PART FOUR: POLITICS AND INTERNATIONAL POLICY

Part Four sets out the politically difficult nature of climate change, using game theory:

- First, the basic game theoretic problem is outlined. Philosophical approaches to cooperation are outlined.
- Second, the literature on global cooperation on climate change is outlined.
- Third, the global climate policy game is outlined. I suggest a specific issue with global emissions trading that may lead to suboptimal outcomes.
- Fourth, a specific sub-national solution is developed, the *Energy Refund* for a *Climate Club*.
- Fifth, a complete set of proposals are outlined for effective global governance relating to greenhouse gas emissions.

Policy and Politics: A summary of the rest of the book

1. Avoiding dangerous climate change requires rapid energy decarbonisation. (Hansen et al. 2008)

2. Tackling climate change is an inherently difficult problem because the collective interests of the world as a whole are perceived to differ from the narrow self-interest of key actors. This is also referred to as the 'Tragedy of the Commons'(after Hardin 1968). Each country has an incentive to defect from the co-operative solution. A key method to solve the tragedy of the commons is to reformulate the problem in ways that avoid it. Any model is an abstraction of reality, a broader or narrower or different model of reality may include different features.(Hess 2007)

3. Later in the book I will deal with in detail with issues of political feasibility. We must avoid collective political '*Akrasia*'(Aristotle 1995; Book II, Chapter III, 1261b) or 'moral incontinence': sincerely wanting to do something and actually doing something else. The policies to achieve rapid decarbonisation would only be adopted by key actors such as nation-states, business and voters if they are to be perceived to be in these groups (broad) interests.[1]

4. The degree to which actions are perceived to be positive to key actors depends on:
a) whether the net benefits (financial and other) that accrue to the actors are in fact positive.
b) the terms in which the policy is expressed and how it is communicated.

5. An important cross-cutting criterion for net benefits for key actors makers is whether a policy increases the wealth of the participant (Dasgupta 2001). The real net benefit to key participants depend both on the design of the policy and the technologies used.

The different classes of participants defined above need to be considered separately:
6a. Nation States: The economic benefits to a country depend upon the benefits to the economy as a whole, to co-benefits such as security of supply. The international interests of nation states are
6b. Companies: The key characteristic of the economy is that it is currently carbon intensive. The structure of the economy can, however, change.
6c. Voters: Any policy changes would create winners and losers

7. Carbon Pricing. Carbon pricing is defined as an additional cost on fossil fuels or the pollution they produce, in addition to their extraction cost (Stern 2006, Chapter 14, p309). Carbon pricing can take the form of a carbon tax or a cap-and-trade scheme.

8. Political Constraints on carbon pricing. There are constraints on how hight the price of carbon can be and equivalently, how rapidly emissions can be reduced. This is related to the existing costs and benefits of activity according to the structure of the economy. However, the fact that a (small) tax on carbon is resisted, is only a product of the existing structure of the economy. The structure of the economy can be changed, by decarbonising the energy system.

9. Decarbonising the energy system will require large scale investment in carbon free energy (primarily electricity) generation technologies. Investment is a product of Expectations of future electricity and carbon prices & Uncertainty and risk in those projections.
In order to encourage large scale deployment, one possible option is the use of Electricity and Carbon Price guarantees (Ismer & Neuhoff 2006).

10.By making significant and well-designed policy changes now, we may even be able to create net economic benefits, but we need a widely adopted economic model that takes the behaviour of people and institutions into account.

1 See chapter 8

Table of Contents

POLITICAL THOUGHT ON COOPERATION IN THE CONTEXT OF CLIMATE CHANGE (*NOTES*) [2]

"We may pretend that we're basically moral people who make mistakes, but the whole of history proves otherwise" – Terry Hands, British Theatre Director

I outline the problem of the 'tragedy of the commons' and ways to tackle this problem from the history of political thought, with reference to global climate change.

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Climate Change and Game Theory

The Prisoner's Dilemma

The prisoner's dilemma is an example in game theory where common and individual interests differ. Two prisoners A and B are interrogated separately for a joint crime. If they say nothing, then each will get 1 year. If one confesses and the other does not, the confessor will get 3 months but the one who did not, will get 10 years. Finally, if they both confess they will each get 3 years. Which choice should they make?
A reasons that if B confesses then his choices are not confess (and face 10 years) or confess (and face (3 years) – in this instance his best response is to confess. If B does not confess, his options are to confess (and get 3 months) or not confess (and get 1 year) – again, his best response is to confess. B has exactly the same response; the net result would be that both confess, and they get 3 years. If they had been able to cooperate, however, they would only face 1 year each. The result was optimal from an individual point of view but socially suboptimal.

The Tragedy of The Commons

Climate change is a global example of the parable of the 'tragedy of the commons'. A limited piece of common land is grazed by many farmers. Each of the sheep eats a certain amount of the limited supply of grass. Each farmer has an incentive to graze more sheep. However, eventually the land is overgrazed, and no-one has enough to feed his sheep.[3]
The problem is that the social costs of the grazing are not felt by each farmer.
Pollution is a similar example. The atmosphere is polluted because each polluter does not notice the effects of his pollution on others.

The Logic of Collective Action

Mancur Olson described how groups may arrange themselves in order to lobby the government for goals. Those groups which are diffuse and unstructured may not be willing to lobby the government for their common goals.
In the case of a perfectly competitive market, collusion is impossible because the many firms that gain from defecting outweigh the possible gains from those who cooperate.
One might think that the groups with a common interest could create an organisation. However, such an organisation would be unable to constrain it's members because it would have exactly the same problem, unless active members were rewarded, there would be an incentive on all to 'free-ride'.
Olson argues that in a democracy it is not the majority that are likely to tyrannise the majority. Rather, minor interests, if they have interests that are concentrated, will be able to overrun the interests of the majority.

Rent Seeking Behaviour

The battle for economic rents is often called 'rent seeking behaviour'.
e.g. Krueger (1974) points out that political restrictions lead to the possibility of excess rents being accrued. She develops a model of rent seeking and is concerned about the possibility of a 'vicious circle' developing of political action inspired by distortions, itself creating more distortions.
This may have been what has happened with global warming. The interests of minor fossil fuel interests have managed to overrule the interests that the majority (and future generations) have in protecting the planet

3 Gardiner terms climate change “A Perfect Moral Storm” due to: Global Dispersion of causes and effects; Fragmentation of Agency; Institutional Inadequacy; Global; Intergenerational; Moral Corruption.

Climate Change and Economics

Does the free market work in this context?

Ignoring distributive concerns, economists suggest that the free market achieves a favourable outcome where an activity does not pollute (more formally, when a transaction between agents does not generate negative effects on other humans, animals or the ecosystem). When an activity pollutes, the market needs adjustment, or else there will be too much pollution generated.

How can the market be adjusted?

The government regulates firms and individuals. Pollution can be directly controlled, taxed, or permits to emit can be sold.

Direct control

Governments impose regulations preventing individuals or firms from emitting certain forms of toxic pollution. Firms are severely fined if they emit such pollutants, or if the concentrations of such pollutants breach safe levels. It is possible that the US clean air act could be used to control greenhouse gases.

Taxation

Taxation is an efficient way to limit a tolerable pollutant that nevetheless imposes costs on society. The amount of pollution is metered, and pollution is charged at a fixed rate. Taxation is an appropriate method of regulation where the social cost of pollution is well known.

Permits

Where the government wants to limit the amount of pollution to a certain level, it can sell a fixed number of emissions permits. The price of these permits will adjust so that the demand for them is equal to the number of permits.

Why is climate change a difficult problem to solve?

The effect of a polluter's actions are distant in space and in time.

Distant in space: Causing Problems for others on earth

The emission of greenhouse gases is a truly global phenomenon. These gases do not cause local problems, but they cause an increase in temperature for all on earth.

Distant in time: Causing Problems for future generations

The effects of CO2 emission will not be felt for some time. In addition, the global warming potential already accumulated has been masked by the global cooling effect of particulates, such as soot, in the atmosphere. Future generations have a direct voice only in the young.

No property rights

No person owns the atmosphere, so there is no voice to protest or negotiate.

Perception of Scientific Uncertainty

Governments may use scientific uncertainty as an excuse not to act

No global government

The solution to the problem of emissions in a national context involves a benevolent, well-informed government being able to impose regulation upon firms and individuals, so that the common good is protected. In the case of emissions of carbon dioxide, we would need a global government. Such a government does not exist. There are only international treaties. In theory, a global government could be created; but this seems unlikely because it involves nation-states giving up sovereignty, which they are generally unwilling to do (the European Union is the exception to this rule).

International Treaties on Climate Change

One way to solve the problem is through international treaties. Such treaties have succeeded when the cost of reducing emissions is low (e.g. Montreal Protocol banning the use of CFCs). The treaty limiting CO2 emissions is the Kyoto protocol. Problems with such treaties are:

Incentive to avoid stringent targets

Governments may avoid agreeing to limits on emissions that may be difficult to keep.

Incentive not to ratify treaties

Government may perceive it not to be in their national self interest to ratify international treaties. In the end even China will see it is in their interests to co-operate, if things get bad. But it may be too late then.

No Enforcement Powers

International treaties cannot be enforced, since international organisations have no enforcement powers. So governments may break their obligation without fear of serious repercussions.

Climate Change and Political Thought

How to cooperate?

How should we solve this problem of the divergence of individual and collective interests? Well, we have already seen two possible solutions.

Locke: Private Property

There is a tragedy of the commons because the land is not owned by anyone. If we assign property rights then whoever owns the land (and therefore the rights to use it) will look after it. He will then negotiate with any potential polluter, ensuring an optimal outcome.
The problem with this solution is that no-one can own the global atmosphere. The idea of emissions permits is a solution, but requires global enforcement, which is difficult. Similar issues exist regarding the global oceans.

Hobbes: The State

Hobbes famously thought that life without a state was 'nasty brutish and short'. He thought that, without a state, there would be war of all against all for three reasons: Competition, diffidence, and glory. We engage in competition for gain, we are diffident about safety, and we feel glory due to pride and reputation. We might think that humans are not necessarily like this, but, the idea of a 'prisoner's dilemma' strengthens the idea that without some sort of authority, nations can descend into anarchy, as is seen in 'failed states' such as Somalia.

Hobbes believed in a central authority who would prefer peace to prevail and would have a monopoly over the rightful use of force.
The problem with this solution to climate change is that there is no global government. One might however suggest that it would be an attractive situation if the world superpowers the US and China, and the source of legitimacy, the UN, were to find further ways of working together.

Utilitarianism; Kant and Rawls: Fairness

One might suggest that the solution to problems of co-operation is the notion of fairness. This may well be a way of preventing fights and feelings of envy over the unequal sharing of cakes. However, there is no guarantee that a 'fair' solution will be an ecologically sustainable one.
Furthermore who ensures what is fair? This could be a state (in which case this solution is perhaps the Hobbesian one) or it could be some sort of rational community (which we will come to). But there is no guarantee that states or communities would choose one notion of fairness over another.
Philosophers of an ecological bent might also suggest that to consider ethics in such an abstract way is to remove it from the aspects of life which make it attractive in the first place.

Marx: Revolution?

It may be that we need quite a large shift in behaviour to solve our problems. However, there is no guarantee that a revolution would produce a solution with a government any better at solving collective problems. Indeed, Eastern bloc countries often had more severe ecological problems than the West.
Smaller-scale socialism, with an emphasis on community self-sufficiency seems to be much more positive from an ecological point of view. Some sense of needs is also important. We will come to these ideas later, within the context of Aristotle.

Perspectives and Aesthetics

There is more than one way of looking at things. For example, consider the tragedy of the commons between individuals. Without institutions (such as moral traditions), the individual self interests of each of the 6 billion people on earth conflict with the collective interests of that population as a whole.
Now consider the tragedy of the commons in an inter-national context (for simplicity consider only the main economies: the G8 plus India and China). The individual interests of the 10 major economies conflict with their collective interests. We still have a tragedy.

But note that the formulation of the inter-national problem presupposes the existence of entities (nation-states), which have already solved some of their collective action problems. These states are presumably capable of choosing between a consistent set of overall national preferences. Given this, it isn't too much further to go to solve our global problems.

If we concentrate on the conflict between interests we may fail to see that co-operation is itself a good which may be reflected in the way we think. The concepts we use may reflect social conditioning, with one will (not necessarily an individual) 'taming' another. Such a process may well produce an outcome which is aesthetically pleasing. We may rationally wish our actions to reflect a creative motif of life that one would want to live again (and in a world that one might want one's children to live in). A philosophy weighed down by a shrill cry for fairness, or the need to encompass alternative views of life, may well be 'unhealthy' in a Nietzschean sense: vulnerable to ideological attack from more brutish tendencies, and incapable of the necessary discipline to generate more attractive alternative worlds.

Liberal thought is sometimes criticised for being schizophrenic: either allowing a free-for-all or imposing blankets laws or taxes. The notion that an ecologically sound way of life is to be preferred is, within Western economies, noticeably more prevalent amongst the well off than the poor. The cynical might say that to be 'environmental' is merely the prerogative of the rich. But ecologically friendly ways of life seem to be more than simply individual preferences, or reflections of wealth: there is both reason and emotion behind them. If we are to solve our problems, we need to have a more integrated world view. For that, we can look back to the Ancient philosophers, and in particular Aristotle.

Nietzsche was also of course somewhat mad. Aristotle will, as we will see, give us more confidence in reason than Nietzsche leads us to expect. This is in part due to a different definition of 'reason'. Aristotle avoids the rather narrow epistemology of (early- and mid-) modern rationalism and empiricism, whilst retaining a rational and empirical approach and a good helping of 'common sense'.

The next page is a bullet point guide to Aristotle's ethics. Aristotelian ethics is considerably richer in basic ideas than some modern approaches. To go into this in detail would require a book, but to concentrate on one or two points might miss something. The main concepts are outlined below. The particular aspects which may be relevant to the climate change problem are emphasised.

Notes – Aristotelian Ethics - What is it?

- Ethics shows the teacher how to build good character
- Ethical philosophy is a guide for the Statesman
- Ethics is a practical art, not a theoretical discipline
- Ethics depends on the sort of animals we are
- Ethics involves an overall 'sketch' of the good
- Aristotle egives space for what might be considered 'philosophical geography'

Virtue Ethics

Virtue Ethics is a solution to collective action without the need for a central authority.
Virtues are the 'golden mean' between two extremes. Virtues rely on spheres of excellence
Man's soul has parts

- Animal Man: Humans have needs inherited from animals e.g. nutrition, sex etc.
- Social Man: Humans have social needs. The 'good' can be defined from use in everyday discourse. Social consensus is a good.
- Rational Man (Theoretical and Practical Reason). Good depends on what we know about ourselves and the world. We need knowledge to act well, but we also require good character.
- Tribal Man? See below on international co-operation.

Ethics and The City State

Close analogy between society (city states) and human beings
A good city should have a moderate number of people: Too few and societies cannot be self-sufficient. too many and order cannot be maintained.

A 'Thin Theory of the Good'

- The good as defined by Aristotle (in contrast to Utilitarianism) is not a complete ordering.
- The realms of the various virtues are contexts in which we can justifiably define some sense of excellence.
- A 'sketch of the good' should be free to consider environmental issues as they impinge on humanity, rather than necessarily being forced to be restricted to discourse which merely considers individuals and their financial interactions.
- Man is a mental animal who makes plans. In solving our collective problems we can therefore frame our solutions in the most simple and convenient way.

Notes – Other important ideas in economics and philosophy

- Non-convexities (fragility) in ecology, human physiology and in human institutions: see Dasgupta.
- The Biosphere as self regulating system: See Lovelock Agency and Climate Change

Agency (abstract noun) is defined as "The Ability to Make Decisions", the ability to think; the ability to act on what is thought. What is agency. Who has agency?

Rationality

- Broome - If you are rational then you respond correctly to beliefs about reasons.
- Ethical Philosophy; Psychological question on why we act.
- Moral psychology is a part of moral philosophy. But much can be reasoned a priori

Group Intentions and Akrasia

PETTIT: Akrasia, Collective and Individual. Plato's Republic - analogy between the constitution of the city and the constitution of the soul. Agent hold intentional state in the light of which a certain response presents itself. States involve may be beliefs or desires judgements or intentions. Agent functions within limits that are favourable; there is no malfunction. However, the agent fails to act in the required way. We need to know what group intentions are. Margaret Gilbert on group intentions. Group intentions are made up of the individual intentions to control climate change. Probably a bit more complicated than that...individuals in groups swayed by large-scale beliefs, strong individuals' views etc

Politics

- Collectiv Action and The State
- Relation between the normative and the position
- Common Sense
- Conditions for the existence of a rational community

A Global Rational Community

It is very important for individuals and governments to interact with one another, allowing global networks and social capital to develop and ethical concepts to align. A global 'rational community' gives the Earth a chance to solve its problems. Such a 'rational community' must, however, ‘swim with the tide’, taking advantage of ‘learning by doing’ in a targeted and effective fashion.

Doctrine of the Whole and Parts

- For the whole to exist, it should take account of the survival conditions of the parts – related to James Lovelock.
- For collective interests to exist,the state needs to be cognisant of the organizations involved. What are the interests of the parts?

THE BENEFITS OF COOPERATION ON GLOBAL CLIMATE POLICIES – A LITERATURE REVIEW [4]

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

- Environmental Effectiveness
- Cost Effectiveness (efficiency)
- 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.[5]

This document analyses potential policy according to three criteria:

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

5 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[6] 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) [7]. 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

6 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

7 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) [8].

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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8 *"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[9]

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).

9 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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THE STRUCTURE OF CLIMATE CHANGE AGREEMENTS AND THE NATIONAL BENEFITS OF TACKLING CLIMATE CHANGE [10]

The incentives of nation states to participate in international agreements to reduce greenhouse gas emissions depend on the structure of the proposed agreements. Emissions trading may make the collective action problem of climate change *worse* because it produces a perverse incentive to commit to less in the original negotiations, due to the value of emissions permits to nation states.

The Kyoto protocol (and possibly the upcoming Copenhagen treaty) impose national targets for future greenhouse gas emissions coupled with emissions trading. Emissions trading, however, implies that the right to emit has tradeable value, which alters the incentives to commit to reductions in the original negotiations. The value of permits therefore provides an incentive for individual nation-states to commit to less stringent targets; because they will wish to grant themselves more permits. These problems are potentially made worse if some parts of the world are allowed to participate without a cap. This result is extended to the notion of a positive global *institution,* as a set of rules which changes agents' incentives to participate and make it more likely that a cooperative outcome is attained. Coordinated taxes with a voting system are a global institution in a sense that quantitative targets with international emissions trading are not.
We consider the national costs and benefits of tackling climate change. Finally we develop an additional conservative design criteria for policy formulation – treaty structures should minimize the transfer of rents relative to the *status quo ex ante* – *incentive* effects can be separated from *income* and *endowment* effects.

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Introduction

Discussions of climate change policy often assume that there is a 'collective action problem' (see e.g. Talbott)' [11] associated with a global public good such as the atmosphere, often referred to as a 'tragedy of the commons' (Hardin 1968; Grasso 2004). This paper analyses such a problem and argues in fact that there may be two, closely related, but separate, problems.

- Firstly there may be a collective action problem[12] associated with the costs of greenhouse gas abatement to individual nations.
- Secondly, there may be a collective action problem[13] associated with the structure of the institutions we use for solving the problem.

Often it is assumed that the two problems are the same; the 'burden' is the reduction in emissions and we might allocate this in various ways by 'burden sharing'.

It may be that the macroeconomic costs of optimal real policy changes to reduce greenhouse gas emissions are positive at the margin, but that the structure of proposed international agreements is such that, at the margin the overwhelming incentive is to negotiate for more permits and therefore fewer emissions reductions.

Why Analyse at the National Level?

National interest is argued to be an appropriate concept for understanding the climate change negotiation game. Nation-states are the key actors involved in taking policy positions to reduce emissions. Most decisions are taken at the national level. The decision over how to set up a tax system; the decision over whether to participate in international agreements; all these decisions are taken at the national level. The primacy of national sovereignty is emphasized (with a few exceptions such as the European Union) in international law; from the treaty of Westphalia to the United Nations founding charter.[14]

That is not to say that the national interest is a straightforward thing to define. Different parts of the world will have different perceived interests, according to their state of development. In this document, I will simplify by considering each state to be an actor which maximises its' long term wealth. A country will act in its own interest.

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11 (Talbott): A **Collective Action Problem** is defined as "A situation in which everyone (in a given group) has a choice between two alternatives and where, if everyone involved chooses the alternative act that is **Individualistically Rational** (IR), the outcome will be worse for everyone involved, in their own estimation, than it would be if they were all to choose the other alternative (i.e., than it would be if they were all to choose the alternative that is not IR).";

For an agent to behave **Individualistically Rationally** (IR) is "To Maximize One's Expected Return (Total Expected Benefits Less Total Expected Costs). This sense of rationality is the twentieth-century development of the concept of Instrumental Rationality. It is the notion of rationality that is employed in economics. (Note that to be Individualistically Rational does not require that one be an egoist.)"

12 Or a "natural tragedy" - i.e. a collective action problem that is unavoidable; assuming that the structure of agents and coercive agents is fixed but the structure of policy is not.

13 Or an "unnatural tragedy" - a collective action problem which is purely an artefact of the structure of the institutions used to solve the problem.

14 On the other hand, it is not clear that modern states are especially simple. The following alternative aspects could be outlined

- Nation State -- National-Hobbesian (Hobbesian National Interest)
- Voters -- Democratic (Democratic/Public Choice Theory)
- Companies -- Interest group theory (Marxist Theory)
- Institutional Interests - Church
- Speaking rational community (Aristotle: representative element, integrative element)

Why Game Theory?

In this paper, I will analyse the incentives of international agents according to *game theory.*

Game theory describes the behaviour of agents under two conditions:
a) the behaviour of agents is completely described by some pay-off function which the agents are expected to strictly target
b) the pay-off of an agent is not only determined by that agent's own choices, but also the choices of other agents.

A collective action problem is a situation where the incentives of individual actors differ from the average interests of all. It is argued that there is such a collective action problem with regard to international agreements to reduce greenhouse gas emissions. There is an incentive to free-ride on the actions of others in regard to international action. One nation can desist from reducing its emissions while others do so. If everyone does this the net result is that few or no reductions take place.

A Game Theoretic Model of Emissions Trading and Harmonized Taxes

In this section we set out the incentives for a country to engage in various emissions reduction treaties. The pay-off for a country for emissions trading and for harmonized taxes are outlined.

Emissions Trading

Country: i

Permits to emit: R_i

Emissions: E_i

Price of permits P(Ri,Ei)

Net international payments: $R_i - E_i P$

Cost of emissions target: $C(E_i)$

Climate Damage: $D_i = D(\Sigma E_i)/n$

Net Benefit: $C(E_i) - D(\Sigma E_i)/n + R_i - E_i P$

1: Negotiation Stage: Choose R_i

2: Implementation: Choose E_i

Harmonized Taxes

Country: i

Tax Rate: T

Emissions: $E_i(T)$

International payments: 0

Cost of emissions target: $C(E_i)$

Climate Damage $D_i = D(E(T))/n$

National Benefit: $C(E/n) - D(E(T))/n$

1: Negotiation Stage: Choose R_i

2: Implementation: Choose E_i

Sharing of a variable-sized pie
Unfortunately, direct or indirect discussion of quotas actually distracts from the problem itself and instead focuses attentions on the size of each participant's slice of the pie. Each wants a larger slice, and the net result is that the pie itself gets bigger, a disastrous outcome for the planet as a whole.

Is there a natural tragedy? Evidence for Positive Benefits from Climate Policy
Some economic evidence suggests that a stable carbon tax might encourage economic growth rather than the reverse. A carbon tax is essentially a consumption tax, which has many positive economic benefits related to promoting economic growth. So quantitative reductions may have and be seen to have negative value for each nation and yet a policy to achieve the same goal (among other things) may have a positive value.

Towards a New Criterion

Climate change agreements are often analysed according to three criteria: effectiveness, efficiency, and equity. When applied to climate change, widely understood to be caused by the industrialized north and largely affecting the poor south, it could be argued that in regard to equity, the importance of a high level of political feasibility and environmental effectiveness trumps the direct short term financial implications of climate change policy.

Here, I argue for a new way of thinking about equity and political feasibility: a climate change policy should be as near as possible a *neutral* change in the *interests* of agents. It is possible to separate the *interests* of agents in participating in an agreement from the marginal *incentives* of agents to change their behaviour once within an agreement, by appropriate lump sum payments.

Is there any way that emissions trading could work?

The simplest solution to the dilemma is to replace emissions trading with coordinated taxes. Another solution is a multi-stage negotiation process, where a *framework* for deciding upon the allocation of permits is considered.

1. Enforcement
2. Framework for the Allocation of Permits
3. Global Target

In this way, the global incentives of harmonized taxes are replicated, ensuring that 'permit seeking' does not make the agreement useless.

National Costs and Benefits Of Mitigation Climate Change

What are the national macroeconomic benefits and costs of tackling climate change?
The macroeconomic benefits and costs of climate change are the changes in (global or national) income as a result of climate change policy. Macroeconomic costs measure the overall change in the economy. Here we focus on the national level (changes in National Income). Estimates of changes in global product are available in the literature (Stern 2006).
Macroeconomic costs is a larger concept, to be distinguished from the *investment* required to tackle climate change (how much money has to be invested now), or the *energy system cost* of so doing (the net change in expenditures for the whole energy system). Macroeconomic cost includes the changes in income (GDP) for the whole economy.[15]

What do macroeconomic costs depend upon?
Climate Change policy usually involves a **price of carbon**: such as carbon taxation or emissions trading. These carbon pricing schemes collect **revenue** for the government which levies the tax, revenues which can be spent to reduce other taxes.[16]

The Economic Benefits from Climate Policy

Capture of Fossil Fuel Scarcity Rent (otherwise taken by cartel members/owners of resource) & Long-term **Security of Supply** (when fossil fuels are imported).

Displacement of Taxation with higher deadweight costs and thus increased economic output, **Environmental Co-benefits** (e.g. low greenhouse gas technologies also have low levels of other pollution, electric cars produce lower levels of ***noise***). (Although wind turbines are noisy).

Conservation of indigenous resources which may have alternative or future uses (when fossil fuels are indigenously produced).

Learning by Doing. Arrow (1962) points out that a quantitative understanding of the major factors in economic growth leads to the conclusion that technological change is of fundamental quantitative importance. While technological learning is usually a global phenomenon, for less mature technologies (e.g. wave power) learning may provide a significant local benefit.

Climate Benefits. For a large country such as China, the direct climate benefits of Chinese action on China itself may be significant. Even smaller countries might have a global influence if they can 'show the way'.

15 Measures of income such (GDP) can be criticised because they do not distinguish between productive and unproductive use of resources. Some have suggested (e.g. Dasgupta 2001) that, rather than GDP change, we should actually look at changes in ***wealth*** (including natural wealth). By this criterion, climate change policy will also cause an increase in wealth, since replacements for fossil fuels tend to require **physical assets**. **Financial wealth** will of course depend on **financial assets**, but these are likely to be increased too, depending on the response of other parts of the economy.

16 The revenue from either a tax or permit scheme could be used for other purposes of course, such as bribing the incumbents to accept the scheme, often known as 'grandfathering' of permits.

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AN 'ENERGY REFUND' FOR A 'CLIMATE CLUB' [17]

Practical proposals for refunded, complete, coordinated carbon taxes are outlined.

The `Energy Refund' is a levy of \$200/t$CO_2^e$ imposed immediately by countries (or trading blocs) that are members of a `Climate Club' on any fossil fuels or other goods that typically produce greenhouse gases; plus goods that have already produced greenhouse gases in their manufacture or transportation in countries (or international space) not in the club. The revenues generated would be refunded to taxpayers, business and local resource owners as contracts to develop low-carbon electricity generation The purpose of the refund is to prevent large rises in the world market price of oil and other fossil fuels, over the next few years, and to accelerate the fight against climate change. It is envisaged that the `Climate Club' would include the majority of the Western (OECD) nations, with the optional addition of India and China [18] [19]

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18 Similar proposals have been outlined before, for example the `Refunded Emission Tax' proposed by Johnson (2007b; 2007a) and the `Untax' proposed by Stoft (2008).

19 This paper elaborates on a suggestion made by Barker (2008) `It would greatly help to establish simultaneously [with fixed exchange rates] other global prices as signals to support accelerated decarbonization of the global economy, namely the carbon price and the prices of the main fossil fuels. This involves recognizing existing and instituting new cartels, but it will encourage consuming countries to compete for carbon rents by raising carbon taxes and tightening their targets in trading schemes. It could also be extended to encourage the supplying countries to lock undeveloped fossil resources into the ground, preserve existing forests, and develop new ones. .'

Background

Fossil Fuel Prices

Between 2000 and 2007, oil prices rose steadily, from $10/bbl in 2000 to $60/bbl in 2006 and to $150/bbl in 2007 (IEA 2009). Gas and coal prices have also risen significantly in this period. Fossil fuel prices fell back during the early part of the recession but are now increasing again (Fig. 1).

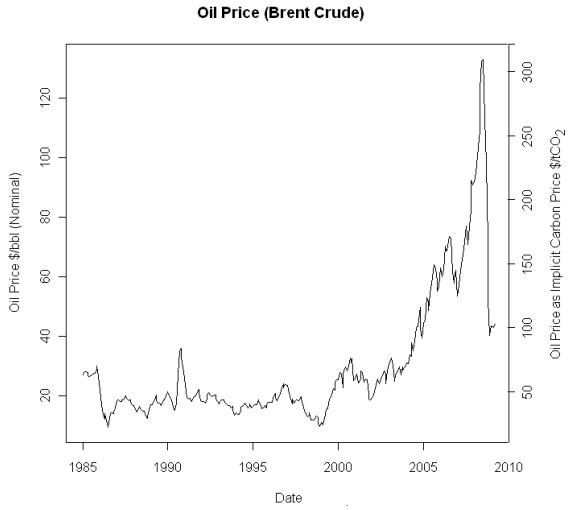

Figure 1: Oil Prices since 1985 (IEA 2009)

The supply of oil is likely to be constrained relative to demand in the near term due to inherent resource limitations (IEA 2008) and the increasing concentration of remaining resources (and therefore market power) in the hands of the National Oil Companies (NOCs) of the Organization of Petroleum Exporting Countries (OPEC). It therefore must be considered likely that the price of oil will rise from the current level of around $65 per barrel of oil (/bbl) to over $100/bbl and then on to the levels seen in 2007 (around $150/bbl). An increase of $85/bbl (from $65/bbl to $150/bbl) is equivalent to a Carbon price of $200/t$CO_2$ (EPA 2009).

Inflation Outlook

The threat of falling prices during the global recession of 2008-9 has only been assuaged by highly interventionist government support. A low or negative inflation rate has serious dangers. Deflation, in a society with high debts, threatens to create a debt-deflationary spiral (Fisher 1933), where falling prices *increase* the *real* value of debt, further depressing demand and reducing prices further.

Central banks can influence the real economy through the real interest rate, which is equal to the bank base rate minus the inflation rate[20]. The main macroeconomic policy tool is the central bank base rate[21].

A lower inflation rate will, for a given *nominal* base rate, *increasing* the *real* interest rate. Normally, the nominal interest rate would be adjusted accordingly so this is not important, but in cases of depression, the interest rate may be near, or at, the *lower bound* of zero. Interest rates cannot fall

20 In this case, the GDP deflator, which includes the price changes according to the whole economy.

21 The particular rate of interest targeted by a central bank (the base rate) varies by jurisdiction. The *Federal Funds Rate* (US), the target base rate in the United States, is the rate at which banks are charged to lend balances at the Federal Reserve to one another. The Official bank rate (UK) is the interest rate that the Bank of England charges Banks for secured overnight lending from the Bank. In practice all of these interest rates are approximately the minimum rate of interest charged on the short term (e.g. overnight) lending between essentially credit-risk-free institutions).

below zero, because people would store bank notes at home rather than invest them in the bank. For example it has been estimated that the ideal interest rate in the United States in early 2009 would be minus 5% (Guha 2009). The increasing ineffectiveness of macroeconomic policy when interest rates approach zero is known as the *Liquidity Trap*.

Governments can engage in alternative activities to stimulate demand (e.g. *quantitative easing*, a form of monetary creation, and *increased government spending (transfer payments, consumption and investment) funded through borrowing*. Such measures risk stoking inflation in the medium term Carbon price provide an alternative method.

What is the Energy Refund?

The Energy Refund is a levy on the importation and extraction of fossil fuels according to carbon content which is then refunded to citizens, business and resource owners as valuable incentives to develop low-carbon sources of energy.

What Level Should The Energy Refund Be Set At?

I suggest a level of $200/tCO$_2^e$. This can be compared to the level of tax needed to encourage the following technologies:

- Coal with Carbon Capture and Storage: $85-130/tCO$_2^e$ for new demonstration plants and $40-60/tCO$_2^e$ in 2030 for commercialized plants[22] [5]
- Concentrated Solar Power: $115/tCO$_2^e$ (Staley et al. 2009)
- Capture and Storage of Carbon Dioxide from Thin Air: > $140/tCO$_2^e$ [23][6] (Keith et al. 2006)

Since recent evidence suggests that we will need to draw down carbon dioxide from the atmosphere, now, or at some point in the future (Hansen et al. 2008) charging for CO_2 at a price higher than that needed to support backstop technologies, which may be enough to draw down CO_2 from the air.

What Is The Coverage Of The Scheme?

The scheme will cover all energy-related, agricultural and industrial emissions of greenhouse gases associated with domestic emissions and foreign emissions associated with imports of all participating countries. There will be levy on fossil fuels at import or extraction, according to carbon content. There will also be an equivalent levy on other greenhouse gases such as those arising from agriculture (methane from cows – levied on the sale of meat; Nitrous Oxide from fertilizers – levied on the sale of fertilizers), fossil fuel extraction (escaped methane – levied on mines, wells or pipelines), and industrial gases (levied on their intended or unintended manufacture). Any products that could decompose or accidentally release carbon should be taxed appropriately.

At What Point Is The Levy Charged?

The tariff could be charged at the point of entry of coal, oil or gas into a member of the Climate Club. The money could either go to the country at which fossil fuels are imported; or it could be that the money is used to centrally fund the EU; to replace the funding by the nation states.

22 Nauclér et al. (2008) suggest €60-90/tCO2e for new demonstration plants and €30-45/tCO2e in 2030 for existing plants. Exchange rate used: €1=$1.4

23 $500/tC (Keith et al. 2006); 1/tC = 0.27/tCO_2

Wherever fossil fuel is imported, the tax incidence will end up with the end-consumer - in other words, the scheme from the point of view of incidence is equivalent to cap-and-trade, but easier to administer.

Who Gets The Refund?

Both the political viability and economic efficiency of this scheme depends substantially on the use of the revenues; but political viability and economic efficiency often pull in opposite directions! I propose that the refund will be rebated to taxpayers, businesses and owners of natural resources within participating countries.

Johnson (2007a; 2007b) sets out a strong case for taxes that are refunded to the emitter according to historical emissions, in a similar way that emissions trading permits are often given away (`grandfathered') to existing polluters. Revenue neutrality within the sector is maintained.

However, it should be noted that behind the existing practice of `grandfathering' there may be a naive theory of tax incidence; namely the `Flypaper Theory' of tax incidence (the incidence of the tax is the same as that entity on which it is levied). The e*conomic incidence of a* tax is not the same as the legal incidence (those on which the tax is levied (Entin 2004)). For example, a perfectly competitive electricity market would simply pass on the marginal cost of carbon permits to the consumers, whoever is given the permits or refund.

This suggest a new criterion for refunds. Political actions should leave unchanged or increase the valuation of assets of key actors. The relevant `losers' are infrastructure owners and resource owners. Carbon resource owners could be compensated by an endowment fund; infrastructure owners by first bite on scarce subsidies to construct alternatives to the infrastructure retired.
It also should be noted that interest groups generally have short-term horizons, whereas the common interest is long-term. In the short term, rebates will be paid to companies, resource owners, and to individuals; in the longer term, as alternatives to fossil fuels are developed, the revenues would be used to pay off the national debt.

Interaction With Existing Cap-and-Trade Schemes

The Energy Refund is complementary to long term greenhouse gas reduction targets or schemes; and supplements cap and trade schemes. It should be noted that fixed-price (this scheme; Carbon Taxes) and fixed-quantity schemes (cap-and-trade) are not inconsistent with one another; and are not necessarily mutually exclusive. If both this scheme and a cap-and-trade scheme are implemented, the combination is a system that puts a floor on *both* prices and quantities; and therefore combines the best elements of both. The combined carbon price could therefore include both the carbon levy/tax and the price of permits.

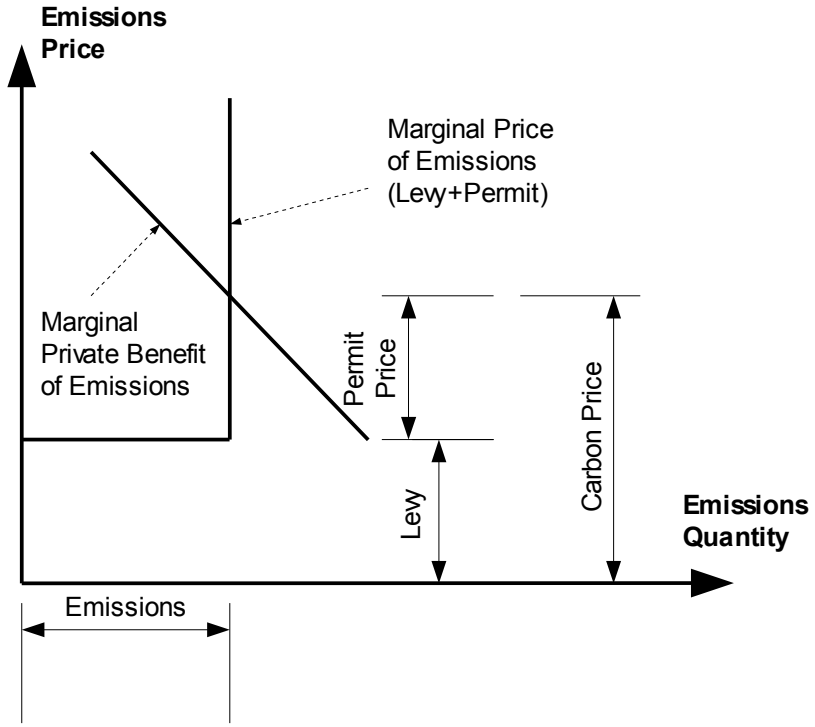

Figure 2: Levy plus Cap-and-Trade: Quantity Constrained.

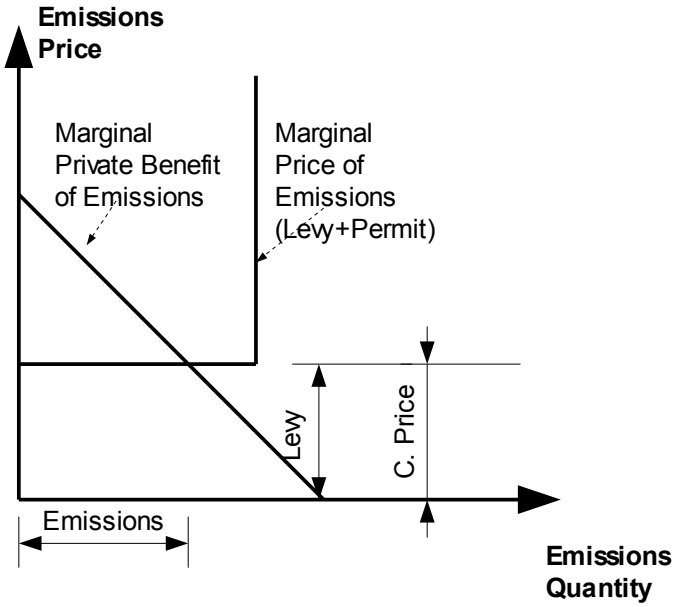

Figure 3: Levy plus Cap-and-Trade: Price Constrained

The Energy Refund provides the price certainty needed by investors in technologies such as carbon capture and storage and solar energy (needing carbon prices of $\$100/tCO_2$), whilst not `picking-winners'.
The advantages of this proposed policy scheme are gains to Organization of Economic Cooperation and Development (OECD) taxpayers, especially if the levy displaces fossil fuel rent that would go to oil-rich countries. It would prevent an rise in the global price of oil of a similar magnitude in the near future which would be damaging to the economic interests of the West. If the tax is perfectly harmonized across the world, we approximate that the levy would prevent an equivalent amount of oil consumption, and therefore provide a net benefit to OECD companies, domestic resource owners and individuals of $42-$85/bbl, or around $1000 per citizen. There may also be a case for increases in carbon prices now, preventing deflation now and preventing the future inflation associated with a rise in fossil fuel prices.

Who Joins The Club?

The energy refund is coordinated (ideally at the same level) across countries, such that they all have a common carbon tariff for the import of carbon-based fuels. Participation in this `Climate Club' is optional. The members of the club (for example, in the first instance, the EU and US and other members of the OECD) would impose a common external tariff on such goods. The carbon price is proposed to be enough to solve climate change once and for all", around $\$200/tCO_2$.

What About Countries Who Do Not Participate?

Two things are charged on import: fossil fuel, and embodied energy. For imports and exports to those countries not participating in the scheme, border adjustments are made. A levy at an equivalent level is also placed on imported goods and services, according to the estimated total greenhouse gas produced in their manufacture and transportation (a so called `border tax adjustment'). The unified levy excludes the case of explicit or implicit subsidies. Fossil fuel border tax adjustment would ensure that all consumption-based emissions are accounted for. See (Helm et al. 2007) for a demonstration of the importance of the emissions embodied in imports and international travel for the UK.

Major Technical Issues

There are major technical issues associated with this proposals:

1. How to *measure* the carbon levy in different countries; Nordhaus (2007) discusses the measurement issue when proposing harmonized carbon taxes.
2. How to determine the border tax adjustments for 'embodied carbon', ensuring legality? This has been dealt with extensively elsewhere (Ismer & Neuhoff 2007).
3. How to enforce price based agreements? One option is so called options for difference on the carbon price (Ismer & Neuhoff 2006).

Major Criticisms of Price-based Approach

Stern (2009) suggests three major criticisms of a tax-based system: First they "do not give much certainty on how big the resulting reductions will be"; Second "taxes are very hard to coordinate internationally"; third "electorates are mistrustful of governments' use of tax revenue".

Regarding the first criticism, obviously, for a given carbon price, whichever instrument has the higher price would reduce emissions the most. There are some reasons, relating to investment incentives, to suggest thatan emissions trading scheme is likely to lead to higher volatility, and therefore higher carbon prices, for a given level of stringency than a tax-based system.

Regarding the second criticism; measurement is certainly an issue for tax-based systems; but countries have coordinated external tariffs before.
The third criticism (use of revenues) is a problem for both cap-and-trade and for carbon taxes; and is a question of how a policy is framed. Governments desperately need revenues in the medium term.
Hamilton (2009) criticizes Nordhaus on grounds of ethics. He suggests that a tax-based system "discards fairness". This is a serious concern. However, it should be mentioned that membership of the Climate Club is optional; and fulfils the principle that, for countries not in the club, emissions from embodied carbon are the responsibility of the importing nation and not the exporting one.

Much of the rest of Hamilton's article is an attack on Nordhaus's economic models and economic philosophy; and therefore is not relevant. Hamilton clearly thinks that more stringent emissions reductions are required; and this proposal aims to fulfil this objective.

Summary: The Case For A Climate Club

1. When the global economy was doing well the oil price shot up to $150/bbl. Part of that price rise was speculative, but lots of it was the constraint on supply and high demand.
2. When the global economy starts to `grow' again we'll eventually (probably quite soon) be back at a similar price, because supply is constrained. This would amount to a `scarcity rent' of about $100/bbl going from Oil Importing Countries (US, EU etc.) to Oil Exporting Countries (the cheapest oil costs $2/bbl to produce).
3. This is a) unfair (unearned income, from economic rent of natural opportunities - what have they done to deserve this) and b) bad for the oil consumer's interests and c) bad for the environment, because it encourages companies to look for new, often dirtier, forms of oil.
4. A coordinated external tariff duty (framed as a `tariff' for internal EU/US consumption and as a neutral `externality tax' for the purposes of WTO rules) can manage down the global price of oil and provide an alternative.
5. Embodied energy needs to be accounted for in Western emissions policy. Much of the emissions from consumption behaviour take place in other countries (e.g. imported TVs from China).
6. The charging for embodied energy gives a huge incentive to join the scheme. because, potentially, carbon could be charged upstream (and accrue to the producing country)
7. So the Climate Club can set rigorous terms for joining the club.

Appendix 1: Frequently Asked Questions (Draft Only)

How Would The Club Enforce Agreements?

The Climate Club enforces its agreements with contracts; it is possible for one country to impose a different carbon price at the border, but it would have to compensate the other members of the club with a certain cost if it were to do this.

How Would We Calculate Embodied Carbon For Imports From Outside The Club?

One simple way is to calculate overall emissions per unit GDP and count the value of imports; or emissions per weight and count the weight. In addition exports should be exempted from the levy to avoid a competitive disadvantage. A discussion of border taxes is available (Ismer & Neuhoff 2007)

Are There Any Trade Concerns?

This scheme is equivalent to a neutral carbon tax where imports and domestic production are charged equivalently. As environmental damage is a real cost; *not* charging for emissions might constitute an unfair subsidy. Recent report from the WTO suggests that border tax adjustments are allowable under WTO rules (Harvey 2009; Tamiotti et al. 2009).

What About Agriculture?

N_2O from fertilizers and Methane emissions from cattle should face an equivalent levy according to their relative contributions to climate change (GWP100). This levy should be imposed upstream, on the manufacture of fertilizer, and as a `grazing license'.

What About Land Use Change?

Changes in forests and other natural sinks is outside the Club's scope. Nevertheless, revenues could be refunded to those with standing carbon (Joslin 2009).

Appendix 2: Other Policy Ideas

- Minimum tax on coal for electricity generation.
- Minimum fossil fuel import tax; minimum fossil fuel extraction tax.
- Guarantee the carbon price / energy tax into the future in order to de-link current behaviour (which causes a political backlash) with investment behaviour.
- The current proposals keep all of the funds within the country that imposes the levy. In addition there could be a small *International* Carbon Tax to fund the United Nations
- To prevent a voter backlash, we could allow "grandfathering" (e.g. based on last year's consumption) for individual energy consumption. In that way nobody would lose in the short term. Ha – that's what grandfathering is.!..

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CLIMATE POLICY – A NEW AGENDA FOR EFFECTIVE GLOBAL ACTION[24]

"Rules must be binding; Violations must be punished; Words must mean something."
(Obama 2009)

New climate change policy structures are proposed that, it is suggested, would be politically feasible and more effective than the structures agreed at Kyoto & Copenhagen.

The negotiations which took place at Copenhagen at the fifteenth Conference of the Parties (COP-15) of the United Nations Framework Convention on Climate Change (UNFCCC) aimed at the fundamental objective of the UNFCCC: to stabilize atmospheric greenhouse gas concentrations at non-dangerous levels. It is argued that the existing institutional tools at our disposal – international treaties and in particular the Kyoto protocol – are insufficient to achieve this goal. Furthermore, the framework put in place at Kyoto suffers multiple and fundamental flaws which fatally undermine its effectiveness; any new treaty must have a structure which evades these flaws if it is to be effective. Treaties, legal structures, and other institutions more commensurate with the scale of the climate change challenge are suggested to inform discussions around the structure of a future climate agreement. An *agenda for effective global action* is outlined:

1. Strong *global institutions – e.g. a world environmental agency* – including an agreed *framework (such as coordinated carbon taxes)* for *collective policy,* to replace *national commitments*.
2. A framework *action plan* to *eliminate carbon emissions* sector-by-sector, region-by-region, over the next *two to three decades*. In particular a plan to develop, transfer and deploy the safe, responsible, and very large-scale use of enhanced energy efficiency, renewable-electric, nuclear, and carbon capture and storage energy technologies; and to encourage responsible land use and agriculture, including the sustainable use of water.
3. A *significant* ($100-$200/tCO_2e), *sectorally complete, substantially geographically complete, agreed,* and *guaranteed minimum carbon price*, levied *upstream* at the *national level* (including embodied carbon from any regions not otherwise carbon-constrained), with revenues *used at national discretion.* It is possible that a carbon tax may have net economic benefits at the national level if used to replace taxes with higher 'deadweight' costs. The removal of fossil fuel subsidies has already been agreed as part of the Kyoto protocol, but has not been fully implemented.
4. A plan to protect forests and other natural carbon stores.
5. A plan to keep high carbon fuels in the ground (following Hansen et al. 2008).
6. An enabling framework for enforceable state-corporation climate contracts (e.g. guaranteeing the carbon price for investors) (Ismer & Neuhoff 2006).
7. An enabling framework for the use of *trade sanctions* to enforce state-state climate commitments, such as *border tax adjustments* (Ismer & Neuhoff 2007).
8. Unimpeachable monitoring and verification of all commitments.

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Introduction

About COP-15

The fifteenth Conference of the Parties (COP-15) under the United Nations Framework Convention on Climate Change (UNFCCC) is took place Copenhagen between 7th and 18th December 2009. The UNFCCC was signed in 1992 at the Earth Summit at Rio, Brazil, and ratified by 192 countries worldwide. Its objective is as follows (U.N. 1992):

> *"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt, is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."*

There were two streams to the Copenhagen meeting: the Ad-Hoc Working Group on the Kyoto Protocol (AWG-KP), which aims to extend the Kyoto treaty and secondly, the Ad-Hoc Working Group on Long-Term Co-operative Action (AWG-LCA) – which aims to develop a successor treaty to Kyoto.

Overall, the main purpose of the negotiations is to agree upon targets for the reduction of emissions of carbon dioxide, and other greenhouse gases. Secondly, rich countries are proposed to provide a fund to aid climate change mitigation and adaptation in the developing world.

What Was At Stake?

Decisions made at the Copenhagen conference decisively influence whether the rise in global average temperature can be limited to two degrees Celsius above the pre-industrial level. Temperature rises above this level make it likely that the Greenland ice sheet would melt , and risk triggering severe positive feedbacks, such as the degradation of the tropical rainforests (Fischlin et al. 2007) and the release of methane stored in permafrost and clathrates.
To have a *likely* chance of keeping temperature rises below the 2 degrees target, total cumulative emissions for the 21st Century need to be less than 1000 billion tonnes of carbon dioxide (M. Meinshausen et al. 2009). In the first decade of the century global emissions already amount to *over a third* of this cumulative budget, so less than 650 Gigatonnes of CO2 are left for the rest of the 21st Century, equivalent to reductions in emissions of the order of 10% per year, in the context of rapidly rising population and economic output (Anderson & Bows 2008). On the pessimistic side, to constrain temperatures *at all,* concentrations of greenhouse gases must be stabilised at *some level.* Simple carbon cycle measurements (Solomon et al. 2007) suggest that emissions would need to fall to less than or of the order of 7 Gigatonnes of CO_2 per year to achieve this.

Existing Structure

Why The 'Kyoto' Approach Fails

The structures for climate change mitigation agreed at Kyoto were flawed in a number of different ways. The most obvious flaw was the lack of effectiveness – it is not clear that the Kyoto treaty has reduced emissions at all. There are three main reasons for this lack of effectiveness:

- Firstly, the treaty does not give binding commitments for all major emitters – in particular, the developing countries has no binding commitments and the United States signed but did not ratify the treaty.[25]
- Secondly, among the countries that implemented the agreement, many did not achieve the Kyoto targets. Little real action was noticeable – those who have achieved the targets (such as the UK and the former Soviet states) seemed to do so largely by accident rather than design.
- Thirdly, the targets, although binding in international law, included no enforcement mechanism, beyond a threat that future targets would be more stringent for those countries that failed to achieve the target. There are also the following problems with international treaties in general:
    - Countries can in principle withdraw from treaties once signed, although this is rare.
    - Treaties face significant barriers in the US congress, with two thirds of United States senators required for ratification.

The Kyoto approach requires national emissions targets, negotiated country-by-country. It is possible that emissions reductions, whilst key to the end goal, are a politically and psychologically negative way of 'framing' commitments. (In other words, if commitments are expressed in different, but likely equivalent, terms, the balance of perceived national benefits may be different, for a given level of expected stringency). Countries may not know if they are able to reduce emissions by a large amount. Fast developing countries such as China or India may wish to play safe, avoiding emissions targets, whereas a more practical action plan (see below) may be perceived more positively by nations.

The Kyoto treaty and the actions since the treaty encourage downstream emissions trading. There are a few fundamental flaws to this approach:

- Low coverage of sectors (the European Emissions Trading Scheme (EU-ETS) covers only 40% of the EU domestic emissions, and none of the net emissions embodied in its net imports);
- An emissions trading scheme gives a volatile price for structural reasons related to the short-run price insensitivity (inelasticity) of fuel demand and the fact that carbon based fuels are ubiquitous in a modern economy (and so fuel demand *is* sensitive to the economic cycle and the weather). This volatility can lead to delayed investment and higher economic costs;
- Emissions trading schemes encourage 'quota seeking' behaviour by nations in any original agreement and by companies in the political process of allocation rights to emit;
- Perverse incentive to avoid stringent commitments – the structure of the agreement with national emissions caps fails to transform incentives of nation states;
- The use of 'offsets', such as the Clean Development Mechanism (CDM) has multiple problems in addition to the lack of a developing country cap. Most fundamentally, it encourages 'double counting'. Offsets provide perverse incentives to developing countries to inflate expected emissions in order to demand payment to reduce them back to more reasonable levels.

25 Late ratification (especially by Russia and Australia) was also a significant problem.

- No incentives to preserve existing forests.

More fundamentally, none of the major powers (with the possible exception of the EU) have agreed to cede any sovereignty to a global institution. There also seems to be a fundamental difference in opinion between developed countries – which expect developing countries to accept binding commitments – and developing countries, who seek financial assistance from the developed world.

Finally, there is a lack of any necessary or direct connection between a treaty being agreed, and any real action to reduce emissions. We need a new treaty that has an 'action plan' to reduce emissions.[26]

26 **Ordering of Negotiations**
Work by Howarth et al. (2009) suggests that any negotiation should be ordered as follows:

1. Determine a global cap;
2. Define a theory of justice or mechanism for allocating costs & benefits;
3. Work out implementation strategies.

A precondition to all three steps might be an understanding that a successor treaty will entail that countries give up a portion of their national sovereignty in regard to climate policy.

Solutions

International Institutions

The most direct way of mitigating the institutional capability gap would be to create a '*world environment agency*' (e.g. see Stern, 2009) with a mandate to achieve the goals of the UNFCCC. The most ambitious and potentially effective proposals (Tickell 2008) suggest that the extraction of fossil fuels is rationed at source by such a global agency.

Alternatively an *international carbon central bank* could set an internationally coordinated carbon tax in order to reach long-term carbon reduction targets.

Credible Commitments

We need to find a way to *monitor and enforce commitments* made, for example on the carbon price or absolute emissions. One possible enforcement mechanism is a climate exchange. This is similar to existing derivatives exchange, but would enforce contracts that governments might make to companies. Such options contracts could guarantee the price of carbon. This would (a) provide international enforcement mechanism for coordinated carbon tax; and (b) provide the high, credible, carbon price needed for investors to invest massively in the infrastructure needed for a carbon-free future.

It is also interesting to note that commitments to reduce fossil fuel supply and demand are, in a sense both instances of cartel-like behaviour. Credible commitments could also provide enforcement mechanisms for an oil *consumer* cartel ('OPIC') (Stoft 2008). Coal extraction needs to be rapidly limited if dangerous climate change is to be averted (Hansen et al. 2008).

Conclusions

The following draft agenda is proposed:

1. Strong *global institutions – e.g. a world environmental agency* – including an agreed *framework (such as coordinated carbon taxes) for collective policy,* to replace *national commitments*.
2. A framework *action plan* to *eliminate carbon emissions* sector-by-sector, region-by-region, over the next *two to three decades*. In particular a plan to develop, transfer and deploy the safe, responsible, and very large-scale use of enhanced energy efficiency, renewable-electric, nuclear, and carbon capture and storage energy technologies; and to encourage responsible land use and agriculture, including the sustainable use of water[27].
3. A *significant* ($100-$200/tCO_2e), *sectorally complete, substantially geographically complete, agreed,* and *guaranteed minimum carbon price*, levied *upstream* at the *national level* (including embodied carbon from any regions not otherwise carbon-constrained), with revenues *used at national discretion.* It is possible that a carbon tax may have net economic benefits at the national level if used to replace taxes with higher 'deadweight' costs. The removal of fossil fuel subsidies has already been agreed as part of the Kyoto protocol, but has not been fully implemented.
4. A plan to protect forests and other natural carbon stores.
5. A plan to keep high carbon fuels in the ground (following Hansen et al. 2008).
6. An enabling framework for enforceable state-corporation climate contracts (e.g. guaranteeing the carbon price for investors) (Ismer & Neuhoff 2006).
7. An enabling framework for the use of *trade sanctions* to enforce state-state climate commitments, such as *border tax adjustments* (Ismer & Neuhoff 2007).
8. Unimpeachable monitoring and verification of all commitments.

27 See http://www.weforest.com/video.php

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