Introduction

The economics of climate change is shaped by the science. That is what dictates the structure of the economic analysis and policies; therefore we start with the science.

Human-induced climate change is caused by the emissions of carbon dioxide and other greenhouse gases (GHGs) that have accumulated in the atmosphere mainly over the past 100 years.

The scientific evidence that climate change is a serious and urgent issue is now compelling. It warrants strong action to reduce greenhouse gas emissions around the world to reduce the risk of very damaging and potentially irreversible impacts on ecosystems, societies and economies. With good policies the costs of action need not be prohibitive and would be much smaller than the damage averted.

Reversing the trend to higher global temperatures requires an urgent, world-wide shift towards a low-carbon economy. Delay makes the problem much more difficult and action to deal with it much more costly. Managing that transition effectively and efficiently poses ethical and economic challenges, but also opportunities, which this Review sets out to explore.

Economics has much to say about assessing and managing the risks of climate change, and about how to design national and international responses for both the reduction of emissions and adaptation to the impacts that we can no longer avoid. If economics is used to design cost-effective policies, then taking action to tackle climate change will enable societies' potential for well-being to increase much faster in the long run than without action; we can be 'green' and grow. Indeed, if we are not 'green', we will eventually undermine growth, however measured.

This Review takes an international perspective on the economics of climate change. Climate change is a global issue that requires a global response. The science tells us that emissions have the same effects from wherever they arise. The implication for the economics is that this is clearly and unambiguously an international collective action problem with all the attendant difficulties of generating coherent action and of avoiding free riding. It is a problem requiring international cooperation and leadership.

Our approach emphasises a number of key themes, which will feature throughout.

- We use a consistent approach towards **uncertainty.** The science of climate change is reliable, and the direction is clear. But we do not know precisely when and where particular impacts will occur. Uncertainty about impacts strengthens the argument for mitigation: this Review is about the economics of the management of very large risks.

- We focus on a quantitative understanding of **risk**, assisted by recent advances in the science that have begun to assign probabilities to the relationships between emissions and changes in the climate system, and to those between the climate and the natural environment.

- We take a systematic approach to the treatment of inter- and intra-generational **equity** in our analysis, informed by a consideration of what various ethical perspectives imply in the context of climate change. Inaction

now risks great damage to the prospects of future generations, and particularly to the poorest amongst them. A coherent economic analysis of policy requires that we be explicit about the effects.

Economists describe human-induced climate change as an 'externality' and the global climate as a 'public good'. Those who create greenhouse gas emissions as they generate electricity, power their factories, flare off gases, cut down forests, fly in planes, heat their homes or drive their cars do not have to pay for the costs of the climate change that results from their contribution to the accumulation of those gases in the atmosphere.

But climate change has a number of features that together distinguish it from other externalities. It is global in its causes and consequences; the impacts of climate change are persistent and develop over the long run; there are uncertainties that prevent precise quantification of the economic impacts; and there is a serious risk of major, irreversible change with non-marginal economic effects.

This analysis leads us to *five sets of questions* that shape Parts 2 to 6 of the Review.

- What is our understanding of the risks of the impacts of climate change, their costs, and on whom they fall?

- What are the options for reducing greenhouse-gas emissions, and what do they cost? What does this mean for the economics of the choice of paths to stabilisation for the world? What are the economic opportunities generated by action on reducing emissions and adopting new technologies?

- For mitigation of climate change, what kind of incentive structures and policies will be most effective, efficient and equitable? What are the implications for the public finances?

- For adaptation, what approaches are appropriate and how should they be financed?

- How can approaches to both mitigation and adaptation work at an international level?