CENTRE *for* ECONOMIC PERFORMANCE

# POLICY ANALYSIS

## Climate Change:
## Economic Sense and Non-sense of Carbon Mitigation Policies

- It is predicted that climate change caused by human activities will raise global average temperatures by between 1.5 and 5 degrees Celsius over the next 100 years. This could raise sea levels by one metre or more and lead to a number of other catastrophic climate changes and related phenomena. It could also have some benefits.

- Humanity's main response to this problem is the United Nations' climate negotiation process. The most important milestone of that process so far is the 'Kyoto protocol' which has set targets for reductions in greenhouse gas emissions and which came into force in February 2005.

- Despite some attractive design elements, the Kyoto protocol alone is unlikely to make much impact on greenhouse gas emissions. This is mainly due to the failure of the agreement to include most of the world's current and future emissions, which will arise in China, India and the United States.

- If, as seems likely, this status quo continues, then research and development (R&D), which leads to innovations that can both reduce the intensity of carbon emissions and reduce costs, will become an even more important part of the strategy to fight climate change.

- While the Kyoto strategy of internationally agreed emission targets might create some incentives to develop these technologies, the incentives are probably insufficient. This suggests that some additional direct support from governments is required.

- Another problem with targets is that by the nature of things, they have to be based on very unreliable forecasts of what can be achieved in the future at reasonable costs. Pressing ahead with ambitious targets – as is the current UK strategy – might therefore risk wasting large amounts of public and private money without having much impact on climate change.

- To avoid the danger of excessive costs or politically disastrous non-compliance, target schemes should include a 'safety valve' mechanism.

- We propose an innovative solution of a safety valve mechanism operating through a Global Environmental R&D Fund. Countries could convert excess carbon into contributions to a research fund that would be used to develop technologies to reduce climate change.

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## Introduction

The Intergovernmental Panel on Climate Change (IPCC), the United Nations (UN) agency for assessing the scientific evidence on climate change, predicts that because of greenhouse gas emissions,[1] global average temperatures could increase by between 1.5 and 5 degrees Celsius over the next 100 years.

Among other things, this could raise sea levels by a metre or more, displace millions of people in countries like Bangladesh, Vietnam and Egypt,[2] induce more and stronger hurricanes, increase the risk of drought, destroy arable land and fundamentally alter the global weather and eco system. It could also have some benefits such as bigger harvests in some regions and longer and warmer summers.

While there are climate change sceptics[3] who believe that the dramatic temperature increase over the last 100 years is a natural phenomenon,[4] the overwhelming majority of scientists support the idea of human causes. Taking the scientific evidence on global warming for granted, we might ask how to address this problem from an economic and political point of view.

Humanity's main structured response so far has been the UN climate change negotiation process.[5] A major milestone came in February 2005 when after a hesitant ratification by the Russian parliament, the Kyoto protocol[6] came into force. Is the global community therefore finally on track to solving the greenhouse gas problem? Moreover, if so, is the problem being solved in the most cost-effective way?

## What is the economic rationale for the Kyoto protocol?

The economic justification for the UN climate negotiation process is a market failure that is associated with greenhouse gas emissions. If we leave it to the decision-making processes of individual consumers, businesses and/or countries, then we get too much pollution because the private costs of polluting activities are typically much lower than the social costs. To drive a car, for example, we pay for the petrol and the car but not for the damages that arise in faraway countries and to future generations because of the car's carbon dioxide emissions.

Worse, most people and organisations, even at the country level, are too small for their individual action to make a difference. If one country alone reduced pollution, it would incur all the costs of that effort without any benefits as long as the other countries continue to pollute. Thus, it is rational for countries and individuals alike to keep on polluting even if they are concerned about the effects.

One escape route from this 'prisoners' dilemma' is to pursue some form of collective action whereby everyone agrees to reduce pollution jointly or organise adequate damage compensation. The Kyoto protocol is an effort to reach such an agreement.[7] Currently, the major policy instrument is to agree on future emission targets. These mandate all industrialised ('Annex B') countries to reduce their emissions by a combined 5% between 2008 and 2012, with varying targets at the country level.

Irrespective of the overall target level, a key economic issue is whether this is the most cost-effective way of achieving a given reduction in emissions. From an efficiency point of view, the reduction should be greatest in countries where the marginal costs to reduce emissions are cheapest. While targets largely do not reflect differences in reduction costs, Kyoto tries to account for them in various ways:

1. The Clean Development Mechanism allows Annex B countries to meet some of their targets by financing carbon-mitigating projects in non-Annex B countries. The key idea is that in non-Annex B

[1] Primarily carbon dioxide from burning fossil fuels.
[2] IPPC (1990)
[3] Kininmonth (2004) is an example.
[4] Variations in solar activity could be a possible explanation.
[5] The legal basis for the climate change negotiations is the United Nations Framework Convention on Climate Change (UNFCC)
[6] http://unfccc.int/resource/docs/convkp/kpeng.pdf
[7] One problem is that the main beneficiaries are future generations who have no current political voice.

countries – mostly developing countries – it is often cheaper to achieve emission reduction because technology and practices are more outdated.[8]

2. The Joint Implementation Mechanism follows the same idea by allowing Annex B countries to implement projects that reduce emissions or remove carbon from the atmosphere in other Annex B countries.

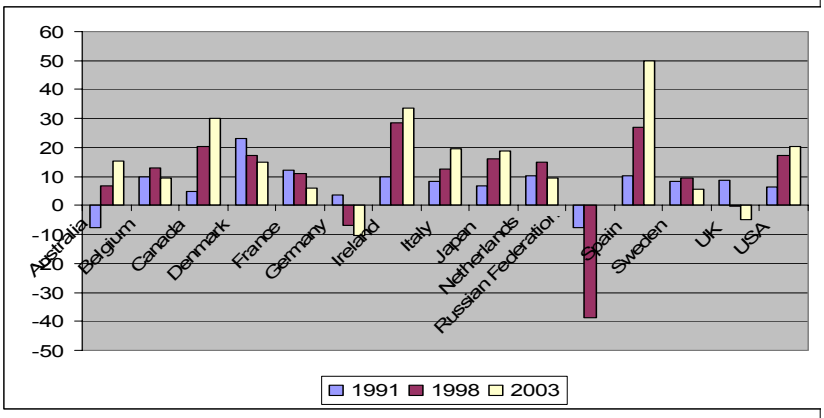
3. Emission trading is a mechanism that allows Annex B countries to trade pollution permits with each other. In other words, a country that can meet its target more easily can sell its pollution rights to a country with difficulties meeting its target.

The consequence of such carbon trading schemes is that in principle any given amount of overall reduction can be achieved at the lowest total cost.

**Problems with Kyoto**

In practical terms, the current trading scheme has the surprising implication that the Kyoto protocol is actually an agreement to increase greenhouse gas emissions: because targets were partly based on 1990 pollution levels, many East European countries, such as Russia, have targets way above their current pollution levels due to their severely reduced economic activity after the end of communism (see Figure 1). Bohringer (2003) estimates that the current signatories of the Kyoto protocol can on a combined basis increase their pollution by about 6% by 2010 without collectively violating the protocol.

**Figure 1: Distance from the Kyoto targets for various years across countries**




Source: Author's calculations based on UNFCC (2005): percentage difference between actual pollution and Kyoto end targets.

This situation may change if the Kyoto signatories agree to tighter targets after 2012. Then the big East European pollution surplus might be a problem after all because what it offers industrialised countries is to meet their targets by transferring huge amounts of income to Eastern Europe, which might not be sustainable politically.[9] Equally, it might be difficult to dedicate much money to potentially controversial projects in developing countries.[10] Therefore, many trading opportunities will not be exploited.

A more fundamental problem of the Kyoto protocol is that irrespective of the tightness of its targets, it will have little impact on climate change because so far it does not extend any targets to the world's biggest current and future polluters: China, India and the United States. Figure 2, which plots current per capita pollution and population, gives a sense of this problem. The United States alone is by far the most pollution-intensive country, currently responsible for about a quarter of global emissions. China and India's per capita pollution levels are still low, but if they continue to grow at current rates, this will change in the near future. Population

[8] Replacing an old power plant with a more efficient one is a typical example.
[9] Already now, industrialised countries are judged by how much they manage to reduce pollution on their own soil and meeting targets by buying permits from somebody else, even if they are cheap, would be widely considered a failure. This has to do with a sense among many environmental campaigners that we should not only do what is best to reduce future pollution but also that past polluters – that is, all industrialised countries – have to be punished somehow.
[10] For example, supporting industrial farming projects as carbon sinks.

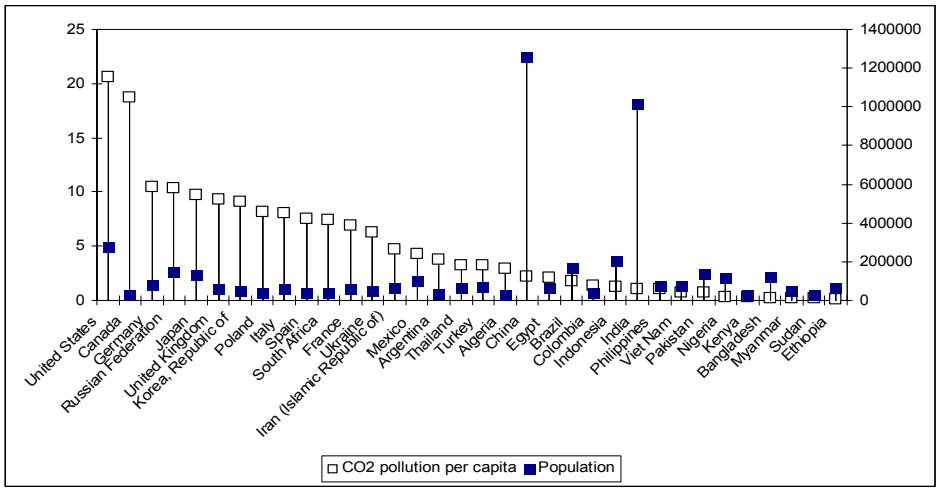
growth in such countries with a lot more potential for economic 'catch-up' will further exacerbate the problem.[11]

**Strategies for beyond Kyoto**

It cannot be ruled out that in the future the United States and major developing countries will become committed to emission reductions. A strategy that might work even if this does not happen is based on technology and innovation. If the incentives created by environmental policies lead to technologies that allow activities that are currently carbon-intensive to be conducted both with less or no pollution *and* at lower cost, then even countries not committed to climate change mitigation will adopt them out of economic self-interest.

How realistic is the emergence of such innovations? Two facts give some cause for optimism:

**Figure 2: Carbon dioxide pollution per person and population across countries in 2000**




Source: Author's calculations based on United Nations Common Database:
left scale is tons of carbon dioxide per person per year; right scale is thousands of population.

- Dramatic reductions in pollution can be expected from innovations in only two very clearly defined areas: electricity generation and transport. In industrialised countries, these account for around two thirds of emissions.

- In both these areas, viable carbon-free alternatives have already been proposed, developed and demonstrated as workable in practice.[12] Relative to their polluting counterparts, the extra costs[13] are often small and have been closing rapidly in recent years.[14]

Are the private incentives sufficient to encourage the necessary investments in research and development (R&D) for these innovations? Because of the difference in the private and social cost of pollution, the private incentives are almost certainly too low. But can Kyoto-style cap and trade schemes (or pollution taxes) create the extra incentives for innovation by increasing the relative price of polluting? Unfortunately, this is unlikely to be enough because:

- To develop the necessary new technologies, companies need to commit significant amounts of R&D money now. But firms will only commit funds if they are very certain that governments will actually

[11] For such reasons, Wigley (1998) finds in an elaborate modeling exercise that even if Annex B countries reduce their emissions continously by 1% every year after meeting the 2012 targets, this will most likely not has much effect on global temperatures or sea levels until 2100. Even when including the United States as a Kyoto country, the effects are only on the scale of delaying the arrival of a certain temperature by 10 years.

[12] See Hoffert et al (2002) for a detailed overview.

[13] The reach of a hydrogen car, for example, is still somewhhat lower than that of a comparable petrol-powered car.

[14] For the potential of renewables, see Neuhoff (2005) and Archer and Jacobson (2005). For the cost of renewable electricity, see IEA (2003) and Royal Academy of Engineering (2004). For clever ways to solve the intermittency problem, see Grubb et al (2005). For the cost of hydrogen for transport, see Jacobson, Colella, and Golden (2005).

implement the measures that would guarantee them a high return on such investments. If these measures include unpopular issues such as carbon taxes,[15] then companies might not be convinced that they will happen.

- There might be a skewing of incentives towards innovations that save emissions in high- but not low-income countries. Think of companies that focus their research activities on the development of luxury hydrogen cars rather than a cheap and carbon-free transport option for the Chinese farmer.

- Equally, companies might focus more on standard technologies that entail less risk. An example would be more research to improve the efficiency of current fossil fuel technologies and carbon sequestration rather than more risky and innovative approaches based on renewables.[16]

- To the extent that environmental regulation reduces the consumption of certain polluting goods, this reduces the incentives for potential innovators to invest in improvements in these areas.[17]

Consequently, direct public support for carbon-mitigating research is likely to be essential in the years to come. In this context, it is unfortunate that the dominant environmental policy instrument emerging from Kyoto appears to be pollution permit trading schemes with freely allocated permits rather than taxes or auctioning of permits, which could raise some extra revenue.[18]

Another concern about targets and cap and trade schemes is that costs can easily turn out much higher than expected. This is especially likely with ambitious targets like the UK government's proposed commitment to reduction targets of 60% (relative to 1990) by 2050. While the government claims to '… have analysed carefully the likely impacts on the UK economy of cutting emissions by 60% by 2050',[19] it is clear that even with the most careful analysis, the uncertainties involved make it more likely that any forecast of costs in 50 years time is wrong rather than right.

To avoid excessive costs, target schemes can be combined with 'safety valve' mechanisms. If a target scheme has provisions for permit trading, then such mechanisms can be implemented by issuing additional permits if the market price for permits exceeds a certain pre-specified value.

**Nuclear energy and renewables**

That these issues are not merely a theoretical consideration can already be seen in the current UK debate on nuclear energy. Many commentators suggest that nuclear technology is the only way to meet medium-term pollution reduction targets.[20]

Clearly, it might be possible that in the end, nuclear technology will play a role in the UK energy mix. But at this stage, it is far from clear that the nuclear industry has solved the nuclear waste problem, made sure that no residual radioactivity is released into the air and managed to operate profitably without government subsidies and the guarantee of limiting damage liability by law in case of a major accident.

Another concern is that even if we have some confidence that nuclear technology could be operated safely at some point in the UK, it might not be the kind of technology we want to export to various developing countries.

[15] These could be explicit or implicit through pollution caps or other regulation.
[16] See Anderson and Bird (1992).
[17] See Grubb and Ulph (2002).
[18] See Margolis and Kammen (1999), who find that environmental R&D spending (both public and private) is extremely low by historical and inter-sectoral standards.
[19] See DTI (2003).
[20] See, for example, Blair (2005).

Similar arguments can be made for renewable energy. For example, if it is clear that, in the long run, most wind electricity will come from large offshore wind farms, then it is not helpful to invest heavily in onshore wind projects just to meet a short-term target.

The general message is that such short-term efforts will have little effect and waste money. It would be far wiser to continue for a couple of years more using the most cost-effective conventional technology and target any extra money to the most promising research routes to establish a viable solution for here and elsewhere in the world. Of course, promoting a certain modest share of renewable technology in the energy mix as has been done in the UK in the past can be a sensible way to promote technological advances through learning by doing. That is different from requesting renewable shares of 20% or more.

**Conclusion**

So far, the UN climate change process has had little impact on climate change and it is not clear that it will in the future. While many commentators see this as a complete failure and conclude that the process should be stopped sooner rather than later, others argue that the key contribution so far has been to establish a forum where a large number of countries try to find a solution to a problem that requires a global act of co-ordination.

For this to be of any use, it is crucial to transform the process into something that has a substantial impact on climate change in the future. A strategy of more of the same – agreement on ambitious further targets – will not be sufficient. A central part of further tightening of targets should also include the designing of safety valves that avoid excessive costs.

This is not only important to ensure continued support in countries that have endorsed Kyoto but also to increase the likelihood that current outsiders such as the United States and various developing countries can be convinced to join. Seeing Kyoto countries suffering economically under tight targets will not be very convincing argument for that purpose.

If no further countries join, then solving the issue through carbon *and* cost-saving innovations will be crucial. This is likely to require additional public funds.

One way of addressing both issues – safety valves and additional R&D funding – with a slight modification to the current Kyoto policy toolbox is as follows: combine targets with an additional implementation mechanism to those already in place, according to which countries can exchange carbon pollution beyond their targets into contributions to a Global Environmental R&D Fund.

The exchange rate – the financial contribution per tonne of excess carbon – could be fixed in a way so that this mechanism operates as a safety valve, that is, the price should be equal to the maximum cost considered acceptable for carbon permits in the international trading mechanism. Companies that are subject to carbon restrictions could equally be allowed to meet their targets by paying into the fund. To ensure transparency, there could be one global fund whose money is allocated by an independent panel of experts to the most promising research proposals. Alternatively, each country could have its own fund but operating according to the same stringent criteria.[21]

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[21] Such a mechanism would have a very virtuous 'automatic' quality: the fund would receive significant resources when a country dramatically overshoots its pollution target. This would be an indication that forecasts about technological possibilities leading to the targets were wrong in the first place and that more research is indeed needed.

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