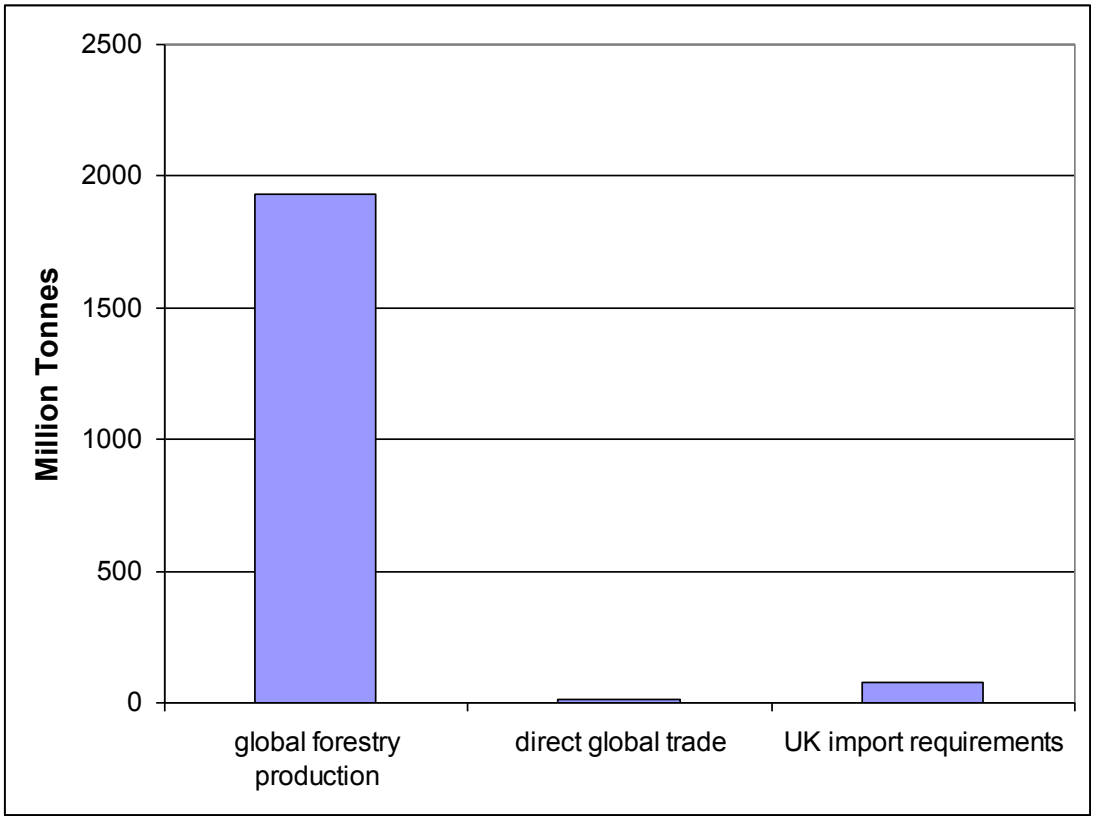
Source: UK Department of Energy and Climate Change

Achieving the UK 2020 target for renewables (15% of final energy) is expected to need large contributions from wind and biomass.

The biomass must be primarily provided by imports.

The main additional options for low carbon sources are nuclear and CCS (carbon capture and storage). Additional targets for energy efficiency and carbon emissions.

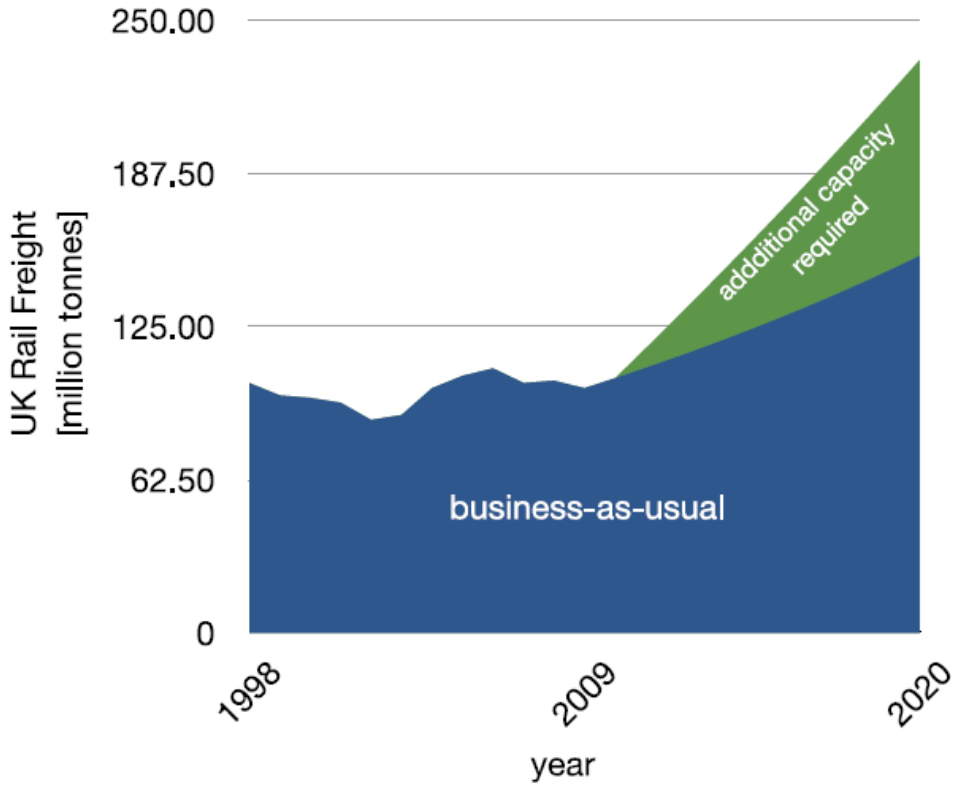
Can Biomass Power the World?



UK requirements (for 10% of energy supply) are around 6 times the present international trade, but potential supply is large. Can this be done in an efficient way without deforestation, taking food and livelihood from poor etc?

Global forestry, if diverted to energy, could be supply around 5% of present global demand.

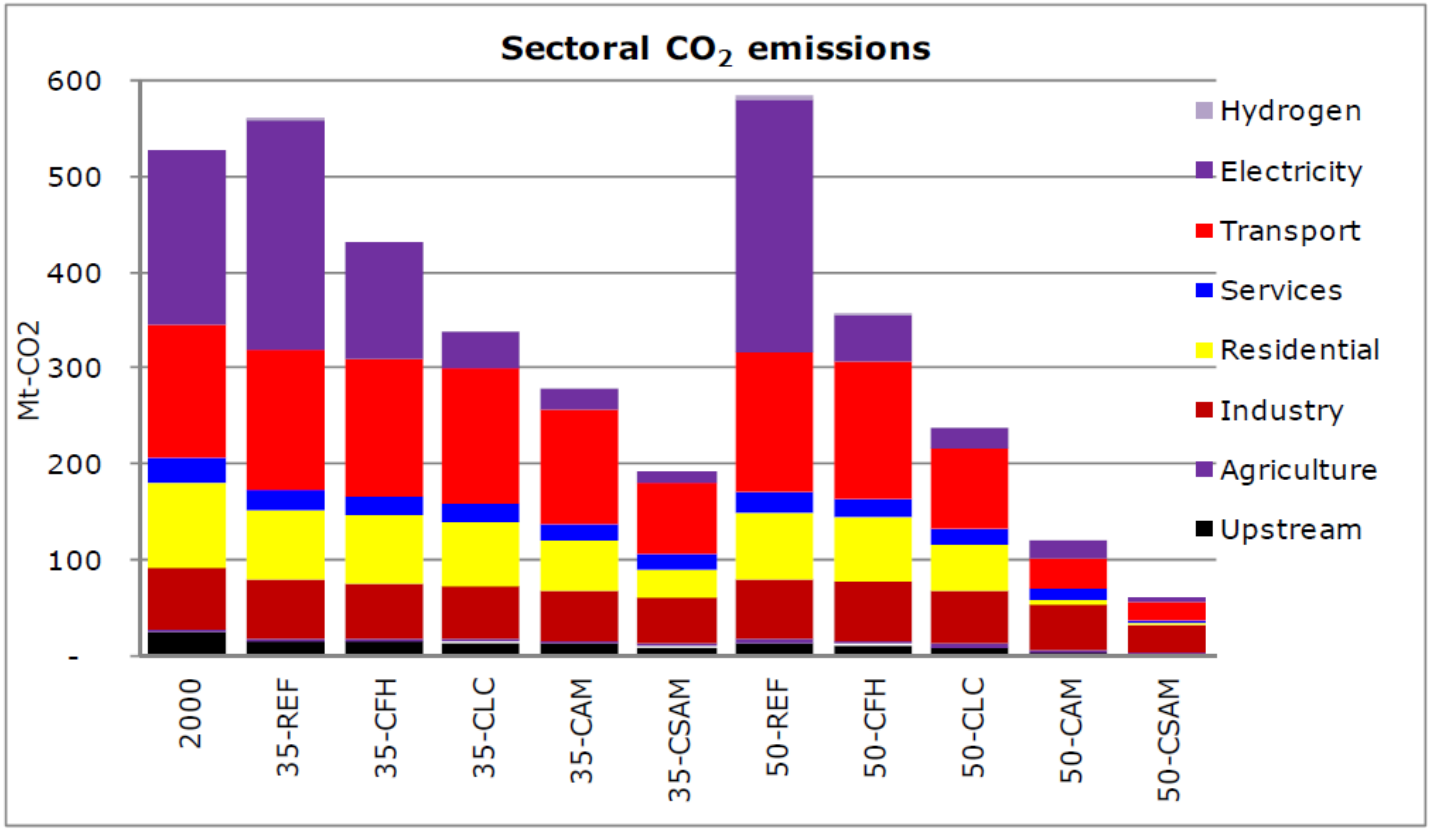
Can we Transport It?



This amount of biomass would represent a large increase in rail freight, if carried by rail. Looks unlikely to happen. Try to use the biomass near ports, to generate biofuels, electricity etc.

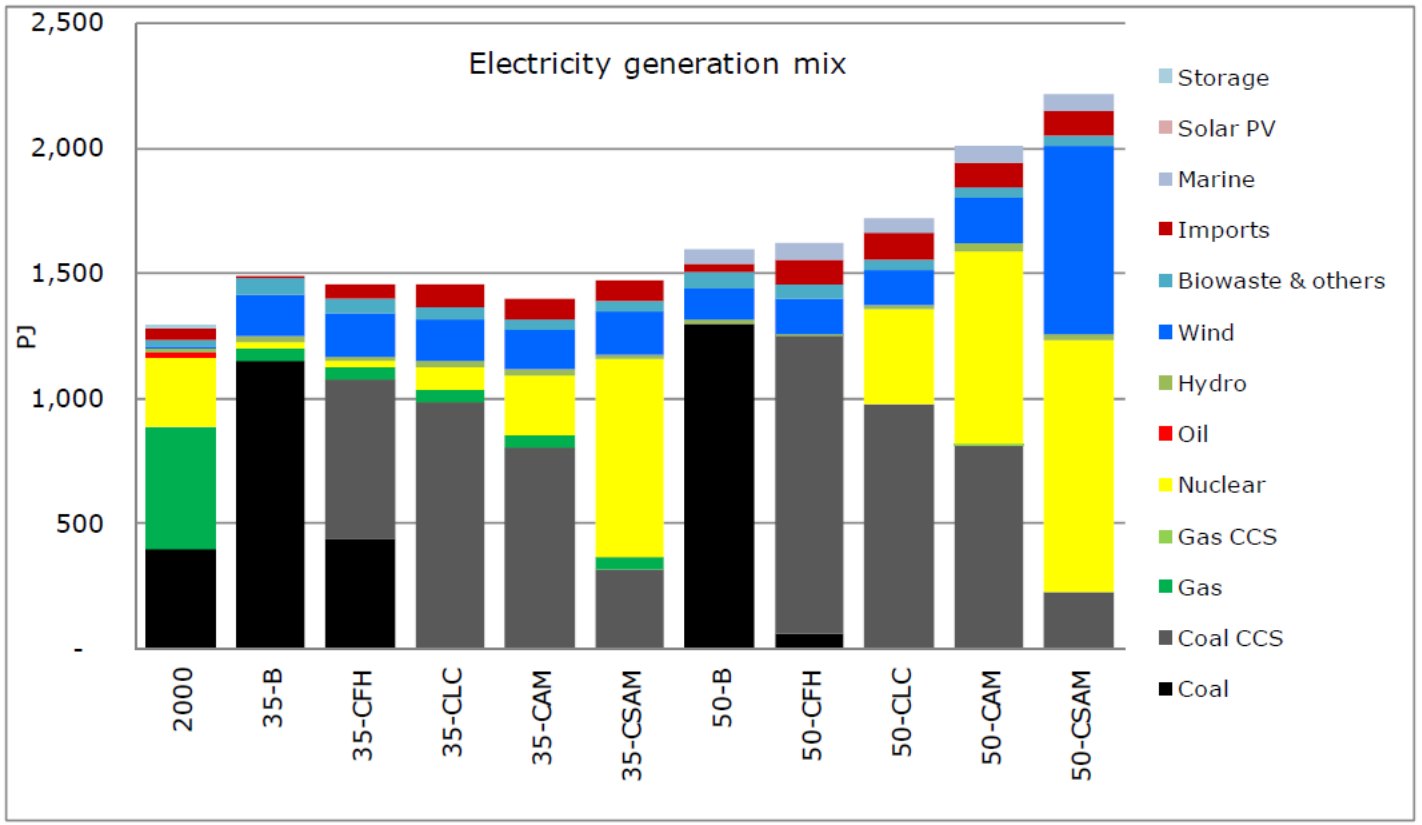
An energy transition (even at the 10% level) can be very disruptive to the wider economy.

UK 2050 - 80% Reduction in CO_2 emissions



This appears to be only possible in the most extreme scenarios, labelled here CAM and CSAM. Where would electricity come from in these scenarios?

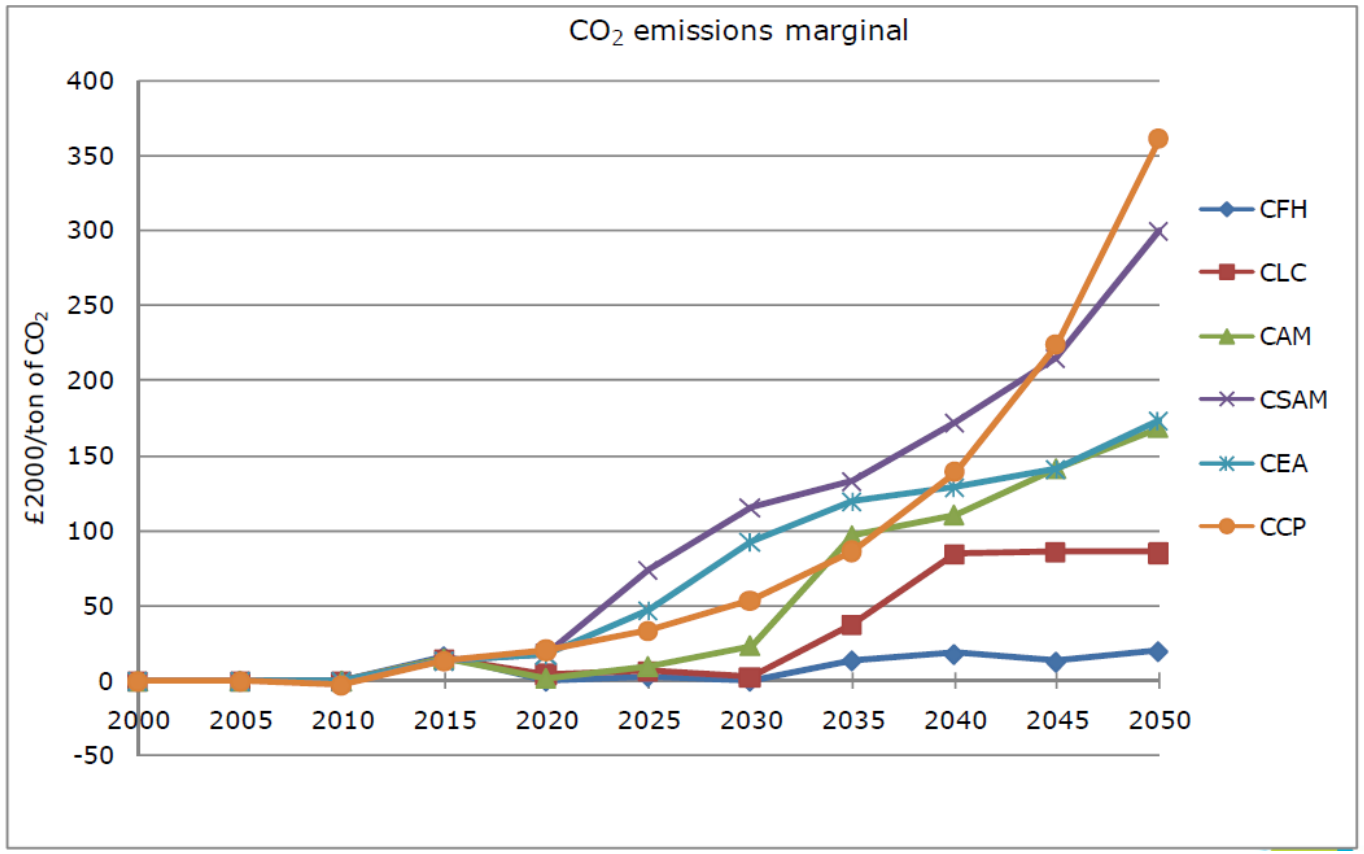
Nuclear, Wind and CCS are the main players in 2050 UK Scenarios



UKERC ENERGY 2050

In the lowest emissions cases, CCS is reduced as it still releases some carbon, nuclear and wind are increased to compensate.

Marginal Cost of Avoiding Emissions



To get to the low carbon emissions, projected marginal costs of CO_2 (in 2050) are in the range £150-300 per tonne.

UK Carbon Price Floor

- To encourage investment in low carbon technologies, the UK has introduced a carbon price floor, which the price of carbon cannot fall below.
- 2013 £16/tonne carbon dioxide
- 2020 £30/tonne
- 2030 £70/tonne
- The UKERC scenario modelling produced this level of marginal cost when halving CO_2 emissions.
- This does not appear to be enough to achieve the 80% reduction target.

The Future of Nuclear

- There are plans to introduce substantial new nuclear capacity in the UK, encouraged by carbon price floor and Electricity Market Reform.
- This is the opposite of present policies elsewhere, particularly Germany and Japan.
- If there is significant nuclear growth globally then we will soon return to considering advanced nuclear plants, including fast breeders and fusion.

BBC News - Hinkley Point nuclear station: Licence granted for site - Windows Internet Explorer

http://www.bbc.co.uk/news/uk-england-somerset-20499033

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26 November 2012 Last updated at 16:14

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Hinkley Point nuclear station: Licence granted for site

The first nuclear site licence for 25 years has been granted to Hinkley Point in Somerset.

EDF wants to build a new nuclear power station at Hinkley Point

The Office for Nuclear Regulation (ONR) awarded the licence to NNB Generation Company (NNB GenCo), which is handling the bid to build new reactors.

It means the company has developed the required plans, procedures and structures to build a new power station.

The government still needs to give the go-ahead before it can be built.

NNB GenCo, a subsidiary of EDF Energy, is also waiting on a permit from the Environment Agency.

Both decisions are expected before the end of the year.

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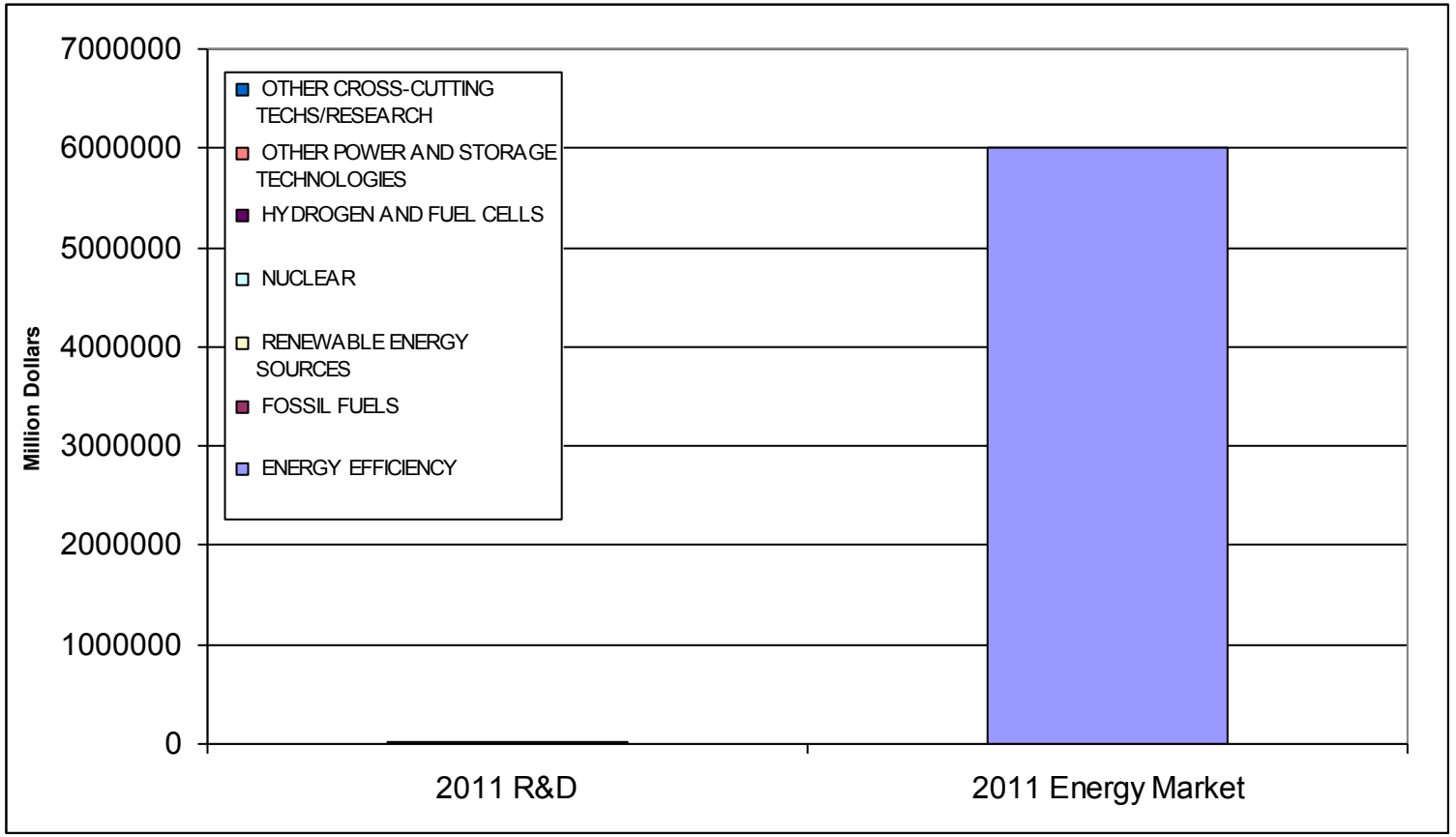
What Should We Do?

- In my opinion:
  - build wind turbines where they are acceptable.
  - Grow and import biomass.
  - Build nuclear power plants
  - Research solar power, fusion, global grids (e.g. transport solar from Africa to Europe) and energy storage. Re-consider fast breeders.
  - Carbon capture and storage may conflict with other targets, particularly the removal of coal from the energy system, but should be pursued.

Are We Doing What is Required?



Very little energy R&D goes on globally (around 0.3% of market expenditure)

Present UK Policies

- Renewable Obligation to boost renewables.
- Carbon price floor to boost wider low carbon systems, especially Nuclear. Electricity Market Reform.
- Generic Design Assessment to improve Nuclear licensing process.
- Carbon budgets, legally binding targets to reduce carbon emissions.
- Are these enough? Probably not.

Conclusions

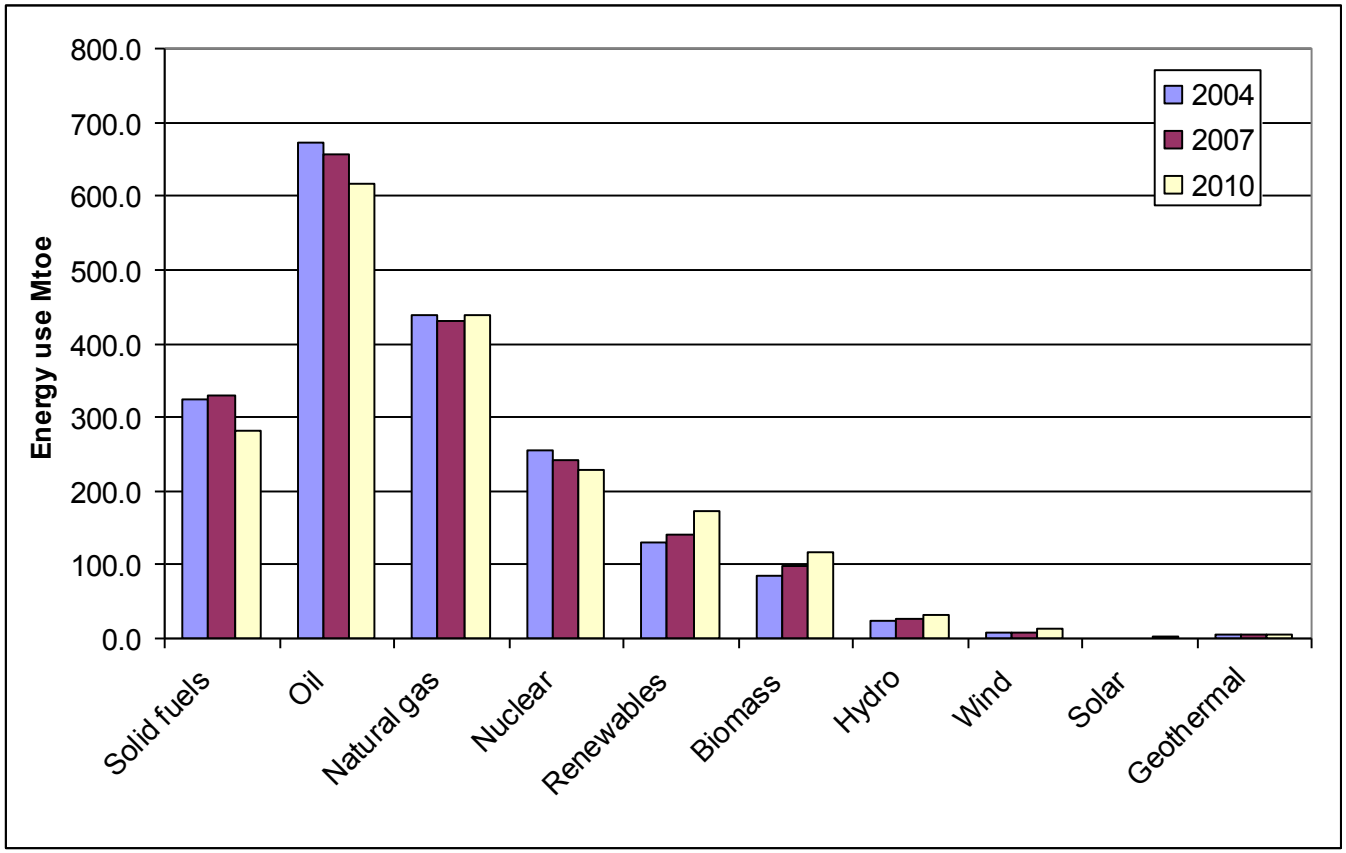
- 10 billion people aspiring to an industrial lifestyle will drive a large increase in the demand for energy.
- We must try to moderate this through energy efficiency measures.
- Fossil fuels are the dominant supply today. If we move out of carbon, and I believe that we need to, we will need to grow other sources by a very large factor.
- Globally, some of the sources highlighted for this are completely inadequate – e.g. tidal and probably geothermal; this does not mean that they should not be pursued as market opportunities, just that they will not, on their own, solve the problem.
- Locally, different regions have different strengths e.g. UK wind, African countries solar etc.

Conclusions

- UK 2020 target of 15% renewable energy is enormously challenging. In my opinion it cannot be reached without large implementation of wind (especially off-shore) and import of biomass in unprecedented quantities. This may be ok for the UK but not if reproduced globally.
- UK 2050 targets are extremely challenging. Very large implementation of nuclear and wind with the possibility of CCS may all be needed.
- Probably the dominant sources of energy will remain fossil fuels for a long time. If we are to replace them, it will be by solar, nuclear (including advanced fission and fusion) and wind.
- This needs action at all points in the supply chain, including research, but not enough is being done.

Spare Slides

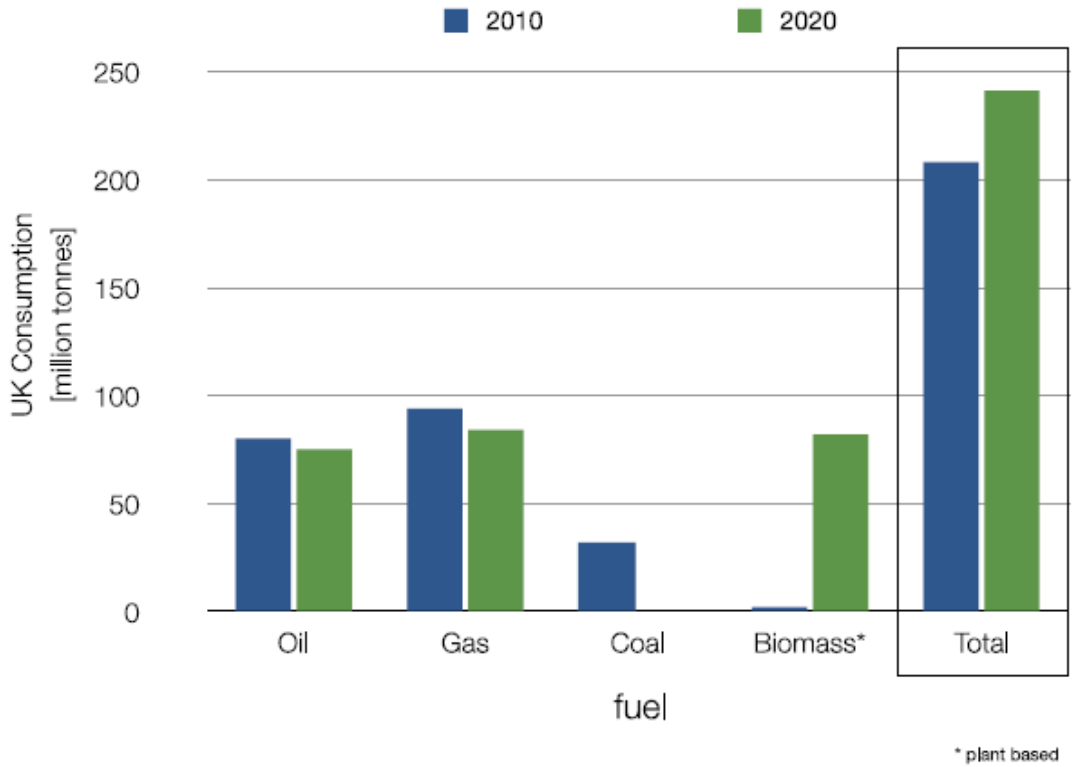
Renewable Contribution - EU



Source EC

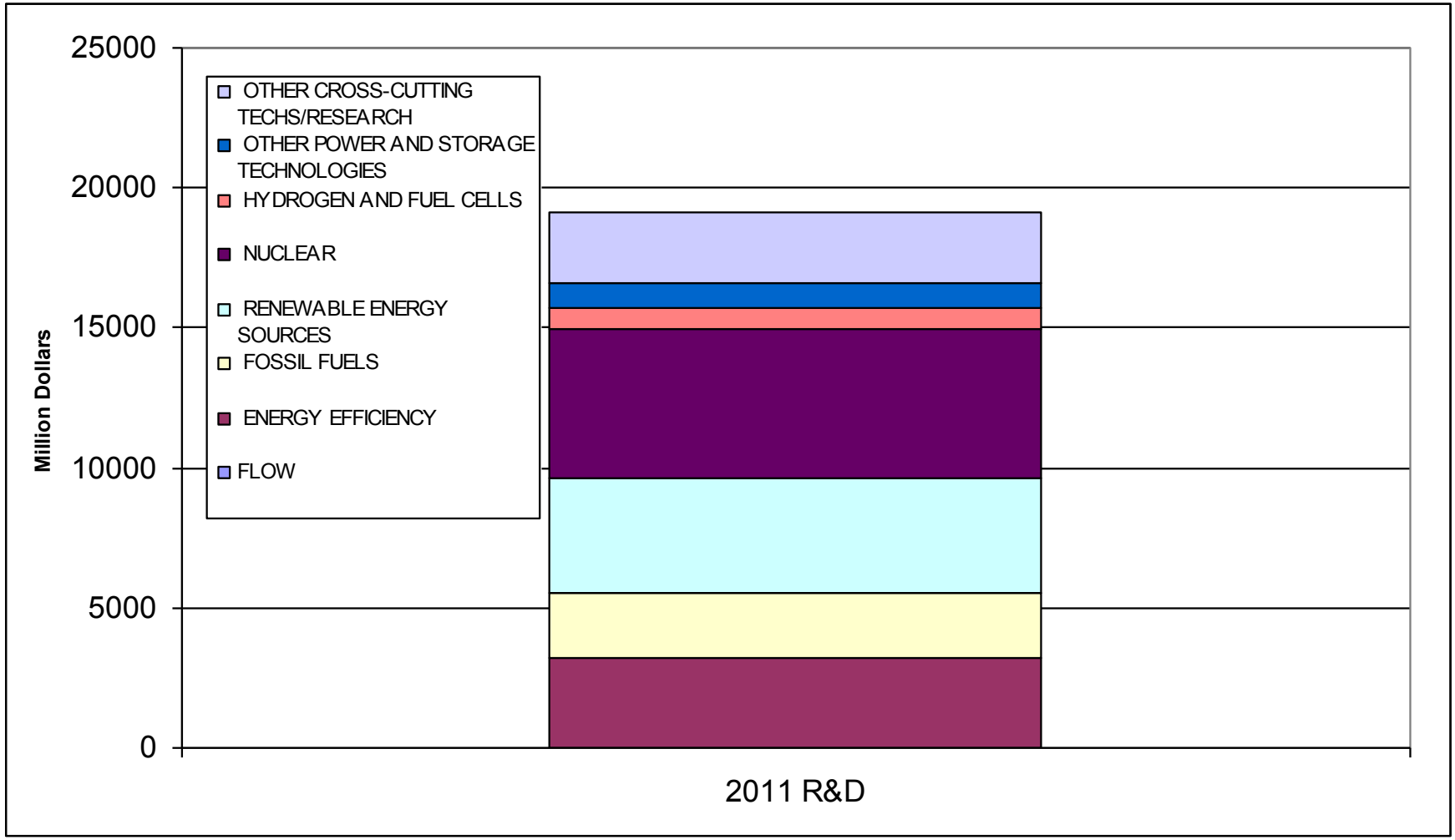
EU renewables almost entirely biomass (for heat) and hydro (for electricity). Wind = 0.7% of energy, solar 0.2%. Changes with time of course.

What Might UK Fuel Use Look Like in 2020?



Coal replaced by biomass and wind electricity? Oil reduced by biofuels. Gas reduced by wind electricity and biomass heat. Total fuel imports increase significantly in terms of mass, much bigger increase in terms of volume. CCS?

Re-scale by a factor of 300



R&D around 0.3% of energy spend – surely 3%? NO.