# THE BENEFITS OF COOPERATION ON GLOBAL CLIMATE POLICIES – A LITERATURE REVIEW [1]

**This document outlines some of the benefits of global cooperation regarding climate change.** Policies are analysed on three criteria:

1. Environmental Effectiveness
2. Cost Effectiveness (efficiency)
3. Institutional & Political Feasibility

**Important aspects to be considered include the incentives for agents to participate and agree to stringent action, distributional considerations, and legal mechanisms for verification and enforcement.**

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## *Introduction: A Global Problem*

Climate change is an inherently global problem, both in its causes and effects (IPCC 2007a). Greenhouse gases are emitted from human activity across the world, albeit unevenly; and climate change has global effects. A 'matching principle' can be formulated for environmental governance (Stavins 1997): the authority responsible for introducing regulation should match the relevant geographical scope of the problem addressed. In the case of climate change that scope is firmly global.[2]

This document analyses potential policy according to three criteria:

1. Environmental Effectiveness
2. Cost Effectiveness (efficiency)
3. Institutional & Political Feasibility

2 Climate Change is a global problem; however, institutions exist primarily on a national level. Taxes are levied, governments are elected and have a single head of government; nations go to war; all on a national level. A single policy is adopted precisely because there is one voice, albeit one that responds to advice. There is no such government at an international level. There is no coercive body equivalent to the police force or army; international law can only legally be enforced with the will of the UN security council, and only de facto by the armies of the members of such a council. The whole of the modern order, from the treaty of Westphalia through the UN charter and to the present day has been based on the sovereignty of the nation state.

## *Environmental Effectiveness*

Environmental effectiveness is defined as “the extent to which a policy meets its intended environmental objective or realizes positive environmental outcomes”. It is contingent on policy design, implementation, participation, stringency and compliance. Environmental effectiveness is reduced if there is less than global participation due to *free rider problems* (some countries do not take action to reduce their emissions) and *carbon leakage* (emissions reductions in some countries may be compensated for by increases in other countries).

## Free Rider Problems

Basic arithmetic suggests that to reduce global emissions to a level needed to stabilize greenhouse gas concentrations requires the participation of the top two emitters, China and the USA, and from the vast majority of the 17 countries[3] that produce three quarters of global emissions. However, developing countries' participation is recognized to be difficult to achieve without developed countries' leadership.

Typical analyses suggest that actions to mitigate climate change have a cost to private agents (individuals, companies) but an aggregate global gain from cooperation (Stern 2006; c.f. IPCC 2007, Weitzman 2008). Emissions reductions require private energy choices that are more expensive in the short run; whereas the impact of those emissions in terms of future environmental damage is global. An archetypal game form illustrating this 'collective action problem' where agents acting in their own self interest can lead to a collectively sub-optimal solution is called the “prisoners' dilemma”.

Collective action problems with a large number of agents using a depletable collective resource are often called a 'Tragedy of the Commons' after Hardin (Hardin 1968)). Game theoretic analysis suggests that such problems are extremely difficult to resolve. Two traditional remedies are a state with enforcement powers ('mutual coercion mutually agreed upon') or the creation of private property rights over the commons. Such solutions are difficult to implement directly in the case of greenhouse gas emissions. Existing global institutions have few enforcement powers, with sovereignty primarily existing at the level of the nation state (U.N. 1945) [4]. Approaches involving property rights are more easily implemented the further 'upstream' in the carbon extraction process (Tickell 2008). The degradation of natural carbon stores such as forests present particular challenges. Ostrom (1991) has analysed historical examples of successful local management of common pool resources (CPR) finding other models apart from privatization and the state. One important example is when agents agree on a mechanism to enforce contracts and agreement in advance of their decision over the use of the common pool resource.

Engel and Saleska (2005) suggest that the climate game might be better modelled as a small number of strategically interacting agents, rather than a commons with an infinite number of agents. The authors do agree that an international framework “is almost certainly necessary for achieving optimal solutions to a global commons problem such as climate change” but also suggest that sub-global action is justified too. They suggest that the question as to whether sub-global solutions are optimal is too simplistic, arguing that “a half-full glass may be better than none at all”. They investigate real action and find that in some cases (e.g. UK, Germany) the action taken is greater than would appear nationally justified. Pereau and Tazdait (2001) provide some supporting evidence by investigating the link between group cooperation and unilateral commitment. Some countries may decide to commit unilaterally: absence of international agreement does not mean global

3 Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, South Africa, Britain, and the United States. Source: IPS http://tinyurl.com/o69nh9

4 Partial exceptions may include the World Trade Organisation: see later in this document.

defection. Insiders of the coalition create an incentive for non-members to commit, without global coordination of emissions. Buchner and Carraro (2005) review work on game theory of coalition formation, concluding that coalitions are likely. The climate regime which is 'least opposed' is one where US and China cooperate.

> *"Despite these differences, at least two conclusions are common to all the aforementioned game-theory contributions. First, if countries can freely decide whether or not to cooperate, they usually divide themselves into two groups: a group of countries cooperate, whereas others free-ride. Secondly, at the equilibrium, the group of cooperators is split into several subgroups of cooperating countries, namely several coalitions form. These coalitions play non cooperatively against each other and against the free-riders."*

Unfortunately, although some decentralized action is likely according to such a game theoretic model, that action appears nevertheless to be rather limited (IPCC 2007b, p.p774) [5].

## Carbon Leakage

As defined by AR4 (*ibid.*, 665) "Carbon leakage is the increase in $CO_2$ emissions for those countries outside the ones that are reducing emissions." Kuik and Gerlagh (2003) conclude that the main problem with leakage is a reduction in world energy prices. As stated in the IPCC report (2007b, p.p665) "a decrease in global fossil fuel demand and resulting lower fossil fuel prices may lead to increased fossil fuel consumption in non-mitigating countries". Stoft (2008) provides an interesting and accessible discussion.

An increase in local fossil fuel prices resulting from mitigation action could also lead to reallocation of production to regions where prices are lower. Palstev et al (2003) use static global-equilibrium model GTAP-EG to determine leakage effects of the Kyoto Protocol. They report a leakage rate of 10.5%, with a range of 5-15%, with chemicals and steel sectors being the most significant sectors, and the leakage from EU to China constituting over 10% of total leakage. It is found that leakage depends on the carbon cost, with a greater carbon price leading to higher carbon leakage. This is a problem for those who advocate a high carbon price.

Since the IPCC Third Assessment Report, the literature has expanded to include effects of trade liberalization and increasing returns to scale. Reinaud (2005) concludes that with free allocation of $CO_2$ allowances, any leakage would be considerably lower than projected without this free allocation.

## Offsets

The Kyoto protocol contains not only areas where emissions are capped but also the use of 'flexible mechanisms' such as the 'Clean Developing Mechanism' (CDM), which allow developed countries to claim a reduction for their target, in exchange for a certified reduction in the developing world relative to an agreed baseline. International carbon offsets were proposed as a mechanism to reconcile equity with efficiency (Swisher & Masters 1992) and have been widely implemented. Disadvantages of such schemes involve questions of additionality and verifiability (IPCC 2007b) and perverse incentives (Stoft 2008), leading to questions about the scheme's effectiveness.

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5 *"Much of the literature on game theory suggests that the conditions necessary for achieving large-scale stable coalitions mean that relatively modest emissions reductions will be achieved (e.g. Carraro and Siniscalco, 1993; Hoel and Schneider, 1997). Cooperative game theory emphasizes the prospect of building stable coalitions if a transfer scheme (e.g. by emissions trading) can allocate the gains from cooperation in proportion to the benefits from reduced climate impacts (e.g. Chander and Tulkens, 1995; Germain et al., 1998; Germain et al., 2003). Eykmans and Finus (2003) note that much of the literature focuses on a 'grand (all party) coalition, analyses stability in terms of the aggregate payoff to coalitions and rests on very strong assumptions about implicit punishment of any free-riding countries.' A more extensive discussion of the issues of free-riding is contained in Chapter 10 of the TAR."*. These issues are discussed further under 'international feasibility'.

## *Cost Effectiveness*

*Baseline Results*
The Fourth Assessment Report Working Group Three of the Intergovernmental Panel on Climate Change (IPCC 2007, Chapter 11, p632) outlines an analysis of the carbon prices required and the macroeconomic costs and benefits of reducing greenhouse gas emissions. The IPCC suggest that the economic potential in 2030 is in the range 16-32GtCO2e at a carbon price of $100/tCO2 (relative Scenario a SRES A1B baseline, of 68GtCO2eq/yr in 2003; a carbon price of $100/tCO2 would reduce emissions to 42-36GtCO2e).

The Effect of Policy and Other Assumptions: The main conclusions from the third assessment report are summarized as follows: "The main conclusions from the TAR on the macro-economic costs of mitigation can be summarized as follows. Mitigation costs can be substantially reduced through a portfolio of policy instruments, including those that help to overcome barriers, with emissions trading in particular expected to reduce the costs." In particular Barker et al., (2006)"emphasizes that the uncertainty in costs estimates comes from both policy and modelling approaches as well as the baseline adopted. Uncertainty about policy is associated with the design of the abatement policies and measures (flexibility over countries, greenhouse gases and time) and with the use of carbon taxes or auctioned $CO_2$ permits to provide the opportunity for beneficial reforms of the tax system or incentives for low-carbon innovation."

The economic cost of achieving a given reduction is reduced by international cooperation to equalize the price across jurisdictions.

*Advantages of One Price*
Policy frameworks which equalize prices across countries (such as harmonized taxes or international emissions trading) are widely found to be more cost-effective than those which do not. The studies typically find that emissions trading halves the macroeconomic costs of the Kyoto treaty, with reductions in GDP of about 0.2% to 2% without emissions trading and 0.1% to 1.1% with emissions trading (Metz 2001, p.p10). Capros and Mantzos (2000, p.p8; IPCC 2007b, p.p641) show that international carbon trading can reduce compliance costs from $20bn to $4.7-7.2bn and bring down the marginal abatement cost from $54/tCO2 to $17-$45 (where ranges depend on the scope of trading across sectors and world regions).

*There may, however, be significant game theoretic disadvantages of emissions trading in particular. The (future) tradeable value of permits may provide a perverse incentives for less stringent commitments from nations in the first place. The future value of permits could be extremely high in the case of stringent targets, so national 'rent seeking' could lead to each nation seeking more permits, leading to a collective action problem which would purely be an artefact of negotiation design. This design flaw exists if (like Kyoto?) national targets are determined flexibly by negotiation. It could prevent nations adopting stringent targets in negotiations (assuming that they are enforceable). These issues are avoided if goals are enforceable and either:*

- *a principle or formula for allocating emissions is defined and agreed upon separately, preferably before the global cap is agreed; or*
- *an alternative approach to international emissions trading is adopted.*

*Spillover Effects*
Spillovers are effects that mitigation in one country or group of countries has on other countries or groups of countries. International spillovers include effects on sustainable development, impact on competitiveness, an effect on *energy prices* and *diffusion of new technology*. Some, using general equilibrium models, argue that spillovers can make mitigation action ineffective or worse if

confined to Annex One (developed) countries. Examples of spillover effects include technological change. However, “no global models can adequately determine the global diffusion of technological change.” There are some drawbacks in common modelling approaches: “Many models focus on substitution effects and ignore information, policy and political spillovers as well as the induced development and diffusion of technology.” (IPCC 2007b, p.p665)

*The Role of International Action; Technology and Price Equalization?*
Pizer (2006) asks three major questions, namely (1) “Is international agreement necessary?”; (2) “should we pursue international emissions trading?”; and (3) “how can domestic and international actions encourage long-term solutions to climate change?”. He finds that international agreement, while desirable, is not necessary: unilateral EU action is a counterexample to the idea that a global agreement is necessary for national action to take place. In regard to international emissions trading “there are easier ways to equalize prices”, while concerns over equity and climate damage may argue against price equalization in the first place. He argues that international activities should focus on tying national policies to developing country energy investments, where the majority of inexpensive mitigation options exist (although he expresses possible reservations about the Clean Development Mechanism).

*Summary: The Advantages of A Global Regime*
Barrett (2003) argues that a global regime “embracing full or nearly full participation” is needed if emissions are to be reduced significantly. Non-global regimes would suffer from free-riding problems, carbon leakage and lack of cost-effectiveness. Free riding is when some countries benefit from others' climate change mitigation, while themselves doing little. Carbon leakage is the phenomenon where carbon mitigation shuts down polluting industry in one country, only for the same goods to be produced in a non-compliant state without such stringent emissions reductions. Finally, cost-effectiveness is reduced in a sub-global deal because the countries that are reducing emissions may not have the cheapest options for doing so globally.

Similarly Poterba (1993) considers the mechanisms which could prevent damage from climate change, focusing particularly on the idea of carbon tax. The benefits of global cooperation are great. Most importantly, unilateral action is likely to be too small, because it may neglect the benefits of climate policy accruing to other countries (free riding); secondly, no single nation acting alone can stabilize greenhouse gas concentrations (lack of single strategic actor); thirdly polluters with high abatement costs may move to other places (carbon leakage). Empirical evidence suggests significant cost advantages of choosing multilateral over unilateral action (Burniaux et al. 1992).

## *Institutional & Political Feasibility*[6]

*Enforcement*

One major criticism of the Kyoto protocol is the lack of an enforcement mechanism. The ability to sanction non-compliance is very limited; and nations in any case retain the ability to fail to ratify any new treaty. Such concerns can only intensify with more stringent targets and suggest some effort to create credible and significant enforcement mechanisms may be justified.

*Sovereignty and Self-enforcing Agreements*

Dasgupta (2001, p.p186) notes that in the absence of an international enforcement agency, treaties may need to be *self enforcing*: where it is in the interest of all who have signed the treaty to abide by it on the assumption that all others who have signed it will abide by it. Dasgupta refers to some of Barrett's earlier work (Barrett 1990; 1997; 1999) pointing out that self-enforcing treaties may involve some nations but not all. "Those who do not sign a treaty would in effect be free-riders but nonetheless it would pay the others to sign it. One should expect globally inclusive treaties to be agreed only if the number of countries is small. Seeking treaties involving two hundred nations could be a futile exercise." Dasgupta continues: "Of course, if relative to the costs of curbing emissions, the perceived benefits are large, agreements can be reached amongst many more." Barrett's work (regarding the level of commitment when there are repeated interactions) is broadly consistent with that of Carraro and Siniscalco (1998), and Hoel (e.g. Hoel & Schneider 1997) which model participation in treaties with the stress on whether countries should negotiate at all. In the end, countries may cooperate if they see that to be the only way to avoid global catastrophe and their own perishing – but short-term considerations may often triumph.

*Interaction of Climate Policy with Trade*

In a dramatic set of results, Copeland and Taylor (2005) show that incorporation of emissions trading may lead to a reassessment of some of the conventional wisdom regarding the advantages of globalism and emissions trading for a closed economy. In particular, unilateral emissions reductions by the rich north can create self-interested reductions by the poor south. Simple rules (such as constant reductions) for allocating reductions in emissions across countries may be efficient even if trading in permits is not allowed, and, further, trading in permits may make both participants *worse off* and *increase* global emissions.

Another important issue is the interaction with the World Trade Organization (WTO), which has enforcement action available to it. Doelle (2004) and Burns (2004) point out that non-ratification of the Kyoto Protocol could imply illegal subsidies to national industries under the WTO and pollution of the seas under UNCLOG

Coseby (2008) discusses whether there are agreements within the World Trade Organisation (WTO) that would further the objectives of the climate regime. He considers both trade measures taken at the national level (with agreed rules of usage) and agreements at the multilateral level on trade rules (within the existing body of WTO law). The WTO is not a standards organisation, nor an environmental organisation; so it should not be used to determine environmental standards. One area of potential is in eliminating fossil fuel subsidies. The question as to whether cap and trade or carbon tax regimes should include a border adjustment is very active, both in the US and Europe. It would be difficult to get such measures through the WTO, but "anything is possible in a trade negotiation if you want it badly enough to pay for it". Analogies between the climate regime and the highly successful Montreal Protocol on controlling ozone-depleting substances are difficult because the contexts are different and "the details matter a lot". Developed countries need to act first if they are to achieve participation from developing countries (Zhang 2008).

6 Including political, legal, and trade issues

Buchner and Carraro (2005) consider 'bottom up' approaches that do not rely on a global climate change framework agreement. They provide a game theoretic analysis of sub-global agreements. An analogy is with Regional Trade Agreements (RTAs) and the international trade regime. Regional agreements - for example standards - can go beyond what is possible multinationally. After having considered the economic and political/legal aspects, Barrett (2003) suggests a R&D protocol and a standards protocol: the R&D protocol to invest in and scale up low carbon technologies; the standards protocol to promote excellent environmental results. Standards provide a natural strategic advantage within WTO rules.

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