EU Emission Trading – better job second time around?

Joachim Schleich
Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI), Germany
Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA
joachim.schleich@isi.fraunhofer.de

Regina Betz
Centre for Energy and Environmental Markets (CEEM), School of Economics
University of New South Wales (UNSW)
Australia
r.betz@unsw.edu.au

Karoline Rogge
Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI), Germany
ETH Zurich, Group for Sustainability and Technology (SusTec), Switzerland
karoline.rogge@isi.fraunhofer.de

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Abstract
The EU Emission Trading Scheme (EU ETS) for CO_2-emissions from energy and industry installations reflects a paradigm shift towards market-based instruments for environmental policy in the EU. The centerpieces of the EU ETS are National Allocation Plans (NAPs), which individual Member States (MS) design for each phase. NAPs state the total quantity of allowances available in each period (ET-budget) and determine how MS allocate allowances to individual installations. The NAPs thus govern investments and innovation in energy efficient technologies and the energy sector. In terms of distribution, they predetermine winners and losers.

In this paper we analyze and evaluate 25 NAPs submitted to the European Commission (EC) for phase 2 (2008-2012) of the EU ETS. At the macro level, we assess whether the submitted ET-budgets are stringent, and whether they imply a cost-efficient split of the required emission reductions between the EU ETS sectors (energy and industry) and the remaining sectors (transportation, tertiary and households). Comparing the submitted ET-budgets with those already approved by the EC suggests that the EC's decisions significantly improved the effectiveness and economic efficiency of the EU ETS. But given the high share of Kyoto Mechanisms companies are allowed to use, the EU ETS is unlikely to require substantial emission reductions within the EU.

At the micro level, we assess (across countries and phases) the allocation methods for existing and new installations, for closures and for clean technologies. A comparison of the NAPs for the second phase and the first phase (2005-2007) provides insights into the (limited) adaptability and flexibility of the scheme. The findings provide guidance for the future design of the EU ETS and applications to other sectors and regions.

Introduction
As the EU's key climate policy instrument, the EU Emissions Trading Scheme (EU ETS) for large CO_2-emitting installations in the energy and industry sectors is expected to help the EU and the EU Member States (MS) reach their short- and long-term greenhouse gas emissions targets in a cost-efficient way. The start of the EU ETS in 2005 may also reflect a shift in environmental policy from command-and-control type environmental regulation, such as setting technology standards, towards market-based instruments. The latter instruments induce demand for innovative, energy/carbon saving processes, products and services because the costs of reducing emissions will eventually be reflected in the market price for EU emission allowances (EUA). This increased demand should in turn lead to more research and development, and the invention, adoption and market diffusion of such innovations. The extent of the technological change induced by the EU ETS crucially depends on the scheme's design (Gagelmann, Frondel 2005; Schleich, Betz 2005). In general, this is governed by the EU Emission Trading Directive 2003/87/EC (CEC 2003) and country-specific design features are determined by the National Allocation Plans (NAPs) of the individual MS for each trading period. The first trading period of the EU ETS is from 2005 to 2007 (phase 1); the second trading period (phase 2) coincides with the Kyoto commitment period from 2008-2012. At the macro level, NAPs state the total quantity of allowances available in

each period (ET-budget); at the micro level, they determine how these allowances will be allocated to individual installations. Thus, at the macro level, the NAPs determine to what extent the individual MS may rely on the EU ETS to achieve their emission targets. In particular, the NAPs establish how to "split the pie": How many allowances should be allocated to the installations covered by the EU ETS trading sectors (i.e. from energy and industry sectors), and which emission reductions are expected from the household, services and transport sectors, which are not covered by the EU ETS (non-trading sectors)? The combined emission budgets for trading and non-trading sectors also determine to what extent MS rely on domestic efforts and to what extent on the Flexible Mechanisms of the Kyoto Protocol to meet their emissions targets, i.e. International Emission Trading, the Clean Development Mechanism (CDM) and Joint Implementation (JI).

The size of the ET-budget at the macro level of the NAPs indicates whether the EU ETS is environmentally effective in terms of reducing CO_2-emissions. The allocation rules specified at the micro level for existing and new installations and for closures shape incentives for innovation and long-term investments in low-carbon energy technologies and in energy-efficiency in the industry sectors. In terms of distribution, the micro plan also predetermines the winners and losers of emission trading. All NAPs need to be approved by the EC based on the criteria specified in Annex III of the Emission Trading Directive (CEC 2003) and in the NAP guidance (CEC 2004a; CEC 2005).

In this paper, we provide a comprehensive first analysis and evaluation of the NAPs of all 25 MS and thus significantly extend and update prior work by the same authors (Betz et al. 2006). The NAPs of Romania and Bulgaria were excluded as they face special circumstances due to joining the EU in 2007. The total proposed budget of the 25 NAPs studied is approx. 2,179 million t of CO_2e p.a. (one EUA corresponds to one tonne of CO_2e). On 29 November 2006 the EC published its assessment of a first group of NAPs from 10 MS, and on 16 January 2007 for a second group of 2 MS. The EC issued two additional NAP decisions for Slovenia and Spain on February 5, 2007 and February 26, 2007, respectively. In addition, we consider the resubmitted NAP of France as "quasi-approved" by the Commission[1] – making a total of 15 "approved" NAPs.

The structure of the paper is as follows. Section 2 consists of the macro-level analysis which presents our evaluations on the stringency of the ET-budgets using historical emissions in 2005, the size of the ET-budgets in phase 1 and projected emissions in 2010 as benchmarks. We also appraise the split of the required emission reductions between the ET-sectors and the remaining sectors (including non-CO_2 sources) from a cost-efficiency perspective. In particular, we assess the impact of the EC's assessments of the NAPS in terms of these four criteria. Section 3 includes the micro-level analysis and assesses the allocation rules for existing and new installations, for closures and for clean technologies based on insights from economic theory. We also survey provisions for combined heat and power (CHP) plants, early action and process-related emissions. The rules at the micro-level are also compared to those applied in phase 1. A summary table in the Annex provides a comprehensive overview of the micro plans. Finally, the concluding Section 4 briefly summarizes the main results, points to areas of improved harmonization and efficiency and offers guidance for the future design of the EU ETS and its possible application to other sectors and regions.

Macro-level Analysis of National Allocation Plans

Since the ET-budgets set by MS are key for the ET-sectors' contribution to reducing greenhouse gas emissions the EC took a close look at the proposed ET-budgets. On 29 November 2006 the EC published its first decision on the NAPs of Germany, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta, Slovakia, Sweden and the United Kingdom, and on January 16, 2007 its decision on the NAPs of Belgium and the Netherlands. As stated above the EC issued two additional NAP decisions for Slovenia and Spain on February 5, 2007 and February 26, 2007, respectively. In this paper, when assessing the stringency of the NAPs, we will compare macro figures from notified NAPs with figures taken from the Commission's NAP decisions.

PROGRESS TOWARDS KYOTO: DISTANCE-TO-TARGET AND SUPPLEMENTARITY ANALYSIS

As of 2004, apart from the new MS, which are - with the only exception of Slovenia - clearly on a path towards reaching their Kyoto emission targets, only France, Greece, Sweden, and the UK appear to be on target, while most other EU-15 MS will need to make substantial additional efforts to meet their targets (see UNFCCC 2006; EEA 2006). Of course, the distance-to-target situation improves for MS intending to use Kyoto Mechanisms (KM), i.e. MS for Austria, Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and Sweden. [2] In total, the 11 EU-15 MS intend to purchase CERs, ERUs or AAUs for emissions of approx. 109 $MtCO_2$e/a, which represents a share of 7.3 % of the Assigned Amount of these EU-15 MS (see Table 2).

In addition, the Linking Directive (CEC 2004b) allows companies to use credits from projects under Joint Implementation (JI) and the Clean Development Mechanism (CDM) to cover their emissions under the EU ETS (see Table 1 and 2). In line with the Linking Directive, MS specified the use of these KM by companies as a percentage of allocation in their NAPs (KM limit) (Article 5, CEC 2004b). These limits differ substantially across countries and range from 0 % in Estonia and Malta to 70 % for public service electricity generation in Spain (only 20 % for remaining sectors). Based on the supplementarity requirements of the Marrakesh Accords and the Kyoto Protocol, the EU ETS Directive requires that the use of KM must be supplemental to domestic action (see Article 30.3, CEC 2004b). For its NAP assessment, the EC has developed a new quantitative criterion to assess the conformity of the KM limit for companies with supplementarity principles. The maximum

1. We are including the figures from France's resubmitted NAP as "quasi-accepted" by the EC, and compare these with figures from France's originally submitted NAP, since France has applied the criteria published in the EC's first NAP II decision on November 29, 2006 for its revised NAP. Also, allocation data and rules of the revised German NAP (of 13 February 2007) are used.

2. Intended governmental use of Kyoto Mechanisms (in $MtCO_2$e/a): Austria 9, Belgium 7, Denmark 4.2, Finland 2.4, Ireland 3.6, Italy 19, Luxembourg 4.7, the Netherlands 20, Portugal 5.8, Spain 31.8 and Sweden 1.1.

Table 1. Notified and accepted use of Kyoto mechanism by governments and companies

	Governmental use of KM	Permitted company use of KM	Sum of max. KM use
		in million ERU and CER / a	
EU-25 (25) Notified	108,9	373,1	482,1
(15) Accepted	*67,3*	*167,4*	*234,8*

Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, and CEC 2007a, CEC 2007b, CEC 2007c

overall amount of credits from JI/CDM projects that a Member State can make use of is half of the amount of reduction it is required to undertake in relation to either base year emissions, greenhouse gas emissions in 2004, or projected emissions in 2010, whichever of the three is highest. The amount of JI/CDM credits that can be used by EU ETS installations in that Member State is reduced by the annual average amount of intended or substantiated government purchases (CEC 2006a, p. 9). In order to stimulate demand in JI and CDM, the EC grants operators a minimum level of 10 % of the allocation – regardless of quantitative supplementarity requirements (CEC 2006a; CEC 2007a, b, c). Since companies may trade credits from JI or CDM-projects for EUAs, restrictions imposed by individual MS on the use of these credits will only be binding at the aggregate level: In the 25 MS analyzed in this paper, the total use of KM would be approx. 373.1 $MtCO_2e/a$.[3] Since the EC imposed restrictions on the size of the ET-budgets (for 12 out of 14 MS, see below) and on the use of KM, this figure has so far dropped to 352.3 $MtCO_2e/a$. [4]

Table 1 depicts the sum of companies' maximum use and governments' intended purchases of KM being approx. 482.1 $MtCO_2e/a$, a figure that decreases when considering the EC assessments. This figure relates to a distance-to-target (DTT as of 2004) of all 25 MS examined of some 21 $MtCO_2e/a$ only, which clearly shows that – EU-wide – there would be no need for additional domestic reductions at all. Of course, there are substantial differences between EU-15 and EU-10 MS (DTT of -306 vs. 285 $MtCO_2e/a$) as well as across MS.

STRINGENCY OF NATIONAL ET-BUDGETS

Verified emissions data for 2005 (CEC 2006c) revealed that only very few countries allocated quantities of EUA in 2005 which are below the actual 2005 emission levels of the ET-sector (Austria, Greece, Italy, Ireland, Spain and the UK). As a consequence of this allowance surplus of about 44 million EUA for 2005, in May 2006 prices for EUA plummeted from around € 26/EUA to around € 10/EUA and are now (January 2007) at € 5/EUA. Scarcity, however, is a prerequisite for a well-functioning market, i.e. without scarcity, the existence of the EU ETS would be hard to justify. As a consequence the Commission has developed its own criterion, which is based on 2005 verified emission data, economic growth and carbon intensity trends (CEC 2006a, p. 3ff.). Applying this criterion has led the EC to require budget cuts in all but two of the assessed plans (the UK and Slovenia).

Figure 1 shows these cuts in ETS budgets for phase 2 in absolute and relative terms. The largest reduction in absolute terms is required of Germany with almost 29 million EUA/a (compared to its NAP II budget of 482 million EUA/a, not the later proposal of 465 million EUA/a), while the largest cut in relative terms applies to Latvia with almost 58 %. In total, the EC reduced the phase 2 budgets of these 15 MS by approx. 134 million EUA or -9.6 %. Of these, -110 million EUA/a were requested of EU-15 MS (corresponding to a reduction of -8.4 %), while -23 million EUA/a can be attributed to the new MS (representing a cut of -30.5 %).

To assess the stringency of the ET-budgets for phase 2 we compare those with verified emissions for 2005 (criterion 1), the size of ET-budgets in phase 2 (criterion 2) and the projected emissions for 2010. Since the type and number of installations participating in the EU ETS differs between both phases – e.g. as a consequence of the EC's attempt to harmonise the coverage installations, or because some MS decided to opt out installations in phase 1 – adjustments had to be made for a meaningful comparison. [5] We also show the impact of the EC's assessment by applying the criteria to both the *notified* ET-budgets and to the ET-budgets allowed by the EC.

Criterion 1: Second phase ET-budgets (without reserve for new entrants*) compared to verified emissions for 2005*

The results of the comparison of phase 2 ET-budgets (without NER) with verified emissions for 2005 are shown (in %) in Figure 2. A positive value indicates that the ET-budget for phase 2 is larger than 2005 verified emissions of the ET-sector, a negative result shows that the ET-budget is set below 2005 emission levels. On the left-hand side, EU-15 MS are depicted, on the right-hand side EU-10 MS. In general, while EU-15 MS tend to pass this criterion (except for Finland, France, Luxembourg and Sweden), especially after the budget cuts demanded by the EC (striped bars), the new EU-10 MS – with the exception of Slovenia – fail this test which means that installations are granted room for growth. [6]

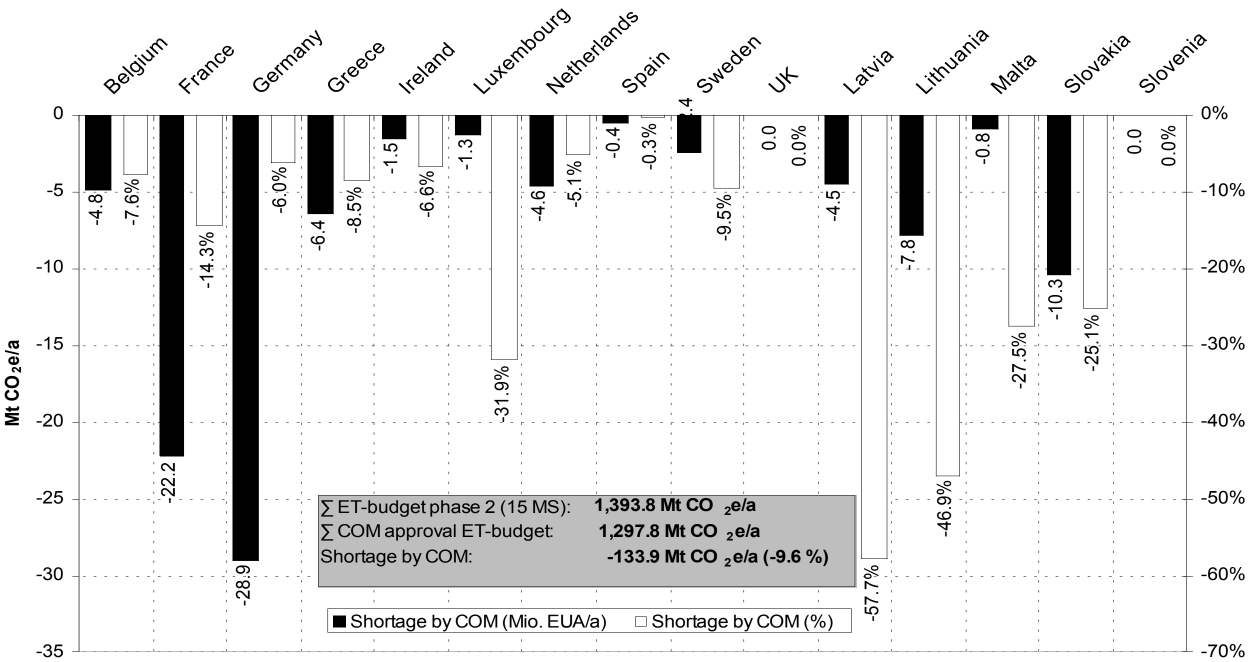
Since the EC did not provide any information, - we assumed the EC's decision would result in a proportional cut of the ET-budgets and the NERs. Of course, MS may decide otherwise, in particular Latvia and Malta, where – because their proposed NERs were relatively large, a proportional reduction would imply substantial shortage of EUAs for existing installations.

3. This figure already includes the increase of the KM limit for German companies from 12 % to now 20 %.

4. Approved (and, if different, originally planned) shares for the use of KM are (in %): Belgium 8.3, Germany 20 (originally 12), Greece 9, Ireland 21.9 (50), Latvia 5, Lithuania 8.9, Luxembourg 10, Malta 0, the Netherlands 10 (12 %), Slovenia 15.8 (17.8), Slovakia 7, Spain 13.2 (70/20), Sweden 10 (20), UK 8. KM limits (in %) of not yet approved NAPs include Austria 20, Cyprus 10, Czech Republic 10, Denmark 19, Estonia N.A., Finland (average of) 15.2, France 10, Hungary 10, Italy 25, Poland 25, Portugal 10.

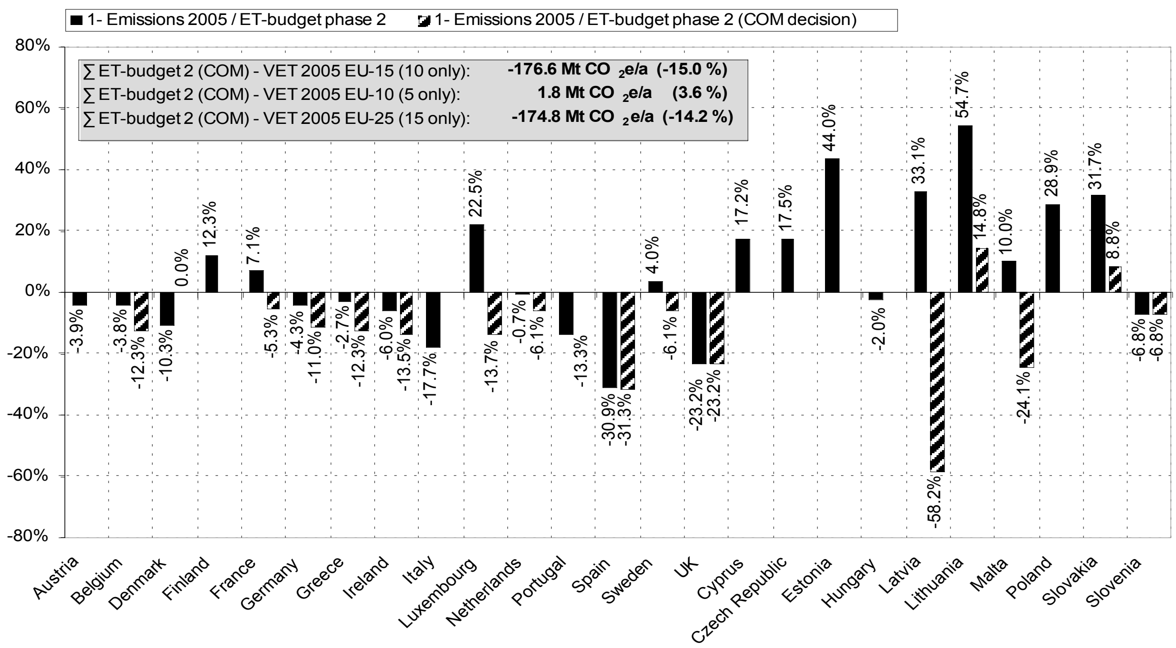
5. For a detailed description on the methodology see Rogge et al. (2006).

6. As registry data for Poland still only covers less than 60 % of the cap set in Poland s first NAP, data from the verified emissions tables (VET) for 2005 for Poland is estimated and thus needs to interpreted with caution (for details see Rogge et al. 2006).



Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a and CEC 2007a, CEC 2007b, CEC 2007c

Figure 1. *ET-budget cuts demanded by the EU Commission for phase 2 (in MtCO2e/a and %)*



Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, CEC 2007a, CEC 2007b, CEC 2007c, CEC 2006b, registry data (CITL as of October 23, 2006), UNFCCC 2006 and EEA 2006

Figure 2. *ET-budgets for phase 2 and COM adjusted budgets compared to emissions in 2005 (in %)*

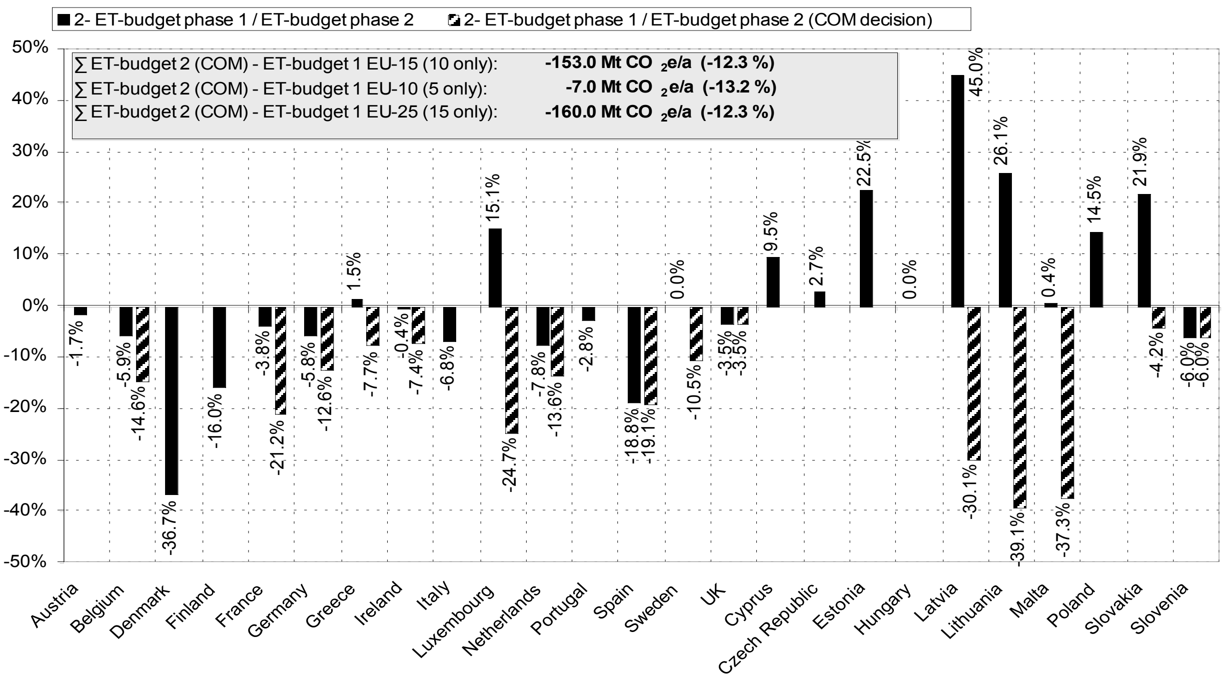
Criterion 2: Second phase ET-budgets compared to first phase ET-budgets (including NERs)

A MS is said to fulfil this criterion if its adjusted ET-budget for phase 2 is lower than the ET-budget for phase 1. Figure 3 presents the results of this assessment, including changes due to budget reductions required by the EC (striped bars).

In the EU-15, all MS except for Luxembourg and Greece reduced their ET-budget for phase 2 below the budget in the pilot phase 2005-07. In contrast, all EU-10 MS – again with the exception of Slovenia – notified ET-budgets for phase 2 that exceed ET-budgets in the current phase. A look at the striped bars shows that the budget cuts required by the EC lead to a situation where all countries fulfil criterion 2.

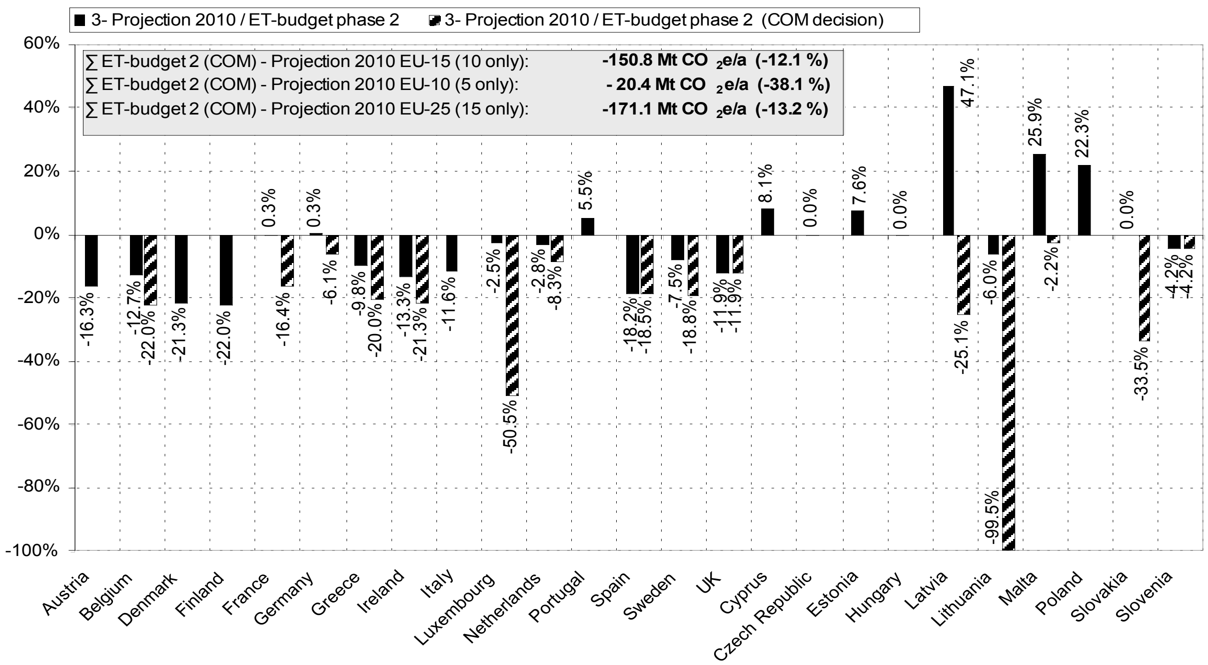
Criterion 3: Second phase ET-budgets (including NERs) compared to projected emissions for 2010

This criterion is considered to be met if the ET-budget for phase 2 is lower than the projected emissions for 2010, i.e. the figures shown in Figure 4 are negative. Again, our assessment



Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, CEC 2007a, CEC 2007b, CEC2007c, CEC 2006b, registry data (CITL as of October 23, 2006), UNFCCC 2006 and EEA 2006

Figure 3. *ET-budgets for phase 2 and COM adjusted budgets compared to ET-budgets in phase 1 (in %)*



Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, CEC 2007a, CEC 2007b, CEC 2007c, CEC 2006b, registry data (CITL as of October 23), 2006, UNFCCC 2006 and EEA 2006

Figure 4. *ET-budgets for phase 2 and COM adjusted budgets compared to projection for 2010 (in %)*

for the EU-15 MS differs substantially from our assessment for the new MS when looking at notified NAP data. While EU-15 MS choose an ET-budget that is lower than projections (with the exceptions of France, Germany and Portugal), most new MS intend to allocate more than or same as projected emissions (with the exceptions of Lithuania - whose projection is rather high – and Slovenia). Again, the decisions undertaken by the EC lead to a situation where all countries meet criterion 3.

Overall, of the 25 notified NAPs analyzed, only nine meet all three criteria, namely Austria, Belgium, Denmark, Ireland, Italy, the Netherlands, Spain, the United Kingdom and – as the only EU-10 MS – Slovenia. The results at the aggregate level of

Table 2. Results for three criteria at aggregate level of 25 NAPs and comparison with companies' KM limit

		ET-budget in phase 2 compared to						KM limit for companies
		VET 2005 (criterion 1)		ET-budget in phase1 (criterion 2)		Emission projections for 2010 (criterion 3)		
		in million EUA	in % of VET 2005	in million EUA	in % of ET-budget phase 1	in million EUA	in % of projected emissions	in million ERU-CER/a
EU-15 (15)	Notified	-149,1	-9,6%	-111,5	-6,7%	-119,7	-7,2%	286,4
(10)	*Accepted*	*-176,6*	*-15,0%*	*-152,9*	*-12,3%*	*-150,8*	*-12,1%*	*163,3*
EU-10 (10)	Notified	127,9	25,8%	65,8	12,7%	67,9	13,1%	86,7
(5)	*Accepted*	*1,8*	*3,6%*	*-7,0*	*-13,2%*	*-20,4*	*-38,1%*	*4,1*
Total (25)	**Notified**	**-21,2**	**-1,0%**	**-45,7**	**-2,1%**	**-51,8**	**-2,4%**	**373,1**
(15)	***Accepted***	***-174,8***	***-14,2%***	***-160,0***	***-12,3%***	***-171,1***	***-13,2%***	***167,4***

Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, CEC 2007a, CEC 2007b, CEC 2007c, CEC 2006b, registry data (CITL as of October 23, 2006), UNFCCC 2006 and EEA 2006

all NAPs – before and after taking into consideration the NAP decisions of the EC – appear in Table 2. After the Commission's ruling on the first 14 (+1) NAPs the majority of MS now meet all criteria. Due to high growth rates for the EU-10 MS, the only notable exception is the comparison of their permitted phase 2 budgets with 2005 emissions. A comparison of the maximum amount of KM companies may use to fulfil their ETS obligations with the reduction requirements implied by the three criteria, entails only few reductions within the EU.

COST-EFFICIENCY OF ET-BUDGETS

To examine the extent to which MS rely on the EU ETS to meet their Kyoto burden-sharing targets, we examine whether the sizes of the notified ET-budgets are consistent with an efficient distribution of reduction efforts between trading and non-trading sectors and again compare our results with new budgets resulting from EC requirements. From an economic perspective, the size of the budgets for the ET-sector and the non-ET-sector should be determined such that (before international trading starts) the total abatement costs are minimized, i.e. that the marginal costs of the abatement measures realized in the trading and the non-trading sectors are equal. Thus, sectors with cheaper measures should contribute more reductions (relatively) to achieving a country's emission target.

Criterion 4: Hypothetical allocation scenario (HAS) between ET- and non ET-sectors for 2008-12

To derive an indicator for the cost-effectiveness of the ET-budgets, we relate the size of the ET-budget in the NAPs to a "hypothetical allocation scenario between ETS and non-ETS" (HAS). The HAS represents the budget resulting for the trading sector (biggest parts of energy and industry) assuming that all sectors contribute proportionally to achieving a country's emission target. In this paper we are using a Kyoto Mechanism scenario for those MS intending to use KM, thereby increasing the national emission budgets (and consequently also the HAS). In our assessment, the NAP of a MS is considered to meet this criterion if the ET-budget is not larger than the budget which corresponds to the HAS, i.e. to a proportional reduction of emissions to reach the Kyoto-target.[7]

Figure 5 shows the differences between the actual ET-budgets and the HAS (in %), again comparing ET-budgets notified by MS with ET-budgets accepted by the EC. Before the Commission's ruling, apart from the UK, Spain, the Czech Republic, and Hungary, the emission budgets for the ET-sectors in all other MS are – often significantly – larger than those which would result from a proportional contribution. In terms of cost-efficiency, this result insinuates that the "pie split" is not efficient in most countries. According to many studies (including Böhringer et al. 2006; Criqui and Kitous 2003; or Peterson 2006), the marginal abatement costs of the ET-sector are lower than the abatement costs of other sectors in the economy (even without considering the ETS-companies' option to use "cheap" credits from CDM or JI-projects to fulfil their obligation under the EU ETS). Thus, from a cost-efficiency perspective, the ET-sectors should actually make a higher than proportional contribution to a MS' required emission reductions.

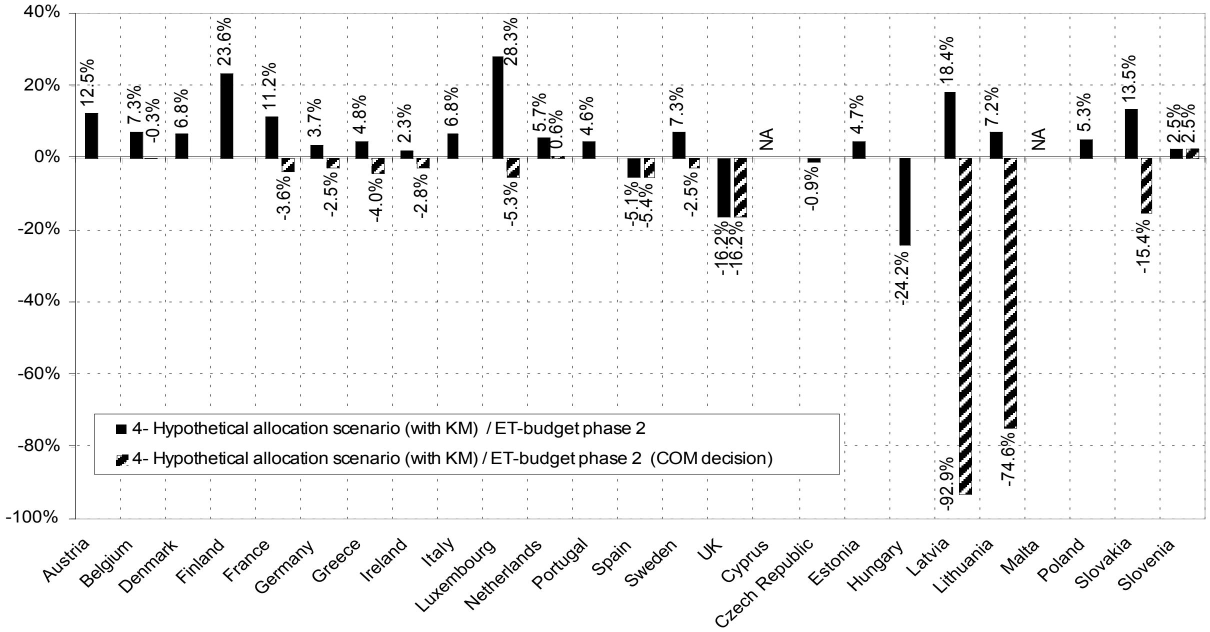
The striped bars show how our assessment improves with the new, EC approved phase 2 budgets: almost all of the 14 (+1) MS are now requested to assign EU ETS budgets that are close to or even clearly below the HAS (only exceptions are the Netherlands and Slovenia). The EU ETS sector would thus actually shoulder an over-proportional reduction burden compared to the rest of the economy, which – due to lower marginal abatement costs in the EU ETS sector – should reduce the overall abatement costs borne by society for meeting emission reduction targets.

Micro level analysis

As in phase 1 of the EU ETS, the majority of MS again apply a two step approach to determine the quantities of EUA allocated to individual installations.[8] In the first step, sector budgets (SB) are determined, typically based on a combination of historical emission levels or average benchmarks, emission saving potentials (EF = efficiency factor), growth projections, and a compliance factor (CF) which ensures that the overall ET-budget is met. In the second step, the sector budgets are then allocated for free to individual installations (IA = installation allocation), typically based on their emissions' share in a base period (rather than on output or capacity). Technically, most EU-15 MS apply sector-specific compliance factors to guarantee that allocation

7. For further details on the methodology applied in calculating the HAS see Rogge et al. 2006.

8. In some countries, the energy sector only includes power installations connected to the grid. In other MS, the energy sector also includes power installations in the industry sector. For simplicity we usually do not make this distinction when presenting the general results.



Source: Fraunhofer ISI based on NAPs of MS, CEC 2006a, CEC 2007a, CEC 2007b, CEC 2007c, CEC 2006b, registry data (CITL as of October 23, 2006, UNFCCC 2006 and EEA 2006

Figure 5. *ET-budget for phase 2 compared to "hypothetical allocation scenario" with KM (in %)*

to installations does not exceed sector budgets. In the simplest case, there are only two budgets: one for energy and one for industry. [9] Most of the new MS (e.g. Estonia, Latvia, Slovakia) will easily reach their Kyoto-targets and do not apply sector budgets or compliance factors at installation level. Next we will analyse in more detail the allocation rules for existing installations, for new projects (including new entrant reserves) and for closures, drawing primarily on arguments from economic theory. The section also covers special provisions for CHP, early action, and process-related emissions.

ALLOCATION RULES FOR EXISTING AND NEW INSTALLATIONS

Auctioning and windfall profits

Economists generally prefer auctioning to conventional grandfathering (e.g. Cramton and Kerr 2002). In particular, under auctioning the "polluter-pays" principle holds so that the outcome may be perceived as "fair". Also, auctioning off part of the budget right at the beginning of the trading period may also generate robust early price signals for the actual scarcity in the market, since participants base their bidding behaviour on their marginal abatement costs (and expected prices in the secondary market) (e.g. Schmalensee et al. 1998). Further, auction revenues could be used for other purposes, including compensation to households or companies for increased power prices, funding for R&D in energy-efficient technologies, reducing public debt, or lowering distorting taxes, thus improving the efficiency of the entire economy (double dividend).

In addition, auctioning off all allowances could avoid most, if not all, problems and distributional aspects which result in inefficient and complex rules in several MS. These aspects include accounting for early action, excess allocation at installation level [10], or the treatment of new installations and closures (see below). Thus, the NAPs could be much simpler, more transparent and more efficient if all allowances were auctioned off. Auctioning off allowances would also address "windfall profits": if companies manage to pass on any additional marginal costs (opportunity costs) associated with emissions (i.e. price of allowances) to customers, extra profits (windfall profits) accrue if allowances are allocated for free. Whether allowances are auctioned off or allocated for free does not alter the opportunity costs (of additional emissions), but the outcomes in terms of the distribution of the scarcity rents are quite different. According to Sijm et al. (2006), the pass-through rates for electricity in the EU vary between 60 and 100 %, depending on the country, market structure, demand elasticity and CO_2-price considered. Also, under (at least partially) free allocation, companies' profits in the product market (e.g. electricity) may rise if prices for EUA increase (above competitive prices) and if these increases can be passed on to consumers in the product markets. Participating companies are better off if allowances are allocated for free, since their wealth increases by the total value of these allowances. Thus a free allocation is politically more palatable which may explain the observed low shares of the ET-budgets that MS intend to auction off also in the second phase (see Annex). Although, compared to phase 1, where only four MS (Denmark, Hungary, Ireland and Lithuania) chose to auction off parts of their ET-budget, more MS (so far 9 MS) will do so in phase 2 (but no longer Denmark), and the shares will usually be larger but tend to be well below the maximum share of 10 %

9. Note that if the emission budget for a particular group of installations is fixed, then a BM allocation implies that the allocation to an installation is in proportion to the share of the activity level of that installation. In particular, the allocation to an installation is independent of the level of the benchmark.

10. To prevent excess allocation, some MS (Austria, Germany) had included so called ex-post adjustments of the allocation in phase 1. Since ex-post adjustments are at odds with the logic of emission trading (ex-ante principle of allocation), the EC has ruled against them.

allowed by the ETS Directive in phase 2. Italy intends to sell 5.7 % of its ET budget to ET-companies, and Germany plans to sell 1 million EUA p.a. on the market to cover administrative costs. To address windfall profits in the power sector, most of the EU-15 MS imposed a higher relative reduction burden on energy sectors compared to industry sectors. Italy, Portugal, Sweden, the UK and (implicitly also) Germany, for example, determine the size of the budget for the power sector as the residual of the ET-budget once allocation to other installations has been determined. The Netherlands apply an additional specific reduction factor of 0.15 to existing power installations to correct for windfall profits.

Conventional grandfathering and benchmarking for existing installations

Under benchmarking, allocation is based on specific emission values per unit of production (e.g. kg CO_2/MWh electricity or t CO_2/t cement clinker) for a particular group of products or installations. The actual number of allowances can be derived from the specific benchmark multiplied by past or predicted installation-specific or standardized activity rates. Average benchmarks are calculated as the activity-weighted average of emission values for a particular group and result in a higher allocation for all companies than benchmarks based on the best-available technology (BAT-benchmarks). A benchmarking allocation at installation level favours carbon-efficient installations over less carbon-efficient installations, since operators of the latter need to purchase missing allowances on the market or have fewer excess allowances. Thus, allocating allowances on benchmarks, may be perceived as more fair than conventional grandfathering. Since benchmarking to existing installations accounts for early action, it may lead to desired distributional effects. Differentiating benchmarks by fuels, technologies or sub-product groups soften these effects compared to benchmark which is uniformly applied to all installations in a group. [11]

Also, if companies can directly affect their allocation (updating), benchmarking leads to more efficient outcomes than conventional grandfathering (Sterner and Muller 2006; Cremer and Schleich 2006). For example, for installations receiving fewer free allowances under benchmarking than under conventional grandfathering, benchmarking provides a greater incentive to substitute inefficient installations if closures result in a termination of allocation (see also paragraph on closures). The tighter the benchmark, the higher this incentive would be. Finally, benchmarking may also facilitate comparison across EU MS and may be seen as a first step towards harmonized allocation rules throughout the EU (Kruger and Pizer 2004). On the other side, benchmarking includes more stringent data requirements and the need to form benchmarking groups (see, for example, Radov et al. 2005). Also, as shown, for example by Cremer and Schleich (2006) for the German power sector, distributional effects may be high even if benchmarks are differentiated.

11. The Netherlands, Flanders and Wallonia, where allocation is based on Covenants or voluntary agreements, use BAT-benchmarks for existing installations. However, as in phase 1, they use benchmarks to calculate the efficiency factor (i.e. difference between BAT and actual efficiency) which is used in the allocation formula (see Annex).

As can be seen from the Annex, most MS allocate allowances to existing installations for free based on historical emissions. But several countries like Austria, Belgium, Denmark, Italy, Latvia, Spain, Sweden and the UK base allocation for some existing installations – mostly power installations – on benchmarks. The revised German NAP (of 13 February 2007) now also includes benchmarking for energy installations. Apart from France and Denmark, these countries did not use benchmarks to allocate EUAs to existing installations in phase 1. The observation that benchmarks tend to be applied to power installations supports the view that the electricity sector is particularly well suited to benchmarking since its output is fairly homogenous and it is relatively easy to assign installations to benchmarking groups. The majority of benchmarks are fuel and/or technology-specific average benchmarks rather than uniform benchmarks or BAT benchmarks. Exceptions include Austria, Denmark, Flanders and Wallonia in Belgium, where a uniform BAT-benchmark is applied for power installations, and Sweden, where allocation for basic oxygen steel furnaces is based on an EU-wide average benchmark. In Austria, the BAT-benchmark is based on gas, but excess and surplus allocation (relative to historic emissions) are capped.

Allocation rules for new projects

The logic of emission trading requires that all allowances for new projects be purchased at market prices, since investment decisions can then be based on the full social costs (i.e. private costs plus environmental cost). As already pointed out by Spulber (1985), allocating allowances for free to new projects amounts to subsidizing investments (and output), and thus increases – ceteris paribus – the total costs to society of achieving climate targets. Having to buy allowances for new projects on the secondary market or at an auction would provide strong monetary incentives to implement energy-efficient, low-carbon technologies since these technologies require the purchase of fewer allowances. [12]

As in phase 1, in phase 2, all MS establish a New Entrant Reserve to allocate allowances to new projects (i.e. new installations and capacity extensions of existing installations) for free, typically on a first-come-first-served basis. The reserves vary substantially in size, ranging from circa 1 % of the ET-budget in Austria to approximately 45 % in Latvia.[13] Only non-CHP plants in the Swedish power sector have to buy all their allowances on the market. As in phase 1, gratis allocation in most MS is typically based on BAT-values for individual installations or on BAT-benchmarks for homogenous products (or technologies). BAT-benchmarks are common in the energy sector, where they tend to be differentiated by fuel inputs. So far only Denmark, Luxembourg, Sweden, Flanders and Wallonia in Belgium and the UK are applying uniform benchmarks. If BAT-benchmarks are used for new projects in industry sectors, they tend to be technology-specific, and often assume gas

12. However, under the current closure rules, which essentially provide an output subsidy to incumbent installations (see below), free allocation to new entrants may be considered second best (Åhman and Holmgren 2006).

13. As in phase 1 Germany again plans to replenish its NER reserve if it turns out to be too small. An independent agency will then purchase a sufficient amount of allowances on the market so that all new entrants may receive allowances for free; part of the reserve in the third trading period will be earmarked to finance the agency. A similar set-up exists in Austria, Lithuania and Luxembourg.

as the fuel input (e.g. Latvia, UK). Sometimes, product groups are further split into sub-groups (e.g. different types of tiles or glass in Germany). However, uniform benchmarks would create stronger incentives to invest in the most efficient technology within a given product group, independent of the level of the benchmark. Any differentiation (e.g. by fuels, processes, or by utilization rates) implies additional subsidization of particular installations and further reduces the cost-saving potential of the EU ETS because innovation incentives are limited to the sub-groups. Further, as Åhman and Holmgren (2006) point out, applying the BAT-benchmark rules across MS to an exemplary power plant would result in substantial differences in terms of allocation. To a large extent, these differences are the result of differences in the BAT-values and activity rates applied (projected output, standardized load factors). To limit such differences within a country, Germany, Luxemburg and the UK for example, apply the same activity rates for allocation to all power installations (connected to the grid) – however the figures across countries differ substantially: 7 500 hours in Germany, 6 500 hours in Luxembourg and 5 600 hours in the UK. In addition, there are differences in the compliance factors applied to new projects across MS (e.g. Wallonia, Spain, UK), if these are applied at all to new projects.

Allocation rules for closures

From an economic perspective, closures should not alter the allocation (updating). By contrast, if allocation is terminated after a closure, companies do not properly account for the opportunity costs, old plants may continue to be operated too long and new investments may be postponed (Spulber 1985, Åhman et al. 2007). Stopping allocation for closures corresponds to an output subsidy, and consequently there will be too many companies in the market. As is typically the case in other cap-and-trade systems (e.g. Ellerman et al. 2003), operators should continue to receive the intended quantity of allowances. By contrast, as already in phase 1, in phase 2 of the EU ETS most MS decided to end the distribution of allowances with the year an installation closes.

For phase 2, Cyprus, Flanders and Malta, among others, joined Greece, Hungary, Luxembourg, the Netherlands, Poland, the UK and – originally – also Germany[14], which continue to include so-called transfer rules. To provide additional incentives for investments, a transfer rule allows the allocated allowances from a closed installation to be reassigned to a new installation. At least to some extent the inefficient closure rules are the consequence of the ET Directive, which requires that allowances can only be allocated to installations which operate under a permit to emit greenhouse gases (Article 11 in combination with Article 4, CEC 2004b). Thus, if closed installations cease to adhere to the permit or no longer hold a permit to emit GHG, allowances may no longer be allocated to that installation. Technically, the ETS Directive would have allowed independent permits for operation and for GHG emissions. Then, a closure would not have resulted in a loss of the permit to emit GHG and allocation could have continued. In practice, however, MS decided to link existing operating permits with the permit to emit GHG. In some MS, a tight schedule for implementing the ETS Directive in phase 1 may have prevented the required changes in legislation. Possibly more importantly, MS may have been concerned that operators might shutdown their installations, keep the allocation, and open a new plant in another country.

Special provisions for CHP, early action and process-related emissions

Provisions for CHP plants, early action or process-related emissions are neither required by the Directive nor do they affect the economic efficiency of the EU ETS. Instead, they may be justified for distributional reasons and to facilitate political acceptance of the system. However, there are no clear-cut rules by which installations "worthy" of these special provisions can be defined and the rules implemented vary substantially across MS.

To support existing CHP, some MS apply a different compliance factor (e.g. Belgium, Greece, Sweden and the UK) or a bonus (e.g. Czech Republic, Hungary, Lithuania), exclude CHP from special cuts which account for windfall profits (e.g. the Netherlands), provide special early action provisions for CHP (e.g. Estonia) or use a "double benchmark" for heat and electricity (e.g. Germany, Italy, Latvia, Poland, Slovenia). Other MS (e.g. Belgium, Ireland, Lithuania and Luxembourg) use such double benchmarks for new CHP plants only. Some MS (e.g. the UK, Wallonia and Flanders in Belgium) apply a less stringent compliance factor to new CHP installations. Finally, some MS which allocate gratis allowances to new projects on a first-come-first-served basis have established a special reserve for new CHP plants only (e.g. UK, Ireland). Compared to phase 1, the number and types of rules to compensate existing CHP have increased.

In phase 1, several MS (e.g. Czech Republic, Germany, Hungary) apply a special bonus or a higher compliance factor to directly compensate for early action. [15] Numerous MS accounted for early action in a more indirect way by using longer or earlier base periods (e.g. Ireland, Luxembourg and Slovenia), applying efficiency factors (e.g. Netherlands, Italy) or benchmarks (Belgium, UK). In phase 2, none of the EU-15 MS accounts for any new early action directly. Only some of the new MS (Estonia and Poland) have kept special early action rules and Lithuania has even introduced a special early action bonus although it did not directly account for early action in phase 1.

Since at least in the short term, the reduction of process-related emissions is believed to be either very expensive or technically not feasible for many applications, some MS have introduced special provisions for installations emitting a higher proportion of process-related CO_2 (e.g. lime, cement clinker, steel, glass) in phase 1. These provisions are applied either directly at the level of individual installations via less stringent compliance factors (e.g. Germany), or indirectly at the level of sectors (e.g. France, UK). Most countries continue their special treatment of process-related emissions in phase 2 in the same way as before. Only Germany has switched from an installation-level to a sector-level approach. Luxembourg now applies

14. The revised German NAP (of 13 February 2007) no longer includes such a transfer rule.

15. Allocating allowances based on a recent base period implies that companies which invested in reductions prior to this period (early action) will receive fewer allowances than those which did not invest.

a uniform CF for all installations and no longer uses a special CF for process-related emissions. The Netherlands and Lithuania have introduced new, special rules for process-related emissions.

Conclusions

Our analysis of the notified NAPs for phase 2 suggests that, for many NAPs, there is ample potential for improvement in terms of environmental effectiveness and economic efficiency.

In terms of environmental effectiveness, our analyses on the stringency of the ET-budgets for the 25 NAPs included in this paper suggest that, on average, the ET-budgets in phase 2 are only about 1 % lower than historical emissions in 2005, and 2.1 % lower than the budgets in phase 1 (2005-2007) as well as 2.4 % lower than projected emissions in 2010. Thus, the intended allocation for the ET-sector in 2008-12 would not require significant reductions. The analyses also indicate a dichotomy between old and new MS. While on average, the EU-15 MS intend to reduce emissions by about 9.6 % compared to VET 2005 data, and ca. 6.7 % and 7.2 % for the other two criteria, the implied average surplus of allowances in the new MS is substantial, ranging from 25.8 % when compared to VET 2005 data and approx. 12.7 % for criteria 2 and ca. 13.1 % for criteria 3. In addition, several governments of EU-15 MS plan to purchase credits from Kyoto Mechanisms corresponding to about 109 MtCO_2e/a. Assuming a price of 15 €/t CO_2e, these purchases correspond to 1.635 billion € p.a. which would have to be financed by the federal budgets. In these MS, the credits from KM contribute substantially to meeting the Burden-Sharing targets, and easing the reduction burden for installations covered by the ETS Directive. Since companies are also allowed a generous use of KM in most MS, the actual requirements for domestic reductions are low. From the perspective of cost-efficiency we find that, with the possible exception of the UK and Spain, the non-trading sectors have to bear a disproportionately high share of the reduction efforts in all EU-15 MS. Thus, while the ETS enables the trading sector to cost-efficiently achieve its ET-budget, the economy as a whole pays a premium for giving a more generous share of the Kyoto budget to the ET-sector rather than to those sectors where emission reductions cost more.

When taking into account the first NAP decisions of the Commission which required a significant downward adjustment of ET-budgets by almost 7 %, our stringency criteria are fulfilled in almost all instances. Therefore, the EC's requested emission budget reductions for the first 14 (15) national allocation plans is a significant and important step towards a more effective and efficient EU ETS. Without these ET-budget cuts, the price for EUA, innovation incentives for low-carbon technologies, and demand for ERUs and CERs by companies would have all expected to be low as well. But even with these reductions of the EU ETS budgets, our analysis shows that domestic reduction requirements remain limited as companies and governments can make use of substantial amounts of KM.

Even though the Directive, which sets the general rules for allocation in phase 1 and phase 2, remained unchanged, MS were able to alter allocation rules across phases within the constraints of the Directive. Based on the 25 NAPs included in this survey, a comparison of the allocation rules between phases 1 and 2 yields mixed results in terms of increased harmonisation and improved efficiency. A general path dependency of allocation rules may be observed, i.e. MS tend to keep the allocation concepts and methodologies applied in phase 1. Consequently, there is only little progress in the implementation of more efficient and more harmonized rules across MS. As a result of the NAP guidance for phase 2 though, the types of installations covered in almost all MS have been harmonised and ex-post adjustments have been banned. Areas of harmonisation and improved efficiency which were not triggered by EC rules or guidelines include a (slight) increase in auctioning or the use of benchmarks for existing and new energy installations, in particular in the power sector in EU-15 MS. Even though the share of allowances to be auctioned off in phase 2 will be higher than in phase 1, it still falls considerably short of the maximum level of 10 % allowed by the Directive. Thus, a future Directive should set a high minimum level rather than a low maximum level for the auction share. Such a rule would also limit the discretionary power of the MSs as well as the lobbying incentives for companies.

Basing allocation to new projects on benchmarks and standard utilization rates to new projects improves efficiency and transparency compared to – as is still the case primarily in new MS – using installation-specific emission values together with projected activity rates for which operators have an incentive to predict "optimistic" data. But differentiated benchmarks or activity rates for new technologies amount to technology- or fuel-specific subsidies, which preserve existing production structures and distort dynamic innovation incentives. They run counter to the logic of emission trading systems, where market prices and flexibility are supposed to guide investment decisions rather than subsidies for particular types of installations. In Denmark e.g. over-dimensional boilers were the result of capacity based allocation rule. Harmonization of the allocation rules for new projects aiming at levelling the playing field across MS would have to include not only benchmarks, but also activity rates and compliance factors. Naturally, this would still leave the differences in other, potentially more relevant, investment criteria across MS . Another area of improved harmonisation concerns the increased use of transfer rules in the case of closures, but the transfer terms vary across MS.

Terminating allocation after closure and allocating free allowances to new projects in all MS are examples where implicit harmonisation has prevailed, but the outcome is not economically efficient. In particular, since MS competing for new investments may have an incentive to use generous allocation rules to attract new projects, a change in the ETS Directive seems indispensable to solve this potential 'prisoner's dilemma' situation. This may also prevent MS to use the NER for strategic purposes, such as the reserve replenishment mechanism, which shift economic costs into the future.

Compared to phase 1, some MS have managed to reduce the complexity of the allocation rules. This is especially true for Germany, where allocation in phase 1 was based on almost 60 different (combination of) rules. Several MS have also facilitated or abandoned special provisions for early action, process-related emissions or CHP installations. Switching from installation-specific to indirect provisions at the sector level or as part of the general allocation rules (like benchmarking) has also improved transparency and is likely to lower transaction costs. Still, a wide range of criteria to determine the "worthiness" of special provisions continues to be used across MS. Since in phase 2, political acceptance should play a smaller role than in phase 1 the introduction of new special allocation rules in phase 2 in several new MS is remarkable.

To conclude, the decisions by the EC on the first 14 NAPs clearly improved effectiveness and economic efficiency and acted as a signal to the international carbon market community. They also have repercussions for other carbon markets and emission trading schemes being set up around the world, for investments and technology transfer through JI and CDM, as well as for post 2012 international climate policy negotiations.

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Glossary

CCGT	Combined Gas Cycle Turbines
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
CITL	Community Independent Transaction Log
EC	European Commission
ET	Emissions Trading
EU	European Union
EUA	EU Allowance
EU ETS	EU Emissions Trading Scheme
HAS	Hypothetical Allocation Scenario
JI	Joint Implementation
KM	Kyoto-Mechanisms
MS	Member State of European Union
NAP	National Allocation Plan
NER	New Entrant Reserve
VET	Verified Emissions Table

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Annex: Summary Table of National Allocation Plans for Phase 2

	Auction Share of ET-budget incl. reserve: Phase 2 (1)	**Allocation to existing installations** Two steps / one step; 1^{st} step = sector budget (SB) 2^{nd} step = Individual allocation (IA) *a) Energy b) Non-energy c)* special provisions *CHP*	**Allocation to new installations** *a) Energy* b) *Non-energy* c) special provisions CHP
AT	1.22% (0%)	***Two steps*** a) b) SB = emissions base period (2002-2005) * growth rate*sectoral reduction potential*CF (sector-specific) *a)* IA = production (2002-2005) * uniform BAT-benchmark for heat and electricity * CF *b)* IA = emissions (2002-2005) * reduction potential (incl. process emissions = 1, CHP, fuel, BAT) * CF (sector-specif.) *c)* if energy savings >10% or supply to public district heating network technological potential reduced	*a) b)* based on authorised capacity, average load factor from existing installations, projected load factor for installations, installation-based BAT
BE-B	0% (0%)	*a)* IA = average emissions in 2002-2005 CF=1 *b)* IA = emissions 2005 * growth factor * individual reduction potential * CHP potential factor *c)* no	*a) b)* based on projected emissions *c)* special CHP New Entrants Reserve
BE-F	0.5% (0%)	*a)* IA = Installed capacity * technology-specific load factor * uniform BAT benchmark (359 g/kWh) *b)* if installation part of covenant: IA = covenant agreement ("world top by 2012"); if installation not part of covenant: CF=0.85 (diminished by 0.008 each year) *c)* CF=1	*a)* based on installed capacity * technology-specific load factor * uniform benchmark (359 g/kWh) *b)* if installation part of covenant: *IA*= covenant agreement ("world top by 2012"); if Installation not part of covenant: CF=0.85 (diminished by 0.008 each year)
BE-W	0% (0%)	*a)* IA = installed capacity * technology-specific load factor * uniform BAT benchmark (400 g/kWh) * CF (=0.839) (= value of 336 g/kWh) *b)* IA = emissions (1 yr. out of 1999 to 2002) * projected growth * efficiency factor (individually agreed or assessed); CF=0.97, if (VET2005 - allocation) > 10% , CF=1 otherwise *c)* IA = average emissions 2000-2004; CF=1	*a)* IA = installed capacity * technology-specific load factor * uniform BAT benchmark (400 g/kWh)*CF(=0.839) (= value of 336 g/kWh) *b)* on individual BAT and projected output *c)* CF=1
CY	0 % (0%)	*a)* IA= BAU projection (future demand based on data from 1995-2005) * energy efficiency and renewables potential *b) (only cement and ceramics) IA*= emission projections including efficiency improvements (future production based on historic data: cement: 1998-2005: ceramics: 2001-2005)	based on rules to be developed.
CZ	0% (0%)	***Tow steps*** *a) b)* SB = emissions (1999-2001 and 2005) * growth factor IA = installation's share of emissions in 1999-2001 (two highest yrs.) + if applicable: Early Action bonus and/or CHP bonus and/or adjustment for district heating *c)* CHP bonus	*a) b)* IA = projected emissions (not more than needed)
DE	0% (0%)	***Two steps (implicit)*** *a)* IA: based on fuel-specific BAT-benchmarks*average capacity use (2000-2005); if installed before 2003, IA: BAT-BM * (standardized load factors); + CF if ET-budget too small; no CF if installation meets BAT; *b)* IA= Average emissions 2000-2005 * CF (=0.9875) *c)* double benchmark *average capacity use (2002-2005);	*a)* based on fuel-specific BAT-BM and standardized load factors *b) homogenous products* (e.g. cement, glass, tiles): standardized load factors and BAT-BM (differentiated by sub-product groups or technologies); *other installations*: BAT *c)* double benchmark
DK	0% (5%)	*a)* IA = fossil power production (1998-2004 or 2004 if emissions for 2004> average for 1998-2004) * uniform BM (0.388 tCO2/MWh) * (includes CF: electricity: 0.57) IA heat = similar as b) *b)* IA *(incl. offshore)* = combustion emissions (1998-2004 or 2004 if 2004 > average 1998-2004) * CF (0.87) + process emissions (1998-2004 or 2004 if 2004 > average 1998-2004) * CF (0.98) *c)* based on a) and b) and distribution between heat and electricity is based on 125 % thermal efficiency	*a)* if capacity expansions > 10 MW and full load hours > 1000h/a IA electricity = capacity * load factor (if 2000-2999 h/a CF = 2/3; if 1000-1999 h/a CF = 1/3) * BAT-BM (1185 tCO_2/MW) IA heat = cap.*BAT-BM (100 tCO_2/MW) *b)* capacity * uniform BAT-BM * CF (same as existing installations) BAT-benchmarks have been reduced compared to NAP 1, BM includes assumed load factor *c)* double benchmark: electricity (1185 tCO_2/MW) and heat (305 tCO_2/MW)
EE	0% (0%)	*a) b)* IA = emissions 1995-2005 (district heating) or 2000-2005 (electricity and industry) * growth factor *(= 6.5% for electricity/3% for* district heating and industry) - no CF *c)* increase in CHP rewarded as early action	*a)* no information on allocation method *b)* Estonian BAT benchmarks *c)* no
ES	0% (0%)	*a)* IA = installation capacity * load factor * BAT benchmark (technology specific) * CF (=0.746) *b)* ***Two steps:*** SB = projected output 2010 * average benchmarks (2005) * efficiency factor; IA = avg. specific emissions * output (2 yrs from 2000-2005) * install.-specific CF c) projected emissions (based on VET 2005)	*a)* same rules as for existing installations *b)* BAT BM * projected output 2008-12 *c)* projected emissions
FI	0% (0%)	*a)* IA = fuel consumption (2000-2003) [peak load and reserve capacity (1998-2002)] * installation-specific BM * CF (condensing power: 0.33 / peak load and reserve capacity: 0.9 / district heating: 0.8) *b)* IA = process emissions*CF (0.95) + combustion emiss. (including industrial power prod..) (1998-2002) * CF (0.9) *c)* IA = emissions (1998-2002) * CF (0.8); CF for CHP in industry is 0.9	*a) b) c)* IA = fuel input (MJ) * sector specific load factor * fuel specific emissions factor (for process emissions = average factor of existing installations applied) * CF(same as for existing installations)

FR	0% (0%)	***Two steps*** *a) b)* SB*:* production (2004/2005) * growth rate * average benchmark (2004/2005)*reduction potential * CF (=0.9729); *IA:* installation's share of emissions in BP (varying: 1996 to 2005, sometimes one single year) *c)* no	*a) b)* based on BAT benchmarks (gas)*projected output; list of benchmarks to be set up *c)* no
GR	0% (0%)	***Two steps*** *a) b)* SB = projected emissions * CF (=0.89 for combustion/=1.0 for CHP and process emissions/=0.91 to 0.99 for industry) IA = average emissions 2000-2004 (without lowest year) * sector-specific CF (<1); "Fuel coefficient" used for other combustion, paper and cardboards, lime and ceramics; special rules for steel and cement *c)* CF=1	*a) b)* capacity * load factor * specific emission factor * sector specific CF for existing installations (if specific emission factor is BAT, CF=1) *c)* CF=1 and special CHP NER
HU	4.3 % (2.5%)	***Two steps*** *a) b)* SB = sector specific output projections (varying methodologies) * sector specific reduction potential (fuel switch and BAU efficiency improvement) *a)* IA = share of sector emissions based on heat and electricity output (2004-2006) * average emissions factor of fuel mix in 2005 * inverse BAT efficiency (output/input fuel in %) * 1.05 if CHP + emissions from SO_2 scrubbers in 2005 + bonus for district heat production with domestic fuel *b)* IA = Share of sector emissions (2005); exceptions for sugar, cement, lime, glass and brick industry *c)* CHP factor of 1.05 + bonus for production of district heat with domestic fuel	*a) c)* expected production (based on previous operation) * fuel specific BAT BM (coal and lignite minimum of 17.8 % biomass is assumed) *b)* expected production (based on previous operation) * BAT BM (gas)
IE	0.5% 0.75%)	***Two steps*** *a) b) SB* = [share of sector emissions 2003 * CF (=0.9 for energy / =1 for industry)* 0.95 (auction factor)] minus sector specific allocation for New Entrants *a) b)* IA = share of emissions (2003-2004) * total SB *c)* electricity part: allowances from energy budget based on CCGT BAT-benchmark (gas)	*a) b)* based on BAT (differentiated by fuel and technology)* installation specific projected emissions (capped at 88% of projected emissions) *c)* specific reserve, double benchmark
IT	0 % but 5.7% or 12Mt/a will be sold at fixed price (0%)	***Two steps*** *a) b) SB*= average allocation 2005-07 (additional reductions for energy, steel, refining) *a)* IA = output 2005 * fuel - & technology-specific BAT BM * trend factor * CF (=0.9897); trend factor = energy policy e.g. renewables (2008 = 1) *b)* IA = allocation 2007 (1 + 0.03 * individual efficiency factor + 0.03* individ. growth factor) * CF: CF sector-specific *c)* CHP similar to a) but double benchmark (heat = 350 g/kWh) * 0.85 (energy savings)	*a)* capacity * load factor * fuel- and technology-specific BM (same as for incumbents) *b)* output projections or capacity and expected use * BAT benchmark (to be defined) *c)* double benchmark * 0.85 (energy savings)
LT	2.7% (1.5%)	***Two steps*** *a) b)* SB = average emissions (2002-2005)* projected growth * efficiency factor (=0.9 for energy/=0.9 to 1.0 for industry) * 0.95 (auction factor); refineries: emissions increase due to legislation by 1.153 IA = Share of SB based on: *2* * fuel consumption in toe (2002-2005) * 0.5 tCO_2/toe + if applicable: process-related emissions + 2 *early action bonus + 2 * CHP bonus *c)* double benchmark	*a) b)* based on product-specific BM and standardized load factors *c)* double benchmark
LU	5% (0%)	a) b) IA= average emissions (3 yrs. from 2002-2005) * growth factor * CF (=0.991) c) no	*a) b)* based on uniform BAT BM and standardized load factors *c)* double benchmark
LV	0% (0%)	*a) b)* IA = average output in sector-specific BP (varies between 2001 and 2006) * (fuel-and product-specific benchmarks) * growth factor* CF (= 0.98) *c)* double benchmark	*a) b)* based on projected output * fuel- and product-specific BM*efficiency factor (for energy) *c)* double benchmark
MT	0% (0%)	*a)* IA = BAU projections * energy efficiency potential and planned contribution from renewables *b) c)* no installations	*a) b)* capacity * planned load factor * fuel specific BAT-Benchmark c) no
NL	4% (0%)	*a)* IA = average emissions (3 yr. from 2000-2005) * growth factor * efficiency factor * CF(=0.73) *efficiency factor (covenant-based) - CF includes 0.15 cut for windfall profits) *b)* IA= emissions (3 yrs. from 2000-2005) * growth factor (1.7) * efficiency factor * CF *(*=0.87 combustion emissions /=0.92 for process emissions) *c)* efficiency benchmark, no CF for small CHP	*a) b)* based on BAT BM (covenant) * projected output (capped at 90%)
PL	1% (0%)	***Two steps+*** *a) b) SB* = output 2005 * growth rate * sector average benchmarks (2005) * efficiency factor a) IA= projected output * fuel specific benchmarks, accounting for SO_2 *b)* IA= similar to SB and projected output agreed with associations + CHP and early action bonus *c)* fuel-specific double benchmark	*a) b)* based on -BAT-BM* projected output *c)* double BM *d)* installations which fall under Directive, but are not included in NAP 2

PT	0% (0%)	*a)* ***Tow steps*** *SB* = ET-budget – allocation for industry and CCGT IA = installations share of emissions (3 yrs. from 2000-2004 or if growth > 20% 2 yrs. from 2002-2004); for CCGT use projected emissions *b) IA* = heat production (3 yrs. from 2000-2004 or if growth > 20% 2 yrs. from 2002-2004) * emissions factor (max. emissions factor: [installation BM + sector BM]/2 or min. emissions factor in case high biomass use) + process emissions (3 yrs. from 2000-2004 or if growth > 20% 2 yrs. from 2002-2004), for steel and refinery use projections *c)* indirectly through max. emission factor	*a) b) c)* installed capacity * sub-sector technology and fuel specific load factor * uniform BM (BAT in Portugal see www.iambiente.pt)
SE	0% (0%)	*a)* IA= avg. emissions in (1998 – 2001) * CF (=0.3 to 0.4) *b)* all, except BOF-steel: IA= emissions in (1998-2001) * growth in process-related emissions * CF(=1); BOF-steel: projected output * EU avg. benchmark (2005) *c)* CF=1	*a) c) free allocation* only to highly-efficient CHP, based on uniform average benchmark (from 464 Swedish installations 2000-2004) and installation-specific projected output *b)* based on BAT and installation-specific projected output
SI	0% (0%)	***Two steps*** *a) b) c)* SB = projected emissions form "with measures scenario" for 4 categories (thermal power plants and thermal power & district heating plants (*CHP* and *CCGT*)/ district heating plants / industry/ process emissions*)* *a) CHP* and *CCGT*: IA = grandfathering factor * share of emissions (2002-2005) of sub-sector budget + BM-factor * fuel- and technology-specific BAT (follows BREF for existing LCP; grandfathering factor: 1.0 in 2008-2010, 0.7 in 2011 and 0.5 in 2012. *peak and reserve capacity*: projected emissions * CF(=0.88) b) (incl. industrial CHP) IA= process emissions (2002-2005) *CF(=1.02) + [0.7 * combustion emissions (2002-2005) + 0.3 * fuel specific BM + if applicable, CHP-bonus] * CF (= 0.945) if IA > projected emissions different formula used *c)* double BM for a) and CHP bonus (=0,1 t/MWh_e) for b)	*a) b)* IA = projected output * fuel- and technology-specific BAT-BM * CF (0.9) + projected output * process BAT (individual assessment) Max. number of EUAs p.a. per new entrant = 14.000. *a) heat* (boiler): IA= capacity installed * projected load factor (max. 4000 h/a) * uniform BM (200 g /kWh) *CF (=0.9) *c)* no upper limit of allocation and double benchmark (heat: 200 g/kWh ; elec.: 350 g/kWh)
SK	0% (0%)	*a) IA Thermal:* avg. emissions in 1998-2003 (or 2005, if higher) * growth of apartment stock (=1.004); IA: *Electric and thermal:* projected energy output * emissions / output (1998 – 2003) *b) large emitters:* negotiated; *small emitters:* emissions (1998 – 2005) * sector-specific growth rates *c)* no	*a) b)* based on projected emissions or BAT (fuel- and technology-specific but not specified any further in NAP) *c)* no
UK	7% (0%)	**Two steps** *a)* SB = (total ET budget – industry allocation) * CF(=0.7); IA= capacity * standardized load factor (2000-2003) * technology- and fuel-based benchmark *b)* SB = proj. emiss. incl. growth and reduct. potential: CF=1 IA= installation's share emissions in 3 yrs. out of 2000-2003 *c*) separate "Good Quality CHP Sector"	*a)* based on uniform BM (CCGT) * standardized load factor * CF (=0.7) *b)* based on uniform benchmark (gas - if applicable) * standardized load factor * CF (=0.9 boilers and generators/= 0.95 other) *c)* see *a)* CF=1