THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

DINNER/DISCUSSION SUMMARY

Stern Review on the economics of climate change

Held at The Royal Society on 8th November, 2006
We are grateful to AREVA, The British Council, Defra, Lloyd's and The Royal Society for supporting this meeting.

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speaker: **Sir Nicholas Stern FBA**
Chair, The Stern Review on the economics of climate change

Respondents: **James Smith**
Chairman, Shell UK

Andy Harrison
Chief Executive, easyJet

Professor Sir Partha Dasgupta FBA FRS
Frank Ramsey Professor of Economics, University of Cambridge

SIR NICHOLAS STERN explained that his was an independent Review, commissioned by the Chancellor of the Exchequer and submitted to both the Chancellor and the Prime Minister, as a contribution to assessing the evidence and building understanding of the economics of climate change. His work had been driven by the science, and he expressed his gratitude for the strong support he had received from the Royal Society and the scientific community. His Review was at heart an economic analysis that drew on many branches of that profession to assess the risks of climate change and their probabilities, on whom the impacts would be likely to fall and what options might exist for mitigation and at what cost. He had assessed costs and benefits of action to reduce the emissions of greenhouse gases (GHGs) in three ways:

- using disaggregated techniques to examine the physical impacts of climate change on the economy, on human life and on the environment and the resource costs of different technologies and strategies to reduce GHGs;

- using economic models, including integrated assessment models that estimate the economic impacts of climate change, and macro-economic models of the transition to low-carbon energy systems for the economy as a whole;

- comparing the current and future trajectories of 'the social cost of carbon' of additional units of GHG emissions with the marginal abatement cost of incremental reductions.

Sir Nicholas drew attention to the unusual characteristics of climate change as an economic externality: its truly global impact, its nature as a long term stock accumulation process, the way it was hedged around by both risks and uncertainties, and the very large and thus potentially discontinuous and irreversible effects it might have. The underlying model for his analysis connected the forecast changes in global population, technology, production and consumption to the emissions of GHGs, and thus to atmospheric concentrations and, given radiation forcing, led to probability distributions for ranges of temperature rise from which both direct impacts (such as on crops, forests, water stress and ecosystems) and indirect effects (on socio-economic activity and markets, disease and migration) could be examined. He had made explicit assumptions about the extent to which the future should be discounted and had taken a very low pure rate of social time preference.

Continuing, Sir Nicholas outlined his results and emphasised that the individual numbers were important to give orders of magnitude for the costs and benefits but should not be over-interpreted. His Review gave a more pessimistic assessment than earlier models of the costs of continuing with 'business as usual', flowing from a radical change in the physical geography of the world threatening the basic elements of life with the poorest countries and people suffering earliest and most. The explanation was driven by updated scientific evidence on the probabilities attached to degrees of temperature rise, of the order of 5 to 6 ^{o}C rather than 2 to 3 ^{o}C that most studies had considered previously. He warned that with such higher temperature ranges the effects were not linear. If non-market impacts, and possible amplifying feedbacks of methane release and weakening of carbon sinks, were all taken into account, and the results re-weighted to take account of the disproportionate impact on poor regions, then the total cost of "business as usual" could be equivalent of around a 20% reduction in consumption per head, now and into the future.

Policy to reduce emissions would have to be based on establishing a carbon price, through tax, trading or regulation, through technology policy to support the development of a range of low-carbon and high efficiency technologies on an urgent timescale; and improving collective and individual understanding to remove barriers to behavioural change in taking up opportunities for energy efficiency.

Concluding, Sir Nicholas said that tackling climate change might cost say 1% of GDP to stabilise at 550ppm CO2e but "business as usual" could lead to economic and social disruption comparable to that of the World Wars or the Great Depression. Early action was a pro-growth policy, and the longer action was left the greater the cost of effective mitigation would be and the greater the difficulty of helping people adapt to that level of climate change that was already now irreversible. From all these perspectives, the conclusion of his Review was that the costs of strong early action were modest compared with the costs of inaction.

JAMES SMITH welcomed the Stern Report and noted that the complex economic analysis led to a stark conclusion of the need for early action. The energy industry was facing a huge challenge in historic terms in meeting the needs of global economic and demographic growth whilst protecting the environment. He was optimistic about the ability to double the efficiency of energy usage and to be able to generate a unit of energy for half or less of the amount of carbon currently used. Based on the pioneering work of his company, Shell, he looked forward to improved carbon capture, second generation bio fuels, hydrogen cycle transportation and alternative energy sources such as wind power. To rise to the challenge would need four things to go right: advanced technology, of which much was already available; substantial resources of the order of 1% of GDP – but that was not an impossible goal; sufficient skilled people, noting that industry was short of skilled people it had to be made more attractive for graduates; and finally strong leadership from the corporate sector and governments, essential if behaviours were to change. It was important that the impetus generated by the Stern Report be maintained and it was important that business be involved in designing effective carbon markets and in agreeing internationally an acceptable carbon pathway. There would be no 'resits' from the climate change 'finals': humanity had to pass first time.

ANDY HARRISON welcomed the report from the perspective of the aviation industry. It was a call to action. The growth of international trade and the beneficial cultural impact of overseas travel and under-

standing were linked to the growth of aviation. He drew attention to the analysis of aviation in the Stern Report that showed its emissions currently account for 1.6% of global GHGs. Taking account of other gases emitted by aircraft and contrail effects at high altitude the full figure was higher, but would still only account for 5% of the total warming effect in 2050. The aviation industry nevertheless recognised the importance of the challenge of reducing these figures, and of reaching international agreement to concerted action. Lighter materials and improved aircraft and engine designs were being employed in the next generation of passenger aircraft, with the ACARE target of new aircraft produced in 2020 being 50% more fuel efficient, but that was some time off. In the short to medium term therefore energy efficiency of operations would have to take the strain. The economic incentives on airlines to use fuel more efficiently were already strong. His company, easyJet, was already achieving fuel costs per passenger carried significantly (27%) below other airlines due to more efficient operating practices, showing that low-cost airlines are part of the solution not the problem. Carbon trading should be extended to aviation, for example by bringing it within the EU Emissions Trading Scheme identifying air carriers/aircraft operators as trading entities. But nations imposing fuel taxes would not provide an equivalent incentive structure, and would lead to harmful market distortions. Airlines could also use their considerable marketing and powerful brands to raise consumer awareness of the issue, for example by persuading individual passengers to commit to adopting carbon offsetting.

PROFESSOR DASGUPTA described the Review as a long and impressive document that puts together much that is now known about the effect of carbon emissions on human well-being and also provides a reminder of those matters that are very unknown. When economists analysed public policy they described the ways in which the world might work, and could thus evaluate the consequences of alternative policies. They also valued those consequences so as to be able to judge the desirability of the alternative policies. Disagreements could thus arise over facts or over the treatment of values. In the case of the Stern Report, the ethical framework used is that followed by most modern economists, following the pioneering work of Frank Ramsey (The Economic Journal, Vol. 38, No. 152, 543-559. Dec. 1928), in which it is necessary to give value to two important parameters. The first is the time/risk discount rate that expresses the trade-offs between the well-being of future generations and our own. The Stern Report had chosen a low value for this parameter, implying that we should not discount future generations' well-being just because they are in the future. The second is the elasticity of the marginal value of the social weight that ought to be placed on individual well-being, that expresses the trade-offs between the well-beings of people regardless of the date when they appear on the scene. The Review appeared to adopt a more inegalitarian view of equity over the distribution of well-being among people, *qua* people. An alternative approach, taken by Nordhaus in his Dynamic Integrated Model of Climate and the Economy (Science, Nov 1992) was to take a value for this parameter that implies that it would be more equitable (and efficient) to invest in physical and human capital now, so as to build up the productive base of economies, and divert funds to meet the problems of climate change in later years. It would hardly be reasonable to assert that current generations should impoverish themselves for the sake of (richer) future generations. Professor Dasgupta suggested therefore that more attention should be given to exploring the sensitivity of the Stern model to the choice of values for the ethical parameters in case it was those rather than any new science that drove the strong conclusion that it would be worth sacrificing 1% of growth now to avert potential damages of up to 20% of GDP under "business as usual".

In discussion there was widespread welcome for the contribution the Review made to understanding of the economics of climate change. The following additional points were made:

a. taxation of aviation fuels should not be dismissed out of hand as an option, and society should insist that the large profits of the energy sector were committed to fighting climate change;

b. nuclear power would have a significant contribution to make to a cleaner energy mix. The French example showed how long term investment in nuclear energy could lead to falls in emissions. The British Government's energy review pointed towards the need for a new mix for the UK;

c. the Stern Report would be a strong lever for policy change and it would therefore be important for all its conclusions to be carefully examined, understood and explained. Agriculture, for example, might turn out to provide a net benefit to reducing GHGs not a liability;

d. the need for international cooperation based on a shared analysis was clear. More science was needed, particularly on the impact on agriculture, the micro-environment and species diversity. Trying to create new institutions, such as an International Research Council on Climate Change which was suggested, would risk adding delay and a layer of bureaucracy. But current institutions might well be inadequate to the task. Business as well as political leadership had responsibilities and in many ways the time horizon of large companies was longer than that of politicians;

e. the amount of debate over analysis and assumptions was not being matched by serious work on policy options for creating efficient and effective international regulatory systems that would reduce carbon emissions overall and on effective incentive structures. Both sticks and carrots were needed. Trading rather than taxation was more likely to gain international consensus, given that national approaches to taxation differed so greatly whereas there was already the beginnings of an internationally acceptable carbon trading regime;

f. The World Business Council for Sustainable Development new publication "Pathways to 2050 – Energy & Climate Change" (by David Hone of Shell) illustrates one possible pathway towards a stabilization level of CO_2 emissions at 550 ppm in 2050 suggesting milestones that must be well underway by 2025, including proven technologies and aligned energy policies aligned carrying the objective of stabilizing CO_2 concentrations. A wide mix of all available technologies would be required in order to succeed. Carbon-free energy sources such as nuclear power will need to evolve together with alternative sources such as hydropower, wind, geothermal, wave and tidal power, as well as the rapid deployment of carbon capture and storage.

g. The insurance industry had welcomed the balance to be found in the Review. Even with the minimum temperature change now inevitable of around 2 ^{o}C, the sea-level impacts would be considerable (possibly of the order of £16bn by 2040) and were unlikely to be insurable, and risk sharing would be needed between those affected and their insurers via higher premiums, taxing the 'polluters' and mitigation programmes and support from governments. Regulation by government of building in risk areas would also be needed;

h. Water stress and other environmental impacts would lead to migrations and be a source of future conflict. Although there would be nations part of whose climate improved, such as in the Siberian tundra, this would itself make the problem worse due to release of captured carbon as the soil warmed.

Concluding, Sir Nicolas Stern welcomed the wide-ranging discussion. He encouraged work to refine and develop his model in Chapter 6, including in the important area of sensitivity analysis. He stressed however that his conclusions rested on a wider analysis. It was the updated science that lay behind his warning of the necessity to take account of the probability that there could be significantly higher temperature rises, earlier, and that coupled with the disaggregated analysis, led to his most striking conclusions about the cost-benefit of acting now.

Sir David Omand GCB

Sir Nicholas Stern's presentation and respondent's texts are on the Foundation website at www.foundation.org.uk. The Stern Review can be found at:
www.hm-treasury.gov.uk/independent_reviews/
stern_review_economics_climate_change/sternreview_index.cfm

Speeches on the Stern Review by the Prime Minister, Gordon Brown and David Miliband can be found at:
www.number10.gov.uk
www.hm-treasury.gov.uk
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