

## **The Economic Benefits of International Cooperation in Mitigating Climate Change**

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### **Summary**

It is possible to quantify the economic benefits of international cooperation in mitigating climate change. Using the Energy-Environment-Economy Model at the Global level (E3MG), constructed as a contribution to the Tyndall Centre, scenarios have been developed to assess the effects of climate change mitigation for the EU acting alone, the US acting alone, the EU and US acting together, all Annex I, Annex I plus China, and finally all countries acting together. The assumed target is a 30% reduction in CO<sub>2</sub> emissions by 2020 for Annex I countries, and a return to 2010 or 15 emissions by the developing countries. The results show unequivocally that a global deal, when compared to unilateral action, results in slightly higher GDP and employment, and significantly lower carbon prices.

### **Introduction**

Human-induced climate change is a classic case of Garrett Hardin's tragedy of the commons—the benefits of burning fossil fuels accrue to individuals, companies and nations, whilst the costs accrue to the planet as a whole. Greenhouse gas emissions are an externality and constitute the greatest market failure the world has ever seen (Stern 2007, p. 1). To ensure that the costs of externalities are internalized in the marketplace, governments should intervene and put a price on greenhouse gas emissions.

### **Method**

The research involved making forecasts conditioned on hypothetical policy scenarios using a well-established model known as E3MG (an Energy-Environment-Economy Model at the Global level). E3MG is a 20-region structural, dynamic, annual econometric simulation model developed by 4CMR and Cambridge Econometrics. For more information on E3MG, see Barker, *et al.* (2006ab) and Pollitt (2009).

A baseline 'business as usual' scenario plus the eight policy scenarios described in Table 1 were developed. The modelling procedure undertaken for each of the eight scenarios was as follows:

1. Calculate the level of emissions in 2020, as defined by the scenario.
2. Calculate the level of emissions for the years 2010–2019, so that the percentage decrease each year to 2020 is constant.
3. For each year, calculate the carbon price that gives rise to the previously-calculated level of emissions by using an iterative procedure that involves running the model and interpolation.
4. Incorporate the carbon price for each year into the model.
5. Run E3MG.

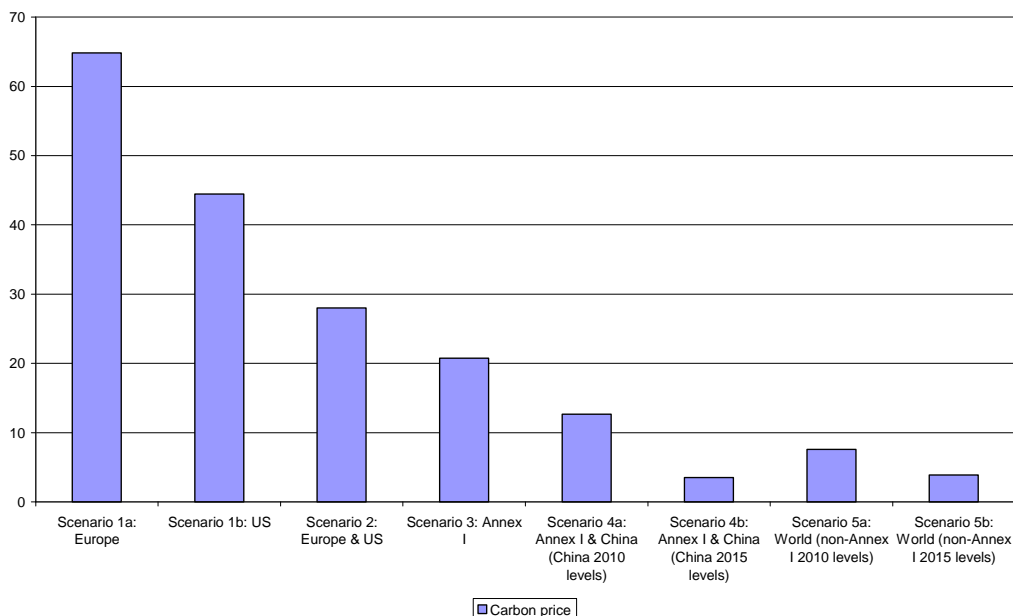
**Results**

**Table 1** Policy scenarios, CO<sub>2</sub> emissions levels in 2020

<i>Policy scenario</i>	<i>EU25</i>	<i>US</i>	<i>Annex I</i>	<i>China</i>	<i>Rest of the world</i>
1a	30% reduction from 1990 levels				
1b		30% reduction from 1990 levels			
2	30% reduction from 1990 levels	30% reduction from 1990 levels			
3	30% reduction from 1990 levels	30% reduction from 1990 levels	30% reduction from 1990 levels		
4a	30% reduction from 1990 levels	30% reduction from 1990 levels	30% reduction from 1990 levels	Return to 2010 levels	
4b	30% reduction from 1990 levels	30% reduction by 2020 from 1990 levels	30% reduction from 1990 levels	Return to 2015 levels	
5a	30% reduction from 1990 levels	30% reduction from 1990 levels	30% reduction from 1990 levels	Return to 2010 levels	Return to 2010 levels
5b	30% reduction from 1990 levels	30% reduction from 1990 levels	30% reduction from 1990 levels	Return to 2015 levels	Return to 2015 levels

The main imposed policy is a carbon price, calculated in step 3 above, which is achieved via both carbon taxes and emissions trading. The revenues from the carbon taxes and auctioned permits/emissions allowances are recycled via reductions in employers' taxes and incentives for introducing low-carbon technologies on the electricity supply side, and supporting low-carbon production methods and energy efficiency on the end-user side (for both industry and households). See Barker, *et al.* (2009).

**Figure 1** Carbon price in 2020 (2000 US\$/tCO<sub>2</sub>)



Source: Step 3 in the modelling procedure described above.

Note: The sequence of countries goes from 1 (unilateral) to 5 (multilateral), whilst the policy scenarios denoted a and b are alternatives. The accuracy of the figures are subject to the usual caveats associated with economic forecasting.

As the area of cooperation expands, global emissions are reduced, carbon prices decrease significantly (Figure 1), and global GDP and employment both tend to increase (Barker, *et al.* 2009). That a multilateral approach to climate change mitigation is superior to a unilateral approach is not surprising, because the tragedy of the commons is a multi-player generalization of the prisoner's dilemma, and the best overall outcome in a prisoner's dilemma is one of cooperation. More specifically, there are at least three theoretical reasons why a global deal would be preferable from an environmental perspective:

- The law of comparative advantage would work against mitigation with a unilateral agreement (due to carbon leakage), but for mitigation with a multilateral agreement (e.g. trading solar power for wind power).
  - Less fossil fuels burned by 'clean' countries means more fossil fuels left to be burned inefficiently by other countries.
  - Unilateral action would be ineffective anyway; it would fail to prevent climate change.

A more surprising result is that the results imply that even if Europe (or the US) undertakes a strong climate change mitigation policy unilaterally, they will be better off economically than under business as usual. Such an outcome removes the prisoner's dilemma, but would fail to mitigate climate change.

### Conclusion

In practice, an international agreement such as a treaty reached at COP15 in Copenhagen in December 2009 would ultimately rely on trust. However, such an agreement would set countries up so that they can either cooperate by honouring the treaty, or defect by failing to honour the treaty. The latter would be considered a form of cheating. Although humans are poor at looking for altruism, we are good at detecting cheating (Cosmides 1989). So, although a strong climate deal is difficult to enforce, our evolved desire to punish cheaters offers a glimmer of hope.

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