Mitigation of Climate Change

The Intergovernmental Panel on Climate Change (IPCC) recently concluded that warming of the climate system was unequivocal and that most of the observed increase in global average temperatures since the mid-20th century "is very likely" due to human activity (IPCC AR4, 2007). "Very likely" in IPCC terminology means greater than 90 percent likelihood. Furthermore, many observed physical and biological impacts are consistent with this warming.

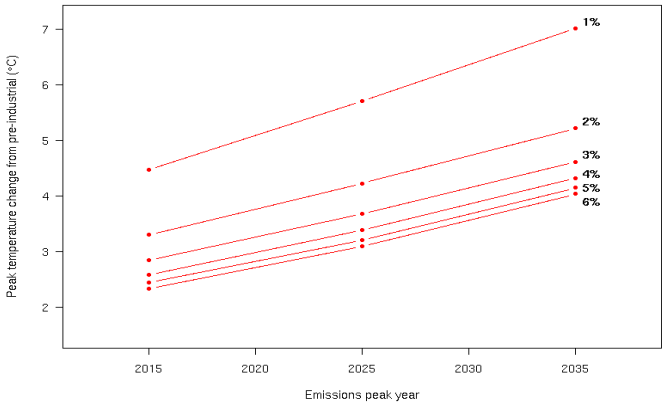
While uncertainties and research challenges remain, it is clear that urgent action is needed to achieve the challenging climate mitigation goals required to avoid the worst risks of climate change.

The meeting hosted by the Society and organised by the Grantham Institute at Imperial College on 10 December 2008 aimed to help forge greater understanding and dialogue between climate scientists and technology specialists.

Brian Hoskins, Grantham Institute and the University of Reading, chairing the meeting, set the scene by linking the IPCC's projections to the recently published report by the UK Climate Change Committee's that recommended a 50 percent reduction in global emissions by 2050, with at least 80 percent reductions in United Kingdom greenhouse gas emissions (GHG) by 2050.

Globally, GHG emissions need to peak soon and fall rapidly (by around 3-4 percent per annum) if we were to avoid a significant risk of global mean temperatures increasing by 3 or 4°C by 2100. *Jason Lowe* from the Hadley Centre of the Met Office (MOHC) explained how peak global mean temperature would vary with different dates for emissions peak year and subsequent rates of GHG emission reductions. Each ten-year delay in the peak year for emissions resulted in an increase of 0.5°C or more in the peak global mean temperature.

Figure 1: How peak emissions year affects peak global mean temperature based on a simple climate model and global average carbon cycle model (HadSCCCM1). Figure 1 is based on the 90th percentile of model frequency distributions.



Dr Lowe used GCM simulations to show that the system exhibited only a slow recovery to higher global mean temperatures even with no further forcing. A key research question was how resilient the climate system would be to prolonged periods at an elevated temperature. A further issue was how to deal with possible overshooting of mitigation targets given that changes in the global carbon cycle would continue well after the point at which emissions were stabilised.

The huge scale of the mitigation challenge against a background of continuing population growth and urbanisation was underlined by *Nigel Brandon*, Director of the Energy Futures Lab at Imperial. The need for continuing economic development in much of the world meant that solutions to the climate issue had huge implications for global equity. Significantly energy consumption per capita in China and India, still falls well below that in G8 economies and the use of cars is likely to explode over the next 20 years.

Globally, a critical issue will be whether the US$22 trillion of investment in energy infrastructure by 2030 estimated by the IEA to be required to meet growing energy demand is directed into low-carbon technologies or not. UK emission trends to

2007 were hardly encouraging evidence that a transition to a low-carbon economy was just around the corner. Nevertheless, there are many options available now that could help us begin to reverse emissions trends (e.g. demand reduction, decarbonising generation). But to reach the 80 percent reduction in emissions called for by the UK Climate Change Committee, more radical options such as the large-scale use of low-carbon electricity will be necessary in parallel with vastly enhanced Research, Development and Deployment programmes and efforts to overcome the critical shortage of skills in many key areas.

One critical renewable technology is solar energy. *Ned Ekins-Daukes*, Imperial College, noted that, even in the UK, with an average flux of solar energy of only 100 W per square metre, there is huge potential for proven solar hot water technologies. However, UK installed capacity at end-2006 was only 0.175 GWth compared to 5.6 in Germany and a far larger 65 GWth in China.

Costs of photovoltaics had been reduced dramatically and third generation photovoltaics had the potential to expand considerably the potential deployability of photovoltaics. With grid parity being achieved from 2010 onwards, industry estimates suggested that,12 percent of EU electricity could come from PV by 2020, with investment up to US$250 billion p.a.. The IEA expected around 11 percent of global electricity to come from PV by 2050. The use of solar concentrator technology could allow PV generation at utility-scale in desert regions.

Even if we are close to peak oil, there remain more than enough hydrocarbon reserves (conventional and unconventional) to drive concentrations of GHGs to extremely high levels. *Martin Blunt*, Imperial College, therefore argued that carbon capture and storage (CCS) is a key technology in our efforts to avoid dangerous climate change but, to make a real difference, CCS would need to deal with volumes of fluid similar to or larger than those currently handled by the oil industry.

Professor Blunt explained the different ways in which CO_2 injected deep underground under high pressure might be stored securely. One promising method was capillary trapping pumping in brine to follow the injected CO_2. Studies at Imperial had shown that this technique could trap more than 90 percent of the CO_2 injected.

The meeting also addressed natural carbon sequestration. Currently, the forestry industry is the third largest contributor to global GHG emissions. But, as *Jemma Gornall*, MOHC, noted, there was significant mitigation potential from afforestation and avoided deforestation. One hectare of tropical forest was estimated to take up around three tonnes of CO_2 per year. In snowy temperate regions, however, any increased sequestration from afforestation could be partly offset by the warming effect of decreased surface albedo. Forests also influence the regional climate through recycling of rain water and cooling via evapotranspiration.

Worryingly, climate change also threatens the survival of Amazonian rainforest as warming and drying may lead to die-back and increased vulnerability to fire. Deforestation is the more immediate threat to forests but may exacerbate any negative influence of climate change. Management strategies that maintain forest resilience by preventing deforestation would therefore be an essential aspect of global mitigation efforts. Complete tropical deforestation could make stabilisation at 550 ppm CO_2-eq much more difficult even if GHG emissions were reduced to zero.

A lively discussion session ensued involving all speakers. Of particular relevance here was the discussion on how best to communicate climate change, with all its uncertainties, in the face of

continuing scepticism and conspiracy theories. Several points emerged. First, individual scientists could play an important within their own local communities, often on a one to one basis. People tended to listen more to people they respected. Second, it was helpful to be able to communicate solutions at the same time as explaining the problems, as this meeting had tried to do. Third, in communicating the results of climate models, it was important to emphasise the broad conclusions and implications (e.g. that tropical forests would be under greater stress) rather than placing undue emphasis on particular model projections.

Finally, some argued that the reluctance of climate scientists to expose disagreements or uncertainties in public as a response to climate sceptics itself posed a problem for communicating the issues effectively. The risk with this approach was that the media always wanted to present – and give equal weight to - two opposing views in its coverage of any story. So if mainstream climate scientists refrained from public debate, this left the field open to less well informed views. The net result was more uncertainty and confusion in public opinion. Now that the fact of anthropogenic climate change was widely accepted outside of the narrow scientific community, perhaps it was time that climate scientists entered into genuine public debate and discussion with each other on areas of genuine controversy and uncertainty? In that way, the media would easily find opposing views to present in its stories – but both sides would start from the position that climate change was real.

Some of the presentations given by the speakers are available on the websites of the Society (www.rmets.org – click on 'Events') and the Grantham Institute (http://www3.imperial.ac.uk/climatechange)

Dr Simon Buckle
Director of Climate Policy
Grantham Institute for Climate Change
Imperial College, London