





**Copenhagen Consensus on Climate Change**  
**Perspective Paper – Climate Change**

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21 March 2012

## **Introduction**

This paper offers a broader perspective on climate change to complement the four challenge papers on the topic. The challenge papers cover most of the policy options that are available to combat climate change, that is:

- constraining emissions through a carbon price (Tol 2012),
- promoting low-carbon technology (Galiana and Green 2012),
- adapting to the consequences of climate change (Bosello et al. 2012) , and
- exploring climate engineering solutions (Bickel and Lane 2012).

The only generic option that is missing is the pursuit of energy efficiency. It is a surprising omission given that energy efficiency improvements are one of the cheapest ways to reduce greenhouse gas emissions. Perhaps it was assumed that a carbon price would take care of these opportunities. A price on carbon is certainly important, but the empirical evidence has identified wider market imperfections and behavioural barriers that have to be tackled separately (Martin et al. 2011; de Canio 1998; de Canio and Watkins 1998; Sanstad and Howarth 1994).

The challenge papers give a fair assessment of the pros and cons of the four options considered. I will offer a few technical comments in passing, but my main concern is not the technical merit of the papers. Instead I make two more fundamental observations.

My first observation is that *the four papers understate the case for tackling climate change*. This is mostly due to the way in which the Copenhagen Consensus experiment is

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set up, rather than misrepresentations in the papers themselves. By exploring individual response options separately, the papers inevitably focus on the relative merit of one option over the others (carbon taxes vs. technology, etc). None of the papers explicitly makes the overall case for climate change action, which entails a smart combination of all four measures. I will address this omission in the next section.

My second observation is that *the four papers could be grounded better in the emerging empirical evidence*. Most of the conclusions are derived from high-level simulation models. Although these models represent the state of the art in climate change economics, they are too stylized to base policy decisions exclusively on their outputs. Where ever possible additional empirical evidence should be mustered to reinforce their conclusions. Such evidence is beginning to emerge from the practical experience with climate policy in countries like the UK. Although still sketchy it can help to inform the Copenhagen Consensus. I will summarise this experience the final section of this paper.

### **The Economic Case for Climate Change Action**

It is worth recapitulating the overall case for climate change intervention before reviewing the relative merit of different climate policies. None of the challenge papers explicitly does this, although the papers by Tol (2012) and Bosello et al. (2012) implicitly look at the question.

Both Tol and Bosello et al base their arguments on a cost-benefit rationale. That is, the aggregate (worldwide) costs of climate action are compared with the aggregate (worldwide) benefits, which take the form of avoided climate change damages. This is an intuitive way for economists to think about the problem, although most economists (including Tol and Bosello et al) would agree that climate change is too complex to lend itself to simple cost-benefit analysis. Complicating factors include tough questions about inter- and intra-generational equity and the fact that climate change poses an existential threat to some unique natural and social systems.

However, the main complication is risk. Stern (2006) and Weitzman (2011) argue convincingly that climate change is primarily an issue of risk management. Unabated climate change would expose the world to climate regimes not experienced for millions of years. No climate model can offer assurances that these fundamental changes will not turn out to be calamitous. In fact most models suggest that they might be.

Tol (2012) gives a sense of the broad range of damage cost (or social cost) estimates. He notes that the probability distribution is skewed, with the possibility of a fat tail at the catastrophic end, and acknowledges that even his wide range may not cover the full set of possible outcomes. Unfortunately, his subsequent analysis is based on a much narrower range of numbers, and this needs to be borne in mind when interpreting his results. The main case, in particular, is based on a marginal damage value that is in no way representative of the underlying probability distribution.

An alternative way of thinking about the problem is to ask what an acceptable insurance premium might be to mitigate the worst (but by no means all) risks of dangerous climate change. Two areas of risk-averse societal behaviour may shed light on this question:

- People in industrialised countries spend the equivalent of about 5 per cent of GDP on life insurance. In emerging markets the corresponding sum is close to 2 per cent of GDP (Swiss Re 2011).
- Most nations spend at least around 1 per cent of GDP on military defence, and often a lot more. This is true even for countries with explicitly defensive armies and no immediate threats from neighbours, such as Austria, Canada, Germany and Switzerland.<sup>1</sup>

There is a clear parallel with climate risks, although it is not perfect. In both examples significant sums of money are spent to reduce a threat that is relatively remote but devastating if it does occur. How do these sums compare to the expected cost of climate change insurance?

The order of magnitude is similar. Energy-economy models suggest that limiting the atmospheric concentration of greenhouse gases to around 450ppm might cost between one and three per cent of GDP over the next 40 years, although achieving this would require near-perfect policy coordination (Edenhofer et al 2010; Clarke et al. 2009). That is, GDP in 2050 would be 1-3 per cent lower than would otherwise be the case. In return, the probability of a risky climate change outcome – say of warming in excess of 4°C – would be reduced to perhaps one per cent (Committee on Climate Change 2008).

While not based on careful integrated modelling, the above line of argument suggests that limiting atmospheric greenhouse gas concentrations to around 450 ppm is a rational precaution and the ensuing cost are a reasonable insurance premium to pay. It still leaves open the question about the appropriate mix of policies, that is, the choice between pricing carbon, promoting technology, adapting and climate engineering. I turn to this next.

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<sup>1</sup> <http://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS>

## **Empirical Evidence on the Choice of Climate Policies**

As more and more countries begin to address climate change it becomes possible to complement the top-down simulation results in the challenge papers with empirical insights from actual climate change policy. Townshend et al (2011) count no fewer than 155 climate change or climate change-related laws in a survey of fifteen G20 economies. Many of these laws have been in place for several years now.

The analysis and evaluation of existing climate policies is only just beginning, but it can add important empirical credibility to the climate change story. Models like DICE (used in Bickel and Lane 2012), FUND (Tol 2012) and WITCH (Bosello et al. 2012) are excellent tools to describe high-level trends, but they are much too stylized to offer firm evidence on how policies work on the ground. They do not have the same level of detail and richness as the models used to inform decisions in Ministries of Finance and Central Banks, for example.

A good place from which to distil policy lessons is the UK, although there is also evidence from many other places. The climate change debate in Britain is fairly advanced, with a strong legal basis for climate action, ambitious targets and sophisticated institutional arrangements (Fankhauser 2012). Through a combination of dedicated policies and serendipity the UK has succeeded in reducing its carbon emissions by about 25 per cent between 1990 and 2010, and by about 12 per cent since 2007. Britain's policy mix features carbon pricing, technology support and adaptation (although not climate engineering). The main planks of low-carbon policy are:

- A price on carbon, primarily through the EU Emissions Trading Scheme (EU ETS), which covers about half of Britain's carbon emissions. This is flanked by a climate change levy on firms outside the EU ETS and soon by a carbon price "underpin" to prop up the ETS price.
- Support for low-carbon technologies, through a mix of supply push (e.g. demonstration projects, a new Green Investment Bank) and demand pull measures (a renewable energy obligation and feed-in tariffs for small-scale renewables and renewable heat).
- Measures to address barriers to energy efficiency, an area that is not covered by the challenge papers but which receives much policy attention. There is a bewildering range of mostly regulatory measures (such as obligations on energy suppliers) to facilitate the uptake of energy efficiency.

Evidence on the effectiveness of these policies comes in the form of empirical policy evaluations, independent monitoring reports and the detailed modelling of policy choices. An econometric analysis by Martin et al. (2009) finds that Britain's climate change levy – a carbon-cum-energy tax – has reduced the energy intensity particularly of larger and more

energy-intensive plants. The authors find no statistically significant impacts of the tax on employment, gross output, total factor productivity or firm exit.

The EU ETS has helped to curtail European carbon emissions, although the amount of abatement has been modest (Ellerman et al. 2010; Ellerman and Bucher 2008). There is a yet no evidence that the scheme has triggered low-carbon innovation (Calel and Dechezleprêtre 2012), although innovation effects associated with pricing policies are documented elsewhere in the literature (Popp 2002). This suggests that additional, technology-oriented policies will be needed, as suggested by Galiana and Green (2012).

The fact that the UK is reducing emissions faster than some of its economic competitors is having a surprisingly small impact on British industry. The sectors for which loss of competitiveness is an issue are those where high trade exposure goes together with high carbon compliance costs (such as aluminium or steel). They account for less than one per cent of UK GDP and UK jobs, although this result will obviously be different in countries with a stronger industrial base (Carbon Trust 2008). In fact, many firms have benefitted from the EU ETS: they are allocated free emissions permits, the opportunity cost of which they are able to pass on to consumers. It is a distributional feature the European Commission is now trying to address.

The Committee on Climate Change (2011) finds that low-carbon policies have added 12.5 per cent, in nominal terms, to the typical household energy bill since 2004. Over the same period, fuel price shifts have added 63 per cent to the typical bill. The general level of inflation was 16 per cent (reflecting, among other factors, the hike in energy prices). The Committee anticipates that the effect of tighter policies between now and 2020 will be roughly offset by the effect of energy efficiency measures. The overall resource cost of Britain's commitment to reduce greenhouse gas emissions by 50 per cent by 2027 is estimated to be less than one per cent of GDP (Committee on Climate Change 2010). The estimate is based on fairly detailed sector-by-sector modelling, although it is a bottom-up estimate and does not include indirect general equilibrium effects.

Despite their small economic impact there has been opposition to Britain's carbon policies from vested interests. Such lobbying is normal, of course, and there are also business interests that have seized the low-carbon opportunities and are pushing for tighter targets (as well as better policies). There is some apprehension in the Treasury about pursuing low-carbon policies at a time of austerity and low growth, but there are also compelling arguments that low-carbon investment is no worse, and arguably better, at kick-starting a flagging economy than other forms of support (Zenghelis 2011; Bowen and Stern 2011).

The UK policy framework recognises the need for both adaptation and mitigation. Although the UK is fairly well adapted to the current climate, a closer look (ASC 2011) identified a number of low-cost options that have attractive benefit-cost ratios even before taking climate change into account (see also Swiss Re 2009). Their short-term benefits in terms of current climate resilience, water efficiency or other concerns are up to five times

higher than the initial outlay. The list is similar to that reviewed in Bosello et al (2012) and includes:

- Improvements in residential water efficiency, such as low-flow taps, showers and toilets, which could reduce water use by up to a third.
- Flood protection measures in buildings, such as airbrick covers, door-guards, repointing of walls, drainage bungs and non-return valves.
- Measures to avoid overheating in buildings, such as energy-efficient appliances to reduce waste heat and increased window shading.
- Improved flood risk management, including awareness campaigns for local residents (such as risk profiles for individual homes) and improved emergency response training.

A rational adaptation policy would focus on such win-win options. They also feature prominently in low-income countries, where there are strong overlaps between adaptation and development (Fankhauser and Burton 2011).

In addition, a rational adaptation policy would begin to incorporate adaptation into strategic long-term decisions on zone planning (e.g. on building in hazard zones like flood plains and coastal zones), infrastructure development and building design, where cheap adjustments today can save potentially large sums of money later. The proposal is not to climate-proof all these investments automatically, but to invest into an informed decision making process that factors in future climate risks and prevents the need for costly retrofits later.

There are no policy frameworks, in the UK or elsewhere, that include climate engineering. However, Bickel and Lane (2012) are right that research into geo-engineering is an important insurance policy to complement the other climate measures. Given the early stage of this research, it seems sensible to cast the net more widely than Bickel and Lane suggest, and explore air capture as well as solar radiation management. Climate engineering raises important ethical and regulatory issues, as well as questions of technical feasibility and environmental side effects. For example, which organisation should provide the global public good “climate stabilisation”? How would that organisation be regulated? How would the optimal level of climate stabilisation be determined? How would potential liabilities be apportioned if something goes wrong? How would unilateral action by rogue states be prevented? These questions are crucial and need to be part of the research effort into climate engineering. Demonstrating technical feasibility and environmental acceptability alone is not enough.

## **Conclusions**

This perspective paper complements the challenge papers on climate change by offering a broader viewpoint on the merits of climate change policy. It makes two key points.



First, spending money to deal with climate change is a worthwhile investment. There is strong scientific evidence about the downside risks from climate change. The “insurance premium” society would have to pay to mitigate these risks is not dissimilar to the premiums paid for other threats to life and territorial integrity. Initial evidence from the UK suggests that early emissions reductions can be achieved at a relatively low cost to the economy.

This risk-based argumentation is different from the straight benefit-cost calculus applied elsewhere in the Copenhagen Consensus. However, it is arguably more appropriate given the levels of risk and uncertainty involved.

Second, a rational response to climate change should combine all the four options put forward in the challenge papers. The main thrust should be to reduce emissions through a combination of carbon pricing (either a tax or trading scheme), the promotion of low-carbon technologies and measures to unlock energy efficiency improvements. We are starting to see evidence from countries like the UK that ambitious decarbonisation policies are technologically and economically feasible. As in other areas of public policy, the challenge is competent implementation.

Some climate change is now unavoidable and measures to adapt to these residual risks are important. Adaptation can be timed, given the gradual onset of climate change, but there are measures that ought to be considered now. They include decisions with long-term consequences, such as infrastructure investments and spatial planning, and decisions with early side-benefits, for example in terms of economic development, resource efficiency and poverty alleviation. It is worth spending money on ensuring climate change is properly factored into these decisions.

Climate engineering solutions play a role as a last resort option to guard against adverse surprises. They are worth spending some research money on, including on work to understand their environmental side-effects and the regulatory, governance and institutional implications of this option.

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