Fondazione Eni Enrico Mattei

Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU

Gernot Klepper and Sonja Peterson

NOTA DI LAVORO 55.2005

APRIL 2005

CCMP – Climate Change Modelling and Policy

Gernot Klepper and Sonja Peterson, *Kiel Institute for World Economics*

Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU

Summary

The objective of this paper is to assess the likely allocation effects of the current climate protection strategy as it is laid out in the National Allocation Plans (NAPs) for the European Emissions Trading Scheme (ETS). The multi-regional, multi-sectoral CGE-model DART is used to simulate the effects of the current policies in the year 2012 when the Kyoto targets need to be met. Different scenarios are simulated in order to highlight the effects of the grandfathering of permits to energy-intensive installations, the use of the project-based mechanisms (CDM and JI), and the restriction imposed by the supplementarity criterion.

Keywords: Kyoto targets, EU, EU emissions trading scheme, National allocation plans, CDM and JI, Computable general equilibrium model, DART

JEL Classification: D58, F18, Q48, Q54

Address for correspondence:

Gernot Klepper
Kiel Institute for World Economics
Duesternbrooker Weg 120
24100, Kiel
Germany
Phone: +49 431 8814 485
Fax: +49 0 431 8814 522
E-mail: gklepper@ifw-kiel.de

Contents:

1. Introduction

One of the major components of the European climate strategy aimed at reaching the European Kyoto targets is the European Emissions Trading Scheme (ETS) for CO_2. The ETS that started in January 2005, covers facilities in energy activities, the production, and processing of ferrous and non-ferrous metals, the mineral industry and the pulp, paper and board production, which are responsible for around 45% of European CO_2-emissions. Besides trading emission allowances within the trading scheme, a linking between the ETS and the two flexible project mechanisms “Clean Development Mechanism” (CDM) and “Joint Implementation” (JI) has been established. This allows European facilities covered by the ETS to carry out emission-curbing projects in other Annex I countries (JI) and non-Annex I countries (CDM) and to convert the credits earned into emission allowances under the ETS.

While the ETS guarantees that the emission targets of the ETS sectors are achieved at minimal costs, the efficiency of the overall climate strategy of the EU respectively the different European Member States depends crucially on the policies introduced outside the ETS. There are broadly three areas in which greenhouse gas emissions in the single Member States can be implemented in order to meet the Kyoto-targets:

1. Domestic CO_2-emission reductions in the ETS sectors
2. Domestic reductions of CO_2-emissions in the sectors not covered by the ETS and reductions of other greenhouse gases (domestic reductions outside the ETS)
3. Emission reductions abroad – mainly via CDM and JI since it is unclear whether international emissions trading in the first Kyoto commitment period from 2008-2012 will take place.

The third option can be used by firms covered by the ETS as well as by governments, which like to set less stringent domestic targets by avoiding emissions abroad.

The allocation of permits to the ETS is subject of the so-called National Allocation Plans (NAPs), which each member state has to prepare before the beginning of an ETS trading period. For the first trading period from 2005-2007, the final NAPs or at least drafts are now made public for all of the EU25 countries. In addition, the NAPs as well as some government programs contain information on the planned government purchase of CDM and JI credits. Some NAPs also indicate the targets for the ETS sectors until 2012. Given this information it is possible to determine how the different EU member states plan to achieve their Kyoto targets in terms of domestic reductions in and outside the ETS and reductions abroad.

While existing simulation studies are based on hypothetical allowance allocation to the ETS and also ignore the possibility of using CDM and JI credits within the ETS and by European governments, the objective of this paper is to examine the implications of the current NAPs under different assumptions about the use and availability of CDM and JI credits using the DART model (Klepper et al. 2003). DART is a computable general equilibrium model designed for the analysis of international climate policies and calibrated for the enlarged EU. With the help of simulations with DART, it will be possible to simulate the ETS, the CDM and JI market and the domestic action under different assumptions about the functioning of these three markets. Since the Kyoto targets are not binding for the former accession countries, except Slovenia, due to the economic recession in the 1990ies, the focus will be on the EU15.

This paper proceeds as follows. In section 2, we derive the current climate strategy towards the Kyoto targets of the different EU Member States and give some background information on the role of the ETS and the market potential of CDM and JI. Section 3 and 4 present the DART model, our simulation studies and interprets the simulation results. Section 5 concludes.

2. Reaching the European Kyoto Targets

In this section, we derive from the NAPs and other sources how the former EU15-countries plan to achieve the Kyoto targets by making use of the three options described in the introduction. In addition, we summarize past findings on the implications of the ETS, give an overview over the potential market for CDM and JI credits and finally discuss the issue of hot-air. The information gathered in this section can then be used to design the policy simulations and to interpret the results.

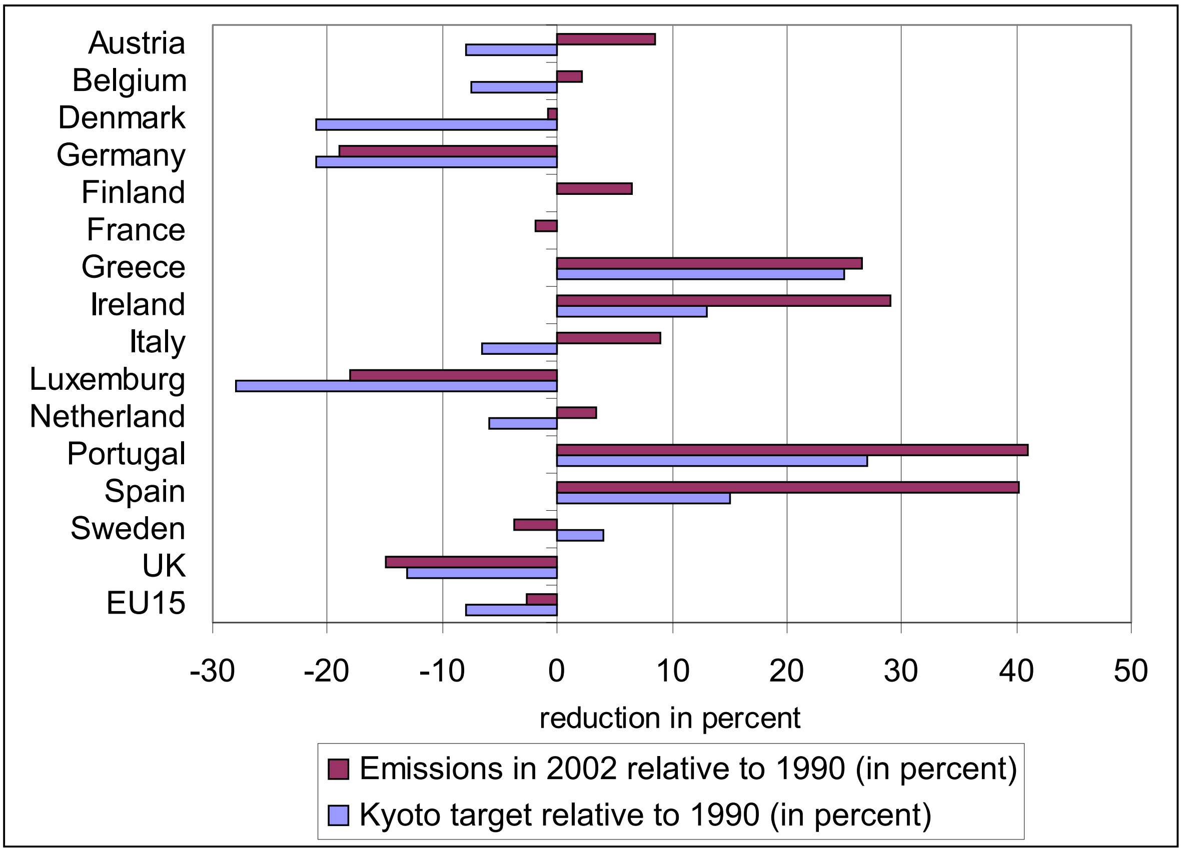
2.1. Distance to the European Kyoto Targets

In the Kyoto Protocol from 1997, the EU agreed to cut their overall GHG-emissions relative to the 1990 level by 8% in the period from 2008-2012. In 1998, this target was differentiated between the different member states in the so-called Burden Sharing Agreement giving cohesion member states, such as Spain, Portugal, Ireland and Greece, a lighter burden, compared to richer member states. The (former) accession countries that joined the EU in May 2004 and those that are scheduled to join in 2007 are not part of the Burden Sharing Agreement but have their own individual Kyoto targets.

Since then, greenhouse gas emissions have risen in most of the EU15-countries, and only few of the countries are on track to fulfill their commitments. Figure 1 shows the Kyoto targets for the EU15-countries as well as the change in GHG-emission from 1990 to 2002. As one can see, the gaps to the Kyoto targets are quite substantial in most countries. Only in Sweden, Great Britain and France, the 2002 GHG-emissions are below the Kyoto target and in Germany only minor reductions are missing.

With the exception of Slovenia, all of the (former) accession countries, where emission fell drastically since 1990 due to the economic break down of their economies, do not face any problems to reach their Kyoto targets. For these countries, the question is thus not how much to reduce in which sectors, but rather, how much of the excess emission rights (hot-air) to use.

Figure 1: Gaps to Kyoto Targets



2.2. The European Climate Strategies

The national climate strategies of the EU member states are summarized in the different National Allocation Plans (NAP). The NAPs contain information in different detail and with differing time horizons. Table A1 in the Appendix summarizes the information contained in the NAPs concerning the allocation to the ETS sectors, the emissions of these sectors and the use of CDM and JI[1]. With the help of official data on GHG-emissions, it is possible to derive or estimate for all EU15-countries the emissions of the ETS and non-ETS sectors in 2002, the planned allocation to the ETS in 2007, the planned use of CDM and JI and the remaining reductions that have to be achieved to reach the Kyoto targets. Germany, Denmark, The Netherlands and the UK have also indicated the allocation to the ETS in 2012. Germany, the UK, and the Netherlands plan to reduce the ETS-emissions by 1.5 to 2.5%. Denmark is a special

[1] The numbers on CDM and JI are taken from Lückge and Peterson (2004).

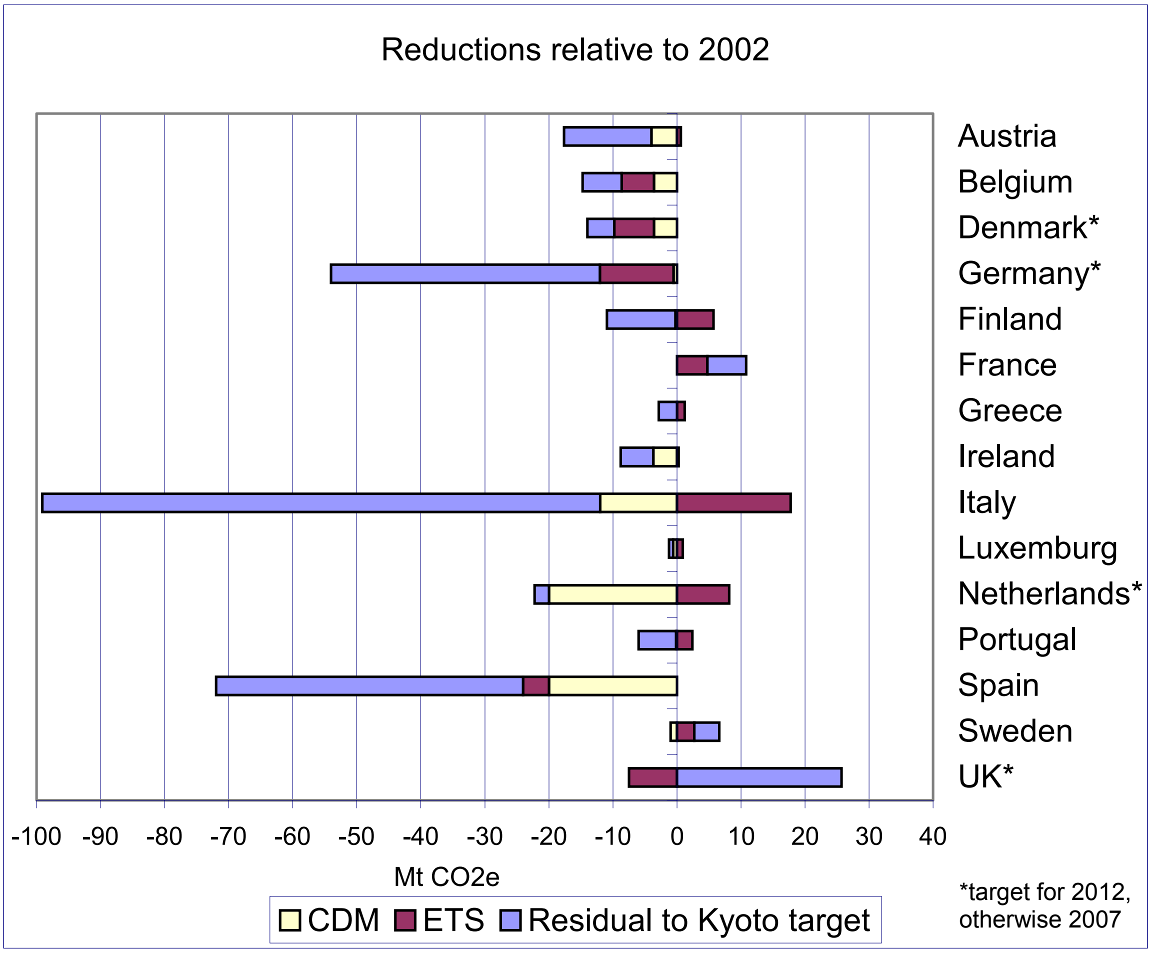
case since emissions in the ETS sectors can grow by about 10% between 2002 and 2007 and then they need to be reduced by 26% between 2008 and 2012.

Figure 2 shows for each of the EU15 states in megatons of CO_2 those reductions relative to 2002 emissions that are necessary to reach the Kyoto target. The dark part of the bars shows the reduction (or increase) of the CO_2-emissions of the ETS sectors associated with the allowance allocation of the NAPs. Where available, these data are for the period 2008-12. In most cases, though, information is only available for 2005-07. The striped bars show the planned reductions via CDM and JI. These reductions will only be relevant for the first Kyoto commitment period from 2008-12. Given the Kyoto targets, the light bars show the necessary reductions in the sectors and gases not covered by the ETS. This residual can be influenced, of course, if the allocation of allowances in the second commitment period or the CDM and JI credits are adjusted accordingly.

In line with Figure 1, Figure 2 shows that only France, the UK and Sweden already meet their Kyoto target in 2002. Nevertheless, the UK plans to reduce emissions in the ETS, which leaves room for rising emissions in the non-ETS sectors.

Even though most countries have to reduce emissions considerably for meeting their Kyoto targets, Portugal, Finland, Denmark, Austria, the Netherlands and especially Italy allocate allowances to ETS sectors that surpass emissions in 2002. In the remaining countries, emission reductions in the ETS sector also play a minor role given the overall Kyoto target. Only Belgium plans to achieve a major part (about one third) of the reductions necessary for the Kyoto target within the ETS. CDM and JI are also of relatively little importance in most countries. In absolute numbers, the Nether lands and Spain plan to make use of these mechanisms most strongly. Each country plans to acquire credits for around 20 $MtCO_2e$ per year in 2008 to 2012. CDM and JI are also part of the climate strategy in Belgium, Denmark, Ireland and Italy. Given these reduction plans, the major burden for domestic reductions falls on the sectors outside the ETS in almost all countries. Only in the UK, Sweden and France, which are on track to fulfill their commitments, emissions outside the ETS, are allowed to rise.

Figure 2: Climate Strategies in the EU15 According to the NAPs



2.3. The Role of the European Emissions Trading Scheme

The European Emissions Trading Scheme (ETS) is intended to contribute to meeting the European Kyoto commitments in an economically efficient way. There is now some evidence that the ETS can indeed generate considerable cost savings.

Klepper and Peterson (2004) show that the gains of the ETS compared to unilateral efficient action of all EU countries depend on how much CO_2 is reduced within the ETS compared to GHG reductions outside the ETS – that is in sectors and gases not covered by the ETS. Optimally designed, the ETS can reduce the welfare losses associated with the Kyoto Protocol by around 20%. The resulting permit price is in this case around 11€/tCO_2. Svendson and Vesterdal (2003) estimate that the ETS could reduce the total abatement costs by 32% compared to a system with no trading between member states.

Estimates about permit prices in the ETS without accounting for the potential use of CDM and JI credits usually vary between 5 and 20€/tCO_2. The so-called linking directive allows to convert CDM and JI credits into emission allowances under the ETS. Even though the first proposal of the directive envisaged to limit the use of CDM and JI credits to 6% of the total quantity of allowances allocated to the ETS, there are no limitations set in the final version. Governments though are required to consider the issue of supplementarity (see section 2.4) in their twice-yearly reports and can set a limit for CDM and JI credits for each single installation.

In January 2005 the trading price for allowances in the ETS was around 8.5€/tCO_2. On the other hand, there are estimates for the shadow taxes needed to achieve the necessary reductions outside the ETS, ignoring international emission trading or CDM and JI. In Klepper and Peterson (2004) these taxes are on average 22€/tCO_2 but can reach almost 40€/tCO_2 under a more generous allocation of allowances to the ETS sector.

Existing studies have the shortcoming that they only analyze potential allowance allocation since the NAPs were not known when the studies were undertaken. More importantly, the studies ignore the possibility of using CDM and JI credits – by ETS firms and national governments.

2.4. Some Background on CDM and JI

The project-based mechanisms Clean Development Mechanism (CDM) and Joint Implementation (JI) have been designed to help countries to accomplish their Kyoto targets in an economically efficient and environmentally effective way. JI allows Annex I Parties of the Kyoto Protocol to implement projects that reduce emissions in the territories of other Annex I parties and use the generated carbon credits to fulfill their Kyoto commitments. CDM gives the possibility for emission reductions in developing (non-Annex I) countries which themselves have no reduction target.

In the EU, it is possible to make use of CDM and JI on both the private and on the governmental level. Governments can use CDM and JI credits to comply with their national Kyoto reduction target. The Linking-Directive allows private entities that are covered by the EU ETS to convert credits from CDM and JI into allowances that can be used in the EU ETS.

In the last years, the global market for carbon credits from project-based mechanisms has been steadily growing. The latest CDM & JI Monitor (2005) reports that 1306 proposed CDM and JI projects have so far been registered in Point Carbon's project Database. Out of these, 271 Projects, potentially yielding 420 $MtCO_2e$ of emission reductions towards 2012, have reached the level of a Project Design Document (PDD). The latest World Bank report on the carbon market (Lecocq 2004) shows that since 1996 sales have doubled from around 40 $MtCO_2e$ to around 80 $MtCO_2e$ in 2003. In 2004, 64 $MtCO_2e$ have been exchanged through projects from January to May 2004 only, suggesting that the market has doubled again by the end of the year 2004.

A study for the World Bank (Haites and Seres 2004) summarizes information on the demand and supply of CDM and JI credits. Mainly based on modeling studies, the average annual demand from 2008 to 2012 for Kyoto units, excluding Australia and the US, is estimated to lie in the range of 600 to 1150 $MtCO_2e$. This includes AAU[2] transfers as well as credits from CDM & JI.

[2] AAUs are the „Assigned Amount Units“ under the Kyoto Protocol – the amount of CO_2 each Annex B country is allowed to emit in the first commitment period. The credits for CDM projects are denoted „Certified Emission Reductions“ (CERs) while the credits originating form JI projects are denoted „Emission Reduction Units“ (ERUs).

According to Natsource (2003)[3] the total demand for CDM and JI credits from industry will be 200 +-100 $MtCO_2e$ and the demand from the European ETS 110 +- 65 $MtCO_2e$. Governments are estimated to buy 84 to 762 $MtCO_2e$ p.a. from which the EU25 will demand 54 to 463 $MtCO_2e$. Announced plans for government purchases amount to 70 $MtCO_2e$ p.a. in the EU25 (Lückge and Peterson 2004), 50 $MtCO_2e$ (including AAUs) in Canada, 95 $MtCO_2e$ in Japan and 5 to 18 $MtCO_2e$ in the EFTA countries.

Haites and Seres (2004) also review studies on the supply of CDM and JI credits. Some studies use simulation models, which result in very flat marginal abatement cost curves and thus in a large supply of CDM and JI credits at low prices. Other curves are differentiated between project type and region and derived from the technical potentials. Haites and Seres conclude that the most conservative estimates yield annual reductions in 2010 in the range of 215 to 405 $MtCO_2e$ at a price of 11 $/$tCO_2e$ +- 50%. Accounting for pre 2008 reductions that can be used for the 2008-12 period, Haites and Seres see the most likely annual supply at 420 $MtCO_2e$ (range 270 to 505 $MtCO_2e$) at a price of 11 $/$tCO_2e$ +- 50%.

Taking the trade volumes from the World Bank (Lecocq 2004) and assuming that the market trend continues and that it needs four years to bring a project on the market (see Haites and Seres 2004), there is a potential of around 220 $MtCO_2$ per year. Since September 2004 the CDM & JI Monitor from Point Carbon also reports on a bi-weekly basis the proposed CDM and JI projects registered in the Point Carbons database, the number of projects that have reached the level of a project design document (PDD) and the resulting emission reductions. Assuming that all PDD projects are actually validated so far 84 $MtCO_2e$ p.a. are available for 2008-2012. How many credits for 2008-2012 will be available in the end depends very much on the kind of market trend that is assumed. Under a linear trend, around 300 to 400 $MtCO_2$ p.a. will be available while under an exponential trend it may well be twice as much. Two

[3] This study is reported in Haites and Seres (2004) but not available for the authors of this paper.

simple calculations also show the range of possible supply. Assuming that as in the past four month, every month around 6.5 $MtCO_2$ are validated and that it takes again four years until a project is running, there is a potential supply of around 290 $MtCO_2$ p.a. Assuming that all proposed projects will be validated and continue to gain an average of 1.5 $MtCO_2$ and that continuously 50 projects are proposed and validated every month, there is a potential supply of 700 $MtCO_2$. In summary, evidence suggests that the minimum supply of CDM and JI credits is around 200 $MtCO_2$ p.a. and that it seems unlikely that it will be far above 600 $MtCO_2$ p.a.

When making assumptions about the supply of CDM and JI credits, it has to be taken into account that institutional issues constitute significant barriers to a more widespread use. Currently institutional capacities are unevenly distributed among potential CDM host countries, and this is likely to remain so. While there is significant capacity in many Asian and South American countries, many African countries still lack behind (Ellis et al. 2004).

Concerning the prices for credits, the World Bank and the OECD see prices in the range of 2.5 to 6 €/tCO_2e (Lecocq 2004, Ellis et al. 2004). Some EU tenders contracted CDM and JI credits for 2.5 to 8.5 €/tCO_2e (Lückge and Peterson 2004). The CDM and JI Monitor of Point Carbon reports 5 to 15 €/tCO_2e.

One problem for deriving prices, e.g. from a simulation model, is the existence of transaction costs for CDM and JI projects. In a survey Michaelowa et al. (2003) report transaction cost ranching from a few €-cent per tCO_2e up to more than 1000 €/tCO_2e depending on the project size and type. There is evidence that transaction costs should not be more than 25% of proceeds from permit sales in order to make a project viable. At current prices this would give a cost threshold of about 1 €/tCO_2e.

Another important issue that influences the demand for CDM and JI credits is the so-called supplementarity requirement. As laid out in the Marrakech Accords to the Kyoto Protocol "the use of the mechanisms [International Emissions Trading, CDM, JI] shall be supplemental to domestic action and that domestic action shall thus constitute a significant effort made by each Party included in Annex I to meet its quantified emission limitation and reduction commitments under Article 3, Paragraph 1." It was in fact the EU that insisted on the inclusion of this requirement and also unsuccessfully pressed for a limit requiring that not more than roughly 50% of the reduction should be imported (see Langrock and Sterk 2004 for the discussion on the supplementarity issue). In principle, the supplementarity requirement holds for each of the EU25 member states as well as for the former EU15. Table A1 in the appendix includes the calculations of the EU for the maximum amount of credits that are allowed under the above mentioned supplementarity criterion.

2.5. The Role of Hot-Air

So far, the possibility of obtaining carbon credits from CDM and JI projects has been introduced. In addition, the Kyoto-Protocol allows the transfer of AAUs between Annex B countries. As far as trade in AAUs between countries with a binding cap is concerned, this option is of minor importance since the project credits are perfect substitutes and can in many cases be obtained at lower prices. This is not the case for countries, which do have a cap that is above their expected business-as-usual emissions in 2012. These excess emission rights are called hot-air. The countries with hot-air are mainly the countries of the Former Soviet Union and to a smaller degree the Eastern European countries. In an extreme scenario where these countries sell all their hot-air, most models, including DART (Klepper and Peterson 2003) predict that the excess supply of allowances is so large that the carbon price falls to zero and the Kyoto targets can be reached at zero cost, however without an emission reduction. Such a scenario is not very likely though. Different studies have estimated that it is optimal for the hot-air countries to restrict their sales of hot-air to around 40% (Haites and Seres 2004, Klepper and Peterson 2003). If some of the hot-air is supplied on the market, the use of CDM and JI credits will be reduced and international carbon prices will fall.

The role of this Kyoto-trading for the ETS is rather limited since the AAUs cannot be used by installations inside the ETS. In addition, the governments of the member states have committed themselves to a strict definition of supplementarity and have opposed the use of hot-air for achieving the Kyoto-targets. Hot-air is therefore not considered in this paper.

3. Simulating the ETS and the Role of CDM and JI

To assess the effects of the current NAPs and the potential role of CDM and JI credit for the European Union, we use the DART-model (Klepper et al. 2003). Below, we first shortly characterize the model and then derive the policy scenarios for the simulation study.

3.1. The DART Model

The DART (Dynamic Applied Regional Trade) Model is a multi-region, multi-sector recursive dynamic CGE-model of the world economy. For the simulation of the European ETS, it is calibrated to an aggregation of 26 regions. Table 1 lists the 17 countries or group of countries of the EU including the accession countries of Eastern Europe and nine other world regions that represent the rest of the world.

In each region or country, the economy is disaggregated into 12 sectors (Table 2). Four of these sectors participate in the ETS. Although there is no perfect match between the installations subject to the ETS and the sectoral structure of DART, the deviations are relatively small.

The economy in each region is modeled as a competitive economy with flexible prices and market clearing. There exist three types of agents: a representative consumer, a representative producer in each sector, and regional governments. All regions are connected through bilateral trade flows. The DART-model has a recursive-dynamic structure solving for a sequence of static one-period equilibria. The major exogenous drivers are the rate of productivity growth, the savings rate, the rate of change of the population, and the change in human capital.

Table 1: Regions in DART

European Union			
AUT	Austria	IRE	Ireland
BEN	Belgium, Luxembourg	ITA	Italy
DEU	Germany	NED	Netherlands
DNK	Denmark	PRT	Portugal
ESP	Spain	SWE	Sweden
FIN	Finland	UK	United Kingdom
FRA	France	HUN	Hungary
GRC	Greece	POL	Poland
XCE*	Bulgaria, Czech Republic, Rumania, Slovakia, Slovenia		
Other Annex B Countries		**Non-Annex B Countries**	
USA	United States of America	MEA	Middle East, North Africa
AUS	Australia	LAM	Latin America
FSU*	Former Soviet Union	CPA	China, Hong-Kong
OAB	Rest Annex B (Canada, Iceland, Japan, New Zealand, Norway, Switzerland)	IND	India

XCE includes Bulgaria and Romania for which the accession in 2007 is planned. It excludes the Baltic Countries, which are aggregated in region FSU, as well as Malta and Cyprus, which are aggregated in region ROW. This is due to the regional disaggregation of the GTAP5 data set. This inconsistency has only a small effect since it distorts CO_2-emissions of ACC by less than 5%.

Table 2: Sector Structure of the Economies

ETS-sectors		**Other sectors**	
OIL	Refined Oil Products	COL	Coal Extraction
EGW	Electricity	GAS	Natural Gas Production & Distribution
IMS	Iron, Metal, Steel	CRU	Crude Oil
PPP	Pulp & Paper Products	CEP	Chemical Products
		AGR	Agricultural Products
		TRN	Transport Industries
		MOB	Transportation Services
		OTH	Other Manufactures & Services

The model is calibrated to the GTAP5 database that represents production and trade data for 1997. The elasticities of substitution for the energy goods coal, gas, and crude oil are calibrated in such a way as to reproduce the emission projections of the EIA (EIA 2002). For a more detailed description of the DART model, see Springer (2002) or Klepper et al. (2003).

3.2. Policy Scenarios for the ETS

For assessing the likely impact of the recently introduced emissions trading scheme and project-based mechanisms, a “business-as-usual” (BAU) reference scenario is determined. This BAU scenario includes the climate policy measures introduced until the year 2002. Hence, it includes the impact of policies such as the German eco-tax or the national emissions trading schemes. From 2003 on, BAU keeps these policies in place but does not include any new climate policies. The implications of the BAU scenario for the NAP targets are discussed in section 4.1.

The BAU scenario is then compared to several policy scenarios with which an assessment of the mix of current policies can be made. The first scenario consists of simulating the impact of the NAPs and the European ETS without the use of CDM and JI projects. The targets in the non-ETS sectors are reached by a uniform, but regionally differentiated CO_2-tax. This scenario is called NoCDM. It helps to illustrate how the burden of the Kyoto targets is distributed between the ETS and the non-ETS in the different national NAPs. It also serves as a reference for the impact of the project based mechanisms. The results of scenario NoCDM are discussed in section 4.2.

The second scenario is designed to capture the national climate policies with respect to CO_2 on the basis of both the ETS and the project-based mechanisms. It is denoted LimCDM and incorporates all the national policy plans made public so far. Thus, there is no restriction for the use of CDM and JI in the ETS, while the national governments only import limited amounts of CDM and JI credits. We furthermore assume that all CDM and JI credits are associated with transaction cost of 3 €/tCO_2, which is above the estimated long run transaction costs of around 1€/tCO_2 but far below the transaction cost in some of the smaller projects. Further assumptions, e.g. concerning the CDM and JI demand from the remaining Annex B countries, are described in the Appendix. Scenario LimCDM illustrates the contribution of the project-based mechanism to the Kyoto targets given the ETS within the EU. The results are discussed in section 4.3.

The third scenario derives the optimal solution by letting the ETS work without restrictions and by allowing all sectors the use of CDM and JI to the degree they wish. This scenario OPT differs from LimCDM in that the national restrictions on the use of project based emission credits are withdrawn. It is discussed in section 4.4. Finally, the last scenario is SUP where the optimal emission reductions and CDM/JI purchases for the non-ETS and ETS sectors are restricted by the supplementarity requirements in each region.

All scenarios are explained in detail in the Appendix.

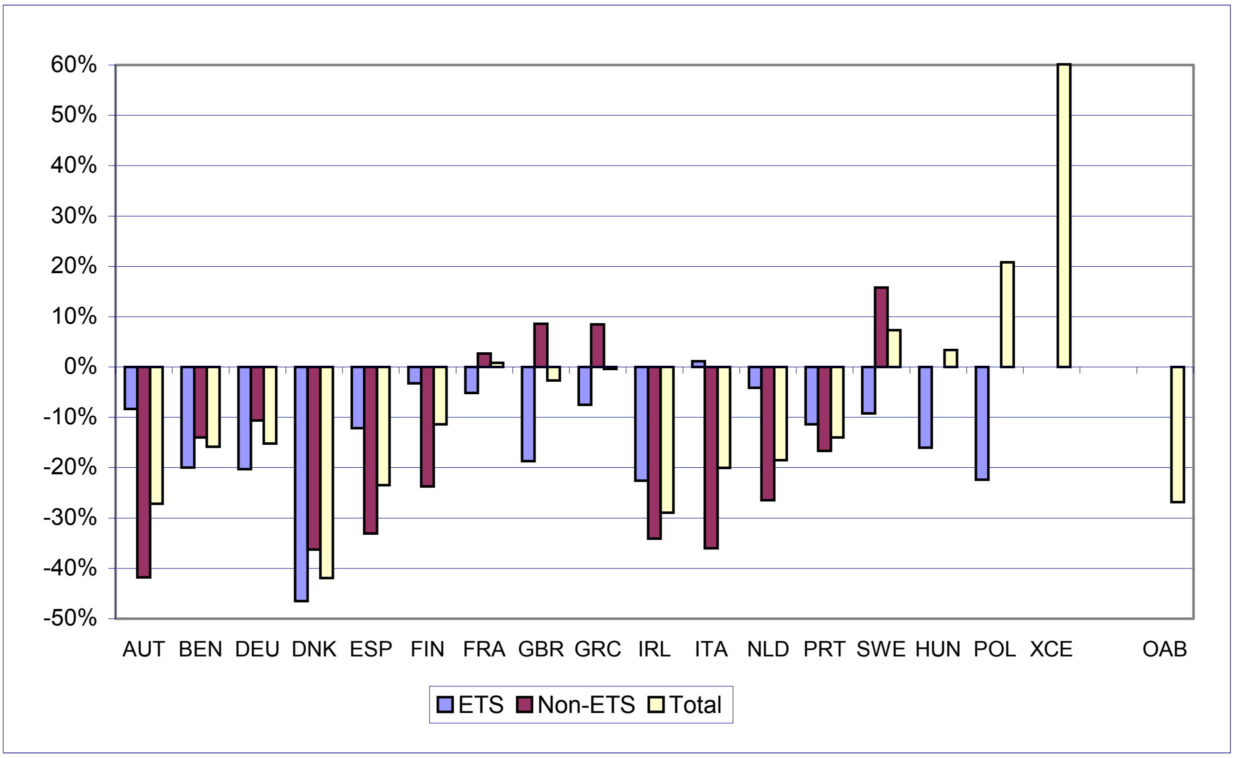
4. Simulation Results

The simulation results of the different scenarios are derived from running the DART-model over the entire period from 1997 to 2012 when the Kyoto targets will be binding. Therefore, only the final results for 2012 are reported in the subsequent figures and tables. All prices are denoted in EUROS of the year 2000.

4.1. Implications of the BAU Scenario

Whereas in Figure 2 above the necessary reductions of CO_2-emissions relative to the emissions in 2002 are indicated, the reduction requirements should actually be determined by computing the difference between the BAU-emissions in 2012 and the emission caps of that year as given by the Burden Sharing Agreement of the EU. Figure 3 illustrates the results. For each country/region the necessary reduction relative to BAU are decomposed into those within the ETS and those outside the ETS. In addition, the overall reduction requirements are presented.

Figure 3: CO_2-Reduction Necessary to Meet the Kyoto Targets Relative to BAU in 2012



Since the emissions of the ETS sectors grow faster than the emissions of the non-ETS sectors in the BAU scenario, the targets from the NAPs imply that considerable reduction efforts in the ETS sectors are needed in order to meet the targets in 2012. Nevertheless, the reduction requirements in the non-ETS sectors are in most cases larger than in the ETS. It is therefore likely that the NAPs do not minimize the costs of meeting the Kyoto targets. This is analyzed in the following sections.

4.2. The ETS without CDM and JI

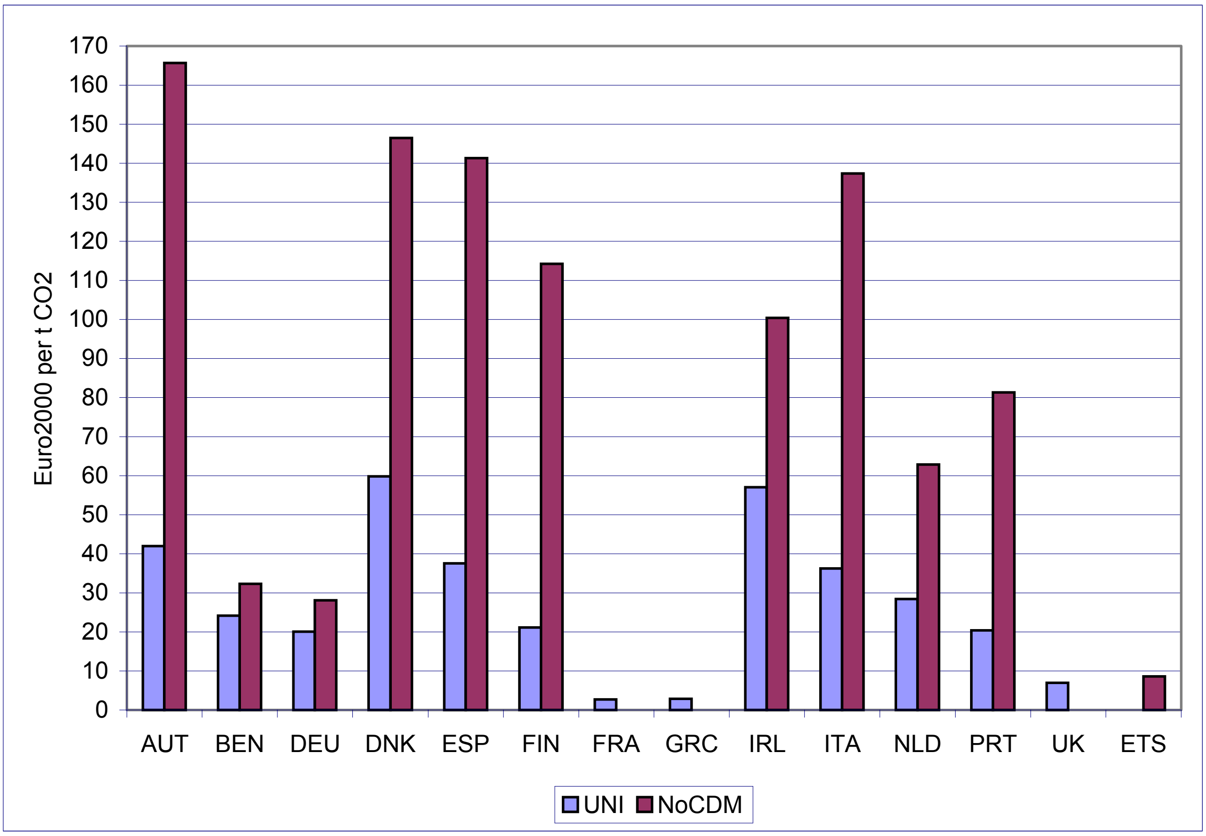
The first scenario looks at the outcome of the climate policy measures laid out in the National Allocation Plans (NAP) but leaves the project-based mechanism outside the system. This NoCDM scenario has emissions trading within the ETS according to the caps as they are defined in the NAPs. It is assumed that each government imposes an emission tax on all emissions outside the ETS at a level that makes sure that the Kyoto target is met.

Whereas the ETS equalizes marginal abatement costs across countries in the energy intensive sectors, the distortions between the ETS-sectors and the rest of the economy within each country remain untouched. The degree of that distortion, of course, depends on the amount of allowances allocated to the ETS relative to the Kyoto target. This is illustrated in Figure 4 where the permit price in the ETS is compared to the tax that needs to be imposed outside the ETS for meeting the Kyoto target. In order to illustrate the distortions imposed by the generous allocation of allowances to the ETS, Figure 4 also shows the tax that would emerge without the ETS. In this case, the international efficiency gains from the ETS cannot be realized but the intersectoral marginal abatement costs in each economy are equalized. The light gray bars denoted UNI indicate the marginal abatement costs if each country were to meet its Kyoto target unilaterally.

It turns out that in the unilateral scenario the implicit taxes vary between 5 €/t CO_2 in France and Greece and around 60 €/tCO_2 in Denmark and Ireland. The emission weighted average tax in the EU15 is around 20 €/tCO_2. This indicates both strongly varying reduction requirements in the EU15 member countries and a significant potential for welfare gains through emissions trading.

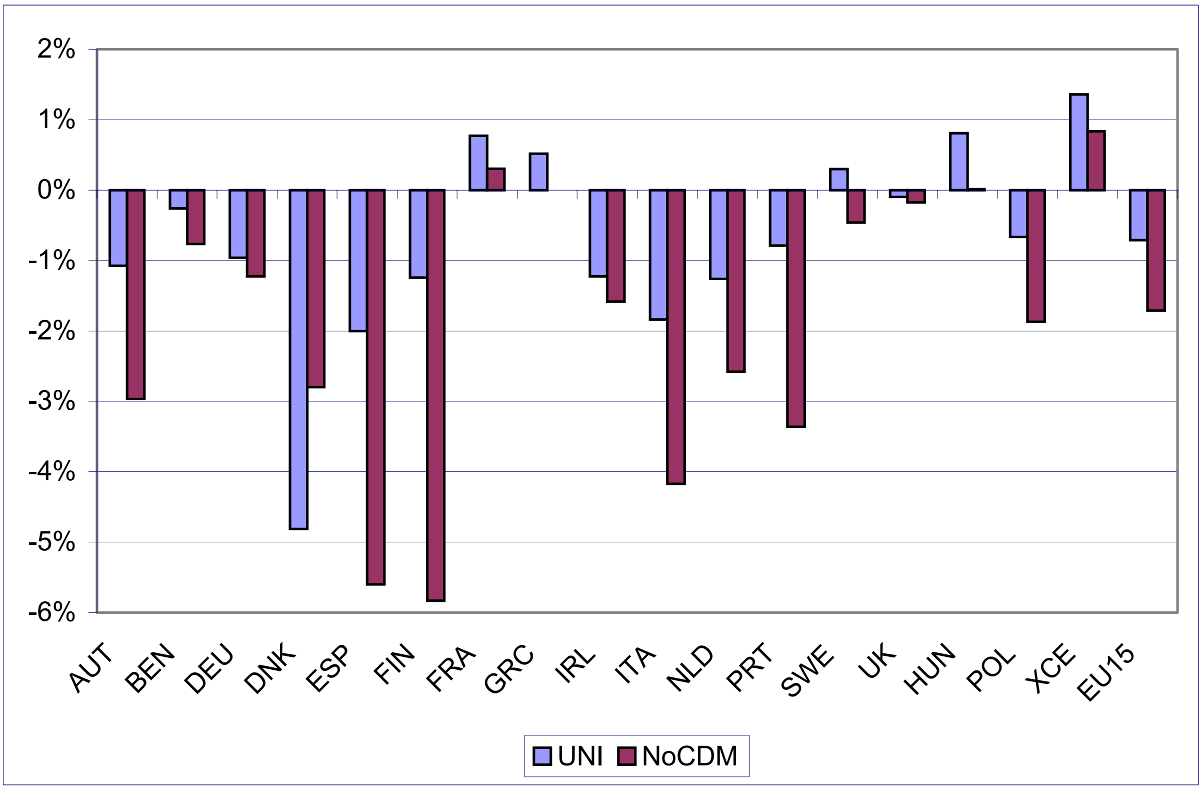
In the NoCDM scenario the ETS with the official NAP targets is simulated and results in an equilibrium allowance price of 8.6 €/tCO_2. This low permit price is partly due to the efficiency gains from trading but also due to the generous allocation of allowances to the ETS. It is therefore not surprising that the implicit taxes outside the ETS rise far above the unilateral scenario UNI. In fact, the emission weighted average tax outside the ETS is 57 €/tCO_2, but reaches extremely high levels in countries like Austria, Denmark, Spain, and Italy.

Figure 4: Taxes and Allowance Price with and without Emission Trading



The welfare effects of the two scenarios illustrate the trade off between efficiency gains through trading and the intersectoral distortions within each country. Whereas the emissions trading scheme provides efficiency gains, these are apparently netted out for many countries by the additional distortions imposed by the inefficient internal caps on the ETS and non-ETS-sectors. A comparison of Figure 4 with Figure 5 supports this. Countries with a large divergence between allowance price and implicit tax in the non-ETS sectors, such as Austria, Spain, and Italy experience a strong negative welfare effect through the ETS. On the opposite side, in France, Greece and the UK, the ETS-sectors are more restricted than the non-ETS sectors, leading to negligible welfare effects.

Figure 5: Welfare Effects Relative to BAU in the NoCDM and the UNI Scenario



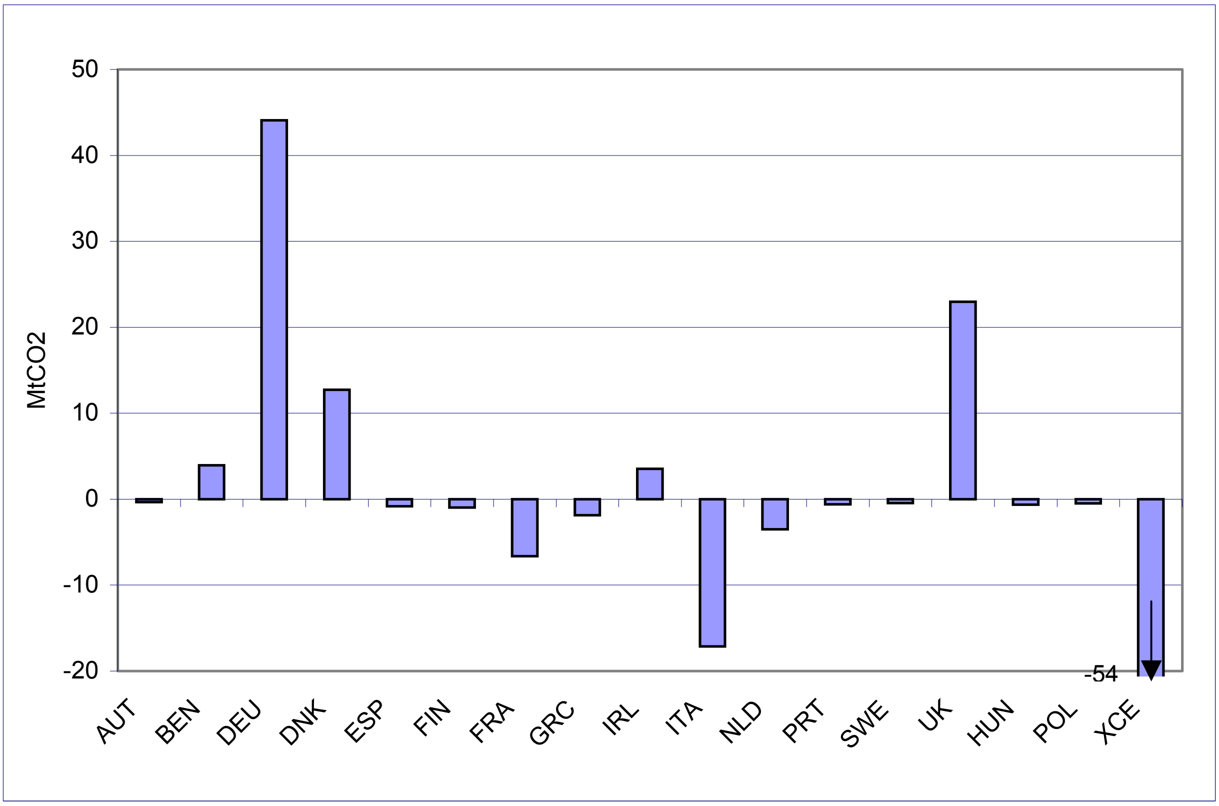
However, there is one country where the efficiency gains from the ETS outweigh the distortions from different marginal abatement costs, that is Denmark. The implicit tax in the unilateral scenario is 60 €/t CO_2 whereas the ETS has less than 10 €/t CO_2. These gains seem to outweigh the distortions between sectors. The welfare costs in the NoCDM scenario are therefore lower than in the unilateral case (see Figure 5).

Turning to the trade with emission allowances in the ETS, the picture has changed compared to the allocation rules that were proposed by the EU Commission and that have been analyzed in Klepper and Peterson (2004)[4]. While under the least-cost orientated emission targets the ETS turned out to be a rather lopsided affair in the sense that the accession countries would be

[4] Some differences also stem from the fact that in Klepper and Peterson (2004) some EU regions were aggregated. Also, in this paper the targets account for reductions in other greenhouse gases, which was not the case in Klepper and Peterson (2004).

the only exporters of allowances, Figure 6 shows that under the current NAPs seven of the EU15-countries become exporters as well.

Figure 6: Trade in Allowances (Scenario NoCDM)



While the exports of Spain, Finland, Portugal and Sweden are negligible, France, Greece, the Netherlands and especially Italy export 5 to 17 $MtCO_2$ in 2012. This is partly the case because these countries are close to meeting their Kyoto targets (France, Greece), but partly because of the generous allocation of allowances in the NAPs of Netherlands and Italy that allow emissions in the ETS sectors to rise. It is worth mentioning that the Italian NAP has not been accepted by the EU commission and is under revision. Nevertheless, the main exporters of allowances are still the Eastern European countries.

As Figure 6 shows the trade in allowances in absolute quantities, the size of a country dominates trade flows. For example, Germany's ETS sectors account for almost one quarter of the total European trading scheme. Hence, Germany is the largest importer with imports of around 45 $MtCO_2$ in 2012.

This picture changes when one looks at the import shares of allowances relative to total emissions. Countries with high marginal abatement costs like Denmark and Ireland rely strongly on imports. Relative to their emissions the largest importers are Denmark and Ireland where 60% and 23% of the emission of the ETS sectors are covered by imported allowances. The ETS sectors in Germany and the UK import allowances for around 11% of their emissions.

4.3. The Current Climate Strategy of the EU

The previous section has illustrated how the separation of the energy intensive installations in the ETS from the other sectors can lead to significant distortions, especially if the ETS sectors become endowed with a large share of CO_2-emissions allowed under the Kyoto-protocol. Some of these distortions can be alleviated through CDM and JI activities. The project-based mechanisms allow governments to relieve the pressure that is imposed on the non-ETS sectors by the generous allocation of emission allowances to the energy intensive installations. They also lower the allowance prices within the ETS since cheap CDM and JI credits can be bought from companies in the ETS as well. The amount of project credits that governments will buy is restricted by the supplementarity criterion to which all member states have subscribed. In this section the scenario LimCDM is computed. It allows installations in the ETS to buy any quantity of credits they wish while the governments buy only the amount of credits they have announced. Table A1 in the Appendix summarizes the amounts of CDM and JI credits which the different governments want to acquire.

The results of scenario LimCDM are summarized in Figure 7, which also documents as a reference the results of the scenario NoCDM without project-based mechanisms. In LimCDM the import of project credits reduces the permit prices in the ETS to 5.7 €/tCO_2. At the same time, the implicit carbon prices in the sectors outside the ETS fall because the government purchases of credits reduce the emission restriction in these sectors.

Figure 7: Implicit Carbon Prices in the non-ETS Sectors

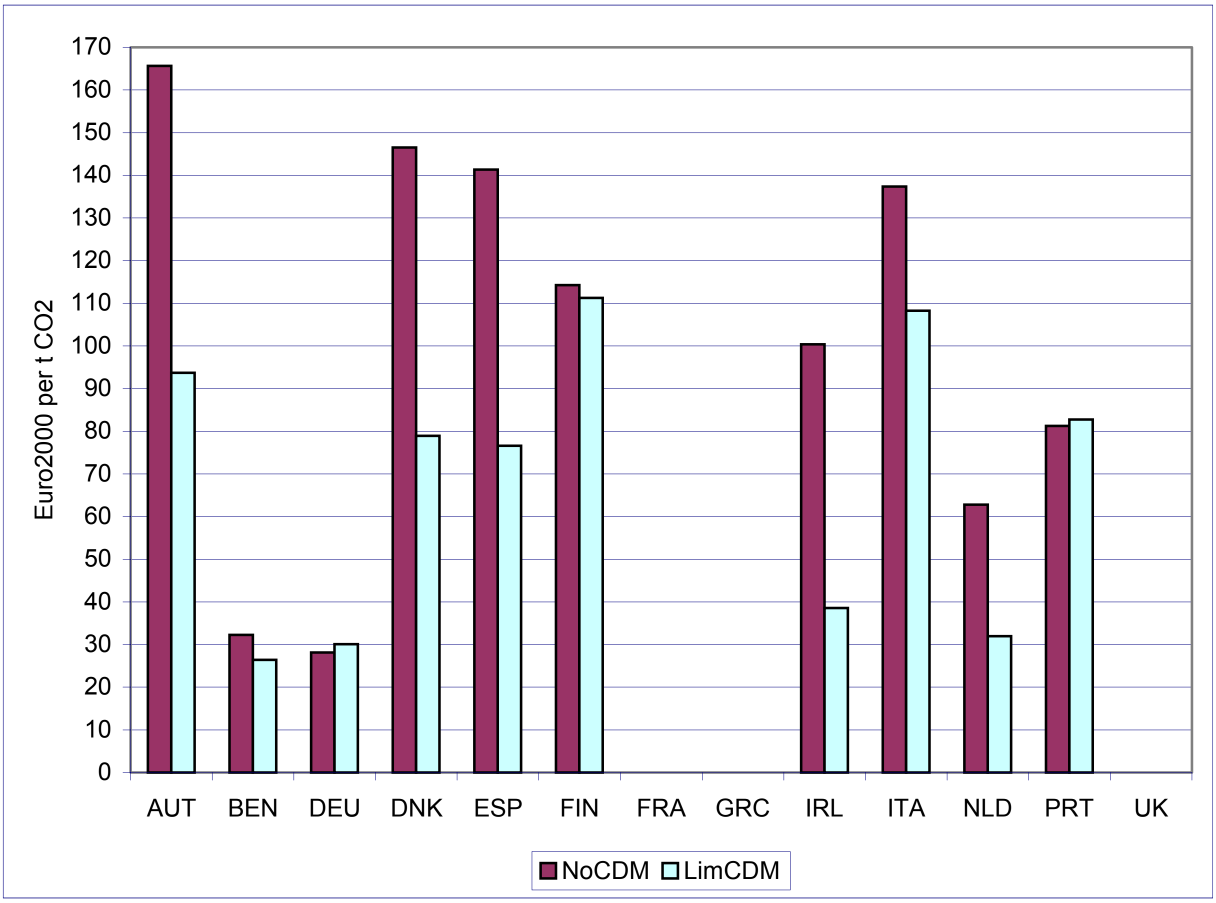


Figure 7 shows that these purchases reduce the inefficiencies imposed by the NAPs that were discussed in the last section and reduce the gap between the allowance price in the ETS and the implicit taxes in the non-ETS sectors. This is especially true for those countries that plan to make considerable use of CDM and JI credits. Austria, Denmark, Spain Ireland and the Netherlands can reduce the marginal abatement cost in the non-ETS sectors by 40 to 60% compared to the NoCDM scenario. In Italy and Belgium, the implicit taxes fall by around 20%. In Germany, Finland and Portugal, where the governments only plan minor (or even zero) purchases of CDM and JI credits, the implicit taxes are not much affected. Altogether, the limited use of the project-based mechanisms still leaves implicit taxes in the non-ETS sectors at levels between 30 and 110 €/tCO_2, compared to an allowance price that has dropped to 5.7 €/tCO_2. In addition, substantial differences in marginal abatement costs between countries remain in the non-ETS sectors.

Turning now to the likely welfare effects of the current climate strategies of the EU member states, in Figure 8 the welfare costs of the LimCDM scenario are compared to the situation without the ETS (i.e. scenario UNI) and with ETS but without CDM and JI projects (i.e. scenario NoCDM). Whereas a unilateral achievement of the Kyoto targets would lead to an average welfare loss of 0.7% in the EU15, this loss rises to 1.7% when the ETS is introduced. The addition of CDM and JI projects lowers it again to 0.9%. Hence, some but not all of the distortions of the ETS can be compensated. Those countries that plan to acquire the largest amounts of CDM and JI credits can decrease their negative welfare effects most strongly. This is most obvious in Spain and the Netherlands that both plan to acquire 20 $MtCO_2$ from CDM and JI projects p.a. As a result, the negative welfare effects are in these countries at least reduced to the level of unilateral efficient action.

Figure 8: Welfare Effects of the ETS with CDM /JI (relative to BAU in 2012)

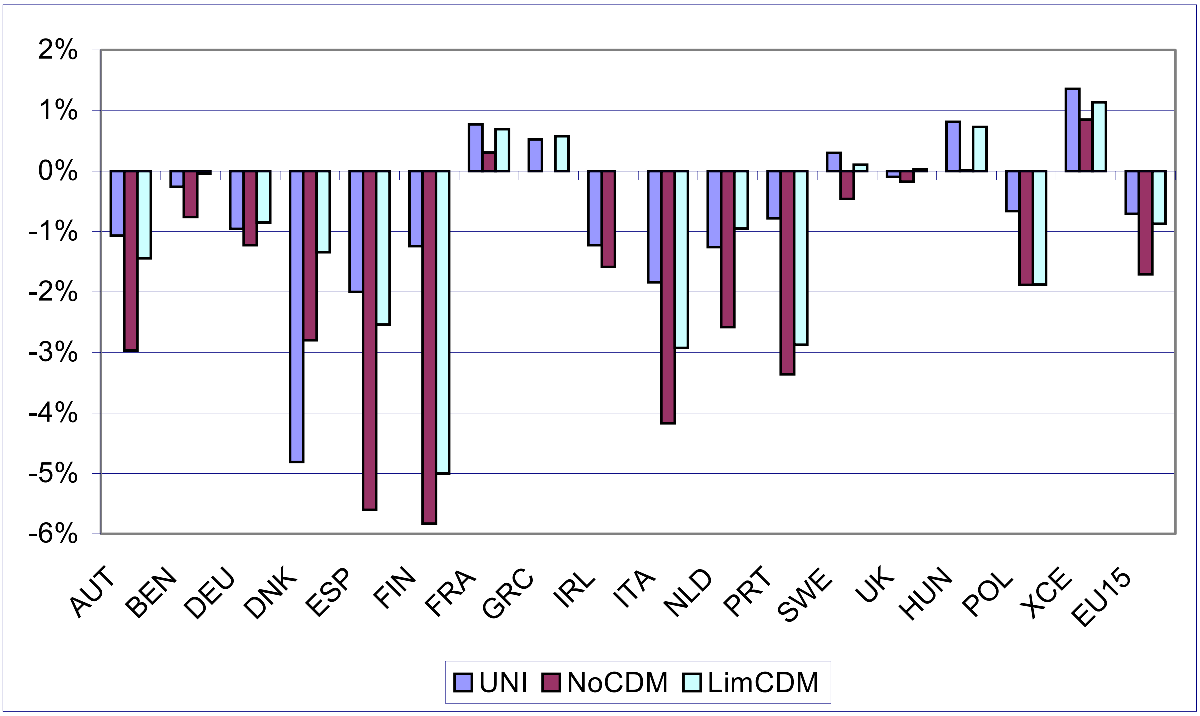
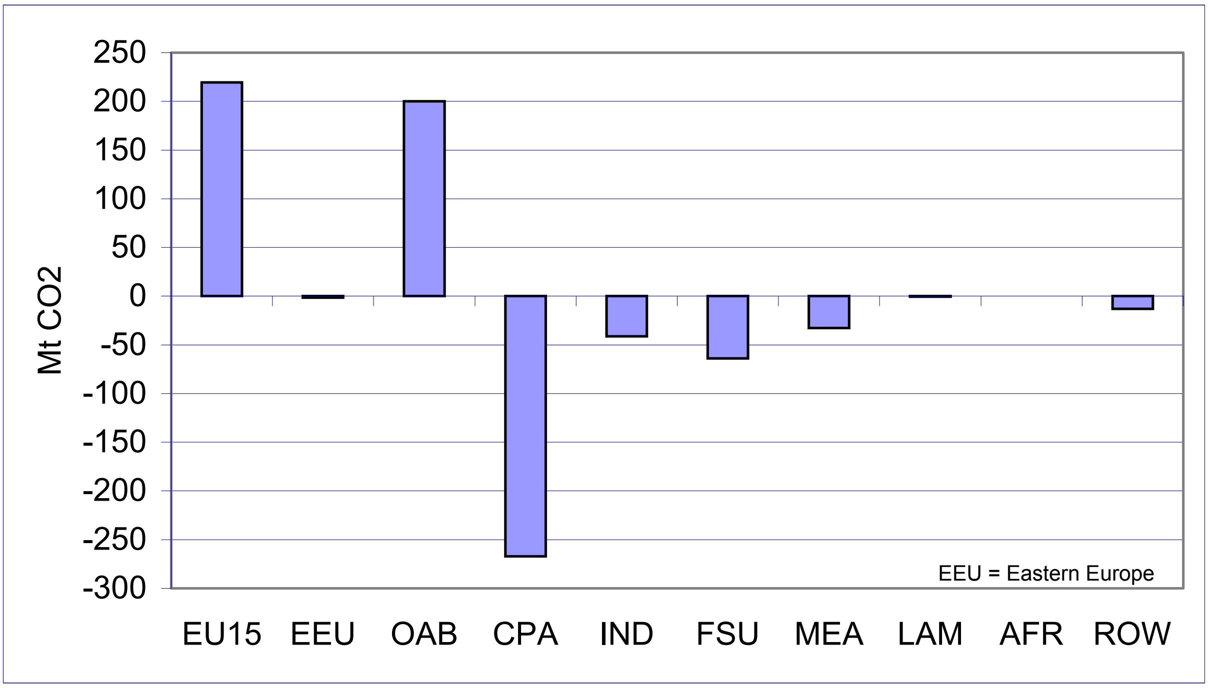


Figure 9 shows the trade flows of CDM and JI credits worldwide. For better readability, the CDM and JI purchases of the EU15 are aggregated. Altogether, the EU15-countries acquire 226 $MtCO_2$ through CDM and JI. The region OAB (other Annex B countries that ratified the Kyoto Protocol) are restricted to a maximum of purchases of another 200 $MtCO_2$. This is a little more then 50% of the reductions relative to the BAU-emission in 2012 that are necessary to reach the Kyoto target and thus an upper estimate of the supplementarity requirement.

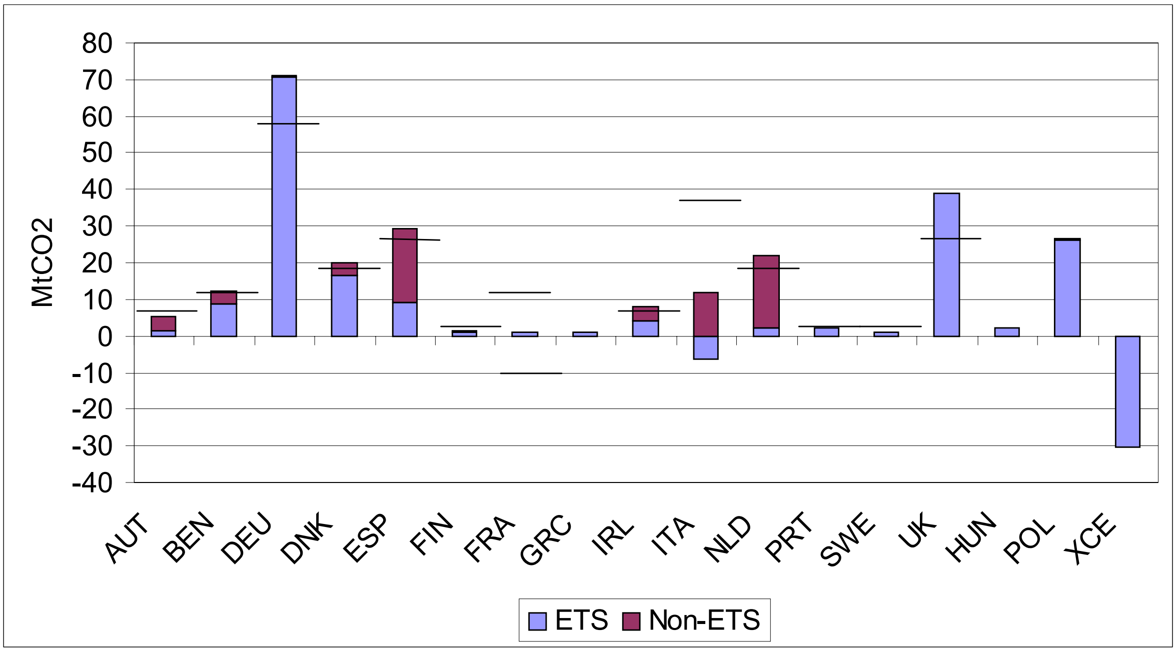
Figure 9: Sales and Purchases of CDM and JI Credits in LimCDM



Concerning the host-countries of CDM projects, about 65% of the CDM allowances are covered by emission reductions in China, followed by the FSU, India and MEA, responsible for around 8 to 15%. Altogether, the size of the CDM and JI market is within the range of estimates presented in section 2.4. However, the distribution of CDM projects across developing countries does not reflect the currently planned projects that are mainly located in Latin America, while only few projects are hosted by China and India (Lückge and Peterson 2004).

Figure 10 shows the allowance flows in the EU in more detail. Negative bars for the ETS sectors indicate that these sectors would sell allowances within the ETS. This is true only for the ETS sectors in the Rest of Eastern Europe (XCE) and Italy. Positive bars for the ETS sectors indicate that these sectors buy allowances, either within the ETS or as credits from CDM and JI projects. The sales inside the ETS are rather small (around 36 $MtCO_2$), most of the allowances (around 150 $MtCO_2$) originate from CDM and JI projects. The ranking of buyers remains quite the same as in the scenario NoCDM without CDM and JI, only that due to cheap CDM and JI credits some countries who have formerly been allowances sellers now become buyers.

Figure 10: JI, CDM and ETS Credit Flows in the EU in LimCDM



Negative bars for the non-ETS sectors stand for JI projects in Annex B countries. Only 0.3 $MtCO_2$ JI reductions would be undertaken in Eastern Europe. This is due to the cheap abatement opportunities in the developing countries and sensitive to the level of transaction cost associated with the project-based mechanisms. The positive non-ETS bars finally show the governmental purchases of CDM and JI credits as announced in the NAPs (altogether around 76 $MtCO_2$).

As discussed in section 2.4, the Kyoto Protocol requires that the use of CDM and JI shall be supplemental to domestic action. The EU has voted for a strict definition of this supplementarity criterion, and continues to stress its importance. It is thus an interesting question how the CDM and JI purchases shown in Figure 10 compare to the limits set by the supplementarity requirement. For this reason, estimates of these limits (as calculated by the EU, see section 2.4) are added as horizontal lines.

Figure 10 shows that there is little need to further restrict the CDM and JI purchases in the ETS in order to stay within the limits of the supplementarity criterion in most countries. In The Netherlands, Spain, Ireland and Denmark where the government plans to acquire the largest amount of CDM and JI credits the limits are slightly exceeded. The only countries that might have to rigorously restrict their ETS sectors in the use of CDM and JI are Germany and the UK. On the other hand, there is in some countries such as Austria, Finland and Italy the potential for larger government purchases of CDM and JI credits, which would further reduce the welfare costs of meeting the Kyoto targets. Overall, most countries come close to the supplementarity limit with the given plans to purchase CDM and JI credits and without controlling their ETS-sectors.

Altogether there are three main conclusions that can be drawn from the scenario LimCDM. First, the project-based mechanism lead to some cost savings compared to a situation without emission reductions abroad. Second, the current European climate strategy is not efficient since it leads to a large wedge between the marginal abatement cost in the ETS sectors (the allowance price) and the marginal abatement costs (the implicit tax necessary to reach the overall Kyoto targets) in the non-ETS sectors. Third, in most countries the supplementarity criterion does not allow to close this wedge by further governmental purchases of CDM and JI credits at least not without restricting the use of those credits for the ETS sectors.

4.4. Making Optimal Use of CDM and JI

In the last section, it was illustrated that even a restricted use of CDM and JI can reduce the costs of meeting the European Kyoto targets considerably. In this section we remove the restriction on the governmental use of the project based mechanisms and also ignore the supplementarity requirements to analyze the cost minimizing use of CDM and JI in the scenario denoted OPT.

In this case, the unrestricted use of CDM and JI throughout Europe leads to an equalization of the carbon prices worldwide. Thus, the wedge between the implicit tax in the non-ETS sectors and the allowance price in the EU ETS is closed. The only exceptions are those countries that do not need to reduce emissions in the non-ETS sectors, which are the UK, France, Greece, Sweden and the Eastern European countries. Here, the implicit carbon tax is zero. The international carbon price would be 6.8 €/tCO_2.[5] It turns out that the unrestricted use of the project-based mechanisms implies that the European Kyoto targets can be reached basically without any negative welfare effects. In fact, in almost all countries the welfare changes relative to o business-as-usual are close to zero. The welfare effects for the different countries are shown in Figure 13, where the welfare effects of all different scenarios are compared.

Figure 11 shows the international allowance flows under the OPT scenario. Again, the EU15 is for better readability aggregated to one region. Compared to the LimCDM scenario, the European purchases of CDM and JI credits have increased by more than 60% to 400 MtCO_2. The other Annex B countries have more than doubled their demand. Altogether, the project-based mechanisms now have a volume of around 880 MtCO_2. China remains the single largest host country of CDM and JI projects as before in the LimCDM scenario.

[5] Theoretically, the countries with a zero implicit carbon tax could supply JI credits. This possibility is excluded for The EU15 countries, since there is no empirical evidences for this to take place. In addition, the amounts supplied would be negligable. In Estern Europe, the model allows for JI (see Figure 11).

Figure 11: Sales and Purchases of CDM and JI Credits in OPT

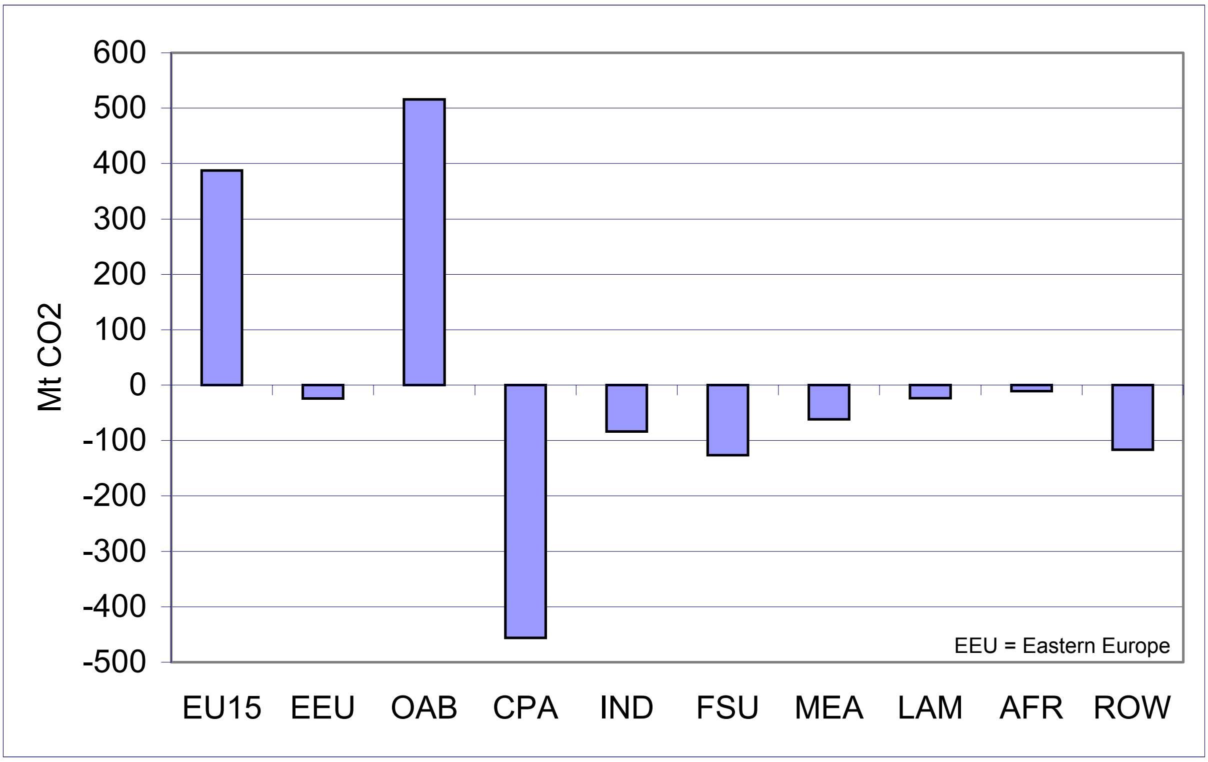
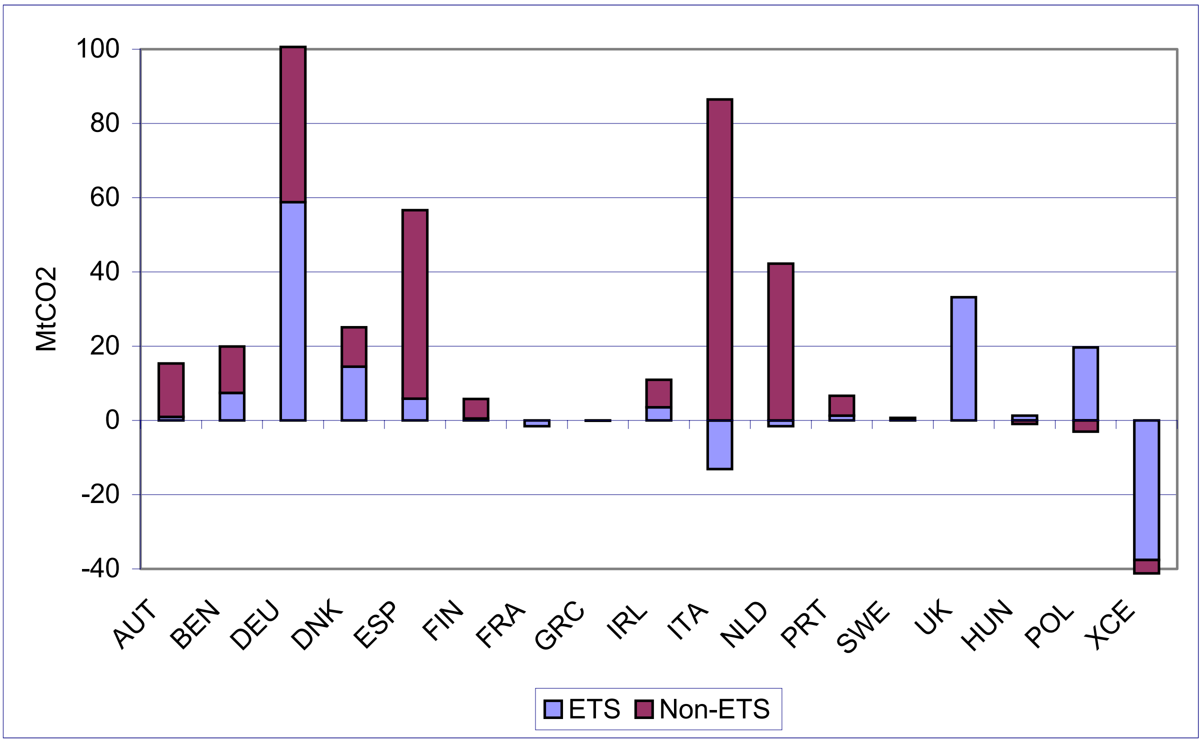


Figure 12 shows the allowance flows in the EU25. Since the higher demand for CDM and JI credits has driven up the price of CDM and JI allowances, the purchases of the ETS sectors have overall decreased by 40% compared to the LimCDM scenario. They now sum up to 94 MtCO_2. In contrast, the sales of allowances within the ETS have increased by 45% to 52 Mt$CO_{2.}$ The governmental purchases to be used in the non-ETS sectors are on average 2.5 times larger than in scenario LimCDM and reach 270 MtCO_2. The largest relative increases can be seen in Germany, followed with some distance by Finland, Italy and Ireland. The Eastern European countries now sell 7.7 MtCO_2 JI credits.

Except for France, Greece and Sweden, no country meets the supplementarity requirement in this scenario. It turns out to be optimal to buy 1.4 to 2.5 times as much CDM and JI credits than allowed by the supplementarity criterion. This implies that only minor emission reductions (2 to 5% relative to BAU in 2012) are undertaken domestically.

Figure 12: JI, CDM and ETS Credit Flows in the EU in OPT



The optimality of the NAPs is not an issue if there is an unrestricted use of CDM and JI credits. In this case, the same single international price will emerge independent of the allocation to the ETS, and from an allocational point of view, the NAPs are irrelevant. The allocation to the ETS sectors determines though, how much CDM and JI credits are bought by governments and how many enter the ETS. Thus, it is a question of how the cost of meeting the Kyoto targets are distributed between the governments and thus tax payers on one side and the industry on the other side.

Instead of searching for an optimum through unrestricted CDM and JI activities given the allocation of allowances to ETS and non-ETS sectors, one can seek the optimal allocation of allowances to the ETS sector given the supplementarity requirement. In this scenario, SUP, there is full European emissions trading in all sectors and limited purchases of CDM and JI credits to stay within the limit of the supplementarity requirement. This results in cost minimizing emissions in the non-ETS and ETS sectors, which can then be compared to the current targets. This is done in Table 3. Table 3 reports in the first three columns the composition of emissions between ETS and non-ETS sectors and the allocation of project credits to these sectors. The numbers are derived from the LimCDM scenario for 2012 that projects current policy objectives as outlined in the NAPs. Columns 4 to 6 show the same numbers for the SUP scenario where emissions can be freely traded between all sectors but the supplementarity restrictions on project credits are kept economy wide.

Table 3: Comparison of Current Policies to Optimal Policies (in percent)

	Emissions in LimCDM rel. to Kyoto target			**Optimal emissions rel. to Kyoto target**		
	(1) ETS = target +CDM/JI	**(2) Non-ETS = target + CDM/JI**	**(3) Total CDM/JI**	**(4) ETS**	**(5) Non-ETS**	**(6) CDM/JI**
AUT	58.1= 55.1 + 3.0	53.0= 44.9 + 8.1	11.1	48.8	69.0	17.8
BEN	36.1= 29.8 + 6.2	73.2= 70.2 + 3.0	9.2	32.0	76.6	8.5
DEU	53.1= 44.5 + 8.6	55.6= 55.5 + 0.1	8.7	47.9	59.3	7.1
DNK	90.6= 50.9+ 39.7	57.7= 49.1+ 8.6	48.3	71.1	71.8	42.9
ESP	56.7= 52.7 + 4.0	55.9= 47.3 + 8.6	12.6	46.0	65.6	11.6
FIN	67.8= 65.7 + 2.1	34.8= 34.3 + 0.5	2.6	61.3	43.3	4.6
FRA	22.8= 22.5 + 0.2	77.5 = 77.5 + 0.0	0.2	24.4	75.6	0.0
GRC	52.3= 51.4 + 0.9	48.6 = 48.6 + 0.0	0.9	54.9	45.1	0.0
IRL	62.5= 49.0+13.9	62.9= 51.0+ 11.9	25.4	49.2	66.2	15.4
ITA	52.5= 54.3 - 1.7	48.4= 45.7 + 2.7	1.0	44.4	65.2	9.6
NLD	42.6= 41.7+ 0.9	66.8 = 58.3 + 8.5	9.4	35.6	71.7	7.3
PRT	56.2= 52.2 + 4.0	47.8= 47.8 + 0.0	4.0	49.1	55.8	4.9
SWE	30.2= 28.5 + 1.8	71.5= 71.5 + 0.0	1.8	34.6	63.0	0.0
UK	41.8= 34.5 + 6.3	65.5= 65.5 + 0.0	6.3	41.4	59.8	1.2

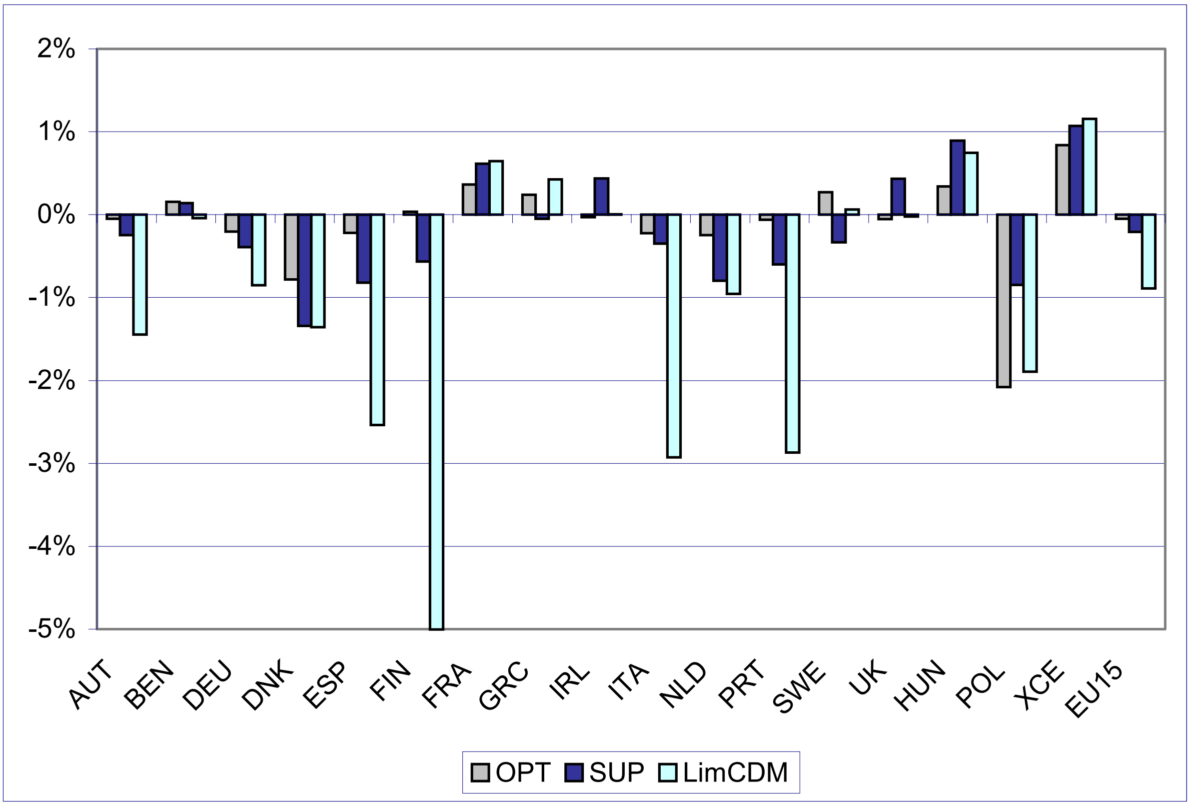
(1)+(2)-(3) = 100%.
(4)+(5)-(6) = 100% (Sweden overcomplies with Kyoto).
For Sweden, UK and France the suppl. criterion is non-binding.

A comparison of columns 1 and 4 reveals that most countries have endowed the ETS sectors too generously with emission permits. In addition, according to the announced government purchases for CDM and JI credits to many project credits go into the ETS sectors. Only France, Greece, Sweden, and the UK did not oversupply their ETS sectors. An extreme case is Denmark where because of a relatively small endowment with allowances the ETS sectors would buy large amounts of project credits. The maximum share of CDM and JI credits under the supplementarity restriction is shown in column 6. Compared to the expected purchases of credits (column 3) Denmark, Ireland, and the UK would have difficulties to meet these targets because of large purchases of ETS installations. Countries like Austria and Italy that have given generous endowments of allowances to the ETS sectors will stay well under the supplementarity limit because of little demand from these sectors.

Figure 13 finally shows the welfare implications of the optimal strategy under supplementarity (SUP) compared to the current situation (LimCDM). It includes also the welfare effects of an unrestricted use of CDM and JI (OPT).

The optimal allocation of allowances and CDM/JI purchases in the SUP scenario leads only to minor welfare effects relative to a BAU scenario (-0.2% in the EU15) and comes very close to the minimal welfare losses under a scenario without any restrictions on the CDM/JI purchases. Thus, even though the supplementarity requirement slightly increases the welfare costs associated with meeting the European Kyoto targets, it is more important to get an optimal allocation of reduction targets between ETS and non-ETS sectors that can avoid the large welfare losses associated with the current allocation.

Figure 13: Welfare Effects of the Scenarios LimCDM, OPT, and SUP (Relative to BAU)

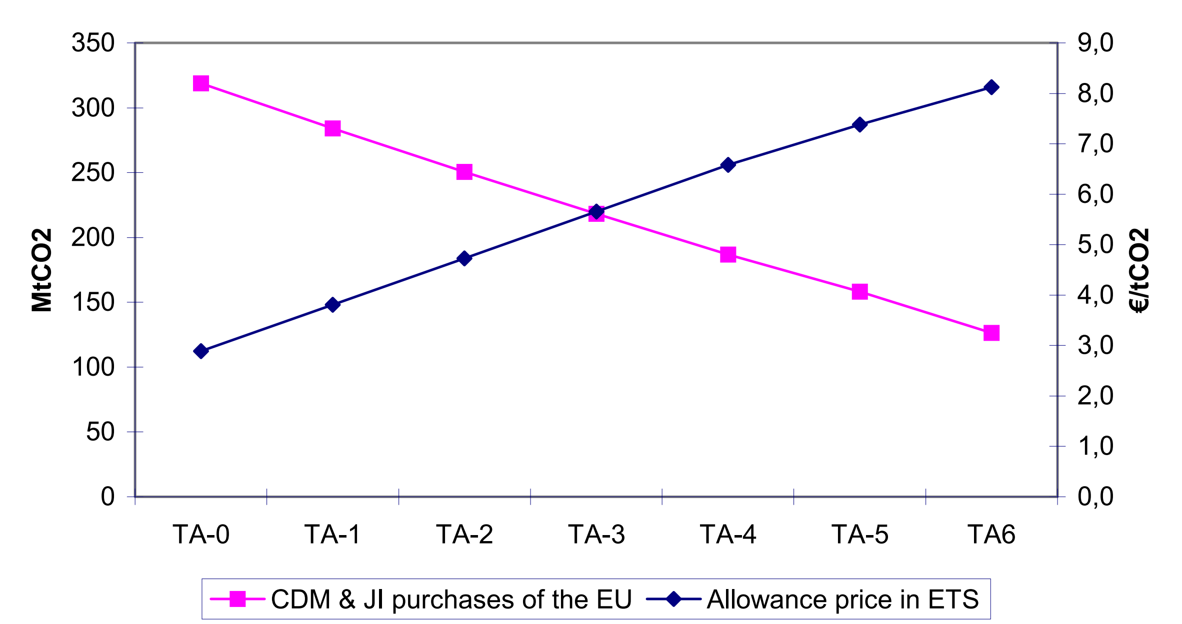


4.5. Sensitivity Analysis with Respect to Transaction Costs of CDM and JI

One critical assumption in this study is the level of transaction costs associated with CDM and JI projects. It was assumed that the level is 3€/tCO_2. For a sensitivity analysis the LimCDM scenario has been run with different levels of transaction cost ranging from 0 to 6€/tCO_2.

Since different transaction costs primarily show up in the international allowance markets, Figure 14 shows the CDM and JI purchases of the EU as well as the allowance price in the ETS. The CDM and JI purchases are shown on the left axis. They fall linearly with rising transaction costs. The allowance price in the ETS is shown on the right axis. It rises almost linearly with rising transaction cost.

Figure14: EU Purchases of CDM and JI Credits and ETS Allowance Prices under Different Transaction Costs



The amount of CDM and JI purchases decreases by 60% when the transaction costs are raised from zero to 6 €/tCO_2. The allowance prices increase by only 5.2 €/tCO_2 even though the transaction cost rise by 6.0 €, since the reduced CDM and JI demand offsets some of the increase.

5. Summary and Conclusions

In this paper, we have analyzed the effects of the current National Allocation Plans (NAPs) for the European emissions trading scheme (ETS) by focusing on the allocation effects of meeting the European Kyoto targets in 2012. Special attention is given to the role of CDM and JI projects within the national climate strategies.

The current NAPs generously endow the ETS sectors with emission rights and thus require large emission reductions outside the ETS sectors – either domestically in the non-ETS sectors or abroad making use of CDM and JI credits. In the first simulation without the use of CDM and JI credits it becomes apparent that the NAPs drive a large wedge between the allowance price in the ETS and the implicit tax necessary for reaching the Kyoto targets in the non-ETS sectors. This inefficiency is important enough to make the welfare costs of meeting the Kyoto targets even larger than under an efficient unilateral action. All gains through international emissions trading are netted out by the distortions created between the ETS and the non-ETS sectors within each economy.

Making use of the option to buy CDM and JI credits, both by ETS sectors and by governments indeed reduces the cost of meeting the European Kyoto targets. We have analyzed a scenario where the use of CDM and JI credits is unrestricted for the ETS sectors, but were the government purchases are restricted to the official plans. In this scenario, there still remains in most countries a large difference between the allowance price in the ETS of 5.7 €/tCO_2 and the implicit tax necessary to achieve the necessary reductions in the non-ETS sectors of 30 to 110 €/tCO_2.

Thus, while the use of CDM and JI drives down the allowance price in the ETS by one third and reduces the wedge between implicit tax outside the ETS and the allowance price, and thus reduces the costs of meeting the European Kyoto targets compared to a situation without the project-based mechanism, the distortions created by the uneven NAPs can not be eliminated. The welfare cost of the current emission targets and policies is larger than under a situation of unilaterally efficient action.

The supplementarity requirement of the Kyoto Protocol to achieve major parts of the emission reductions domestically, negatively affects the cost of reaching the Kyoto targets. Whereas the current policies will have a welfare loss of close to 1% in 2012 relative to “business-as-usual” policy an unrestricted trading in project credits and allowances would result in an allocation where the Kyoto targets can be met with hardly any welfare costs. Altogether, given the current NAPs, the European ETS sectors buy around 150 MtCO_2 of CDM and JI credits and the governments add another 75 MtCO_2. On the other side, only minor amounts of allowances (36 MtCO_2) are traded within the ETS. The only sellers of allowances are in this case some Eastern European countries and Italy.

The best strategy to reduce the costs of the current European climate strategies is to reduce the burden for the non-ETS sectors. This can be achieved by setting stricter targets for the ETS installations and by restricting the use of CDM and JI for the ETS installations. The first measure directly reduces the necessary emission reductions outside the ETS and can be implemented by setting stricter targets in the NAPs for the second trading period from 2008-2012. The second measure allows governments to reduce the burden of the non-ETS sectors by purchasing larger amounts of CDM and JI credits while staying within the limits of the supplementarity criterion. For this reason, the provision for restrictions is already made in the EU linking directive that governs the use of CDM and JI credits within the ETS. The simulations showed that a more efficient climate strategy – even given the supplementarity requirement – can achieve the European Kyoto targets at low costs. Compared to a "business-as-usual" scenario the welfare in the EU15 is only reduced by 0.2% compared to 0.9% under the current plans. Finally, even under an optimal allocation of allowances there are distributional issues that need to be resolved. Basically, the decision of who is allowed to use the restricted amount of CDM and JI credits determines how the costs of meeting the Kyoto targets are distributed between the governments and thus tax payers on one side and industry on the other side.

6. References

Ellis, J., J. Corfee-Morlot, H. Winkler (2004). Taking Stock Of Progress Under The Clean Development Mechanism (CDM). OECD COM/ENV/EPC/IEA/SLT/-(2004)4/FINAL.

Energy Information Agency (EIA) (2002). International Energy Outlook 2002.

Haites, E., S. Seres (2004). Estimating the Market Potential for the Clean Development Mechanism: Review of Models and Lessons Learned. PCFplus Report 19.

Klepper, G., S. Peterson (2004). The EU Emissions Trading Scheme – Allowance Prices, Trade Flows and Competitiveness Effects. European Environment 14:201-218.

Klepper, G., S. Peterson (2003). Trading Hot-Air – The Influence of Permit Allocation Rules, Market Power and the US Withdrawal from the Kyoto Protocol. Kiel Working Papers 1133. Kiel Institute for World Economics. Kiel.

Klepper, G., S. Peterson, K. Springer (2003). DART97: A Description of the Multi-regional, Multi-sectoral Trade Model for the Analysis of Climate Policies. Kiel Working Papers 1149. Kiel Institute for World Economics. Kiel.

Langrock, T., W. Sterk (2004). The Supplementarity Challenge: CDM, JI & EU Emissions Trading. Policy Paper 1/2004. Wuppertal Institute for Climate, Environment and Energy.

Lecocq, F. (2004). State and Trends of the Carbon Market 2004.

Lückge, H., S. Peterson (2004). The Use of CDM and JI for Fulfilling the European Kyoto Commitments. Kiel Working Paper 1232, Kiel Institute for World Economics. Kiel.

Michaelowa, A., M. Stronzik; F. Eckermann, A. Hunt (2003). Transaction Costs of the Kyoto Mechanisms. Climate Policy (3): 261-278.

Natsource (2003). Governments as Participants in International Markets for Greenhouse Gas Commodities, draft. Washington D.C. September.

Svendsen, G.T., M. Vesterdal (2003). Potential gains from CO_2 trading in the EU. European Environment (13):303-313.

Springer, K. (2002). Climate Policy in a Globalizing World: A CGE Model with Capital Mobility and Trade. Kieler Studien. Springer, Berlin.

7. Appendix

7.1. Assumptions to Implement the Kyoto and the EU-ETS Targets

- Since DART only includes CO_2-emissions, we used official emission data from the EIA and IEA to calculate the Kyoto target as the CO_2 target that has to be achieved after planned reductions (see below) in non-CO_2 GHG are taken into account. The resulting CO_2 target is calculated relative to 2002 CO_2-emissions and also implemented in DART relative to 2002 emissions.
- Reductions in non-CO_2 GHG were taken from NAP were available (Germany -6.9%, UK -40.9%, Netherlands -26.5%, Denmark -6.1%, Finland -10% relative to 2002 levels). In the remaining EU15-countries as well as in Hungary and Poland and OAB a 10% reduction relative to 2002 was assumed, which is the median of the available plans.
- The allocation of permits to the ETS sectors and the reported historical ETS-emissions were used to derive for each country the ETS targets for 2005-2007 resp. 2012 relative to ETS-emissions in 2002. These targets relative to 2002 ETS-emission were implemented in DART, since there is not always a perfect match between the DART ETS-emissions and those reported in the NAPs.
- For the region XCE that does not match the former accession countries without Poland and Hungry exactly, it was assumed that emissions in the ETS follow the BAU path.
- Where available we used targets for 2012 (DEU, DNK, GBR, IRL, NLD). In the remaining regions, we assume a reduction of 3% relative to the 2007 target, which is the median reduction of those plans having a 2012 target.
- Data on plans for CDM and JI are taken from Lückge and Peterson (2004).

7.2. Scenarios that were Run with the DART Model

Except for the BAU scenario, emission reductions resp. emissions trading always starts in 2005. The model is run until the year 2012, the end of the first commitment period.

BAU

- business-as-usual

NoCDM

- European ETS with targets as indicated above
- Uniform, regionally differentiated CO_2-taxes in non-ETS sectors in EU25 to reach individual Kyoto targets
- No use of CDM and JI
- BAU in all other regions except the EU25.

LimCDM

- Same as NoCDM but use of CDM and JI: full use in ETS and governmental use as indicated in NAPs
- For the region OAB the use of CDM and JI is limited to 200 $MtCO_2$ p.a.
- For CDM and JI credits transaction cost of 3 €/tCO_2 are assumed.

OPT

- Same as LimCDM but unrestricted use of CDM and JI both in the ETS and on governmental level in the EU25 and the other Annex B regions.

SUP

- Inclusion of all sectors in the European ETS .
- The use of CDM and JI is restricted to the supplementarity requirement
- For CDM and JI credits transaction cost of 3 €/tCO_2 are assumed.

Sensitivity Analysis

- Scenario LimCDM with transaction cost of 0 and 6 €/tCO_2.

Table A1: Emissions and Emission Targets in the EU15

Country	Emissions 2002 in $MtCO_2e$			Emissions in ETS in $MtCO_2$		Allocation to ETS sectors		CDM/JI in 2008-12; $MtCO_2e$ p.a.	
	CO_2	All GHG	Kyoto target	Information available	2002 (est)	2005–2007	2012	Government plans[d]	Max for supplementarity
Austria	70,5	85.0	67.9	31.7 in 2001	32.1[a]	32.7 p.a.	?	4	8.8
Belgium	146,3	150.0	134.3	70.22 in 2007	67.6[b]	64.4; 63.1; 62.55	?	3.56	11.8
Denmark	54.9	68.0	54.5	30.9 in 2002	30.9	33.5 p.a.	24.7	3.6	17.9
Finland	54.3	82.0	77.0	40.9 in 2002	40.9	44.9; 45.2; 64.6	?	0.24	2.4
France	407.3	554.0	565.0	156.96 in 2001	150.2[a]	155 p.a.	?	?	11.8
Germany	838.3	1116.0	986.7	506.5 in 2002	506.5	503 p.a.	495	0.52	58.6
Greece	104.4	135.0	131.3	70.2 in 2002	70.2	74.4 p.a.	?	?	-
Hungary	56.1	86.0	95.5	29.4 in 2002	29.4	29.9 p.a.	?	0.0	-
Ireland	49.1	69.0	59.9	32% of total GHG	22.1[c]	22.3 p. a.	20.9	3.7	4.8
Italy	448.7	554.0	470.6	51% of total GHG	256.5[c]	240.0; 240.6; 241.6	?	10.0	35.3
Luxemburg	10.3	11.0	9.4	2.5 in 2001	2.7[a]	3.52 p.a.	?	0.6	0.3
Netherlands	256.2	241.0	199.0	84.5 in 2000	86.8[a]	98.3 p.a.	95	20.0	17.2
Poland	268.4	358.5	530.6	264.2 in 2001	257.2[a]	286.2 p.a.	?	0.00	-
Portugal	67.0	82.0	73.7	36.5 in 2002	36.5	38.9 p.a.	?	0.01	2.9
Spain	341.5	400.0	327.75	164.3 in 2002	164.3	160.28 p.a.	?	20.0	26.9
Sweden	54.9	70.0	74.88	20.2 in 2002	20.2	22.9 p.a.	?	1.0	1.5
UK	552.8	635.0	653.0	252.8 in 2002	252.8	152.03 p.a.	145.3	0.0	27.6

[a] Assuming same CO_2-emission growth in ETS sectors than in whole economy
[b] Assuming CO_2-emissions growth in ETS sectors from 2002-07 is the same as CO_2-emission growth in whole economy from 1997-2002.
[c] Assuming that this share holds for 2002.
[d] See Lückge and Peterson (2004).

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:
http://www.feem.it/Feem/Pub/Publications/WPapers/default.html
http://www.ssrn.com/link/feem.html
http://www.repec.org

NOTE DI LAVORO PUBLISHED IN 2004

IEM	1.2004	*Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB*: Empirical Analysis of National Income and So2 Emissions in Selected European Countries
ETA	2.2004	*Masahisa FUJITA and Shlomo WEBER:* Strategic Immigration Policies and Welfare in Heterogeneous Countries
PRA	3.2004	*Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI:* Do Privatizations Boost Household Shareholding? Evidence from Italy
ETA	4.2004	*Victor GINSBURGH and Shlomo WEBER:* Languages Disenfranchisement in the European Union
ETA	5.2004	*Romano PIRAS:* Growth, Congestion of Public Goods, and Second-Best Optimal Policy
CCMP	6.2004	*Herman R.J. VOLLEBERGH:* Lessons from the Polder: Is Dutch CO2-Taxation Optimal
PRA	7.2004	*Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN* (lxv): Merger Mechanisms
PRA	8.2004	*Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER* (lxv): IPO Pricing with Bookbuilding, and a When-Issued Market
PRA	9.2004	*Pegaret PICHLER and Alex STOMPER* (lxv): Primary Market Design: Direct Mechanisms and Markets
PRA	10.2004	*Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER* (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions
PRA	11.2004	*Bjarne BRENDSTRUP and Harry J. PAARSCH* (lxv): Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders
PRA	12.2004	*Ohad KADAN* (lxv): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values
PRA	13.2004	*Maarten C.W. JANSSEN* (lxv): Auctions as Coordination Devices
PRA	14.2004	*Gadi FIBICH, Arieh GAVIOUS and Aner SELA* (lxv): All-Pay Auctions with Weakly Risk-Averse Buyers
PRA	15.2004	*Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER* (lxv): Competition and Cooperation in Divisible Good Auctions: An Experimental Examination
PRA	16.2004	*Marta STRYSZOWSKA* (lxv): Late and Multiple Bidding in Competing Second Price Internet Auctions
CCMP	17.2004	*Slim Ben YOUSSEF:* R&D in Cleaner Technology and International Trade
NRM	18.2004	*Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU* (lxvi): Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics
SIEV	19.2004	*Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA:* Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice
NRM	20.2004	*Guido CANDELA and Roberto CELLINI* (lxvii): Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly
NRM	21.2004	*Jacqueline M. HAMILTON* (lxvii): Climate and the Destination Choice of German Tourists
NRM	22.2004	*Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ* (lxvii): Land, Environmental Externalities and Tourism Development
NRM	23.2004	*Pius ODUNGA and Henk FOLMER* (lxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya
NRM	24.2004	*Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO* (lxvii):Tourism, Trade and Domestic Welfare
NRM	25.2004	*Riaz SHAREEF* (lxvii): Country Risk Ratings of Small Island Tourism Economies
NRM	26.2004	*Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA* (lxvii): Tourism and Economic Growth in Latin American Countries: A Panel Data Approach
NRM	27.2004	*Raúl Hernández MARTÍN* (lxvii): Impact of Tourism Consumption on GDP. The Role of Imports
CSRM	28.2004	*Nicoletta FERRO:* Cross-Country Ethical Dilemmas in Business: A Descriptive Framework
NRM	29.2004	*Marian WEBER* (lxvi): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest
NRM	30.2004	*Trond BJORNDAL, Phoebe KOUNDOURI and Sean PASCOE* (lxvi): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting
CCMP	31.2004	*Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy
CCMP	32.2004	*Marzio GALEOTTI, Alessandra GORIA ,Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy
CTN	33.2004	*Wilson PEREZ:* Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution
KTHC	34.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI* (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities
KTHC	35.2004	*Linda CHAIB* (lxviii): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison

KTHC	36.2004	*Franca ECKERT COEN and Claudio ROSSI* (lxviii): Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context
KTHC	37.2004	*Kristine CRANE* (lxviii): Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari
KTHC	38.2004	*Kiflemariam HAMDE* (lxviii): Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm
ETA	39.2004	*Alberto CAVALIERE:* Price Competition with Information Disparities in a Vertically Differentiated Duopoly
PRA	40.2004	*Andrea BIGANO and Stef PROOST:* The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?
CCMP	41.2004	*Micheal FINUS* (lxix): International Cooperation to Resolve International Pollution Problems
KTHC	42.2004	*Francesco CRESPI:* Notes on the Determinants of Innovation: A Multi-Perspective Analysis
CTN	43.2004	*Sergio CURRARINI and Marco MARINI:* Coalition Formation in Games without Synergies
CTN	44.2004	*Marc ESCRIHUELA-VILLAR:* Cartel Sustainability and Cartel Stability
NRM	45.2004	*Sebastian BERVOETS and Nicolas GRAVEL* (lxvi): Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach
NRM	46.2004	*Signe ANTHON and Bo JELLESMARK THORSEN* (lxvi): Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits
NRM	47.2004	*John MBURU* (lxvi)*:* Wildlife Conservation and Management in Kenya: Towards a Co-management Approach
NRM	48.2004	*Ekin BIROL, Ágnes GYOVAI and Melinda SMALE* (lxvi)*:* Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy
CCMP	49.2004	*Gernot KLEPPER and Sonja PETERSON:* The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects
GG	50.2004	*Scott BARRETT and Michael HOEL:* Optimal Disease Eradication
CTN	51.2004	*Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG:* Simple Priorities and Core Stability in Hedonic Games
SIEV	52.2004	*Francesco RICCI*: Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory
SIEV	53.2004	*Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON:* Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?
NRM	54.2004	*Ingo BRÄUER and Rainer MARGGRAF* (lxvi): Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams
NRM	55.2004	*Timo GOESCHL and Tun LIN* (lxvi): Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices
NRM	56.2004	*Tom DEDEURWAERDERE* (lxvi): Bioprospection: From the Economics of Contracts to Reflexive Governance
CCMP	57.2004	*Katrin REHDANZ and David MADDISON:* The Amenity Value of Climate to German Households
CCMP	58.2004	*Koen SMEKENS and Bob VAN DER ZWAAN:* Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios
NRM	59.2004	*Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA* (lxvii): Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management
NRM	60.2004	*Timo GOESCHL and Danilo CAMARGO IGLIORI* (lxvi):Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon
CCMP	61.2004	*Barbara BUCHNER and Carlo CARRARO*: Economic and Environmental Effectiveness of a Technology-based Climate Protocol
NRM	62.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Resource-Abundance and Economic Growth in the U.S.
NRM	63.2004	*Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ* (lxvi): Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis
NRM	64.2004	*E.C.M. RUIJGROK and E.E.M. NILLESEN* (lxvi): The Socio-Economic Value of Natural Riverbanks in the Netherlands
NRM	65.2004	*E.C.M. RUIJGROK* (lxvi): Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method
ETA	66.2004	*Giannis VARDAS and Anastasios XEPAPADEAS*: Uncertainty Aversion, Robust Control and Asset Holdings
GG	67.2004	*Anastasios XEPAPADEAS and Constadina PASSA*: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach
GG	68.2004	*Michael FINUS*: Modesty Pays: Sometimes!
NRM	69.2004	*Trond BJØRNDAL and Ana BRASÃO*: The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications
CTN	70.2004	*Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT*: On Coalition Formation with Heterogeneous Agents
IEM	71.2004	*Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA*: Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants
IEM	72.2004	*Alessandro LANZA, Matteo MANERA and Michael MCALEER*: Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns
SIEV	73.2004	*Margarita GENIUS and Elisabetta STRAZZERA*: The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests

CCMP	74.2004	*Rob DELLINK and Ekko van IERLAND*: Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment
ETA	75.2004	*Rosella LEVAGGI and Michele MORETTO*: Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach
CTN	76.2004	*Salvador BARBERÀ and Matthew O. JACKSON* (lxx): On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union
CTN	77.2004	*Àlex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERÀ and Fernando VEGA-REDONDO* (lxx): Optimal Information Transmission in Organizations: Search and Congestion
CTN	78.2004	*Francis BLOCH and Armando GOMES* (lxx): Contracting with Externalities and Outside Options
CTN	79.2004	*Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE* (lxx): Merger Performance under Uncertain Efficiency Gains
CTN	80.2004	*Francis BLOCH and Matthew O. JACKSON* (lxx): The Formation of Networks with Transfers among Players
CTN	81.2004	*Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO* (lxx): Bicameralism and Government Formation
CTN	82.2004	*Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT* (lxx): Potential Maximization and Coalition Government Formation
CTN	83.2004	*Kfir ELIAZ, Debraj RAY and Ronny RAZIN* (lxx): Group Decision-Making in the Shadow of Disagreement
CTN	84.2004	*Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ* (lxx): Economics: An Emerging Small World?
CTN	85.2004	*Edward CARTWRIGHT* (lxx): Learning to Play Approximate Nash Equilibria in Games with Many Players
IEM	86.2004	*Finn R. FØRSUND and Michael HOEL*: Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power
KTHC	87.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Investment and Long-Term Income
CCMP	88.2004	*Marzio GALEOTTI and Claudia KEMFERT*: Interactions between Climate and Trade Policies: A Survey
IEM	89.2004	*A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE*: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?
GG	90.2004	*Rolf GOLOMBEK and Michael HOEL* : Climate Agreements and Technology Policy
PRA	91.2004	*Sergei IZMALKOV* (lxv): Multi-Unit Open Ascending Price Efficient Auction
KTHC	92.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI*: Cities and Cultures
KTHC	93.2004	*Massimo DEL GATTO*: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution
CCMP	94.2004	*Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON*: Equilibrium with a Market of Permits
CCMP	95.2004	*Bob van der ZWAAN and Reyer GERLAGH*: Climate Uncertainty and the Necessity to Transform Global Energy Supply
CCMP	96.2004	*Francesco BOSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL*: Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise
CTN	97.2004	*Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA*: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form
CTN	98.2004	*Siddhartha BANDYOPADHYAY and Mandar OAK*: Party Formation and Coalitional Bargaining in a Model of Proportional Representation
GG	99.2004	*Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA*: The Impact of Surplus Sharing on the Stability of International Climate Agreements
SIEV	100.2004	*Chiara M. TRAVISI and Peter NIJKAMP*: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents
SIEV	101.2004	*Chiara M. TRAVISI, Raymond J. G. M. FLORAX and Peter NIJKAMP*: A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure
NRM	102.2004	*Valentina BOSETTI and David TOMBERLIN:* Real Options Analysis of Fishing Fleet Dynamics: A Test
CCMP	103.2004	*Alessandra GORIA e Gretel GAMBARELLI:* Economic Evaluation of Climate Change Impacts and Adaptability in Italy
PRA	104.2004	*Massimo FLORIO and Mara GRASSENI*: The Missing Shock: The Macroeconomic Impact of British Privatisation
PRA	105.2004	*John BENNETT, Saul ESTRIN, James MAW and Giovanni URGA*: Privatisation Methods and Economic Growth in Transition Economies
PRA	106.2004	*Kira BÖRNER*: The Political Economy of Privatization: Why Do Governments Want Reforms?
PRA	107.2004	*Pehr-Johan NORBÄCK and Lars PERSSON*: Privatization and Restructuring in Concentrated Markets
SIEV	108.2004	*Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI*: Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective
CTN	109.2004	*Somdeb LAHIRI*: The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results
NRM	110.2004	*Giuseppe DI VITA*: Natural Resources Dynamics: Another Look
SIEV	111.2004	*Anna ALBERINI, Alistair HUNT and Anil MARKANDYA*: Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study
KTHC	112.2004	*Valeria PAPPONETTI and Dino PINELLI*: Scientific Advice to Public Policy-Making
SIEV	113.2004	*Paulo A.L.D. NUNES and Laura ONOFRI*: The Economics of Warm Glow: A Note on Consumer's Behavior and Public Policy Implications
IEM	114.2004	*Patrick CAYRADE*: Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?
IEM	115.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Oil Security. Short- and Long-Term Policies

IEM	116.2004	*Valeria COSTANTINI and Francesco GRACCEVA:* Social Costs of Energy Disruptions
IEM	117.2004	*Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI*: Market-Based Options for Security of Energy Supply
IEM	118.2004	*David FISK*: Transport Energy Security. The Unseen Risk?
IEM	119.2004	*Giacomo LUCIANI*: Security of Supply for Natural Gas Markets. What is it and What is it not?
IEM	120.2004	*L.J. de VRIES and R.A. HAKVOORT*: The Question of Generation Adequacy in Liberalised Electricity Markets
KTHC	121.2004	*Alberto PETRUCCI*: Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy
NRM	122.2004	*Carlo GIUPPONI, Jaroslaw MYSIAK and Anita FASSIO*: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application
NRM	123.2004	*Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO*: Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach
ETA	124.2004	*Paul MENSINK*: Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited
NRM	125.2004	*Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI*: Integrated Environmental Study for Beach Management:A Methodological Approach
PRA	126.2004	*Irena GROSFELD and Iraj HASHI*: The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic
CCMP	127.2004	*Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL*: A General Equilibrium Analysis of Climate Change Impacts on Tourism
CCMP	128.2004	*Reyer GERLAGH*: A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings
NRM	129.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Innovation, and Growth
PRA	130.2004	*Bernardo BORTOLOTTI and Mara FACCIO*: Reluctant Privatization
SIEV	131.2004	*Riccardo SCARPA and Mara THIENE*: Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation
SIEV	132.2004	*Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT*: Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models
IEM	133.2004	*Santiago J. RUBIO*: On Capturing Oil Rents with a National Excise Tax Revisited
ETA	134.2004	*Ascensión ANDINA DÍAZ*: Political Competition when Media Create Candidates' Charisma
SIEV	135.2004	*Anna ALBERINI*: Robustness of VSL Values from Contingent Valuation Surveys
CCMP	136.2004	*Gernot KLEPPER and Sonja PETERSON*: Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices
ETA	137.2004	*Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK*: Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game
CCMP	138.2004	*ZhongXiang ZHANG*: The World Bank's Prototype Carbon Fund and China
CCMP	139.2004	*Reyer GERLAGH and Marjan W. HOFKES*: Time Profile of Climate Change Stabilization Policy
NRM	140.2004	*Chiara D'ALPAOS and Michele MORETTO*: The Value of Flexibility in the Italian Water Service Sector: A Real Option Analysis
PRA	141.2004	*Patrick BAJARI, Stephanie HOUGHTON and Steven TADELIS* (lxxi): Bidding for Incompete Contracts
PRA	142.2004	*Susan ATHEY, Jonathan LEVIN and Enrique SEIRA* (lxxi): Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions
PRA	143.2004	*David GOLDREICH* (lxxi): Behavioral Biases of Dealers in U.S. Treasury Auctions
PRA	144.2004	*Roberto BURGUET* (lxxi): Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More Simple Economics
PRA	145.2004	*Ali HORTACSU and Samita SAREEN* (lxxi): Order Flow and the Formation of Dealer Bids: An Analysis of Information and Strategic Behavior in the Government of Canada Securities Auctions
PRA	146.2004	*Victor GINSBURGH, Patrick LEGROS and Nicolas SAHUGUET* (lxxi): How to Win Twice at an Auction. On the Incidence of Commissions in Auction Markets
PRA	147.2004	*Claudio MEZZETTI, Aleksandar PEKEČ and Ilia TSETLIN* (lxxi): Sequential vs. Single-Round Uniform-Price Auctions
PRA	148.2004	*John ASKER and Estelle CANTILLON* (lxxi): Equilibrium of Scoring Auctions
PRA	149.2004	*Philip A. HAILE, Han HONG and Matthew SHUM* (lxxi): Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions
PRA	150.2004	*François DEGEORGE, François DERRIEN and Kent L. WOMACK* (lxxi): Quid Pro Quo in IPOs: Why Bookbuilding is Dominating Auctions
CCMP	151.2004	*Barbara BUCHNER and Silvia DALL'OLIO*: Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol's Adoption Process
CCMP	152.2004	*Carlo CARRARO and Marzio GALEOTTI*: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model
PRA	153.2004	*Alejandro M. MANELLI and Daniel R. VINCENT* (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly
ETA	154.2004	*Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS*: Is there any Scope for Corporatism in Stabilization Policies?
CTN	155.2004	*Johan EYCKMANS and Michael FINUS*: An Almost Ideal Sharing Scheme for Coalition Games with Externalities
CCMP	156.2004	*Cesare DOSI and Michele MORETTO*: Environmental Innovation, War of Attrition and Investment Grants

CCMP	157.2004	*Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA*: How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?
ETA	158.2004	*Y. Hossein FARZIN and Ken-Ichi AKAO*: Non-pecuniary Value of Employment and Individual Labor Supply
ETA	159.2004	*William BROCK and Anastasios XEPAPADEAS*: Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling
KTHC	160.2004	*Alberto PETRUCCI*: On the Incidence of a Tax on PureRent with Infinite Horizons
IEM	161.2004	*Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRÍGUEZ*: Microsimulating the Effects of Household Energy Price Changes in Spain

NOTE DI LAVORO PUBLISHED IN 2005

CCMP	1.2005	*Stéphane HALLEGATTE*: Accounting for Extreme Events in the Economic Assessment of Climate Change
CCMP	2.2005	*Qiang WU and Paulo Augusto NUNES*: Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China
CCMP	3.2005	*Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU*: A Global Database of Domestic and International Tourist Numbers at National and Subnational Level
CCMP	4.2005	*Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL*: The Impact of Climate on Holiday Destination Choice
ETA	5.2005	*Hubert KEMPF*: Is Inequality Harmful for the Environment in a Growing Economy?
CCMP	6.2005	*Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI*: The Dynamics of Carbon and Energy Intensity in a Model of Endogenous Technical Change
IEM	7.2005	*David CALEF and Robert GOBLE*: The Allure of Technology: How France and California Promoted Electric Vehicles to Reduce Urban Air Pollution
ETA	8.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: An Empirical Contribution to the Debate on Corruption Democracy and Environmental Policy
CCMP	9.2005	*Angelo ANTOCI*: Environmental Resources Depletion and Interplay Between Negative and Positive Externalities in a Growth Model
CTN	10.2005	*Frédéric DEROIAN*: Cost-Reducing Alliances and Local Spillovers
NRM	11.2005	*Francesco SINDICO*: The GMO Dispute before the WTO: Legal Implications for the Trade and Environment Debate
KTHC	12.2005	*Carla MASSIDDA*: Estimating the New Keynesian Phillips Curve for Italian Manufacturing Sectors
KTHC	13.2005	*Michele MORETTO and Gianpaolo ROSSINI*: Start-up Entry Strategies: Employer vs. Nonemployer firms
PRCG	14.2005	*Clara GRAZIANO and Annalisa LUPORINI*: Ownership Concentration, Monitoring and Optimal Board Structure
CSRM	15.2005	*Parashar KULKARNI*: Use of Ecolabels in Promoting Exports from Developing Countries to Developed Countries: Lessons from the Indian LeatherFootwear Industry
KTHC	16.2005	*Adriana DI LIBERTO, Roberto MURA and Francesco PIGLIARU*: How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence
KTHC	17.2005	*Alireza NAGHAVI*: Asymmetric Labor Markets, Southern Wages, and the Location of Firms
KTHC	18.2005	*Alireza NAGHAVI*: Strategic Intellectual Property Rights Policy and North-South Technology Transfer
KTHC	19.2005	*Mombert HOPPE*: Technology Transfer Through Trade
PRCG	20.2005	*Roberto ROSON*: Platform Competition with Endogenous Multihoming
CCMP	21.2005	*Barbara BUCHNER and Carlo CARRARO*: Regional and Sub-Global Climate Blocs. A Game Theoretic Perspective on Bottom-up Climate Regimes
IEM	22.2005	*Fausto CAVALLARO*: An Integrated Multi-Criteria System to Assess Sustainable Energy Options: An Application of the Promethee Method
CTN	23.2005	*Michael FINUS, Pierre v. MOUCHE and Bianca RUNDSHAGEN*: Uniqueness of Coalitional Equilibria
IEM	24.2005	*Wietze LISE*: Decomposition of CO2 Emissions over 1980–2003 in Turkey
CTN	25.2005	*Somdeb LAHIRI*: The Core of Directed Network Problems with Quotas
SIEV	26.2005	*Susanne MENZEL and Riccardo SCARPA*: Protection Motivation Theory and Contingent Valuation: Perceived Realism, Threat and WTP Estimates for Biodiversity Protection
NRM	27.2005	*Massimiliano MAZZANTI and Anna MONTINI*: The Determinants of Residential Water Demand Empirical Evidence for a Panel of Italian Municipalities
CCMP	28.2005	*Laurent GILOTTE and Michel de LARA*: Precautionary Effect and Variations of the Value of Information
NRM	29.2005	*Paul SARFO-MENSAH*: Exportation of Timber in Ghana: The Menace of Illegal Logging Operations
CCMP	30.2005	*Andrea BIGANO, Alessandra GORIA, Jacqueline HAMILTON and Richard S.J. TOL*: The Effect of Climate Change and Extreme Weather Events on Tourism
NRM	31.2005	*Maria Angeles GARCIA-VALIÑAS*: Decentralization and Environment: An Application to Water Policies
NRM	32.2005	*Chiara D'ALPAOS, Cesare DOSI and Michele MORETTO*: Concession Length and Investment Timing Flexibility
CCMP	33.2005	*Joseph HUBER*: Key Environmental Innovations
CTN	34.2005	*Antoni CALVÓ-ARMENGOL and Rahmi İLKILIÇ* (lxxii): Pairwise-Stability and Nash Equilibria in Network Formation
CTN	35.2005	*Francesco FERI* (lxxii): Network Formation with Endogenous Decay
CTN	36.2005	*Frank H. PAGE, Jr. and Myrna H. WOODERS* (lxxii): Strategic Basins of Attraction, the Farsighted Core, and Network Formation Games

CTN	37.2005	*Alessandra CASELLA and Nobuyuki HANAKI* (lxxii): Information Channels in Labor Markets. On the Resilience of Referral Hiring
CTN	38.2005	*Matthew O. JACKSON and Alison WATTS* (lxxii): Social Games: Matching and the Play of Finitely Repeated Games
CTN	39.2005	*Anna BOGOMOLNAIA, Michel LE BRETON, Alexei SAVVATEEV and Shlomo WEBER* (lxxii): The Egalitarian Sharing Rule in Provision of Public Projects
CTN	40.2005	*Francesco FERI*: Stochastic Stability in Network with Decay
CTN	41.2005	*Aart de ZEEUW* (lxxii): Dynamic Effects on the Stability of International Environmental Agreements
NRM	42.2005	*C. Martijn van der HEIDE, Jeroen C.J.M. van den BERGH, Ekko C. van IERLAND and Paulo A.L.D. NUNES*: Measuring the Economic Value of Two Habitat Defragmentation Policy Scenarios for the Veluwe, The Netherlands
PRCG	43.2005	*Carla VIEIRA and Ana Paula SERRA*: Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms
SIEV	44.2005	*Anna ALBERINI, Valentina ZANATTA and Paolo ROSATO*: Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice
CTN	45.2005	*Michael FINUS and Bianca RUNDSHAGEN:* Participation in International Environmental Agreements: The Role of Timing and Regulation
CCMP	46.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: Are EU Environmental Policies Too Demanding for New Members States?
IEM	47.2005	*Matteo MANERA*: Modeling Factor Demands with SEM and VAR: An Empirical Comparison
CTN	48.2005	*Olivier TERCIEUX and Vincent VANNETELBOSCH* (lxx): A Characterization of Stochastically Stable Networks
CTN	49.2005	*Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH* (lxxii): R&D Networks Among Unionized Firms
CTN	50.2005	*Carlo CARRARO, Johan EYCKMANS and Michael FINUS*: Optimal Transfers and Participation Decisions in International Environmental Agreements
KTHC	51.2005	*Valeria GATTAI*: From the Theory of the Firm to FDI and Internalisation:A Survey
CCMP	52.2005	*Alireza NAGHAVI*: Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal
SIEV	53.2005	*Margaretha BREIL, Gretel GAMBARELLI and Paulo A.L.D. NUNES*: Economic Valuation of On Site Material Damages of High Water on Economic Activities based in the City of Venice: Results from a Dose-Response-Expert-Based Valuation Approach
ETA	54.2005	*Alessandra del BOCA, Marzio GALEOTTI, Charles P. HIMMELBERG and Paola ROTA*: Investment and Time to Plan: A Comparison of Structures vs. Equipment in a Panel of Italian Firms
CCMP	55.2005	*Gernot KLEPPER and Sonja PETERSON*: Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU

(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003

(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003

(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003

(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003

(lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

(lxxi) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004

(lxxii) This paper was presented at the 10th Coalition Theory Network Workshop held in Paris, France on 28-29 January 2005 and organised by EUREQua.

2004 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
GG	*Global Governance* (Editor: Carlo Carraro)
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRA	*Privatisation, Regulation, Antitrust* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*

2005 SERIES	
CCMP	*Climate Change Modelling and Policy* (Editor: Marzio Galeotti)
SIEV	*Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)
NRM	*Natural Resources Management* (Editor: Carlo Giupponi)
KTHC	*Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)
IEM	*International Energy Markets* (Editor: Anil Markandya)
CSRM	*Corporate Social Responsibility and Sustainable Management* (Editor: Sabina Ratti)
PRCG	*Privatisation Regulation Corporate Governance* (Editor: Bernardo Bortolotti)
ETA	*Economic Theory and Applications* (Editor: Carlo Carraro)
CTN	*Coalition Theory Network*