Evidence to

House of Lords Select Committee on Economic Affairs
Aspects of the economics of climate change

9 March 2005

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This paper addresses five aspects of the economics of climate change that I understand to be of interest to the Committee:

- The driving forces on global emission scenarios and the PPP vs MER debate in this context
- The relationship between GDP and emissions and the prospects for decoupling in developed economies
- Problems in the 'Copenhagen Consensus'-type arguments in relation to climate change and developing country welfare
- The role of technology and its relationship to policy
- The Kyoto Protocol from an economic perspective

1. The driving forces on global emission scenarios and the PPP vs MER debate in this context

The debate on PPP vs MER has been at risk of obscuring the fundamental issues surrounding emission projections. In Figure 1 I have set out two important dimensions, by country/region, namely per-capita emissions (vertical) and population (horizontal). Total emissions (= per-capita x population) is represented by the area of the blocks. A glance at this reveals not only the big difference in per-capita emission levels between regions, but also the huge potential for emissions growth if the industrialised countries continue to increase whilst developing countries move significantly in the direction of per-capita emission levels prevalent even in Europe and Japan, let alone those in the New World economies, and their populations also continue to grow.

The first-order drivers of global emission projections are to do with underlying assumptions about population growth and the general pace of global industrialisation. The second (also very important) driver will be underlying assumptions about convergence between rich and poor.

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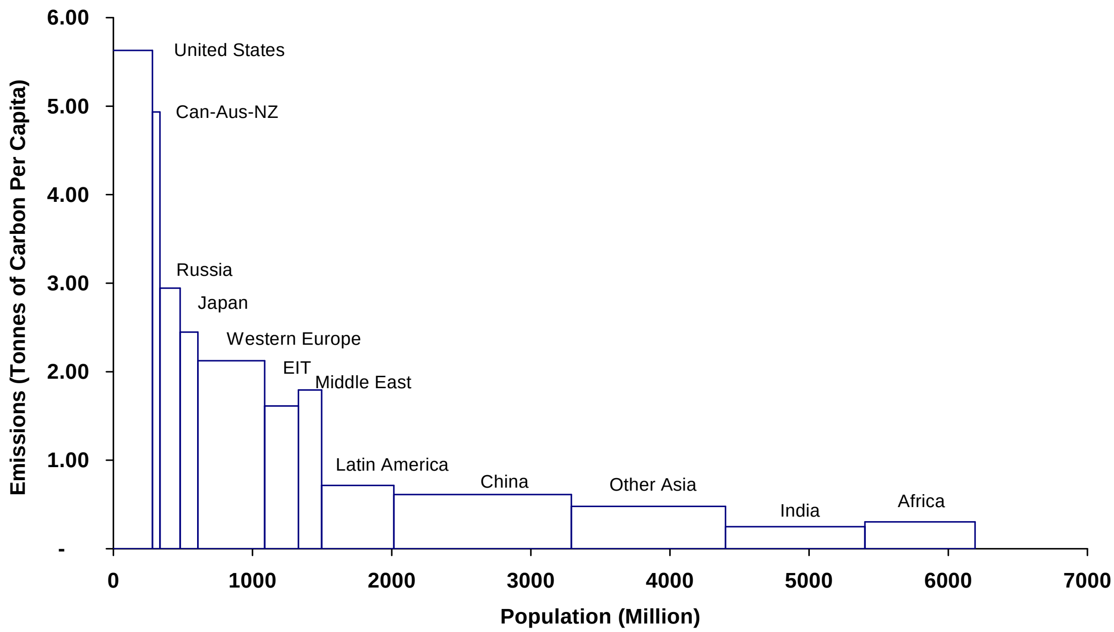


Figure 1 CO2 Emissions in 2000, per capita and population by region

The choice of metric for measuring economic activity (PPP vs MER) is a third order effect on global emission projections. It is not, in my view, irrelevant, because it could have an indirect effect on assumptions about rates of convergence, and structural change in economies. But these effects will be small compared to basic assumptions around the scale of the first and second-order drivers. Of course the choice of PPP or MER affects the numbers attached to economic growth rates, but as clarified amongst others by Bjart and Holtsmark, this in itself is cancelled by the corresponding change in intensity assumptions (one is taking a physical quantity – CO2 - and arguing about how to measure the economic index by which one first divides, and then projects and multiplies, the physical quantity).

The debate has focused particularly on the IPCC scenarios, the projected emissions in which span a huge range by the end of the century, from roughly returning to present levels, to a threefold increase. Intuitively, a three-fold increase in the total area covered by the blocks in Fig.1 does not seem implausible – indeed taken at face value and allowing for extension of the X-axis due to population growth, it seems disturbingly possible in the absence of any policy action to the counter the pressures for emissions growth.

It is of course important that questions related directly to international welfare comparisons use a PPP basis. But I simply do not see any way that the PPP vs MER debate makes a material difference to the conclusions one may draw about the prospects for substantial growth in global emissions, well within the range set out under the IPCC scenarios.

2. The relationship between GDP and emissions and the prospects for decoupling in developed economies

An important underlying question is the nature of the relationship between GDP growth and emissions in the past, and the prospects for accelerated decoupling.

The available international evidence on the relationship is quite complex. Figure 2 shows a (cross-sectional) scattergram of (per-capita) GDP and emissions. In poor countries, higher levels of GDP are unambiguously associated with higher emission levels. This is not surprising: basic industrialisation unavoidably requires development of industrial, building and transport infrastructure that consumes large amounts of fossil fuels. The evidence in countries with per-capita income above US$5-10,000/yr – and emission levels above about 1.5tC/yr - is however far more ambiguous.

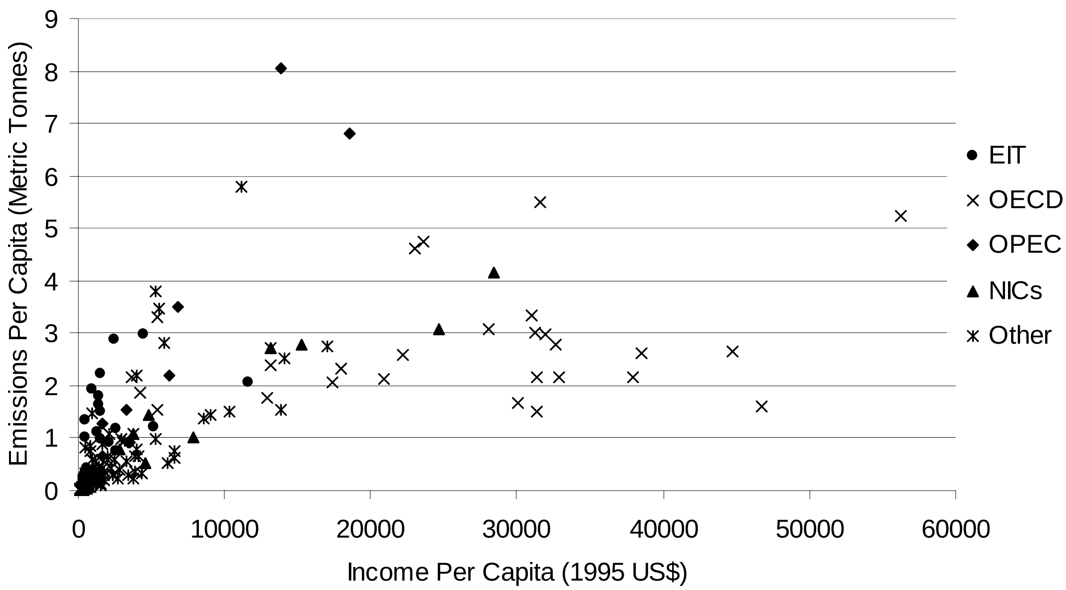


Fig. 2. Scattergram of national per capita income vs CO2 emissions.

There has been significant effort to quantify econometric relationships, with some analysts claiming to discern evidence of a 'Kuznet's curve' type relationship in which CO2 emissions start to decline at very high income levels. The intuitive argument is that income in rich countries is derived more from information technologies and the service sector, which are very low emitters, whilst there is less need for heavy duty industries like construction. It is probably safer to say that in richer countries, the CO2-GDP relationship is weak and the empirical evidence from cross-country comparison to support any other specific assertion about the relationship is also very weak.[4]

[4] It is also often claimed that any decoupling is because rich countries just import energy-intensive products manufactured elsewhere – the evidence for this as a major factor, with the partial exception of a few specifics like aluminium, is also tenuous: most rich regions still manufacture much of their own heavy industrial product.

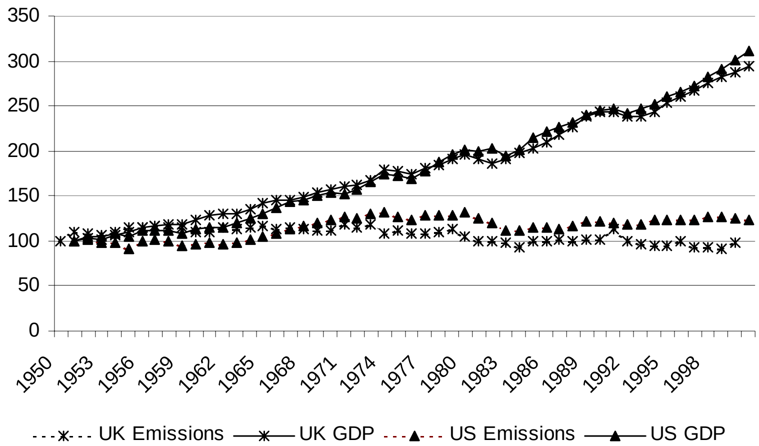


Figure 3: Carbon Dioxide Emissions and GDP per capita in US and UK indexed to 1950 levels

Time series data help to underline that assumptions of a strong coupling between GDP and CO2 in industrialised economics are unsupported by the evidence. Fig.3 shows per-capita CO2 and GDP relative to 1950 levels in the two countries that could best lay claim to have fully industrialised by then, namely the US and UK. Per-capita emissions in each, half a century later, were at similar levels to those in 1950, whilst their GDP per capita had trebled. Decoupling has occurred more recently for the rest of western Europe and Japan. Rising CO2 emissions is not an unavoidable fate, but is driven far more by specific economic circumstances and policy choices, to which I return below.

3. Problems in the 'Copenhagen Consensus'-type arguments in relation to climate change and developing country welfare

The Questions posed by the Committee ask directly about the monetary equivalent impact of climate change, with particular reference to its impact on developing countries and the use of resources for example in relation to Overseas Development Assistance. The "Copenhagen Consensus" has been widely cited as representing a consensus among its participants that acting on climate change should be at the bottom of a list of global concerns.

There seem to me several big problems about this aspect of the "Copenhagen Consensus". First is that it is not even a consensus amongst those specifically chosen for the task; I know directly that at least one of those cited has publicly disavowed the conclusions on climate change and complained of being misrepresented, I am told another has expressed similar concerns.

Second, measuring the value of impacts on developing countries is fraught with difficulties – not only ones of physical impact and economic measurement, but also of global aggregation. As alluded to in earlier evidence, the IPCC was nearly torn apart by the debate around the monetary value of statistical life in developing countries being far lower than in rich countries, and the ensuing debate in my view clarified that the key questions surround who is expected to pay, from what resource, and what value should they place on damage they inflict on others - which is an ethical question, that can be expressed in terms of equity weighting, but for which values cannot be deduced purely from economic reasoning.

To focus on the substance of the position put forward by Bjorn Lomborg, the main need is to be clear how the question is posed and constrained. Overseas Development Assistance is about 0.35% of rich-country GDP in total. If by prior construction, we are not allowed to question the disposition of the remaining 99.65% of rich country wealth in relation to the damages that consumption imposes on others, then we are forced to choose whether we should divert some of the relatively tiny amount we give to alleviate current suffering in poor countries into climate change mitigation instead. I consider that to be an immoral way of constraining the choice, not least because the climate damages are associated with our consumption, not with our foreign aid expenditures.

To try and define climate policy as a trade-off against foreign aid is thus a forced choice that bears no relationship to reality. No government is proposing that the marginal costs associated with, for example, an emissions trading system, should be deducted from its foreign aid budget. This way of posing the question is both morally inappropriate and irrelevant to the determination of real climate mitigation policy.

4. The role of technology and its relationship to policy

New technology will be central to delivering long-run solutions to climate change. Behind this consensus, the economic and policy implications are complex and contentious. Having read some of the earlier evidence to this Committee, I would like to offer the following main points. The essential context is to recognise that innovation is not just about public R&D. Energy-consuming choices and most supply investments are now made by private entities, and major innovations have to traverse a long and risky 'innovation chain' to get from basic R&D to market diffusion.

Low carbon innovation needs to address a wide range of technologies and systems at different stages of development: there is no 'silver bullet' or 'key' set of technologies. Energy-related CO_2 emissions arise from three broad categories of end use (buildings, industry and transport) and two major conversion sectors (electricity generation, and fuels refining). Each involves diverse activities, and low-carbon solutions are likely to involve a range of technologies within each. Many low-carbon technologies are already developed, but insufficiently deployed. Energy innovation strategies must thus be broad-based, must encompass both end-use and conversion systems, must connect innovation and deployment, and must harness ongoing private investment.

Innovation is a continuous, market-based process; the history of state intervention in energy technology has been poor and technology transfer from government funded programmes into private investment is difficult. Whilst there have been some qualified successes (such as the French nuclear programme), other programmes have consumed many £bn without delivering commercially viable products (eg. UK AGR reactors, US Synthetic Fuels Corporation): governments are not good at 'picking and funding winners' without market rigours. Innovation is a continuous process in which market feedbacks, experience from investment ('learning-by-doing') and scale economies are crucial. The key is to accelerate learning and diffusion of diverse low carbon technologies, starting with those already close to market.

The energy sector, and in particular utilities and buildings, are regulated sectors with exceptionally low inherent innovation. The bulk construction industry is notoriously conservative, also the utility industries are less than a tenth as R&D-intensive as sectors like information technology or pharmaceuticals. New technologies do not offer the marketing incentive of product differentiation (insulation, or new generation technology, does not change the product that final consumers see). We are seeking radical innovation in sectors which have been dominated by the same basic set of technologies for at least half a century. Furthermore, they are regulated sectors in which regulation does not reward, and may deter, innovation.

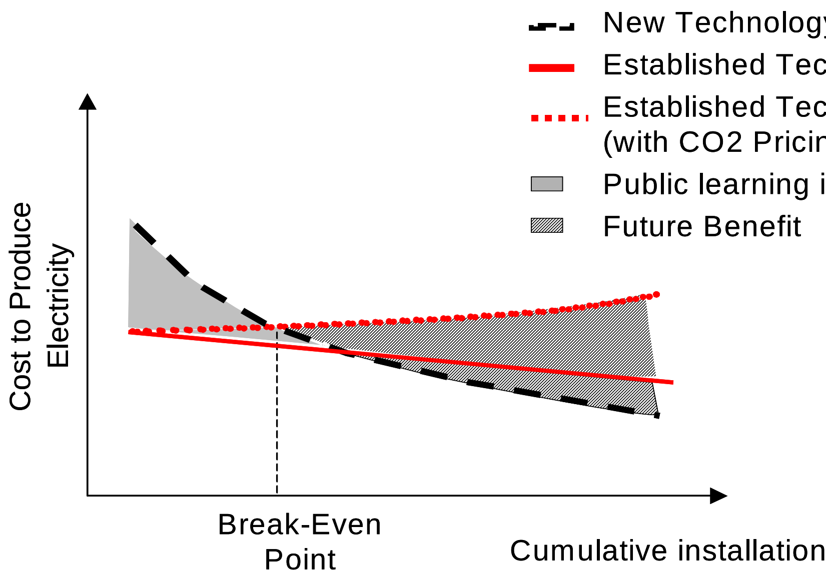
Properly implemented, policies for low carbon resource efficiency and innovation have potential to improve economic competitiveness. Technology studies highlight enormous scope for both carbon and cost savings, and empirical evidence from implemented programmes suggests that such savings can be delivered in practice given appropriate policy. In addition, successful development of low carbon industry sectors could improve UK industrial competitiveness as carbon constraints extend internationally. This does *not* imply that the lunch is free: one needs to invest something (money and/or political effort) to get the potential returns.

The scale of innovation investment required to deliver low carbon energy systems is beyond the reach of most individual governments. A few new supply technology industries have been successfully developed for just a few £bn subsidies (eg. wind energy in Denmark and Germany, ethanol in Brazil). However the 'learning investment' required to make solar PV competitive has been estimated at US$20-100bn, that required for advanced biomass and sequestration may be comparable. The International Energy Agency has estimated that learning investments totalling up to $400bn over the next 3 decades may be required to make very low-carbon power systems viable globally.

Practical policies to deliver low carbon innovation at scale must combine R&D with targeted market-based instruments that move ongoing private investment towards low carbon technologies. The $400bn cited is under a tenth of estimated global power sector investment needs over the period (investment in other parts of power system could double this). Measures like the UK Renewables Obligation Certificates can divert increasing amounts of this towards low carbon innovation, financial instruments (like grants and subsidised loans) can contribute earlier in the innovation chain, whilst additional instruments may be required eg. to foster effective spin-outs from university research. The appropriate mix, balance, and cost-effectiveness of instruments to foster low-carbon innovation is not well understood, policy needs to encourage a diversity of approaches domestically and internationally.

The 'benefit/cost' ration of market-based innovation may be large – if we can get it right. Public support for investment in many demand-side technologies is justified by the documented market barriers and imbalances; though economic assessment is complicated by transaction costs, programmes nevertheless frequently deliver net economic savings over project lifetimes. There is no evidence that energy efficiency technologies have any less potential for innovation than supply technologies; it is just that current practice is further from the best of existing technologies and the incentives for deeper innovation are therefore even weaker than in supply technologies. Strategic deployment of a low carbon supply technology generally has to ‘buy down’ its cost, to the level of higher carbon alternatives (whose costs may also decline, but more slowly as an incumbent technology) plus the gradual incorporation of carbon costs, after which it generates profits (fig.4). Development of the Danish wind and Brazilian biofuels industries each required sustained government support over decades. The Danish subsidies totalled $1.3bn, and Danish wind companies now earn more than that each year. At current oil prices, Brazil may soon similarly recoup its investment in biofuel technology. For low carbon innovation, the time to commercial viability – and hence the incentive for private investment in the technology – may be strongly affected also by the emergence of a ‘carbon price’.

Figure 4. Technology “strategic deployment” costs and subsequent benefits, including potential impact of rising CO2 prices



The grey area illustrates the strategic deployment subsidies needed to secure learning-by-doing cost reductions, declining per unit until a break-even point is reached, after which new technologies produce electricity below the costs of established technologies (whose costs may also decline, but generally more slowly since they are already developed and deployed at scale), with potential benefits as indicated in the striped area. The time to break-even, and the longer term gains, will also depend upon the emergence of policies that reflect environmental damages. In economic terms, the up-front subsidies seek to internalise the benefits of strategic learning, which to a large degree is an external, public good.

5. The Kyoto Protocol from an economic perspective

The Kyoto Protocol has four main elements:

- it states that the way to solve the climate problem is for countries to negotiate quantified, binding limits on their overall greenhouse gas emissions, sequentially over time as the uncertainties reduce and they gain experience;
- these commitments are embedded in a variety of flexible market-based instruments like emissions trading, to make them as efficient as possible;
- the Treaty specifies the first round of limits, on emissions during 2008-12 for the industrialised countries that had already agreed in the original Convention to take the first specific steps;
- it has various provisions to bring in the rest of the world, including the 'Clean Development Mechanism' under which industrialised countries can gain emission credits for investments that reduce emissions in developing countries.

Like any agreement, it is far from perfect, but it is basically a sensible package. In its emphasis upon sequential negotiations to learn as knowledge evolves; in defining commitments in terms of the outcome (emissions, on as wide a gas basis as practical, rather than trying to mandate specific technologies, policies, or measures); and in building in an unprecedented array of economics instruments with global reach, it is a Treaty probably more strongly influenced by economic reasoning than any other in history save those specifically related to trade and investment.

Economic critics seem torn between criticising the Treaty for being too strong, and deriding it for being too weak. The fact that its first period commitments will not solve the problem is self-evident but misses the point entirely: no one step, defined for a first period of five years, will solve a century-long problem. Yet no-one in their right minds would try to get a binding global agreement that mandates all national emissions (or actions) for the rest of the Century. A sequential approach that allows for learning is the only sensible approach, and no big journey can be completed if one does not take the first step.

This intrinsic reality does however considerably weaken the value of Kyoto in terms of driving innovation, particularly since implementation legislation (of which the flagship is the European Emissions Trading System, which started operating in January 2005) has been slow and relatively weak. Carbon-based market signals (such as the EU ETS) may accelerate diffusion of commercialised low carbon technologies, but their practical impact on innovation incentives remains modest because the prices are so low and the future remains so uncertain.

The national caps under Kyoto form a rather different role, in terms of guiding government policy and signalling the need for longer term innovation-oriented policies that could help to support deeper reduction targets in the future. The existence of the Kyoto system may affect strategic R&D in some of the big multinational companies, because it does signal that low carbon technologies will have a value in the future. But in my view, such a system clearly needs to be complemented by additional policies that support low-carbon innovation more directly. I think it remains an open question how much of such technology innovation policy needs to be coordinated at an international level, but it is certainly a very interesting and important topic. I do not see however that this can displace the need for some Kyoto-type architecture as the foundation of long-term global efforts.