CLIMATE CHANGE

SCIENTIFIC ASSESSMENT AND POLICY ANALYSIS

Options for post-2012 EU burden sharing and EU ETS allocation

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Wetenschappelijke Assessment en Beleidsanalyse (WAB) Klimaatverandering
Het programma Wetenschappelijke Assessment en Beleidsanalyse Klimaatverandering in opdracht van het ministerie van VROM heeft tot doel:

- Het bijeenbrengen en evalueren van relevante wetenschappelijke informatie ten behoeve van beleidsontwikkeling en besluitvorming op het terrein van klimaatverandering;
- Het analyseren van voornemens en besluiten in het kader van de internationale klimaatonderhandelingen op hun consequenties.

De analyses en assessments beogen een gebalanceerde beoordeling te geven van de stand van de kennis ten behoeve van de onderbouwing van beleidsmatige keuzes. De activiteiten hebben een looptijd van enkele maanden tot maximaal ca. een jaar, afhankelijk van de complexiteit en de urgentie van de beleidsvraag. Per onderwerp wordt een assessment team samengesteld bestaande uit de beste Nederlandse en zonodig buitenlandse experts. Het gaat om incidenteel en additioneel gefinancierde werkzaamheden, te onderscheiden van de reguliere, structureel gefinancierde activiteiten van de deelnemers van het consortium op het gebied van klimaatonderzoek. Er dient steeds te worden uitgegaan van de actuele stand der wetenschap. Doelgroep zijn met name de NMP-departementen, met VROM in een coördinerende rol, maar tevens maatschappelijke groeperingen die een belangrijke rol spelen bij de besluitvorming over en uitvoering van het klimaatbeleid.
De verantwoordelijkheid voor de uitvoering berust bij een consortium bestaande uit MNP, KNMI, CCB Wageningen-UR, ECN, Vrije Universiteit/CCVUA, UM/ICIS en UU/Copernicus Instituut. Het MNP is hoofdaannemer en fungeert als voorzitter van de Stuurgroep.

Scientific Assessment and Policy Analysis (WAB) for Climate Change
The Netherlands Programme on Scientific Assessment and Policy Analysis Climate Change has the following objectives:

- Collection and evaluation of relevant scientific information for policy development and decision–making in the field of climate change;
- Analysis of resolutions and decisions in the framework of international climate negotiations and their implications.

We are concerned here with analyses and assessments intended for a balanced evaluation of the state of the art for underpinning policy choices. These analyses and assessment activities are carried out in periods of several months to a maximum of one year, depending on the complexity and the urgency of the policy issue. Assessment teams organised to handle the various topics consist of the best Dutch experts in their fields. Teams work on incidental and additionally financed activities, as opposed to the regular, structurally financed activities of the climate research consortium. The work should reflect the current state of science on the relevant topic. The main commissioning bodies are the National Environmental Policy Plan departments, with the Ministry of Housing, Spatial Planning and the Environment assuming a coordinating role. Work is also commissioned by organisations in society playing an important role in the decision-making process concerned with and the implementation of the climate policy. A consortium consisting of the Netherlands Environmental Assessment Agency, the Royal Dutch Meteorological Institute, the Climate Change and Biosphere Research Centre (CCB) of the Wageningen University and Research Centre (WUR), the Netherlands Energy Research Foundation (ECN), the Netherlands Research Programme on Climate Change Centre of the Vrije Universiteit in Amsterdam (CCVUA), the International Centre for Integrative Studies of the University of Maastricht (UM/ICIS) and the Copernicus Institute of the Utrecht University (UU) is responsible for the implementation. The Netherlands Environmental Assessment Agency as main contracting body is chairing the steering committee.

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Preface

The present report is part of a research project called 'Options for EU Burden Sharing and EU ETS allocation post-2012'. The project has been conducted by a consortium of three research institutes in the Netherlands, consisting of the Netherlands Environmental Assessment Agency (MNP), Ecofys and the Energy research Centre of the Netherlands (ECN).

The project has been financed by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) as part of its programme dealing with 'scientific assessment and policy analyses for climate change' (WAB).

The present report has benefited from useful comments by a Steering Committee, consisting of Maurits Blanson Henkemans (Ministry of Economic Affairs), Henriette Bersee (VROM), Paul Koutstaal (Ministry of Finance), Rob Aalbers (SEO), Herman Vollebergh (EUR) and Ernst Worrell (Ecofys) and useful suggestions from Bert Metz (MNP) and Monique Hoogwijk (Ecofys). In addition, we would like to thank Stefan Bakker en Bas Wetzelaer (both ECN) for reviewing the semi-final draft of the report, and Marlies Kamp (ECN) for preparing the Dutch summary of the report.

This study assesses various options for EU burden sharing and EU ETS allocation beyond 2012, based on a sample of policy evaluation criteria and a review of the literature on (i) international and EU burden sharing of future GHG mitigation commitments, and (ii) allocation of GHG emission allowances among countries, sectors and emitting installations. It shows that these options score differently with regard to a variety of individual evaluation criteria (such as environmental effectiveness, economic efficiency, social equity or political acceptability), while the overall performance of these options depends on both the selection, interpretation, weighing and adding of these criteria.

Key words: burden sharing, post-Kyoto, EU ETS, allocation methods, policy evaluation criteria.

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Purpose of the study
Discussions on post-2012 climate change policies have again raised the question of EU internal burden sharing. Due to the introduction of the EU Emissions Trading Scheme (ETS) these discussions have become related to the future of the allocation of emission allowances under the ETS. The purpose of the present report is to assess various separate and joint options for EU burden sharing and EU ETS allocation beyond 2012, based on a sample of policy evaluation criteria and a review of the literature on (i) international and EU burden sharing of future GHG mitigation commitments, and (ii) allocation of GHG emission allowances among countries, sectors and emitting installations.

Criteria for evaluating post-2012 options
In this study, post-2012 options for EU burden sharing and ETS allocation are assessed by means of a variety of policy evaluation criteria, including environmental effectiveness, economic efficiency, political acceptability, social equity, industrial competitiveness, administration costs, etc. It should be noted, however, that these criteria have often different meanings and interpretations, depending on whether they are used to evaluate (i) international/EU burden sharing options, (ii) ETS allocation options, or (iii) joint options for EU burden sharing and ETS allocation. Moreover, besides the selection and interpretation of the policy evaluation criteria, the overall assessment of these options depends on the weighing and adding of these (sometimes qualitative, subjective) criteria.

Options for EU burden sharing post-2012
There exists a large variety of options for international and (internal) EU burden sharing of GHG mitigation commitments beyond 2012, including continuing the present regime. The latter consists of the Kyoto Protocol for the international differentiation of abatement efforts and the EU Burden Sharing Agreement (BSA) for EU internal differentiation of emission reductions. This regime, however, is characterised by a number of drawbacks such as limited international participation, economic inefficiencies, lack of long-run certainties, and unequal burden sharing.

Alternative options for international differentiation of GHG mitigation commitments in general and internal EU burden sharing in particular include:
- *Grandfathering,* i.e. applying a flat reduction rate for all EU countries to their historic emissions in a certain reference period.
- *Per capita convergence,* i.e. differentiation of emission reductions based on equal per capita emissions in a certain convergence year.
- *Multi-criteria convergence,* i.e. differentiation of emission reductions based on a mix of (i) GDP per capita, (ii) emissions per capita, and (iii) emissions per unit GDP.
- *Ability to pay,* i.e. differentiation of emission reductions based on GDP per capita.
- *The (extended) Triptych approach,* i.e. differentiation of emission reductions based on a variety of sector and technology criteria.
- *Equal mitigation costs,* i.e. differentiation of emission reductions based on equal mitigation costs per country (e.g. a certain percentage of GDP).

These options score differently with regard to a selection of policy evaluation criteria, but no option scores highest or lowest in all respects. Nevertheless, depending on the interpretation, weighing and adding of the criteria, some options seem to have a better overall score than other options. For instance, the overall score of the grandfathering approach seems to be lower than the other options, while the overall performance of the multi-criteria convergence option and the Triptych regime seem to be relatively higher.

Options for EU ETS allocation post-2012
The major characteristic of the EU ETS allocation system up to 2012 is that it is basically a *national*-oriented system based on *free* allocations on emission allowances, i.e. grandfathering

for incumbents and, generally, fuel- or technology specific benchmarking for new entrants. The major advantages of such an approach are:

- National-oriented allocation can be fine-tuned to the socioeconomic circumstances of a country, including data availability and existing cultural or policy conditions, thereby enhancing the socio-political feasibility and acceptability of the ETS among the Member States.
- Free allocation comes to meet those emitters who are not able to pass through the costs of emissions trading into their outlet prices and, hence, it reduces the resistance of these emitters to accept the EU ETS (and, therefore, facilitates its implementation).

On the other hand, some major disadvantages of the present allocation system are:

- It leads to significant differences between countries in allocation at the installation level, which may distort the Internal Market by affecting the competitiveness and/or the profitability of installations throughout the EU.
- It leads to an imbalanced or unequal distribution of the total national emission cap (including the use of JI/CDM credits) between the ETS sectors and the other sectors of a country, particularly to a relative - or even absolute - over-allocation of the ETS sectors at the expense of other sectors.
- It results in windfall profits to those firms passing through the opportunity costs of freely allocated emission allowances.
- It results in a widely diversified, complex and non-transparent system of allocation rules throughout the EU ETS.
- It reduces the incentive for investments in less carbon intensive technologies and, hence, undermines the rationale and credibility of the EU ETS to support the transition towards a less carbon intensive economy.
- It leads to all kinds of lobbying, gaming and other rent-seeking activities of interested parties.

To deal with these disadvantages, a variety of allocation options beyond 2012 are available, including a harmonization or centralization of allocation decision making at the EU level combined with a selected number of allocation methods such as auctioning or uniform/product-generic benchmarking. However, governments of EU Member States are likely to be rather reluctant to transfer a major part of their allocation decision competence to the EC level as allocation decisions may have significant distributional and competitive effects at the national, sector and firm levels.

Moreover, whereas allocation options such as auctioning or uniform/product-generic benchmarking have certain advantages, they also have certain disadvantages, notably if outside competitors do not face similar climate policy-induced cost increases. Therefore, in such a situation, a selection of allocation methods could be considered, including (i) auctioning for sheltered sectors, i.e. the power sector and other sectors where outside competition is lacking, (ii) grandfathering for incumbents in exposed sectors, (iii) relative, uniform and/or product-generic benchmarking for newcomers in exposed sectors, and (iv) recycling of auction revenues to compensate the adverse effects of passing through carbon costs, notably for those firms exposed to outside competition. Once a global climate policy regime is introduced, i.e. all relevant competitors face similar cost increases due to climate policy, auctioning can be applied to all ETS participants while the auction revenues can be used to finance general socioeconomic purposes.

Joint options for EU burden sharing and ETS allocation post-2012

Major types of joint options for EU burden sharing and ETS allocation beyond 2012 include:

1. *Present system,* i.e. firstly, sharing the overall EU emission target among its Member States and, subsequently each Member State (MS) divides its national target between the ETS and other sectors, while the allocation of the national ETS cap to eligible installations is based on (different) MS rules.
2. *EU burden sharing with ETS allocation at EU level,* i.e. both the top-down ETS cap and the bottom-up allocation rules are set at the EU level, while the EU target for the non-ETS sectors is shared among the MS.

3. *EU burden sharing with EU-wide ETS cap and MS allocation for either (a) both existing and new installations (Type 3a) or (b) existing installations only (Type 3b),* while the EU target for the non-ETS sectors is shared among the MS.

These three types of options have different implications in quantitative terms (e.g. assigned amounts of emissions and costs at the EU, national, sector or installation level), depending on the specific burden sharing and allocation rules applied (which is beyond the scope of the present study). In addition, the option types have different implications in qualitative terms, notably in terms of decision competence, competitive distortions and other potential adverse effects of national-oriented versus EU-harmonised allocation. Centralising or harmonising the process of setting the ETS cap and the allocation rules for eligible installations throughout the EU may appear an attractive - or even 'ideal' - option as it reduces competitive distortions and other adverse effects due to a national-oriented allocation process, but it implies a significant transfer of decision competence from the national to the EU level (compared to the present allocation process). Hence, for the allocation period immediately post-2012 an 'intermediate' option might be possible, i.e. an approach in which certain parts of the allocation process are centralised - such as setting an EU-wide cap for the ETS as a whole or harmonising fully the reserve of allowances and allocation rules for new entrants - while other parts are left to the discretion of national decision-makers or subject to a gradual process of increasing harmonisation of allocation rules in the trading periods beyond 2012.

Interaction between international burden sharing and EU ETS allocation post-2012
Options for EU ETS allocation post-2012 are well compatible with a variety of options for post-Kyoto international agreements on addressing climate change (including a variety of emissions targets and policy measures or instruments). However, if major competitors outside the EU ETS do not participate in such agreements or only take part in agreements that to not raise production costs in a similar way as the EU ETS, it raises competitiveness problems for those EU ETS sectors facing outside competition and, hence, the need for additional options to deal with these problems. This includes border tax adjustments, indirect allocations, recycling and targeting auction revenues, output-based allocations, or opt-out options for these sectors.

Samenvatting

Doel van dit onderzoek
Door de discussie over internationaal klimaatbeleid na 2012 is burden sharing binnen de EU weer actueel geworden. De introductie van de EU Emission Trading Scheme (ETS) heeft ervoor gezorgd dat deze discussie nauw verbonden is met de toekomst van de allocatie van emissierechten onder het ETS. Dit rapport heeft als doel opties voor EU burden sharing en ETS allocatie na 2012 te evalueren op basis van een aantal beleidscriteria en literatuuronderzoek op het gebied van (i) burden sharing binnen en buiten de EU en (ii) de allocatie van broeikasgasemissierechten tussen landen, sectoren en emitterende installaties.

Criteria voor de evaluatie van opties na 2012
In dit rapport worden opties voor burden sharing binnen de EU na 2012 geëvalueerd op basis van een aantal beleidsevaluatiecriteria, waaronder milieueffectiviteit, economische efficiency, politiek draagvlak, sociale gelijkheid/billijkheid, industrieel concurrentievermogen, administratiekosten, etc. Wel dient opgemerkt te worden dat deze criteria vaak verschillende betekenissen en interpretaties kennen, afhankelijk van datgene wat geëvalueerd wordt, te weten (i) opties voor internationale/EU burden sharing, (ii) opties voor ETS allocatieopties, of (iii) gezamenlijke opties voor EU burden sharing en ETS allocatie. Naast de selectie en interpretatie van de evaluatiecriteria hangt de beoordeling van deze opties af van het wegen en optellen van deze (soms kwalitatieve en subjectieve) criteria.

Opties voor burden sharing in de EU na 2012
Er bestaat een grote variëteit aan opties voor internationale burden sharing en burden sharing binnen de EU met betrekking tot broeikasgasmitigatie na 2012, waaronder het continueren van het huidige regime. Dit regime bestaat uit het Kyoto Protocol voor het internationaal differentiëren van de mitigatieverplichtingen en de EU Burden Sharing Agreement (BSA) voor interne differentiatie van emissiereducties binnen de EU. Dit regime kent echter een aantal nadelen waaronder economische inefficiënties, het niet deelnemen van de VS en andere, belangrijke landen, het ontbreken van lange termijn zekerheid en ongelijke burden sharing tussen de deelnemende landen.

Alternatieve opties voor internationale differentiatie van broeikasgasmitigatieverplichtingen in het algemeen en burden sharing binnen de EU in het bijzonder omvatten onder meer:
- Grandfathering, d.w.z. het toepassen van een gelijk reductiepercentage op alle Europese landen met betrekking tot hun historische emissies in een bepaalde referentieperiode.
- Per capita convergentie, d.w.z. differentiatie van emissiereducties op basis van gelijke per capita emissies in een bepaald convergentiejaar.
- Multi-criteria convergentie, d.w.z. differentiatie van emissiereducties op basis van een mix van (1) BNP per capita, (ii) emissies per capita en (iii) emissies per eenheid BNP.
- Ability to pay, d.w.z. differentiatie van emissiereducties op basis van BNP per capita.
- De (uitgebreide) Tryptych benadering, d.w.z. differentiatie van emissiereducties gebaseerd op een variëteit aan sectorale en technologiecriteria.
- Gelijke mitigatiekosten, d.w.z. differentiatie van emissiereducties op basis van gelijke mitigatiekosten per land (bijvoorbeeld een bepaald percentage van het BNP).

Deze opties scoren verschillend met betrekking tot een selectie aan beleidsevaluatiecriteria, maar geen van de opties scoort het hoogst of laagst op alle fronten. Toch lijken sommige opties over de gehele linie een betere score te hebben dan andere opties, afhankelijk van de wijze van interpretatie en het wegen en optellen van de criteria. De totale score van de grandfathering aanpak, bijvoorbeeld, lijkt lager te zijn dan bij de overige opties, terwijl de totale score van de multi-criteria convergentie benadering en het Triptych regime relatief hoger lijken te zijn.

Opties voor ETS allocatie binnen de EU na 2012
De belangrijkste eigenschap van het EU ETS allocatiesysteem tot 2012 is dat het in principe een nationaal georiënteerd systeem is dat gebaseerd is op een gratis allocatie van emissierechten, d.w.z. grandfathering voor bestaande installaties en brandstof- of technologiespecifieke benchmarking voor nieuwe toetreders. De belangrijkste voordelen van een dergelijke aanpak zijn de volgende:

- Nationaal gerichte allocatie kan nauwkeurig afgestemd worden op de maatschappelijk-economische omstandigheden van een land, inclusief de beschikbaarheid van data en bestaande culturele en beleidsomstandigheden. Hierdoor wordt de maatschappelijk-politieke haalbaarheid en het draagvlak voor ETS onder de lidstaten aanmerkelijk verbeterd.
- Vrije allocatie komt die emitterende partijen tegemoet die de kosten van emissiehandel niet kunnen doorberekenen in hun afzetprijs en vermindert op deze wijze de weerstand van deze partijen tegen de EU ETS (en vereenvoudigt dus de invoering ervan).

Er zijn echter ook een aantal nadelen aan het huidige allocatiesysteem:

- Er ontstaan significante verschillen tussen landen met betrekking tot allocatie op installatieniveau, wat kan leiden tot verstoring van de interne markt doordat de concurrentiepositie en/of de winstgevendheid van installaties in de EU wordt beïnvloed.
- Het kan leiden tot een onevenwichtige of ongelijke verdeling van de totale nationale emissieruimte (inclusief JI/CDM credits) tussen de ETS sectoren en andere sectoren in een land, en in het bijzonder kan het leiden tot een relatieve of zelfs absolute overallocatie van ETS sectoren ten koste van andere sectoren.
- Het leidt tot additionele winsten ('windfall profits') voor bedrijven die kosten doorberekenen van gratis gealloceerde emissierechten.
- Het leidt tot een zeer complex en ondoorzichtig systeem van allocatieregels in de EU ETS.
- Het vermindert prikkels tot investering in minder koolstofintensieve technologieën en ondermijnt daardoor het doel en de geloofwaardigheid van de EU ETS in het ondersteunen van de transitie naar een minder koolstofintensieve economie.
- Het leidt tot allerlei vormen van gelobby door belangenorganisaties.

Er is een variëteit aan allocatieopties voor na 2012 beschikbaar om met deze nadelen om te kunnen gaan, waaronder harmonisatie of centralisatie van allocatiebesluitvorming op EU niveau in combinatie met een aantal specifieke allocatiemethodes op installatieniveau zoals veilingen of uniforme productgenerieke benchmarking. Regeringen van EU lidstaten zullen echter ongetwijfeld aarzelen om een aanzienlijk deel van hun allocatiebesluitvormingscompetentie over te hevelen naar Europees niveau, aangezien allocatiebesluitvorming een significant effect kan hebben op de inkomensverdeling en concurrentiepositie op nationaal, sectoraal en bedrijfsniveau.

Verder hebben allocatieopties zoals veilingen of uniforme productgenerieke benchmarking naast voordelen ook nadelen, vooral als externe concurrerende partijen niet te maken hebben met gelijkwaardige klimaatbeleidgerelateerde kostenstijgingen. Daarom zou in een dergelijke situatie een combinatie van allocatiemethodes moeten worden overwogen, waaronder (i) veilingen voor beschermde sectoren, bijvoorbeeld de elektriciteitssector en andere sectoren die geen hinder ondervinden van externe concurrentie, (ii) grandfathering voor bestaande installaties in sectoren die blootgesteld zijn aan externe concurrentie, (iii) relatieve, uniforme en/of productgenerieke benchmarking voor nieuwkomers in blootgestelde sectoren en (iv) het recyclen van veilingopbrengsten om de nadelige effecten van de doorberekening van CO2 kosten tegen te gaan, in het bijzonder voor die bedrijven die blootgesteld worden aan externe concurrentie. Vanaf het moment dat een mondiaal klimaatbeleidsregime is geïntroduceerd, d.w.z. alle relevante concurrenten hebben te maken met dezelfde kostenstijgingen door klimaatbeleid, kan veilen toegepast worden op alle ETS deelnemers en de veilingopbrengsten gebruikt worden om toekomstige maatschappelijk-economische activiteiten - zoals klimaatbeleid - te bekostigen.

Gezamenlijke opties voor EU burden sharing en ETS allocatie na 2012

1. Huidig systeem: d.w.z. eerst wordt de totaal beschikbare EU emissieruimte verdeeld over alle lidstaten en vervolgens verdeelt elke lidstaat haar nationale ruimte tussen de ETS

versus overige sectoren, terwijl de allocatie van het nationale ETS plafond op installatieniveau plaatsvindt op basis van nationale allocatieregels.
2. EU burden sharing met ETS allocatie op EU niveau: d.w.z. zowel het top-down ETS plafond als de bottom-up allocatieregels worden op EU niveau bepaald, terwijl de EU emissieruimte voor niet-ETS sectoren wordt verdeeld over de lidstaten die vervolgens hun eigen nationaal beleid bepalen voor deze sectoren.
3. EU burden sharing met EU breed ETS plafond en allocatie door de lidstaten voor (a) zowel bestaande als nieuwe installaties (Type 3a) en (b) alleen bestaande installaties (Type 3b).

Deze drie opties hebben verschillende effecten in kwantitatief opzicht (bijv. toegewezen hoeveelheid emissies en kosten op Europees, nationaal, sectoraal of installatieniveau), afhankelijk van de specifieke burden sharing en allocatieregels die van toepassing zijn (wat buiten de reikwijdte van dit onderzoek valt). Verder hebben de opties verschillende effecten in kwalitatief opzicht, te weten in termen van besluitvaardigheid, concurrentieverstoringen en andere potentieel nadelige effecten van nationaal georiënteerde versus EU geharmoniseerde allocatie. Het centraliseren of harmoniseren van het proces van vaststelling van het ETS plafond en de allocatieregels voor ETS installaties zou gezien kunnen worden als een aantrekkelijke of zelfs ideale optie, aangezien het concurrentieverstoringen en andere nadelige effecten vermindert die voortkomen uit een nationaal georiënteerd allocatieproces. Dit brengt echter een significante competentieverschuiving van besluitvorming van nationaal naar EU niveau met zich mee (vergeleken met het huidige allocatieproces). Daarom zou voor de periode direct na 2012 een tussenoplossing mogelijk kunnen zijn in de vorm van een aanpak waarin een aantal onderdelen van het allocatieproces gecentraliseerd worden, zoals het vaststellen van een EU breed plafond voor het ETS als geheel of het volledig harmoniseren van rechten en allocatieregels voor nieuwe toetreders, terwijl andere delen overgelaten worden aan nationale besluitvorming of onderworpen worden aan een geleidelijk proces van toenemende harmonisatie van allocatieregels in de handelsperiode na 2012.

Interactie tussen internationale burden sharing en ETS allocatie binnen de EU na 2012
Opties voor ETS allocatie binnen de EU na 2012 sluiten goed aan bij een grote verscheidenheid aan opties voor post-Kyoto internationale overeenkomsten met betrekking tot de aanpak van klimaatverandering (waaronder een variëteit aan emissiedoelstellingen en beleidsmaatregelen of -instrumenten). Als belangrijke concurrenten van buiten de EU ETS echter niet meedoen in zulke overeenkomsten of slechts deelnemen in overeenkomsten die de productiekosten niet op een gelijkwaardige manier als de EU ETS verhogen levert dit concurrentieproblemen op voor die EU ETS sectoren die te maken hebben met externe concurrentie waardoor extra (compenserende) maatregelen voor het aanpakken van deze problemen noodzakelijk zijn . Dit omvat onder meer (compenserende) aanpassingen in grensbelastingen (‘border tax adjustments’), indirecte allocatie van emissierechten (bijvoorbeeld aan de gebruikers van elektriciteit), het gericht herverdelen van veilingopbrengsten van emissierechten, allocatie van emissierechten gebaseerd op gerealiseerde productieomzetten, of opties voor deze sectoren om uit het ETS te stappen (‘opt-out’).

1 Introduction

1.1 Background and objectives of WAB project

Discussions on post-2012 climate change policies have again raised the question of EU internal burden sharing. Due to the introduction of the EU Emissions Trading Scheme (ETS) these discussions have become related to the future of the allocation of emission allowances under the ETS. The aim of the WAB project 'Options for EU burden sharing and ETS allocation post-2012' is to explore and analyze post-2012 internal EU burden sharing options for GHG mitigation, taking into account the future of the EU Emissions Trading Scheme (ETS) and options for international burden sharing (including non-EU countries). The project is envisaged to have two phases.

In December 2004, the Environment Council of the EU concluded that in order to have a reasonable chance of limiting global warming to 2 degrees above pre-industrial levels, global emissions would need to be reduced possibly by as much as 50% by 2050 compared to 1990 levels. In March 2005, it concluded that as part of a global effort industrialised countries would need to adopt emission reductions in the order of 15-30% by 2020 and should consider reductions up to 60-80% by 2050.

In February 2007, the EU Environment Council adopted new conclusions that set even more stringent climate policy targets: a 30% reduction target for the EU and other industrialised countries as part of a post-2012 international climate policy agreement and, independent from that, a 20% reduction target for the EU (i.e. in case on no global agreement). Although these figures are well conditioned by broader participation and other Parties taking on similar commitments, the EU has send out a strong signal. This is quite remarkable for two reasons:

a) the EU has not yet fully explored the economic implications of such targets, and
b) the EU has still to discuss and agree on the internal allocation of the emission reduction efforts among its Member States and/or economic sectors.

This is in contrast with the policy process preceding the agreement on the Kyoto Protocol (COP-3, 1997), when the EU only made a proposal for a 15% emission reduction target for the industrialised countries after an internal agreement on the EU burden sharing among its Member States. However, as the discussions on the new climate targets in the Environmental Council already indicated the issue of how to distribute the emission reduction burden internally has again become important. In the new council conclusions it has been decided that a differentiated approach to the contributions of the Member States is needed, that should reflect fairness, be transparent and take into account national circumstances of the member states. The Environmental Council recognises that the implementation of these targets will be based on Community policies and on an agreed internal burden sharing. Finally, it invites the European Commission to start immediately, in close cooperation with the Member States, a technical analysis to provide a basis for further in-depth discussion.

Compared to the pre-Kyoto Protocol period, there are a number of factors that will complicate the internal EU burden sharing discussion, including:

1. The extension of the EU from 15 to 27 Member States, increasing not just the number of parties involved but also the diversity in national circumstances.
2. The introduction of the EU Emissions trading Scheme (ETS), starting from 1 January 2005. This raises questions about the future of the ETS after 2012, irrespective of developments in international burden sharing negotiations.

Hence, there is ample need for a timely exploration and evaluation of options for EU burden sharing and ETS allocation post-2012 and the interaction of these options with developments in international post-Kyoto mitigation negotiations.

Over the years, the issue of future action and international burden sharing in the post 2012 climate policy has received more and more attention in both academic and policy circles.

Overviews and analyses of proposals can be found in Aldy et al. (2003), den Elzen et al. (2003), Höhne et al. (2003), and Bodansky (2003). Since the agreement on the KP much less attention has been paid to the issue of internal EU burden sharing and in particular the interplay between the issue of EU burden sharing and the development of the ETS (e.g. Bode, 2005). This research project intends to fill in this gap, building on ideas and insights from both areas of analysis.

1.2 Purpose and structure of report

The purpose of the present report is to assess various options for EU burden sharing and EU ETS allocation beyond 2012, based on a sample of policy evaluation criteria and a review of the literature on (i) international and EU burden sharing of future GHG mitigation commitments, and (ii) allocation of GHG emission allowances among countries, sectors and emitting installations. The report focuses on the assessment of the conceptual and socio-economic aspects of these options.

The structure of the report runs as follows. Chapter 2 discusses first of all criteria for evaluating international and EU burden sharing regimes and, subsequently, criteria for evaluating EU ETS allocation options. Next, Chapter 3 assesses options for EU burden sharing post-2012, while options for EU ETS allocation beyond 2012 are analysed and evaluated in Chapter 4. Subsequently, whereas Chapters 3 and 4 consider the two categories of options separately, Chapter 5 assesses some combined or joint options for EU burden sharing and ETS allocation post-2012, while Chapter 6 discusses some linkages and interactions between EU burden sharing and EU ETS allocation post-2012. Finally, Chapter 7 presents a summary of the major findings and conclusions of the report.

2 Criteria for evaluating post-2012 options

This chapter provides a brief discussion of the criteria to evaluate options for EU burden sharing and EU ETS allocation post-2012. Although the criteria to assess international mitigation regimes overlap to some extent with those to evaluate EU ETS allocation options, they are treated separately as they have often different meanings and interpretations, depending on the context in which they are used. Hence, Section 2.1 elaborates on criteria for evaluating international climate regimes, while Section 2.2 discusses criteria to assess EU ETS allocation.

2.1 Criteria for evaluating international climate regimes

In defining a set of evaluation criteria, a number of studies have been used, notably Torvanger et al. (1999), Berk et al. (2002), Höhne et al. (2003) and den Elzen and Berk (2003). Following Höhne et al. (2003), a general distinction is made between environmental criteria, political criteria, economic criteria and technical criteria.[1] For all types of criteria some specific elements have been identified.

Environmental criteria
A clear first requirement of any regime is *environmental effectiveness*, i.e. it possesses the ability to effectively control and eventually to reduce global GHG emissions with the aim of stabilizing GHG concentrations. The effectiveness of a climate change regime depends on a number of factors such as (a) the level of participation of significant emitters; (b) the comprehensiveness of the regime with respect to the gases and sources covered; and (c) the stringency of the commitments adopted. If some countries remain outside the regime, part of the efforts undertaken by participating states can be offset by leakage: the increase in the emissions of non participating countries resulting from factors such as lower international energy prices and a relocation of production from participating to non-participating countries due to improvement in competitiveness (terms of trade). Moreover, with the growing share of developing countries in global GHG emissions, the environmental effectiveness of any post-Kyoto climate regime will to a large extent depend on the actions taken by the larger developing countries in particular. For this reason, a further environmental criterion is whether a given regime approach provides *incentives for developing countries to take early action*, that is before adopting quantified commitments.

Political criteria
Political criteria generally relate to factors directly affecting the political acceptability of a climate change regime. One of the political criteria will be its perceived equity or fairness. Perceptions about an equitable differentiation of future commitments differ widely. In looking for acceptable climate change regimes it thus seems wise not to focus on any single equity principle, but instead to look for approaches embracing different equity principles, although these may not be much more than compromises, since distinct principles often contradict each other (e.g. egalitarian and sovereignty principles). *Robustness regarding equity principles*, as they are set out in Box 2.1, is thus considered a relevant first criterion. At the same time, it is clear that a regime is unlikely to come about or to be effective when it fundamentally conflicts with the positions of some key countries. Thus the idealism in the application of principles should be tempered by realism in acknowledging the power relations resulting from the need to ensure the regime's *acceptability for key countries,* in particular those with significant emissions such as the US, FSU, EU, China and India. This relates to considerations beyond the reduction efforts required.

Up to now there has been a clear policy divide between the developed and developing countries in the climate change negotiations, with developing countries sticking together in the G77

[1] Here a subset of criteria has been selected based on a more elaborated list of criteria in den Elzen et al. (2003).

notwithstanding clear differences in their interests (e.g. between the Alliance of Small Island States (AOSIS) and OPEC member states). This historic North-South policy divide will have to be overcome in order to broaden participation and differentiate developing country commitments in the climate change regime. Another important policy criterion for a climate change regime would be that the regime be *conducive to trust building* between the Parties. Generally, trust can be enhanced by making decisions in a fair and transparent way, by agreement on regime rules binding all Parties (avoiding arbitrariness in future decision making), and by respecting previously agreed stipulations in the UNFCCC. Finally, a regime proposal ideally should be sufficiently flexible in order to leave *room for negotiation* to reach compromises. This means that the approach includes enough policy variables or allows for addition or modification of parameters to provide sufficient room for negotiation, without directly affecting its basic architecture.

Box 2.1: Equity principles

Equity principles refer to general concepts of distributive justice or fairness. Many different categorizations of equity principles can be found in the literature (Ringius et al., 1998; Ringius et al., 2000). In den Elzen et al. (2003a) a typology of four key equity principles was developed that seem most relevant for characterising various proposal for the differentiation of post-Kyoto commitments in the literature and international climate negotiation to date:

- *Egalitarian*: i.e. all human beings have equal rights in the 'use' of the atmosphere;
- *Sovereignty and acquired rights*: all countries have a right to use the atmosphere, and current emissions constitute a 'status quo right';
- *Responsibility/polluter pays*: the greater the contribution to the problem, the greater the share of the user in the mitigation/economic burden;
- *Capability*: the greater the capacity to act or ability to pay, the greater the share in the mitigation/economic burden.

The basic needs principle is included here as a special expression of the capability principle: i.e. the least capable Parties should be exempted from the obligation to share in the emission reduction effort so as to secure their basic needs. An important difference between the egalitarian and sovereignty principle, on the one hand, and responsibility and capability, on the other, is that the first two are *rights-based*, while the latter two are *duty-based*. This difference is related to the concepts of resource-sharing, as in the Contraction & Convergence approach, and *burden-sharing* in the Multi-Stage approach (see Chapter 3).

Economic criteria

A first clear economic criterion, stipulated by the UNFCCC (Article 3.3), is that of *cost-effectiveness:* reducing emissions at the lowest possible cost. This criterion is important because the potential for and costs of GHG emission abatements differ widely between countries. With the introduction of the Kyoto Mechanisms (KMs) (international emissions trading, project-based Joint Implementation, and the Clean Development Mechanism (CDM) countries and companies have gained the option of allocating emission reductions abroad if this is more cost-effective than internal reductions. The KMs thus have created so-called 'where' flexibility. If these mechanisms are preserved in the future climate change regime, they would help in attaining a high level of cost-effectiveness regardless of the allocation of commitments. However, the cost-effectiveness to be expected from emissions trading is higher than for JI and CDM because of lower transaction costs and an easier utilization of reduction potentials (accessibility factor). This implies that the highest level of cost-effectiveness is attained in a regime where most countries are able to participate in emissions trading.

Another important economic criterion is *certainty about costs.* Certainty about the level of costs and related economic impacts is important to avoid the risk of high costs possibly resulting in a disproportional or abnormal burden. It is also important for the willingness of countries to take on commitments (Philibert and Pershing, 2001). This is particularly the case for developing countries that fear that taking on climate change commitments poses a threat to their economic development. Reducing the uncertainty about future mitigation costs may thus increase the willingness of developing countries (and Australia and the US) to take on emission control commitments. Next, it will be important that a climate change regime proves able to

accommodate different national circumstances resulting from factors such as geographical situation, (energy) resource endowment, and economic structure and international specialization (Articles 3.2, 3.3, 3.4, and 4.8 UNFCCC). A climate change regime that fails to take account of such circumstances may result in disproportional or abnormal burdens for some (groups of) countries. This would not just be unfair, but also politically unacceptable.

Technical and institutional criteria
These criteria concern technical and institutional requirements of regime approaches related to both the negotiation process and the implementation and monitoring of commitments. These requirements can be technical, legal, or organizational in nature. A first criterion is *compatibility with the Kyoto Protocol and UNFCCC.* From a legal point of view, and given the importance of continuity in policymaking, it is desirable that a future climate change regime does not require major legal revisions of the UNFCCC and or the Kyoto Protocol. A second criterion is *simplicity of the negotiation process*. Regime approaches that are complex in nature, either conceptually, due to need for complex calculations, data requirements or the number of policy variables, complicate international negotiations. They make it more difficult for Parties to assess the implications of regimes, will result in a long and complex negotiation process and are hard to communicate to high-level policy makers and constituencies. Complex regime approaches are particularly to the disadvantage of developing countries that posses less scientific and analytical capacity and negotiating staff.

A third related criterion 'ease of implementation', concerns the technical and institutional feasibility of implementation, monitoring and enforcement. Even conceptually simple approaches can pose major implementation problems due to their technical and institutional requirements, particularly in less developed countries. Any regime approach that implies monitoring and enforcement action from least developed countries will face major implementation problems. Involving these countries in international emissions trading will be difficult due to lack of reliable emission data, statistical capacity to meet eligibility requirements, and sufficient capacity for verification and enforcement (Baumert et al., 2003).

2.2 Criteria for evaluating EU ETS allocation options

2.2.1 General criteria

In order to assess alternative options for EU ETS allocation, a variety of criteria is used, including:[2]

- *Environmental effectiveness:* defined as the likelihood of an option achieving a specific environmental objective.
- *Economic efficiency:* including static versus dynamic economic efficiency. *Static economic efficiency* is defined as the potential to minimise the direct costs of meeting an option objective in the short term by allocating available resources in the most optimal way. *Dynamic economic efficiency* is defined as the potential to minimise costs in the long run by promoting technological innovations.
- *Equity:* defined as fairness in sharing the costs and benefits of an option among different social groups.
- *Industrial competitiveness:* defined as the impact of an option on the competitiveness of industrial firms. Competitive effects may be either internal (i.e. within the EU) or external (i.e. firms located in EU Member States versus those in other countries).
- *Political acceptability:* defined as the acceptability of an option by key groups in the society.
- *Predictability (certainty):* defined as the ability of an option to give sufficient certainty about its implications in the long term.
- *Transparency:* defined as whether an option is open, clear and coherent, and whether the rationale for it is easy to perceive.

[2] See, for instance, Rio Gonzalez (2006); Cosmann et al. (2006); Oxera (2005); Matthes et al. (2005); PWC (2005); Sijm and Van Dril (2003); NERA (2002); and Jensen and Rasmussen (2000).

- *Simplicity:* defined as the administrative burden of an option on both the target group and the implementing organisations.
- *Transaction costs:* defined as the costs for preparing and implementing an option.

2.2.2 Specific criteria

In addition to the above-mentioned general criteria, there are a variety of specific criteria for evaluating EU ETS allocation such as (i) the criteria laid down in Annex III of the EU ETS directive (see Table 2.1), (ii) specific guidelines by the European Commission (EC, 2004 and 2005), or (iii) additional criteria specified in National Allocation Plans of individual Member States.

Table 2.1 Allocation criteria of Annex III of the EU ETS Directive[a]

Annex III criteria	Content
(1) Kyoto commitments	The total quantity of allowances to be allocated shall be consistent with the Member States obligation to limit its emissions, considering the proportion of these allowances represent in comparison with emissions from non-covered sources. The quantity shall be consistent with a path towards achieving compliance with the Kyoto Protocol (M).
(2) Assessments of emissions development	The total quantity of allowances shall be consistent with assessments of actual and projected emissions.
(3) Potential to reduce emissions	The quantity of allowances to be allocated shall be consistent with the technological potential of activities covered by this scheme to reduce emissions (M). MS may base their distribution of allowances on average emissions of GHG by product and achievable progress in each activity (O).
(4) Consistency with other legislation.	The NAP shall be consistent with other Community legislation (M). Unavoidable emissions increases resulting from new legislation should be considered (O).
(5) Non-discrimination between companies or sectors	The NAP shall not discriminate between companies or sectors as to unduly favour certain installations or sectors.
(6) New entrants	The NAP shall inform on the treatment of new entrants.
(7) Early action	The NAP shall inform on the treatment of early action.
(8) Clean technology	The NAP shall inform on the treatment of clean technology.
(9) Involvement of the public	The NAP shall inform on how public comments are considered.
(10) List of installations	The NAP shall contain the list of covered installations with the quantities of allowances allocated to each.
(11) Competition from outside the Union	The NAP may inform on how the existence of competition from countries or entities outside the EU will be considered.

a) M=Mandatory; O=Optional.

3 Options for EU burden sharing post-2012

This chapter provides a discussion of the major options for EU burden sharing post-2012 against the background and history of the present EU burden sharing and the future development of the international climate policy regime provided by the UNFCCC and the Kyoto Protocol. It starts with a short history and evaluation of the present EU burden sharing agreement. Next it discusses the international context of a future EU burden sharing arrangement. Finally, some options for future EU burden sharing are discussed.

3.1 History and evaluation of the present EU burden sharing agreement

3.1.1 The history of the EU burden sharing arrangement

From Rio de Janeiro 1992 to Kyoto 1997

In 1992, at the Earth Summit in Rio de Janeiro, over 150 states accepted the objective 'to protect the climate system for the benefit of present and future generations by stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UNFCCC, 1992). In 1995, it was concluded that emission and reduction objectives of states beyond the year 2000, had to be set in a protocol that should be adopted at the third Conference of the Parties in Kyoto in 1997 (COP-3). The EU stated in its ratification of the Climate Convention that it would comply jointly, allowing some Member States to increase emissions (EU, 1993). However, within the EU the negotiations on targets and timetables were thwarted by questions concerning the contribution of individual Member States to a common EU target and the associated economic burden (Phylipsen et al., 1998). As a preparation to its Presidency of the European Union (January – June 1997), the Netherlands' government commissioned a study on burden differentiation within the EU which resulted in the so-called Triptych sectoral approach.

Table 3.1 Burden sharing 'agreements' for EU 15 in the run-up to the 3rd Conference of the Parties

	Original 1997[1]	Triptych 1997[2]	Dutch proposal	1997 agreement[3]	UK 1998[4]	proposal	1998 agreement[5]
Austria	-1 to -25	-25	-25		-20.5		-13
Belgium	-12 to -15	-15	-10		-9		-7.5
Denmark	-12 to -25	-25	-25		-22.5		-21
Finland	-4 t0 -7	-10	0		0		0
France	-4 to -12	-10	0		0		0
Germany	-17 to -30	-30	-25		-22.5		-21
Greece	-2 to 2	5	30		23		25
Ireland	-2 to -5	15	15		11		13
Italy	-5 to -9	-10	-7		-7		-6.5
Luxembourg	-17 to -20	-40	-30		-30		-28
Netherlands	-6 to -9	-10	-10		-8		-6
Portugal	16 to 21	14	17		15		15
Spain	6 to 11	14	17		15		15
Sweden	5 to26	5	5		5		4
UK	-17 to -20	-20	-10		-12		-12.5
EU	-9 to -17	-15	-9.2		-8.5		-8

1) Range of four variants: Blok et al. (1997); 2) Ringius (1997); 3) EU Council (1997); 4) Michaelowa et al. (2001); 5) EU Council (1998).
Source: Bode (2005).

The EU agreement in the Kyoto protocol
The Triptych sectoral approach to burden sharing is a relative simple method which incorporates important national circumstances. The three categories distinguished are the power sector, the internationally operating energy-intensive industry and the remaining domestically oriented sectors. Emission allowances are calculated by applying rules, such as limitation of coal use of power production, minimum requirements for renewable energy, and minimum energy efficiency improvement rates in the industry. For the domestic sectors a per capita emission allowance approach is used. March 1997 the EU agreed for a 10% reduction in 2010 relative to 1990 with an internal differentiation between member states using the Triptych approach. This was the basis of the EU proposal for a 15% reduction target for industrialized countries at Kyoto. This led to the agreement in the Kyoto Protocol at COP-3 with an 8% reduction target for the EU countries and a bubble arrangement, allowing for internal differentiation within the EU. The Kyoto Protocol includes the so-called flexible mechanisms which makes it easier for countries to reach their target. In 1998, the EU internal burden sharing was re-negotiated which resulted in a relatively less stringent reduction goal of 6% for Austria and the Netherlands, while the UK accepted a more stringent target.

3.1.2 The evaluation of the EU burden sharing agreement

In the political (negotiation) process of the EU and its Member States, the application of the Triptych approach was very successful because it resulted in increased insight among EU negotiators concerning differences in national circumstances and their role in greenhouse gas emissions. On the basis of this improved understanding it was possible to come to an agreement on a 10% reduction within the EU15 that was translated into a negotiation position in the AGBM process of a 15% reduction for industrial countries (Phylipsen et al., 1998).

However, the evaluation with respect to economic criteria is less positive. According to Eyckmans et al. (2002) and Viguier et al. (2003) the allocation of reductions is not balanced. Some countries (Sweden, Belgium, the Netherlands, Spain and Portugal) have a relatively heavy burden, while others (Germany, United Kingdom and France) have a relatively light burden. Eyckmans et al., 2002 presents an ex post welfare analysis of the European burden sharing agreement (BSA). Overall, the BSA would cost the EU economy approximately one eight (0.125) of a percent of its projected GDP in 2010. The EU average per capita cost would amount to 31 € per capita. However, this relatively low figure hides important regional differences which range from about 8.9 € per head in Germany to as much as 175 €/head in the Netherlands. The EU average marginal abatement cost amounts to about 46 €/tCO_2. This overall EU marginal abatement cost estimate for the EU BSA without emissions trading is comparable to the estimates by, for instance, Criqui (1999), Capros and Mantzos (2000), Capros et al. (2001), and Viguier et al. (2003; see below). Again, the overall EU figure hides substantial regional difference. Marginal abatement costs for implementing the EU BSA are relatively low in Germany and the United Kingdom (23 and 27 €/ton CO_2 respectively) and are as high as 109 and 123 €/ton CO_2 in the Netherlands and Sweden respectively. These large discrepancies in marginal abatement costs indicate that the EU burden sharing agreement remains far from achieving a cost efficient implementation of the EU Kyoto reduction objective.

Eyckmans et al. (2002) presents also an inverse welfare approach with different degrees of inequality aversion reflecting alternative opinions on the importance of distributional equity. This approach makes it possible to explore the trade off between efficiency and equity in the allocation of emission abatement efforts over the EU member states. The publication concludes that the EU BSA did not differentiate enough the individual EU countries 'effort levels from a pure efficiency point of view'. (The large countries UK, Germany and France have too low targets). Introducing some inequality aversion reinforces this conclusion. The argument that the BSA takes into account equity considerations to deviate from a plain cost efficient allocation is clearly refuted by the inverse welfare approach and the authors of the publication claim that the BSA agreement can be called efficient, nor equitable. The EU ETS softens the economic unbalance. Individually, all EU member countries are better off with than without trading but some gain more than others. E.g., the Netherlands may lower their total costs from 0.71% to 0.47% of GDP, Sweden from 0.23% to 0.14% in 2010. With emission trade compared to the

BSA without trading, total EU abatement costs fall from 0.125% to 0.10% of GDP in 2010. The Kyoto Mechanisms are not included in the figures and will soften the unbalance even more.

If EU countries were to individually meet the EU allocation Viguier et al. (2003), estimates that domestic carbon prices vary from 25 - 37 \$95/tCO_2 in the United Kingdom, Germany and France to 80 -105 \$95/tCO_2 in the Netherlands, Sweden and Denmark; welfare costs range from 0.6% to 5% in 2010. For nine observed EU countries, the average carbon price is 43 \$95/tCO_2. No results are given in case of EU emissions trading or the application of the Kyoto Mechanisms. One needs to keep in mind that the estimated costs and welfare impacts are highly sensitive to the baseline or reference projections.

Marklund and Samakovlis (2003) concluded that both efficiency and equity were important aspects considered in the EU burden sharing agreement: 'The fact that the results indicate both efficiency and equity considerations contradicts the general opinion that there necessarily is an efficiency-equity trade-off'. Their general conclusion drawn is that efficiency did not rule out equity, and vice versa, when settling the BSA. The results show that efficiency arguments had an influence on burden-sharing. EU member states with higher marginal abatements costs of greenhouse gas emissions were assigned easier emission change requirements compared to states with lower marginal abatements costs. Also, equity arguments were important in the settlement. The results show that countries with lower standards of living, in terms of consumption, were assigned easier emission change requirements.

3.1.3 Conclusions

Assuming different criteria, the following conclusions for the EU burden sharing arrangement can be drawn:

- *Environmental effectiveness.* The bubble approach allows some member states to increase emissions, so the resulting target for the EU as a whole was probably less stringent than without the bubble approach. Application of the Triptych approach resulted in a target for the EU as a whole that is substantially higher than targets that had been stated earlier.
- *Political criteria*. The Triptych approach was accepted by the EU and its Member States because it was based on the main issues encountered in the negotiations: differences in population size, in standard of living, in fuel mix, in economic structure and the competitiveness of internationally oriented industries. It seems that the incorporation of different equity principles in the Triptych approach was successful for the political acceptability of the burden sharing agreement.
- *Economic criteria*. The EU burden sharing is not balanced with regard to cost-effectiveness (i.e. marginal costs of reductions) and welfare impacts: some countries have a relatively heavy burden, while others have a relatively light burden. The EU ETS as well as the Kyoto Mechanisms softens the unbalance. There are no indications in the literature that for the EU15 there is an efficiency-equity trade-off. In contrary, a more economic balanced burden sharing (Germany, United Kingdom and France having a heavier burden) with respect to marginal abatement costs and welfare impact might be also in favour with equity criteria. However, it is not certain that this would also hold for the EU27 with larger differences in national income and new Member States with not just lower incomes, but also higher emission intensity levels.

3.2 The international context for future EU burden sharing arrangements

The present international climate change regime is characterized by increasing fragmentation. In 2001, the United States of America (followed by Australia) decided not to ratify the Kyoto Protocol and, subsequently, launched some climate change initiatives outside the UNFCCC framework, notably a number of technology-oriented international initiatives, such as one on hydrogen, methane, and carbon capture and storage (White House, 2002).

In 2005, the United kingdom took the initiative to discuss the issue of climate change at the G8 meeting in Gleneagles, where also a dialogue with a number of key developing countries was started (India, China, Brazil, South Africa, Mexico) (G8 Gleneagles Communiqué and Joint Declaration, 2005). Finally, in 2005, the USA together with Australia took the initiative for setting

up an Asian Pacific Partnership on Clean Technology and Climate (APP), which focuses on promoting clean economic development by voluntary agreements on the application of various policies and measures to enhance the development and diffusion of technologies (APP, 2006). While these initiatives are not necessarily conflicting with the approach taken under the Kyoto Protocol, as some of the Asian members of the APP stressed, they clearly present alternative approaches to the 'cap and trade' approach taken under the Kyoto Protocol.

Meanwhile, under the UNFCCC two tracks for discussing future climate policies have started, known as the Kyoto and Convention tracks. At COP-10 (Buenos Aires, 2004) it was decided to organise a seminar of governmental experts (SOGE) that was followed by the start of a Dialogue on long-term cooperative action at COP11 in Montreal in 2005. Under the Kyoto Protocol, the Parties to the Kyoto Protocol at their first meeting (MOP1, which coincided with COP11) installed an Ad Hoc Working Group to start negotiations on new commitments under the Kyoto Protocol after 2012 in accordance with Art 3.9 of the Kyoto Protocol.

The outcome of both tracks is very uncertain and politically linked. The key issue determining the success of both tracks is the participation of the USA and at least a number of important developing countries, in particular rapidly developing countries like China and India. As long as it remains unclear how the participation will be broadened it is unlikely that serious progress under the Kyoto Protocol track will be made. At the same time, it is unlikely that the USA will ever rejoin the Kyoto Protocol. Therefore, it seems plausible that a real breakthrough will only be achieved after an eventual merger of the Kyoto and Convention tracks allowing for negotiating a package deal on various issues (not just mitigation commitments) that could result in a new and broader agreement.

However, given the present fragmentation it is by no means certain that an agreement under the UNFCCC will be reached. It is quite conceivable that the present fragmentation is prolonged. This seems to depend particularly on the position taken by the USA, because of its long-standing domestic scepticism towards the UN and preference for bilateralism versus multilateralism (Egenhofer et al., 2003). Even though the Democrats have a majority now in both the Senate and the House it is uncertain if any new legislation will pass during the Bush Presidency. Moreover present proposals (see Pew Centre website for an overview) focus only on domestic climate policy and leave it unclear if the US will reengage in an international climate change agreement, even after the new Presidential election in 2008.

Apart from broadening of participation another key issue in the debate about future climate policies is the type of commitments. It is widely acknowledged that an extension of mitigation commitments to non-Annex I countries would probably require others types of commitment than the binding quantified emission limitation or reduction objectives (quelro's) adopted under the Kyoto Protocol. The main issue is what these new types of commitments should be. Here a range of options is under discussion (see below). The probably most controversial issue concerns the type(s) of future commitments for Annex I Parties. Here, the USA Bush administration has shown a clear preference for relative and non-binding emission targets and for technology oriented agreements.

In Japan there is also much debate about the type of commitments to adopt after Kyoto (IGES, 2005). Japan's support for the APP initiative can also be considered as a reflection of its doubt about the appropriateness of binding emission targets. The future of the USA federal climate policy is still very uncertain. At the state level there are various initiatives for binding emission caps and the use of emissions trading instruments (in a number of Eastern States and most recently in California). Also on the federal level there are a number of proposals for cap and trade systems with absolute caps that would fit in with the Kyoto Protocol approach. It is thus in no way certain that the US would adopt relative instead of absolute emission caps.

In conclusion, the EU is faced with major uncertainty about the direction of international climate policies, both with respect to the institutional framework of new commitments, the types of commitments and the moment when agreement on new commitments will be reached. If no new international agreement under Article. 3.9 of the Kyoto Protocol or a broader framework can be

reached in time (well before 2012) this would force the EU to continue its climate policies on its one and implement unilaterally the newly adopted emissions targets to sustain the functioning of the EU ETS and the Kyoto Mechanisms, such as the CDM. If the new agreement would be based on other types of commitments than absolute and binding emission targets, this may hamper linking the ETS to initiatives of other countries.

3.2.1 Options for the development of the international climate regime

Both prior and subsequent to the negotiations on the Kyoto Protocol there have been many proposals for differentiating mitigation commitments among countries. These came from both academic circles and from Parties to the UNFCCC.[3]

Key dimensions of future international climate change regimes are (den Elzen et al., 2003; Höhne et al., 2003):

- *Problem definition*: The climate change problem can be defined as a pollution problem, a resource-sharing issue or as a sustainability issue. These different approaches have implications for the design of climate regimes. In the first approach, '*burden-sharing*', the differentiation of commitments will focus on defining who should reduce or limit pollution and by how much. In the second approach, '*resource-sharing'*, the problem is defined as an allocation of emission rights; the reduction of emissions will be in line with the user rights.
- *Goal definition***:** the goal of a mitigation regime can be defined in terms of emission reductions or other objectives, like technological change or environmental quality goals (e.g. temperature increase). Moreover, the goals may be quantified using a top-down approach (like defining allowed emissions on the basis of concentration or temperature targets combined with certain participation and allocation rules) or instead, bottom-up, by implementing policies and measures or by following a pledge-based approach to target setting.
- *Participation* (thresholds/timing): Another dimension is the degree of participation in mitigation efforts. Here all Parties may participate from the start or there are rules for participation are agreed upon that determine when Parties need to participate.
- *Type of actions/commitments*: Instead of fixed absolute emission targets, commitments may be defined as relative or dynamic targets and relate to other indices than emissions, such as reduction in energy and/or carbon intensity levels, or in terms of policies and measures (including technology development and diffusion). Moreover, commitments can be legally binding, non-binding commitments or conditionally binding (e.g. no-lose target). The type of action/commitment may be equal for countries (like the binding emission target in the Kyoto Protocol) but can also be differentiated amongst Parties. The differentiation can be linked to the level of development of Parties, such as in so-called staged approaches.
- *Scope of the commitment*: This dimension is related to the question whether the commitment covers all GHGs and sectors or is limited to particular GHGs or sectors. Particularly for developing countries, new commitments could be limited to particular sectors or GHGs for reasons of verification and monitoring, and because emissions certain sectors are difficult to predict and control (e.g. agriculture). The present commitments under the Kyoto Protocol cover all GHGs and sectors but exclude emissions from international aviation and maritime activities.
- *Allocation principles/rules***:** for sharing the emission reduction burden various allocation criteria or rules can be applied. The main criteria are responsibility (for the problem), capability (to reduce emissions), and equity. The equity principle is often related to either equal excess to the atmosphere or right to development (basic needs). Other principles are sovereignty (equal reductions), opportunity (equal marginal costs) and horizontal equity (comparable efforts for countries with comparable conditions). These principles can be translated into various criteria or allocation rules. A general formula for allocating the emission reductions could be agreed for

[3] See www.fiacc.net as well as Banuri et al. (1996); Reiner and Jacoby (1997); Jacoby et al. (1997; 1999), Rose et al. (1998); Ringius et al. (1998); Torvanger and Godal (1999), Sijm et al. (2001), Berk et al. (2002), Depledge (2000); Philibert (2001); Babiker and Eckhaus (2002); Baumert et al. (2002); Evans (2002); den Elzen (2002); OECD/IEA (2002); Aldy et al. (2003); den Elzen et al. (2003); Höhne et al. (2003), Müller et al. (2003), Philibert et al. (2003), Bodansky (2004); Kameyama (2004); Blok et al. (2005); Philibert (2005); and Höhne et al. (2005).

countries. This rule could lead to emission reductions for each individual country, which can then be modified by negotiations.
- *Institutional framework*: the commitments can be part of multilateral agreements under the United Nations, agreements within regional organisations, or be based on multi-lateral and bilateral accords.

Apart from these key dimensions, there are other dimensions related to institutional aspects such as compliance and enforcement.

Not all proposals for post-2012 international climate policies deal with all these regime dimensions. Only few proposals/studies deal with the issue of long-term climate goals and their implications for the stringency of mitigation commitments (Bodansky, 2004). Only few proposals explicitly address the institutional framework of new commitments. Most proposals focus either on certain allocation principles or on the type of actions/commitments. Given the central focus on the types of commitments in the regime debate and to better understand the regime proposals we first give an overview of proposals relating to the type of future commitments.

3.2.2 Types of post-2012 regime commitments

When the Kyoto Protocol was negotiated, two basic options were on the table: 'common and coordinated policies and measures' and 'targets and timetables'. With the Kyoto Protocol, all countries agreed to adopt the 'targets and timetable' approach with binding absolute national emission targets for Annex I countries and the option of emissions trading. In the literature many alternatives to the binding emission reduction targets in the Kyoto Protocol have been proposed to deal with either some of the perceived drawbacks of such targets or to allow for a broader participation of countries (see for example, Bodansky, 2003; Höhne et al., 2003; see for example, Philibert and Pershing, 2001). Some options propose different types of targets, while others return to the concept of 'policies and measures' such as some sector based proposals or technology cooperation agreements. Moreover, some options are focused on developing country participation, while others concern actions by developed countries. A comprehensive overview of possible (mitigation) commitments can be found in Höhne et al. (2005).

Quantified emission commitments:
There have been various alternatives for absolute targets, including the following options (Höhne et al., 2005; Philibert, 2005):
- Dynamic targets (also known as indexed targets, or relative targets), meaning that targets are expressed as a function of the GDP ('intensity targets') or variables of physical production, e.g. emissions per tonne of steel produced (Ellerman and Wing, 2003; Hargrave and Helme, 1998; Kim and Baumert., 2002).
- Price cap (also known as safety valve or price ceiling), meaning that an unlimited number of additional emission rights are issued at a given maximum price to cap (marginal) mitigation costs (Jacoby and Ellerman, 2002).
- Positively binding emission targets, meaning that additional emission rights can be sold, if the target is reached, but no additional emission rights have to be bought, if no rights have been sold and the target is still not met (also known as no-lose targets (Philibert, 2000); related to growth-targets (Frankel, 1999);
- Dual targets, meaning that two targets are defined, i.e. a 'selling target', below which emission rights can to be sold, and a 'buying target', above which emission rights have to be bought (Kim and Baumert., 2002).
- Non-binding emission targets, meaning that not reaching them has no consequences. Here emissions trading could not be applied.

Alternative to quantified commitments
The literature also documents types of commitments in other ways than national emission targets:
- Policies and measures, i.e. action targets: a commitment to reduce emissions with a certain percentage from baseline levels (Baumert and Goldberg, 2006); Sustainable Development Policies And Measures (SD-PAMs) (Winkler et al., 2002).

- Technical agreements, i.e. technology and performance standards e.g. energy-efficiency standards. (e.g. Barrett, 2001; Edmonds and Wise, 1999; Tol 2002) or technology, research and development incentives (e.g. Barrett, 2001; Edmonds and Wise, 1999; Buchner et al. 2003).
- Carbon taxes (e.g. Cooper, 2001; Nordhaus, 2002).
- Sectoral targets and sectoral CDM (e.g. Samaniego and Figueres, 2002; Schmidt et al., 2007).
- Financial measures, including subsidies and government-funded investments (e.g. Schelling, 2002).

3.2.3 Post 2012 regime proposals

This section gives an overview of approaches on how to design a post-2012 mitigation regime. For a quantification of most of the regimes described below, see den Elzen and Lucas (2005).

Kyoto Continued
A first option would be a continuation of the Kyoto Protocol approach (Baumert et al., 2002; Höhne et al., 2003), with maintaining two groups of countries, Annex I and Non-Annex I (with the idea that gradually more countries would move into Annex I over time); binding absolute emissions reduction targets for Annex I countries for a basket of greenhouse gases; flexibility through Kyoto Mechanisms, such as emissions trading (ET), Joint Implementation (JI) and the Clean Development mechanism (CDM).

For the first commitment period, the differentiation of commitments has not been lead by any explicit allocation principles but has been more or less pledge-based. In principle, this could be changed for the second commitment period, by using certain allocation principles. Some refer to a 'Kyoto Plus' approach that incorporates more changes such as the introduction of new elements, like 'price caps' or an extension of the CDM to sector-based CDM (see below). More fundamental changes would include changing the types of commitments, such as including intensity targets instead of absolute targets, non binding targets or a menu approach allowing Parties to select among different types of commitments. The main problems with a continuation of Kyoto would be the uncertainty about (future) non-Annex I participation and re-entrance of the USA.

Equal Per Capita Allocation/ Contraction & Convergence (equity/ sovereignty based)
An alternative approach that would represent a major shift from the current Kyoto Protocol approach is resource sharing. Instead of focusing on the question of how to share the emission reduction burden as in the present Kyoto Protocol, this approach starts from the assumption that the atmosphere is a global common to which all are equally entitled, and focuses on sharing the use of the atmosphere. Two main proposals based on this concept have been presented:
- Per Capita Allocation (Agarwal et al., 1991; Bear et al., 2000; Wicke, 2005),
- The 'Contraction & Convergence' (C&C) approach (Meyer, 2000).

In the first approach global emission rights are instantly redistributed according to population; in the second approach, emission rights are redistributed on the basis of a convergence of per capita emissions under a contracting global emission profile within a predefined time. The C&C approach constitutes a redistribution of emission rights over time based on a shift from a sovereignty based approach to an equal per capita allocation approach. In both approaches, all Parties would participate immediately after 2012 and a global emissions ceiling would need to be established (top-down) first. Other proposals related to Equal Per Capita Allocation/Contraction & Convergence are:
- Global Preference Score (Müller, 1999): proposes a procedure for allocation based on a stated preference of for either per capita allocation or grandfathering. The final allocation for all countries is weighted between the two, based on the sum of the countries' population for one or the other.
- C&C with sustainable emission rights (CSE, 1998): here equal sustainable emission rights are allocated first, while C&C is applied to the remaining emission space.

Common but differentiated convergence (equity based)
Höhne et al. (2006) proposed the 'common but differentiated convergence', in which all countries' per capita emissions converge to an equal level, but the timing of convergence is differentiated according to: (1) Annex I countries' per capita emission allowances converge within a defined number of years to an equal level for all countries; (2) individual non-Annex I countries' per capita emissions converge within a defined number of years to the same level but convergence starts from the date when their per capita emissions reach a certain percentage threshold of the global average; and (3) non-Annex I countries that do not pass this percentage threshold do not have binding emission reduction requirements. Either they take part in the CDM or they voluntarily take on 'positively binding' emission reduction targets. Under the latter, emission allowances may be sold if the target is overachieved, but no emission allowances have to be bought if the target is not reached. The Common but differentiated convergence approach, similarly to C&C, aims at equal per capita allowances in the long run. In contrast to C&C it considers the historical responsibility. Annex I countries would have to reduce emissions similarly to C&C, but many Non-Annex I countries are likely to have more time to develop until they need to reduce emissions. Non-Annex I country participation is conditional to Annex I action through the gradually declining world average threshold. No excess emission allowances or 'hot air' would occur.

Grandfathering (sovereignty; reductions)
The emission reduction burden is distributed according to current emission levels. It results in a simple flat-rate reduction. This is the most common approach in international sharing agreements over scarce resources.

Brazilian Proposal (BP; responsibility based))
During the negotiations on the Kyoto Protocol, the delegation from Brazil presented an approach for distributing the burden of emission reductions *among Annex I Parties.* This was based on the effect of their cumulative historical emissions from 1840 onwards and on the global average surface temperature (UNFCCC, 1997). The Brazilian Proposal was not adopted but did receive support, especially from developing countries, and has become a subject of continued debate and analysis. Although the proposal was initially only developed for further discussion on differentiation of commitments among Annex-I countries, it is here adopted for application on the global scale. Berk and den Elzen (2001) argued that in such case, a threshold for participation of the non-Annex-I regions should be added that would avoid immediate binding targets for developing countries. Such a threshold would allow low-income countries (with considerably lower per capita emissions than high-income countries) to focus on economic development. Such an extended Brazilian Proposal case has been elaborated on by den Elzen et al. (2005a; 2005b). Den Elzen et al. have selected an income threshold for participation (to the reductions) of non-Annex I regions as a result of their work. For the temperature attribution calculations, UNFCCC-ACCC methodology can be used (UNFCCC, 2002a). More work in the direction of the Brazilian proposal has done by Rosa et al. (2003); Trudinger and Enting (2004), Andronova and Schlesinger (2004), Höhne and Blok (2005), and Rovere et al. (2002).

Jacoby Rule approach (GDP/capita: capability based)
Another bottom-up approach for burden-sharing is the so-called 'Jacoby rule', introduced by Jacoby *et al.* (1999) as an illustrative model of accession and burden-sharing. The basic principle behind this approach is the ability to pay. In contrast with the other approaches being analysed here, the regional emission allowances are not calculated by sharing the emission space of the global emission target profile using pre-defined burden-sharing rules, but by using a mathematical equation for calculating the emission allowances. The basis of this equation is that Parties only enter the international climate regime (and reduce their emissions) once they have exceeded a level of per capita welfare (a welfare 'trigger'). Otherwise, they follow their reference emissions (unconstrained no-policy emissions trajectory). The emissions reduction is calculated on the basis of the difference between the per capita welfare income trigger level and a region's per capita welfare. Therefore, the total regional emissions are calculated bottom-up.

Multi-Stage approach
The Multi-Stage approach is an incremental but rule-based approach to extend the present Kyoto Protocol regime, and consists of a system for a gradual broadening of the group of countries taking on quantified emission limitations and reduction objectives and deepening of their commitments over time (Berk and den Elzen, 2001). The Multi-Stage approach consists of a system to divide countries into groups with different levels of efforts and types of commitments, or stages. The aim of such a system is to ensure that countries with similar circumstances in economic, developmental and environmental terms have comparable commitments under the climate regime. Moreover, the system defines when a country's level of commitment changes according to pre-determined rules related to a change in its circumstances.

The Multi-Stage approach thus results in an incremental evolution of the climate-change regime, i.e., a gradual expansion over time of the group of countries with commitments (Annex I), with countries adopting different levels and types of commitments according to participation and differentiation rules. The approach was first developed by Gupta (1998). Later, in Berk and den Elzen (2001) and den Elzen (2002), the approach was elaborated into a quantitative scheme for defining mitigation commitments under global emission profiles compatible with the UNFCCC objective of stabilising GHG concentrations. Den Elzen et al. (2006) developed a simpler case with some new types of participation thresholds, i.e. the approach is based on three consecutive stages for the commitments of non-Annex I regions beyond 2012. These are: Stage 1 - no commitment (baseline emissions), Stage 2 - emission limitation targets (intensity targets) and Stage 3 - absolute reduction targets. Participation thresholds are used for the transition from Stage 1 to 2, and from Stage 2 to 3.

This staged approach provides a general framework and provides room for many variants in altering stages, targets and thresholds.
- Gupta (2003) proposed a concrete grouping of developing countries using GDP/cap and emissions/cap.
- Ott et al. (2004) proposed a concrete grouping of developing countries based on several indicators.
- Höhne et al. (2003; 2005) and Blok et al. (2005) proposed a multistage setting where the first stage is a pledge for sustainable development (a 'soft' target), followed by moderate absolute limits and then absolute reductions. In such a setting, only a few countries change stages in future years: The first stage aims at development with low emissions and therefore the thresholds are not reached.
- CAN (2002) also proposed a variant with different tracks: Kyoto-, de-carbonisation- and adaptation track.
- Michaelowa et al. (2005) presented a variant of the Multi-Stage regime based on graduation and deepening.

The Triptych approach
The Triptych approach is a sector- and technology-oriented approach allowing different national circumstances to be taken into account. The Triptych approach was originally developed at the University of Utrecht, and has been used for supporting decision-making to differentiate the European Union's internal Kyoto target between its Member States both before and after Kyoto (COP-3) (Blok et al., 1997; Phylipsen et al., 1998; Ringius, 1999). The *Original Triptych* approach only included energy related CO_2 emissions, and distinguished between three sectors: 1) the power/electricity sector; 2) internationally orientated, energy-intensive sectors of industry (or heavy industry); and 3) the domestic sector. The selection of these categories was based on a number of differences in national circumstances raised in the negotiations that are relevant to emissions and emission reduction potentials: differences in standard of living, in fuel mix for the generation of electricity, in economic structure and the competitiveness of internationally-oriented industries. The emissions of the three categories are treated differently: For each of the categories a reasonable emission allowance is calculated, in the light of the relevant national circumstances. The methodology derives these allowances for each sector using uniform criteria applied to all countries. The allowances of the categories are added up to a national allowance for each country. Only one national target per country is proposed, no

sectoral targets, to allow countries the flexibility to pursue any cost-effective emission reduction strategy.

In the following years, the approach has been extended to the global scale and to include more sectors and non-CO_2 greenhouse gases (CH_4, N_2O, HFCs, PFCs and SF_6), at the level of world regions. The *Global Convergence Triptych* developed by Groenenberg et al. (2004) based on earlier investigations (Groenenberg et al., 2001; Groenenberg, 2002) prescribes convergence trajectories in each of the three energy-consuming sectors: convergence of energy efficiency in the energy-intensive industrial sector, convergence of GHG emission intensity in electricity production and convergence of per capita emissions in the domestic sector. Global long-term targets are defined for each of these variables. Improvement and transfer of technology will be necessary for ultimate achievement of these targets.

The *Triptych 6.0* approach (Phylipsen et al., 2005) was the first attempt to extend the calculations for countries, for the various sectors, which are added to obtain a national target (Höhne et al., 2005). Unfortunately, this approach still includes a number of short-comings (i.e. the uniform structural factor, simple methodology for downscaling, the use of industrial value added (economic output) at the level of regions for the physical production growth function in the industry, and the use of regional data at the level of countries, in stead of country-specific data). A revised Triptych approach that addresses these shortcomings is under development (den Elzen et al., 2007).

Multi-Sector Convergence approach
The Multi-Sector Convergence approach combines features of the Contraction & Convergence and Triptych approach. In principle, it aims at a converge of per capita emission levels, but tries to account for differences in national circumstances that cause variations of per capita emission requirements among countries. It groups emission sources into seven sectors for defining national emission allowances (electric power generation, households, transportation, heavy industry, services, agriculture, and waste), but this grouping could be adjusted. For each of these sectors global convergence rates are defined on the basis of global trends in activity level and emission factors. National emission allowances result from combining the sectoral allowances (Sijm *et al.*, 2001).

Sectoral Approach for Electricity and Major Industries
In this sectoral approach, the ten highest-emitting developing countries in the electricity and other major industrial sectors pledge to meet voluntary, 'no-lose' GHG emissions targets in these sectors (Schmidt et al., 2006); the term 'no-lose' denotes that no penalties are incurred for failing to meet a target, but all emissions reductions achieved beyond the target level earn Emissions Reduction Credits that can be sold to industrialized nations. Participating developing countries establish initial 'no-lose' emissions targets, based upon their national circumstances, from sector-specific energy-intensity benchmarks that have been developed by independent experts. Industrialized nations then offer incentives for the developing countries to adopt more stringent emissions targets through a *Technology Finance and Assistance Package*, which helps these nations to overcome financial and other barriers to technology transfer and deployment.

3.2.4 Implications for the post-2012 EU burden sharing

How does the development of the international climate regime interact with the EU internal burden sharing discussion? There are a number of ways in which the development of the international regime and EU burden sharing regime interact:
a) the type of regime
b) the type of commitments
c) the stringency of commitments
d) the timing of negotiations.

Type of Regime
One option would be that the international regime would be merely a continuation of the present Kyoto Protocol type of approach, extended by new commitments for some more advanced

developing countries, and the preservation of the Kyoto Mechanisms resulting formally or de facto in a multi-stage type of international climate regime. In that case, it can be assumed that the present type of EU burden sharing, with a common emission cap (bubble) and differentiate emission targets will be continued. However, if other Annex I parties, like the US, Canada or Japan would not be willing to take on binding emission reduction targets, this could have its repercussion within the EU. It may result in a lack of support within the EU for adopting more stringent new internationally binding emission reduction targets. Another case would be if internationally it would be agreed to adopt a Contractions and Convergence approach (as a way to broaden participation) which is based on a resource sharing concept in stead of a burden sharing concept. This could affect the EU burden sharing concept as well as the differentiation of targets within the EU. For political reasons it could be difficult to deviate from the C&C concept within the EU bubble, although this may depend on whether more regional bubbles are created (e.g. in Latin America or Africa).

Type of commitments
Another complication for continuation of the present EU burden sharing approach would be if other Annex I parties opt for other types of commitments than absolute emissions reduction targets, like relative targets or technology centred policies and measures.

Stringency of commitments
The EU environmental council recently has adopted a unilateral emission reduction target of 20% by 2020 compared to 1990 levels. It is willing to commit to more stringent targets, such as the proposed a 30% (absolute) emission reduction target for 2020 for all developed countries, but only as part of a international climate change regime with broad participation. While it is conceivable that the EU takes on more stringent targets than other Annex I parties (as under the first commitment period of the Kyoto Protocol), its climate target will be contingent on the targets adopted by others, in particular other developed countries.

Timing of negotiations
The interaction could be both ways, depending amongst other things on the timing of events. For example, as it looks now the discussion on the internal EU burden sharing (and future of the EU ETS) is likely to precede decisions on the future of the international climate regime. When the discussion on the EU burden sharing takes place parallel to the international negotiations they could interact.

3.3 Options for post-2012 EU burden sharing

While there has been much attention in the literature and policy circles for both post-2012 international climate regimes and the - mainly near-term - future of the EU ETS, hardly any attention has yet been paid to the issue of future internal EU burden sharing and how it may relate to the future of the ETS. The issue of EU burden sharing has only just been set on the EU climate policy agenda. On reason for this is that the other issues have been of a more immediate concern. The international regime because of the uncertainty about the future of the Kyoto Protocol after the withdrawal of the USA, and the ETS because of its central role in meeting the EU's present commitments under the Kyoto Protocol up to 2012.

At the same time, the EU has started with defining its medium and long-term international climate strategies. It did so in a top-down instead of a bottom up approach and from a global perspective. The Environment Council in December 2004 concluded that in order to have a reasonable chance of limiting global warming to 2 degrees Celsius above pre-industrial levels, global emissions possibly would need to peak within two decades and subsequently reduced possibly by as much as 50% by 2050 compared to 1990 levels. In March 2005 it concluded that as part of a global effort industrialised countries would need to adopt emission reductions in the order of 15-30% by 2020 and should consider reductions up to 60-80% by 2050. In February 2007, the EU Environment Council adopted new conclusions that set even more stringent climate policy targets: a 30% reduction target for the EU and other industrialised countries as part of a post-2012 international climate policy agreement and independent from that a 20% reduction target for the EU.

Although, these figures are well conditioned by broader participation and other Annex I Parties taking on similar commitments, the EU has send out a strong signal. This is quite remarkable for two reasons. First, the EU has not yet fully explored the economic implications of such targets. Second, the EU has still to discuss and agree on the internal allocation of the emission reduction efforts. This is in contrast with the policy process preceding the agreement on the Kyoto Protocol (COP-3, 1997), when the EU only made its proposal for a 15% emission reduction target for the industrialised countries after an internal agreement on EU burden sharing. Nevertheless, the issue of how to distribute the emission reduction burden internally is likely to remain also important for the positioning of the EU in the international discussion on post-2012 climate policies as uncertainty about internal implications will hamper further EU policy steps.

3.3.1 New circumstances for EU burden sharing

Compared to the pre-Kyoto Protocol period, there are a number of factors that have changed and will affect the internal EU burden sharing discussion, including:

- The extension of the EU from 15 to 27 member states: the extension not just increases the number of Parties which concerns and interests are to be met; it also has resulted in more diversity in national circumstances. The new Eastern European MS are generally much less wealthy than the other EU MS and their economies less efficient. Some states also are relatively carbon-intensive economies due to high share of coal in power generation (e.g. Poland, Czech Republic, and Bulgaria).
- The introduction of the EU ETS, which has taken effect in the beginning of 2005. This system has introduced national caps on the (CO_2) emissions from major emitting sectors (energy production, heavy industry). It implies that the emissions of MS are not only affected by future internal burden sharing arrangements, but also by the allocations under the ETS. Moreover, in contrast to the internal burden sharing, the allocation of emissions to sectors under the ETS is subject to the scrutiny of the EU Commission instead of the MS only. Thus the ETS has reduced the flexibility for MS in distributing emission reductions among sectors. On the other hand, the ETS has enhanced the opportunities for MS to meet their EU burden sharing commitments in a more cost-effective way.

Theoretically, the internal EU burden sharing could be heavily impacted by the ETS, depending on the future development of the ETS. If the allocation of emissions under the ETS is more and more determined by the EU Commission (either by direct allocation or via strict guidance for the MS in making allocation plans) and the scope of the ETS more and more broadened, this will increasingly affect the EU burden sharing amongst the Member States. At first, it may result in MS anticipating the allocations under the ETS and trying to get compensation. Eventually, the EU BS may be stripped down to dealing only with the remaining emission allowances of the sectors not included in the ETS. In the longer term, it can be envisaged that a continuing extension of the scope of the ETS and a loss of national jurisdiction would result in only the EU becoming a Party taking on new commitments under future international climate agreements instead of the Member States.

3.3.2 Top-down allocation options

The emission reduction percentages of the EU countries for the first commitment period of the Kyoto Protocol were essentially based on the political willingness of EU countries themselves. There was little underpinning of the level of global or Annex I action needed. The initial proposal for an allocation of emission reductions was based on the Triptych approach, but these figures were further renegotiated before and after the Kyoto agreements (see Section 3.1). It is not clear how a new internal EU BS agreement would be reached. Given the fact that the EU has already proposed a 20 independent reduction target, this seems the most logical starting point for internal BS negotiations. In the new council conclusions, the European Commission is ask to start immediately, in close cooperation with the Member States, a technical analysis to provide a basis for further in-depth discussion on how to differentiate the contributions of the Member States in a way that reflect fairness, is transparent and take into account national circumstances of the member states. Again negotiations could be based on initial proposals applying certain

allocation formula, but this is not certain. In principle two options for differentiating future emission targets between EU Member States can be envisaged (Höhne et al., 2005):

1. In a next round of negotiations, the EU Member States start the process by indicating what individual reductions they consider feasible/acceptable for their country (pledge-based approach). This approach has the risk that these reductions do not lead to the emission level needed to reach the overall agreed EU total reduction (20-% reduction compared to 1990 levels).
2. Alternatively a common formula could be agreed (see below) according to which the emission targets are differentiated starting from the overall reduction targets aimed for. This rule could lead to reduction percentages for each individual country, which could then be modified by further negotiations.

For option 2, an allocation rule or formula would have to be selected to share emission allowances between the EU countries. Here, the same rules for differentiation of commitments as described in Section 3.2 could be used.

The simplest would be to choose a reference year and to apply equal percentage reductions to all countries ("flat rate"). This method is simple but does not take into account structural differences between countries, historic trends and reduction potentials. It is therefore very unlikely that this will happen. Some of the other rules have been proposed during the negotiations on the Kyoto Protocol. Early in the negotiations France proposed differentiation based on per capita emissions, but this was withdrawn on the advent of the agreed common EU target (Depledge, 2000). Another simple proposal could thus be based on GDP per capita, or a multi-criteria formula, like proposed by Poland. Norway and Iceland suggested a burden sharing based on a set of indicators: (a) GDP per capita; (b) contribution to global emissions and (c) emissions per capita and/or emission intensity of GDP (UNFCCC, 1997).

Instead of simple allocation rules also more complex allocation approaches could be used. Here two other obvious candidates can be mentioned:

- (renewed) Triptych approach,
- Equal welfare loss for all Member States.

The first approach has proved its use in the late 1990s in arriving at an EU burden sharing that was acceptable for all Member States. Its main strength is that its bottom-up character helps in making the feasibility and comparability of emission reductions clear. It also fits in well with the sector-based approach of the ETS. However, as was shown in the evaluation of the BS arrangement for the first commitment period, it does not necessarily result in equal relative costs for all Member States. This risk may be enhanced by the increase in the diversity between EU Member States since the late 1990s.

This is what the second approach intends to secure. This is an outcome instead of an allocation-based equity formula (Rose et al, 1998). It does require the use of macro-economic modelling tools. This implies that the allocation becomes model dependent and thus would first require agreement on the tools to be used. Obvious candidates would be models already widely used by the EU commission, like the GEM -E3 model, but in stead of one common model also a set of different models could be used to check the robustness of the outcomes.

3.3.3 Evaluation of EU burden sharing options

Table 3.2 provides an indicative evaluation matrix for the qualitative comparison of six selected EU burden sharing options based on a sample of five main policy assessment criteria. In brief these options include (for details, see Sections 3.2.1 and 3.3.3):

1. *Grandfathering,* i.e. applying a flat reduction rate for all EU countries to their historic emissions in a certain reference period.
2. *Per capita convergence,* i.e. differentiation of emission reductions based on equal per capita emissions in a certain convergence year.
3. *Multi-criteria convergence,* i.e. differentiation of emission reductions based on a mix of (i) GDP per capita, (ii) emissions per capita, and (iii) emissions per unit GDP.
4. *Ability to pay,* i.e. differentiation of emission reductions based on GDP per capita.

5. *The (extended) Triptych approach,* i.e. differentiation of emission reductions based on a variety of sector and technology criteria.
6. *Equal mitigation costs,* i.e. differentiation of emission reductions based on equal mitigation costs per country (e.g. a certain percentage of GDP).

Table 3.2 Indicative evaluation matrix for the qualitative comparison of six post-2012 EU burden sharing options

Criteria	Grand-fathering	Per capita convergence	Multi-criteria convergence	Ability to pay	Triptych	Equal mitigation costs
Environmental effectiveness	0	0	0	0	0	0
Economic efficiency (before trading)	-	-	-	-	0	+
Political acceptability	0	0	+	+	+	0
Equity	-	+	++	++	++	+
Simplicity/ease of implementation	++	++	+	+	-	-

Note: ++ (very good score), + (good), 0 (intermediate), - (poor), -- (very poor).

Table 3.2 shows that the options mentioned above score differently with regard to the selected policy evaluation criteria, but that no option scores highest or lowest in all respects. For instance, grandfathering scores 'very good' (i.e. '++') on the criterion 'simplicity/ease of implementation' but 'poor' (i.e. '-') on 'equity', while for the Triptych approach the scores are 'poor' in terms of simplicity but 'very good' regarding equity concerns. Nevertheless, depending on the weighing and adding of the criteria, some options seem to have a better overall score than other options. For instance, balancing the number of plusses and minuses according to equal weights, the overall score of the grandfathering approach seems to be lower than the other options, while the overall performance of the multi-criteria convergence option and the ability to pay regime seem to be relatively higher.

Some qualifications, however, should be added to Table 3.2. Firstly, although partly based on the literature (Höhne et al., 2003; Torvanger and Godal, 2004), the scores of the EU burden sharing options with regard to the policy evaluation criteria are qualitative, and to some extent subjective, while the overall assessment of the options depends highly on the weighing and adding of these individual scores. Secondly, some criteria are rather general and need further specification, differentiation or clarification before they can be used unequivocally, for instance:

- *Economic efficiency.* This criterion can not only be regarded from a static perspective (i.e. what is the cost-effectiveness of an option in the short run?) but also from a dynamic perspective (i.e. what is the effect of an option to generate cost/carbon-saving technologies in the long run?). Moreover, the evaluation of the options mentioned in Table 3.2 assumes no emissions trading. However, once full and free emissions trading is allowed (among the EU Member States themselves and/or their emitting installations), all options may achieve a very good score regarding (static) economic efficiency.
- *Environmental effectiveness.* Similarly, this criterion can also be regarded from a short-term perspective (i.e. does an EU burden sharing option meet the mitigation target in the short run?) and a long-term perspective (i.e. does an option contribute to generate cost/carbon-saving technologies, thereby enabling a more stringent target in the future?). Moreover, environmental effectiveness may be considered not only with regard to the countries covered by the option but also covering leakage effects to outside these countries. Finally, the environmental effectiveness of an option does not so much depend on how the emission reductions are set for different countries but rather on how these reductions are achieved as well as on the adequacy of the monitoring and compliance system. While the setting or differentiation of mitigation targets is generally well covered by the options mentioned in Table 3.2, they hardly deal with these other (more important) aspects of environmental effectiveness. That's the reasons why all options have scored 'intermediate' (i.e. '0') regarding this criterion.

Finally, some options are not unambiguously defined but may have to be further specified or interpreted. For instance, what is exactly meant by ‘ability to pay’? How are the different elements of the multi-criteria convergence regime weighted and added? And what version of the Triptych approach - including which values for the parameters - will be used? Therefore, the overall evaluation of the EU burden sharing options depends not only on the selection of the assessment criteria and the scores op the options regarding these criteria but also on the weighing and adding of the evaluation criteria as well as on the interpretation and specification of both the criteria and options concerned.

4 Options for EU ETS allocation post-2012

This chapter provides a general overview and short discussion of the major options for the EU emissions trading allocation process post-2012 (see Sections 4.2-4.8). First of all, however, Section 4.1 presents a brief outline and discussion of the present EU ETS allocation system up to 2012.

4.1 The present EU ETS allocation system

Up to 2012, allocation of EU carbon emission allowances is predominantly the prerogative of individual Member States as laid down by the present ETS Directive, including the allocation criteria and guidelines laid down by the European Commission (EC 2003a, 2004 and 2005). For both the first trading period (2005-7) and the second phase (2008-12), each Member State designs a National Allocation Plan (NAP I and II, respectively), which sets the overall amount of emission allowances available at the national level and the allocation of these allowances to individual, eligible installations. Based on the EC allocation criteria, these NAPS are judged and, if necessary, adjusted and, finally, agreed by the Commission. Besides other considerations (see below), this present, national-oriented allocation approach ensues from the present EU Burden Sharing Agreement which translates the EU Kyoto objective into fixed absolute emission targets for each Member State (MS). Hence, in the present context, these national targets are a major starting point for Member States to design their allocation plans and a major criterion for the Commission to assess these plans.

In the sections below, the major characteristics of the first and second set of NAPs are considered, followed by an evaluation of the present EU ETS allocation system.

4.1.1 Major characteristics of the first National Allocation Plans (2005-7)

For the first trading period, the EC has accepted - after some adjustments - national allocation plans of 25 Member States. Overall, these plans allocate the equivalent of approximately 2.2 billion tonnes CO_2 emission allowances per annum among about 11,400 installations throughout the EU. In brief, the major characteristics of these first NAPs are:[4]

- The NAPs cover the sectors and activities specified by the ETS Directive. At the installation level, however, coverage of the trading system varies as some Member States have used a broad definition of combustion installations while others have applied a more restricted interpretation. Moreover, while some countries have used opt-in/opt-out clauses to adjust the coverage of installations, others have not.
- Although the ETS Directive allows for auctioning up to 5 percent of total allowances during the first trading period, almost all allowances have been allocated for free. Only four small countries intend to auction a tiny share of their allowances, i.e. Ireland 0.75 percent, Lithuania 1.5 percent, Hungary 2.5 percent, and Denmark 5.0 percent.
- In most countries, free allocation to existing installations is based on historic emissions ('grandfathering'). Between countries, however, this allocation method has varied sometimes significantly at the sectoral/installation level due to differences in applying base periods of historic emissions, sectoral growth rates, energy efficiency factors, compliance factors and/or other correction factors (to match the sum of bottom-up allocations at the installation level with the top-down approach of setting the national cap of available emission allowances).
- All countries have set aside a special reserve of allowances to new entrants. The relative size of this New Entrants Reserve (NER), however, has varied substantially among the Member States and, more importantly, the rules how to allocate these allowances among new entrants have varied at the MS level. For instance, while almost all countries have allocated allowances for free to newcomers, based on benchmarking, they have used different kinds of

[4] For a more extensive analysis of the first NAPs, see Betz et al. (2004), Gilbert et al. (2004 and 2006), Zetterberg et al. (2004), Matthes et al. (2005), DEHSt (2005), LETS (2006a and 2006b), EEA (2006), Can Europe (2006a and 2006b), or the special website of the EC: http://ec.europa.eu/environment/climat/first_phase_ep.htm.

benchmarks, i.e. (average/best available) technology-, fuel- or product-specific benchmarks, multiplied by different input or output variables.
- While in most countries installations have to return freely allocated allowances in case of plant closure, in a few Member States they are allowed to keep them without conditions. Some countries, however, have introduced so-called transfer rules, enabling operators to transfer allowances from old, closed installations to newly invested plants.
- In addition, Member States have used a variety of different allocation rules with regard to process emissions, 'early action' (i.e. previous investments in energy efficiency or carbon abatement), reduction potentials of installation or the use of clean technologies, including combined heat and power (CHP) technologies.

4.1.2 Major characteristics of the second National Allocation Plans (2008-12)

According to the ETS Directive, Member States had to submit their second NAPs to the Commission by the end of June 2006. Only Estonia, however, has met this stipulation. At the time of writing (early February 2007) 23 Member States had submitted their NAPs-II to the European Commission, while 4 NAPs were still missing. Moreover, 13 NAPs had been judged by the Commission (but most of them have not yet been adjusted by the Member States and, subsequently, re-judged and approved by the Commission), while the other NAPs still have to judged by the Commission. Hence, it is hard to draw firm conclusions with regard to the NAPs-II, although some (preliminary) trends and observations compared to NAP-I can be noted:[5]
- There seems to be a more harmonized approach with regard to the coverage of installations, notably concerning the definition of combustion installations and the use of opt-in/opt-out clauses (although some differences in coverage may remain among Member States, in particular regarding the inclusion of small installations and other gases besides CO_2). On the other hand, there is hardly any (further) harmonization of national allocation rules with regard to existing installations, new entrants, plant closures, early actions, clean technologies, process emissions, etc. Hence, existing differences in these rules among countries will largely remain.
- More countries will likely auction a small part of their allowances, although less than the maximum stipulated share of 10 percent for the second trading period, while several countries will not auction at all. Overall, the allocation pattern will hardly change, with 90-100 percent allocated for free, based on grandfathering for incumbents and benchmarking for new entrants, including different rules and applications of these allocation methods among Member States.
- While some NAPs propose a more stringent cap during phase II (compared to phase I), others suggest being more relaxed. Overall, the stringency of the NAPs II will depend on the final drafts agreed by the Commission, including the use of JI/CDM credits, related to the economic conditions during 2008-12.

4.1.3 Evaluation of the EU ETS allocation system up to 2012

Although the (empirical) implications of the NAPs I and II are yet hardly known, based on the allocation rules of the ETS Directive and the NAPs published thus far, some preliminary assessments regarding the EU ETS allocation system up to 2012 can be made. First of all, the present *national-oriented* allocation of CO_2 emission allowances will be assessed, followed by an evaluation of the present *free* allocation of these allowances. Finally, the *length* or duration of the present allocation period will be briefly assessed.

Pros and cons of MS-oriented allocation

As indicated above, the present allocation system ensues to some extent from the EU Burden Sharing Agreement, in which the EU Kyoto objective is differentiated at the MS level. Hence, countries have to design allocation plans within the context of this national mitigation target, which appears to vary significantly among Member States in terms of relative efforts to be

[5] For details, see Rogge et al. (2006), Neuhoff et al. (2006), Jones (2006), Point Carbon (2006a and 2006b), ENDS (2006), Schleich (2007), or the website of the EC: http://ec.europa.eu/environment/climat/2nd_phase_ep.htm.

achieved. In addition, other arguments for a national, MS-oriented allocation system - or against a uniform, EU-wide approach include (Grubb et al., 2005, and Vesterdal and Svendsen, 2004):

- National allocation institutions are less remote from the details of company emissions and domestic political considerations that might determine reasonable or acceptable allocations.
- MS governments are likely to be rather reluctant to transfer a major part of their allocation decision competence to the EC level as allocation decisions may have significant distributional and competitive effects at the national, sectoral and firm levels.

On the other hand, a major disadvantage of the present, MS-oriented approach is that it may lead to significant differences between countries in allocations at the installation level, which may distort the Internal Market by affecting the competitiveness and/or the profitability of installations throughout the EU. However, the implications of EU ETS allocation for the Internal Market, particularly for the competitiveness and/or profitability at the installation level, is sometimes exaggerated or poorly understood. The impact of the EU ETS on the short run competitiveness of existing installations - in terms of output or production decisions - depends primarily on the carbon intensity of the installation and the price or (opportunity) cost of an emission allowance (and, hence, on the total amount of allowances allocated throughout the EU), but not on the specific allocation method, let alone on national differences in allocation at the installation level.

The *profitability* of eligible installations, however, is affected by (national differences in) the allocation method, notably the amount of allowances received for free or bought at an auction or market. This may affect the long run competitiveness of existing installations in terms of having a capital market advantage, i.e. existing installations that receive more allowances for free (compared to similar incumbents in other countries) may have to borrow less or at more favourable conditions on capital markets in order to finance their investments.

In addition, as the profitability of eligible installations is affected by (national differences in) the allocation method, the latter may influence the competitiveness of new entrants, notably in terms of investment decisions regarding the carbon intensity and/or location of new plants. Similarly, (national differences in) allocation rules regarding plant closures may affect industrial competitiveness in terms of decisions to close/replace (or not) existing, carbon intensive installations.[6]

Some qualifications, however, have to be added to the potential impact of (national differences in) EU ETS allocation on the competitiveness of installations within the Internal Market. Firstly, in the power sector, international trade and competition is often restricted due to a lack of transmission capacity or other trade restrictions. Hence, national differences in EU ETS allocation hardly affect the international competitiveness or location of power installations. Secondly, in other sectors, carbon costs are often a small share of total costs and, hence, the profitability and accompanying decisions regarding new investments - including the location of new entrants - are often less dependent on national differences in EU ETS allocation than other factors affecting a country's attractiveness for new investments.

Another drawback of the present EU ETS allocation system is that, in most countries, it leads to an imbalanced or unequal distribution of the total national emission cap (including the use of

[6] For a more extensive discussion of the impact of (national differences in) allocation rules regarding incumbents, new entrants, and plant closures on industrial competitiveness under the EU ETS, see Matthes et al. (2005), Aalbers (2006), and the special issue of Climate Policy, Vol. 6, No. 1, edited by Grubb and Neuhoff (2006b).

JI/CDM credits) between the ETS sectors and the other sectors of a country, particularly to a relative - or even absolute - over-allocation of the ETS sectors at the expense of other sectors.[7] This favourable treatment of the ETS sectors results from a variety of related factors, including (i) the inclination of national governments to protect their domestic (energy-intensive, internationally competing) industries, (ii) the interests and incentives of the EU ETS sectors to lobby for a generous allocation of allowances by means of all kinds of rent-seeking and gaming strategies, resulting in an exaggeration of industrial growth rates, emission allowance needs, etc., and (iii) the absence or under-representation of the interests of the non-trading sectors in the institutional process of designing national allocation plans.

In general, the above-mentioned favourable treatment of the ETS sectors implies higher social costs to meet domestic mitigation commitments (as marginal costs of the non-trading sectors are usually higher than those of the ETS sectors) and less certainty that these commitments will be met (as instruments to achieve emission reductions in non-trading sectors are often politically more difficult to agree or to implement, while the mitigation results of these policies/sectors are less secure than a fixed cap for the trading sectors).

Finally, as indicated above, the advantage of a national-oriented allocation approach is that it may be fine-tuned to the socioeconomic circumstances of a country, including data availability and existing cultural or policy conditions, thereby enhancing the socio-political feasibility and acceptability of the ETS among the Member States. On the other hand, such an approach may not only lead to significant differences in (free) allocation to similar installations and, hence, to competitive distortions between countries but also to a widely diversified, complex and non-transparent system of allocation rules throughout the EU ETS. This diversity, complexity and non-transparency among the ETS Member States is enhanced by the fact that allowances are allocated for free, which encourages all kinds of national interest groups to lobby for special treatments and allocation rules accounting for differences at the national, sectoral and installation levels (see also below).

Pros and cons of free allocation

As noted, a major characteristic of the present allocation system is that allowances are distributed for free to the eligible parties. The major advantages of free allocation are that it reduces the resistance of these parties to accept the EU ETS (and, therefore, facilitates its implementation) and that it comes to meet those parties who are not able to pass through the costs of emissions trading into their outlet prices. On the other hand, free allocation has also some major disadvantages or unintended, adverse side effects, including:

- Several parties, especially in the power sector - accounting for more than half of total ETS allowances - are able and do indeed pass through the ('opportunity') costs of free emission allowances into their outlet prices, resulting in significant additional ('windfall') profits of existing installations (Sijm et al., 2006b).
- Free allocations reduce the incentive for investments in less carbon intensive technologies and, hence, undermine the rationale and credibility of the EU ETS to support the transition towards a less carbon intensive economy. This is particularly the case when the allocation to newcomers is based on fuel- or technology specific benchmarks (rather than generic input/output benchmark allocations or, even better, auctioning of allowances), implying that investments in more carbon-intensive technologies receive more allowances for free than less carbon-intensive technologies.
- As outlined above, the allocation of notably free allowances leads to all kinds of lobbying, gaming and other rent-seeking activities of interested parties leading to a complex, non-transparent system of allocation rules and a biased sharing of the Kyoto burden among sectors, resulting in higher social costs to meet this burden (including the rent-seeking and

[7] A comparison of the allocation of ETS allowances and verified emissions in 2005 at the installation, sectoral and national levels shows that overall a significant over-allocation has occurred (ENTEC, 2006). Moreover, (preliminary) analyses of NAPs I and II indicate that in meeting national Kyoto targets, the ETS sectors have generally been treated favourably compared to the other sectors of individual Member States (Betz et al., 2004; Gilbert et al., 2004 and 2006; DEHSt, 2005; Can Europe, 2006a, and Neuhoff et al., 2006).

other transaction costs to design and implement a complex, administratively demanding allocation system).

Pros and cons of the length of the present allocation period
The length of the allocation period up to 2012 amounts to three years during the first trading phase and five years during the second phase. These relatively short periods result largely from (i) the absence of national EU mitigation commitments beyond 2012, and (ii) the fact that the EU ETS is still in its pilot, learning phase and, hence, the scheme might be significantly adjusted after 2012 based on a review of its performance during its early years. Moreover, given the fact that allowances are allocated for free and that governments prefer to distribute these allowances equitably according to firms' future needs, these relatively short periods offer the advantage that (i) they reduce the need for reliable data on future emissions and abatement options at the industrial or installation level, (ii) they offer the opportunity to respond flexibly to changing circumstances, for instance changes in the potential and costs of abatement technologies, and (iii) they offer the opportunity to deal adequately with new entrants and plant closures.

On the other hand, the lifetime of investments in the power and energy-intensive sectors is often 30-50 years and, hence, the present short allocation periods of the EU ETS offer little certainty to these investments. In order to enhance investment security in these sectors, an extension of the EU ETS allocation period may be considered. However, given the flaws of the present allocation system (as discussed above), it may be questioned whether extending the allocation plan offers an overall advantage or not, as it may imply a continuation for a longer period of certain adverse effects of the present, national-oriented and free allocation system (i.e., windfall profits to existing installations, perverse investment incentives to new entrants, and a non-harmonised, complex and non-transparent set of allocation rules). Therefore, it may be sensible to first address certain flaws of the present allocation system before extending the length of its runtime period.

4.2 Overview of EU ETS allocation issues and options post-2012

Figure 4.1 provides a schematic overview of the major issues and options for the EU ETS allocation process post-2012. First of all, it indicates the interaction between the international post-Kyoto negotiations on the burden sharing of future mitigation commitments and the EU ETS allocation options post-2012 (see Chapter 5 for further details). Secondly, Figure 4.1 presents the general criteria to evaluate alternative options of EU ETS allocation post-2012, as discussed in Section 2.2.1. Finally, it shows that the options for the emissions trading allocation process post-2012 include actually several interrelated aspects:

- Allocation design level,
- Type of emissions trading scheme,
- Coverage of the scheme,
- Overall cap of the scheme,
- Allocation method.

These aspects will be discussed below.

4.3 Allocation design level

The first allocation option is whether the key allocation decisions should be taken at the EU or national level, including the question whether the overall EU mitigation objective should be (a) first translated in national targets and, subsequently, in EU ETS allocations of allowances to participating sectors/installations in a certain country (as practised by Member States during the first and second trading periods, following the EU Burden Sharing Agreement), *or* (b) directly translated in a cap for the EU ETS as a whole and, subsequently, in allowance allocations to participating sectors/installations throughout the EU (to be decided by the Commission, starting from the third trading period).

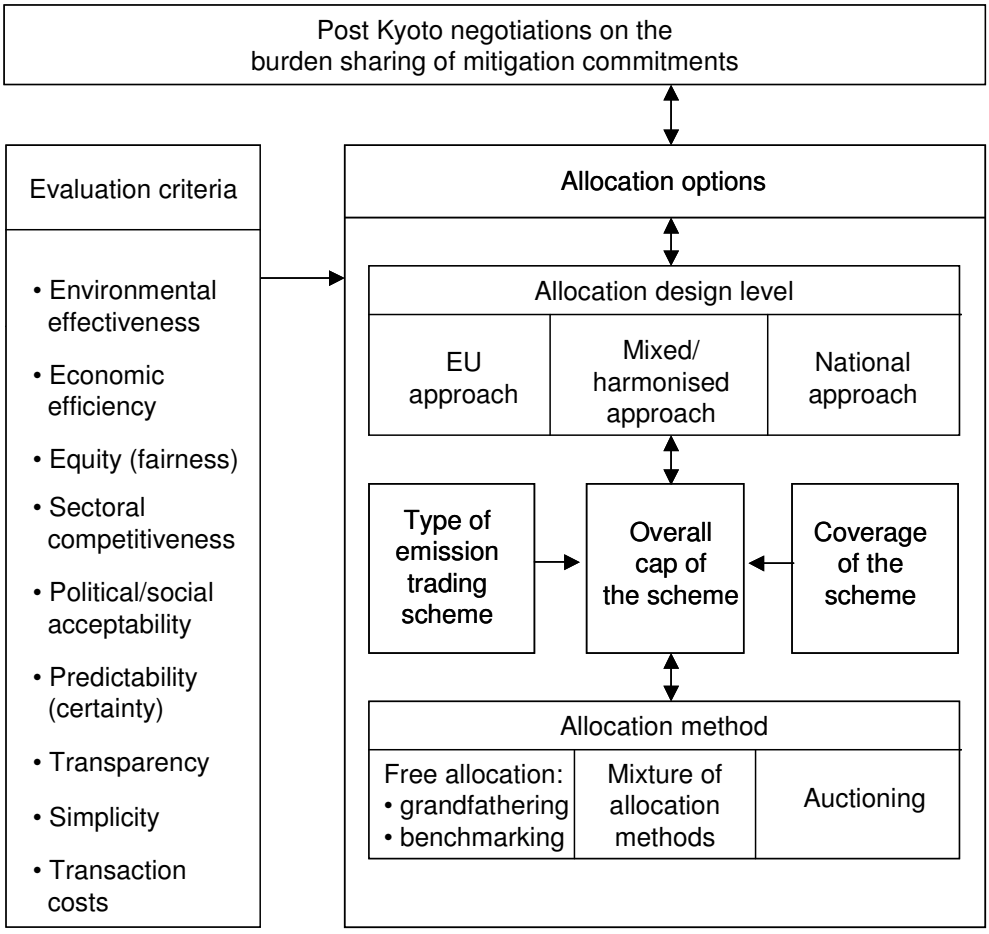


Figure 4.1 Options for EU ETS allocation 2012

As discussed above, the major advantage of an EU-wide approach is that it may lead to a more optimal outcome as a whole, either by avoiding distortions of the Internal Market resulting from differences in allocation decisions at the national level or by avoiding situations in which national governments may be faced with incentives that lead to a decision - for instance, allocation rules regarding new entrants, plant closures or auctioning of allowances - that is not the optimal approach for the scheme as a whole (i.e. the so-called "prisoners' dilemma" or 'race to the bottom' effect). On the other hand, governments will likely be rather reluctant to transfer a major part of their allocations decision competence to the EC level, notably of potentially valuable assets to their companies. More generally, allocation decisions may have significant distributional effects among countries and, hence, governments may be reluctant to transfer these decisions to the EU level. In addition, EU institutions would anyway be more remote from the details of company emissions and domestic political considerations that might determine reasonable or acceptable allocations (Ahmed and Holmgren, 2006; Grubb et al., 2005, and Vesterdal and Svendsen, 2004).

In a recent paper, Rio Gonzalez (2006) has distinguished four different levels of harmonisation (centralisation/decentralisation) with regard to the design of the EU ETS. These levels include:

- *Absolute harmonisation*. The decisions on key EU ETS design choices are taken at EU level meaning that MS have a very low degree of discretion. By considering a path to Kyoto, the Community sets the aggregate quantity of allowances allocated to the trading and non-trading sectors on an EU-wide basis and determines the allowances distributed to each MS for specific sectors.
- *Relative harmonisation.* NAPs are undertaken by countries, but based on obligatory and detailed guidelines set up by the Commission, with very limited discretion by MS.

- *Soft harmonisation.* NAPs are undertaken by countries. The allocation method is decided at Community level but MS are free to decide on other NAP provisions.
- *No harmonisation*. MS would have total freedom to decide on key design provisions. This would lead to different domestic trading schemes linked between each other through intra-Community co-operation, with the Community's role being only to make sure that the domestic systems conform to Community law.

Subsequently, Rio Gonzalez has assessed the pros and cons of these harmonisation alternatives for general and specific allocation choices by means of a set of evaluation criteria (which largely overlaps with the general criteria to assess EU ETS allocation discussed in Section 2.2.1). This assessment is summarised in Table 4.1.

Table 4.1 Summary of the assessment of different harmonisation alternatives

Criteria	Harmonisation choice			
	Absolute	Relative	Soft	No harmonisation
Cost-effectiveness	++	++	++	++
Environmental effectiveness	++	+	0	--
Dynamic efficiency	++	+	0	-
Administrative transaction costs	-/-- (- nat; -- Com)	- (- nat; - Com)	- (-- nat; 0 Com)	0 (-- nat; ++ Com)
Firm transaction costs	+	0	-	--
Political feasibility	-	+	+	--
Distortion of competition (internal)	++	0	0	--
Distortion of competition (external)	-	0	0	++
Consideration of national circumstances	-	0	0	++
Equity	++	0	0	--

Note: ++ (very good score), + (good), 0 (intermediate), - (poor), - - (very poor).
Source: Rio Gonzalez (2006)

It should be realised, however, that the optimal level at which allocation decisions might be taken, may vary depending on the allocation method or specific allocation theme considered. For instance, free allocation to new entrants or benchmarking to all installations may require a more centralised or harmonised approach than grandfathering to incumbents or full auctioning to all installations. Hence, in practice a mixture of allocation design levels - including different degrees of harmonisation and centralisation/decentralisation - may occur depending on the allocation method or specific allocation theme concerned.

4.4 Type of emissions trading system

The EU ETS is a so-called downstream cap and trade system covering direct emissions. The major characteristics of such a scheme are:[8]

- A cap is set on the total emissions of all participants in the scheme by allocating a certain amount of emission allowances, which is fixed ex ante for a certain period. These allowances can be freely traded among the participants.
- Participants are obliged to surrender a quantity of allowances equal to their emissions over a certain period. A surplus of allowances can be sold (or banked for the next period), while a deficit has to be covered by purchasing additional allowances (or paying a penalty).

[8] For a further discussion of the classification and characteristics of different Emissions Trading Systems, see Sijm (2003).

- The obligation to surrender allowances is imposed on fossil fuel *users* (in contrast to an upstream system in which this obligation rests on the *suppliers* of fossil fuel).
- Emissions of electricity and off-site heat are attributed directly to power and heat *producers* (in contrast to an indirect system in which such emissions are imputed to *consumers* of electricity and heat).

In theory, the basic type of the EU ETS - and, hence, its allocation process - could be changed post-2012 to either an upstream system or a downstream system covering indirect emissions (or to a system in which allowances are allocated to power consumers, while power producers remain obliged to surrender allowances for their emissions and, hence, have to buy them at the market (i.e. from the power consumers). For the present study, however, it is assumed that the post-2012 EU ETS remains basically a downstream cap and trade system covering direct emissions and, hence, potential alternative types of ETS - and related allocation options - are not considered. On the other hand, as some stakeholders are in favour of a relative cap system, this option will be assessed as part of the possible allocation methods discussed in Section 4.7.

4.5 Coverage of the scheme

At present, the EU ETS covers CO_2 emissions from combustion plants (>20 MW thermal input; including power generators), oil refineries, coke ovens, as well as from activities and sectors such as ferrous metals, cement clinker, pulp from timber, glass and ceramics (>threshold capacity level; including process emissions). For the period post-2012, this coverage may be changed, including the following options:

- *Emissions:* It has been suggested to exclude process emissions from the EU ETS in order to make the designs of National Allocation Plans more transparent and simple (also because it is hard to reduce process emissions).
- *Gases:* Coverage of the EU ETS could be expanded by including other greenhouse gases than CO_2, such as methane or perfluorcarbons (PFCs).
- *Sectors/activities:* On the one hand, it has been suggested to expand the present coverage of the scheme to other sectors and/or activities (notably aviation) in order to enhance the environmental effectiveness and economic efficiency of the scheme. On the other hand, it has been proposed to exclude small installations from the scheme because of the high transaction costs for these installations that contribute only a small fraction of the total emissions covered.

Evaluating options for extending the coverage of the EU ETS was a major topic of a recent study (LETS, 2006a and 2006b). A major finding it that the ETS could readily be expanded to include:

- CO_2 from production of ammonia, fertilisers and petrochemicals
- N_2O from adipic acid and nitric acid plants
- CH_4 from active coal mines
- CO_2 and PFCs from aluminium production.

It also notes that these findings have been contested by the industries concerned, notably the aluminium sector. Inclusion of the above-mentioned sectors would increase the current coverage in GHG equivalent by an estimated nine percent, and by 300 new sites. Overall, however, the LETS study concluded, 'there is limited scope for modifying the current Directive to include additional sectors and gases in the scheme for practical reasons. Many sectors either consist of a large number of small emitters or their emissions are too uncertain. Other measures may be more appropriate for tackling emissions from these sectors.'

Finally, similar to the question of extending the present allocation period (see Section 4.1.3), it may be questioned whether it is sensible to extend the coverage of the EU ETS given the flaws of the present allocation system, or first address these flaws before extending the scope of the scope.

4.6 Cap of the EU ETS

The cap of the EU ETS can be expressed in either absolute (fixed) or relative (flexible) terms, and may be determined at either the EU-wide level or at the national level for each Member State. In an absolute cap system, the overall (ex-ante fixed) number of allowances depends on the coverage of the scheme, while in a relative cap system this number depends also on the (ex-post) input or output level of the activities covered by the scheme.

In addition, the setting of the cap for the activities covered by the scheme may also depend on the outcome of the international negotiations on the burden sharing of mitigation commitments, including the sharing of the EU/MS commitments between covered and non-covered sectors. However, given (i) the uncertainties with regard to the timing and ultimate outcome of these negotiations and (ii) the need for providing timely, long-term certainty on allocation issues to the covered sectors, a cap may be set apart from the proceedings of the international mitigation talks (or even with the intention to stimulate or direct these talks).

4.7 Allocation method

In an absolute target system, once the cap has been fixed, it can be allocated among the covered activities and eligible installations by, in principle, three different methods:
- Grandfathering, i.e. free allocation of emission allowances based on historic emissions.
- Benchmarking, i.e. free allocation of emission allowances based on benchmarks or emission factors linked to certain specified inputs, outputs or technologies.
- Auctioning, i.e. selling emission allowances at an auction (or market).

An assessment of these allocation methods will be outlined in the sections below. As benchmarking can be applied in both absolute and relative cap systems, this option will be considered for both systems.

4.7.1 Grandfathering

Grandfathering, i.e. free allocation on the basis of historic emissions is the most widely used method for the initial distribution of emission allowances to existing installations, including for the EU ETS allocation system up to 2012. The major arguments pro free allocation in general and grandfathering in particular include:
- It compensates stakeholders for stranded costs, compliance costs or loss of output due to the implementation of emissions trading.
- In theory, it is rather simple to implement.
- It makes the implementation of emissions trading acceptable to (industrial) stakeholders and, hence, reduces the resistance to the initial introduction of emissions trading.

On the other hand, free allocation in general and grandfathering in particular has some adverse effects (Sijm et al., 2005 and 2006b; Matthes et al., 2005):
- Free allocation does not provide the appropriate incentive to reduce emissions. This applies particularly if free allocation is used for newcomers on a fuel- or technology-specific basis as it actually implies a subsidy on carbon-intensive investments (whereas the EU ETS is intended to encourage efficient investments in less carbon-intensive investments).
- Free allocation may have adverse distributional/equity effects, firstly by overallocating some stakeholders (who may benefit by selling the surplus allowances without any mitigation effort) or, secondly, by passing through the opportunity costs of freely allocated allowances into outlet prices, thereby realizing ‘windfall profits’ and violating state aid rules.
- In practice, grandfathering may become quite complicated and less transparent, particularly when stakeholders and policy makers argue successfully for a variety of specific rules and special provisions.
- Transaction/administrative costs may increase significantly due to rent-seeking activities of stakeholders and high administrative demands when the grandfathering scheme becomes more complicated.
- Over time, the base year becomes increasingly remote which implies either a lack of data to account for recent developments (for instance structural changes in growth rates among

installations) or the need for periodic updating of the base year (which may reduce efficiency).

To conclude, grandfathering may be justified as an allocation option in the initial stages of emissions trading for incumbent installations (in order to ease its introduction), but should be phased out by other allocation methods over time (notably for newcomers and incumbents who are able to pass through costs of emission allowances).

4.7.2 Benchmarking

Benchmarking refers to a system of free allocation of emission allowances based on a performance standard rate (PSR, i.e. the benchmark) such as an emission factor or an energy/carbon efficiency rate per unit input, output or technology used. Although it can be applied to both existing and new installations, in practice it appears to be particularly attractive for new entrants as grandfathering, based on historic emissions, is not feasible to new entrants while auctioning would reduce their competitiveness/profitability if they are faced by outside competition and, hence, can not pass on the costs of emission allowances without losing production output.

The choice of a benchmarking approach involves the selection of a variety of parameters, including (DTI, 2005; Matthes et al., 2005):

- Input, output or capacity benchmark (including different input/output measures of energy efficiency as a benchmark).
- Basis for benchmark rate, e.g. the 'best' technology available, the industry average, or some projected level. Moreover, benchmarks can be either fuel- or technology specific - i.e. varying depending on the technology or fuel used - or product generic, i.e. a similar benchmark regardless the technology or fuel used (e.g. a coal-generated MWh of electricity receives the same amount of emission allowances as a gas-fired MWh).
- Subsector categories. A benchmark rate can be differentiated for multiple subsectors or other categories within a sector. Categories can be defined in different ways (e.g. fuel use, technology).
- Geographical scope. A benchmark rate can be set at the EU-wide level or at a national level for each individual Member State.
- Historical, projected or updated activity. The activity (e.g., input, output) used in the benchmark formula for each installation can be determined in various ways including historical (e.g., 2002-2004), projected (e.g., projected 2008 level as of 2005), or updated (e.g. 2008 levels in 2012).

PSRs or benchmarks can be multiplied by a certain activity level during a certain period in order to determine ex-ante, i.e. before the trading period commences the total fixed amount of allowances allocated at the installation, national and system levels, as allowed by the European Commission (EC, 2003b). Alternatively, these benchmarks can be multiplied by the *realised* output volume during certain periods in order to determine ex-post, i.e. after the trading period has ended, the total amount of allowances - varying by ex-post, realised production - allocated at the installation, national and system levels, as proposed by organisations and representatives of industrial stakeholders (see, for instance, Schyns and Berends, 2003a and 2003b; and Schyns, 2005). The first (ex-ante) option is usually known under different labels (such as 'absolute allocation system', 'absolute target system' or 'absolute cap-and-trade system'), while the second (ex-post) option is generally denoted under a variety of related headings, including 'relative allocation system/target/cap-and-trade system', 'PSR system', 'intensity emission cap system' or 'output-based allocation system'.[9]

[9] For a discussion of these absolute versus relative allocation systems, see Demailly and Quirion (2006), Dissou (2005 and 2006), Dissou and Robichaud (2003), Dudek and Golub (2003), Ellerman and Wing (2003), Fischer (2001, 2003, 2004a and 2004b), Grubb and Neuhoff (2006b), Haites (2003), Muller and Muller (2003), Quirion (2005), Schyns (2005) and Schyns and Berends (2003a and 2003b).

Evaluation
In general, a benchmarking system has the following advantages (DTI, 2005; UCE, 2005; Ahmed and Holmgren, 2006):
- Equity and efficiency: it rewards (early) action on enhancing energy/carbon efficiency, thereby increasing the economic efficiency of the trading scheme compared to allocation based on historical emissions. Especially rules for new entrants can be harmonised using a benchmarking approach.
- It can be used to balance burdens among sectors (e.g. by applying similar targets relative to the best standard).
- If applied in a generic way, it provides an incentive to invest in less carbon intensive technologies.

On the other hand, benchmarking raises some problems and other disadvantages (DTI, 2005; UCE, 2005; Ahmed and Holmgren, 2006):
- High data and other administrative demands.
- Distributional effects: benchmarking benefits installations/countries with high energy/carbon efficiency but disfavours installations/countries with low energy/carbon efficiency. Dealing with this issue is difficult and will increase complexity of the allocation.
- If applied in a fuel- or technology specific way, it undermines the incentive structure of the EU ETS to invest in less carbon intensive technologies.

More specifically, when comparing the pros and cons of an absolute versus relative allocation system (i.e. benchmarking based on ex-ante versus ex-post output production), the following arguments apply:

Arguments pro an absolute allocation system:
- An absolute allocation system provides certainty with regard to the environmental effectiveness of an ETS.
- An absolute allocation system is more efficient than a relative allocation system, i.e. the abatement costs and the price of an allowance are lower, as an absolute allocation system provides an incentive to reduce production volumes.

Arguments contra an absolute allocation system:
- An absolute allocation system creates uncertainty to both carbon-intensive and carbon-saving investments as the price of an allowance is uncertain.
- An absolute allocation system does not account for (uneven) growth patterns of different industries, which may lead to competitive distortions, notably of high-growth industries facing outside competition (although a stringent relative allocation system may distort competitiveness as well).

Arguments pro a relative allocation system:
- A relative allocation system mitigates the cost burden on participants and, hence, reduces the impact on outlet prices, implying less windfall profits for those participants who can easily pass on carbon costs to their output prices, and less losses in competitiveness for those participants who have to compete with outside firms not subject to similar climate policy costs and, therefore, less losses in profitability, domestic production and/or leakage of emissions to outside locations (Demailly and Quirion, 2006; Fischer 2001, 2003, 2004a and 2004b).
- A relative allocation system accounts for differences in production growth, although it still may distort the competitiveness among firms (Jansen, 2002; Elzenga and Oude Lohuis, 2003).
- A relative allocation system does not lead to allocation of excess allowances without any mitigation effort or a bonus on reducing or relocating production.

Arguments contra a relative allocation system:
- A relative allocation system is less efficient because it is a combination of a tax on emissions and a subsidy on production output. Consequently, production will exceed the optimal output level, and the allowance price and abatement costs need to be higher in order to meet the same emission target as in an efficient system based on absolute allocations (Koutstaal et al., 2002; Koutstaal, 2002).

- A relative allocation system does not provide certainty with regard to the environmental effectiveness of an ETS and may lead to an overrun of international commitments on carbon mitigation or the need to take additional (more expensive, short-term) measures to meet these commitments. To some extent, this problem can be controlled by a regular adjustment of the PSR, but this creates uncertainty in the carbon and products markets.
- A relative allocation system does not fit into the present Directive (and political consensus) on the EU ETS - opting for a fixed cap and trade system, at least up to 2012 - and, hence, it may take years (if ever) to change the fundamentals of the EU ETS.
- A relative allocation system implies either the same CO_2 price and less domestic emission reductions or a higher CO_2 price and similar emission reductions.
- A relative allocation system may imply high information and other transaction costs, notably if a large number of PSRs has to be determined and regularly updated for a large number of firms and/or products, including process emissions. It may be cumbersome and time-consuming to determine EU-wide PSRs or to find a political consensus on what an acceptable, average EU benchmark should be (Reinaud, 2004; CEPS, 2005). Moreover, even if a relative allocation system based on EU-wide PSRs could be developed and agreed on, it still may distort the competitiveness among firms (Jansen, 2002; Elzenga and Oude Lohuis, 2003).

Hone et al. (2005) note that benchmarks have the potential to play a significant role in future allocations. They offer the potential of improving the consistency of national allocation approaches. Also they can be used as a basis to determine a long-term emission cap, and to compare allocation in different Member States. The report recommends that benchmarks be developed for certain dedicated sectors in case an overall agreement on benchmarks would prove difficult.

DTI (2005) concludes that for several sectors ‘some form of benchmarking’ can be applied. For some sectors an output-based approach can be developed, including production of electricity, cement and aluminium. For some sectors disaggregation by product may be necessary to apply output-based benchmarks for (part of) the sector, e.g. iron & steel and ceramics. For several sectors input-based benchmarks are more suitable. Overall the study concludes that benchmarks can be developed for sectors accounting for 80% of the total emissions covered by phase I of the EU ETS.

To conclude, although a uniform benchmarking system throughout the EU ETS has certain advantages above grandfathering (notably in terms of long-term environmental effectiveness or inducing carbon saving technologies), it is probably hard to implement due to its distributional effects (especially among countries) and its high data and other administrative demands. Benchmarking is particularly interesting for new entrants, but if it is applied in a fuel- or technology specific way it undermines the incentive structure of the EU ETS to invest in less carbon intensive technologies. If an ETS covers all firms competing in a certain (international) market, an absolute allocation system based on benchmarking has certain advantages in terms of economic efficiency and environmental effectiveness. On the other hand, a relative allocation system based on benchmarking may become attractive if the ETS covers only a part of a certain market (while outside, competitive installations are not subject to similar climate policy costs) and/ or auctioning of emission allowances to autarkic sectors - such as the power sector - is not feasible. Therefore, it is recommended to conduct a more detailed assessment of different kinds of benchmarking allocation systems under different sectoral market and global climate policy conditions.

4.7.3 Auctioning

Auctioning implies the selling of emission allowances at an auction (or market). Different forms of auctioning can be distinguished depending on the following design characteristics (Cramton and Kerr, 2002; Oxera, 2005; Mandell, 2005; Hepburn et al., 2006):

- *Pricing mechanisms*. Possible pricing mechanisms include (i) pay-as-bid (i.e. each bidder pays the amount he or she actually bids), (ii) uniform pricing (i.e. all the bidders pay the price by the lowest winning bidder), and (iii) Vickrey pricing (i.e. winning bidders pay the price bid by the second highest bidder for the units of the object won).

- *Auction mechanism*. Options include (i) static (sealed-bid) auctions, involving one round of bidding where all bidders submit sealed bids that are opened once everyone has submitted their bids, (ii) ascending (price-dynamic) auctions, involving multiple rounds of bidding where all the participants submit bids that are opened up at the end of each round of the auction and where, subsequently, bidders use this information of others' bids to decide on their bids in the next round.[10]
- *Periodicity:* e.g., monthly, quarterly, annually or once during a certain trading period.
- *Eligibility:* e.g., all covered installations of EU/MS, all firms - including traders, etc. - of EU/MS, no restrictions on entities/persons to participate in an auction.
- *Percentage of allowances to auction*.

Important factors influencing the optimal type of auctioning are information availability, liquidity of the secondary market, number of participants and administrative costs.[11] Hepburn et al. (2006) conclude that sealed-bid auctions are likely to be appropriate, while different pricing rules could be applied. The auctions could be held at relatively frequent intervals, e.g. every six months for the period 2008-12. According to Oxera (2005), static sealed-bid auctions have the advantage of simplicity, while Vickrey auctions are the most efficient.

It should be noted that, while the implementation of auctioning emission allowances can be implemented largely at the MS-discretion level, the *minimum* percentage of allowances to auction should be determined at the EU level (in order to avoid the 'prisoner's dilemma' or 'race to the bottom' effect).

Auctioning has been advocated by policy analysts as the preferred option for allocating allowances, based on the following arguments (Cramton and Kerr, 2002; Sijm and Van Dril, 2003; Oxera, 2005):

- All participants, including new entrants, are treated in the same, equal and fair way. Companies that have reduced their emissions in the past need to buy fewer allowances and, hence, are rewarded for this 'early action'.
- Auctioning avoids windfall profits due to the (over)allocation of free allowances and the passing through of the opportunity costs of these allowances into higher outlet prices and/or by selling excess allowances on the market without any mitigation effort.
- Depending on the selected design features, auctioning may be a relatively simple, transparent and less expensive allocation system in terms of administrative demands and other transaction costs (compared to a national-oriented, free allocation system inducing lobbying and rent-seeking activities by all kinds of interest groups and resulting in a wide variety of specific allocation rules).
- Auctioning is preferable from an efficiency point of view as, compared to free allocation, it provides the best reflection of the polluter-pays principle and, hence, the best incentive for technological innovations and cost-effective adjustments in existing production and consumption patterns, notably for carbon-intensive goods.
- Auctioning generates revenues for the public sector, which may be used to finance government expenditures, to reduce existing market distortions such as taxes on labour or capital, or to compensate users of carbon-intensive products for the higher prices of these products due to the passing through of the CO_2 allowances costs.

In addition to these classical arguments pro auctioning, Hepburn et al. (2006) have recently discussed the potential for auctions (and the resulting revenues) to provide several new benefits, including (i) an increase in the environmental effectiveness of the trading system by enhancing management awareness on carbon costs; (ii) an amelioration of competitiveness considerations, either by direct support or by legitimising border-tax adjustments; (iii) a clearer

[10] When combining these auctioning mechanisms with the above-mentioned pricing mechanisms, a variety of options results, including e.g. pay-as-bid sealed auction, uniform-price sealed bid auction, sealed-bid auction with Vickrey pricing, ascending clock auction with uniform pricing, etc. For an analysis of these options, see Oxera (2005).

[11] Considerations for the optimal type of auctioning include (among others): efficiency, simplicity, equity and revenue raised.

long term price signal, and (iv) an improvement to price stability if Member States agree to coordinate auctions by including an auction price floor.

The main disadvantage of auctioning, however, is that it raises the costs of participating industries (comparable to a carbon tax). If applied to the EU ETS only, this would deteriorate the competitiveness of EU industries operating on international markets, resulting in a loss of economic growth, income and employment. Although recycling the auction revenues to these industries can to some extent lift these adverse effects, it raises the problem of how the auction revenues can be recycled in the most optimal way. For instance, it may be administratively complicated to exactly compensate only energy-intensive industries for the total amount of the ETS-induced increase in their production costs (including indirect cost increases due to ETS-induced higher power prices). A possible solution to this problem is to compensate these industries (and other end-users of electricity) in more general terms for ETS-induced cost increases, for instance by recycling auction revenues through lowering the overall level of taxation and social premiums. This solution is administratively less complicating, while it has the least distortive impact on the overall competitiveness of the industrial sectors (although it causes a shift in competitive advantage from the energy-intensive to the energy-extensive industries, while it also benefits highly profitable sectors such as the banking or insurance sectors).

Another drawback of auctioning is that it may be politically hard to accept, notably by the power producers but also by other, carbon-intensive industries covered by the scheme and even by the (non-covered) power-intensive industries since they will be faced by higher costs for their emissions (as they have to buy their emission allowances rather than getting them for free) and/or by higher costs for their electricity used (as the rate of passing through CO_2 costs may be higher under auctioning than grandfathering). Only if affected industries are sure that they will be lastingly compensated through the recycling of auction revenues, the political resistance may dwindle but, as indicated above, it may be hard to design such a recycling system and guarantee its durable character.

To conclude, although there is a large variety of strong arguments pro auctioning of emission allowances, it may be hard to accept and implement for socio-political reasons, notably when similar cost-raising efforts are absent outside the EU. To some degree, political resistance to auctioning can be relieved by restricting auctioning of emission allowances to new entrants and/or the sheltered sectors only, notably the power sector, and/or by recycling auctioning revenues to those sectors most affected by the EU ETS (including both direct and indirect cost increases).

4.7.4 Evaluation of allocation methods

Table 4.2 Evaluation of ETS allocation methods

Criteria	Grandfathering	Benchmarking		Auctioning
		Absolute	Relative	
Economic efficiency	0	+	-	++
Environmental effectiveness	+	+	-	+
Industrial competitiveness	0	0	+	-
Political/social acceptability	+	+	-	-
Predictability (certainty)	0	0	0	0
Transparency	0	0	-	+
Simplicity	0	- -	-	+
Transaction costs	-	--	-	+
Equity (fairness)	-	0	+	+

Note: ++ (very good score), + (good), 0 (intermediate), - (poor), -- (very poor).

Table 4.2 provides an indicative evaluation of the allocation methods outlined above. Some qualifications, however, should be added to this table. Firstly, the scores of the allocation methods with regard to the policy evaluation criteria are qualitative, and to some extent subjective, while the overall assessment of the allocation method depends highly on the

weighing and adding of these individual scores. Secondly, some criteria are rather general and need further specification, differentiation or clarification before they can be used unequivocally, for instance:

- *Economic efficiency*. This criterion can not only be regarded from a static perspective (i.e. what is the cost-effectiveness of an allocation method in the short run?) but also from a dynamic perspective (i.e. what is the effect of an allocation method to generate cost/carbon-saving technologies in the long run?).
- *Environmental effectiveness.* Similarly, this criterion can also be regarded from a short-term perspective (i.e. does the method meet the mitigation target during the trading period considered?) and a long-term perspective (i.e. does the method contribute to generate cost/carbon-saving technologies, thereby enabling a more stringent target in the future?). Moreover, environmental effectiveness may be considered not only with regard to those sectors covered by the scheme but also covering leakage effects to outside sectors and/or countries.
- *Industrial competitiveness.* This criterion raises several questions. For instance, does it refer to competition between existing and/or new installations within a single Member State, within the ETS sectors throughout the EU, or outside the ETS/EU? Or, does industrial competitiveness particularly refer to a change in (domestic) production or a change in profitability?
- *Political/social acceptability.* Does this criterion include only stakeholders or also policy makers and other socio-political groups?
- *Equity.* Does this criterion also include the (indirect) effects of passing through the opportunity costs of freely allocated allowances into outlet prices?

Thirdly, as illustrated in the sections above, each allocation method is not set unambiguously but may be further specified in a variety of ways. For instance, there is a large diversity of benchmarking methods - depending on the type of benchmarks and/or input/output variable selected - while grandfathering can be implemented either in a simple, uniform and transparent way or in a complex way with a large variety of specific allocation rules differentiated by country, sector or type of installation. In addition, the performance of an allocation method should not be assessed in isolation (e.g., only with regard to existing installations) but for the set of allocation rules as a whole, including the coherence of allocation rules for incumbents, new entrants and plant closures since it is this coherence which finally determines the incentive structure for the deployment of existing installations and their replacement by new investments in carbon-saving technologies. Moreover, the performance of an allocation method (in terms of industrial competitiveness, cost-effectiveness, social acceptability, etc.) depends on whether comparable climate policies are undertaken outside the EU ETS. Therefore, the overall evaluation of allocation methods depends not only on the weighing of (subjective) scores of individual policy evaluation criteria but also on the further specification of these methods and criteria, as well as the coherence of the allocation rules and the (global) climate policy context in which an allocation method is implemented.

5 Joint options for EU burden sharing and ETS allocation

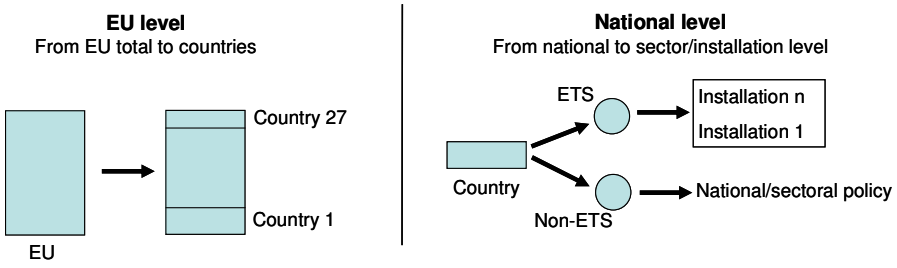
This chapter discusses briefly a few joint options for EU burden sharing and ETS allocation post-2012. These options are firstly characterised in Section 5.1 and, subsequently, further elaborated and evaluated in Section 5.2.

5.1 Major types of joint options

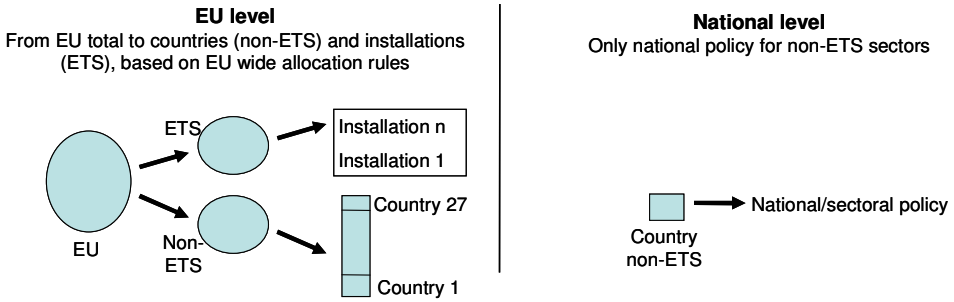
In brief, the major types of joint options for EU burden sharing and ETS allocation beyond 2012 can be characterised as follows (see Figure 5.1):

1. *Present system*. As noted, the present system (up to 2012) is characterised by, firstly, sharing the EU Kyoto target (i.e. the EU assigned amount of GHG emissions) among the Member States and, subsequently, each Member State divides its national target (including eventual purchases of JI/CDM credits) between the ETS and non-ETS sectors. Finally, while national/sectoral policies are implemented in order to achieve the target for the non-ETS sectors at the MS level, the assigned amount of emission allowances for the ETS sectors is distributed further at the installation level by means of national allocation rules (subject to the allocation guidelines and judgement by the European Commission). In principle, this joint option of EU burden sharing and ETS allocation can also be used for the post-2012 period (with further guidelines and harmonisation of allocation rules by the EC). In short, with regard to the EU ETS allocation process (i.e. setting the top-down cap and the bottom-up allocation rules) this option is characterised by a high level of decision-making at the MS level.
2. *EU burden sharing with ETS allocation at EU level*. This option is characterised by (i) the distribution of the EU assigned amounts of GHG emissions between the ETS and other sectors (i.e. setting an overall, EU-wide cap for the ETS), (ii) the allocation of the cap to eligible installations based on EU uniform allocation rules, and (iii) the distribution of the EU emission target for the non-ETS sectors among individual Member States (based on a corresponding EU burden sharing agreement post 2012). In short, with regard to the EU ETS allocation process, this option is characterised by a high level of decision-making at the EU level. In principle, there is also another (version of this) option conceivable in which not only the ETS target and allocation rules are set at the EU level but also the achievement of the target for the non-ETS sectors is implemented or harmonised at the EU level, for instance by means of harmonised energy efficiency and renewables policies, CO_2 technology standards for motorcars, etc. Although it may take some time before this option is realised, it would imply that an EU burden sharing agreement among its Member States will no longer be needed to achieve the overall EU mitigation target.
3. *EU burden sharing with EU wide ETS cap and MS allocation for (a) both existing and new installations (Type 3a) or (b) existing installations only (Type 3b)*. In terms of centralising or harmonising EU decision-making on ETS allocation issues, option types 3a and 3b are less extreme than option type 2 (actually, they can be regarded as 'intermediate' or 'transfer' options between types 1 and 2). Similar to type 2, in these options the overall EU emission target is first divided between the ETS and the other sectors of the EU Subsequently, the assigned amount of emissions to the non-ETS sectors is further distributed among the Member States based on a corresponding burden sharing agreement. In contrast to type 2, however, the EU-wide ETS cap is not allocated straight to the eligible installations, based on EU-wide allocation rules, but first distributed among the Member States which are free to further allocate their national ETS cap to their eligible installations according to their own rules (within certain guidelines set by the European Commission). In addition, the major difference between option types 3a and 3b is that in option 3a the national allocation system refers to all eligible installations (i.e. both incumbents and newcomers), whereas in type 3b it applies only to existing installations while newcomers obtain their allowances from an EU-wide reserve based on EU-harmonised allocation rules.

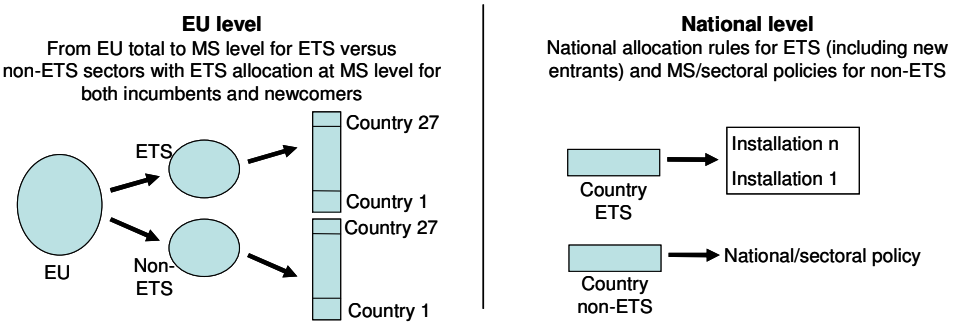
Option 1: Present system: EU burden sharing with ETS allocation at national level



Option 2: EU burden sharing with ETS allocation at EU level



Option 3a: EU burden sharing with EU-wide ETS cap and MS allocation for all installations



Option 3b: EU burden sharing with EU-wide ETS cap and MS allocation for incumbents only

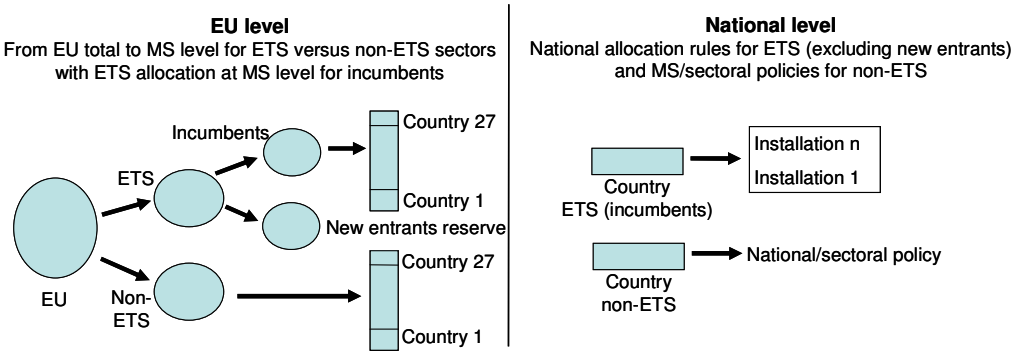


Figure 5.1 Joint options for EU burden sharing and ETS allocation post-2012

Purchases of JI/CDM credits
In each option type mentioned above, purchases of JI/CDM credits may be used to supplement assigned amounts of emissions at the EU, national, sector and/or ETS installation level. However, the use of these credits may be restricted by EU and/or national legislation. Moreover, whereas (the maximum limit of) using JI/CDM credits at the ETS installation level may vary significantly between Member States in option types 1 and 3a, it seems logical to apply an EU-wide maximum limit for purchasing these credits in option type 2 for (similar categories of) ETS installations and in option type 3b for new entrants.

5.2 Further elaboration and assessment of joint options

5.2.1 Quantitative aspects

The implications of the joint option types mentioned above in quantitative terms - for instance, in terms of costs or assigned amounts of emission allowances at the EU, national, sector or installation level - depends on a variety of other aspects and choices to be made. For instance, such implications depend first of all on the overall reduction target adopted by the EU as a whole. For the year 2020, the EU has proposed a reduction target of 20-30 percent (compared to the 1990 reference level) depending on the outcomes of the international post-Kyoto negotiations.

Subsequently, the quantitative implications depend further on the approach or methodology used for distributing the EU assigned amount of emission allowances at the national or sector level as discussed below for the different types of joint options for EU burden sharing and ETS allocation post-2012.

Option type 1
For option 1, the allocation of the EU assigned amount of emissions post-2012 to the 27 Member States can be based on different approaches, including:
- Emissions per capita.
- Emissions per Euro GDP.
- Emissions per economic activity (i.e. benchmarking), for instance per unit input or output.
- Emissions based on a mix of the above-mentioned parameters (for instance, the Triptych approach covering all sectors of the economy).

Subsequently, each Member State can allocate its national target amount of emissions between the ETS and non-ETS sectors (based on sector climate policy targets and evaluation criteria), while the national cap for the ETS sector is further allocated at the installation level, based on national allocation rules and EU guidelines.

Option type 2
For option 2, setting an EU-wide target for the ETS as a whole versus the other sectors can be based on different approaches, including:
- *Equal marginal abatement costs* of ETS versus non-ETS sectors, i.e. the EU-wide reduction commitments are divided between the ETS and non-ETS sectors, based on estimates of the marginal abatement costs and potentials of these sectors, in order to equalise these costs between the ETS and other sectors of the EU and, hence, to minimise the social costs of the mitigation commitments.
- *Simple grandfathering,* i.e. allocation based on historic emissions of ETS versus non-ETS sectors over a certain reference period, adjusted for new entrants and other changes in sector coverage, and corrected by a uniform ('flat') reduction rate in order to meet the overall EU mitigation target.
- *Advanced grandfathering,* i.e. allocation based on historic emissions of ETS versus non-ETS sectors over a certain reference period, adjusted by specific allocation rules for the ETS versus non-ETS sectors such as accounting for sector differences in growth rates (including new entrants), trends in carbon intensity improvements and abatement costs, and corrected by a (uniform/differentiated) reduction rate in order to meet the overall EU mitigation target.

Subsequently, the EU-wide cap for the ETS as a whole is allocated straight to the eligible installations throughout the system, based on EU-wide allocation rules. In contrast, the EU-wide target for the non-ETS sector is first shared among the Member States, which can be based on a variety of burden sharing approaches, including:

- Non-ETS emissions per capita.
- Non-ETS emissions per Euro GDP.
- Non-ETS emissions per economic activity (i.e. benchmarking), for instance per unit input or output.
- Non-ETS emissions based on a mix of the above-mentioned parameters (for instance, the Triptych approach covering only the ETS sectors).

Finally, each Member State is free to further subdivide its national target for the non-ETS sectors and to set its domestic/sector policies to achieve this target (including MS purchases of JI/CDM credits).

Option type 3a

To a large extent, type 3a is similar to option 2 and, hence, a similar quantitative allocation approach can be used at the EU, national and/or sector level. The major difference between these options is that in type 3a the EU-wide cap for the ETS as a whole is not allocated straight to the eligible installations but first divided among the 27 Member States and, subsequently, by each MS further allocated to its eligible installations, based on national allocation rules and EU guidelines. The division of the EU-wide ETS cap among the Member States can be based on different approaches, including:

- *Simple grandfathering,* i.e. allocation based on historic (verified) emissions of the ETS sectors for each Member State over a certain reference period, adjusted for new entrants and other changes in ETS coverage, and corrected by a uniform ('flat') reduction rate in order to meet the overall EU mitigation target for the ETS as a whole.
- *Advanced grandfathering, i.e.* allocation based on historic (verified) emissions of the ETS sectors for each Member State over a certain reference period, adjusted by specific allocation rules such as accounting for national/sector differences in growth rates (including new entrants), trends in carbon intensity improvements and/or abatement costs, and corrected by a (uniform/differentiated) reduction rate in order to meet the overall EU mitigation target. This approach resembles the methodology applied by the European Commission when judging the ETS caps of the second NAPs. More specifically, the Commission has estimated these caps by means of the following formula: national ETS cap = verified ETS emissions in 2005 * GDP growth rate for the years 2005-2010 * carbon intensity improvement rate for the period 2005-2010 + adjustments for new entrants and other changes in ETS coverage (see EC, 2007).[12] A similar formula could be used to set the national ETS caps post-2012, although verified ETS emissions could be based on more than one year (say 2005-2010, in order to avoid occasional, annual fluctuations in CO_2 emissions), while a reduction or correction factor - either uniform or diversified by Member State - may be used to meet the overall EU cap for the ETS as a whole.

Option type 3b

To a large extent, option 3b is similar to options 2 and 3a and, hence, a similar quantitative allocation approach can be applied at the EU, national or sector level. The major difference between options 3a and 3b is that in 3b the EU-wide cap for the ETS as a whole is first sub-divided in an EU-wide cap for the existing installations and an EU-wide reserve for new entrants. However, whereas the EU-wide cap for the incumbents is subsequently divided among the EU Member States (based on, e.g., the allocation approach outlined under option 3a, excluding adjustments for new entrants), the allocation of the reserve for newcomers is based on EU-wide rules.

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[12] A consistent set of estimated rates for GDP growth and carbon intensity improvement, ensuring equal treatment of EU Member States, can be obtained from the recently updated study 'European Energy and Transport Trends to 2030' (DG TREN, 2006).

Specific ETS allocation rules
In addition, the implications of the option types outlined above in quantitative terms (costs, assigned amounts of emissions at various levels, etc.) depends also on the specific allocation rules for the EU ETS. Regardless whether the ETS cap and allocation rules are primarily set the EU or national level, the major options concerning these rules include:

- A similar or differentiated reduction rate for ETS sectors, i.e. is the number of emission allowances allocated at the sector level reduced by the same flat rate - say 30 percent for all ETS sectors - or differentiated per sector, e.g. 50 percent for the power sector and 10 percent for the other ETS sectors?
- A similar or differentiated rate of free allocations per ETS sector, i.e. is the share of free allocations similar for all ETS sector - say 50 percent for all sectors - or differentiated per sector, e.g. 20 percent for the power sector and 80 percent for the other ETS sectors?
- A similar or differentiated reduction rate for incumbents versus newcomers?
- A similar or different rate of free allocations for incumbents versus newcomers?
- Will free allocations be based on a mix of grandfathering (for incumbents) and benchmarking (for newcomers) or only on benchmarking (for both existing and new installations)? Moreover, particularly in option 2, will benchmarking be generic or specific (i.e. specific per Member State and/or per technology/fuel used)?
- To which extent will certain national ETS allocation rules be harmonised EU-wide (particularly in options 1, 3a and 3b)?

In order to give a full or exact assessment of the implications of the joint options for EU burden sharing and ETS allocation post-2012 in quantitative terms, an EU-wide and disaggregated model is required, which is beyond the scope of the present project. However, regardless the specific EU reduction scenario, the specific EU burden sharing approach and the specific ETS allocation rules, these joint options can be assessed to some extent in qualitative terms by discussing the major pros and cons of these options, as outlined below.

5.2.2 Qualitative assessment

Option type 1
The major advantage op option type 1, i.e. continuing the present EU burden sharing and ETS allocation process, is that it leaves the responsibility and decision-making power at the Member State level, enabling national governments to meet their agreed national targets while accounting for national differences in socioeconomic circumstances, data availability and cultural-political conditions that might determine more reasonable or acceptable decisions.

On the other hand, the major disadvantage of this option is that the national-oriented ETS allocation process may lead to (i) all kinds of distortions of the Internal Market, (ii) a widely diversified, complex and non-transparent set of allocation rules throughout the EU ETS, and (iii) national allocation decisions - for instance regarding new entrants, plant closures or auctioning of allowances - that are not optimal for the scheme as a whole (the so-called ‘prisoner’s dilemma’ or ‘race to the bottom’ effect).

Option type 2
The crucial difference between option types 1 and 2 is that the decision-making competence on the ETS cap and the allocation rules is transferred from the national to the EU level and, hence, in this respect the pros and cons of options 2 are largely opposite to those of option 1. More specifically, as argued in Section 4.3, the major advantage of option 2 is that by centralising the setting of the ETS cap and allocation rules at the EU level, it may result in a more optimal outcome as a whole, either by reducing distortions of the internal market or by avoiding other (‘race to the bottom’) effects. On the other hand, a major disadvantage or obstacle for realising option 2 is that governments nee to transfer a major part of their ETS allocation decision competence to the EC level and may be rather reluctant to do so (or that it may be hard to harmonise ETS allocation issues among 27 different Member States).

Options 3a and 3b
As stated above, option 2 may be a very attractive or even ‘ideal’ option for a variety of efficiency reasons, but the main hindrance to realise this option might be that it implies a major

transfer of decision power from the MS to the EU level. To address this issue, two 'intermediate' options, i.e. types 3a and 3b, have been designed. In option 3a, setting the overall ETS cap has been centralised at the EU level, but in contrast to option 2 this cap is not allocated straight to the eligible installations based on EU-wide allocation rules, but first divided in national caps for each Member State that, subsequently, has the authority to allocate its cap to its eligible installations according to its own rules (within certain general EU guidelines, which may be further harmonised over time). The major advantage of this option is that it may be more acceptable for national decision-makers and that certain shortcoming of the present situation (i.e. option 1) may be reduced to some extent. The main disadvantage of this option is, however, that the allocation rules are still primarily set by the individual Member States, which may still result in significant distortions of the Internal Market and other adverse effects.

In option 3b, decision-making has been centralised at the EU level for setting both the overall ETS cap and the allocation rules for newcomers (by creating an EU-wide New Entrants Reserve, allocating allowances straight to new installations based on EU-wide allocation rules). Since a major part of the competitive distortions and other adverse effects of options 1 and 3a are related to new entrants, the main advantage of option 3b is that these issues are partly addressed. However, distortions and other adverse effects due to national-oriented allocations to incumbents still remain, while - compared to the present situation - option 3b implies a major transfer of ETS allocation decision competence from the national to the EU level (though less than in option 2).

To conclude, there are several joint options for EU burden sharing and ETS allocation post-2012. Centralising or harmonising the process of setting the (top-down) ETS cap and the (bottom-up) allocation rules for eligible installations throughout the EU may appear an attractive - or even 'ideal' - option as it reduces competitive distortions and other adverse effects due to a national-oriented allocation process, but it implies a significant transfer of decision power from the national to the EU level (compared to the present allocation process). Hence, for the allocation period immediately post-2012 an 'intermediate' option might be more realistic, i.e. an approach in which certain parts of the allocation process are centralised - such as setting an EU-wide cap for the ETS as a whole or harmonising fully the reserve of allowances and allocation rules for new entrants - while other parts are left to the discretion of national decision-makers or subject to a gradual process of increasing harmonisation of allocation rules in the trading periods beyond 2012.

6 Interactions between options for EU burden sharing and EU ETS allocation

As indicated by Figure 4.1, there are linkages and interactions between the international post-Kyoto negotiations on the burden sharing of future mitigation commitments and the EU ETS allocation options post-2012. On the one hand, the emissions cap post-2012 of the EU ETS and the options to allocate this cap among participating sectors and installations depend to some extent on the prospects and outcome of the post-Kyoto negotiations. For instance, the number of non-EU countries taking part in a post-Kyoto agreement and the level of mitigation commitments shared by these countries will influence not only the amount but also the options of allocating allowances to EU industries that have to compete on a global market.

On the other hand, given the fact that, at present, the EU ETS is the major determinant of EU/Kyoto compliance (including its linkage to other instruments such as JI and CDM), the performance of this scheme and the allocation choices made will influence the future global climate policy regime. For the EU, continuing the EU ETS beyond 2012 will be a major stepping-stone for proposing, evaluating and, finally, accepting post-Kyoto mitigation commitments. For the EU, however, it is also important to realise what the different options for EU ETS allocation mean for the chance of getting other countries to take part in a post-Kyoto regime or, more particularly, to link with the EU ETS. Hence, these interactions have to be considered when evaluating options for international burden sharing and EU ETS allocation beyond 2012.

For the EU ETS, the most ideal outcome of post-Kyoto climate policy negotiations would be early clarity (e.g. 2008) on medium-term quantitative mitigation commitments, a continuation of the Kyoto mechanisms and clarity about the long-term development of the climate policy regime covering all countries in the world. This would imply that amply before the start of the post-2012 trading period, the EU ETS could set its overall cap for a longer-term period (say up to 2020) and allocate this cap periodically by means of the socially most optimal allocation method, including the efficient promotion on carbon abatement investments while reducing carbon leakage, competitive distortions, windfall profits and other adverse effects of national-oriented, free allocations of emission allowances.

By now, it is already clear that the above-mentioned ideal outcome will not be reached. Below, different aspects and potential outcomes of the post-Kyoto climate policy negotiations will be discussed, including the implications for EU ETS allocation post-2012.

In December 2005, the Montreal Meeting of Parties launched negotiations on post-2012 quantified commitments in the framework of the Kyoto Protocol. Given the fact that these negotiations do not include new commitments for non-Annex I countries and the complexity of the issues involved, however, an agreement is unlikely before 2009 at the earliest (Grubb and Neuhoff, 2006b). This is too late to be of much use in setting and allocating post-2012 caps under the EU ETS in order to timely inducing efficient investments in carbon abatement technologies. Therefore, to the EU will probably first have to orient itself in setting post-2012 sector caps under the ETS on its independent reduction target of 20% by 2020 and review and adjust these at a later stage when an international climate policy agreement is reached.

However, even if ultimately an international (long-term) agreement on mitigation commitments post-2012 is reached, it may cover only a part of the global community, e.g., the present Annex I countries, possible still without Australia and the US. This implies that it might be hard to set stringent abatement caps for those EU ETS sectors facing outside competition or to phase out free allocations to these sectors (including new entrants). In principle, the following options could be considered to deal with such a situation:

- *International sector agreements*, covering all major competitors - rather than a global agreement covering all sectors in all countries - in order to implement policies that reflect carbon costs in product prices of energy-intensive, internationally mobile goods of core

sectors such as aluminium, cement, iron and steel, refineries and some chemical products. Agreement to reflect carbon costs in power production would also be desirable because of its downstream cost impacts (Grubb and Neuhoff, 2006b).

- *Border tax adjustments* (BTAs) to compensate industries producing in regions with high carbon costs for these costs when exporting, with a symmetric tariff being applied to imports. WTO regulations mean, however, that companies could only by compensated for the real costs they incur as a result of policy regulations - not for the marginal costs or opportunity costs that follow from free allocation. Therefore, to implement effective BTAs, a prerequisite for WTO compatibility is most likely auctioning of emission allowances (Hepburn et al., 2006; Grubb and Neuhoff, 2006b; Ismer and Neuhoff, 2004).
- *Intensity- or output-based allocations*. Sectors exposed to international competition could receive carbon allowances in proportion to their output, implying either 'ex-post' or at least 'within-period' adjustments. Although such an approach would be less efficient (and is precluded by the present EU ETS Directive), it would reduce carbon leakage and competitive problems of these exposed sectors (see Section 4.7.2 above and references cited there).
- *Auctioning of emission allowances and recycling of auction revenues,* in particular to those sectors faced by outside competition and significant cost increases due to the EU ETS (including increases in power prices). It might be hard, however, to find a good, precise mechanism to (i) target auction revenues to these sectors, (ii) avoid a perverse incentive on the (direct and indirect) emissions of these sectors, and (iii) avoid potential violations of EU state aid regulations.
- *Indirect allocations of allowances*, i.e. giving allowances for free to (industrial) power users faced by outside competition (rather than direct free allocations to power producers) in order to compensate these users for EU ETS-induced increases in electricity prices. Similar to the option mentioned above, however, it might be hard to find a good, precise mechanism to (i) allocate allowances to these end-users, (ii) avoid a perverse incentive on electricity use (and, hence, indirect emissions), and (iii) to avoid potential violations of EU state aid regulations.
- *Opt-out of sectors facing competition outside the EU ETS.* Rather than emissions trading, these exposed sectors could be subject to other carbon abatement measures such as (i) carbon taxes (which might be more easy to compensate by BTAs than carbon emissions trading), (ii) command-and-control regulations (which may apply only to domestically sold products, including imports, thereby avoiding competitiveness problems), and (iii) R&D measures that support investments in carbon abatement technologies in these sectors.

Finally, even if ultimately a widespread, international agreement on climate policy beyond 2012 is reached, it may not focus exclusively on fixed quantitative mitigation commitments and flexible instruments (such as ET, JI and CDM) but on a variety of targets and policy measures that may be selected and differentiated by regions or (groups of) countries depending on their socioeconomic development and political preferences.

The implications of such an agreement for the EU ETS depend on the specific characteristics and coverage of these targets and policy measures. For instance, besides fixed, binding quantitative mitigation commitments, there is a variety of options for other quantitative greenhouse gas emission commitments that are technically compatible with both domestic and international emissions trading. These options include dynamic targets, binding targets with price caps, non-binding targets, sector-wide targets/mechanisms, action targets, and long-term permits (Philibert, 2005, see also Section 3.2).[13]

On the other hand, qualitative targets or agreements - for instance, the use of certain policy measures or instruments - are usually less easily compatible with domestic/international emissions trading. Besides the specific type of targets, however, the implications for the EU ETS of an international policy regime depends also on the type of policy measures or

[13] In addition, there is another option for quantitative GHG emission commitments - 'allowances and endowments' or the so-called McKibben-Wilcoxen approach - that is technically compatible with domestic ET but hardly with international ET (Philibert, 2005).

instruments agreed on. Broadly, the following categories of policy measures and instruments can be distinguished:

- *Voluntary agreements*. Depending on the type and character of the agreement (including its stringency, its 'voluntary' character, its degree of compliance, etc.), voluntary agreements on enhancing energy efficiency or reducing carbon emissions could to some extent be compatible with emissions trading in general and the EU ETS in particular, as illustrated by the Netherlands where voluntary agreements on energy efficiency have been used as a basis for the NAPs up to 2012.
- *Energy or carbon taxes.* If producers (and consumers) are faced by cost effects of both emissions trading and energy/carbon taxes for the same products or activities, it may result in all kinds of double taxation, inefficiencies or other distortions (Sorrell and Sijm, 2003; Sorrell et al. 2003; and Sijm, 2005). Hence, from a socioeconomic point of view, the EU ETS does not well comply with energy/carbon taxes on the same products or activities covered by the scheme. However, the EU ETS may be well compatible with energy/carbon taxes on (the same) products or activities outside the scheme (both inside and outside the EU). Such taxes may even be quite favourable to the scheme as they may reduce competitive distortions between the same products or activities inside and outside the EU ETS.
- *Command-and-control regulations* (such as setting technology or performance standards for production or end-use purposes). Similarly, if producers (and consumers) are faced by cost effects of both emissions trading and command-and-control regulations for the same products or activities, it may result in all kinds of trading restrictions, inefficiencies or other distortions (Sorrell and Sijm, 2003; Sorrell et al. 2003; and Sijm, 2005). Hence, from a socioeconomic point of view, the EU ETS does not well comply with such regulations on the same products or activities covered by the scheme. However, the EU ETS may be well compatible with command-and-control regulations on (the same) products or activities outside the scheme (both inside and outside the EU). Such regulations may even be quite favourable to the scheme as they may reduce competitive distortions between the same products or activities inside and outside the EU ETS.
- *Technological research & development*. International technology or R&D agreements are well compatible with international emissions trading. More strongly, they are in fact two necessary, complementary approaches in order to deal adequately with the two sets of market failures restricting the development and deployment of carbon abatement technologies and hence, to provide an optimal mix of push and pull factors to encourage these technologies (Sijm et al., 2004).[14] This implies that the EU ETS is not only well compatible with international agreements to promote carbon abatement technologies but that a well mixed combination of these two instruments would be the most ideal, optimal approach to address climate change. However, if outside the EU one sticks to international technology agreements only (without a complementary instrument such as emissions trading or other carbon cost increasing measures to induce technological change), such an approach would not only be less effective but also raise competitiveness problems for those EU ETS sectors facing outside competition and, hence, the need for additional options to deal with these problems (as discussed above).

To conclude, options for EU ETS allocation post-2012 are well compatible with a variety of options for post-Kyoto international agreements on addressing climate change (including a variety of emissions targets and policy measures or instruments). However, if major competitors outside the EU ETS do not participate in such agreements or only take part in agreements that to not raise production costs in a similar way as the EU ETS, it raises competitiveness problems for those EU ETS sectors facing outside competition and, hence, the need for additional options to deal with these problems (including border tax adjustments, indirect allocations, recycling and targeting auction revenues, output-based allocations, or opt-out options for these sectors).

[14] However, if the R&D and, particularly, the deployment of (specific) carbon abatement technologies is highly subsidised, it may result in 'picking the winners' and distorting market efficient approaches to carbon abatement.

7 Summary of major findings and conclusions

Options for EU burden sharing post-2012
There exists a large variety of options for international and (internal) EU burden sharing of GHG mitigation commitments beyond 2012, including continuing the present regime. The latter consists of the Kyoto Protocol for the international differentiation of abatement efforts and the EU Burden Sharing Agreement (BSA) for EU internal differentiation of emission reductions. This regime, however, is characterised by a number of drawbacks such as limited international participation, economic inefficiencies, lack of long-run certainties, and unequal burden sharing.

Alternative options for international differentiation of GHG mitigation commitments in general and internal EU burden sharing in particular include:
- *Grandfathering,* i.e. applying a flat reduction rate for all EU countries to their historic emissions in a certain reference period.
- *Per capita convergence,* i.e. differentiation of emission reductions based on equal per capita emissions in a certain convergence year.
- *Multi-criteria convergence,* i.e. differentiation of emission reductions based on a mix of (i) GDP per capita, (ii) emissions per capita, and (iii) emissions per unit GDP.
- *Ability to pay,* i.e. differentiation of emission reductions based on GDP per capita.
- *The (extended) Triptych approach,* i.e. differentiation of emission reductions based on a variety of sector and technology criteria.
- *Equal mitigation costs,* i.e. differentiation of emission reductions based on equal mitigation costs per country (e.g. a certain percentage of GDP).

These options score differently with regard to a selection of policy evaluation criteria, but no option scores highest or lowest in all respects. Nevertheless, depending on the interpretation, weighing and adding of the criteria, some options seem to have a better overall score than other options. For instance, the overall score of the grandfathering approach seems to be lower than the other options, while the overall performance of the multi-criteria convergence option and the Triptych regime seem to be relatively higher.

Options for EU ETS allocation post-2012
The major characteristic of the EU ETS allocation system up to 2012 is that it is basically a *national*-oriented system based on *free* allocations on emission allowances, i.e. grandfathering for incumbents and, generally, fuel- or technology specific benchmarking for new entrants. The major advantages of such an approach are:
- National-oriented allocation can be fine-tuned to the socioeconomic circumstances of a country, including data availability and existing cultural or policy conditions, thereby enhancing the socio-political feasibility and acceptability of the ETS among the Member States.
- Free allocation comes to meet those emitters who are not able to pass through the costs of emissions trading into their outlet prices and, hence, it reduces the resistance of these emitters to accept the EU ETS (and, therefore, facilitates its implementation).

On the other hand, some major disadvantages of the present allocation system are:
- It leads to significant differences between countries in allocation at the installation level, which may distort the Internal Market by affecting the competitiveness and/or the profitability of installations throughout the EU.
- It leads to an imbalanced or unequal distribution of the total national emission cap (including the use of JI/CDM credits) between the ETS sectors and the other sectors of a country, particularly to a relative - or even absolute - over-allocation of the ETS sectors at the expense of other sectors.
- It results in windfall profits to those firms passing through the opportunity costs of freely allocated emission allowances.
- It results in a widely diversified, complex and non-transparent system of allocation rules throughout the EU ETS.

- It reduces the incentive for investments in less carbon intensive technologies and, hence, undermines the rationale and credibility of the EU ETS to support the transition towards a less carbon intensive economy.
- It leads to all kinds of lobbying, gaming and other rent-seeking activities of interested parties.

To deal with these disadvantages, a variety of allocation options beyond 2012 are available, including a harmonization or centralization of allocation decision making at the EU level combined with a selected number of allocation methods such as auctioning or uniform/product-generic benchmarking. However, governments of EU Member States are likely to be rather reluctant to transfer a major part of their allocation decision competence to the EC level as allocation decisions may have significant distributional and competitive effects at the national, sector and firm levels.

Moreover, whereas allocation options such as auctioning or uniform/product-generic benchmarking have certain advantages, they also have certain disadvantages, notably if outside competitors do not face similar climate policy-induced cost increases. Therefore, in such a situation, a selection of allocation methods could be considered, including (i) auctioning for sheltered sectors, i.e. the power sector and other sectors where outside competition is lacking, (ii) grandfathering for incumbents in exposed sectors, (iii) relative, uniform and/or product-generic benchmarking for newcomers in exposed sectors, and (iv) recycling of auction revenues to compensate the adverse effects of passing through carbon costs, notably for those firms exposed to outside competition. Once a global climate policy regime is introduced, i.e. all relevant competitors face similar cost increases due to climate policy, auctioning can be applied to all ETS participants while the auction revenues can be used to finance general socioeconomic purposes.

Joint options for EU burden sharing and ETS allocation post-2012
Major types of joint options for EU burden sharing and ETS allocation beyond 2012 include:

4. *Present system,* i.e. firstly, sharing the overall EU emission target among its Member States and, subsequently each Member State (MS) divides its national target between the ETS and other sectors, while the allocation of the national ETS cap to eligible installations is based on (different) MS rules.
5. *EU burden sharing with ETS allocation at EU level,* i.e. both the top-down ETS cap and the bottom-up allocation rules are set at the EU level, while the EU target for the non-ETS sectors is shared among the MS.
6. *EU burden sharing with EU-wide ETS cap and MS allocation for either (a) both existing and new installations (Type 3a) or (b) existing installations only (Type 3b),* while the EU target for the non-ETS sectors is shared among the MS.

These three types of options have different implications in quantitative terms (e.g. assigned amounts of emissions and costs at the EU, national, sector or installation level), depending on the specific burden sharing and allocation rules applied (which is beyond the scope of the present study). In addition, the option types have different implications in qualitative terms, notably in terms of decision competence, competitive distortions and other potential adverse effects of national-oriented versus EU-harmonised allocation. Centralising or harmonising the process of setting the ETS cap and the allocation rules for eligible installations throughout the EU may appear an attractive - or even 'ideal' - option as it reduces competitive distortions and other adverse effects due to a national-oriented allocation process, but it implies a significant transfer of decision competence from the national to the EU level (compared to the present allocation process). Hence, for the allocation period immediately post-2012 an 'intermediate' option might be possible, i.e. an approach in which certain parts of the allocation process are centralised - such as setting an EU-wide cap for the ETS as a whole or harmonising fully the reserve of allowances and allocation rules for new entrants - while other parts are left to the discretion of national decision-makers or subject to a gradual process of increasing harmonisation of allocation rules in the trading periods beyond 2012.

Interaction between international burden sharing and EU ETS allocation post-2012
Options for EU ETS allocation post-2012 are well compatible with a variety of options for post-Kyoto international agreements on addressing climate change (including a variety of emissions targets and policy measures or instruments). However, if major competitors outside the EU ETS do not participate in such agreements or only take part in agreements that to not raise production costs in a similar way as the EU ETS, it raises competitiveness problems for those EU ETS sectors facing outside competition and, hence, the need for additional options to deal with these problems. This includes border tax adjustments, indirect allocations, recycling and targeting auction revenues, output-based allocations, or opt-out options for these sectors.

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