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How to improve the efficiency of the EU emission trading scheme?

Preliminary version, for comments

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Abstract

On January 1. 2005, the EU launched an emission trading scheme (EU ETS). The scheme only covers energy intensive sectors while the other sectors are regulated by different national or European policies. As the Kyoto Protocol defines a national emission cap on EU countries, this generates an interdependance between energy intensive sectors and the others sectors.

This paper investigates whether the quantity of permits allocated to the market participants allows to minimize the cost of achieving Kyoto targets. We use a computable general equilibrium GTAP-ECAT developed by the Danish consulting company COWI.

We show that the 2005-2007 allocation has been too generous, implying stricter targets for the rest of the economy. Accordingly, we investigate solutions to mitigate these inefficiencies. The first straightforward solution obviously consists in reducing the quantity of allowances. A second solution is to import CDM/JI credits. A third solution consists in extending the sectoral coverage of the market.

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Introduction

The Kyoto Protocol imposes national emission cap on European countries for the 2008-2010 period. Since 2005, the European Union has launched an emission trading scheme covering the energy intensive sectors. Each European state had to establish a National Allocation Plan (NAP) which defines the initial allocation to the sectors taking part in the market (hereafter, the ET sectors for Emission Trading sectors). In 2008, the European emission trading scheme (EU-ETS) will enter in its second phase and the NAP will implicitly share the abatement effort between the ET sectors and the sectors which are not included in the market (hereafter, NET sectors for Not Emission Trading sectors). The crucial point is that the combination of the Kyoto commitments and the EU-ETS generates an interdependence between the emission constraint on ET and NET sectors.

This paper addresses the question of the cost-efficiency of the burden sharing between the ET and NET sectors. We intend to compare the difference between the market allowance price and the shadow price of emission in the NET sectors which ensures the Kyoto compliance. We show that the NAP elaborated for the first phase of the EU-ETS leads to a cost-inefficiency if they were to be replicated for the 2008-2012 period. We propose and use the GTAP-ECAT model to simulate three solutions to mitigate this inefficiency: adjusting the quantity of allowances allocated by the NAP, importing more JI/CDM credits and extending the sectoral coverage of the EU-ETS.

Several studies already carried out simulations on the EU-ETS, but they address different issues. Criqui and Kitous (2003) evaluate the effect of JI/CDM imports on the European emission trading market using the POLES model. Bernard & Al (2004) use the Gemini-E3 model to analyze the consequence of various allocation rules to ET sectors on the market equilibrium. The Danish Agency of Environmental Protection (2004) which simulates with the GTAP-ECAT model various scenarios of abatement efforts sharing between ET and NET sectors. Klepper & Peterson (2005) are the first to incorporate real data of NAP in order to simulate with the DART model the effect of JI/CDM credits imports. Reilly and Paltsev (2005) analyze the EU-ETS for the 2005-2007 period with the EPPA-EURO model and discuss the sharp contrast between their simulated carbon price and the actual history of carbon prices.

Our main results are the following. First, we show that replicating the 2005-2007 NAP to allocate allowances for the 2008-2010 period leads to an inefficient burden sharing : NET sectors face a carbon shadow price more than twenty times higher than the quota market price. Including the forecast of JI/CDM forecast does not modify this result. We then simulate three solutions to improve the efficiency of the burden sharing. We show that the optimal allocation - which equalizes the marginal abatement costs among ET and NET sectors in all European countries - require a reduction of about 17% of the quotas quantities allocated by the 2005-

2007 NAP. We also point out that for two countries - Austria and the Netherlands - there remains a marginal abatement cost gap between ET and NET sectors, meaning that reducing the quantities of quotas allocated by the NAP is not sufficient to reach the optimal allocation. Relying on JI/CDM credits import can improve the burden sharing if theses credits are used to relax the emission constraint of NET sectors. However, an heterogeneity remains between countries such as France which still has to set up a NET tax higher than the quota price while the situation is reversed for other countries. It is thus necessary to combine credits import with a specific NAP adjustment. Lastly, we show that combining a sectoral extension to the chemical or/and transport sectors with a particular adjustment of the ET allocation make it possible to approach the optimal burden sharing.

The paper is organized as follows. Section 1. briefly presents the GTAP-ECAT model and its main assumptions. Section 2 reports the results of the market simulation assuming the 2005-2007 NAP are replicated for the 2008-2012 period. Section 3, 4 and 5 assesses three solutions to improve the cost-efficiency of the burden sharing between ET and NET sectors.

1 Model overview and main assumptions

1.1 Basic structure of GTAP-ECAT

Estimating the financial impact of implementing a domestic emission trading scheme requires a comprehensive wide-global data set and a suitable model which can make use of this data set. Indeed, interdependences between countries are strong. Thus, environmental policies implemented in a country affect the prices and the volumes of bilateral trades and carbon policies may have a significant impact on welfare through changes in the terms of trade. To take into account these complex interactions (for instance between carbon markets and energy markets), it is relevant to use a Computable General Equilibrium model which will capture the international trade effects of climate change policy choices.

GTAP model (Rutherford & Paltsev, 2000) is a static, multi-region, multi sector computable general equilibrium model, with perfect competition and constant return to scale. Bilateral trade is handled via the Armington assumption which states that domestic and imported goods are qualitatively distinct, that is to say imperfect substitutes (to avoid total specialization of each economy). Each country is represented by a representative agent who supplies the primary production factors to the producers and consumes goods produced domestically or abroad. Producers use the primary factors and intermediates produced domestically and abroad to produce goods for domestic consumption and for exports.

We use the GTAP-ECAT (EU Carbon Allowance Trade) model which is being developed by the consulting company COWI on behalf of the Danish Environmental Protection Agency. It is based on energy-environmental versions of the GTAP model: GTAP-E by M. Berniaux & T. P. Truong and GTAP-EG by T. Rutherford & S. Paltsev. These models provide the possibility of modelling the energy-economy-environment-trade linkage by incorporating energy substitution into the standard GTAP model. They also incorporate carbon emission from the combustion of fossil fuels and provide for a mechanism to trade these emissions internationally.

The standard GTAP-E and GTAP-EG models cannot deal with inter-sectoral emission trading or inter-national emission trading within a specific group of regions. This comes from the fact that these models implement emission reductions by applying a carbon tax for each region covering all sectors of the economy. GTAP-ECAT adds some modification of the model similar to those implemented by Truong (2001). The basic modification lies in allowing for a distinction between the Emission Trading Sectors and the Non-Emission Trading Sectors. ET sectors can trade allowances between themselves while NET sectors achieve their emission reductions fulfillment through taxation.

GTAP-ECAT defines CO_2 emissions as an additional primary factor of production which is incorporated as a non-substitutable component of the fossil energy composite. This means that the energy type and CO_2 emissions will be demanded in fixed proportions to the combustion of fossil fuels. These proportions are determined by the physical emission coefficient associated to each type of fossil fuels according to IPCC guidelines. Thus, depending on the fossil fuels inputs, emission level can be computed.

We use an aggregation of the 1997 GTAP database with 28 regions and 22 sectors, listed in tables 14 and 15 in Annex B. We point out two fundamental assumptions : a uniform GDP growth rate of 2,5% per annum and a CO_2 GDP intensity reduction of 1,3% per annum.

1.2 National allocation plan data

Each Member State has to establish a national allocation plan for each trading period. In this allocation the Member State decides the total number of allowances to be created for the period and the distribution of these allowances to individual plants. The first trading period runs from 2005 to 2007, and there after the Directive foresees 5-year trading periods.

The EU-ETS covers around 11 400 facilities to which nearly 2200 Mt CO_2 were allocated. Germany counts for nearly 23% of the allocation while the United Kingdom, Italy and Poland count each one for approximately 11%. These four countries have thus allocated to their ET sectors more than 50% of the allowances allocated for the first period. Table 1 summarizes the number of allocated allowances and of covered facilities.

To simulate the EU-ETS when ET sectors receive the quantity of allowances defined by the NAP, we have to adjust them. Indeed, the delimitation of ET sectors in the model does not match exactly with reality for two reasons.

On the first hand, we cannot distinguish within the selected sectors the facilities excluded

Table 1: NAP for 2005-2007

	Yearly average allocation Mt CO_2	Number of covered facilities
Germany	499	1849
Austria	33	205
Belgium+Luxembourg	62,9+3,4	363+19
Denmark	33,5	378
Spain	174,4	819
Finland	45,5	535
France	156,5	1172
Greece	74,4	141
Hungary+Slovenia	31,3+8,8	261+98
Eire	22,3	143
Italy	232,5	1240
Netherlands	95,3	333
Baltic states	19+4,6+12,3	43+95+93
Poland	239	1166
Portugal	38,2	239
United Kingdom	245,3	1078
Sweden	22,9	499
Czech+Slovakia	97,6+30,5	435+209
Cyprus+Malta	5,7+2,9	13+2
Total	2 191	11 428

Source : European Commission, press communicate IP/05/762, June 20. 2005

by the Member States. This effect is limited because only small facilities can be excluded. On the other hand, some facilities covered by the EU ETS belong to NET sectors in our model. For example, the chemical sector as a whole is not covered by the directive, but the combustion facilities of more than 20 MW in the sectors are covered. Our sectoral delimitation does not enable us to take account of them.

To adjust the NAP, we compared the ET sectors real emissions with those generated by our model in 2002. Table 2 highlights two sources of differences :

- the difference between total real and simulated emissions : depending on the country, total emissions can be over-estimated or underestimated. This comes from the 1997 database and the uniform GDP growth rate we implement and which does not take into account the national specificities of the 1997-2002 period.
- the difference between ET sectors real and simulated emissions: except for the Baltic States, GTAP-ECAT underestimates the quantities emitted by ET sectors.

We decided adjust the quantity of allowances allocated by the NAP such that the ratio of the quantity of allocated allowances and of the emission level remain the same between real data and simulated levels.

Table 2: NAP adjustement

	Real emissions 2002				GTAP-ECAT 2002			NAP
	ET[1]	Total[2]	% ET	NAP	ET	Total	% ET	Adjusted
Germany	506,5	838,3	60,4	499	409	936	43,7	403
Austria	31,1	70,5	44,1	33	25	67	37,3	27
Belgium-Lux	70,3	156,6	44,9	66,3	49	159	30,8	46
Denmark	30,9	54,9	56,3	33,5	35	70	50,0	38
Spain	164,3	341,5	48,1	174,4	112	285	39,3	119
Finland	40,9	54,3	75,3	45,5	38	66	57,6	42
France	150,2	407,3	36,9	156,5	86	413	20,8	90
Greece	70,2	104,4	67,2	74,4	44	92	47,8	47
Hungary+Slovenia	39,4[3]	72,8	54,1	40,1	36	76	47,4	37
Eire	22,1	49,1	45,0	22,3	15	39	38,5	15
Italy	256,5	448,7	57,2	232,5	178	443	40,2	161
Netherlands	86,8	256,2	33,9	95,3	81	248	32,7	89
Baltic states	20,7[4]	42,2	49,5	36	26	42	61,9	45
Poland	206[5]	268,4	95,8	239	233	369	63,1	270
Portugal	36,5	67	54,5	38,2	25	59	42,4	26
United-Kingdom	252,8	552,8	45,7	245,2	233	595	39,2	226
Sweden	20,2	54,9	36,8	22,9	18	67	26,9	20
Czech+Slovakia	112,2[6]	141,8	79,13	128,1	100	169	59,2	114

Source : Klepper and Peterson 2005, European Commission and GTAP-ECAT simulation

As we intend to make simulation in 2010, we need to make an assumption on the quantity of allowances allocated by the 2010 NAP. We assume that ET sectors receive a quantity of allowances such that the share of their emissions in the national emissions remains the same as that granted by the 2005-2007 NAP. Since in 2010 national emissions are constrained by the Kyoto commitment and in 2006 the majority of the European countries emit more than this commitment, the 2010 NAP should allocate less allowances than the 2005-2007 NAP. Table 3 recapitulates.

[1] Unless otherwise specified, the estimate of ET sectors emissions is drawn from Klepper & Peterson (2005).

[2] Data of the IEA (2004).

[3] The Slovenian NAP indicates that ET sectors covered 60% of the country emissions in 2002

[4] Data from the NAP of Latvia and Lithuania. For Estonia, we used the figure provided by the ECOPHYS report (Gilbert, Bode, and Phylipsen 2004).

[5] Calculated from 2001 ET emission data of the Polish NAP, supposing that the ET emission share remained constant between 2001 and 2002

[6] Calculated from 2000 ET emission data of the Czech NAP, supposing that the ET emission share remained constant between 2000 and 2002. For Slovakia, we took the quantities indicated for 2002 by its NAP

Table 3: 2010 NAP adjustement

	2005-2007		2010	
	NAP	% ET	NAP	% ET
Germany	403	42%	327	42%
Austria	27	38%	15	38%
Belgium-Lux	46	28%	34	28%
Denmark	38	51%	20	51%
Spain	119	40%	96	40%
Finland	42	58%	31	58%
France	90	21%	75	21%
Greece	47	48%	46	48%
Hungary+Slovenia	37	42%	37	42%
Eire	15	38%	13	38%
Italy	161	37%	138	37%
Netherlands	89	34%	53	34%
Baltic states	45	72%	66	72%
Poland	270	59%	257	59%
Portugal	26	42%	23	42%
United-Kingdom	226	37%	182	37%
Sweden	20	29%	15	29%
Czech +Slovakia	114	55%	109	55%

Source : simulations GTAP-ECAT

We could rely on an other adjustment and grant to ET sectors in 2010 the quantity of allowances defined by the 2005-2007 NAP. This would simulate a situation where all the abatement efforts necessary between 2006 and 2010 is imposed on NET sectors. We did not retain this scenario because it seemed to us not very realistic. Indeed, it leads for example to allow Austrian ET sector to emit 70% of the national Kyoto commitment whereas in 2006 these sectors account for only 38% of total emissions.

2 Market simulation in 2010

In this section we simulate the EU-ETS assuming the ET sectors receive for the 2008-2012 period a quantity of allowances based on the 2005-2007 NAP. We aim to analyze wether such an allocation would minimize the cost of compliance with Kyoto commitments.

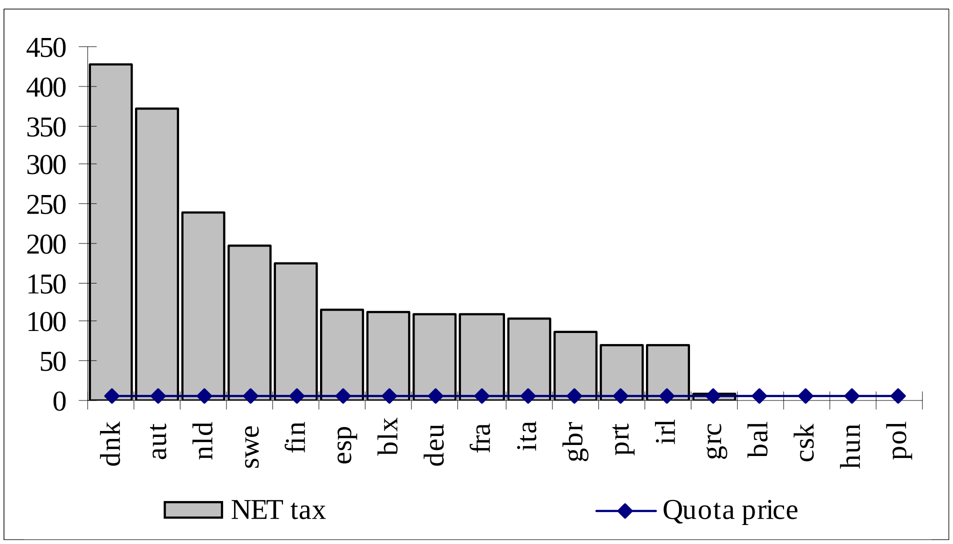
The first phase of the EU ETS (2005-2007) is a test before the first Kyoto commitment period. During this phase, the countries do not have any abatement targets so that an over-allocation to the ET sectors does not imply a greater emission constraint for NET. This will not be any more the case for the second period of the EU ETS (2008-2012) : each European country will have a national emission constraint and a too generous allocation to ET will imply stricter constraint on NET. Thus, the allocation to ET sector implicitly determine the cost efficiency of the burden sharing between ET and NET sectors.

2.1 Evaluation of NAP cost efficiency

Our first simulation allocates the adjusted 2010 NAP to ET sectors and supposes that each European State respects its Kyoto commitment in 2010 by imposing a CO_2 tax on NET sectors. In this scenario, European countries do not import CDM/JI credits. If the marginal abatement costs in ET sectors are equalized thanks to the market, each NET sector faces a different national tax. The difference between the quota price and each national NET tax depends on sectoral marginal abatement costs and on the quantity of quotas allocated to ET sectors.

We obtain a quota price equal to 6,5€. Figure 1 highlights the gap between the quota price and national taxes.

Figure 1: Quota price and NETS tax with adjusted 2010 NAP



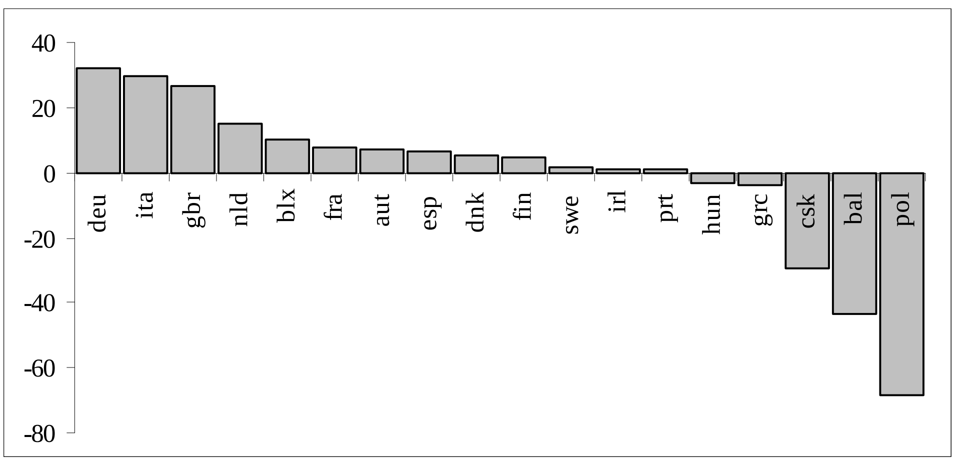
Source : GTAP-ECAT simulation

European States can be divided into two main groups: on the first side, the UE-15 countries-15 have to impose on their NET sectors a tax much higher than the quota price: indeed, EU-15 NET sectors are subjected to an average tax of 113 € per ton of CO_2. This figure however hides a great heterogeneity as the tax level varies from less than 9 € per ton of CO_2 for Greece to nearly 430 € for Denmark. The abatement efforts sharing between ET and NET sectors induced by the NAP does not ensure abatement costs equimarginality. This is a cost inefficiency and it would be welfare improving to reduce the allocation to ET, in order to lighten the abatement constraint on NET. Within UE-15, it is obviously the countries with the greatest gap between the quota price and the NET tax which benefit the most from a less generous allocation to ET sectors.

On the other side, the Eastern Europe countries do not need to impose of tax on their NET sectors because their business-as-usual emissions remain in 2010 lower than Kyoto commitments. However, they have an unquestionable interest to take part in the EU ETS because they are net exporters of quotas and thus draw a consequent income from quota sales to EU-15 ET sectors. The consequence of their participation in the EU-ETS is that their ET sectors face a quota price much higher to the NET emission shadow price (which is equal to zero). Cost-efficiency would require that they allocate more quotas to ET, but it seems difficult as they undergo a political constraint from the European Commission who will reject a too generous NAP.

149 $MtCO_2$ are exchanged on the market, which represent more than 8% of the total of allocated quotas to ET. Figure 2 summarizes the quantities of traded quotas.

Figure 2: Number of traded quotas in 2010



Source : GTAP-ECAT simulation

Eastern European countries are net exporters of quotas. The Baltic states and Poland provide more than 75% of offered quotas. The main importers are Germany, Italy and Great Britain which imports each one approximately 30 $MtCO_2$. Let us note that the countries with the most inefficient effort sharing (Scandinavian Countries and Austria) buy few quotas, which corroborates the fact that their NAP is too generous.

2.2 Including forecasted quantities of JI/CDM credits imports

Each NAP indicate the volume of JI/CDM credits which is expected to be imported by European government to satisfy part of their commitment. Recall that there are two manners to use credits generated by JI or CDM projects, either at a governmental level, or at the firm level (thanks to the linking directive).

At the first level, the governments can buy credits and use them to comply with their Kyoto target. Governments can buy credits through carbon funds created by themselves(for example program ERUPT and CERUPT of the government of the Netherlands) or to which they contribute financially (for example the Prototype Carbon Fund created and managed by the World Bank and financed by the investments of six governments, seventeen companies and three banks).

Each NAP indicates the volume of credits each country intends to purchase. These data are summarized in the table 4.

Table 4: Volume of JI/CDM credits intended to be imported in 2008-2012

	Credits quantities per year	% of the abatement effort
Germany	0	0 %
Austria	5	15,1 %
Belgium-Luxembourg	8,5	15,7 %
Denmark	3,7	10,3 %
Spain	20	27 %
Finland	3	15 %
France	0	0 %
Greece	0	0 %
Eire	3,7	41,1 %
Italy	0	0 %
Netherlands	20	17 %
Portugal	0,01	0,1 %
United-Kingdom	0	0 %
Sweden	0	0 %
Total	64	5 %

Source : Gilbert et al. 2004, Zetterberg et al. 2004 and Lückge and Peterson 2004

The Netherlands and Spain are the two countries which intend to buy the larger quantities of JI/CDM credits. The Netherlands launched seven governmental programs and also took part in two other funds. Spain recently launched Spanish Carbon Fund. To a lesser extent, Austria, Belgium, Luxembourg, Denmark, Finland, Ireland and Portugal announced their intention to rely on JI/CDM credits to cover part of their commitments. Thus, around 64 $MtCO_2$ could be imported per year in 2008-2012.

At the firms level, the linking directive (2004/101/CE) allows a private entity to buy

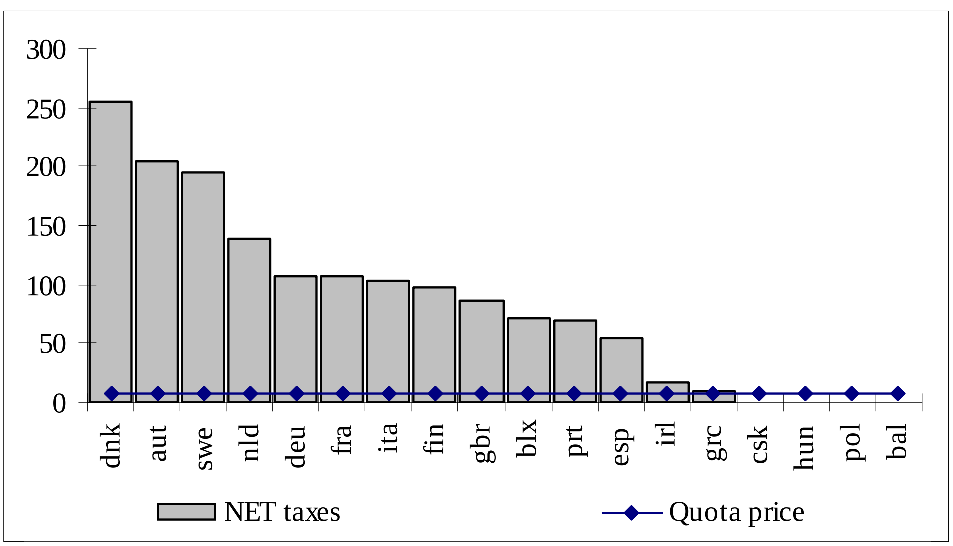
JI/CDM credits and to convert them into European allowances.

Even if the countries not listed in the Annex 1 of the Kyoto Protocol offer a very large reserve of CDM credits at low prices, it is necessary to take into account the significant institutional barriers which are likely to strongly limit the credits offer. Indeed, few countries are likely to set up the institutional organization necessary to the CDM. To take into account the transaction of purchasing JI/CDM credits, we include in the model an additional cost associated with the purchase of each credit of 1 €.

In addition to the fact that the importation of JI/CDM is likely to be limited, the supplementary principle added to the Protocol of Kyoto by the Marrakech and Bonn agreements (COP6, 2001) limit the quantity of credits each Part of Annex 1 can rely on to fulfill its commitment. This principle states that the purchase of Kyoto quotas and JI/CDM credits should remain a complement to national abatement measures. The European Union militated in favour of 50% limit. Even if this limit had not been retained in the final agreement, the European Union chose to respect it.

We simulate the market in 2010 by allocating the 2010 adjusted NAP to ET sectors and by incorporating the import forecasts of JI/CDM credits listed in table 4. Figure 3 draws the results of our simulation regarding the quota price and NET taxes.

Figure 3: Quota price and NETS tax with adjusted 2010 NAP and JI/CDM credits import forecasts



Source : GTAP-ECAT simulation

The main effect of credits purchase is that they can be used to relax the abatement constraint of the NET sectors and thus it leads to a decrease of the tax each country has to impose on them. The Netherlands and Spain which intend both to import 20 Mt of credits strongly decrease the NET tax: it decreases from 238 to 139 € for the Netherlands and from 115 to 55 € for Spain. Globally, the average NET tax decreases from 113 to 99 € thanks to the importation of 45 Mt.

The quota is indirectly affected by the governmental credits purchase. It increases by 0,6 € and reaches 7,1 €. This comes from the fact that, as the NET emission constraint is relaxed, their input demand, in particular that addressed to ET sectors, increases. This has a positive effect on the output level of ET sectors, increasing their emission level and thus their abatement costs.

Table 5 synthesizes the main results of our two simulations.

Table 5: 2010 market with and without JI/CDM credits

	2010 adjusted NAP	2010 adjusted NAP and JI/CDM credits
Quota price	6,5 €	7,1 €
Average NET tax (EU-15)	113 €	99 €
ET allocation ($MtCO_2$)	1536	1536
JI/CDM Credits to ET	0	0
Abatement effort	20%	20%
NET emissions ($MtCO_2$)	2117	2180
JI/CDM Credits to NET		64
Abatement effort	21%	19%

Source: GTAP-ECAT simulation

3 Solution 1: adjusting the quantity of allowances allocated by the NAP

We show that an allocation based on the 2005-2007 NAP would lead to an inefficient burden sharing in 2010. Indeed NET sectors would face a CO_2 tax seventeen times higher than the allowance market price. This result is robust to the inclusion of JI/CDM credits import forecasts.

We thus simulate in the next three sections, three solutions to mitigate this inefficiency : adjusting the quantity of allowances allocated by the NAP, relying for a larger part on JI/CDM credits purchase and including new sectors into the ET sectors.

The most immediate solution to the over-generous allocation of the 2005-2007 NAP is simply to decrease the quantities of quotas allocated to the ET sectors. Our first series of simulations analyses the effect of modifying the quantity of allocated allowances. We simulate two scenarios: the first one is based on a grandfathering allocation to ET sectors, while the second one defines the optimal allocation which equalize marginal abatement costs between ET and NET sectors.

3.1 Optimal allocation

The optimal allocation is defined as the allocation to ET sectors which ensures the equality between the quota price and national NET taxes. When this optimal allocation exists, it reproduces a situation where all sectors are ET sectors (i.e. the quotas market covers the whole economy) and ensures the cost minimization of Kyoto compliance for the EU-25. The optimal allocation is calculated by the model. For that, we simulate a scenario where all sectors are ET, which enables us to determine the quota price which emerges from the marginal abatement costs equalization between all sectors in every European country. We then obtain the quantities emitted by the sectors which are NET in the directive, and we can allocate to ET sectors a quantity of allowances equal to the Kyoto commitments minus the NET emissions. Table 6 summarizes the optimal allocation to ET sectors.

Table 6: 2005-2007 NAP and optimal allocation in 2010

	2005-2007 NAP		Optimal allocation	
		%ETS		%NAP
Germany	327	42%	245	31,5%
Austria	15	38%	*-0,5*	*-1,4%*
Belgium-Lux	34	28%	12,6	10,4%
Denmark	20	51%	5,4	13,6%
Spain	96	40%	65	27,2%
Finland	31	58%	23,7	44,8%
France	75	21%	26,7	7,5%
Greece	46	48%	48,2	50,2%
Hungary-Slovenia	37	42%	49,2	55,9%
Eire	13	38%	9,9	29,9%
Italy	138	37%	104,3	27,9%
Netherlands	53	34%	*-9,5*	*-6,1%*
Baltic states	66	72%	75	82,6%
Poland	257	59%	309,7	71,2%
Portugal	23	42%	20,3	36,9%
United-Kingdom	182	37%	134,1	27,2%
Sweden	15	29%	3,2	6%
Czech+Slovakia	109	55%	137	69%

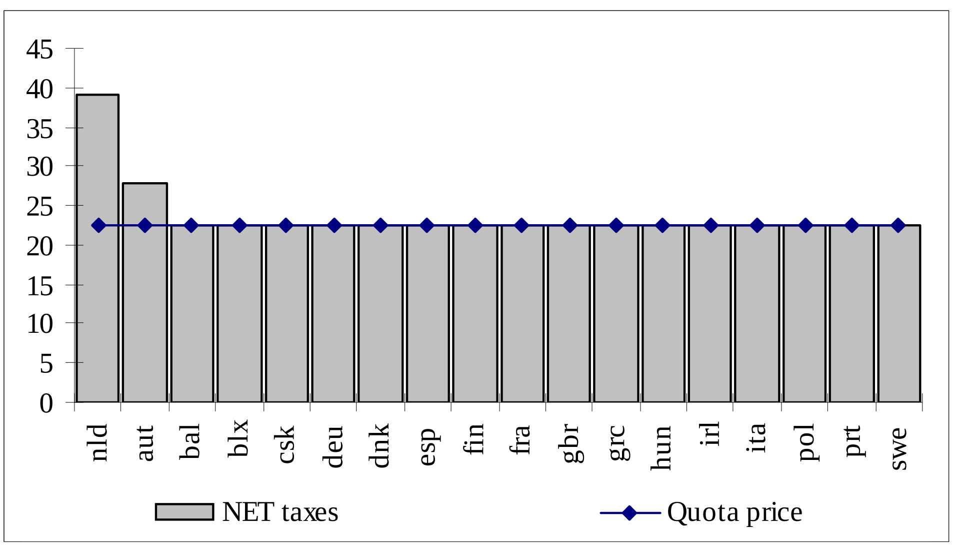
Source: GTAP-ECAT simulation

The optimal allocation results in a strong reduction of the quantity of allocated quotas ET sectors in nearly every country of the EU-15. The situation of Austria and of the Netherlands is extreme as these two countries should even allocate a negative quantity of quotas to their ET sectors. Indeed, even in the situation where the NET sectors emit the totality of the Kyoto commitment, the NET tax is still higher than the quota price. If we suppose that such a negative allocation is not feasible, the optimal allocation cannot be implemented. It is only possible to approach it, ensuring the equalization of the quota price with the NET taxes of each country - except Austria and the Netherlands. In this case, the quota price is equal to 23 € as well as the NET taxes, except for Austria which must impose a tax of 28 € and the Netherlands of 39 €.

The only exception is Greece which is in a situation rather similar to the East European countries for which the optimal allocation would require to increase in the quantity of allowances allocated to ET sectors in order to impose a sufficient constraint on the NET sectors.

UE-25 ET sectors receive approximately 1270 Mt of quotas, which represents a fall of approximately 17% compared to the quantities allocated by the 2005-2007 NAP. Their abatement effort reaches 30% under business-as-usual trend while NET sectors have to reduce their emission from 10% under business-as-usual. 409 Mt of quotas are exchanged, which accounts for 32% of the total allocation

Figure 4: Quota price and NET taxes under an optimal allocation



Source: GTAP-ECAT simulation

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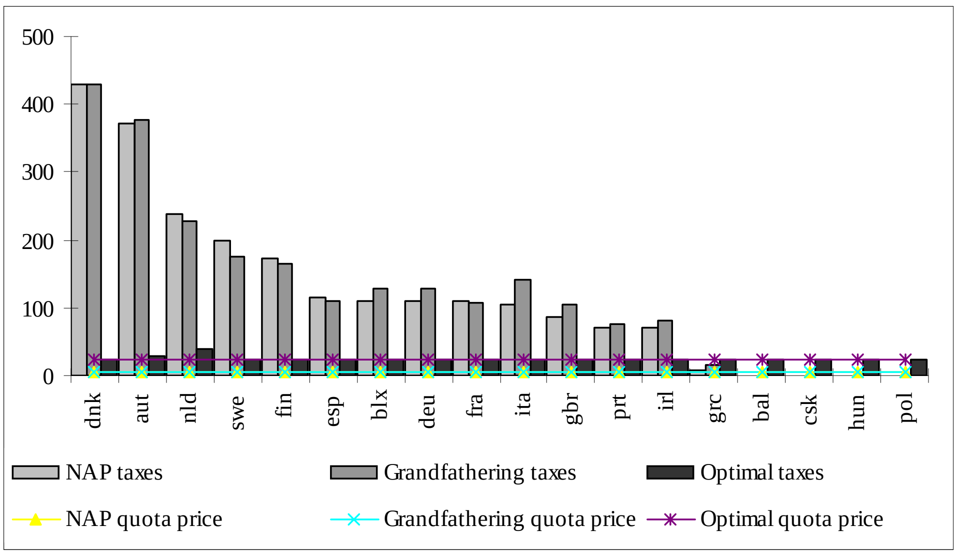
3.2 Conclusion

Table 7 and figure 5 make it possible to compare the quota prices and the NET taxes for the simulated scenarios. We also included the results of a grandfathering allocation presnted in the Annex. We retain that the 2005-2007 NAP allocation is very closed to grandfathering and result in imposing an average NET tax 20 times greater that the quota price. The optimal allocation equalizes the quota price with NET taxes.

Figure 5: 2005-2007 NAP, grandfathering and optimal allocation



Source: GTAP-ECAT simulation

Table 7: 2010 market with 2005-2007 NAP, grandfathering and opitmal allocation

	2005-2007 NAP	Grandfathering	Optimal allocation
Quota price	6,5 €	4,2 €	23 €
Average NET tax	113 €	130 €	23 €
ET allocation ($MtCO_2$)	1536	1595	1270
Abatement effort	20%	17%	34%
NET emissions ($MtCO_2$)	2117	2081	2431
Abatement effort	21%	23%	10%

Source: GTAP-ECAT simulation

We note that global emission level of the EU-25 varies according to the scenario considered: 3653 $MtCO_2$ for 2005-2007 NAP, 3674 for the grandfathering allocation, and 3701 for the optimal allocation. In the model, UE-25 Kyoto commitment is equal to 3701 $MtCO_2$. Thus, apart from the optimal allocation, the EU-25 emission level remains lower that its Kyoto commitment. This comes from the fact that, except for the optimal allocation, NET sectors of the Eastern European countries emit less than what they are authorized to. By definition, these sectors do not take part in the EU-ETS thus cannot sell their surplus to other emitters.

The optimal allowance leads to an increase of the quantity of quotas allocated to EU-NM ET sectors so that all their quota surplus can be sold on the market. Thus, if the optimal allocation minimizes compliance cost with Kyoto commitments, the emission level is also the highest. We should certainly moderate this observation since our model does not incorporate the possibility for an Annex 1 country to sell part of its assigned amount. Some Kyoto quotas transfers from Eastern Europe to the EU-15 would decrease the inefficiency of 2005-2007 NAP by reducing the emission constraint on UE-15 NET sectors.

With a quota price multiplied by four and a volume of exchanged quotas increasing from 149 Mt to 409 Mt, the ET sectors of Eastern Europe countries win a lot from the passage of the 2005-2007 NAP to an optimal allocation. Indeed their income is multiplied by ten, passing from 968 millions euros to more than nine billions euros. On the contrary, the optimal allocation will damage the UE-15 ET sectors as the optimal allocation reduces their quantity of allowances by approximately 34% compared to the NAP.

The UE-15 NET sectors benefit from the optimal allocation as they are subjected to a tax which is divided by five. It is the opposite for the NET sectors of Eastern Europe countries which were not constrained under the 2005-2007 NAP whereas they face the same CO_2 price as the other sectors in the optimal scenario.

Thus, decreasing the quantity of quotas allocated by the 2005-2007 NAP to reach the optimal allocation benefits to ET sectors of Eastern European and to NET sectors of the UE-15 and be unfavorable to UE-15 ET sectors and NET sectors of Eastern Europe. Even if the optimal allocation is preferable from a welfare maximizing point of view, decreasing the quantity of quotas allocated to ET sectors could face strong opposition from EU-15 ET sectors. Moreover, we have seen that the optimal allocation could not be reached for Austria and the Netherlands since it would result in allocating a negative quantity of quotas to their NET sectors. Increasing the efficiency of the burden sharing between ET and NET sectors could not rely only on decreasing the allocation to ET sectors.

4 Solution 2: importing JI/CDM credit

A second solution to improve the efficiency of the burden sharing is to rely on JI/CDM credits imports to reduce the abatement constraint of the NET sectors. Our business as usual scenario simulates an emission level of 3886 $MtCO_2$ in 2010 for the UE-15. These countries have to reduce this level by 998 $MtCO_2$ to comply with their Kyoto commitments. The supplementary principle allows them to import a maximal amount of 499 $MtCO_2$ of credits. Table 8 highlights the gap between the government forecasts and the maximal quantity of JI/CDM credits each country is allowed to import.

Table 8: Quantity of imported JI/CDM credits per year (Mt CO2)

	2005-2007 NAP	Maximum
Germany	0	124
Austria	5	16
Belgium-Luxembourg	8,5	27
Denmark	3,7	18
Spain	20	37
Finland	3	10
France	0	49
Greece	0	2
Eire	3,7	5
Italy	0	56
Netherlands	20	59
Portugal	0,01	5
United-Kingdom	0	80
Sweden	0	10
Total	45,9	499

Source : European Commission and GTAP-ECAT simulation

At the European level, forecasted credits purchase does not reach 10% of the maximal quantity which could be imported. UE-15 is divided into two groups. Eight countries (Austria, Belgium, Luxembourg, Finland, Spain, Eire, Denmark and the Netherlands) intend to buy between 20 and 55% of the maximal quantity. The other countries do not envisage to buy credits and thus will have to comply with their Kyoto commitments thanks to internal measures only.

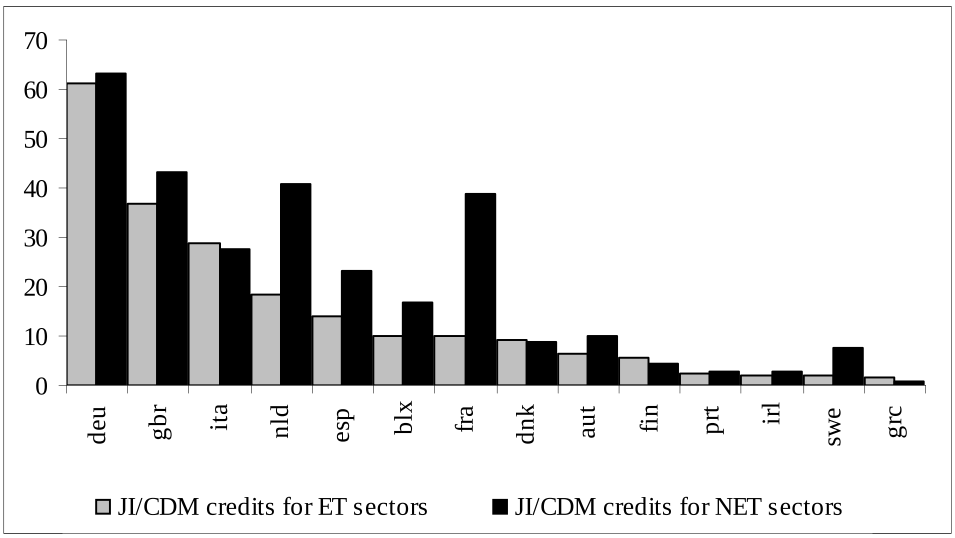
4.1 2005-2007 NAP and maximal import of JI/CDM credits

In the next two simulations, we assume that ET sectors receive the quantity of allowances defined by the adjusted 2005-2007 NAP and that the maximal quantity of credits (499 $MtCO_2$) is imported by the UE-15 countries. The two simulations differ from the way these credits are used. Let us recall that there are two ways to use JI/CDM credits. Thanks to the linking directive, companies from ET sectors can import credits and convert them into European allowances. Governments can also import credits either directly or via a carbon fund, and in this case, the imported credits decrease the abatement effort of the NET sectors.

4.1.1 Credits allocated proportionally to ET and NET sectors abatement efforts

In the UE-15, ET sectors have to reduce their emission by 416 MtCO_2 below business as usual and thus import 208 Mt of credits. NET sectors have to reduce their emissions by 582 Mt and import 291 Mt of credits. Thus, ET sectors import 42% of the imported credits while NET sectors receive 58% of them. This distribution is however not the same for each country as each NAP allocates differently the abatement effort between ET and NET sectors. Figure 6 recapitulates the quantities of credits imported by ET and NET sectors in the UE-15.

Figure 6: JI/CDM credits to ET and NET sectors

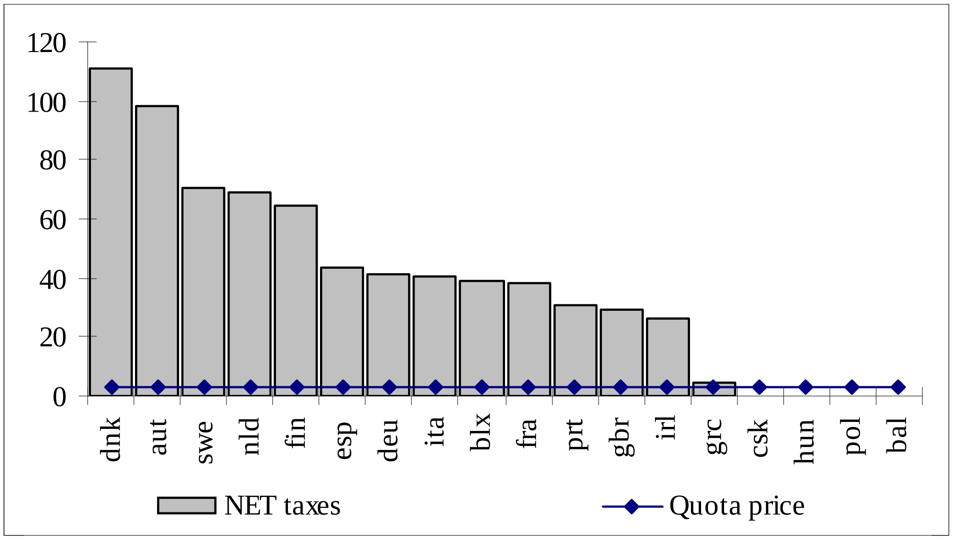


Source: GTAP-ECAT simulation

The maximal amount of imported credits leads to a fall of the quota price by more than 50%. It is established to approximately 3 €. Figure 7 also shows a strong reduction of the NET taxes. The average tax is divided by more than three, passing from 133€ to 41€. However, there still remains a significant gap between the quota price and NET taxes.

When the imported credits are used to reduce both the abatement effort of the ET and NET sectors, they do not modify the relative countries positions. The Scandinavian countries (Denmark, Sweden and Finland), Austria and the Netherlands are still the countries where the gap between the quota price and NET taxes is the largest. Their NET sectors face a CO_2 price 20 to 35 times the quota price. The other EU-15 countries, Greece excepted, face a less significant gap but which remain high since the NET taxes are approximately ten times higher than the quota price.

Figure 7: Quota price and NET taxes, 2005-2007 NAP and maximal import of credits to ET and NET sectors



Source: GTAP-ECAT simulation

4.1.2 JI/CDM to NET sectors

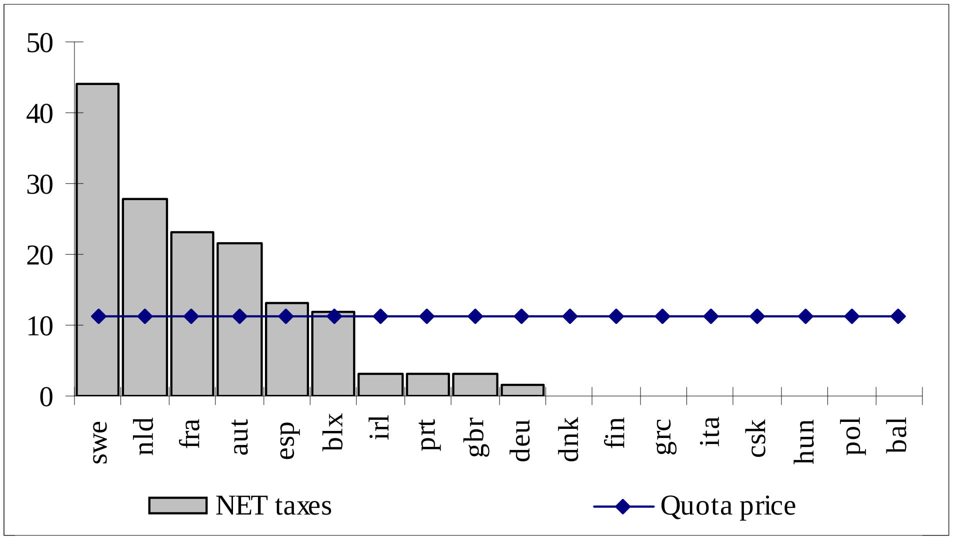
In this section, we assume that all the imported credits are used to relax the emission constraint of NET sectors.

The direct effect is a strong reduction of the NET taxes. Indeed the average tax is divided by a factor 12, passing from 113 € to 9 €. The lightening of the NET abatement effort has an indirect effect on the quota price: as abatement costs are reduced, the NET output level increases and so does their input demand, in particular for intermediary goods produced by ET sectors. ET output level and emission increase which made abatement more costly for ET sectors. As ET sectors are subjected to the same global constraint on their emissions, the quota price increases significantly, passing from 6,5 € to 11 €.

In this situation, NET sectors face a carbon price lower than the quota price, which means that allocating more quotas to ET sectors would improve the cost efficiency of the burden sharing. This result however hides a great heterogeneity between countries which is revealed by Figure 8.

Four countries - Sweden, the Netherlands, France and Austria - are still obliged to impose on their NET sectors a tax which is two to four times higher than the quota price. For these countries, the maximum import of JI/CDM credits is not sufficient to equalize the marginal abatement costs between ET and NET sectors. Spain, Belgium and Luxembourg are very close to the optimal burden sharing. For all the other UE-15 countries, the NET tax is lower

Figure 8: Quota price and NET taxes, 2005-2007 NAP and maximal import of credits to ET and NET sectors



Source:GTAP-ECAT simulation

than the quota price. For four of them (Denmark, Finland, Greece and Italy) it is not even necessary to impose a tax on their NET sectors and their situation becomes similar to that of the Eastern Europe countries.

4.2 Maximal amount of JI/CDM credits and optimal allocation

This last scenario optimizes the abatement efforts distribution by adjusting the ET allocation. We obtain the optimal allocation to ET sectors when the quota price equals NET taxes.

Let us note that the destination of JI/CDM credits has an impact on the optimal allocation .Indeed, if we assume that more credits are imported by ET sectors, the optimal allocation will be accordingly adjusted to allocate less quotas to ET sectors. However, we saw in section 5.1.2, that the optimal allowance could not be reached since it implies for the Netherlands and Austria a negative allocation to ET sectors. The positivity constraint of the ET allocation is likely to be again saturated if too many JI/CDM credits are imported by ET sectors and in this case, the optimal allocation would not be reachable. In order to eliminate this case, we choose to carry our simulations by assuming that the totality of JI/CDM credits is imported by the governments for the NET sectors. This assumption does not modify the markets equilibrium but ensure the optimal allocation is achievable.

The quota price which is equal to NET taxes is established to 8€. The quantity of quotas allocated to ET sectors increase a little bit as they receive 1611 Mt while 2005-2007 NAP give them only 1536 Mt. This was expectable as we saw that with the 2005-2007 NAP and maximal credits imports to NET sectors, the NET taxes were on average smaller than the quota price.

It is interesting to notice that the maximum credits import allows to reach the optimal allowance, without modifying the quantity of allowances allocated by the 2005-2007 NAP. It is the case when ET sectors import 75 Mt of credits, the remainder (424 Mt) being imported by the governments for NET sectors. The optimal allocation based on the 2005-2007 NAP is thus achievable when 499 Mt of credits are imported. It is not any more the case if the EU only import the forecasted quantities (45,9 Mt). There is a minimal quantity of credits to import in order to make the optimal allocation achievable while allocating the 2005-2007 NAP to ET sectors.

4.3 Conclusion

Table 9 synthesizes the main results of our simulations depending on the assignment of imported credits. We retain the following results: the maximal credits import distributed between ET and NET sectors according to their abatement efforts cause a drop of their emission constraint and lead to a significant reduction of the quota price and of the NET taxes. The compliance cost with the Kyoto commitments is obviously reduced by the import of low cost credits. However, to improve the cost efficiency of the burden sharing, it is necessary to use JI/CDM credits to relax in priority the NET constraint.

Table 9: JI/CDM credit import

	No credits	Max credits ET and NET	Max credits NET	Max credits and optimal allocation
Quota price	6,5 €	3 €	11 €	8 €
NET average tax (UE-15)	113 €	36 €	9 €	8 €
ET Allocation ($MtCO_2$)	1536	1536	1536	1611
ET credits	0	208	0	0
Abatement efforts	20%	9%	20%	16%
NET emissions ($MtCO_2$)	2117	2404	2605	2589
NET credits		291	499	499
Abatement efforts	21%	11%	3%	4%

Source: GTAP-ECAT simulation

Table 10 makes it possible to compare the optimal allocation depending on the importation and of the use of JI/CDM credits. The destination of the credits, when it is combined with a reallocation of the abatement efforts between ET and NET sectors does not modify the equilibrium.

Table 10: JI/CDM credit import and optimal allocation

	No credits Optimal allocation	Max credits NET Optimal allocation	Max credits NAP = optimal allocation
Quota price	23 €	8 €	8€
NET average tax (UE-15)	23 €	8 €	8€
ET Allocation ($MtCO_2$)	1270	1611	1536
ET credits	0	0	75
Abatement efforts	34%	16%	16%
NET emissions ($MtCO_2$)	2431	2589	2589
NET credits		499	424
Abatement efforts	10%	4%	4%

Source: GTAP-ECAT simulation

Credits import makes it possible to reduce the compliance cost with Kyoto commitments on the one hand, to improve the cost efficiency of the burden sharing on the other hand.

In practice, credits import is strongly limited by their low availability, high transaction costs and many uncertainties. European countries will not be able to increase by a factor ten their forecasts of credit purchase within four years. Thus, the limited credits import will not be sufficient to restore an efficient burden sharing between ET and NET sectors.

5 Solution 3: extending the sectoral coverage of the directive

The inefficiency of the burden sharing between ET and NET sectors would not exist if all the sectors were covered by a single emission market. This situation is obviously theoretical since the extension of the EU ETS to a multitude of small emitters is not possible because of high administrative and transaction costs. It is however useful to study the effect of a sectoral extension of the directive on the efficiency of the burden sharing. In this section, we simulate two possible sectoral extensions of the EU-ETS: chemical industry and transportation.

The inclusion of the chemical sector seems natural to us since this sector was considered to be included in the ET sectors, and was finally not included because of the very strong German opposition.

In the GTAP-ECAT database, air transport and road haulage are aggregated. The extension to the transport sector is less obvious because of the emissions diffuse nature and, regarding the road haulage, of the multitude of small emitters. However, the European Commission is now considering the inclusion of air transport and it is completely possible to set up an emission trading scheme to regulate mobile emissions sources.

The simulation of a sectoral extension require to make a choice on the quantities of quotas allocated to the new sectors and we need to adjust each NAP. We simulate two possible extreme adjustment rules: an proportional adjustment and no NAP adjustment. A proportional adjustment simply consists in imposing to the new sector the same abatement effort than other ET sectors.

5.1 Sectoral extension and NAP proportional adjustment

We simulate three extension scenarios, by separately including the chemical sector then that of transport and finally by including these two sectors at the same time. Table **??** summarizes the NAP proportional adjustment for each extension. With no extension, ET sectors count for 42% of the UE-25 total emissions. The inclusion of the chemical and transport sector increases respectively this share to 51% and 57%. With the extension to the chemical and transport sectors, the EU-ETS covers more than 66% of the total emissions.

Table 11: NAP proportional adjustement

	No extension		Chemical = ETS		Transport = ETS		Transport + Chemical = ETS	
	2005-2007 NAP	%ETS	Adjusted NAP	%ETS	Adjusted NAP	%ETS	Adjusted NAP	%ETS
Germany	327	42%	397	51%	420	54%	490	63%
Austria	15	38%	18	46%	21	54%	24	62%
Belgium-Lux	34	28%	47	39%	59	49%	72	59%
Denmark	20	51%	21	53%	28	71%	29	74%
Spain	96	40%	122	51%	156	65%	182	76%
Finland	31	58%	34	64%	38	72%	42	78%
France	75	21%	125	35%	153	43%	200	56%
Greece	46	48%	47	49%	68	71%	70	73%
Hungary+Slovenia	37	42%	44	50%	44	50%	51	58%
Eire	13	38%	15	43%	18	53%	20	58%
Italy	138	37%	168	45%	198	53%	228	61%
Netherlands	53	34%	76	49%	98	63%	122	78%
Baltic States	66	72%	72	79%	80	87%	86	94%
Poland	257	59%	279	64%	274	63%	296	68%
Portugal	23	42%	29	53%	33	60%	39	72%
United-Kingdom	182	37%	216	44%	266	54%	300	61%
Sweden	15	29%	21	40%	30	58%	36	69%
Czech+Slovakia	109	55%	125	63%	117	59%	135	68%

Source : simulations GTAP-ECAT

Table 12 recapitulates the main results of our simulation. Extending the sectoral coverage of the directive results in an increase of the quota price. This is due to a specificity of the included sectors, whose marginal abatement costs appear to be higher than those of the other ET sectors. Regarding the NET taxes, the effect of the inclusion of chemical industry and of transport is different. The inclusion of the chemical sector increases the NET tax which reveals that this sector has a lower marginal abatement cost than the other NET sectors. The situation is the opposite in the case of the extension to the transport sector so that we can infer that the marginal abatement cost of transport is higher than the other NET sectors.

Table 12: Sectoral extension with NAP proportional adjustement

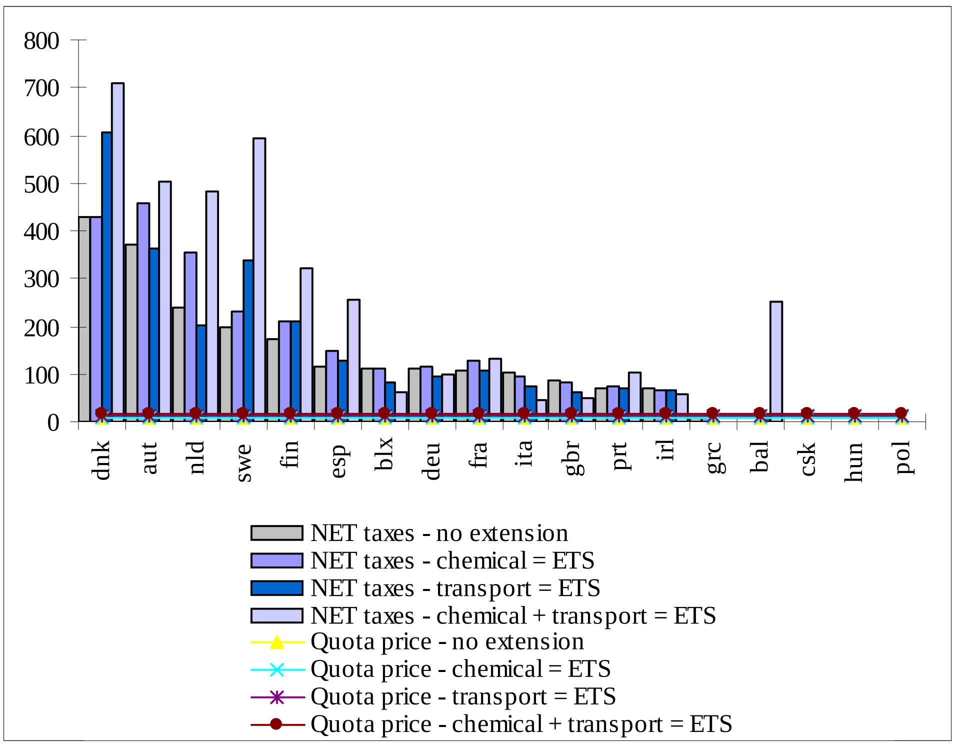
	No extension	Chemical	Transport	Chemical +Transport
Quota price	6,5 €	9,4 €	13,6 €	16,1 €
NET average tax (UE-15)	118,5 €	130,7 €	106 €	127 €
ET allocation ($MtCO_2$)	1536	1857	2103	2422
Abatement effort	20%	21%	21%	22%
NET emission ($MtCO_2$)	2117	1795	1553	1233
Abatement effort	21%	21%	20%	18%

Source: GTAP-ECAT simulation

Graphically, we note differences between countries. For a first group - Denmark, Austria, the Netherlands, Sweden, Finland and Spain - the sectoral extension results in increasing the NET taxes. For the other UE-15 countries, the extension rather tends to decrease the NET tax, which mean that in these countries, marginal abatement costs are higher in the chemical and transport sectors than in the other NET sectors. The case of the Baltic States is remarkable, since the extension of the directive obliges them to impose a NET tax which rises to more 250€ whereas they did not need to impose a NET before the extension. This effect confirms that the Baltic States allocated too many quotas to ET sectors. As long as the sectoral extension remains moderate, this over-allocation does not require the imposition of a significant constraint on the NET sectors since the Baltic States emit much less than their Kyoto commitments. But, when the sectoral extension is more significant, because of the proportional adjustment, the constraint on the remaining NET sectors is severely tightened.

The principle of a NAP proportional adjustment consists in keeping constant the abatement effort of ET and NET sectors before and after the extension. This adjustment prevent the extension to efficiently improve the burden sharing as we saw that an efficient burden sharing requires to increase the ET sectors emission constraint.

Figure 9: Quota prices and NETtaxes, setoral extension with NAP proportionnal adjustment



Source: GTAP-ECAT simulation

5.2 Sectoral extension without any NAP adjustment

We now assume that NAP are not adjusted when the sectoral coverage is extended. This obviously leads to an increase of the ET abatement effort and a decrease of NET. Table 13 and Figure 10 recapitulate the main results of our simulations.

Table 13: Sectoral extension with no NAP adjustement

	No extension	Chemical	Transport	Chemical +Transport
Quota price	6,5 €	27,9 €	62,5 €	104,7 €
NET average tax (UE-15)	118,5 €	38 €	2,1 €	0 €
ET allocation ($MtCO_2$)	1536	1536	1536	1536
Abatement effort	20%	34%	43%	50%
NET emission ($MtCO_2$)	2117	2064	1901	1503
Abatement effort	21%	9%	2%	0%

Source: GTAP-ECAT simulation

The sectoral extension without any NAP adjustment reallocates the efforts in favour of the NET sectors and improve the efficiency of the burden sharing. The inclusion of the chemical sector make it possible to approach the optimal allocation. The quota price is multiplied by more than 4 and reaches 27,9 € while the average NET tax is divided by almost a factor 3 and established at 38€.

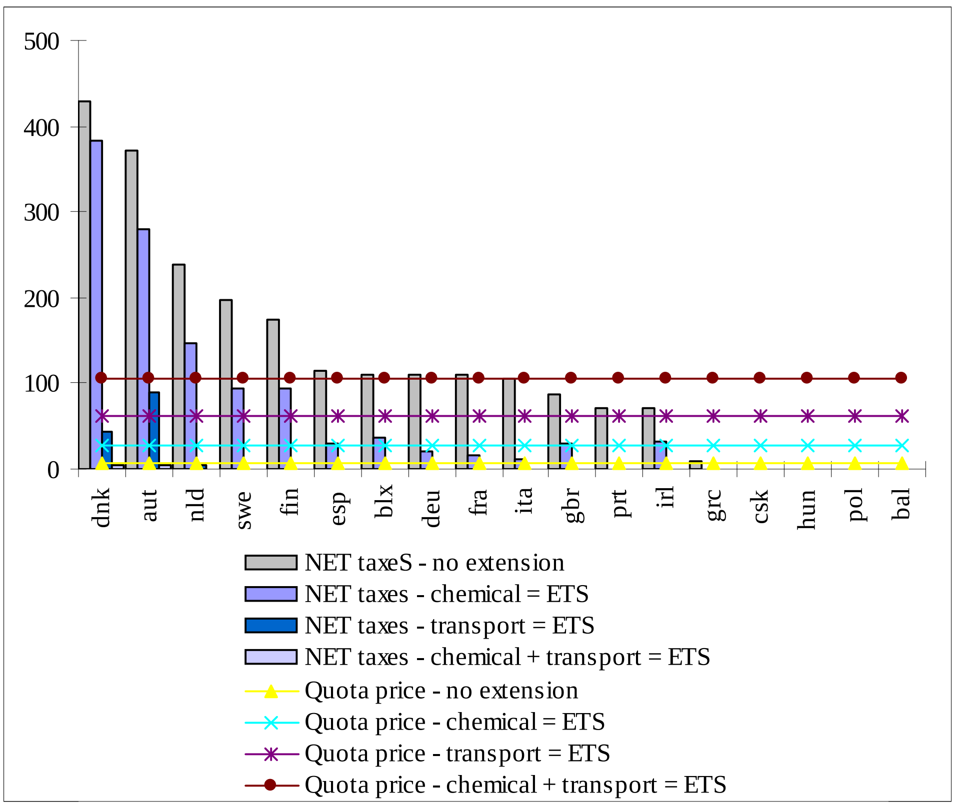
The inclusion of the transport sector reverses the relative situation of ET and NET sectors: ET sectors are now facing a quota price of 62,5€ which is higher than the average NET tax which decreases to 2,1€. The extension of the directive to the transport sector without any NAP readjustment of the NAP reverses the inefficiency of the burden sharing.

The case of a sectoral extension to the chemical and transport sectors obviously leads to an even more unbalanced situation: ET sectors face a quota price exceeding 100 € while it is not any more necessary to impose of tax on the NET sectors - except for Austria and Denmark.

Graphically the inversion of the burden sharing inefficiency results in a quota price which passes over the NET taxes.

To sum up, we simulated two extreme cases of NAP adjustment following a sectoral extension: an extension with a NAP proportional adjustment which fails to reallocate efficiently abatement efforts between ET and NET sectors, and an extension without any NAP adjustment which reverses the burden sharing inefficiency. Between theses two adjustments, there is an infinity of possible adjustments meaning that combining a sectoral extension with an appropriate NAP adjustment makes it possible to reach the optimal allocation.

Figure 10: Quota prices and NET taxes, setoral extension without any NAP adjustment



Source: GTAP-ECAT simulation

Conclusion

We have shown than if the NAP were replicated for the first Kyoto commitment period, the resulting burden sharing would be inefficient: indeed, ET sectors would face a quota price of 6,5€ while NET sectors would face an average tax of 133€. This gap indicates that the compliance cost with the Kyoto commitments is not minimized.

In this paper, we simulated various scenarios which could improve the burden sharing between ET and NET sectors. We analyzed three solutions.

The most immediate solution is simply to decrease the quantity of quotas allocated by the NAP to ET sectors. We showed that the optimal allocation - which equalizes the marginal abatement costs among ET and NET sectors in all European countries - required a reduction of about 17% of the quotas quantities allocated by the 2005-2007 NAP. We also showed that for two countries - Austria and the Netherlands - there remained a difference in marginal cost between ET and NET sectors, meaning that reducing the quantities of quotas allocated by the NAP is not sufficient to reach the optimal allocation.

The second solution is to rely on JI/CDM credits import. If each country was to import the maximum quantity of credits authorized by the supplementary principle and if theses credits come to decrease the NET emission constraint, the burden sharing efficiency would be improved. However, an heterogeneity remains between countries such as France which is still obliged to set up a NET tax higher than the quota price while the situation is reversed for other countries. It is thus necessary to combine credits import with a specific NAP adjustment.

Lastly, we simulated two possible sectoral extension of the directive while including in ET sectors, the sector of chemistry then that of transport. We showed that if the sectoral extension were accompanied by an adjustment proportional of the NAP, the effectiveness of the distribution of the efforts was not improved. On the other hand, the inclusion of the sector of chemistry without adjustment of the NAP makes it possible to approach the optimal distribution of the efforts while the inclusion of the transport sector without adjustment of the NAP led to a reversed inefficiency of the distribution of the efforts: it is then effective to increase the quantities allocated by the NAP.

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Annex A. List of Abbreviations

AAU	Assigned Amount Unit
CDM	Clean Development Mechanism
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
GTAP-ECAT	GTAP - European Carbon Allowance Trading
ET sectors	Energy intensive sectors covered by the EU-ETS
EU-15	The 15 old members of the European Union
EU-25	The 25 members of the European Union
EU-ETS	European Union Emission Trading Scheme
JI	Joint Implementation
UE-NM	The ten new members of the European Union
NAP	National Allocation Plan
NET sectors	Sectors not covered by the EU-ETS

Annex B. Sectors and regions aggregation

Table 14: Regions in GTAP-ECAT Simulations

AUT	Austria
BLX	Belgium and Luxembourg
DNK	Denmark
FIN	Finland
FRA	France
DEU	Germany
GBR	United-Kingdom
GRC	Greece
IRL	Eire
ITA	Italy
NLD	The Netherlands
PRT	Portugal
ESP	Spain
SWE	Sweden
CSK	Czech Republic and Slovakia
HUN	Hungary and Slovenia
POL	Poland
BAL	Baltic states
NOR	Norway
CHE	Switzerland
XEU	Other European countries
RUS	Russia
CHN	China
IND	India
USA	United States and Australia
AX1	Japan, Canada and New Zealand
NIC	Newly industrialized countries
ROW	Rest of the world

Table 15: Sectors in GTAP-ECAT simulations

AGR	Agriculture
FPR	Food Products
OIL	Crude Oil
COL	Coal transformation
GAS	Gas production and distribution
P_C	Refined oil products
OMN	Mining
TWL	Textiles wearing apparel and leather
LUM	Lumber
PPP	Paper pulp and print
CRP	Chemical industry
I_S	Iron and steel
NFM	Non ferrous metals
TRN	Transport equipment
OME	Other machinery
OMF	Other manufacturing
ELY	Electricity
CNS	Construction
T_T	Trade and transport
SER	Public and private services
DWE	Dwellings

Annex C. Grandfathering allocation

We simulate the effects of a grandfathering allocation to ET sectors, meaning that theses sectors receive a quantity of quotas corresponding to their historical share in the national emissions. There is obviously no reason that such an allocation could ensure abatement cost equimarginality between ET and NET sectors. However, this allocation rule relies on a very simple criterion and we thus wish to compare it to the 2005-2007 NAP allocation. Table 16 makes it possible to compare the two allocation rules.

Table 16: 2005-2007 NAP and granfathering allocation in 2010

	2005-2007 NAP		Grandfathering	
	allocation	%ET	allocation	%ET
Germany	327	42%	340	44%
Austria	15	38%	*15*	*38%*
Belgium-Lux	34	28%	37	31%
Denmark	20	51%	20	41%
Spain	96	40%	94	39%
Finland	31	58%	30	57%
France	75	21%	75	21%
Greece	46	48%	46	48%
Hungary-Slovenia	37	42%	41	47%
Eire	13	38%	13	40%
Italy	138	37%	151	40%
Netherlands	53	34%	*51*	*33%*
Baltic states	66	72%	55	61%
Poland	257	59%	275	63%
Portugal	23	42%	23	43%
United-Kingdom	182	37%	192	39%
Sweden	15	29%	14	27%
Czech+Slovakia	109	55%	117	59%

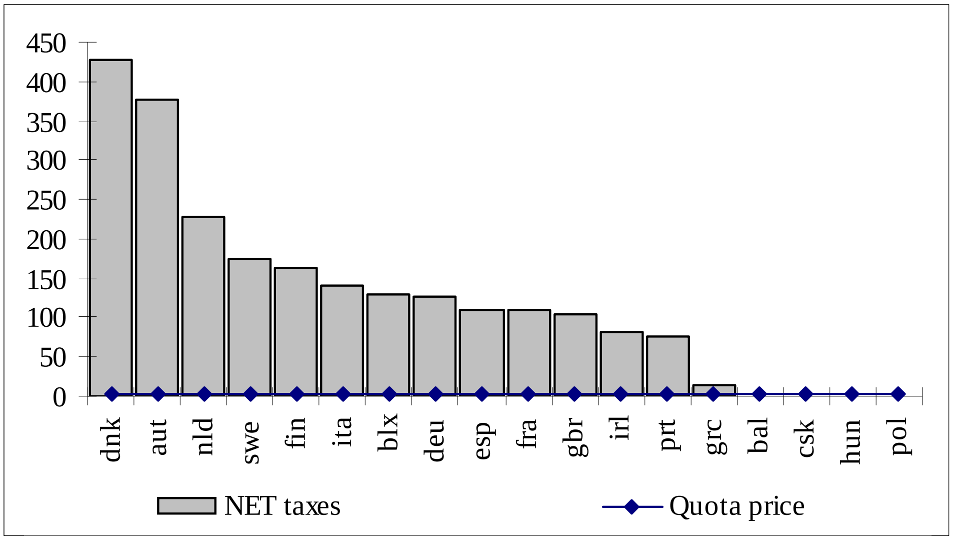
Source: GTAP-ECAT simulation

We emphasize three categories of country:

- those to which the NAP are very close to grandfathering : Austria, Denmark, France and Greece.
- those whose NAP are more ambitious than grandfathering : Germany, Belgium, Luxembourg, Hungary, Slovenia, Eire, Italy, Poland, Portugal, the United Kingdom the Czech republic and Slovakia.
- those whose NAP are more generous than grandfathering : Spain, Finland, the Netherlands, the Baltic States and Sweden.

At the European level, grandfathering is a little bit more generous than the 2005-2007 NAP as it allocates a total of 1595 Mt while the 2005-2007 NAP allocate only 1536 Mt. This results in a lower quota price which is established to 4,2 €. Table 11 report the quota price and national NET taxes under a grandfathering allocation.

Figure 11: Quota price and NET taxes under a grandfathering allocation



Source : simulations GTAP-ECAT

When the 2005-2007 NAP is very close to grandfathering, the NET tax remains obviously the same one. When grandfathering is stricter that the NAP, the tax decreases and so does the distortion between ET and NET sectors. It is the opposite when grandfathering allocates more allowances than the NAP. Globally, grandfathering increases the distortion between NET and ET sectors and the average NET tax raises from 113€ to 130€. Thus the 2005-2007 NAP are slightly more efficient than grandfathering. The difference is however tiny and one should certainly put it in balance with the long negotiations necessary to establish each NAP.