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Joint Implementation, Clean Development Mechanism and Tradable Permits

International Regulation of Greenhouse Gases

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Abstract

This report deals with international environmental instruments aimed at a cost-effective reduction of greenhouse gas emissions. More precisely the instruments mentioned in the Kyoto Protocol, namely Joint Implementation (JI), the Clean Development Mechanism (CDM) and Tradable Permits (TP). The report describes the background for the international co-operation on reducing the greenhouse gases and the background for the instruments. How the instruments work in theory and what the practical problems may be. What agents' incentives are when they engage in JI or CDM, and how the initiation of the instruments can be organised. The institutional frameworks for JI, CDM and TP are discussed. The report describes how the Kyoto instruments and the Kyoto commitments interact with other instruments and describe distributive effects between countries. It is analysed how the use of CDM may influence the developing countries incentives to participate in the coalition of committed countries. In the concluding chapter some recommendations on the use of JI, TP and CDM are given. The recommendations are a kind of dialog with especially the Norwegian and Swedish reports on tradable permits.

Some of the issues described in this main report are analysed in separate working papers. The working papers are collected in an appendix to the main report.

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Contents

Preface

This report presents the analyses carried out under the project 'Joint Implementation as an instrument to reduce greenhouse gases'. The project was funded by the Energy Research Programme (Energy and Society) (project number 1753/97-0008) and carried out during the period March 1997 to May 2000. The subject of the report is and has been highly relevant. International negotiations under the Framework Convention on Climate Change (FCCC) have resulted in the Kyoto Protocol, December 1997, and intensive international research has been devoted to the area. These factors have to some extent changed the focus of the report compared to the original description of the project. The report is titled 'Joint Implementation, Clean Development Mechanism and Tradable Permits – International Regulation of Greenhouse Gases' and this reflects that tradable permits as an instrument has come more into the analysis.

Work has been done by Lise Nielsen (project leader, PhD. (Econ.)) and Kim Rose Olsen (student (Econ.)) (from April 1998 to March 1999). Inspired by work on the present project, the subject of Kim Rose Olsen's master thesis was Joint Implementation and free riding in the Climate Convention'. Part of his thesis has been used in this report.

1 The scope for JI, CDM and TP

1.1 Climate change and international co-operation

Climate change and emissions

Scientific research relates the increased concentration of Green House Gases (GHGs) in the atmosphere with climate change.

The greenhouse gases (GHGs) are hindering the earth from giving off the heat absorbed from the sun. The increased stock of GHGs in the atmosphere are – popularly speaking – 'building a greenhouse' around the earth. The consequence is that the mean temperature on the earth's surface is rising.

According to the IPCC the rise in GHG concentration, since pre-industrial times is largely a consequence of human activities. The three most important GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The main source of CO_2 emission is burning of fossil fuels. For CH_4 the main emission sources are rice paddies, animal husbandry, landfills, biomass burning and for N_2O the main sources are agriculture and biomass burning. (IPCC, 1996a).

The stocks of the three most important GHGs have, since pre-industrial times (since about 1750), increased by about 30%, 145% and 15% respectively. The CO_2 concentration is by far the most important – as reflected by the earth's radiative forcing, which for CO_2.is 60%[1].

The effects of the increased concentration of green house gases are projected in the climate models. Based on the GHG concentrations reported by IPCC, Working Group I, and the range of sensitivities of climate to increases in GHG concentrations, these models project an increase in global mean surface temperature of about 1-3.5°C by 2100 and an associated increase in sea level of about 15-95 cm. (IPCC, 1996b).

Changes in temperatures have impacts on ecosystems, agriculture and food production, human health, human infra structure and water resource management. The regional vulnerability differs, but increases as adaptive capacity decreases. Because vulnerability of human health and socio-economic systems further depends upon economic circumstances and institutional infrastructure, developing countries are typically more vulnerable than more developed countries (ibid.).

The scientific research relates increases in *human related* emissions of greenhouse gases with climate change. But no direct proof is given, and there are remaining uncertainties. Despite of these, the seriousness of the climate change problem has induced countries and international organisations to take action.

Why international co-operation?

The climate change problem and the greenhouse gas pollutants are special compared to many other forms of environmental problems and pollutants. As a consequence the policies to cope with climate change cannot rely on individual countries policies, because the individual country

[1] Radiative forcing is acording to IPCC (1996b, p. 3) 'A simple measure of the importance of a potential climate change mechanism. Radiative forcing is the perturbation to the energy balance of the Earth-atmosphere system (in watts per square metre (W m^{-2}))'. Of the direct radiative forcing of the long lived GHGs (total 2.45 W m^{-2}) 1.56 W m^{-2} (60%) is due to CO_2, 0.47 W m^{-2} (20%) is due to CH_4 and 0.14 W m^{-2} (6%) is due to N_2O (ibid.).

either do not have incentives to take action or there is a risk that countries do not have incentives.

What makes the greenhouse gas problem special and some of the reasons why it calls for international actions are listed below. The list is further explained in the following section, which focus more specific on the countries individual incentives to take action and reduce emissions.

The arguments listed below show that there are major asymmetries between countries and regions with respect to:

- who are the emitters (single countries) and who suffers (all countries),
- who are responsible for the increased concentration of GHGs in the past and
- who will be responsible in the future,
- who will experience the worst damages,
- who will have the lowest emission reduction costs,
- who will be in an economic position to cope with the damages and
- who will give emission reduction policies political priority.

The asymmetries and interdependencies are arguments for international co-operation and co-ordination of the emission reduction efforts.

Green House Gases have *global deposition*. This means that for example Danish emissions of GHGs have environmental effects in Denmark and the rest of the world. The Danish emission of GHGs will increase the concentration of GHGs in the atmosphere in general, and there will be no country or region specific variance in the concentration. All countries suffer from the damages of GHGs – even if the bulk of human activity related emissions are due to a few countries or regions. This means that there is an *asymmetry in who are the emitters of GHGs and who suffers.*

The *damages* of climate change and the increased concentration in the atmosphere of GHGs are *different in different parts of the world* – even though the concentration in the atmosphere is the same. The damages of climate change are for example increased watershed, changed conditions for the ecological systems and changed weather conditions (storms, rain, sun, etc.). These damages may have serious impacts on living conditions and on the national economies – for example changed conditions for the agricultural sectors.

The asymmetric impacts of climate change are dependent on geographic region (which part of the world: Antarctic or Africa), geography (coastal area or mountains), vulnerability of the ecosystems, etc., but it is also dependent on the *economies ability to adapt and cope with the problems*. Both Holland and Bangladesh have low lying coastal areas, but it may be easier for a rich country like Holland to cope with the impacts of an increased water shed, than for Bangladesh. The more dependent the countries' economies are of agriculture and ecosystems the more vulnerable will they be to climate change. In general the Developing Countries are more dependent on the agricultural sector, have low capability of adapting the economies to new conditions and do not have the economic resources to do so. This further strengthens the asymmetry between who are the major emitters of GHGs and who suffer from the emissions.

The western, industrialised, economies have until now been the main emitters of GHGs. But even if the western countries should come to agreements on reducing emissions, by ratifying the Kyoto Protocol and later more ambitious reduction schemes, this will not solve the problems of increased concentration. The developing countries emissions of GHGs are estimated to increase considerably in the future. This is due to increased population and increased welfare in this region. The main emitters in the future will be the developing countries.

The developing countries face many serious problems connected to poverty, hunger, health, education, economic growth, infra structure, lack of investments, etc., etc. Reducing emissions or investing in new expensive (foreign) low emission technology may not have first priority. The severe environmental damages that may or may not show up in a not very near future may seem a very hypothetical problem compared to today's serious problems.

The marginal emission reduction costs vary among countries. It seems that the marginal emission reduction costs are lower in the economies in transition and the developing countries than in the rich developed economies.

Disagreements on the magnitude of the climate change problem, and maybe lack of information on the newest scientific findings, may be an incentive for some countries not to take action.

Almost all the asymmetries above point to a moral responsibility for the rich developed countries to remove the danger of climate change, which they themselves are the main responsible for. The developing countries have a moral responsibility in the future to cut the direct dependency between high economic growth and high emissions.

With respect to reduction of GHGs countries moral and economic incentives most likely point in different directions.

A major problem is incentives

If countries do take the green house gas problem serious, they must take action and emissions must be reduced. But the asymmetries listed above imply that individual countries have considerably economic incentives to continue to pollute and incentives not to reduce emissions. The following explains why.

The fact that the benefits of one country's emission reductions are spread out on all countries in the world gives the country very little benefit out of its own action and therefore does not give the individual country incentives to take action and reduce emissions. A cost-benefit analysis relating the individual countries costs and benefits from its own emission reduction efforts will show that individual non co-ordinated action is not 'profitable'.

Even if countries agree on taking actions to reduce emissions, the individual country has incentives to 'free ride'. That is, to 'lean back' and enjoy the benefits of other countries emission reductions, without doing anything to reduce emissions itself. This calls for legally binding international agreements.

The asymmetries with respect to who is emitting and who experiences damages imply that it is not sure, that those experiencing the damages – or those giving avoidance of damages high priority – have the option to really do something to avoid the damages (these countries human related emissions may be low). Suppose Africa as a region is suffering most from climate change, then it may be very likely that Africa cannot avoid the damages by its own emission reducing actions (even if it had the incentives and the economic willingness to pay).

The developing countries preferences for investment in emission reductions may be very weak compared to investments in policies to cope with poverty, hunger, low or maybe even negative economic growth, etc. If the industrialised counties therefore wish the developing countries to join the emission reduction efforts, it may be necessary for them to give economic and other incentives for the developing countries to do so.

The costs of reducing emissions by a given amount will not be the same in all countries. The economic incentives for a country to employ emission reduction policies are less the higher the marginal emission reduction costs the country experience.

The climate change problem has a time perspective: What matters to the climate change is the concentration of GHGs in the atmosphere, but there is not a linear dependency from the concentration to the climate change. Therefore shortsighted time preferences – preferences for solving today's problems rather than tomorrows – may influence the incentives to do something to reduce emissions. The motives for short sighted time preferences may be very different.

As mentioned disagreements on the magnitude of the climate change problem, lack of information, etc. may be incentives for some countries not to take action.

The incentives can be summarised:

- countries in general have no economic incentives to individual uncoordinated emission reduction efforts,

- countries have economic incentives to 'free ride' unless prevented by a legally binding framework
- even if a group of countries have economic incentives to take action, it is not sure that these countries themselves have 'enough emissions' to reduce the risks of global warming,
- pour countries' budget constraints may prevent them from taking action,
- high emission reduction costs or low benefits from abatement imply that countries have less incentives to take action compared to a situation with low emission reduction costs or high benefits from abatement,
- differences in time preferences between countries will influence the incentives to take action

International co-operation

International co-operation and co-ordination is the optimal response to the asymmetries mentioned above and the incentive problems.

The risks of not co-operating are that individual countries' differently motivated incentives *not* to reduce emissions take over and, as a result, very little are done.

The international co-operation and co-ordination can secure that the incentives and actions of the individual countries reflect what they themselves see as their common interests. If all the co-operating countries want to reduce emissions, given that all the other countries reduce, an international legally binding agreement can guarantee that all do take action.

International co-operation has been organised within the FCCC and IPCC. These forums has been set up to secure:

- more scientific research – improved scientific foundation of the link between human activity related emissions and climate change.
- common agreement on the interpretation of the scientific findings and warnings
- common agreement on the need for actions to reduce emissions of GHGs
- identification of the problems related to carrying out emission reduction policies
- co-operation with the aim of trying to solve the problems related to emission reduction policies (for example problems related to asymmetries and incentives)
- common actions.

The rest of the chapter discusses some of the initiatives of the FCCC to make a consistency between individual and collective (international) incentives. Section 1.2 deals with the legally binding emission reduction targets of the Kyoto Protocol (once it has been ratified). Section 1.3 deals with the 'flexible mechanisms' of the Kyoto Protocol.

1.2 Fixed emission reduction targets

The Kyoto protocol: The environmental aspects

The FCCC conference in Kyoto, December, 1997, resulted in a 'consensus decision to adopt a Protocol under which industrialised countries will reduce their combined greenhouse gas emissions by at least 5% compared to 1990 levels by the period 2008-2012' (UNFCCC, 1998). In the words of UNFCCC (1998) 'this legally binding commitment promises to produce an historic reversal of the upward trend in emission that started in these countries some 150 years ago'. A number of countries agreed to commit to specific fixed reduction targets. The individual country's commitment (percentage of the 1990 level) are listed in annex B to the Kyoto Protocol and shown in Table 1.1. Countries commit themselves to reach the specified target within the period 2008-12. The Kyoto protocol is not yet ratified and consequently does not have any legal status. The Protocol will inter into force 90 days after it has been ratified by at least 55 Parties to the

Convention, given that these 55 Parties include developed countries accounting for at least 55% of the total 1990 carbon dioxide emissions from this group of industrialised countries.

Table 1.1 Country specific reduction commitments in Annex B to the Kyoto Protocol

Party	Quantified emission limitation or Reduction commitment (percentage of base year or period)
Australia	108
Austria	92
Belgium	92
Bulgaria*	92
Canada	94
Croatia	95
Czech Republic*	92
Denmark	92
Estonia*	92
European Community	92
Finland	92
France	92
Germany	92
Greece	92
Hungary*	94
Iceland	110
Ireland	92
Italy	92
Japan	94
Latvia*	92
Liechtenstein	92
Lithuania*	92
Luxembourg	92
Monaco	92
Netherlands	92
New Zealand	100
Norway	101
Poland*	94
Portugal	92
Romania*	92
Russian Federation*	100
Slovakia*	92
Slovenia*	92
Spain	92
Sweden	92
Switzerland	92
Ukraine*	100
United Kingdom of Great Britain and Northern Ireland	92
United States of America	93

The Kyoto Protocol and the commitment to fixed reduction target are examples of the co-operation and co-ordination that the preceding sections argued were necessary if significant emission reductions were to be implemented. The Kyoto Protocol therefore is a step forward from an environmental point of view. And it will be a major step back if the Protocol will not be ratified.

The Kyoto protocol is however not the answer to all the problems about asymmetries and incentives to reduce emissions:

– **Coverage:** It is important is that a very large number of countries have not signed a binding commitment to reduce emissions. Among the so-called non-Annex B countries (those who have not signed) are the developing countries, whom are supposed to be the most significant emitters of GHGs in the future. This limited coverage may turn into a very big problem at a later stage – if the position (and incentives) of the non-Annex B countries are not changed.

– **Leakage:** the fact that it is not all countries who have committed themselves to fixed reduction targets may reduce the environmental effects of the Annex B countries commitments (cf. Table 1.1) through the so-called 'leakage' effect. Actions to reduce emissions have 'leakage effects', if emissions in the committed countries imply increased emissions in the non-committed countries. Leakage effects may be caused by incentives for Annex B countries and firms to export the production of emission intensive products to non committed countries, and import the products from these countries. Leakage effects will only be a problem if coverage is not full.

– **Hot air:** some of the reduction commitments are not binding because the countries in question already have lower emissions – they have what has been called 'hot air'[2]. Hot air may decrease the environmental effects of a non-hot-air-country's commitment, because the Protocol allows the *committed* (Annex B) countries to buy and sell the hot air. Hot air becomes a problem when forming of 'bubbles' and JI, CDM and TP are allowed. Speculations in buying hot air have been seen as a strategy for some committed countries to reinforce their free riding position. Hot air has therefore been a much-debated issue.

– **Measurement:** there are problems of measuring and monitoring some of the five GHGs mentioned in the Kyoto Protocol. This may give countries an alibi for systematic overestimating the emission reducing effects of their own actions – and changing their emission reducing efforts to gases with a high uncertainty level. Uncertainties of measurement are shown in Table 1.2.

– **Monitoring and control:** The protocol allows committed countries to invest in emission reductions in *non committed* (Non-Annex B) countries instead of reducing emissions at home. This raises a multitude of problems connected to estimating the emission reducing effect of these investments, and monitoring and control problems.

– **Cheating:** the way the protocol is 'composed' imply that there are risks that countries or individual agents find it profitable to cheat. Some of these incentives are connected to the use of the Kyoto instruments: joint implementation, clean development mechanism and tradable permits.

It is important to notice that for example problems of measurement and cheating are not only related to the use of the Kyoto instruments, but also are related to all instruments regulating emissions. The size of the problems may vary though.

Table 1.2. Greenhouse Gas Emissions: Roughly estimated uncertainty levels.

CO_2	± 1-5%
CH_4	± 30-60%
N_2O	± 30-100%
HFCs	± 10% [1)]
PFCs	- 30%, + 50%
SF_6	± 5%

[1)] Based on consumption (potential emissions). The data for the real HFC emissions are far more uncertain.
Source: Audun Rosland, Norwegian Pollution Control Authority (SFT).

[2] 'Hot air' is equal to the difference between the emission reduction target and actual base-line emissions (ie. emissions given no policies to reduce emissions). The concept is only used when a county's emissions are below the target.

Costs of a national implementation of the fixed reduction targets

The Kyoto protocol specifies reduction targets for the committed countries. To reduce emissions and to reach the target is costly – except for the 'hot air countries', who have no need to invest in emission reductions. National emission reductions may imply investments in new techniques, substitution to more expensive inputs in production, changed consumption behaviour, etc.

One of the reasons why the reduction targets in the Kyoto Protocol are not uniform (cf. Table 1.1) is that national emission reductions costs differ between countries. Differentiated commitments can compensate for differences in marginal emission reduction costs between countries. But the purpose of differentiation can also be to make the Kyoto Protocol political tractable to all the committed countries, to make the coalition of committed countries as big as possible and the percentage of world emissions covered as high as possible.

Numerous empirical, model based studies try to estimate the costs of national and international fulfilment of the Kyoto protocol. The costs of national fulfilment are dependent on the specific country in question. But it is general that estimates of a particular (Annex B) country's costs vary a lot between different model studies (cf. the next section). In general cost of a national fulfilment are high – except for the countries in transition.

1.3 The Kyoto instruments

Why Kyoto instruments?

The background for the Kyoto instruments are the fixed reduction targets given in Table 1.1, the reported high costs of national fulfilment of the Kyoto protocol and differences in marginal emission reduction costs between countries.

From economic theory it is well known that fixed emission quotas or emission reduction targets are in general cost *in*efficient, because the compliance is costly to some agents and inexpensive to others. A redistribution of the quotas, so they reflected marginal emission reduction costs, would reduce *total* costs.

From a cost efficiency point of view co-ordinated taxes would be preferable to fixed targets or quotas. But taxes have several deficiencies when used in an international context. For example: if national legislation forbid international authorities to tax national legal entities (international emission tax), the national authorities must tax the national emitters of GHGs. But if national authorities receive the emission tax revenues, it may be very easy for them to redistribute the tax revenues in a way, so the 'free rider' position of the country is to some extent restored.

The aim of the Kyoto instruments is to reduce the costs of fulfilling the national emission reduction targets. A precondition for this is that committed countries are allowed to reduce emissions abroad, if it is cheaper to do so.

The Kyoto instruments contribute to a cost efficient implementation of the Kyoto Protocol. Cost efficiency is secured trough the creation of competitive international markets for emission quotas or competitive markets for emission reduction projects.

The competitiveness on the markets is not obvious because there are a few countries, which are supposed to be very important as suppliers of cheap emission reductions (Russia, China, Brazil and India), and a few very important countries on the demand side (the US, Australia, Japan).

The Kyoto instruments

Table 1.3 presents the Kyoto instruments and specifies where in the Protocol the instruments are defined. The following chapters describe Joint implementation, Clean Development Mechanism and tradable permits in detail. The basic idea behind these instruments is that countries with high marginal abatement costs can buy emission reductions in countries with low marginal emission reduction costs. There will be a transfer of reduction commitments among Annex B

countries – or an accreditation of emission reductions carried out in non-Annex B countries – that secure cost efficiency.

Table 1.3 The Kyoto instruments.

Article 3.1	Defines individual and overall commitments; multiple gases are included; defines five year commitment period (2008-2012)
Article 3.10 to 3.12	Defines credits and debits in emissions trading
Article 3.13	Banking for subsequent periods is allowed; banking and borrowing is allowed within each commitment period
Article 4	Allows the forming of 'bubbles'.
Article 6	Emission reduction units in Annex B (joint implementation)
Article 12	Certified Emission Reductions with non-Annex B (Clean Development Mechanism)
Article 17	Acceptance of trading between Parties and possibly also between private legal entities

What are the gains from using the Kyoto instruments

The intentions of the Kyoto instruments are to secure cost efficiency given the cost ineffective emission reduction targets of the Annex B countries. The following presentation of a few model-based studies will show that *there are gains from using the Kyoto instruments*. This is a generally accepted conclusion, and the result of most (all?) empirical studies of permit prices and costs. But the presentation will also show that *there are significant differences among the studies of the estimated gains from using the instruments.*

A recent article by Criqui et al. (1999) use the POLES and EPPA models to estimate both costs of fulfilling the Kyoto agreement in different regions of the world and permit prices for these regions. Estimated permit prices are listed in Table 1.4. All prices are in constant 1990 US dollars or constant 1990 Danish currency (DKK). EPPA is a general equilibrium macroeconomic model and POLES is an energy system model with some common features with the 'top-down' models. The abatement costs calculated by the POLES model are 'sectoral cost', whereas the EPPA model takes the 'full range of impacts of reduction policies' into account (Criqui et al., 1999, p 588). The size of the permit prices and the gains from using the Kyoto instruments are much dependent on the model: According to Table 1.4 the EPPA model estimate prices twice the size of the POLES model prices for the Annex B market and EU market.

Table 1.4. Permit prices for year 2010

Region/Model	POLES	EPPA
World*	21.3 $/ton C (41.9 DKK/ton CO_2)	24 $/ton C (47 DKK/ton CO_2)
Annex B	63 $/ton C (124 DKK/ton CO_2)	127 $/ton C (250 DKK/ton CO_2)
EU	166 $/ton C (326 DKK/ton CO_2)	330 $/ton C (650 DKK/ton CO_2)

Notes: All prices are in constant 1990 US dollars or constant 1990 DKK. Non annex B countries are assumed to have reduction target equal to their baseline.
Source: Criqui et al. 1999.

A special issue of the Energy Journal (1999) is dealing with 'The costs of the Kyoto Protocol: A multimodel evaluation'. Thirteen different modelling teams use their particular model to analyse some standard questions:

'First, each team was asked to run a 'modellers reference' scenario, with modeller chosen GDP, population, energy prices, etc. This scenario was to assume no new policies other than those currently in effect (e.g. nothing new from Kyoto).

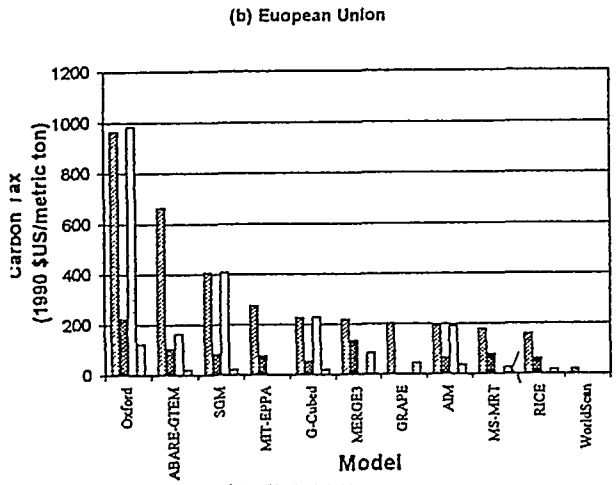
Second, the modelling teams were asked to run a number of stylised Kyoto scenarios varying on three dimensions: (i) The amount of international emissions trading assumed, (ii) The availability of sinks and 'other greenhouse gas' emission reductions to satisfy the Protocol's requirement, and (iii) The required emission reduction beyond 2010.'

The modelling teams estimate permits prices (carbon taxes) for different areas. With respect to the European Union the results of eleven modelling teams are summarised in the following Figure 1.1 showing four different emissions trading scenarios: 1. No international trade (first bar from the left), 2. Annex 1 trading, 3. 'Double Bubble', i.e. separate EU and separate 'rest of Annex 1' trade, and 4. Global trading.

The EU carbon tax in the no international trade scenario is equal to the permit price in the 'Double bubble' EU emission-trading scenario (there may be minor differences). It is seen that there is an extreme variance between the most optimistic (<20 \$/t C = 5 \$/ton CO_2) and most pessimistic price estimates (>900 \$/t C = 245 \$/ton CO_2). Apart from the most optimistic model study, all the permit prices exceed 300 DKK/ton CO_2 (175 \$/ton C, exchange rate 6.19 DKK/\$). The Annex 1 trading scenario in most of the studies more than half the model based permit prices. This is to a large extent due to Russian 'hot air'.

The different permit prices of course reflect different reference scenarios, team specific assumptions and the differences of the models. The modelling teams agree on significant cost reducing effects of Annex 1 trading and global trading.

If there are any common lessons from the different model studies it must be that there are significant gains from using cost efficient Kyoto instruments for the countries in the European Union.



Source: Weyant and Hill (1999)

Figure 1.1 Year 2010 Carbon Tax Comparisons for the European Union

2 How JI, CDM and TP works

2.1 Theory

It is useful to compare CDM, JI, TP and taxes to understand the similarities and differences of the instruments. CDM, JI and TP can be interpreted as endogenous taxes. All the instruments are in theory cost effective. But where emission tax levels are directly decided upon by governments, JI, TP and CDM presuppose an initial use of one or more cost *in*efficient instruments – for example national or individual (distributed to firms or consumers) quotas or country specific taxes – and create cost efficiency via markets for emission reduction projects or emission permits.

The following describe how the markets for tradable permits and emission reducing projects work.

Cost efficiency

Figure 2.1 illustrates how the cost effectiveness of Joint implementation, tradable permits and taxes is achieved. CDM is illustrated in Figure 2.2. Figure 2.1 shows, that in principle the three instruments may give the same cost-effective solution, but it also illustrates that the mechanisms behind the cost efficiencies are different. The different mechanisms give rise to the different properties of the instruments.

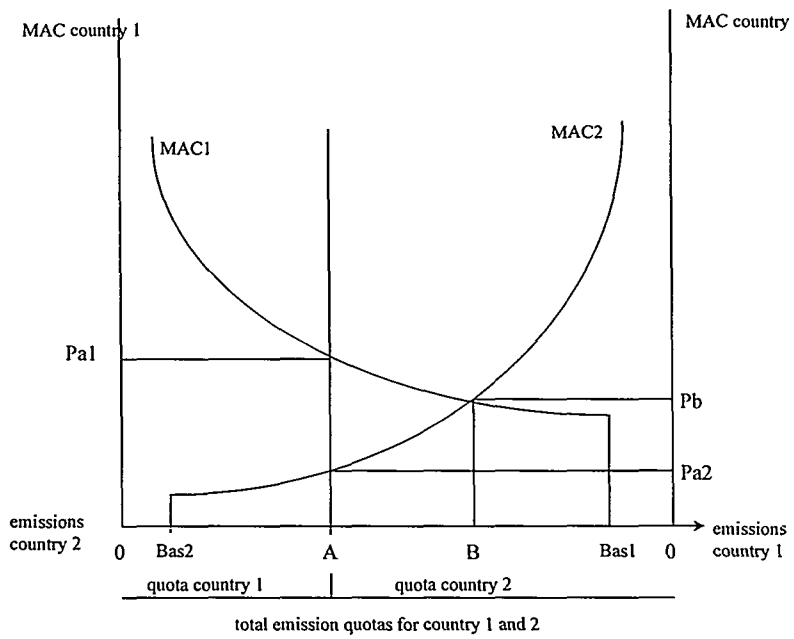


Figure 2.1. Cost effectiveness of Joint Implementation, Tradable Permits and taxes.

Figure 2.1 shows marginal abatement cost curves (MAC1 and MAC2) for two countries (1 and 2) with international emission reduction commitments equal to 0A and AB0. The countries marginal abatement cost are higher the lower the level of emissions. The line 0AB0 is the sum of the national quotas. The (initial) distribution of quotas implies marginal abatement costs in

country 1 and 2 equal to Pa1 and Pa2 respectively. To reach national compliance country 1 must reduce emissions by the amount Bas1-A (Bas1 is the baseline emissions) and country 2 must reduce the amount Bas2-A. The difference in marginal abatement cost may be eliminated through co-ordinated taxes or by allowing joint implementation or tradable permits. In theory all three instruments will deliver the same cost optimising result, namely the price Pb and the distribution 0AB and B0 of emission levels between country 1 and 2. But the mechanisms behind the cost optimising results are, as previously mentioned, different:

If the instrument is a co-ordinated tax on emissions, and the target level for total emissions are equal to 0AB0, a tax rate equal to Pb will deliver the desired target. Every single emitter has the opportunity of either investing in emission reductions and reduce his tax payments or to continue to pollute and pay the (full) emission tax.
The equilibrium is reached where marginal abatement costs are equal to the tax rate. If the marginal abatement cost curves are not known, it may be necessary to adjust the tax rate one or more times to reach the target level for total emissions. The need for maybe several tax adjustments to reach a desired emission level is one of the disadvantages of the tax instrument. An important advantage is that the instrument is always cost efficient (tax differences between countries or areas may be cost inefficient).

If the instrument is tradable permits, country 1 and 2 distribute permits equal to their national quotas 0A and AB0 to the (domestic) emitters. (How governments distribute permits is one of the much-debated issues). Permission to pollute a certain amount of emissions demands that the polluter spend an equivalent amount of his tradable emission permits. Alternatively he could invest in emission reductions and sell some of the permits on the permit market. Every single emitter has the opportunity of buying or selling emission permits, and either to continue to pollute or to invest in emissions reductions. The choice of the rational emitter will be to minimise costs and maximise profits. Cost minimisation will be reached where marginal abatement costs are equal to the price of the emission permits.

If the instrument is joint implementation, *emission reduction projects* are traded between the two countries. Lower marginal abatement costs in country 2 means that it is cheaper to invest in emission reductions in country 2 than in country 1. In a system with JI, country 1 invests directly or indirectly (through brokers) in the concrete projects, which lie behind county 2's marginal abatement cost curve. There may be different incentives for firms and others to engage in JI – for example firm specific emission reduction quotas and tax refunds. But all countries engaging in JI have the opportunity either to invest in reductions of their own emissions or to invest in reductions abroad. If emission reduction projects are cheaper in other countries JI will be chosen.

Whereas tradable permits and the use of the tax instrument demands a co-ordination of the instruments between country 1 and 2, joint implementation needs no co-ordination: country 1 and 2 need to agree on the terms for the specific JI contracts, but it need not be co-ordinated (cf. chapter 4).

In theory all tree instruments are cost efficient, and deliver the same distribution of emission levels. But in practise, the instruments may be very different, as the following sections will show.

The CDM depart from JI in that only one of the participating countries have committed to a fixed emission reduction target. Figure 2.2 show this case. The two countries marginal abatement cost curves represents supply and demand for emission reductions in the non committed country. CDM is like JI based on trade of *emission reduction projects*. P_{a1} is the price of emission reductions in case of national compliance of the reduction commitment, and P_{CDM} is the price of emission reductions if CDM is a possibility.

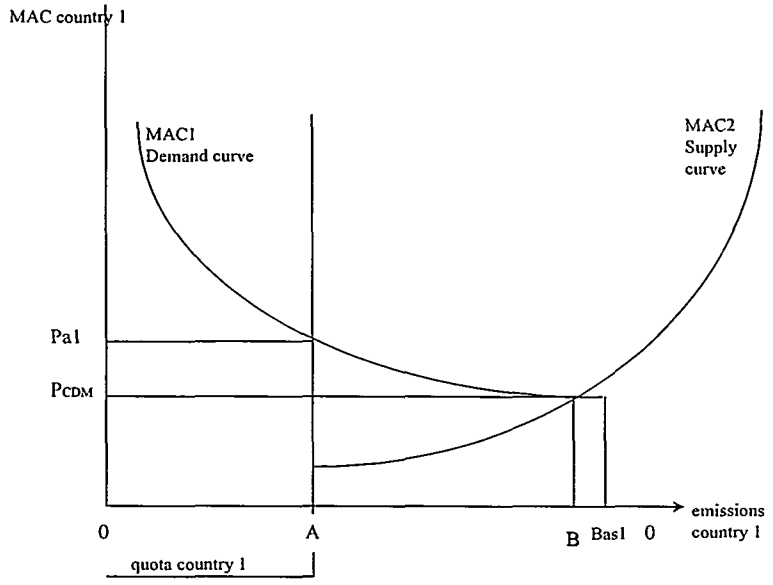


Figure 2.2. Cost effectiveness of Clean Development Mechanism

Competitiveness of the markets

Figure 2.1 and Figure 2.2 illustrate competitive markets and prices for JI, TP and CDM. Competitiveness does not seem a problem if the agents acting on the markets are individual emitters and 'reducers'. If the agents acting on the market are countries competitiveness may be a problem.

Among the Annex B countries there is one very big supplier of low cost emission reductions (Russia) and some small (other countries in transition), and one very big demander of emission reductions (the US) and some smaller (the rest of the OECD). In a global perspective the big demanders of emission reductions are the same, but China, Brazil and India would also be big suppliers of emission reductions.

If the institutional set-up for JI, TP and CDM does not prevent countries in exploiting a market dominance, the competitive forces will be weakened, and the international market prices for emission reductions will be higher. The ability for countries or groups of countries to exploit market power depends on the size of the differences in the marginal abatement costs between countries. The smaller the differences, the less the ability to exploit market power, because those who potentially can be exploited have alternative possibilities which are not very costly (to reduce themselves, to buy from others, etc.)

Abatement cost curves

The models used to construct national marginal abatement cost curves (as shown in the figures above) are mainly technical-economic models. Emission reduction potentials and costs of substituting the existing technologies within the country with less emission intensive technologies are computed, and the different emission reduction options are ranked after sizes of costs. Future emission reduction costs and potentials are computed using alternative technology forecasts and comparing 'no emission reduction scenarios' (these are called baseline scenarios) with 'emission reduction scenarios'.

The emission reductions framing the marginal abatement cost curves are reductions which are not part of the normal economic development and which will not be carried out unless special incentives are given. This is one of the many difficulties of constructing marginal abatement cost curves: how can one know which emission reduction possibilities will be carried out and which will not. Emission reducing projects and investments, which are part of the general economic development, have marginal emission reduction cost equal to zero. Whether projects and investment are part of the normal economic development are very much dependent on future activity levels, prices, technological developments, demand patterns, etc. The economically most interesting emission reduction opportunities are the ones around the 'border line'.

Others difficulties of constructing marginal abatement cost curves are forecasts of future technology choice, forecasts of technological development and computations of present and future costs.

Some abatement costs will depend on the speed of the emission reductions: the reduction costs will be higher if the investments are carried out within a limited time frame.

2.2 Relations between cost curves, reduction commitments, trade and macroeconomic costs

The reasons why it is relevant to discuss the use of TP, JI and CDM in the international climate change policy are 1. that a number of countries have agreed on binding emission reduction commitments, 2. that there are differences in national marginal abatement costs, 3. that the binding emission reduction commitments do not equate the marginal emission reduction costs between countries and 4. that emission reduction costs in the non-committed countries are lower. The aim of the three instruments is to equate differences in marginal emission reduction costs.

It is reasonable to assume that the need for the instruments, and how intensively the instruments will be used is dependent on sizes of the cost differences and the amount of emission reductions, which can be carried out cheaper abroad. The relation between for example permit prices, incentives to trade and the trade volumes can be illustrated in figures showing national differences in marginal abatement cost and the effects of different distributions of reduction commitments. This is done in the following subsections.

A country's macroeconomic activity level is decisive for how tight the country's international reduction commitment will be, and will therefore also be decisive for the country's supply or demand for permits or for emission reduction projects. How market prices of emission reductions are influenced by the countries' activity levels are illustrated below.

The analysis of differences in marginal abatement costs between countries and the countries' reduction commitments will say something about the gains from using flexible instruments. But these gains are 'partial' compared to a macroeconomic analysis. The subject of the last subsection is the macroeconomic cost of reducing emissions and the macroeconomic gains from using flexible instruments.

Incentives to trade

The following three figures illustrate the countries' incentives to trade on a JI or TP market

Given that cost curves are as shown, and given the distribution of reduction commitments, incentives to international emission reduction trade are highest in Figure 2.3 and lowest in Figure 2.5. In Figure 2.3 and Figure 2.4 the countries cost curves intersects in the same point (the same price and volume), but country 1's marginal abatement cost curve is steeper in Figure 2.3, and country 1's economic gain from trade is therefore higher in this case. The economic gain and the economic incentives to trade are for the same reasons higher in Figure 2.4 than in Figure 2.5: compared to Figure 2.4 the Mac1 curve in Figure 2.5. is a parallel projection downward (B and Pb refers to Figure 2.4.).

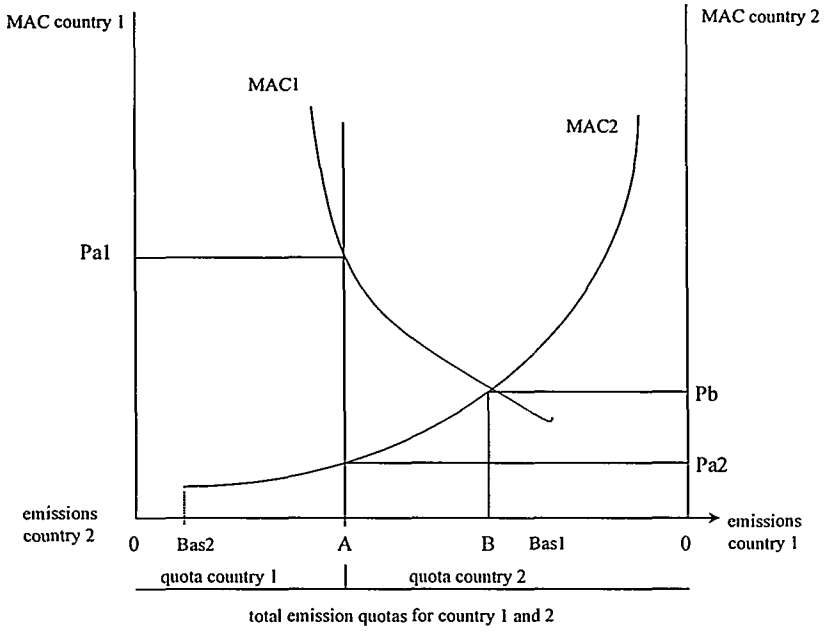


Figure 2.3. Incentives for trading permits

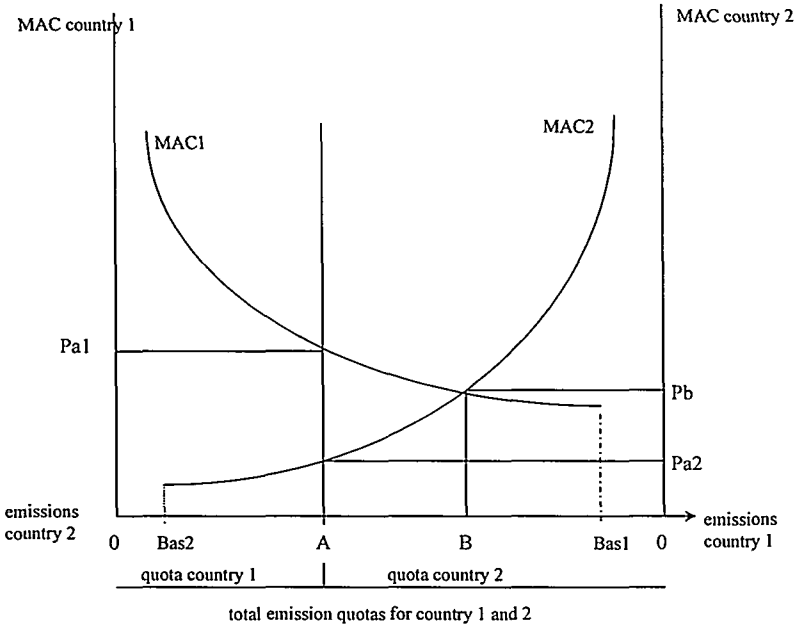


Figure 2.4. Incentives for trading permits. Traded volume and price as in figure 2.3, but lower consumers surplus.

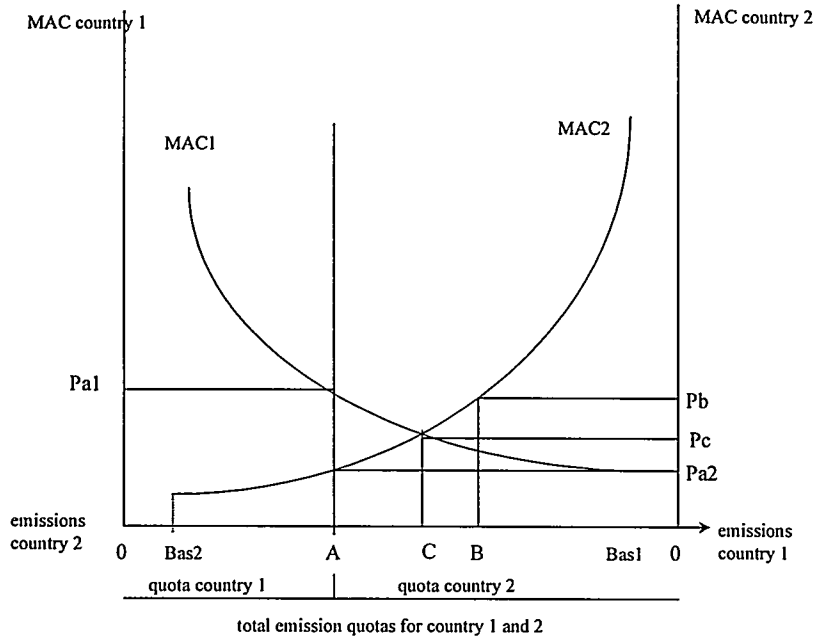


Figure 2.5. Incentives for trading permits. (Traded volume and price lower than in figure 2.3.)

Effects of changes in the distribution of quotas

Figure 2.6 and Figure 2.7 illustrate how prices and traded volumes on international markets for emission reductions depend on the distribution of emission reduction commitments between countries. Figure 2.6 illustrates that a distribution of reduction commitments, which equate marginal emission reduction costs in the two countries, make international trade superfluous and therefore also make international agreements on JI and TP superfluous. Compared to Figure 2.6 Figure 2.7 illustrates that the more distant the quota distribution from the cost efficient quota distribution (of Figure 2.6) the larger the traded volumes.

Figure 2.3–Figure 2.7 illustrate prices and traded volumes at competitive markets. Prices and traded volumes at monopolised markets need special analysis.

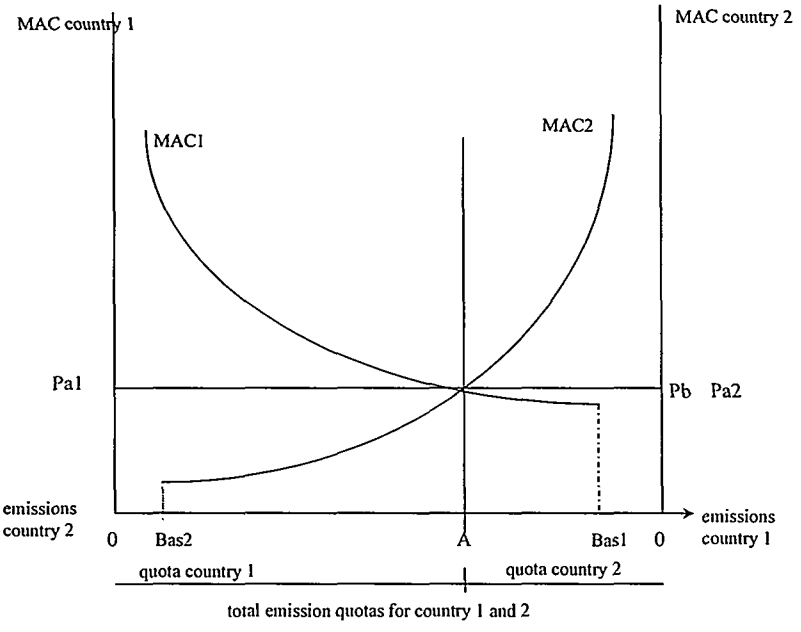


Figure 2.6. Incentives for trading permits. Effects of changing quotas (compared to figure 2.3.–2.5.)

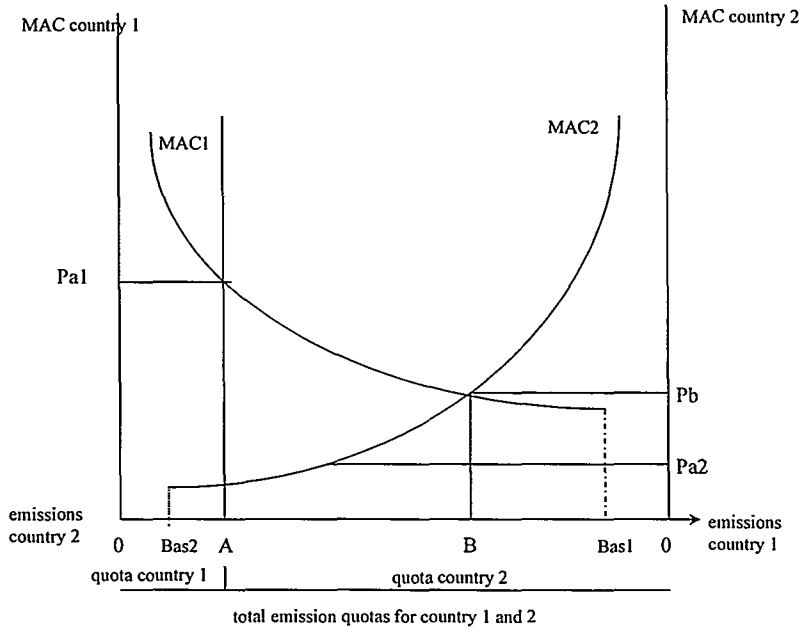


Figure 2.7. Incentives for trading permits. Effects of changing quotas (compared to figure 2.3.–2.6.)

Effects of changes in economic activity levels, emission reduction costs, etc.

The following four figures illustrate the effects of changed activity levels (changed baselines), no regret options, technological change and hot air on trade volumes and emission reduction prices.

Country 1 is assumed to have the same activity level (baseline (Bas1)) in all the figures. Country 2 have decreasing activity level from Figure 2.8 to Figure 2.11. When activity and emissions fall the need for extra emission reductions to reach the quota targets is diminished and the figures' cost curves are moved to the right.

Figure 2.8 is reference. Comparing Figure 2.8 and Figure 2.9 show that a higher activity level in country 2 – which is a net supplier of emission reductions to the market – result in a higher price on emission reductions and a lower traded volume. Both countries 1 and 2 reduce more at home. This illustrates that higher activity levels increase the need for emission reductions to secure compliance. (A higher activity level in country 1 – which is a net demander of emission reductions at the market – would also result in a higher price on emission reductions, but the traded volume would increase).

In Figure 2.10 country 2 have either some hot air or some no regret options. Where hot air illustrates that a country's reduction commitment is not binding (Bas2 hot air), no regret options illustrate that emission reductions are profitable (Bas2 no regr). Figure 2.10 illustrates the situation of Russia and other economies in transition, which have hot air. Figure 2.11 illustrates the extreme case, where country 2 have so much hot air, that none of the countries have to reduce emissions to secure global compliance.

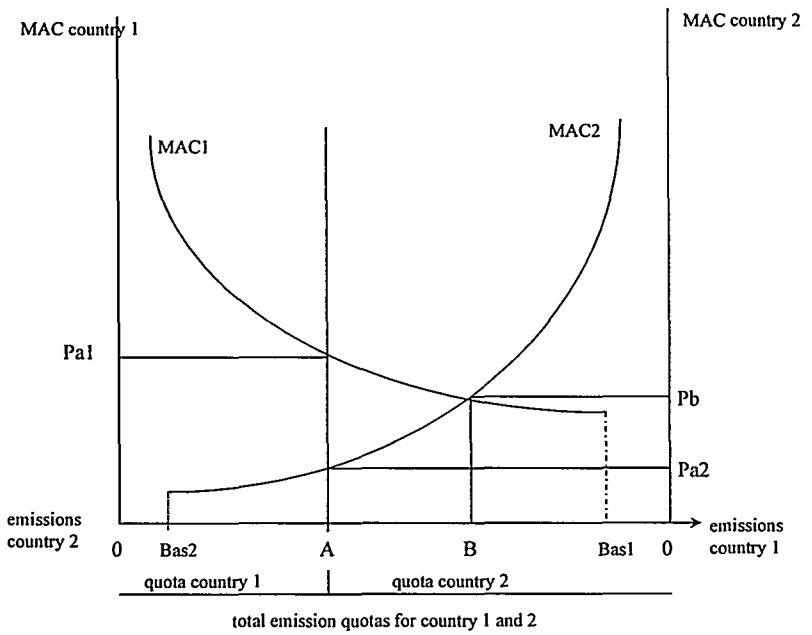


Figure 2.8. Incentives for trading permits. Effects of changed activity level (reference)

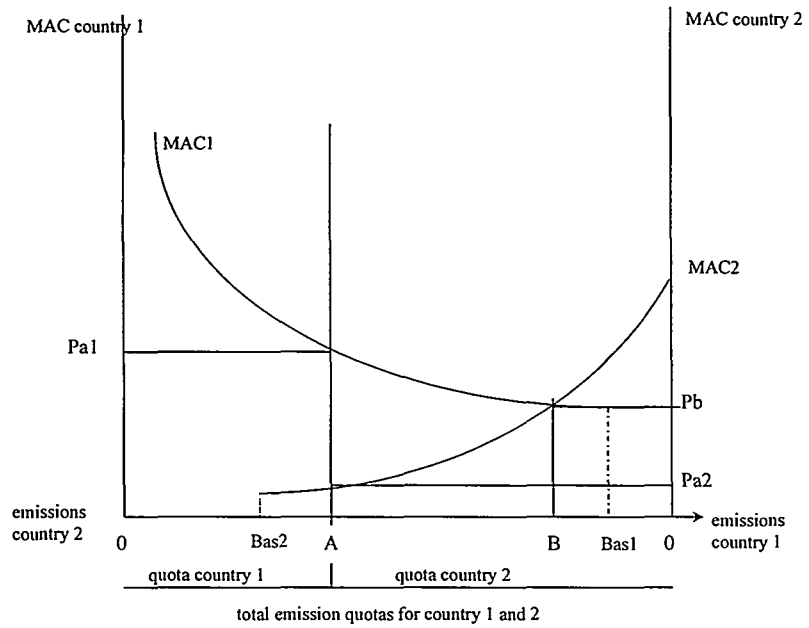


Figure 2.9. Incentives for trading permits. Effects of changed activity level (activity level in country 2 lower than reference)

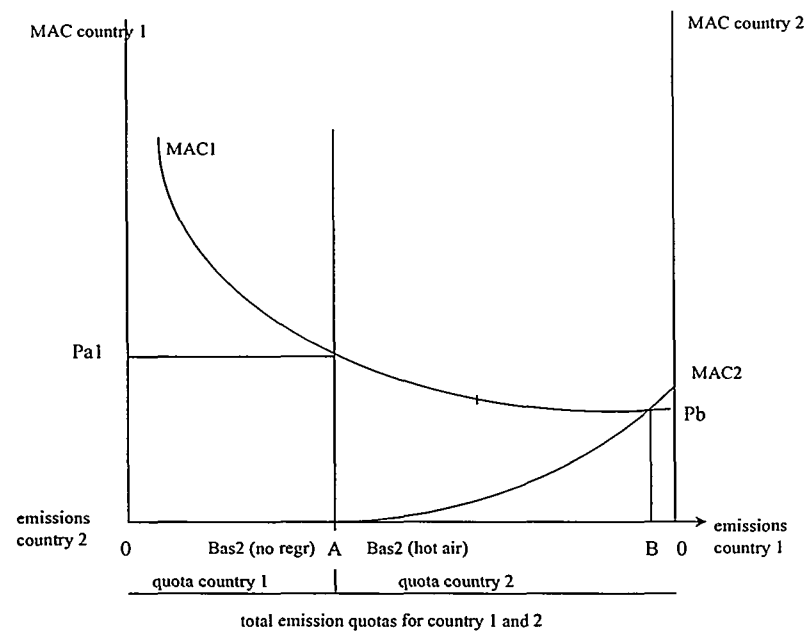


Figure 2.10. Incentives for trading permits. Effects of changed activity level (hot air or no regret options in country 2)

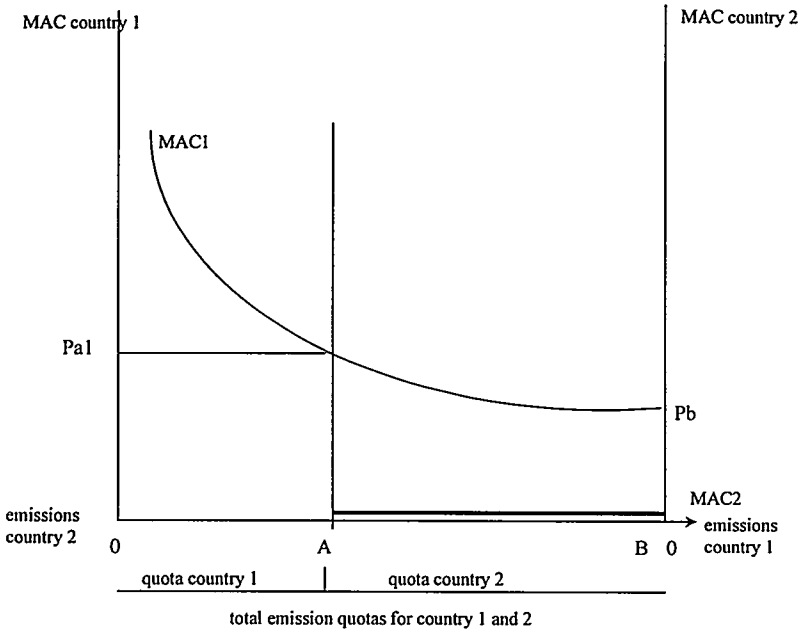


Figure 2.11. Incentives for trading permits. Effects of very low activity level. 'Hot air'

Macroeconomic costs

The TP, JI and CDM *prices* are formed on markets where supply and demand for permits or emission reduction projects are presented. The prices are equal to the *marginal* abatement cost on the market.

Cost curves for all the countries participating in a quota system combined with country specific emission reduction targets will say something about the quota market, the amount of trades and the permit price. Cost curves are estimated for given activity level, prices and technological development.

The *macroeconomic costs of reducing emissions* – the *costs to society* – are the direct and indirect economic consequences of firms and consumers being forced to reduce emissions or to buy permits etc. Permit prices and prices for JI and CDM project can be interpreted as taxes on firms and consumers and the wider economic consequences of these taxes can be analysed in the macroeconomic models. For *given* prices on permits, JI or CDM the national macroeconomic models estimate the macroeconomic costs of the emission reductions.

National macroeconomic and technical models cannot estimate permit prices on quota markets, which include more countries.

As the following examples will show there are no 'one to one' relations between for example the size of permit prices and the macroeconomic costs of CO_2 reductions. And therefore it is important to distinguish between permit prices and macroeconomic costs.

The higher the economic activity in a country, the more emissions (in general) and the more emission reductions needed to reach a fixed emission target for the country. At a national permits market higher economic activity will in general increase the permit price, because the price of the marginal emission reduction increases. But it is not obvious that the permit price at a very comprehensive TP market (including many countries) will be affected. The possibility that the international permit price is unaffected of a higher national activity level, does not imply that the national macro economic costs are unaffected.

Along the same lines, changes in a small country's fixed emission reduction target do not necessarily lead to changes in permit prices. But the macroeconomic cost change.

A high permit price may have less influence on a country's macroeconomic activity level than a low, if the high permit price is co-ordinated between countries and the low permit price is not. (Depends on how the foreign competitiveness is influenced, and the importance of foreign trade).

A given permit price will have different macroeconomic implications dependent on for example the structure of a country's industry. The extremes could be an economy, which produce emission-reducing technologies, and therefore would have an economic advantage of international policies towards emission reductions. And economies where firms are closed and firm and processes are exported to countries without environmental regulation (the polluting goods are imported).

2.3 Cost efficiency in practise

Cost efficient commitment strategy and cost efficient emission reductions. Hot air and leakages

Assume Denmark buys hot air in Russia. Will this be a cost efficient transaction?

From a Danish point of view costs are low – provided that the hot air is cheap. And Denmark need not reduce emissions at home so in that respect Denmark does get the good that was demanded. But emissions are not reduced. And therefore it may be a very high level of abstraction to claim cost efficiency.

It may be useful to look upon 'hot air trading' as an economic transfer between countries. Countries who buy hot air may have a *cost efficient commitment* strategy – but it is not a *cost efficient emission reduction* strategy, because no reductions are carried out.

The term 'leakage effect' describes a situation, where emission reductions in a committed country imply that emissions in a non-committed country increase: The global environmental effect of the national reduction effort is diminished or offset.

Leakages will only be a problem if not all countries have committed to fixed reduction targets. And leakage effects are therefore an environmental argument for international co-operation and co-ordination of reduction commitments and instruments. The larger the group of co-operating countries, the less the leakage problem. And the less foreign trade with countries outside the group of co-operating countries, maybe the less the leakage problems; trade patterns may change as a result of the differences in environmental costs between committed and non-committed countries. High JI and TP prices (and high emission taxes) may be associated with more leakages than low prices.

Leakages are results of the rational economic behaviour of the agents – of market mechanisms and cost minimising behaviour. The effects are that emission intensive production processes are exported to countries without environmental regulations and the 'polluting goods' imported from these countries. Leakages can in some instances be traced back to the origin, when big/important firms are involved (moved from committed to non-committed countries). But in general this will not be possible.

Leakages are results of cost efficient behaviour, but if no emission reductions are carried out – when taking the global perspective – it may be an exaggeration to claim it cost efficient emission reductions.

If a concrete emission reduction effort is associated with relative high leakage effects, the *global cost efficiency of the emission reduction* is diminished.

The discussion above showed that it is useful to be able to be more precise with respect to, what is meant by cost efficiency, because this term have different meanings dependent on the perspective. Three terms were introduced above:

- *cost efficient commitment* (which include hot air trade)
- *cost efficient emission reduction* or *regional cost efficiency* (which exclude hot air, but do not take leakage effects into account)
- *global cost efficiency* (which exclude hot air and take leakage effects into account. (Leakage effects are often not directly measurable)

The global cost efficiency term is the most restrictive, the cost efficient commitment the least.

JI and CDM

The cost efficiencies of joint implementation and CDM depend on choosing the right projects, i.e. the projects, which will equate marginal abatement costs between countries. This may not be an easy task. The projects must both be additional (not part of the baseline) and low cost. (Cf. chapter 4).

One of the problems about joint implementation and CDM is to find the additional projects and limit the amount of projects supplied to the JI and CDM markets. There are huge numbers of projects, which involve reduced emissions, but all these projects cannot be financed through JI and CDM, and all the emission reductions cannot be assigned credit. Emissions reductions, which are part of normal investment practise, are free, and will be carried out despite the JI and CDM financing opportunities. Therefore financing should not be given to this type of projects.

But if the projects are additional, and if the projects also are the projects with the lowest emission reduction cost, then JI and CDM will be (regional) cost efficient instruments in practice. Additionality will rule out trade of hot air, but not leakage effects.

In practice the selection of additional projects involves baseline scenarios – but these are nothing but informed guesses (they can never be right in every detail). One of the basic assumptions behind baselines is, to exclude the emission reducing policy that is actually conducted, and therefore baselines can never be tested against the actual development. Emission reduction costs are measured relative to the baselines – and this introduces a high degree of uncertainty into costs.

Non-competitiveness of the JI and CDM markets will reduce the cost efficiency of the markets. Because JI and CDM are project related it might not be straight ahead to secure full transparency of the markets.

Monopolies

If taxpayers behave rationally, the tax instrument is efficient with respect to costs. And no monopoly position can be exploited.

The cost efficiency of tradable permits, JI and CDM depend on the market structure for the permits and the JI and CDM projects – whether the competition on the market is perfect or monopolistic. Big countries dominant position as suppliers or demanders may be a problem. Whether it will be a problem or not depends on the institutional set-ups. Agents must be atomised.

Policies that restore the free riding position of the agents

A common environmental tax co-ordinated between countries is a way to reduce the individual countries free riding and competitive advantage of not taking action. Once the tax is co-ordinated, the individual countries may have an incentive to re-establish their original free rider or competitive position by trying to undermine the national effects of the tax. For example by paying subsidies to the environmental taxpayers, lowering other taxes or lowering the price of publicly regulated raw material prices. (A CO_2 tax on gasoline may for example partly be undermined by lowering other taxes on vehicles (the CO_2 tax may still have an effect of the marginal behaviour, but considering the economy of driving in own car to the alternative of using public transportation - the relative 'over all' prices have not been changed), CO_2 taxes on the heavy energy intensive industries may be offset by heightening the subsidies for labour, capital,

cheap loans, etc. with the consequence of easing some of the economic pressure for energy savings, and perhaps giving a competitive advantage to companies which are inefficient in energy terms).

When countries try to re-establish their free riding positions the cost efficiency of the tax will be lower.

It is much more complicated – and in some strict sense impossible – to re-establish the free riding positions, when the instruments are JI, TP and CDM, because countries have fixed emission reduction targets and reductions *will* take place. But countries may try to pass the burden of cost to other countries by conducting policies, which for example secure that the emission reduction costs do not hurt the foreign competitiveness of the domestic firms. Cost efficiency will diminish by these policies.

Cheating and 'undermining' the flexible mechanisms

A dictator selling a substantial part of, or maybe all, emissions permits initially distributed to his country may undermine the TP system. The same is true with respect to a country selling to many JI projects. Therefore these kinds of behaviours must be avoided or heavily punished.

There are several elements relevant in evaluating cheat: who will have incentives to cheat? Will countries have incentives to an effective control? How can control be effective? Cheating is not particular to the Kyoto instruments. Also the alternatives (taxes, norms, etc.) will be subject to some element of cheating. But it is likely that the easier it is to cheat and the higher the economic gain, the more cheating. Cheating can be kept down by designing institutional frameworks making incentives to cheat small, by making high penalties and by securing an effective control.

The administrative burden

JI, CDM, TP and environmental taxes work through different channels and have different requirements for the institutional frameworks surrounding the instruments. The burden of administration will most likely differ, but it is difficult to make a comparison. The administrative burdens will depend on the institutional set-ups of the four instruments, and there are many different administrative elements to evaluate. The administrative burdens may be on the shoulders of the international environmental authorities, countries or individual agents. Some of the administrative costs are related to: The degree of co-ordination between countries, the amount of control, the transparencies of the markets, the amount of information needed to trade on the markets.

The administrative burden of individual emitters is a cost included in his emission reduction costs. The total administration costs are included in the global cost efficiency measure.

3 Choosing among more instruments

Choosing the right instruments is an important issue within the national and international debates on environmental policy. Avoiding climate change, preserving the water resources, cleaning polluted soil etc. may be very costly in terms of GDP growth rates and may require substantial international co-operation and co-ordination. Therefore it is important to the national governments and the international environmental authorities to single out the environmental instruments which are the most effective with respect to environmental protection and economic costs, and which are easy to co-ordinate. The more efficient the environmental instrument the less the negative effects to the national economies.

The national and international authorities can choose between a range of environmental instruments. The instruments will differ with respect to cost effectiveness, environmental protec-

tion, the administrative burden etc. Choosing a specific instrument may involve a trade off between certain desirable properties for example cost effectiveness and environmental protection.

This chapter compares three instruments: joint implementation, tradable permits and environmental taxes. The main focus is on joint implementation and tradable permits. These instruments are seen as alternative instruments in the post Kyoto debate on environmental regulation of the greenhouse gases. Both instruments are – at least in their textbook versions – cost effective, and both instruments may be interpreted as mechanisms to impose exactly the environmental tax, which will provide a specific environmental goal. These properties make it relevant to incorporate environmental taxes in the comparison.

The comparisons of the instruments are not complete. But some important criteria are sort out and different rankings of some of the criteria are suggested.

A problem related to a comparison of joint implementation and tradable permits is that each of the instruments can be implemented in actual policy in different ways – and these different 'set-ups' or ways to implement the instruments may affect the properties of the instrument – for example the degree of environmental protection. This fact makes the comparison more difficult, but does not however makes the comparison superfluous: The comparison points to forces and weaknesses of the instruments – in the eyes of different actors.

Through out the chapter it is assumed that TP and JI are used to eliminate *international* cost inefficiencies, because this is what is relevant in the post Kyoto debate. But both instruments may be used as purely national instruments as well. The evaluation of the instruments, when used in a national context may however differ in some respects.

In the following subsection a list of criteria for comparing joint implementation and tradable permits is set up.

Comparing the instruments

Joint implementation and tradable permits are in some respects very similar instruments. Both instruments presuppose the coexistence of other cost ineffective instruments, and the aim of both instruments is to eliminate these cost inefficiencies induced by the other instruments. Setting up markets eliminates the cost inefficiencies, where the agents have mutual benefit in trading the cost inefficiencies away.

The main difference between the two instruments is that joint implementation is related to concrete emission reduction projects and, what is traded on the JI market is emissions reductions. The agents (directly) involved in joint implementation are those involved in concrete reduction projects. tradable permits are permits to pollute, and these permits must be distributed to – in principle – every single polluter, as tradable permits are related to – in principle – every single emission of greenhouse gases in the involved countries. Thus the amount of trades on the markets for tradable permits and the amount of players involved in these trades may be substantially higher than is the case for joint implementation.

Whereas the market for TP is a market setting a price on emissions (an externality), the market for JI is a kind of investors market: the agents invest in projects which will give - or are supposed to give – the investor a later pay off in terms of emissions reductions. The differences with respect to what is traded in a TP and JI regime give rise to significant differences in the institutional set-up between the two regimes. And give rise to the different properties of the two instruments.

Comparisons and evaluations of the instruments may be done at a theoretical, a practical and a political level, where the theoretical level describes the ideal conditions under which the instrument can work, and the practical level includes the practical problems connected to the functioning of the instruments. Key elements in the comparisons are the environmental and economic efficiencies of the instruments. But also problems relating to initiating the instruments (including the distribution of permits), the amount of monitoring and control needed, and the problems relating to selecting the right projects for joint implementation (including the problems of creating baselines).

The criteria are summarised in Table 3.1, which also indicates different rankings.

Table 3.1. Criteria for evaluating the instruments and possible rankings of the criteria

Criteria	Ranking from the perspective of a legislator (FCCC)	Ranking from the perspective of an individual agent
Environmental protection	1	6 – if agents costs are not tied to the environmental protection 3 – if agents costs are tied to the environmental protection
Global cost effectiveness*	3	6
Cost effective commitment*	5	2
Initiating the instrument	2	1
Degree of co-ordination between countries	2	5
Effectiveness of control	2	6
Administrative burden	2	3
Technology transfer	4	4

*Note: * For a definition see section 2.3.*

Table 3.1 does not list all relevant criteria for the comparison of the instruments, and there may be lots of different rankings even from a legislator and an individual agent's perspective. A JI donor and host may for example have different evaluations of cost effectiveness and technology transfer. But these criteria are some of the most important, and the rankings presented in the table may illustrate actual rankings:

The reasoning behind the rankings are the following: The legislators (the FCCC in case of green house gases) primary concern are the environmental efficiencies of the instruments, because protecting the environment was the sole reason for the legislators to take action in the first place. If there is reason to believe that allowing JI or TP will undermine the environmental goals (for example the Kyoto commitments) – this may be too high a price to pay to obtain cost efficiency. The reason why JI and TP are interesting instruments is their cost efficiency property, but the reason why the global cost efficiencies of the instruments only rank third to the legislators is, that the cost efficiency only is interesting to them if other criteria are fulfilled. The concern of the legislators is to secure the environment and to create the right administrative and institutional framework for the instruments. Given this, the individual agents (countries, firms, and others) may be expected to secure the cost effectiveness of the instruments through permits trading or joint implementation.

The individual agents primary concern is the cost *in*effective instruments initiating JI or TP. How burdensome are for example the initial quotas? And with respect to TP, how is the permits distributed. The distribution of permits and the 'design' of the instruments working as incentive for JI have important economic influence to the individual agents. Some of the negative economic influence can be eliminated through the cost effectiveness of JI or TP – if the administrative burden is not too large. It is the cost effectiveness of the commitment that the individual agent is interested in (a JI host may disagree). The degree of environmental protection of JI and TP is only interesting to the individual agent if costs are linked to this measure: JI accreditations may be directly linked to actual emissions reductions associated with concrete JI projects.

In chapter 2 the cost efficiencies of JI and TP and other of the criteria in Table 3.1 were discussed. In the following subsection the initiation of the instruments are briefly discussed.

Initiating the instruments

Both TP and JI presuppose other cost ineffective instruments. tradable permits presuppose national quotas, and presuppose an initial distribution of permits. The initial distribution of permits is one of the much-discussed problems of TP, because of the economic significance to the 'polluters'. Different principles for distributing the permits – for example 'grandfathering' or auc-

tioning – have different effects on the distribution of costs and the competitiveness of firms (cf. chapters 7 and 8).

Joint implementation may be initialised through several instruments. Table 3.2 describes different environmental instruments, and indicates whether these instruments can be used as incentives for JI and can coexist with JI. Table 3.2 shows that all the listed instruments can coexist with – and be used as incentives for – joint implementation. The incentives may not be equally strong though. The mechanism behind the incentives is that either taxes or (investment) costs can be avoided if joint implementation secure emission reductions elsewhere. If subsidies are given to specific emission reduction projects (for example within firms), these subsidies may alternatively be spent on more cost-effective joint implementation projects.

For all the initial instruments (except quotas) it is necessary to define 'exchange rates' which specify the amount of emission reductions which must be carried out through JI projects in exchange for the removal of the initiating instrument.

In chapter 7 a British report on TP is summarised. One of the incentives for firms to join the voluntary TP system, which this report describes, is to convert environmental taxes to emission reduction commitments.

There is no need for co-ordination of the 'initiating instruments' between countries.

Table 3.2. Incentives for agents to engage in Joint Implementation

Primary instruments	Short description of the instruments	Can coexist with JI and be used as an incentive for JI?
Taxes or fees	Taxes on emissions, raw materials or the like	Yes
Subsidies	Subsidies to for example emission reducing investments, preferred raw materials or preferred technologies	Yes
Quotas	Quotas specifying the maximum level of emissions e.g. for firms, industries or countries	Yes
Norms	Norms specifying for example the maximum emissions per produced unit.	Yes
Technical standards	Specifying technical demands to the production technologies.	Yes
Public cleaning	Public cleaning may be an option – if cleaning is possible (this is not the case with respect to CO_2 emissions)	Yes
Voluntary agreements	Voluntary agreements are agreements between the government and for example polluting industries about emission reductions, technologies, etc.	Yes

Choosing JI or TP

The choice of JI or TP may be a trade off between different criteria. Different agents may come to different conclusions depending on how they rank the criteria.

Table 3.3 summarises some of the issues with respect to evaluating joint implementation and tradable permits as international environmental instruments. Most of these issues were touched upon in chapter 2. Both instruments use the market mechanism to eliminate cost inefficiencies, tradable permits through markets for emission permits, and joint implementation through markets for emission reductions. In practice the instruments are very different, as the table suggests.

Given the fixed reduction commitments it must be assumed that the environmental 'effectiveness' of JI and TP is almost the same, although there will be differences in leakage effects, the amount of hot air traded and cheating. The TP instrument is more cost efficient than JI (because

selecting the right projects may be difficult), but JI is easier to initiate and demands very little co-ordination between countries.

Combining Table 3.1 and Table 3.3 suggests that different actors may have different opinions on forces and weaknesses of the instruments.

Table 3.3. Important issues with respect to evaluating joint implementation and tradable permits

Criteria\Issues	Tradable Permits	Joint Implementation
Environmental protection	Fixed reduction commitment, but 'Hot air' Leakage Cheating	Fixed reduction commitment, but ('Hot air') Leakage Cheating
Cost effectiveness	Competitiveness of market	Selecting the right projects Competitiveness of market
Initiating the instrument	Presuppose a permit market Distribution of permits	Presuppose cost ineffective instruments and an 'exchange rate' between this or these instruments
Degree of co-ordination between countries	High All participants must have binding commitments Agreement on institutional set-up	Low
Effectiveness of control	Control at the level of individual emitter? Do countries have an incentive to control their own citizens?	Control at country level Countries do have an incentive to control their own citizens.
Administrative burden	The organisation of the market. Control.	The organisation of the market. Selecting the (right) projects. The accreditation procedure.

4 JI and CDM and accreditation of emission reductions

Prior to the Kyoto protocol the CDM instrument was a special case of JI, where the host country was a non committed country. In the Kyoto protocol a distinction was made between JI and CDM. The very good reason for this distinction is documented in the present chapter, which deals with incentive analysis and institutional frameworks. Incentives and recommendations for frameworks for JI (in the old definition of this instrument) change so much dependent on the host country's status as committed or non-committed country that a split in two separate instruments are clarifying.

In the present chapter *JI is used in its prior to Kyoto definition.* That is, JI is including CDM as a special case. Treating the instruments as one and focussing on different agent's incentives to reduce emissions and motivations to use the instrument will as said show the differences between the instruments.

4.1 Accreditation

The accreditation aspect is what characterises joint implementation from other instruments, and the problems relating to accreditation are the problems to be solved to make joint implementation operational. Issues like baseline, additionality, incremental costs, control, cost curves, fairness and equity – discussed in extension in the literature on joint implementation – are all related to the accreditation methodology. The following will describe how.

Joint implementation is an environmental economic instrument, which involves both market forces and administrative procedures:

The aim of joint implementation is to level out differences in cost of emission reductions between countries, regions or for example firms. Host countries supply emission reduction projects, and donor countries demand emission reduction projects at costs, which are as low as possible. Donor countries will finance emission reduction projects in the host countries if prices are favourable. Prices equalise supply and demand, and joint implementation in this way makes use of the market forces.

The reason why donor countries are interested in financing emission reductions in other countries is that joint implementation allow the donor countries to substitute between emission reductions at home and abroad, and allow them to be accredited the emission reductions financed abroad. The accreditation of emission reductions abroad is crucial to the donor countries because the higher the accredited emission reduction, the easier and the less expensive it will be to fulfil the national emission reduction targets. The accreditation procedure is an administrative procedure involving official acceptance of (in principle) every single JI project.

The market for JI projects levels out differences in emission reductions costs between countries, delivers a price on emissions reductions (for example a price per ton CO_2 reduced) and minimises inoptimalities. The market price is conditional on the institutional framework for JI. What the market can not do by itself is first, to assure that there is a *limit* to the *supply* of projects to the market for JI, and second, to avoid *cheating* and *leakage* effects. The institutional framework must deal with these problems.

The main problems connected to an international acceptance of JI as instrument are tied to the problems of additionality (limiting the supply of JI projects) and of avoiding cheat. For the instrument to be effective, it is important that JI projects are limited to projects, which contribute to reduce global emissions *by at least as much ad would otherwise have been done,* and it is important that the national and/or international accreditations of these projects reflect real emissions reductions. If it is possible to bring cheating to a minimum, and possible to assure that credit is assigned only to the 'right' projects – JI will be a desirable instrument in theory and in practice.

The theoretical and practical problems connected to JI are mirrored in the accreditations, and therefore it may be informative to compare the problems in relation to their effects on the accreditations.

Accreditation of emission reductions raises a long range of practical and theoretical problems. These problems are dealt with in the following sections.

It is concluded that a theoretically correct accreditation is non-existing. Instead the JI framework and the specific contracts associated with every particular JI project will *define*, what is the correct accreditation. The *JI framework* and the *specifications in the JI contracts* must cope with the problems connected to the accreditation.

The analysis of motivations, incentives and leakage in this chapter demonstrate that the character of cheating and leakage is very much dependent on the host country's status as Annex B or non-Annex B country. This point is not new, but the argument is one output from a more systematic and detailed analysis. And the analysis gives the background for the split of the JI instrument in the Kyoto Protocol in two instruments dependent on the host country status.

Internationally there has not yet been any agreement on the institutional framework needed to regulate joint implementation. A very important – if not the most important – criteria for which framework to choose is the ability of the institutional framework to assure that the agents incen-

tives work in the direction of maximising the environmental and other benefits of JI, and minimising the associated direct and indirect costs. Sections 4-8 analyses the incentives, motivations and interests of the participants directly and indirectly involved in a given JI arrangement.

Which international framework (international rules, international bodies) there might be set up to regulate joint implementation in a FCCC perspective will not be discussed in this chapter. And it will not be discussed which national regulations or mechanisms in the donor countries, will make it advantageous to the firms or industries in the donor countries, to engage in JI arrangements.

4.2 Problems related to accreditation

There are several reasons why accreditation is not straightforward. The problems show up when you ask questions like, how to assure correct accreditations for JI projects. Problems occur on a theoretical and a practical level.

The theoretical and practical problems may best be illustrated by the fact that it is a problem even to define what a correct accreditation is:

A clear-cut definition of the theoretical correct accreditation (on the project level) is impossible, if the emission reductions associated with different JI projects (and other investments) are not separable. Non separability means that there is no theoretical answer to, how to allocate emissions reductions between interdependent JI projects.

Another theoretical and practical problem is, that it is not obvious, what will be the correct accreditation, if a JI project fails due to circumstances that the donor (and maybe even the host) have no influence on, and could not foresee. Who will carry the risk of project failures?

A large amount of the future investments in donor and host countries may imply reduced emissions. But not all these investments will be approved as JI projects – and therefore credit will not be given for every emission reduction observed in the future. Projects suitable for JI are usually limited to *additional* projects, i.e. projects that would not have been carried out without JI financing. Countries are supposed to make projections of their economy – reference scenarios or 'baselines' – showing the development of the economy and the future emissions without JI (i.e. without the additional projects). But if JI becomes a possibility, JI may change the investment behaviour, and additionally may be a very difficult criterion. After some years with JI, JI – like every other actual policy – is taken into account in plans and projections – and the reference scenario may be constructed as a residual. The residual will show a 'realistic' projection of the economy, but subtracted the projects that the countries want to be approved as JI projects. In this case additionally has no positive meaning.

Below is listed some important problems related to a correct accreditation at the project level:

- Additionality. If accreditation should only be given to emission reduction projects, which are additional to those that would otherwise have been carried out, it is important to know how additionality can be defined.
- References. The concept of additionality involves a reference scenario. Should 'no regret options' be included in the reference scenario (if yes, this implies that 'no regret options' can not be JI projects)? Should the reference scenario include standard assumptions. Should there be special requirements to the level of energy prices in the reference scenarios – or the level of growth of energy prices?
- Time perspective. For how long time should it be possible to the donors to be accredited a specific JI project. The JI project may for example be a simple forwarding of a later baseline project.
- Project failure. Who will carry the risk of project failures. Failures may be caused by circumstances outside the control of the donor and host.
- Other (minor) uncertainties. Who will carry the risk of uncertainties. What will for example be the correct accreditation, if the emission reductions are higher or lower than projected due

to higher or lower activity level – at the national economy level, or at the plant level – than projected.

- Leakage. If a JI project implies increased emissions elsewhere – for example because firms and countries change behaviours towards importing polluting goods rather than producing these goods – the net effect on emissions reductions of that project may be limited, and even negative.
- Systems effects. What will be the correct accreditation if the indirect emission reduction decreases because of for example other JI projects. (The indirect emission reducing effects of projects that reduce electricity consumption are dependent on how the electricity is produced).
- Incentives. Who (at the project, systems and macro level) will be in a position, where they have all relevant information, so they in principle can report the emission reductions? What are the incentives to reveal the true direct and indirect emission reduction?
- Control. What are the needs for control (given different institutional frameworks)? Will the control be effective?

Because it is difficult to make a clear-cut definition of the theoretical correct accreditation, and because the practical problems relating to accreditation are even bigger, the institutional framework for joint implementation becomes very important in defining what should be accredited for. An example of a very simple institution is that every single JI contract specify, who will carry the burden of project failure and uncertainties, and that the price of the accreditation associated with the JI project reflects the specific contract conditions. The formulation of the JI contract, the evaluation of project failures and uncertainties and the price of the JI contract may be left to the host and donor firms to negotiate. But the analysis in section 8 show that if the host and donor *countries* are committed by the contracts, the governments may want to approve or even directly negotiate the contract conditions.

The best answer to the theoretical and practical problem of defining what a correct accreditation is, may be that the accreditation depends on the institutional framework for joint implementation. The accredited emission reductions may be the emission reductions actually experienced in relation to a concrete project (with or without systems and macroeconomic effects (for example price effects)) or emissions reductions experienced in relation to for example a pool of projects (eventually related to the total emission reductions of the host country). The institutional framework will define at which 'level of aggregation' the emission reductions can be 'measured'. And the institutional framework or the JI contract will specify who will carry the risk of project failure, etc.

Several parties – for example donor and host countries, donor and host firms and industries, the international community (represented by different international institutions) – may be interested in a particular JI project. Their perspectives on JI (the reason why they are interested in JI) may be different. Their main concerns are in the money transfer, the accreditation, and the emission reductions. But they are not necessarily interested in accreditation at the same level of aggregation (i.e. country, industry, systems or project level). The international (JI) institutions may for example be interested in accreditation at the country level, while accreditation at project and system levels are only of secondary interest, if at all interesting. This means that the different parties will pose different demands to the accreditation methodology (and to the institutional framework for JI), for example with respect to accuracy, treatment of uncertainties, verification and control.

At which level the accreditation is carried out is decisive to which tools are needed to assure a 'correct' accreditation.

A 'correct' accreditation at the project level demands a detailed and carefully elaborated accreditation methodology. The need for baselines, technical and macroeconomic models, external control of the fulfilment of the JI contract, etc. may be extensive in this case.

A correct accreditation at the country level may, with respect to CO_2, be fairly simple. It may be as simple as, a technical measuring of the CO_2 emissions at two different dates for two different countries engaging in JI arrangements with each other.

Given a demand for a correct accreditation at the project level, the institutional framework should be designed in a way so as to minimise cheat, and to minimise the necessary control of the claimed accreditations. The framework must deal with, how to reveal the, in principle, private information concerning the exact emission reductions, how to avoid incentives to cheat, how to take account of systems and other effects, project failures etc. An effective control of the project data is essential at this level of accreditation. The framework must make the effective control possible.

If successful the accreditation methodology (the JI framework) must deal with the problems listed above. Sections 4.4 to 4.8 analyse the list from the perspective of the agents involved in JI. To whom is additionality a problem, who needs baselines etc. The analysis shows that the different agents have different interests, incentives and motivations.

4.3 How can the problems related to accreditation be dealt with?

In the previous sections the expression 'correct accreditation' was used in the meaning 'the theoretical correct accreditation'. But as mentioned this idea of a correct accreditation is not possible – neither in theory nor in practice.

In practice a correct accreditation is defined according to the accreditation methodology specified by the particular framework for JI in question. As it may be useful to refer to both the 'theoretical correct accreditation' and the 'accreditation specified by the JI framework' the later is referred to by the term 'framework accreditation'.

Different 'tools' may be needed or help/assure a correct framework accreditation. Some of these are listed below.

- Appropriate macroeconomic models.
- Appropriate technical models – project and/or system level.
- Official (and other) physical plans for the energy supply sector, and energy demand.
- Official forecasts of the macroeconomy.
- List of existing and planned policies with relevance for emissions.
- An official definition of terms relevant for the accreditation. For example a definition of baselines.
- Control
- International agreements on, and accept of, the accreditation procedures

The tools may be used to construct:

- Baseline scenarios
- JI scenarios
- Cost curves for emission reductions.

– and to implement effective control.

The tools on the list are all tools that especially the *host governments* may want to use to help prioritising JI projects, and to help the *host government* prevent that individual firms or industries via JI-arrangements commit the host country to reduce emissions more than these firms and industries themselves can be hold responsible for. The tools may also be used to help control the

actual emissions from the firms and industries, and to take the interrelationship of projects (for example system effects and macroeconomic effects) into account

The donor government may be interested in baselines, cost curves, plans, etc. pertaining the host countries to evaluate the market, the prices and the potentials in the host countries for emissions reductions and joint implementation. The donor governments – and the donor plants and industries – may have special interests with respect to the particular (type of) JI project (and the economic and technical environment to the project) that they want to engage in. A macroeconomic projection of the host economy may give the donors some idea of for example the uncertainties with respect to the emissions reductions connected to a particular project

The donor governments may want these tools – baselines and cost curves for the donor country itself – to help prioritising between the amount of emissions reductions carried out at home and abroad, and which emissions reductions projects should be carried out at home.

Host industries and plants need projections of the future markets for their products – and good estimates of their likelihood of /ability to reduce emissions.

4.4 The interests of the 'players' in JI

Non compliance, cheating and some types of leakage effects become problems because some of the participants in JI arrangements have other interests than the environment. This section analyses the participants (agents/players) primary and secondary interests in JI. The interests of the participants will influence their attitudes to baselines, additionality, control etc.

The analysis tells something about in which direction different agents may wish to exploit JI if they follow their own interests. Especially big donors or hosts may be in a position to exploit their market powers on the market for JI. An example could be that host firms are 'forced' to use technology produced or developed in powerful donor countries.

The analysis may also tell something about conflicting or mutual interests of the different agents: donor and host, host country and host firm, etc.

The knowledge of primary and secondary interests of the agents and conflicting and mutual interests of the agents is valuable when designing the institutional framework for JI.

The table below assumes fixed reduction targets (uniform or non-uniform) posed on donor and Annex B host countries. If there were no fixed reduction targets all hosts would have the same interests and motivations as non-Annex B hosts. Donors would not have fixed reduction targets as the driving force and primary interest, but another incentive to engage in JI. Otherwise the interests of the donors would be the same.

It is obvious that what the table lists as the agents primary and secondary interests, will not be true in all cases. Countries and even firms may for example have the environment as first priority. What are listed are the interests and motivations when emissions reductions are analysed as a free rider problem. The area of joint implementation will typically be emissions with global deposition, for example CO_2, and for this type of emissions free riding may be a serious problem.

Table 4.1. Agents motivations to participate in JI arrangements

	Primary interests	Secondary interests
International Bodies	The environment. That countries fulfil their reduction commitments (to obtain the full environmental effects). An environmentally and economically efficient emission reduction effort (to assure the success and credibility of the policy).	JI as development aid Transfer of technology
Donor countries	To fulfil their emission reduction targets (to avoid a bad international reputation and to avoid possible sanctions) To buy the emission reduction as cheap as possible	The environment To promote national technology and products in the host countries.
Host Countries a) Annex B	To sell emissions reductions at high prices – without hindering the fulfilment of the countries own commitment at low costs (good business). New and resource saving techniques are introduced and financed by foreign countries/firms/industries	Local environmental benefits
b) non Annex B	To sell emissions reductions at high prices . There will be no limit to the supply of JI projects. New and resource saving techniques are introduced and financed by foreign countries/firms/industries	Local environmental benefits
Donor industries	To avoid the burden of national measures (fixed commitments, taxes, etc.) and to buy emissions reductions as cheap as possible.	To promote own products or own technology. To promote a desired environmental profile
Host industries	To sell emissions reductions at high prices . New and resource saving techniques are financed by foreign countries/firms/ industries (may be a competitive advantage)	Local environmental benefits
Donor firms	To avoid the burden of national measures (fixed commitments taxes, etc.) and to buy emissions reductions as cheap as possible.	To promote own products or own technology. To promote a desired environmental profile
Host firms	To sell emissions reductions at high prices . New and resource saving techniques are financed by foreign countries/firms/ industries (may be a competitive advantage).	Local environmental benefits.

4.5 Leakage

A leakage connected to a JI project is an increase in emissions, which are not taken into account in the accreditation for JI projects. Leakages occur at the JI plant, or in other parts of the national or international economy. Leakages may be very difficult to measure, because leakages may be indirect effects of the JI projects or because the leakage effects as just mentioned may occur in other parts of the national or international economy.

Examples of indirect leakage effects are increased activity levels caused by JI projects: In general JI may reduce energy consumption and energy demand and thereby lower energy prices. If lower energy prices stimulate higher energy consumption – and this is not taken into account in the JI accreditation – this is a leakage effect. Another indirect leakage effect (relevant in many eastern European countries) may be increased private energy consumption for heating purposes – and increased welfare – followed by JI insulation projects.

Examples of direct leakage effects are JI projects, which involve a cut off of polluting processes, or export of these processes and buying of intermediate 'polluted' products.

Leakages occur when JI projects are evaluated in 'isolation' (for example at the plant level) (and in this perspective reduces emissions), but if evaluated at higher levels of aggregation (industry, country, world) reduces emissions by less, or even increase emissions.

Table 4.2 describes to whom leakages may be a problem.

Leakages are a problem to an agent, if the agent cannot pass it (further) on to somebody else. Leakages are a problem to the environment if *no* agents are responsible of neutralising the leakages. The institutional frameworks will im- or explicitly decide who will carry the burden of neutralising the effects of leakages. If the institutional framework or the JI contract does *not* specify explicitly who will be responsible of neutralising leakages there are several possibilities:

- Donor firm/industry/country is responsible. For example: the contract specify that the donor should be accredited actual emission reductions at the plant level, but emissions at the plant level are not reduced as much as expected because of a rise in activity due to JI (better or cheaper products). This makes the donor carry the burden of leakage, because the donor gets fewer emissions reductions than he expected.
- Annex B host is responsible. For example: the contract specifies that the donor should have the contracted, fixed accreditation, despite the actual emissions reductions, or should be accredited the emissions reductions compatible with a specified activity level. In this case the host firm/industry or country is responsible for neutralising the leakage effects.
- The environment is 'victim'. For example: polluting processes or firms are exported to non-Annex B countries, which do not have any national obligations to reduce emissions. The increase in emissions in these countries, due to their increased export of emission intensive products, will therefore not be offset by decreases in emissions elsewhere.

If donors and Annex B host countries are committed by fixed reduction targets leakages are only a problem to the *environment* if the leakage effects occur in a non Annex B country. In this respect leakage may be seen as a problem of co-ordinating the international agreements on fixed reduction targets. If those countries which today are non-Annex B counties are committed by realistic fixed reduction targets leakages will not be a problem to the environment. [3]

[3] Realistic fixed reduction targets means that these targets on the one hand must be compatible with the international environmental goals. On the other hand, if a substantial part of the cheap reduction potentials (low cost JI projects) is located in the non annex 1 countries, it is important to limit leakages and make the non-annex 1 counties interested in efficient emissions reductions projects (cf. table 1) by simply having a not too "loose" fixed target.

Table 4.2. Types of leakages relevant to different agents, when countries emissions targets are fixed

	Annex B host country	Non Annex B host country
International bodies (leakage is a problem)	Export of polluting industrial processes, firms or industries to non Annex B countries Import of 'polluting products' from non Annex B countries	Removal of polluting industrial processes, firms or industries to other firms or industries within the host economy or to other non Annex B countries Import of 'polluting products' from other firms or industries within the economy or from other non Annex B countries
National governments a) Donor b) Host (leakage may be a benefit or a problem)	Problem: if leakages in the host country diminish the amount of emission reductions accredited to relevant JI projects Benefit: The cheapest way (also as part of JI projects) to reduce emissions may be to export polluting industrial processes, firms or industries to other countries (Annex B or non Annex B) and to import the 'polluting products' from abroad Problem: if leakages for example due to increasing activity levels diminish the amount of emissions reduced, and if this makes a gap between the emissions reductions sold – and legally committed to 'deliver' – and the actual emissions reductions, extra steps will be necessary to reach the 'revised' emission reduction target.	It will be no disadvantage to the host country to carry the 'risk' of leakage unless the international body 'makes it a risk'. Leakage will therefore only be a problem to the *donor* if the international body makes it a risk to the donor. Leakage is no problem to the host – unless others make it a problem (for example by making a solution to the leakage problem a precondition for engaging in JI arrangements with Annex B countries).
Industries (Pool) a) Donor b) Host	Leakages in the host country /firm/industry is only a problem if the donor industry is (legally or otherwise (by sanction)) obliged to 'neutralise' the leakages Leakages is only a problem if the host industry is (legally or otherwise (by sanction)) obliged to 'neutralise' the leakages	Leakages is no problem unless legally enforced Leakages is no problem unless legally enforced
Plants a) Donor b) Host	Leakages in the host country /firm/industry is only a problem if the donor firm is (legally or otherwise (by sanction)) obliged to 'neutralise' the leakages Leakages is only a problem if the host plant is (legally or otherwise (by sanction)) obliged to 'neutralise' the leakages	Leakages is no problem unless legally enforced Leakages is no problem unless legally enforced

If the donor or Annex B host *country* carry the burden of leakages, they can pass it further on to plants or industries, consumers, taxpayers, etc.

4.6 Additionality

One of the problems about an international agreement on joint implementation is to limit the amount of projects supplied to the JI market. The limit inherent in the market for JI projects is the level of emission reduction costs (there is no idea in supplying high cost projects, which will have no chance of being financed through JI). But this is not the only limit relevant in an environmental perspective: There are huge numbers of projects which involves reduced emissions, but all these projects cannot be financed through JI and all the emission reductions cannot be assigned credit. The success of JI is dependent on choosing the right projects for JI.

The main purpose of JI is to reach the international environmental goals at as low extra costs as possible. The outcome of an efficient international market for JI is to deliver as much direct and indirect emission reduction as possible per unit of cost. Emissions reductions, which are secondary effects of normal investment practise, are free. Therefore JI financing should not be given to this type of projects – and this type of projects should be excluded from the 'optimal' JI market. The maximum emission reduction is obtained when the JI projects supplied at the market for JI are additional.

But how crucial is it that JI projects are additional. Is lack of additionality always a problem to the environment or is it the cost minimising property of JI, which is lost.

There is no environmental effect, and therefore no cost reducing elements, in financing JI projects in non-Annex B countries, unless the JI projects are additional. If the donor countries are accredited emission reductions they off cause experience low costs, but if the net effect to the environment is zero, the JI projects has failed to bring you any step nearer the international environmental goals.

Whether additional or not, there will always be a cost reducing element in financing JI projects in Annex B host countries as long as the emission reduction costs are lower in the host country than in the donor country. But if the JI projects are additional the environmental effects and the cost reducing effects of JI are maximised. As long as the Annex B host country is committed by a fixed reduction target, and by international sanctions of JI contracts which means extra obligations to reduce emissions – additionality is not a problem to the environment, but a problem to the host, who does not get the optimal effects out of JI. In second place non-additionality can be a problem to firms, industries and consumers because the host country can pass the extra costs of reducing the emissions on to these groups. So, when Table 4.3 say that non-additionality is not a problem to host firms and industries, this means that it is not a*direct* problem to them.

If the JI projects are not additional it will be much harder, and much more expensive, to the Annex B host to reach the emission reduction targets it has committed itself to reach. If this means that the Annex B host country is unlikely to fulfil its obligations it will be a problem to the environment – and to the international bodies which have allowed the JI arrangements (therefore additionality may be an indirect problem to the international bodies). If the JI projects are not additional, there may be distributional effects between donor and host and between firms within the host country. It may be – and it seems very likely – that the donor country will pay a too low price for the accreditation, if the projects are not additional. The reason for this is that the extra JI financing is not needed in projects, which would be carried out any way. So, in principle there is no lower limit to the price of the accreditation in these projects.

Non additionality may be a distributional problem between host firms and/or host industries because non-additional JI projects enhance the differences in emission reduction costs between firms/industries.

Table 4.3. To whom is non- additionality a problem?

	Annex B host country	Non Annex B host country
International bodies	No	Yes
National governments		
a) Donor	No	No
b) Host	Yes and no. Additionality of projects may be desirable, because additionality secures the extra emission reductions, which are needed to reach the targets. Given extra financing is needed to reach the target, additionality is a criteria which help securing that JI financing is given to emission reduction projects which need extra money to be realised.	No
Industries (Pool)		
a) Donor	No	No
b) Host	No. (Non additionality may be an advantage to industries with non-additional projects).	No
Plants		
a) Donor	No	No
b) Host	No. (Non additionality may be an advantage to firms with non-additional projects).	No

4.7 Who needs baselines

A baseline is a projection of the economy and the technologies into the future. The baseline is a 'business as usual' scenario and does *not* include additional JI projects. Therefore baselines are important in deciding which potential JI projects are additional (they are not in the baseline). But it is clear that the baselines technically must be very detailed if it should be possible to identify specific projects.

It is important to ask questions like: who precisely wants the baselines, is additionality the only motivation to make baselines, who makes the baselines, who should make the baselines? Baselines at which level of aggregation, how elaborated or detailed must the baselines be, who wants which accuracy of the baseline.

If the baselines are used to define additional projects, will it then be necessary to give these baselines international status. Will there be 'official national baselines', and can these baselines be revised?

Table 4.4 shows who needs baselines for what reasons given fixed future emission reduction targets. (If, according to the table, a donor country 'needs baselines', it means baselines pertaining the country itself. A donor country/firm/industry may often find it very informative to know the host countries baselines, as it may tell something about the technical and economical environment that the JI projects are placed in).

Table 4.4 shows that baselines are very useful tools – but only the international bodies need them to control JI in non-Annex B countries. The international bodies need the baselines to control additionality, accreditations and leakages in the non-Annex B countries.

The host governments may want to use baselines to help prioritising JI projects, and to help the host government prevent that individual firms or industries via JI-arrangements commit the host country to reduce emissions more than these firms and industries themselves can be hold responsible for. The tools may also be used to help control the actual emissions from the firms and industries, and to take the interrelationship of projects (for example system effects and macroeconomic effects) into account

The donor government may be interested in baselines, cost curves, plans, etc. pertaining the host countries to evaluate the market, the prices and the potentials in the host countries for emissions reductions and joint implementation. The donor governments – and the donor plants and industries – may have special interests with respect to the particular (type of) JI project (and the economic and technical environment to the project) that they want to engage in. A macroeconomic projection of the host economy may give the donors some idea of for example the uncertainties with respect to the emissions reductions connected to a particular project

The donor governments may want these tools – baselines and cost curves for the donor country itself – to help prioritising between the amount of emissions reductions carried out at home and abroad, and which emissions reductions projects should be carried out at home.

Host industries and plants need projections of the future markets for their products – and good estimates of their likelihood of /ability to reduce emissions

Table 4.4. The need for baselines

	Annex B host country	Non Annex B host country
International bodies	No need	Need (for control purposes etc.)
National governments		
a) Donor	Useful tool	Useful tool
b) Host	Need, self interest	Obliged? (by international bodies)
Industries (Pool)		
a) Donor	Useful tool. Partial baseline concerning own prospects	Useful tool. Partial baseline concerning own prospects
b) Host	Useful tool. Partial baseline concerning own prospects Obliged ? (by national government)	Obliged? (by international bodies)
Plants		
a) Donor	Useful tool. Partial baseline concerning own prospects	Useful tool. Partial baseline concerning own prospects
b) Host	Useful tool. Partial baseline concerning own prospects. Obliged ? (by national government)	Obliged? (by international bodies)

It is necessary to make a distinction between baselines for your own use and information and baselines for the use of others (control, planning, etc.). The two baselines may differ with respect to evaluations of economic growth conditions etc.

4.8 The need for control

Table 4.5 shows who need control at which level for what reason? The table can be used to say something about what should be controlled, and what kind of control is crucial to the JI process.

To ease the burden of control it is important to design the institutional framework so the incentives to 'optimal' behaviour and the incentives to give correct information are right, or more realistic, as good as possible. It is important to place the control on the JI agents who are relatively best informed *and,* in whose interest it is to reveal the information. The question is whether it is possible to create a JI framework so either the donor country has an incentive to invest only in additional projects in non Annex B countries – or at least to reveal all relevant information – or the non Annex B country has the correct incentives.

Table 4.5 show that host countries, industries and firms in general have no need for any control. An important exception is the Annex B host country, who want to control that the host plants and industries do not sell more accreditations, than they themselves can be hold responsible for. If the amount of JI accreditations sold are larger than the amount of JI emissions reduced, and if the price of the accreditations are too low, the host country can be in trouble if the international bodies hold the country responsible for the JI contracts.

The international bodies need intensive and detailed control of the non-Annex B countries, but only need control at an aggregated level of the Annex B countries.

Unless the donors have got JI contracts which specify fixed accreditations at fixed costs, they need to control, that they get the amount of accreditations paid for. When engaging in JI contracts with non-Annex B countries, both donor and host can have incentives to boost accreditations.

Governments in donor countries may want to control that their plan for emissions reductions are 'on track'. Otherwise it is necessary to impose new regulations to fulfil the emission reduction targets.

Table 4.5. The need for control

	Annex B host country	Non Annex B host country
International bodies	Country level: Control of countries reduction commitments	Country, industry and plant level: The international bodies what to control the additionality of the JI project, the accreditation and leakages.
National governments		
a) Donor	The 'JI contract level': The donor countries want either domestic emissions reductions or accreditation for foreign JI contracts. The donor countries want to be sure or even to control that domestic donors do get the emission reductions they (on average) have paid for (if not it may be cheaper to reduce at home). The donor country may have specific demands to the type of contracts the donor firms or industries are allowed to engage in. If the JI contracts specify a fixed accreditation and a fixed transfer of money, the donor country has no need for control.	The 'JI contract level': The donor countries want either domestic emissions reductions or accreditation for foreign JI contracts. The donor countries want to be sure or even to control that domestic donors do get the emission reductions they (on average) have paid for (if not it may be cheaper to reduce at home). The donor country may have specific demands to the type of contracts the donor firms or industries are allowed to engage in. If the JI contracts specify a fixed accreditation and a fixed transfer of money, the donor country has no need for control. The host has got no incentive to cheat the donor with respect to accreditations.
b) Host	The 'JI contract level': The host countries want to control that JI accreditations are sold at prices which are high enough to cover the 'relevant' costs. The host countries may want to restrict the amount of JI contracts, because it itself is committed to reduce emissions.	No need for control.
Industries (Pool)		
a) Donor	The 'JI contract level': If forced to by domestic policies (taxes, quotas, penalties, etc.), the donor industries want to control that they get the emissions reductions and accreditation specified in the JI contracts.	The 'JI contract level': If forced to by domestic policies (taxes, quotas, penalties, etc.), the donor industries want to control that they get the emissions reductions and accreditation specified in the JI contracts. But this should not be a problem since the host has got no incentives to cheat the donor).
b) Host	No need for control	No need for control.
Plants		
a) Donor	The 'JI contract level': If forced to by domestic policies (taxes, quotas, penalties, etc.), the donor industries want to control that they get the emissions reductions and accreditation specified in the JI contracts.	The 'JI contract level': If forced to by domestic policies (taxes, quotas, penalties, etc.), the donor industries want to control that they get the emissions reductions and accreditation specified in the JI contracts. But this should not be a problem since the host has got no incentives to cheat the donor).
b) Host	No need for control	No need for control.

4.9 Conclusions

The preceding sections tell something about the pitfalls of JI. And something about the problems that the institutional framework must solve. The main environmental problems are related to JI contracts with non-Annex B countries. Therefore a very effective political strategy would be to try to move all important non-Annex B countries into the group of Annex B countries. If this can not be done, the institutional framework concerning JI arrangements with non-Annex B countries must be very specific. The analysis shows that the non-Annex B host country (when considered as a free rider), does not care about the environment, additionality, leakage, baselines and control. Therefore the institutional framework for JI must be designed in a way so it either gives the non Annex B host incentives to care about environment, additionality etc., or gives the donor incentives to care about the same, or gives international bodies power to set conditions for JI projects with non Annex B countries and accept and reject projects.

If donors and Annex B hosts acts rationally and if countries have got sufficient incentives to fulfil their fixed reduction targets, the needs for regulations and restrictions on the JI contracts are few. Maybe in this situation the most important contribution of the institutional framework to cost effectiveness and additional emission reductions, is to make the market for JI mare transparent.

5 CDM and TP

Because the global warming problem is a long run problem it is important to analyse the long run consequences of policy instruments. CDM is primary an instrument to improve cost efficiency. But how does the CDM affect the Developing Countries incentives to commit to fixed reduction targets? The developing countries – may be said to free ride against the *Kyoto Protocol*, because they are not committed to reduce emissions, but remember that the Annex B countries until now have been the main responsible for the human related increase in the GHGs. Will CDM enhance the Developing countries' free rider incentives and make the Developing countries' future commitment more unlikely? Or will the opposite be true; that CDM will make Developing countries' future commitment to fixed reduction targets more likely.

There are arguments for both. On the one hand it could be expected that because CDM in many ways are identical to a TQ regime, CDM could develop into a TQ regime. On the other hand Developing countries could argue that if they participate in CDM the additional gains from going to a more comprehensive TQ regime would diminish.

Chapter 3 discussed how the choice of instrument depends on different incentives related to economic and/or environmental concerns. Developing countries have a special position because they, according to the Kyoto Protocol, only participate in the CDM – i.e. they do not have a choice, at least in the short run. The appropriate question is therefore whether they have incentives to switch to a TQ regime. The major concern in doing this is that it presupposes a commitment to a given emission target. The developing countries have so far rejected any step in the direction of commitments, but this has mainly been due to political and moral considerations.

It is often argued that by participating in the CDM, developing countries will sell out the cheap abatement projects and therefore increase the costs for later commitments and TQ. It is however more complicated and rather difficult to say anything precise about this issue. Section 5.1 deals with the question.

Another important issue with respect to the decision of whether or not to switch to a TQ regime is, which principle is used to allocate the emission permits. Allocations involve welfare changes and may therefore affect the countries' incentives to join a TQ regime. Barrett expresses the importance of initial allocations by; " *the initial allocation of permits creates wealth. The*

issue is not purely distributive, for the initial allocation will determine which countries sign an international agreement" (Barrett, S., 1991; 90). Section 5.2 looks at the allocation debate.

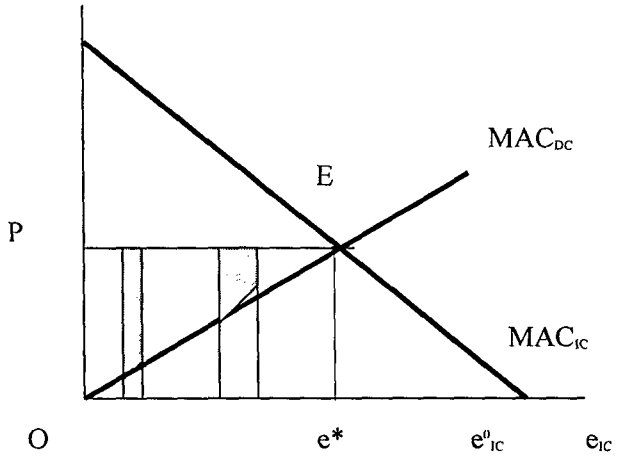
The last issue to be dealt with is the possibility of strategic use of the supply of CDM projects. If the supply of CDM projects affect the level of future gains it is obvious that developing countries can try to find the optimal strategy of making this supply. One argument is that while the supply of CDM projects under some circumstances can be viewed as an exhaustible resource (see e.g. Rose et al, 2000 for an argument) it is possible to find the optimal path of extracting this resource. Section 5.3 will discuss this view as well as an alternative way of describing the strategic possibilities of the supply of CDM projects, namely the possibility of connecting the supply of CDM projects to negotiations on permit allocations for a TQ regime.

5.1 CDM and gains from a future TQ regime.

As noted above it is often argued that developing countries by selling the cheap abatement projects under the CDM will reduce the gains from later participation in TQ. The argument is often referred to as the 'sold-out' argument. Figure 5.1shows the argument as illustrated by Bohm (1994a).

The figure shows that the Developing countries' gains from trade in the absence of CDM is equal to the triangle OEP. This triangle equals the export revenue (quota unit price times quota export) OPEe* minus abatement costs OEe*. If, however, the CDM is implemented prior to the TQ regime and e.g. the two projects marked by the shaded areas are carried out in CDM operations, then the Developing countries' gains from entering the TQ regime will be lowered by the amount of the shaded areas. This is because the Developing countries are now unable to sell these 'projects' at the TQ price. They have in other words sold out of their TQ potential. Hence Bohm concludes that: *'If the Developing countries' willingness to join the TQ treaty depends on the expected benefits from joining, the DC may now decline to co-operate'* (Bohm, P., 1994a; 13).

Figure 5.1. The sold-out argument.



Source: Bohm 1994a; figure 4

This section will assess the 'sold-out' argument by looking at the assumptions behind the argument.

In looking at Figure 5.1 it must be noticed that the Developing countries still have gains from entering the TQ regime even though they are reduced because of the CDM projects. Therefore they still have an incentive to join the TQ regime. If the Developing countries could be sure that

a TQ regime would be implemented in the (near) future, then it would ceteris paribus not be rational for the Developing countries to engage in CDM (as the figure is drawn). But if the Developing countries are uncertain about the establishment of a TQ regime (if, when, how comprehensive, etc.), then the scenario could be more sequential. It could then be rational to engage in CDM now and then to join a TQ regime later if gains were positive.

The CDM price.

The loss from initial CDM illustrated by the shaded areas might furthermore not be as large as postulated. It is not given that Developing countries will only receive the marginal abatement costs in exchange for the CDM projects and hence the loss might not be so large (it might even be a gain). Because the ICs total abatement costs are lower compared to a situation where they would have to undertake all of the abatement 'unilaterally' the Developing countries might be able to 'sell' the CDM projects at a price higher than the Developing countries' MAC as long as the ICs will experience some degree of cost reduction. Moreover most studies show that the market for flexible mechanisms in the Kyoto Protocol will be dominated by a few suppliers, which mean that they will be likely to have some market power. If say India and China completely dominate the market or if the developing countries form a cartel in the same way as the oil producing countries they will be able to control the price of CDM projects. Of course the price can never exceed the permit price at the isolated Annex B TQ market, but it would certainly be higher than the incremental costs as assumed in the figure.

Technological improvements and local environmental improvements.

There are additional gains from CDM for example connected to technology transfers, which are not shown in Figure 5.1. Improved technology in the Developing countries gives a more efficient production technology and may boost production or have other more secondary benefits for example on the local environment. If e.g. a CDM project replace a coal fired power plant with a cleaner alternative it would not only reduce GHG emission, but also reduce local health problems connected to using coal. These gains could be an incentive for the Developing countries to join CDM projects, even though they were aware that joining CDM now may reduce their (direct) gains from joining a TQ regime later.

More ambitious IC targets

Another situation that was shortly touched upon above is neglected in Figure 5.1, which is static in time. If the framework included two periods the following situation is possible: assume in period 1 that the IC was committed to emission reductions that either could be undertaken through CDM or unilaterally. In period 2 new commitments would be made and these were allowed to be traded in a global TQ regime. Then if the commitments in period 1 was undertaken through CDM, then the ICs might be willing to commit to larger reductions in period 2. This incentive could be strengthened if CDM reduces leakage effects, because ICs abatement efforts would then be more effective in reducing emissions and hence they would be more willing to accept more ambitious reduction targets. This could result in more trade and hence more gains to the Developing countries. Section 5.3 will take up this perspective by modelling the CDM/TQ relationship in a sequential bargaining model.

Leakage.

Several arguments point in the direction that CDM could reduce leakages and hence improve the effectiveness of ICs' abatement efforts. But can we be sure that leakage is reduced because of CDM? Below we try to find arguments for this.

Leakage arises mainly through trade effects and therefore trade restrictions are often suggested as a way to reduce leakage. This kind of policy is, however, not always fair. If for example the non-participating countries free ride because of low economic development, the economic loss from undertaking abatement could be threatening their ability to fulfil basic human needs. Trade restrictions could be holding these countries trapped in poverty, and this is not in the interest of any of the countries.

If trade restrictions are called the 'stock' policy, CDM could in this connection be thought of as a possible so-called 'carrot' policy to reduce leakage (See Barrett, S., 1994b; 25 and Barrett, S., 1995; 18). This mechanism does not reduce the leakage effect by punishing the free riders through trade restrictions, but by making them join abatement implementation by transferring new technology. There is four obvious ways in which abatement undertaken by a group of countries can be undermined by increased emission in free riding countries. We will try to assess how CDM can reduce these effects.

First of all abatement policies tend to raise the cost for the participating countries' industry and hence imply comparative advantages to the non-participating countries. This means that when participating countries reduce their fuel intensive production because of rising cost, non participating countries will raise their fuel intensive production and hence their emission. This effect, however, depends on the trade volume between participating and non-participating countries and on the degree of substitution between IC and DC tradables. What CDM now does to this leakage effect is that it tends to equalise the marginal abatement cost and hence reduce the change in competitive advantage. Non-participating countries' emission levels are therefore less affected by participating countries' abatement measures.

Second, if CDM imply lower abatement cost in the Annex B countries compared to a situation with a closed Annex B TP system, then the lower CDM cost may lead to less leakage effects. It could be expected that IC industries, that are subject to environmental regulation (e.g. CO_2 taxes), would move their 'dirty industries' to Developing countries with no regulation. But the empirical evidence on this issue show that environmental regulation is a less important factor when industries choose location (Jaffe et. al 1995). If CDM means lower abatement cost, the incentive to move industries may be less.

The third channel through which leakage is working is also connected to trade effects. Maybe abatement undertaken by annex I countries will decrease the world demand for fossil fuels and hence reduce the price on fossil fuels. This could lead to an increase in the non annex countries' use of fossil fuels and hence undermine the abatement efforts undertaken. When transferring new technology, with less fossil fuel consumption, to the non-annex countries through CDM projects, their demand for fossil fuels would fall (relatively) and thereby lower the described leakage effect.

Finally, if we assume that free riding countries only undertake abatement such as to equalise their marginal costs to their own marginal benefits - that is $MAC_D = MB_D$ - we can expect that they will reduce this abatement when participating countries increase their abatement measures. If we assume that MB is positive but falls when abatement increases, this leakage effect is effectuated through the reduction in marginal benefit, when abatement rises. It is not obvious how CDM will affect this mechanism, but with the free riding incentives in focus here this mechanism might not be that substantial. Both because the free riding countries are hardly undertaking abatement at all and because abatement benefits are not very likely to be used as policy indicator.

The discussion above shows that the sold out argument is not in general valid. The gains from entering a TQ regime may not be reduced due to participation in the CDM. We have pointed out that price determination and market power, secondary benefits from technological improvements, leakage effects and the effect of CDM on ambitions in a post Kyoto regime will be determinative. The working paper '*Will CDM be an Obstacle to Later Commitment by Non Annex B Countries to Fixed Reduction Targets?*' in the appendix is dealing with the question in more depth.

5.2 The allocation debate.

In allocating the reduction quotas (national emission quotas) the burden of emission reductions and the potential shares of the permit market are allocated. If a developing country receives a large national emission quota it is able to sell more emission reductions on the TQ market and the incentives to switch to a TQ regime will therefore increase.

The (non-tradable) emission quotas in the Kyoto Protocol are based on a non-uniform percentage reduction from 1990 emission levels. This means that the total emission quota, set to approximately 95% of the industrialised countries total 1990 emission level, is allocated such a way that the quotas for some countries only amounts to 92% of their 1990 emission level (for example the EU), while other countries have quotas exceeding 100% of their 1990 emission level (Australia, Norway and Iceland). One of the advantages of a non-uniform allocation rule is that the distribution can reflect for example differences in marginal abatement costs. The developing countries will not benefit from allocation that reflect marginal abatement cost and can be expected to have their own views on the allocation rules. The reason is that allocation rules based on cost efficiency would give them low allocations because: a) their 1990 emission levels are very low due to low economic development and b) their abatement costs are relatively low.

Larsen and Shah show in an interesting study how different allocation principles might change different countries' (regions) gains from entering a TQ regime. It is supposed that emission should be reduced to the 1987 level in year 2000. Their analysis shows that allocation principles do change the post trading costs and thereby also the incentives to sign binding commitments. Specifically they show that if allocations are based on the countries share of world population[4], then decreasing baseline emissions per capita will increase the benefits from quota tradability. This conclusion is interesting because it indicates that the CDM by decreasing baselines could increase Developing countries' benefits..

Larsen and Shah further show, in empirical simulations, that if allocations are based on population then all Developing countries will gain from quota trade. OECD countries will have lower costs than if they were to undertake all abatement 'unilaterally', but middle income countries such as the economies in transition may have relatively high costs. The importance of the last group at the market may as a consequence decline (ibid. p. 846). Developing countries in general and India in particular argue for a population based responsibility perspective. If forced to negotiate emission allocations, India's position would obviously be to argue for population based allocations.

Finally Larsen and Shah show that if allocations are designed so non-OECD countries are fully compensated, then OECD countries would still have lower costs than if they were to undertake all the abatement unilaterally. And all non-OECD countries and countries in transition would have positive gains from trade. Therefore it is concluded that this allocation principle is the most appropriate for inducing all countries to participate (ibid. p. 850).

One can think on the allocation debate in another way by looking at the GHG accumulation as a global externality with the characteristics of a public good; no one can be excluded from the damage of the externality. Then by following Coase (1960), if i) property rights are defined and ii) there is a small number of involved parties and iii) no transaction costs, then negotiation and/or trade will secure an optimal use of the externality, no matter how the property rights are distributed[5]. The problem with global warming is, however, the large number of agents involved – all human beings now and in the future. This means that the bargaining process is connected

[4] This principle distributes a quantity POP_i/POP_g of a global emission quota to country i. POP_i is the level of country i's population and P_g is the global level of population.

[5] See Hanley et al 1997 chapter 2.

to huge transaction costs and secondly that the bargaining among the involved agents is not at all possible – if one take the intergenerational view on the problem. Baumol and Oates state that the Coase theorem might hold true only for the case where a small number of agents are involved and hence not for the global warming case (Baumol and Oates, 1988; 35). It could therefore be argued that the distribution of property rights (emission quotas) does matter in the global warming case.

Anyway, Rose and Stevens show that the welfare effects of allowing for quota trade are not effected by the initial distribution of quotas. Their empirical results show that post trading abatement cost for any country will always be the same for a given CO2 reduction target no matter what the initial allocation of permits may be (Rose and Stevens, 1993). The conclusion of their analysis is hence indicating that the Coase Theorem holds in the sense that no matter how quotas are distributed, the outcome will be the same.

In the Kyoto protocol, which is a non-tradable quota (NTQ) regime, the quotas are based on base year emissions - 1990 in most cases. The committed Annex I countries are however obligated to reduce emission with a different percentage under 1990 emission level. The EU have for example committed to reduce emissions to 8% *less* than 1990 emission while Australia has committed to reduce emissions to 8% *above* 1990 emission level. This may be called a modified grandfathering principle.

Every signatory has different gains and losses from using exactly this base year and it would be painful to re-negotiate which base year to use. The G-77 and China have posed a list of questions regarding the flexibility mechanisms in the Kyoto protocol. In article 17 on International emission trading, it is asked how the emission rights of developed country parties are to be determined. In a shared answer by a group of the largest ICs including USA, Australia, Japan and Russia but excluding EU it is stated that while the *'assigned amounts in the Kyoto Protocol were negotiated so as to reflect enhanced developed country responsibilities (in that they do not apply to developing countries) and to reflect equity the allocations from which international emission trading among ICs begins are the assigned amounts reflected in the Kyoto Protocol'* (UNFCCC, 1998; 43-44).

It is therefore likely that quotas in a later TQ regime also would be based on 1990 emission levels. A further advantage with base year allocations compared to baseline allocations, is that it is well known for almost all countries. This cannot be said about baseline emissions, which could be extremely difficult to estimate. Indeed Developing countries would have an incentive to overestimate their baseline such as to get larger quotas - hence if incomplete information is incorporated, even baseline allocations could lead to ineffective abatement measures.

The allocation principle where quotas are based on historic emissions is discussed in the literature as the grandfathering principle and is stated by Pearce as: "*the only initial allocation that will meet with agreement*" but he further states that: "*The sheer newness of tradable permits on the international scene may in any event militate against them totally. If so, one essential message for international negotiators is that they should 'mimic' as best they can the efficiency of market based approaches*" (Pearce, D., 1990; 385). In this statement a recommendation to CDM might be hidden, while this system in many respects mimic the workings of a TQ regime.

The discussion of allocations above can be summarised by relating the discussion to equity concerns. Table 5.1 lists various equity principles and related allocation rules.

Table 5.1. Quota allocations and equity principles.

Equity principle	Allocation rule	Relatively largest share to:
Ability to pay	Allocate by total cost relative to GDP	DC
Rawls (maxmin)	Largest quotas to Developing countries	DC
Sovereignty	Current or baseline emission	IC
Egalitarian	Population based allocation	DC
Polluter pays	Allocation based on the inverse of historic emissions (grandfathering)	DC
Consensus	Grandfathering	IC

Source: discussion above and Rose and Stevens 1993

The table shows that Developing countries would have relatively high allocations if ability to pay, Rawlsian, egalitarian and polluter pays principles are used. This is conditional on the fact that even though Developing countries may have low MACs, their total abatement cost might involve a large share of GDP and hence ability to pay is low. If Rawls' criterion of maximising the benefits of the countries with the lowest total benefits is chosen, it would also require relatively large quotas to the Developing countries. Following Egalitarianism the atmosphere is a global common that every human being should hold an equal property right to use – hence allocations should be based on populations, which would again result in large quotas to Developing countries. Finally the polluter pays principle catches the historic responsibility of the ICs and therefore demands large quotas to Developing countries.

The only equity principle covering baseline allocations is the sovereignty principle. But it is clear that not all countries can be given allocations equal to their baseline, because this would involve no abatement to be undertaken, and therefore this principle cannot stand alone.

5.3 Non Annex B countries can use the CDM to increase bargaining power

How initially to allocate the quotas in an emission trading regime has been discussed in the literature.[6] The (non-tradable) emission quotas in the Kyoto Protocol are based on a non-uniform percentage reduction from 1990 emission levels. This means that the total emission quota, set to approximately 95% of the industrialised countries total 1990 emission level, is allocated such that the quotas for some countries only amounts to e.g. 92% of their 1990 emission level (for example the EU) while other countries have quotas exceeding 100% of their 1990 emission level (Australia, Norway and Iceland). One of the advantages of a non-uniform allocation rule is that it, at least in principle, can be cost-efficient. But with respect to the desirability of a cost-efficient distribution of quotas, it is important to notice that only the industrialised countries signed the Kyoto Protocol. Developing countries can be expected to have other views on allocation rules. The reason is that allocation rules based on cost efficiency would give them low allocations because: a) their 1990 emission levels are very low due to low economic development and b) their abatement costs are relatively low. The position of developing countries can more likely be expected to be based on a per capita view. The reason shall shortly be summarised.

One of the main arguments for developing countries participation is that these countries relative share of global emissions is rapidly increasing and is expected to exceed the emissions from

[6] See e.g. Larsen, B. & A. Shah (1994) and Rose, A. & B. Stevens (1993).

industrialised countries within a range of 30 years time. Estimates show that developing countries' share of global annual emissions in 2025-2030 will be between 58% and 64%, i.e. larger than the industrialised countries.[7] Other estimates show that the developing countries at the same time will be inhabited by more than 80% of the world's population. These figures and the need for economic development in the developing countries and their low share of accumulated emissions are used against the pressure for commitment. It would therefore be obvious that the developing countries would advocate for a per capita quota allocation as the basis for international emissions trading.

It seems that there are several reasons why developing countries may be in a potentially favourable bargaining position. The purpose of the following sections is to explore how this bargaining position can be used by the developing countries to increase their pay-off by looking at game theoretic descriptions of quota bargaining.

Two quota allocation Bargaining games

There are three basic assumptions behind the analysis in this section. First it is assumed that abatement costs are relatively low in the developing countries. Second it is assumed that the developing countries are relatively patient with respect to reaching an agreement on an allocation rule. And finally the developing countries are assumed to make the first move in the negotiations. Given these assumptions, we consider two bargaining games over the allocation of emission quotas between industrialised- and developing countries in a global regime of emission trading. The first two assumptions mentioned fits well into the description of the developing countries above, whereas the last assumption may be considered as normative. We show that JI may improve the developing countries' outcome of the bargaining.

I. A simple quota bargaining game.

We will start by looking at a simple bargaining game where industrialised and developing countries bargain over the allocation of quotas given the total amount of emissions. There is no possibility of JI in this game. The two countries alternately propose an allocation leaving x_{IC} to the industrialised countries and x_{DC} to the developing countries. All the proposals must belong to the set of possible quota allocations defined by X. For convenience the total amount of emissions quotas are normalised to 1:

$$X = \{(x_{DC}, x_{IC}) \in \mathbf{R}^2 : x_{DC} + x_{IC} = 1 \text{ and } x_i \geq 0 \text{ for } i=\text{IC, DC}\}$$

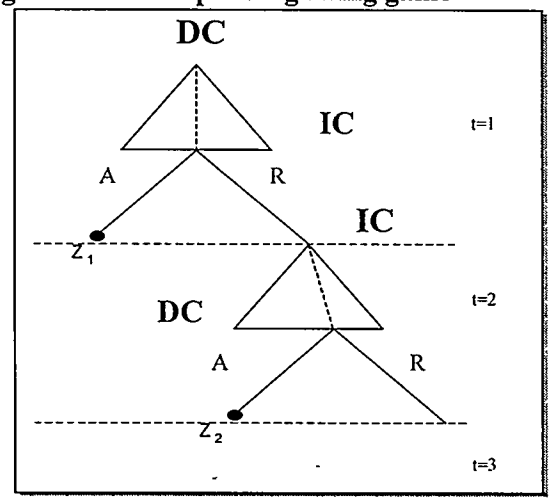
After each proposal the opponent can either accept or reject. An allocation, x_i, at time t gives player i more utility than the same allocation received at time $t+1$. This time preference is incorporated in the utility function by a constant discount factor $\delta_i \in]0;1[$. The utility function for player i is

$$u_i(x_i, t) = \delta^{t-1}{}_i x_i, \quad \text{for } i=\text{IC,DC}$$

The assumption that the developing countries are relatively more patient with respect to when an agreement on the quota allocations is reached implies that $\delta_{DC} > \delta_{IC}$: developing countries value future utility relatively higher than industrialised countries.

[7] Fenhann, J. (1998).

Figure I: The simple bargaining game



The structure of the bargaining game is shown in figure I. The bargaining starts in period 1 where the developing countries propose an allocation x' within the set of possible allocations X. Figure I illustrates the proposed allocation by the dashed line reaching the bottom of the triangle. The bottom of the triangle illustrates X. Immediately after the developing countries proposal the industrialised countries shall either accept (A) or reject (R) the proposal. If they choose (A) the game ends with an agreement on x' - if not the game proceeds to period 2. In period 2 the industrialised countries propose an allocation which the developing countries either accept (A) or reject (R). Acceptance ends the game and rejection makes the game proceed to period 3. In principle the game can continue like this in infinity. In the very simple game - given that each player knows everything about the other player and everything about the game, and given no uncertainty - an agreement will be reached in the first period of the game. This means that the allocation proposed by the developing countries can be accepted by the industrialised countries.

We use a non co-operative solution concept where each player optimises his strategy given the other players strategy and where each player is able to reconsider his action at each point in the game. The game has a unique solution.[8] Given perfect information each negotiator is well aware of the opponents' strategy. The unique solution gives, with the chosen utility function, an allocation where the developing- and industrialised countries receives

$$x_{DC} = \frac{(1-\delta_{IC})}{(1-\delta_{DC}\delta_{IC})}, \quad x_{IC} = \frac{\delta_{IC}(1-\delta_{DC})}{(1-\delta_{DC}\delta_{IC})}$$

Two conclusions can be drawn from the simple bargaining game. First of all the developing countries have an advantage of being the first to make a proposal, a so-called first mover advantage. To see this assume that $\delta_{DC}=\delta_{IC}=\delta$ such that there is symmetry in everything except who starts the game. This involves that $x_{DC} = \frac{(1-\delta)}{(1-\delta^2)}$ and that $x_{IC} = \frac{\delta(1-\delta)}{(1-\delta^2)}$, which clearly show that $x_{DC} > x_{IC}$, indicating that the developing countries get the largest allocation solely because they start the game. Secondly the developing countries has an advantage of being patient. This can be verified by noticing that x_{DC} is increasing- and x_{IC} is decreasing in δ_{DC}. The opposite is true for increases in δ_{IC}. Thus the more patient developing countries are (relative to industrialised countries) the larger the allocations they get.

[8] For a formal description and proof see Fernandez, R. & J. Glazer (1989) or Michelsen, M. B. & K.R. Olsen (1999).

Thus in the simple quota allocation game the developing countries will have the largest share of the total emission quota because they are the first to propose allocations and because they are relatively patient.

II. A quota bargaining game which include Joint Implementation (the CDM).

We will now enlarge the game structure in a way that further strengthens the developing countries bargaining power. In the simple bargaining game above we assumed that there was no possibility of joint implementation (CDM) between developing- and industrialised countries. In what follows we will assume that there prior to the quota bargaining exist an agreement which make joint implementation (CDM) between the two negotiators possible, and that this agreement is relevant for the bargaining. Even though an agreement of quota allocations will not be reached there will be an agreement of joint implementation, namely the CDM. The existence of an initial relationship, a reference agreement, between the negotiators adds new perspectives to the game. We will show that the reference agreement can improve the developing countries' bargaining power. In other words we will show that the CDM can be used strategically by the developing countries.

Denote the reference agreement (the CDM) by $x^0=(x^0_{DC}, x^0_{IC})$ where $x^0 \in X$. The CDM involves cost-efficient reduction of the industrialised countries' Kyoto commitments. The gains from this shall be shared between the host and donor countries by agreeing on the transfer of financial resources to the host and credits to the donor. If the gains from the CDM are normalised to 1 we face the same allocation problem as under the quota allocation bargaining. The share that the reference agreement allocates to the developing countries, x^0_{DC}, can now be thought of as gains from the CDM expressed in units of quota allocations. The developing countries utility from the CDM then exactly equals the utility from an emission allocation equal to x^0_{DC}, in a regime of emission trading. The same holds for the industrialised countries share of the reference agreement, x^0_{IC}.

The presence of a reference agreement in quota bargaining means that the outcome is x^0 instead of 0 whenever a proposal is rejected. What it further means is that the negotiators can use the reference agreement as a potential threat because they can punish the opponent by withdrawing from the reference agreement if a proposal for a new agreement is rejected. This game structure is very common in the literature on wage bargaining between labour unions and firms.[9] In this literature a union and a firm bargain over the share of the firms revenue. The reference agreement is a wage w^0 for the union and a profit 1- w^0 to the firm (the firm's total revenue is normalised to 1 in the same way as we normalise the total amount of emission quotas). The union can now threat to withdraw from the reference agreement by going on strike. In every period the union strikes the firm will be restrained from obtaining the reference profit. An overall conclusion from the wage literature is that the union is able to gain larger wage by being able to go on strike. Basically it is the same idea that forms the ground for the game we are about to develop. We give the developing countries the opportunity to 'go on strike' by cutting the supply of projects to the CDM and thereby restrain the gains from the reference agreement.

The outcome when the developing countries carries out the punishment is denoted by $x^s = (x^s_{DC}, x^s_{IC}) \equiv (0, 0)$. The bargaining structure of the game is illustrated in figure II below. The bargaining structure is essentially the same as in the simple game. The only difference is that that the outcome in situations where a proposal is rejected can either be $x^0 = (x^0_{DC}, x^0_{IC})$ or $x^s = (0,0)$ depending on whether or not the developing countries choose to use the punishment option. The negotiators may on this background be thought of as maximising the sum of future utility

$$u_i(x_i, t) = \sum_{t=1}^{\infty} \delta^{t-1} x_i$$

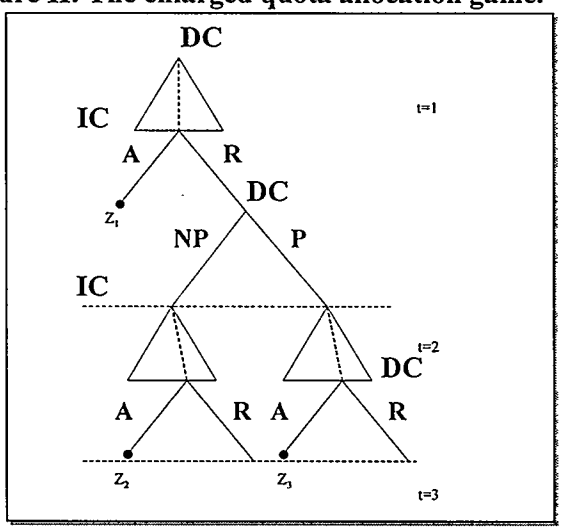
[9] See e.g. Fernandez, R. & J. Glazer (1989), Haller & Holden (1990) and Shaked, A. & J. Sutton (1984).

whereas the maximisation of $u_i(x_i,t) = \delta^{t-1}x_i$ was sufficient for preference ordering in the simple game. Figure II illustrates that when a proposal is rejected the developing countries will make a choice of punishment strategy, where NP stands for No Punishment and P stands for Punishment.

It can be shown that the optimal punishment strategy the developing countries can choose is to use the punishment option only when their own proposal is rejected, and therefore it is this case which is shown in the figure.

The intuition for this asymmetric punishment strategy being optimal is straightforward. If the developing countries use the punishment option only when their own proposal is rejected and not when they reject the opponents proposal, rejection of their own proposal is made relatively more expensive. In this way they can force the industrialised countries to accept proposals more favourable to the developing countries. The game can in principle proceed in infinity, but like the simple game it turns out that optimal strategies lead to immediate agreement: the developing countries forms a strategy which results in their proposal on quota allocations being accepted in period 1. This result rests again on the assumption of perfect information and no uncertainties.

Figure II: The enlarged quota allocation game.



Where the simple bargaining game had a unique solution the present game where joint implementation (CDM) is a possibility has multiple solutions. Remember that the solution concept is non co-operative so that each negotiator takes the opponents strategy as given but is able to reassess his own strategy as the game proceeds. The most interesting solutions to the game is i) that x^0 - the joint implementation allocation - can be an outcome of the bargaining ii) that the agreement from the simple game x' - where joint implementation was not taken into consideration - can be an outcome and finally that iii) it can be shown that there is a maximal quota that the developing countries can get as an outcome in the game structure. This maximal quota exceeds x^0_{DC} and x'_{DC}. We denote the agreement leading to the maximal allocation to the developing countries by $x^* = (x^*_{DC}, x^*_{IC})$. Obviously x^0_{DC} (the joint implementation outcome) is the minimum allocation the developing countries can obtain because it is always possible to sustain status quo. It should further be noticed that it can be shown that every agreement leading to an allocation to the developing countries between the reference agreement x^0_{DC} and x^*_{DC} can be an outcome of the game. In other words, every $x \in]x^0, x^*[$ is a possible outcome of non co-operative bargaining.

We will limit this chapter to discuss the strategies leading to x^* and will not go into details in explaining the existence of a maximal allocation, x^*_{DC} (for details see[10]).

[10] For a comprehensive analysis we refer to Michelsen , M.B. & K.R. Olsen (1999).

It can be proved that, given the specific utility function we use, the largest possible quota allocation that the developing countries can achieve is expressed by:

$$x^{*}_{DC}=\frac{(1-\delta_{IC})}{(1-\delta_{DC}\delta_{IC})}+\frac{\delta_{IC}x^{0}_{DC}(1-\delta_{DC})}{(1-\delta_{DC}\delta_{IC})}$$

Notice that the first part of x^{*}_{DC} equals the allocation in the unique solution of the simple game so that x^{*}_{DC} obviously is larger than x'_{DC}. To achieve the largest possible allocation, x^{*}_{DC}, the developing countries' strategy include the punishment option previously mentioned, and a trigger strategy. The trigger strategy involves a (tacit) agreement with the industrialised countries to let the reference (Joint implementation) agreement be an outcome in infinity if the developing countries defect from their overall bargaining strategy. Their overall bargaining strategy is to propose an allocation (x^{*}_{DC}) in the first period and make it clear that they will use the punishment option to cut the supply of joint implementation projects (CDM) if the industrialised countries rejects this offer. Furthermore their strategy must be never to use the punishment option in periods where industrialised countries are proposers. Remember that perfect information is an underlying assumption so that the industrialised countries are fully aware of the developing countries strategy and vice versa.

To summarise on the enlarged game we conclude that the developing countries can use joint implementation (CDM) strategically to increase their future quota allocation. By threatening the industrialised countries with a costly cut off of the supply of joint implementation (CDM) projects they can increase their own allocation on the expense of the industrialised countries.

Discussion

In this section we will discuss the interpretation and plausibility of the maximal quota.

In the introduction we argued that it would be in the developing countries interest to take a per capita view on the responsibility pattern of the climate problem. In the bargains over future quota allocations one could therefore expect that the developing countries would propose to allocate the emission quotas on the basis of population size. Taking our game literally it gives an indication of the size of allocation the developing countries can expect to obtain in negotiation with the industrialised countries. An interesting question is on this background whether or not a population based allocation principle lies within the interval of possible outcomes predicted by the bargaining game.

In 1993 world population was about 5,5 billion people.[11] The population of the countries defined as developing countries in the Climate Convention was in the same year amounting to 4,3 billion people. In other words approximately 80% of the worlds population lived in the developing countries. More recent estimates of these numbers and projections of future world population levels will surely tend to increase this percentage share of people living in developing countries. Thus if the developing countries shall be able to obtain a quota allocation based on the level of population they shall be able to negotiate a division of the global emission quota that leaves more than 80% to themselves.

According to the equation above the maximal quota allocation x^{*}_{DC} depends on the factors of time discounting and the level of the reference agreement x^{0}_{DC}. Under what assumptions on these parameters will a population based allocation proposal be obtainable as an outcome of negotiations? The table below calculates some scenarios.

[11] All population estimates are from Fenhann, J. (1998).

The two first scenarios illustrate the first mover advantage. Assuming that the negotiators have identical time preferences the developing countries are able to obtain the relative largest allocation even without the existence of a joint implementation (CDM) reference agreement and the possibility of using joint implementation (CDM) as a punishment option. This is shown by the fact that the allocation to developing countries in the simple game, x'_{DC}, is 0,53, leaving 0,47 to the industrialised countries.

Scenario 1 assumes that the reference agreement are splitting the CDM gains on a fifty-fifty

Table I: Scenarios for obtainable quota allocations.

Parameters	**scenario 1**	**scenario 2**	**scenario 3**	**scenario 4**
δ_{IC}	0,90	0,90	0,90	0,90
δ_{DC}	0,90	0,90	0,99	0,99
x^0_{DC}	0,50	0,30	0,50	0,30
Allocation -	**scenario 1**	**scenario 2**	**scenario 3**	**scenario 4**
Simple game x'_{DC}	**0,53**	**0,53**	**0,92**	**0,92**
Enlarged game x^*_{DC}	**0,76**	**0,67**	**0,96**	**0,94**

basis while scenario 2 more realistically gives developing countries a lower share of the CDM gains (30%). Scenario 2 is more realistic regarding the reference agreement because the main purpose of the CDM is cost-efficiency, which will be lowered the larger the financial transfers the developing countries receives in relation to the joint implementation projects. The industrialised countries can therefore be expected to have the largest share of the gains from the projects (above 50%). The enlarged scenario 1 - given identical time preferences and given the existence of a CDM reference agreement combined with the punishment strategy - will according to the table give the developing countries a maximum of 76% of the total emission quota. If the reference agreement only gives developing countries 30% of the CDM-gains, scenario 2 show that the maximal obtainable quota is 67%. Scenario 3 and 4 adds asymmetry in time discounting factor in scenario 1 and 2. By letting the developing countries time discounting factor be close to 1 it is assumed that these countries barely discount future utility and that they are patient relatively to the industrialised countries. The simple bargaining game now enables the developing countries to obtain 92% of the emission quota. The table shows that the possibility of using a punishment strategy is less important than in scenario 1 and 2, as it only raises the quota from 92% to 96% in scenario 3 where the reference agreement is equally split and from 92% to 94% in scenario 4 where the developing countries only gets 30% of the CDM gains.

What table I show us is that asymmetry in the time discounting is the most important aspect for the developing countries to obtain a large quota allocation. The possibility of joint implementation (CDM) as a punishment option is most important when the asymmetry in discounting factors is small or absent.

Conclusion

The present section has discussed whether joint implementation between developing- and industrialised countries can improve the bargaining position of the developing countries in negotiations over quota allocations. The analysed mechanism is simply that the CDM can be viewed as an reference agreement, that enables the developing countries to form a punishment strategy. The conclusion is that the CDM can improve the bargaining position of the developing countries. It is worth noticing that this conclusion does not only apply to negotiations on quota allo-

cations but to allocation problems in general. This means that if the international society (the FCCC) e.g. decides that the international abatement regime should include an international tax system where the tax revenue should be allocated between the countries the conclusion is still applicable.

6 Distributional effects and the interaction of instruments

There are many distributional aspects of the Kyoto Protocol. The income distributions between countries and within countries depend on how quotas are distributed and how the Kyoto instruments are implemented. The distributional effects of the quotas and instruments are dependent on how, and how much, other emission reducing policies are used within the individual countries.

To unravel the distributional aspects of the Kyoto mechanisms and other instruments is very complicated because there are interdependencies between the instruments. In principle it is only possible to describe the distributional aspects if the countries use of instruments, the countries marginal abatement cost curves and the distribution of quotas between countries and within countries are known. This is of course unrealistic.

In the following subsections examples of interdependencies between instruments and distributional effects between countries are given. This is by no means an exhaustive description.

6.1 Quotas and flexible instruments

When a country commits to a fixed emission reduction target, it places a financial burden on its own shoulders – unless hot air is involved (see section 2.1). The size of the financial burden will depend on how high or low the reduction target is. If the commitment implies 'hot air', the extra costs of reaching the target is zero, and if the commitment implies comprehensive investments in new emission reduction techniques, the extra costs of reaching the target may be very high.

The distribution of emission reduction targets between countries will tell something about the distribution of financial burdens between countries. But these financial burdens will not be independent on the use of the flexible mechanisms and the distribution of marginal emission reduction costs between countries. This will be illustrated in the following subsections.

The EU bubble and marginal abatement costs

Figure 6.1 show the commitments of the individual countries within the EU bubble. The overall EU reduction commitment is 8% (cf. Table 1.1). One of the reasonings behind differentiated reduction commitments is difference of marginal abatement costs within the EU. High marginal abatement cost in a country can be compensated through lower national reduction commitments. Other arguments for differentiated reduction commitments are the decrease in nuclear power production in Sweden, expected higher emission growth in some economies and countries' financial capacity. All these arguments are concerned about the *distribution of costs*: marginal emission reduction costs, total costs and the 'burden' of the costs. It is reasonable to assume that the EU burden sharing represent what the EU perceives as a fair distribution of the total emission reduction costs. At least it is accepted

If the different EU reduction commitments shown in Figure 6.1 equate the marginal abatement costs in all the EU countries then, following section 2.1, there will be no need for internal EU cost efficiency measures like TP or JI.

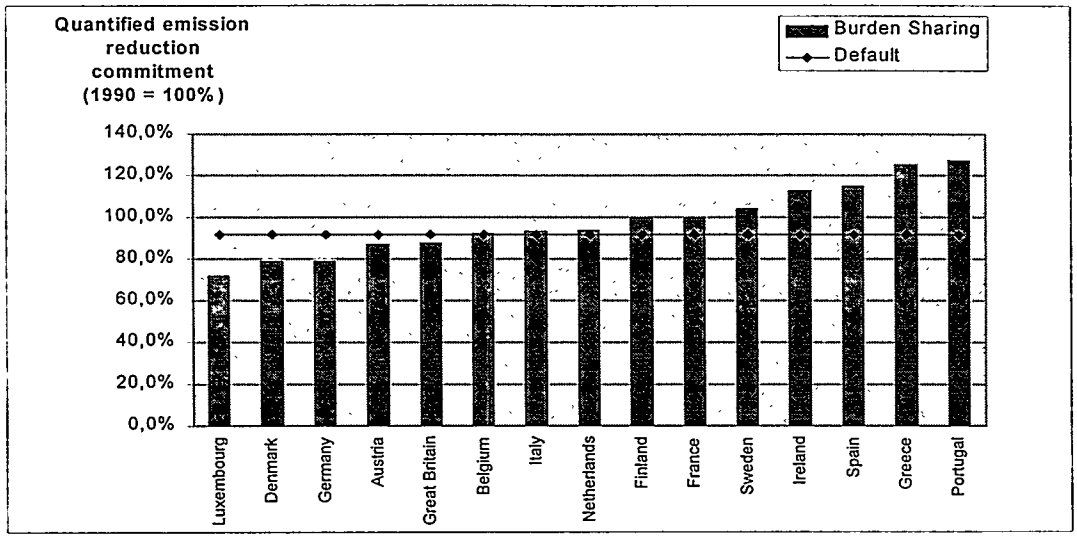


Figure 6.1 EU Burden Sharing Agreement

The impact of flexible instruments

How the EU commitment of 8 percent is distributed among the individual EU countries has implications for the distribution of costs among countries. How this distribution of costs – implied by the individual reduction commitments – is dependent on flexible mechanisms can be illustrated by the following examples. The examples illustrate national, regional and global compliance. Table 6.1 summarises the examples. Regional and global compliance involves flexible mechanisms.

National compliances
National compliances of the EU burden sharing agreement and national differences in marginal abatement costs imply that the total (EU) sum of costs of national compliances is high. The distribution of costs between countries reflects the national commitments and the national marginal reduction cost curves.

Regional (EU) compliance
Regional (EU) compliance of the EU burden sharing (using either tradable permits or joint implementation or both) change the distribution of costs among countries, by changing the costs of emission reductions. A tradable permit system makes the price of emission reductions (or the marginal abatement costs) the same in all the EU countries. Compared to the national compliance, national commitments are the same (it's the same amount of emissions that the individual country is responsible for is being reduced), but the price (per to CO_2) of the emission reduction is changed.

The distribution of emission reduction costs *within* each individual country is also changed by the changed trading conditions for emissions. The flexible mechanisms and the broader EU market changes the markets price of emission reductions. In some countries the market price will fall and in some countries it will increase compared to national compliance. In countries where the EU market price is lower, buyers of emission reductions will benefit from the low price, whereas sellers loose because they sell less and at a low price. In countries with a higher EU price, buyers of emission reductions will loose because they now have to either reduce emissions themselves or to buy emission reductions at a high price, whereas sellers gain from the increased prices.

At the EU level costs of regional compliance is lower than national compliance.

Global compliance

Global compliance of the EU burden sharing (using some combination of tradable permits, joint implementation and CDM) change the distribution of costs among countries by changing the costs of emission reductions. Provided that marginal emission reduction costs are lower outside the EU, total EU reduction costs will fall and be lower than in the EU compliance example. A tradable permit system makes the price of emission reductions (or the marginal abatement costs) the same all over the world.

The flexible mechanisms and the global market change the national costs of compliance for the same reasons as in the regional example. Again, compared to the national compliances, the national commitments are unchanged – meaning that it is the same amount of emissions that the individual country is responsible for is being reduced. The price (per to CO_2) of the emission reduction is however lower.

The distribution of costs and benefits (from selling emission reductions) within each individual country change with the changing trading conditions.

If politicians have specific ideas about, which distribution of total costs will be the optimal or 'just' or 'fair' distribution of costs between countries, politicians should decide simultaneously on the distribution of reduction commitments and the use of instruments. If politicians think that the reduction commitments should reflect differences in marginal abatement costs, reduction commitments should be uniform whenever full emission trading is possible.

Comparing for example the Danish (-21%), Norwegian (+1%) and Dutch (-5%) costs of Kyoto and EU commitments under different assumptions of compliance and instruments will show that the distributional implications are considerable.

From a cost efficiency point of view global compliance is more efficient than regional compliance, which is more efficient than national compliance. At least in a static world, and disregarding national distributional effects, all countries together will prefer both a regional and a global compliance to a national compliance. (The group of countries, which buy emission reductions, will benefit from lower compliance costs and the group of countries, which sell emission reductions, will profit from the selling). But it is not obvious that for example *individual* EU countries will prefer a global compliance to a regional EU compliance. The following example will show.

Assume two groups of EU countries: one with high marginal emission reduction costs and one with low marginal emission reduction costs. Within each group all countries are identical. Assume that the reduction commitments for the low cost group are equal to their baseline emissions – i.e. they have no need to invest in emission reductions, and they have no 'hot air' to sell. We compare an EU tradable permits system and a global tradable permit system. Assume that the permit price of the global market is lower than the marginal emission reduction costs of the low cost EU countries.

Regional EU compliance implies that the low cost countries sell emission reductions to the high cost countries. The low cost countries gain a profit from the trade. Global compliance implies that the high cost countries prefer to buy emission reductions outside the EU, at a lower price. The 'commodity' that the EU low cost countries can sell at a closed EU market is not competitive at the global market, and therefore the low cost countries loose when 'trade restrictions' are removed. The high cost countries gain.

It may well be that the economies in transition will benefit from an Annex B trading regime compared to a global regime.

Table 6.1. Comparisons of distributional impacts given national, regional or global compliance. Examples. Reference case national compliance.

	National compliance	*EU compliance using TP or JI*	*Global compliance using TP, JI and CDM*
Distribution of reduction commitment	Assume the distribution is independent of the use of flexible instruments and reflects differences in national abatement costs. Countries with high marginal abatement costs have low reduction commitments, etc.		
Prices of emissions/marginal abatement cost	Country differences High marginal abatement costs on average	No country differences Low marginal abatement costs	No country differences Lower marginal abatement costs
Emission reductions where?	Domestically	Within the EU	Outside the EU – maybe some within
Who gains from trade compared to national compliance? *Group of countries with:* *a) high EU marginal costs* *b) low EU marginal costs* *c) marginal costs equal to the EU TP price*		a) Gain from import of low cost emission reductions b) Gain from net export of emission reductions c) No gains and no losses	a) Gain from import of low cost emission reductions b) Gain from import of low cost emission reductions c) Gain from import of low cost emission reductions
Distribution of costs among countries	Assumption: 'Equal'	'Unequal'	'Very unequal'?

6.2 Tradable Permits and national policies

Figure 6.2 shows that different types of economic and technical regulations contribute to the compliance of the national reduction commitments. Denmark is chosen as an example. The circle illustrates the Danish international reduction commitment and the slices the contribution of the different instruments to the overall commitment. A change in one of the policies changes the contribution of that instrument (the size of that slice) to the overall commitment and changes the need for other instruments. The sizes of the slices in the figure are chosen at random.

A change in CO_2 taxes changes consumption behaviours of the consumers so CO_2 emissions either increase or decrease. The change in CO_2 emissions changes the need for further regulation of emissions, given the international commitment.

Green certificates and increasing target levels for the percentage of renewable electricity (in total electricity consumption) promote CO_2 free electricity production, and reduce the need for other regulations of GHG emissions.

If the liberalisation of the Nordic electricity market implies that consumer prices on electricity in Norway and Sweden increase and electricity consumption therefore decreases, it may imply lower Danish electricity production and lower Danish CO_2 emissions (cf. Amundsen, 1999). Danish consumer prices on electricity are estimated to fall as a consequence of the liberalisation, and this may tend to increase Danish electricity consumption and CO_2 emissions.

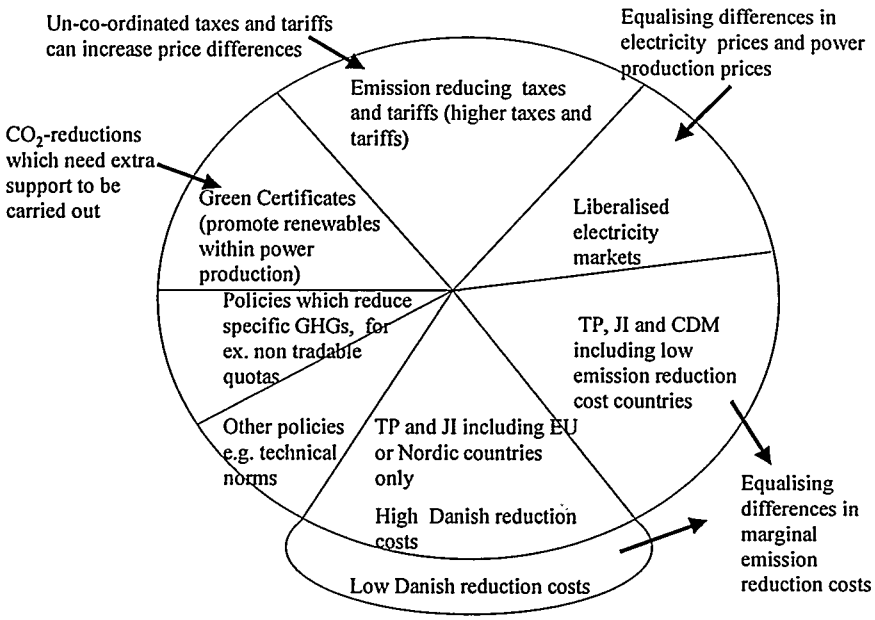
Emission reducing regulations of other of the six Kyoto GHGs reduce the need for further regulations to reduce CO_2.

Tradable permits, joint implementation or CDM including countries with low marginal emission reduction costs reduce the need for national Danish emission reductions.

If the TP or JI systems only include countries with high marginal emission reduction costs (for example the Nordic countries or the EU) emission reductions in Denmark may exceed the Danish emission reduction commitment – provided Denmark is a low cost emission reduction country, and provided CDM is not an option. The 'extra' reductions will be financed from abroad.

Joint Implementation, CDM and tradable permits equalise differences in marginal emission reduction costs between countries. Some of the other instruments will tend to increase differences in marginal emission reduction costs between countries, for example emission taxes and technical norms. The liberalisation of the electricity market will tend to equalise differences in electricity production costs and electricity consumer prices. If emission taxes, energy taxes, energy prises and emission related technical norms are the same in all countries, these taxes, prices and norms will give the same incentives to reduce energy consumption and emissions i all countries and therefore tend to equate marginal emission reduction costs among the countries. Country differences in taxes, prices and norms give different emission reduction incentives.

Figure 6.2 Reduction commitment and national and international instruments



Which instrument for which purpose

Figure 6.2 illustrates that the instruments to some extent can substitute each other, as they all have emission regulating properties. The instruments are related to energy consumption, emissions, climate change and technologies. They do not reduce emissions via the same channels,

and therefore the emission reduction costs will differ. Also effects on consumer prices and macro economy will be different.

A policy objective aiming at cost effective emission reductions points to co-ordinated emission taxes, tradable permits, CDM or JI as the optimal tools. If prices of emission reductions are lowest at the markets for CDM or JI, these options should be preferred. Other instruments do not have the same cost equalising effects. The use of these instruments must therefore be based on other arguments than cost effective emission reductions.

Removal of national regulations, which are barriers to cost effective emission reductions – for example energy subsidies, but also energy taxes – do increase cost efficiency. What matters to the cost efficiency between countries are that subsidies and tax levels are the same.

There may be reasons other than cost efficient emission reductions to choose some of the instruments in Figure 6.2. For example national rather than international emission reductions, promotion of specific (promissing) technologies, reduction of other emissions than the GHGs and increased competition in the electricity sector. In comparing the instruments it is important to notice what the instruments cannot do, as this analysis suggest the complementarity of the instruments.

How the instruments interact

Figure 6.2 shows that national reduction commitments can be reached by using a mix of instruments. If a mix of national as well as international instruments is used, it is important to be aware how the instruments interact. Section 6.1 showed how the distribution of total emission reduction costs among countries depended on alternative uses of flexible mechanisms, when countries' emission reduction targets were fixed. In this section focus is on how national instruments interact with international.

The three examples below show how national policies can interact with a tradable permits market. Denmark, Norway and Sweden are taken as examples. The effects for these countries are conditional on a TP trade between these countries.

The effects of green certificates on permit trades and permit prices

Within a tradable permit system the introduction of green certificates in some countries can give the other countries cheaper emission reductions. The mechanism can be illustrated in the following way. Scandinavia is taken as an example.

The introduction of green certificates in Denmark promote Danish wind power production and Danish CO_2 free electricity production. Seen in isolation this reduces the need for other GHG reducing initiatives in Denmark, and increases the Danish supply of permits to a Nordic permit market (at given prices). An increased supply of permits will reduce the Nordic permit price and increase the volume of trades – provided Denmark is a net supplier of permits. A lower permit price means that it will be cheaper for the other countries participating in the TP system to fulfil their Kyoto reduction commitments. The fulfilment of the Danish Kyoto commitment will be more expensive, because promotion of renewable electricity production is an expensive way of reducing GHGs.

The introduction of green certificates in Sweden – which is assumed to be a net demander of permits – also reduces permit prices and changes the distribution of emission reduction costs between countries. The mechanism is a bit different. The green certificates promote CO_2 free electricity production in Sweden. Increased renewable electricity production in Sweden can substitute Swedish CO_2 polluting electricity production or decrease imports of for example Danish coal based electricity. In either case the need for other Nordic emission reducing initiatives is reduced. Dependent on where the emission reduction will happen – in Sweden or in Denmark (net demander and net supplier of permits) – demand for permits will fall or supply of permits will increase. In both cases the permit prise will fall. The trade volume will fall in the former case and increase in the last.

The effects of reductions in Swedish nuclear power on permit prices and permit trade volumes
A Swedish decision to reduce its nuclear power capacity will – seen in isolation – increase the permit price and increase all the participating countries' costs of fulfilling the Kyoto reduction commitment. The reduced nuclear power capacity reduces the CO_2 free power production in Sweden and increases CO_2 emitting electricity production in for example both Sweden and Denmark – unless hydropower or renewable power production substitutes nuclear power. It will be more difficult for either Sweden or Denmark or both countries to fulfil their national reduction commitments and this will be reflected in higher permit prices. The volume of trade on the permit market tend to be less, if Denmark as a net supplier of permits increase production of CO_2 emitting electricity, and tend to be higher, if Sweden increases its capacity of CO_2 emitting electricity production.

The increased permit price will increase *all* the participating countries' reduction commitment cost. Denmark will benefit from increased electricity export.

The effects of CO_2 taxes on permit prices and permit trade volumes
If only Denmark introduces a CO_2 tax the following will hold:

– Danish CO_2 emitters will pay both the CO_2 tax and a permit price
– CO_2 emitters in other countries only pay the permit price

These differences imply that it becomes more expensive to pollute in Denmark, and imply that emission reductions in Denmark will be more profitable. So Denmark will reduce emissions relatively more than before the CO_2 tax was introduced. This means that Denmark will supply more permits to the Nordic permit market and the permit price will therefore fall. Because Denmark is assumed to be a net supplier of permits the trade volume will increase.

The non co-ordinated introduction of a CO_2 tax in Denmark implies that the Danish Kyoto commitment costs increase, whereas the Kyoto commitment costs of the rest of the TP countries fall. A removal of an existing Danish CO_2 tax will have the opposite effects.

The Danish introduction or removal of the CO_2 tax will have no effect on the emission level within the TP area. This means that if the Danish government is inferior to, where the CO_2 reductions take place – in Denmark or other TP countries – the Danish government should remove the CO_2 tax, because this will increase the international competitiveness of Danish firms and make the Kyoto compliance cheaper.

The three examples show that national environmental and energy related policies might influence other countries' emission reduction cost through international emission reduction trade.

7 The institutional set-up for TP

This chapter gives a brief summary of the Norwegian (NOU, 2000), Swedish (SOU, 1999) and British (Emissions Trading Group, 1999) reports on a tradable permits system. It is interesting to compare the reports because they present different views on important issues related to a TP system. The different views are reflecting the debate on tradable permits. The differences illustrate that there are no recommendations, which are the 'right' ones.

The present reports recommendations for a TP system (given in chapter 8) are therefore a kind of dialogue with the recommendations given in the three reports.

7.1 Norwegian, Swedish and UK reports on TP

The following is a very brief summary of the Swedish and Norwegian Official Reports on emissions trading and on the report from the UK Emission Trading Group. Special emphasis is on what is said on the institutional set-up for a TP system, what is said on the preconditions for the

initialisation of a trading system and on a Nordic trading system (the Norwegian and Swedish reports). The UK Emission Trading Group consists of a group of UK companies. The focus of the UK report is on the industry's contribution to emission reductions, and it gives proposals for a narrow industry related Emission Trading Scheme.

Although the objectives of the two Scandinavian reports are much the same, the stile and ambitions of the two reports are very different. This is to a high degree a reflection of the different frameworks and time schedules set up for the work. The UK report is representing the UK companies views.

The summaries are *brief* and concentrated on what the three reports say on:

1. How comprehensive should the TP-system be
- Which countries should be included
- Which types of emissions
- Which sectors

2. The initial distribution of Permits
- Free of charge – different distribution principles other than grandfathering
- Grandfathering (a free distribution of Permits related to past emission levels)
- Auction (compatible with the Polluter Pays Principle (PPP))

3. The organisation of the market
- Need for institutions: a self-organised market or an exchange market
- Control
- Sanctions

4. The time perspective
- Permit trade – when
- How will the TP-system be initialised

These questions are essential – but they are off cause not the only ones. The reports touch upon a long range of interesting questions.

The UK report is written by an interest group, the Swedish report by an officially appointed person (Generaltulldirektör, Kjell Jansson)[12] and the Norwegian report by a group of appointed experts[13]. These differences frame the reports. There is no doubt that there has been put most financial resources into the work of the Norwegian Commission. This is reflected in the final report, which is by far the most comprehensive.

Apart from the way the work on the reports has been organised, there seems to be different opinions in the Swedish and Norwegian reports, as to how comprehensive the TP systems should be – countries, emissions, etc. The starting point in the Norwegian report seems to be that for example all six gases in the Kyoto Protocol should be included, and then to exclude emissions from very specific sources because of problems of defining ownership, measurement problems, etc. The Swedish report show a table specifying uncertainties of measurements of the six Kyoto emissions, and seems to conclude on this background that only two of the six gases (CO_2 and SF_6 (Sulphur Hexafluoride)) should be included in the proposed TP system. The Norwegian report is very focused on costs and incentives to free ride – and the recommendations are economically rational (given the set-up).

The Norwegian report is the recommendation of eleven experts. On a number of questions there are minority and majority views.

[12] The Swedish report: Generaltulldirektör, Kjell Jansson, officially appointed and responsible for the report. According to the directive describing the work to be done, the appointed person must consult the Committee for Climate Related affairs and other experts. Duration of work: 8 month.

[13] The Norwegian report: An expert committee of eleven appointed persons. Responsible for the report. Special analysis by consultants. Duration of work: 14 month.

The following three tables are brief summaries of the Swedish, Norwegian and UK reports. If a cell in a table is empty this can *not* be interpreted as 'on this subject the report does not say anything'!

Table 7.1 summarises the three reports on the questions of how comprehensive the TP system should be. The Norwegian report is the most ambitious, the UK report the least. The UK system is a voluntary system, where companies can choose to commit themselves to fixed reduction targets. What the UK report says about the incentives for firms to voluntary join a TP system is quoted in section 7.3. The question of a Nordic TP system is also dealt with in section 7.2.

Table 7.1. How comprehensive should the TP system be?

Subject/Reports	**Norwegian report**	**Swedish report**	**UK report**
Countries	A national quota system *from* 2008 A national system because an international system may have longer time perspective. A broad international system is preferable. A Nordic TP system, in case of no ratification of the Kyoto Protocol, is problematic. Three members of the commission think it is not preferable	A national quota system maybe *before* 2008 (before 2005 may not be practically possible) A national TP system compatible with (later) broader –Nordic, Baltic, EU – international systems.	Propose a national voluntary industry related TP system. But it is important that 'international trades in permits and other Kyoto mechanisms such as CDM and JI would be recognised in the scheme once the rules covering these matters had been agreed'.
Sectors and sources	As comprehensive as possible: If possible in practice all sources should be included. Problems: legal ownership of sources, accounting and control.	In *principle* as comprehensive as possible.	Voluntary: Open to all companies operating in the UK, who commit them-selves to binding greenhouse gas limits agreed by Government.
Emissions	As comprehensive as possible: All should be included, if possible in practice. Problems: legal ownership of sources and responsibility of emissions, accounting and control. Some specific exclusions are mentioned	For some of the GHGs uncertainties on measurements of the emissions are considerable. Therefore a TP system should only include CO_2 and SF_6	All six greenhouse gases

Table 7.2 shows the different opinions with respect to the initial distribution of permits. The Norwegian commission is divided on the question: A majority proposes that the government sell the permits on an international permits market or in an auction. The arguments for auctioning are that those who pollute the most, will pay the most (the Polluter Pay Principle), and that the government's revenue from the auction can be used to tax relieves or other policies, which may create a 'double dividend'. A minority of the commission proposes permits to be distributed to the industry free of charge. The arguments are the competitiveness of Norwegian products and leakage effects (the effect that polluting firms and processes are exported to countries without binding commitments).

Table 7.2. The initial distribution of permits

Report/Initial distribution	**Auction**	**Distribution free of charge**
Swedish	A possibility. Only what speaks in favour of auctioning is mentioned.	A possibility. Only what speaks against is mentioned.
Norwegian	A majority of members of the commission propose this as the *general* (i.e. only) distribution principle (it is in line with Polluter Pays Principle). Two possibilities: a) Government's sale of Norwegian quotas on international quota market b) Government's auctions	A minority of members of the commission proposes this – for practical and political reasons – as the distribution principle within *production* sectors. Problem: It may be seen as hidden subsidies to different industries and as a violation of international treaties on competitiveness
UK		A voluntary TP system. Distribution of permits free of charge to firms with fixed reduction targets. Tax incentives to commit to a fixed reduction target

Table 7.3 shows the opinions on the time perspective of the proposed TP system, definitions of permits, etc. With respect to the time perspective the UK system is the most ambitious and the Norwegian the least. It is open to the UK companies weather they will participate in the TP system or not. Section 7.2 is a quotation of the Norwegian report illustrating the report's views on the initiation of a TP system.

Table 7.3. Time perspective, definitions of permits, etc.

		Norwegian report	Swedish report	UK report
Time perspective	TP – when?	No need for a broad system before 2008	Maybe before 2008	TP-scheme covering industry operational April 2001
	First steps	Main features of a TP system should be decided upon as soon as possible.	Credible framework	Framework and (tax) incentives to participate
Need for institutions		Self organised market		Electronic trade – registered and controlled by an 'Emission Trading Authority'
Control			Difficult for some of the greenhouse gases (argument for not including all the GHGs in the TP system)	By the 'Emission Trading Authority' and internationally certified registration bodies
Permit types and definitions	Permit types	a) Tradable b) Non-tradable		
	Permit definition	Permits not time limited Convertible with JI and CDM Ton CO_2 equivalents	The Kyoto protocol is not specific with respect to time limitations of quotas (subject for int. negotiations). Ton CO_2 equivalents	Permits not time limited Convertible with JI and CDM Ton CO_2 equivalents
Other instruments		For some sources: a) Limiting the activity level through production quotas. b) Technology requirements		The TP system should be an alternative for firms with production quotas.
JI and CDM		The use of these instruments presupposes routines for proper accounting and control. If there are no international limits on the use of these instruments all should be allowed to use them directly		The system should be prepared for JI and CDM

A Nordic TP system

In the summary of the Norwegian report it says that 'the commission has not discussed the question of establishing a Nordic permit market independent of the ratification of the Kyoto

Protocol, but points to a number of problems that will be raised' (my translation). The problems are centred around the argument that: If emission reductions after 2008 are relatively cheap – because of the Kyoto mechanisms – the economic cost of reducing emissions prior to 2008 may be high. Furthermore it will be a problem for the countries to find out how much to reduce, which sectors to include, etc. A smaller market will increase the likelihood of market power.

In the following section part of the Norwegian report's discussion on these problems is quoted.

In the summary of the Swedish report it says that: 'If a Swedish TP system is implemented before the Kyoto Protocol is ratified or maybe more likely before the first budget period starts in 2008, it is important that the Swedish system is so flexible that the implementation of a future international system will be as simple as possible. It is therefore part of the work to see that the proposals for a national TP system, in a later stage, can be integrated with an international TP system. The international system can, to a start, comprise for example the Nordic countries, the Baltic region or the EU'. After having mentioned initiatives in Norway, Denmark and Finland to examine and use emissions trading the summary concludes: ' It would therefore be interesting to examine the consequences of and the preconditions for – in the future – to attach a Swedish system to a Norwegian or Nordic' (my translations).

Where the Norwegian report is very sceptic with respect to a Nordic TP market, the Swedish report is much more open.

7.2 Views on initiation of a TP system

The following is a quotation from the Norwegian report on TP (NOU, 2000). In the quotation it is discussed whether a Norwegian or Nordic TP market should be initiated before the beginning of the Kyoto commitment period in 2008.

Uddrag fra den norske rapport om 'Et kvotesystem for klimagasser' kapitel 12

Ved å innføre et kvotesystem i Norge som supplement til eller erstatning for dagens virkemidler er det en rekke forhold som må avklares... Dette gjelder blant annet om det skal innføres et absolutt tak på utslippene og eventuelt hvilket utslippstak som skal settes. Det er langt fra klart hvordan et utslippstak i årene før 2008 i tilfelle bør fastsettes. Et tak på utslippene svarende til forpliktelsen for 2008-12 (at utslippene ikke skal overskride 101 prosent av 1990-nivået), hvor det utelukkende er adgang til å gjennomføre reduksjonene i Norge, vil medføre at det må gjennomføres langt dyrere tiltak før 2008 enn i den første forpliktelsesperioden.

.... Med et kvotesystem i stedet for dagens virkemidler kan den norske virkemiddelbruken enklere koples til andre lands kvotesystemer. Utvalget vil i den forbindelsen vise til at både Sverige og Finland er i ferd med å utrede nasjonale kvotesystemer. Det forventes at utrederne der vil se på mulighetene for et felles nordisk kvotesystem med kvoteplikt før 2008. Videre har Danmark bestemt å innføre kvoteplikt fra 2000 kombinert med avgift for utslipp fra produksjon av elektrisitet. Dette systemet skal kunne kobles til andre lands kvotesystemer. Hvordan denne typen regionalt kvotesystem eventuelt vil påvirke kostnadene for Norge avhenger av reduksjonskostnadene i de involverte landene og det totale taket innenfor systemet; altså for landene samlet sett.

Nordisk ministerråd har over lang tid gjennomført studier av mulige kvotesystemer for Norden og /eller Østersjøregionen. I Østersjøsamarbeidet (hvor Norge deltar) vurderes det om og eventuelt hvordan regionen kan gjøres til et utprøvingsområde («testing ground») for den typen fleksible mekanismer som finnes i Kyotoprotokollen. Det vil være mange juridiske, økonomiske og miljømessige problemstillinger som i tilfelle må vurderes i forhold til disse forslagene.

Utvalget vil peke på at en i Kyotoprotokollen, og i EUs oppfølgende byrdefordeling, har blitt enige om tallfestede forpliktelser for de ulike landene. Et slikt utgangspunkt er ikke tilstede for årene før 2008. Dersom Protokollen ikke skulle tre ikraft, vil de respektive landene også måtte vurdere om de ønsker å sette nasjonale utslippstak og, hvis de ønsker å etablere slike tak, hvilke nivåer de bør settes på.

Blant annet innenfor det nordiske samarbeidet har det vært utredet et felles kvotesystem for elektrisitetssektoren. Denne type systemer vil medføre en del ekstra problemstillinger i forhold til sektorovergripende systemer. De enkelte sektorene, som for eksempel elektrisitetssektoren, kan være enda mer forskjellige enn landene fremstår totalt sett, og systemer som kun skal gjelde enkeltsektorer vil kreve helt nye vurderinger av initiell fordeling av kvoter mellom land. Det vil bli krevende å finne en balanse mellom utslippsforpliktelsene i de aktuelle landene som gir en god miljøeffekt og samtidig en rimelig økonomisk fordeling. Det vil også være krevende for landene å oppnå en kostnadseffektiv nasjonal politikk hvis ulike sektorer skilles ut på denne måten.

Det må videre vurderes om kvotene skal selges eller tildeles gratis og muligheter for å handle med kvotene. Det må også vurderes hvem som skal få delta i kvotehandelen, og her bør det legges vekt på å hindre misbruk av markedsmakt.

Et nasjonalt system, eller et system med deltakelse fra et begrenset antall små land, vil gi et vesentlig mindre marked enn det som det åpnes for under Kyotoprotokollen. I et lite marked, som også kan være mer utsatt for bruk av markedsmakt, vil det kunne være behov for at staten spiller en mer aktiv rolle i å utforme institusjonene og kontrollere de ulike typene deltakere enn det som hovedregel legges opp til i kap. 11.

Utvalget har ikke vurdert disse forholdene nærmere, men vil peke på at de vil påvirke kostnadene ved å innføre et kvotesystem som supplement eller erstatning for dagens virkemidler.

Et kvotesystem som iverksettes uavhengig av Kyotoprotokollen kan utformes bredt, slik at det omfatter alle virksomheter det er mulig å inkludere i systemet, jf. kapittel 9, eller det kan kun omfatte de industrielle virksomhetene som i dag ikke er ilagt CO_2-avgift. Det kan også i prinsippet omfatte utslipp og opptak i skog dersom disse skulle vise seg å være egnede. Et bredt kvotesystem vil erstatte dagens virkemidler, mens et begrenset kvotesystem for de virksomhetene som har avgiftsfrie utslipp i dag, vil være et supplement til dagens virkemidler.

Innføring av et kvotesystem vil ha virkninger for statens proveny. Størrelsen på det samlede provenyet vil avhenge av en rekke faktorer, men utvalget vil ikke utelukke at et bredt kvotesystem kan gi lavere inntekter for staten enn dagens CO_2-avgifter. Et begrenset system for de sektorene som i dag ikke har CO_2-avgift vil ikke redusere provenyet, men myndighetene må vurdere hvordan kvotesystemet skal gjøres kompatibelt med det eksisterende avgiftsystemet. Utvalget vil peke på at det i et begrenset kvotesystem kan komme press fra andre næringer som er ilagt avgift, om å bli omfattet av kvotesystemet. Inkludering av disse sektorene vil øke kostnadseffektiviteten i virkemiddelbruken, men vil redusere statens proveny.

De argumentene utvalget har ført i marken for å gjøre systemet så bredt som mulig i et Kyotoprotokollregime vil også kunne brukes i forhold til et system uavhengig av Protokollen. Vekten på argumentene vil imidlertid kunne være ulik. For eksempel vil behovet for styringseffektivitet være avhengig av hvor viktig det vil være å nå ett bestemt kvantitativt mål.

Særmerknad til kapittel 12

Medlemmene Bjerkedal, Hagem, Hoel og Weltzien «vil understreke at Norge bør innføre et kvotesystem for Kyoto-perioden først i 2008, og ikke tidligere. En innføring av kvoter før 2008 gir bedriftene unødige tilleggskostnader, jf. drøftingen i avsnittene over. Som påpekt i avsnitt 12.3, vil dessuten et kvotesystem før 2008 nødvendigvis måtte bli forskjellig på flere viktige punkter enn kvotesystemet som vil gjelde fra 2008. En innføring av et kvotesystem før 2008 vil derfor virke forstyrrende i forhold til innføringen av det mer langsiktige kvotesystemet.

Å vurdere tilknytning til andre kvotesystemer (regionale eller sektorvise) før Kyoto-perioden ligger ikke innenfor utvalgets mandat. Utvalget har likevel valgt å drøfte visse problemstillinger i tilknytning til slike kvotesystemer. Etter disse medlemmenes syn vil problemene med å knytte seg til andre kvotesystemer før det er avklart om Kyotoprotokollen trer i kraft være meget store, bl. a. fordi slike kvotesystemer både må tilpasses en situasjon der Protokollen eventuelt ikke trer i kraft og en situasjon der Protokollen trer i kraft. Selv om en vet at Kyotoprotokollen trer i kraft, vil tilknytning til regionale eller sektorvise kvotesystemer kunne føre til høyere kostnader og vanskeligere tilpasning til et langsiktig system.

Dersom Kyotoprotokollen ikke trer i kraft, vil situasjonen være en helt annen enn den som utvalget har lagt til grunn i sitt arbeid. Hva slags klimapolitiske virkemidler som vil være fornuftige for Norge å bruke i en slik situasjon vil bl.a. avhenge av

Den internasjonale situasjonen, spesielt hva som vil komme av internasjonale klimaavtaler og/eller koordinering av klimapolitikk dersom Kyotoprotokollen ikke trer i kraft

Målsettingene Norge vil ha for klimapolitikken i en slik situasjon

Utvalget har ikke drøftet disse punktene. En ikke kan utelukke at elementer av utvalgets foreslåtte kvotesystem kan være en del av den norske klimapolitikken hvis Kyotoprotokollen ikke trer i kraft. Dette er imidlertid ikke opplagt, og en løper uansett en høy risiko for at deler av et tidlig innført kvotesystem må omgjøres dersom det senere viser seg at Kyotoprotokollen ikke trer i kraft. En situasjon hvor en først innfører et kvotesystem for deretter få år etter å avvikle det, eller endre det på vesentlige punkter, vil være svært uheldig».

7.3 .The UK report on companies incentives to participate in a voluntary Emissions Trading Scheme (ETS):

16 Incentives to participate

16.1 Each potential participant in the UK ETS would need to consider various incentives including:

- The opportunity for cost reduction
- The opportunity to make trading profits
- Flexibility in the application of IPPC energy requirement to their plant.
- Preparation for expected future international opportunities
- Preparation for expected future legislation
- Potential to develop emissions trading expertise
- Corporate positioning on environmental issues.

16.2 It should be recognised that companies participating in the trading scheme would in some cases be taking on additional risk. Firms that volunteer to join the scheme and accept a cap on their emissions (as opposed to firms who have already accepted a cap/unit target as part of a negotiated agreement) would incur additional expense to meet targets or pay penalties. Although direct savings in CCL from lower energy consumption provide an incentive to improve efficiency and thus cut emissions – they do not provide any incentive for a company to take on a binding emission reduction target.

16.3 If the scheme is to attract a wider participation from UK companies than those already in the CCL negotiated agreements then an additional incentive will be required. This is especially the case for the early phase of the scheme where the price of permits is not well established. It is suggested that the most obvious means to encourage wider participation would be to provide a tax incentive for companies that volunteered for the scheme outwith the negotiated agreements.

16.4 Although we agree with Marshall that companies with very low levels of energy use and small companies would not want to volunteer, this still leaves a significant number of other companies which are not covered by the negotiated agreements. We calculate that the emissions from those companies could amount to approximately 14m tonnes of carbon.

16.5 The tax incentive would need to be set at a level sufficient to attract companies to participate. In exchange for this, participating firms would need to accept an emissions cap based on the initial allocation principles set out above with the target to achieve emissions reductions.

8 Recommendations

8.1 A 'trade off' between desirable criteria

This report demonstrates that the choice of instruments to curb emissions and climate change is a choice between a number of desirable criteria. National and international instruments interact in ways that are not trivial.

The informed choice presupposes careful analysis. But there are a number of questions that the theoretical analysis cannot answer – and which will depend only on practical experience when using the instruments. Some practical knowledge on how the instruments works and how the involved agents respond to the instruments may be obtained from pilot projects or pilot implementation of the instruments. The size of administrative costs related to the use of the instruments is one important issue that practical experience may shed light on. It is not likely that pilot project etc. will say anything on for example leakage effects and incentives for new technological development.

Given that the choice of instruments is a choice – or a trade off – among different criteria it may be useful for decision-makers to give these criteria different priority. And useful to be aware of the priorities of interest groups. (Cf. chapters 3 and 4). Included in the list of criteria or priorities are: cost efficiency, environment efficiency, early start, administrative costs, control, reduction at home versus reduction abroad and distributional effects

It may be important for governments to be aware of which goals it should work for in international environmental policy making, in regional (EU) and in national policy making. The environmental regulations, frameworks and rules must be implemented on a level where problems can be coped with – and incentives will work.

Following chapter 1 the climate change problem can not be solved on a national uncoordinated level. This is due to different types of asymmetries between countries and incentives for countries to 'free ride'. The problems relating to the incentives for countries to reduce emissions and the economic and ethical problems related to the asymmetries between the (developing and developed) countries must be dealt with at the international level.

The international authorities should be concerned about

- Eliminating free rider incentives and make sure that countries can not reinforce these incentives. Countries must commit themselves to reduce emissions; the group of participating countries must be as big as possible and other policies or instruments should not be able to undermine the emission reducing effort.
- Negotiating a solution to the international distributional problems following the asymmetries of the climate change problem. One way of solving the distributional problems between countries is through the distribution of national emission reduction quotas and eventually 'hot air'. Given that the quotas have an economic value to the individual countries, the distribution of quotas (and hot air) can be seen as a distribution, and a transfer, of economic resources. Distribution of 'hot air' to developing countries is one way of creating incentives to increase participation.

An economic rational response to the commitments to fixed reduction targets is that countries co-operate and co-ordinate to reduce their individual and collective costs of compliance. The Kyoto instruments are the instruments that the committed countries are allowed to use to secure cost efficiency. The institutional framework for the Kyoto instrument should be framed so the freerider incentives are not reinstalled and the environmental goals are met.

It is important to notice that the use of the Kyoto instruments – and how the instrumets are used – can significantly change the immediate distributional impacts of the fixed reduction targets. Therefore, if distributional concerns are important arguments in the distribution of emis-

sion reduction targets, the countries' ability to reduce costs through the use of cost-effective instruments must be taken into account.

The nature of the climate change problem calls for international co-operation and co-ordination, because the economic incentives for individual countries to take action are very weak. The international agreement changes the incentives and obligations of the countries. But on top of that, it's also the nature of the climate change problem that countries follow their own economic or political interests. Denmark may have tougher emission reduction targets than the Kyoto commitment, but that's a Danish priority. Denmark and other countries may give priority to domestic expensive emission reduction projects (for example renewable energy production), but that's the priority of those countries. Some countries may focus on cost efficiency, or the interaction of national with international policies, or domestic distribution of costs related to emission reductions. That's their priority. It's the individual country's decision whether to use one or more of the Kyoto instruments or not.

On the EU level countries will care about how the national emission reduction policies are implemented and responded to. The focus of the EU is very much on policies, which support or prevent competitiveness within the EU. National emission reduction policies may highly affect the countries' international competitiveness, and therefore the EU may try to co-ordinate the national emission reduction policies.

8.2 Which instrument should be used for what purpose

There is a comprehensive international literature on the Kyoto instruments. Comparisons of the Kyoto instruments are however very seldom and not very detailed. A very important reason is that the instruments have different strength and weaknesses and therefore are difficult to compare.

From an economic textbook point of view a system with tradable permits is preferable to JI. And the CDM is so problematic with respect to incentives, control and accreditation that there is a danger that the theoretic properties may be undermined, when used in practice. Instead the FCCC and Annex B countries could try to 'persuade' (for example by making it economical attractive to) non-Annex B countries to commit themselves to fixed reduction targets. This would make a global TP system – and global cost efficiency – possible.

This textbook point of view may be the right policy. But some of the problems of this policy are the time perspective, and the relative high emission reduction costs in the initial period (with few committed countries). How long time will it take before the most important non-Annex B countries commit them selves and will be included in a TP system? Can all countries with a fixed emission reduction target join a TP system without conditions?

The Norwegian, Swedish and British report on tradable permits each recommend an institutional set-up for a tradable permit system. The reports also have views on the interaction with other instruments. These reports are very comprehensive, lots of resources have been put into the work, and they all represent an elaborate set of recommendations.

The following recommendations are therefore not the only recommendations possible. The intention is to try to give a set of recommendations that fit into Danish emission reduction policy. But also to bring new arguments into consideration, and maybe question the validity of some of the recommendations often heard, and for example expressed in the Norwegian report on tradable permits.

CDM includes countries without fixed emission reduction targets whereas JI and TP presuppose countries with fixed reduction targets. It is a theoretical possibility that all three instruments are available at the same time to agents in some Annex B countries: for example TP within the EU countries, JI with the rest of the Annex B countries and CDM with non-Annex B countries. Restrictions on the use of some of the instruments may imply different prices on emission reductions at the different markets. If there are no trade restrictions, the prices of emis-

sion reductions will either be the same on all markets, or all trades will be concentrated on the markets with the lowest price.

If the Annex B countries entire reduction commitments are carried out via CDM most of the rules regulating the trade on TP and JI markets become uninteresting – unless for example changing prices could change the trade pattern. If TP is the cheapest alternative, the rules for TP are the interesting.

To whom (sectors and emitters (of some or al gases)) the national reduction commitment is redistributed is very important to the individual actors.

JI and CDM give governments in host and donor countries possibilities to give certain types of investments priority: to set up plans for emission reductions, and to follow these plans (provided somebody will finance). TP will not be possible to direct or regulate in this way. It is possible to limit TP to some sectors and gases, but it is not part of the system that governments intervene in trades.

JI and CDM therefore delivers an extra possibility especially for host countries to include other priorities than investments in the cheapest emission reductions – for example investments of strategic importance to economic growth, infrastructure and local environment (damages other than climate related).

A TP system only assigns value to reductions of GHG emissions. But is on the other hand – given a well functioning system – a very powerful tool in reducing emissions.

Tradable Permits

The Norwegian, Swedish and British report on tradable permits represent different views on how a tradable permit system can be implemented. These views are valid and can be followed. The following is a kind of dialogue with these reports.

Should a tradable permit system be as comprehensive as possible – including as many countries, sectors and gases as possible? The Norwegian report argues for cost efficiency and as broad a system as possible. The Swedish report seem to conclude that only two of the six gases should be included because of problems of measurement with the rest.

For a TP system to be credible, valid and efficient the traded good must be well defined and the buyers must be convinced that the emission rights that they buy reflect emission reductions elsewhere. It is damaging to the whole system if countries or sellers just sell the permits and continue to pollute. Buyers must be convinced that they don't directly or indirectly buy from cheaters. It must be possible to hold countries and polluters responsible for levels of emissions, which exceeds the amount of emission permits. In practice this will limit the TP system. If some gases introduce an uncertainty about the traded good (for example by giving an alibi for a systematic and too low estimation of emission levels, and by giving special incentives to reduce emissions of these gases) these gases should be omitted or treated separately. If some countries' participation introduce an uncertainty these countries should be omitted or treated separately.

As CO_2 and SF6 emissions amounts to about 80 percent of total annual emissions in a country like Denmark nothing much is excluded by limiting a TP system to these gases and eventually introducing 'supportive taxes' for the rest (cf. below).

Initiation: the Swedish, Norwegian and British reports describe national systems, which are compatible with later international systems. For reasons of cost efficiency, the Norwegian report recommends that the national (or international) TP market will not be initiated before 2008 and the ratification of the Kyoto protocol. The two other reports recommend an earlier start.

The Norwegian report focuses on cost efficiency and the Kyoto protocol. But Norway, Denmark and other countries do already conduct emission-reducing policies. They have for example introduced CO_2 taxes, CO_2 regulation and renewable policies. It is likely that these policies will be enhanced in the period up till 2008. If a national, Nordic or any other TP system is superior to national emission reducing policies (for example more cost effective), this could maybe be a

start of a TP system. British firms are apparently interested in such a system. If the TP system is more cost-effective, the same emission reductions could be achieved for less money.

This report has shown that instruments interact in non-trivial ways. A TP system may under all circumstances call for a revision of emission reducing policies.

It is essential for the political accept and practical implementation of a TP system that agents know, what will be the maximum prises of permits, and knows estimates of likely prices of emission permits. So far national and international estimates of permit prices have not shown any consensus. Permit prices on markets, which do not include the developing countries (provided they had binding commitments) and the economies in transition are in general high, but with a significant variance.

Nielsen (2000) shows that it may be possible to identify maximum permit prices for different reduction targets. If these maximum prices are low, and this is what the analysis indicates, it may be very valuable information to the decision-makers and to the market.

Grandfathering or auction? Grandfathering has been proposed as the pragmatic solution to the problem of how to distribute permits. One of the advantages is that the initial costs to the existing emitters of the TP system are low, compared to for example auction. Existing emitters prefer grandfathering because this distributional principle favours this group. Auctioning is compatible with the polluter pays principle, and the system has no perverse distributional implications.

The resistance against auctioning as the distributive mechanism of tradable permits may be compared to the resistance against an emission tax. There is however one important difference, namely that the emission tax level is set by the government and therefore is known to all the tax payers in advance, whereas the price of the emission permit bought on an auction is unknown to all before the auction.

The resistance against auctioning is very understandable if estimated permit prices are in general very high or predictions very uncertain.

Resistance against auctions could be reduced to the resistance normal to taxes, if agents could be convinced of the maximum level of the permit price or a likely level of the permit price. (See Nielsen, 2000). The government could choose to announce a maximum permit price.

Each participating country should carefully examine the interaction between national policies and the TP system and the distributional effects of the TP system.

Clean Development Mechanism

CDM involves lots of problems related to a correct accreditation of emission reductions. To cope with these problems will be costly – and as a consequence emission reduction costs will increase. Cost will increase because of intensive administration and control, or because of limitations in the use of the instrument, or both.

There are many ways of setting up the institutional framework for CDM. And it may be difficult to choose. But in relation to CDM it is important to be aware that:

- Costs related to accreditation and control of a project may be significant compared to the direct project related emission reduction costs
- Speaking of cost efficiency in relation to CDM and only taking direct project related emission reduction costs into account gives no sense.
- In practice there will be no 'correct' accreditation. Baselines are estimated and cannot be verified.

This report argue that the CDM should be limited to a few sectors (in the non-Annex B countries) comprising the power producing sectors, the transport sectors and maybe a few others. Only two gases should be included, namely CO_2 and SF_6 (maybe only CO_2). The purpose should be to minimise the costs of qualifying projects for CDM, the cost of control, accreditation and

other administration. By limiting the amount of sectors and gases it is likely that the direct project related part of total emission reduction cost will increase.

CO_2 emissions amount to approximately 80 percent of total GHGs. The power producing sector and the transport sector include 50–70 percent of total CO_2 emissions – and both sectors have positive emission growth trends. Together these two limitations of the CDM instrument imply that around 50 percent of total non-Annex B emissions (of the six Kyoto gases) are included as the basis of the CDM market. But this restriction does not necessarily mean that 50 percent of the low cost emission reduction potential is cut off. If the largest and the cheapest emission reduction potential is to be found within the power producing sector, the transport sector and other possible CDM sectors, a hundred percent of the relevant emission reductions may still be included, and the 'limitation' will have no direct price effect. If all the low cost emission reduction potential is to be found outside the selected sectors, the 'limitation' may increase prices considerably.

At least the power-producing sector has large low cost emission reduction potentials.

As for TP it is essential that the good traded on the CDM market is well defined. The buyers, but especially the international authorities, must be convinced that the emission reductions sold are additional.

A competitive market demands that the CDM good is somehow standardised (to increase transparency).

To secure aditionality and a correct accreditation will not be an easy task.

The least cost solution could be to standardise: to define which type of project will be considered as additional and to announce how much accreditation a certain type of projects will give, under certain well-defined conditions. The standardisation need not secure that every single project is additional and will result in a correct accreditation. But on average the accreditation must be 'correct'.

Within the power producing sector and transport sector there are relative few technologies, investments have long time horizons and baselines, additionality and emission reductions are *relatively* easy to define. This could make standardisation relatively easy.

There may be special reasons to focus on emission reductions in sectors with long-lived investments. If it is more expensive, or even impossible, to reduce emissions once the investment is implemented – failure to influence the investment decision and reduce emission now may be very costly later. The CDM system should include this type of strategic emission reductions.

International authorities must regulate and control the CDM instrument. Given well-defined rules the instrument could be open to all.

The proposed institutional set-up for CDM is one out of several. The basic idea is to create a system that:

- is relatively easy to administer,
- includes a high percentage of emissions,
- includes low cost emission reductions with a large emission reduction potential,
- where uncertainties about emission reductions are relatively low,
- reduce the costs of qualifying, control and accreditation of CDM projects by more than the direct emission reduction costs increase (ie. total costs are minimised),
- influences investment decisions, which have important implications for future emission levels (long lived investments, which are in some sense irreversible),
- gives high credibility to the emission reduction good traded on the CDM market
- secures a clean development

Joint Implementation

In principle the only regulation needed is that the two involved countries sign legally binding contracts about the transfer of the accreditation. The only problem arises if the country selling the joint implementation projects do not comply. But this problem is not isolated to JI. In fact non-compliance may be easier to deal with when the instrument is JI than TP and CDM. This is because it is well defined who's responsibility it will be to reduce emissions in case of JI. Governments in both buying (donor) and selling (host) countries are involved in every JI project and must say yes or no to the particular project. In this way governments have a direct responsibility. And the international authorities may take action towards the individual non-complying countries.

Governments will not be directly involved in the international transfer of emission permits. This may be a problem in case of non-compliance (if the national emission level is higher than the amount of emission permits).

In practice both host and donor governments may have an interest in securing transparency in relation to the JI projects. To make it easy to evaluate what is bought and sold. Transparency and homogenous products will make it easier to establish competitive markets and market based emission reduction prices.

To reduce risks and uncertainties it may be optimal to host and donor countries to formulate JI investment policies that the individual actors in their countries must follow.

JI project may be relevant in host countries or host sectors not covered by a TP system. Donor countries and sectors may or may not be covered by a TP system. Compared to TP, JI is a very flexible instrument, in the sense that national rules for JI can easily be changed.

By giving economic incentives like emission reduction quotas, tax refunds, etc. a donor country can decide who (within the donor country) will have the economic incentives to engage in JI. Through the acceptance or non-acceptance of the JI transfer of emission reduction, the donor country has another veto opportunity.

If the donor country wants to it can further restrict, who may engage in JI, and it can also announce which type of host projects it will accept and not accept. It is clear that restrictions tend to reduce the cost efficiency gain unless costs of administration are significant and will be reduced by the restriction.

In the host country firms, organisations and consumers have an economic incentive to sell emission reductions. The host country should care about its own emission reduction commitment and be careful that the accepted JI projects will reduce emissions and will be an economic gain to the country. Provided funding it is rational for the host countries to give priority to emission reduction projects, which have other positive externalities to the country than reduction of GHG, for example economic growth potential, importance to the infrastructure and importance to the local environment.

Supportive emission taxes

Taxes are, like TP, JI and CDM (at least in theory), cost-effective instruments. TP, JI and CDM can be interpreted as endogenous taxes. Seen from a national perspective the national *initiation* of TP, JI and CDM will almost certainly be more costly than imposing an emission tax on emitters. But it is difficult to say how high or low these cost will be. If it is costly to implement and to 'run' very comprehensive systems of either TP, JI or CDM compared to narrower systems only covering some national sectors and gases, the national governments could choose to support for example a narrow TP system with an emission tax. The tax could be adjusted – for example on a yearly basis – to reflect the permit price. If the permit price is relatively stable little fine-tuning of the system is needed. The tax revenue could eventually be used to buy emission permits, if there was a danger that the country could not fulfil its international commitment.

The adavantages of using supportive taxes in combination with TP, JI or CDM systems, which do not cover all sectors or gases are several: a) Coverage is increased in this indirect way. b) For different reasons it may be easier to implement for example a narrow TP system, and after some time of experience to widen it. c) Costs may be lower.

Compared to for example a full coverage TP system a system with supportive taxes implies that not all emissions are evaluated via a market. But this need not have any significant influence on the price of the marginal emission reduction and the permit price. A criteria for selecting which sectors or gases to pay supportive taxes could be that the inclusion or exclusion of these sectors and gases from the TP market only had a a very little – if any – estimated price effect on the market.

Uncoordinated supportive taxes may have implications for the countries' international competitiveness.

8.3 Other recommendations

EU reduction commitments and the use of flexible mechanisms

If one of the main arguments for the differentiated EU reduction commitments was different marginal abatement costs between the EU countries, there may be reasons for once again to analyse the arguments behind the reduction commitments. There will be no difference in marginal abatement costs if for example an EU permit market is established or if substantial trade on JI and CDM markets is allowed.

Negotiations within the EU in summer, 1999, resulted in an agreement, which in practice will allow the EU countries to secure compliance by carrying out most of the emission reductions abroad. According to chapter 6.1 this decision will change the distribution of total costs between the EU countries. It may well be that the distribution of costs will be very far from the distribution of costs, which formed the background for the EU commitments shown in Figure 6.1.

If distributional concerns are important in the international negotiations on emission reduction commitments – the emission reduction commitments should be negotiated together with decisions on, to which extent to used the Kyoto instruments. The use of the Kyoto instruments has significant impacts both on total emission reductions cost and the distribution of costs between countries.

Hot air

'Hot air' is a much-discussed issue in the debate on climate change and Kyoto instruments. There is a risk that hot air reduces the emission reduction effect of international compliance relative to national compliance, and in that sense hot air is an argument against international compliance. Countries with hot air receives an economic transfer (payment for the hot air) from countries, which – using a common moral explanation – don't care about the environment and don't want to contribute actively to reduce emission.

This interpretation of the moral incentives for countries to buy hot air may be very right. But the question is what to do about it.

One possibility could be to exclude hot air countries from trade. But it does not increase global emission reductions, if only some countries exclude the hot air countries from trade. In this case the only effect would be to change the distribution of emission reduction costs so excluding countries paid more and the rest paid less. Another effect could be to exclude all the 'real' emission reduction possibilities in the hot air countries.

Following chapter 5 distribution of hot air to non-Annex B countries – through agreements on binding emission reduction targets, that are higher than actual emissions – is one type of economic incentive, which can be used to increase the coalition of countries with binding emission reduction commitment. Therefore distribution of hot air is an instrument which may be used actively within the climate change negotiations to transfer of economic gains.

The economies in transition who have hot air have paid a very high price for this hot air – because it is linked to a significant decrease in economic activity levels in these countries.

Joint implementation could be a possible way to avoid trade of hot air, because JI is project related. But in practice to avoid hot air coming into the JI projects would imply heavy control. And one of the important advantages of JI was that no international control of the projects was needed.

The conclusion drawn in this report is to look at the trade of the hot air as an economic transfer to the countries in question. And instead of trying to exclude the hot air, to argue for higher emission reduction targets in general as a response to the hot air and low emission reduction prices.

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Abstract (max. 2000 characters)

This report deals with international environmental instruments aimed at a cost-effective reduction of greenhouse gas emissions. More precisely the instruments mentioned in the Kyoto Protocol, namely Joint Implementation (JI), the Clean Development Mechanism (CDM) and Tradable Permits (TP). The report describes the background for the international co-operation on reducing the greenhouse gases and the background for the instruments. How the instruments work in theory and what the practical problems may be. What agents' incentives are when they engage in JI or CDM, and how the initiation of the instruments can be organised. The institutional frameworks for JI, CDM and TP are discussed. The report describes how the Kyoto instruments and the Kyoto commitments interact with other instruments and describe distributive effects between countries. It is analysed how the use of CDM may influence the developing countries incentives to participate in the coalition of committed countries. In the concluding chapter some recommendations on the use of JI, TP and CDM are given. The recommendations are a kind of dialog with especially the Norwegian and Swedish reports on tradable permits.

Some of the issues described in this main report are analysed in separate working papers. The working papers are collected in an appendix to the main report.

Descriptors INIS/EDB

AIR POLLUTION ABATEMENT; COST; ENVIRONMENTAL POLICY; GREENHOUSE GASES; INTERNATIONAL AGREEMENTS; INTERNATIONAL COOPERATION; LICENSES; MARKET; ORGANIZING; REGULATIONS; TRADE

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