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Options for a 2020 EU Burden Sharing Agreement

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Disclaimer

The views expressed in this study represent only the views of Öko-Institut and the authors and not necessarily those of any other institution or organisation.

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Summary

Within the European Union the Member States face the problem of finding target sharing agreements for different binding and quantified commitments, the total greenhouse gas emission targets for 2020, the caps for the European Union Emissions Trading scheme and the Member States' targets for use of renewable energies. The three targets are interlinked and the process for the target sharing agreement does not follow the same timing in all aspects.

The analysis of different economic approaches for the parametrisation of burden sharing shows the main merits of such approaches in terms of total efficiency and the opportunity to address distributional effects. However, the main barrier for such an approach results from the issue of modelling, parametrisation and uncertainties:

- The parties of the burden sharing would have to agree on a model which reflects the full set of mitigation measures and in which the modelling of allowances trades and the allowance flows is adequately implemented.
- A set of transparent, robust, consistent and agreeable data is needed for all factors which determine the abatement cost curves and the baseline emission trends.
- Due to the nature of every projection, a comprehensive and transparent uncertainty analysis for the abatement cost curves as well the baseline scenarios should be undertaken to identify robust trends and results.

Furthermore, the necessary modelling should also reflect the efforts which were already undertaken by certain targets in the past. If these past efforts for reducing greenhouse gas emissions were related to costs, a modelling approach which only considers future action and futures costs would not be appropriate. Although this could be done in principle, the ex-post modelling of past efforts is extremely complicated in terms of models and its parameters.

Against this background, two consequences can be drawn. First, the efforts for building a consistent and extremely transparent modelling toolbox as well as for the development of comprehensive and well-founded data should be strengthened. Secondly, the approaches based on costs and burdens should at least be complemented by structural approaches, which eventually could also more or less completely replace the above described economic approaches.

Structural approaches do not rely on economic assessments but on the analysis of emission trends and the underlying parameters. Complex approaches for the structural analysis focus on the driving forces of emission trends and specific emission intensities. Simple structural approaches rely on structural emissions data only.

The robustness and transparency of structural approaches is significantly better than for the economic approaches. However, the assumption that comparable levels for structural indicators also reflect comparable cost structures and could also serve as proxies for cost analysis could be questioned.

Against this background, the quantitative analysis presented in this paper should be seen as a complementary one to many other possible approaches.

With regard to the EU-27 emission levels in 1990 and 2005, the greenhouse gas emission targets for the EU-27 can be translated into the following emission targets:

- A (unilateral) 20% emission reduction based on 1990 levels is equivalent to an emission ceiling of 4,496 Mt CO_2-e for the year 2020. Compared with the 2005 levels, an additional aggregate emission reduction of about 682 Mt CO_2-e would be necessary to meet this commitment by domestic action. This equals an emissions reduction of 13.2% compared to 2005 or a ceiling which is 16.1% lower than the aggregate commitment for the first commitment period of the Kyoto Protocol.
- The more ambitious target of a 30% emissions reduction results in an emission ceiling of 3,934 Mt CO_2-e which is 1,244 Mt CO_2-e less than the 2005 levels. This would require a further emission reduction of 24% compared to the recent (2005) levels and would go 26.6% beyond the recent aggregate EU-27 commitment within the framework of the Kyoto Protocol.

Given the special importance of the EU ETS caps, three different options for an EU-wide cap were considered in the analysis:

- The base case ('medium cap') marks an approach in which the contribution of the EU ETS to gap closure is equivalent to the share of the (adjusted) emissions from installations under the EU ETS in the total greenhouse gas emissions in 2005 (42.6%). As a result the medium cap ceiling is about 1,917 Mt CO_2–e in the 20% scenario for 2020 and 1,678 Mt CO_2–e in the 30% scenario. This equals an emissions reduction of about 291 Mt CO_2–e in the 20% scenario and an emissions reduction of about 530 Mt CO_2–e by 2020, compared to (adjusted) 2005 levels.
- In the first variation ('modest cap') this share was reduced by 15 percentage points. This corresponds to a modest cap of about 2,020 Mt CO_2–e in the 20% scenario or an emissions reduction of about 188 Mt CO_2–e by 2020, compared to 2005 levels. For the 30% scenario the modest cap is 1,864 Mt CO_2–e which is 344 Mt CO_2–e less than the 2005 emission level.
- In the second variation ('strong cap'), the share of the EU ETS in gap closure for the overall commitment was increased by 15 percentage points. In the 20% scenario this results in a strong cap ceiling of about 1,815 Mt CO_2–e for 2020 which is 393 Mt CO_2–e lower compared to 2005 emissions levels. The respective ceiling for the strong cap in the 30% scenario is 1,491 Mt CO_2–e in 2005, equalling a reduction of 717 Mt CO_2–e compared to 2005 emissions levels.

For the aggregate emissions targets as well as for the EU ETS and the non-ETS targets (if appropriate) three options with some additional variants are analysed:

1. Simple top-down approaches:
    a. Option 1.1: 2020 target proportional to base year emissions
    b. Option 1.2: 2020 target proportional to 1990 emissions
    c. Option 1.3: 2020 target proportional to 2005 emissions
    d. Option 1.4: 2020 target proportional to Kyoto target
2. Top-down approaches with an EU-wide ETS cap:
    a. Medium EU-wide caps for the EU ETS
    b. Modest EU-wide caps for the EU ETS
    c. Strong EU-wide caps for the EU ETS
3. Bottom-up models based on sectoral reduction targets:
    a. Sectoral cuts for ETS, proportional cuts for non-ETS based on Kyoto commitments
    b. Sectoral cuts for EU-15 ETS caps, constant ETS caps for EU-12, and proportional cuts for non-ETS based on 2005 emission levels
    c. Sectoral cuts for ETS for EU-15, modest sectoral cuts for ETS caps for EU-12, and proportional cuts for non-ETS based on the average of 2005 emission levels and the Kyoto target
    d. Sectoral cuts for ETS caps and non-ETS emissions
    e. Sectoral cuts based on EU wide policies and measures effects

Based on some rough quantitative analysis of key interactions between an increase of energy supplies from renewable energies and the EU ETS some conclusions of analogy can be drawn:

- In the case of the 20% scenario, probably only the strong cap variant (for the medium variants for power generation from renewable energies) would maintain a level of allowance prices that is comparable to the EU ETS phase 2 market results.
- For the 30% scenario, especially for the medium and strong cap option, the variants with a strong contribution from renewable power generation (i.e. the three-quarters and the two-thirds variant) could limit the necessary efforts within the EU ETS and as such the allowance price increases – if this is a major concern.

The interactions between the ETS and renewable energy targets must be seriously considered in the definition phase for caps and targets, but there are sufficient options (tighter caps, assignment of targets to renewable power generation) for avoiding counterproductive effects for both the EU ETS and the renewables targets.

The comparison of the different scenario analysis based on the simple structural approach leads to some general principles:

- Target sharing approaches which are based on emission levels and structures from recent years at the whole or partly (ETS or non-ETS segment) lead to the need for relatively more efforts for countries which have decreased their emissions significantly in the past. Other countries which ensure their compliance to the existing commitments with purchases of emission credits will comparatively benefit from such approaches.
- The emission reduction gains from the transition process of the EU-10 (EU-12 without Cyprus and Malta) will be redistributed among the Member States if the target sharing is based on data from more recent years.
- If the target sharing is fully or partly based on 1990 emission levels and structures or the existing burden sharing commitments for 2008-2012, very strong emission reduction targets occur for many of the EU-15 Member States whereas significant emission increases for most of the EU-12 would still fit in with their 2020 targets.

However, a wide spread of targets for 2020 (compared to the recent emission levels) must not necessarily be seen as a prohibitive approach but rather will lead to major distributional effects if the Member States have to trade significant amounts of allowances. The key question is to what extent emission reduction gains from the past should be redistributed among all Member States in the framework of more or less strong future commitments of the EU-27 as a whole.

The definition of the cap for the EU ETS plays a crucial role in the framework of the target sharing. Whether the cap is set EU-wide and than assigned to the Member States or the installations covered by the EU ETS are defined as an ‘additional Member State’, a separate analysis of the ETS and the non-ETS is inevitable for the target sharing analysis. Setting the size of the EU-wide ETS cap is a crucial staring point for the analysis. Against the background of the uncertainties related to the unilateral and the multilateral commitments of the EU, the following points on the cap setting should be highlighted:

- If the cap is defined on a medium or modest level in the framework of the 20% scenario, the potential adjustment of the total share would require additional efforts in the non-ETS sectors which would probably lead to a major reliance of non-domestic emission reductions, in other words: major emission reduction credit purchases. Only a strong cap variant in the 20% scenario (which equals an emission reduction of significantly more than 18% compared to the 2005 ETS emission levels) could also somehow fit in the framework of the 30% scenario. As an alternative, the length of future trading phases should be defined in a way which allows for cap adjustments before the year 2020.
- The definition of the ETS sector target and a possible assignment to the Member States dominates the outcome of the target sharing for the total emissions

in many cases. Also against this background, the cap setting within the EU ETS is the key exercise of the target sharing.

If the EU-wide cap is assigned to the Member States (because of auctioning revenues or the architecture of the future international regime), the following findings should be highlighted:

- If the assignment to the Member States is based on flat rate approaches significant competition distortions can occur because of the strong differences in the structure of branches which are covered by the EU ETS in the different Member States.
- Sectoral differentiation could constitute a suitable and robust approach to reflect the different structures of the EU Member States. Even if different growth rates will be assumed for some sectors between the Member States (what is relevant especially for the EU-12 Member States), it could be integrated into sectoral differentiation approaches without major complications. The significant differences between the total emissions covered by the EU ETS in the EU-15 and the EU-12 Member States lead to limited changes for the EU-15 even if significant adjustments are assumed for the EU-12 Member States.
- With the cap setting for the first and the second phase of the EU ETS, a clear pathway is defined for future cap setting and its breakdown to sectors and/or Member States: The caps will refer to more recent emission levels, the emission reduction gains from the transition process will not materialise within the EU ETS. In the context of potential competition distortions among the industries in the EU-27, this is an important starting point.

Whatever the approach for the EU ETS is, the Member States will definitely remain in charge of the 2020 commitments for the emissions from the non-ETS sectors.

- All approaches which rely on early base years or the non-ETS shares in the 2008-2012 commitments (if these are expressed as the difference between the total commitments and the ETS cap) will lead to significant emission reduction targets for the EU-15 and a strong potential for emissions growth or allowance sales for the most EU-12 Member States. Even for approaches which combine more recent reference years and the existing commitment structures, the emission reduction gains from the transition period dominate the outcome.
- The divergence between the real emission trends and the commitments under the EU burden sharing in the framework of the Kyoto Protocol from 1997 are so significant that a pure reference to these ‘historical commitments’ will probably not constitute a reliable basis for the 2020 target sharing because of the order of magnitude of the distributional effects. However, the reference to more recent reference periods will create the updating problem with its perverse incentive signal (Member States could benefit from delayed efforts).
- If the targets for the non-ETS sectors are based on recent emission levels and structures, the emission reduction gains from the transition period for most of

the EU-12 Member States will be redistributed among all EU-27 Member States.

- Approaches based on sectoral emission structures which are adjusted for major differences in growth rates in certain sectors could constitute an appropriate starting point for the target sharing regarding non-ETS sector emission targets. Neither flat rate approaches for the non-ETS sector emissions nor simple sectoral differentiation approaches will be able to soften major distributional effects of target sharing for the non-ETS sector emissions.

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1 Introduction and Scope of the Paper

Within the European Union the Member States face the problem of finding target sharing agreements for different binding and quantified commitments:

1. The unilateral target of a 20% reduction of total greenhouse gas emissions compared to 1990 emission levels and the multilateral reduction target of 30% if other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries contribute adequately according to their responsibilities and respective capabilities.
2. The cap for at least the third phase of the EU Emissions Trading Scheme (EU ETS) which must be defined prior to the start of this phase in 2013. Whether an EU-wide cap is assigned to the Member States or not still has to be decided.
3. For renewable energies the EU agreed upon a binding target of a 20% share of renewable energies in the overall EU energy consumption by 2020 and a 10 % binding minimum target to be achieved by all Member States for the share of biofuels in overall EU transport petrol and diesel consumption by 2020. These EU targets must be assigned to the different Member States.

The three targets are interlinked and the process for the target sharing agreement follows not in all dimensions the same timing.

The main scope of this paper is to outline the different approaches which could constitute the basis for the upcoming debates. Against the background of the available resources, the analysis had to rely on a more general analysis and more simple analytical approaches. As such the scope of the analysis presented in this paper is more geared to identifying starting points, general principles and key findings for the debate and to presenting complementary analysis to other analytical approaches than it is to developing concrete proposals for the political process.

In chapter 2 we provide a more general overview of the different options for the analysis of target sharing options, referring to different economic and structural approaches. We also address the sectoral and geographical differentiation we used for the following analysis. Chapter 3 contains the description of data sources which were used for the analysis and of the differences to other recent analytical studies. In chapter 4 we present the historical emission trends for the total greenhouse gas emissions and the different sectors. Regarding the sectoral analysis we especially focus on the emissions from the installations which are covered by the EU ETS at the moment and in the foreseeable future. In addition, we quantify the targets which constitute the basis for the quantitative analysis. The assumptions and results for the different options regarding the target sharing for the total greenhouse gas emissions, the EU ETS emissions as well as the non-ETS emissions are described in chapter 5. Some complementary analysis on the interaction between emission and renewable energy targets and on other analytical exercises on target sharing is presented in chapter 6. Some conclusions are drawn in chapter 7.

2 Methodological Aspects

2.1 Overview

In this section we discuss the general methodological options for target sharing. First, we provide an overview of the different options to derive targets from an economic analysis, based on the cost efficiency and the equal burden approach. Secondly, we define and discuss simple and complex structural approaches for the target sharing analysis. The goal of this overview is to describe the methodological environment of the approach on which we base on our analysis. Furthermore, we discuss the differentiation by countries and sectors which was used for the analysis. Regarding the sectoral differentiation we put a special focus on the implication of the interaction between national emission targets and the caps within the EU ETS.

2.2 Economic approaches

The economic approaches for target sharing address the costs of achieving a certain target and the cost sharing between the participating parties:

1. the economic efficiency approach addresses the equilibrium of marginal mitigation costs;
2. the equal burden approaches addresses the costs sharing between the parties, with and without the use of flexible mechanisms.

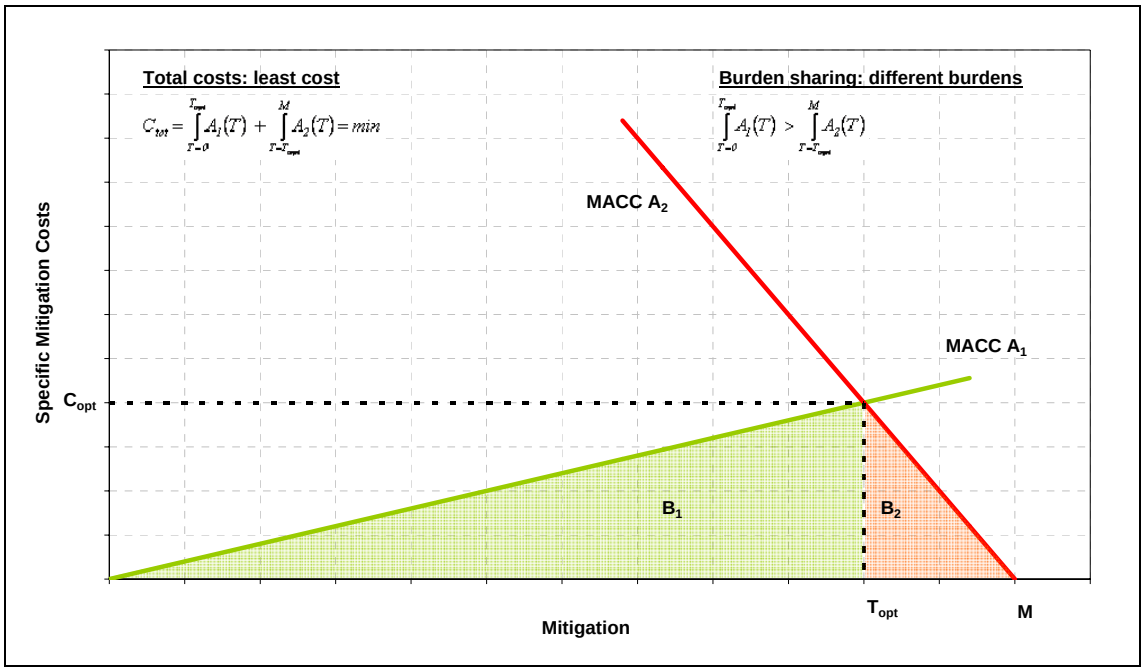
Figure 1 shows a graphic representation of the economic efficiency approach for a very simple case of the target sharing of a given overall mitigation target between two parties. The total mitigation is allocated to the two parties 1 and 2 in a way that the target structure T leads to the same marginal abatement costs for both parties. In any case this target sharing leads to a minimum of the total costs for the total mitigation target. Both parties would internally implement measures with abatements costs below the optimal marginal abatement costs C_{opt}. In the case that both parties were to implement an internal emissions trading scheme, the price of emissions allowances would tend towards the level of C_{opt}.

The total economic burden for a party from these measures results from the area below the respective parts of the marginal abatement cost curves (MACC). However, if the marginal abatement cost curve (MACC) for party 1 is significantly different from the MACC for party 2 this allocation model leads to unequal burdens for both parties, indicated by the area B_1 for the party 1 and B_2 for party 2.

In summary it can be concluded that the economic efficiency approach would lead to a least cost solution. However, it would result in an unequal allocation of the burdens in order to reach the respective targets if the shape of the marginal abatement costs curves significantly differed between the parties. Furthermore, it should be considered that more or less complete information must be available on the marginal abatement

costs curves of the parties and that there should be no significant uncertainties regarding the shape of the cost curves.

Figure 1 Schematic representation of the economic efficiency approach for target sharing



Source: authors' calculations.

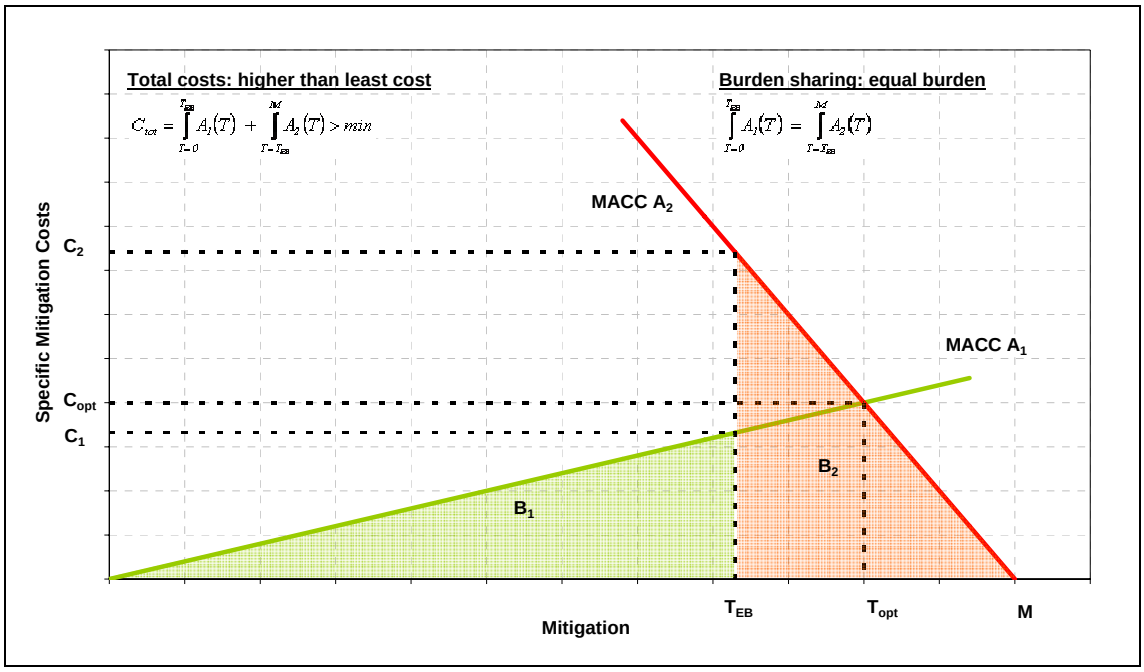
The contrary economic approach would primarily focus on the distribution of burdens between the parties.

Figure 2 indicates the first and most extreme version of this approach. If the marginal costs do not matter and the target sharing is completely based on the equilibrium of the mitigation costs for each party, a different set of measures would need to be implemented by the parties. Party 1 would have to implement measures with specific abatement costs up to the level C_1 (which is below the optimal abatement cost level C_{opt}) and party 2 would need to implement measures with abatement costs of up to C_2, which is higher than the optimal abatement costs. If both parties implemented an internal and non-interlinked emissions trading scheme to reach the emissions targets given by the target sharing T_{EB}, two different allowances prices for the market 1 and market would result.

As can clearly be seen from Figure 2, the costs B_1 and B_2 for party 1 and party 2 reach the same level but the total costs for the two parties exceed the least cost level significantly.

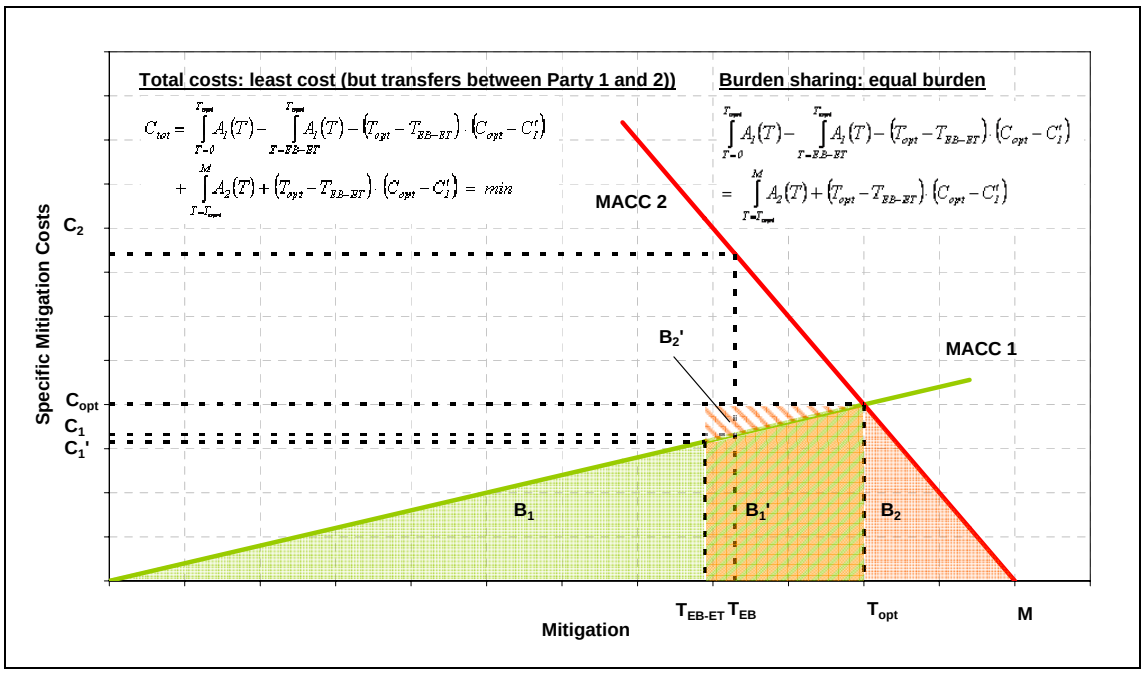
In summary it can be concluded that the equal burden approach without flexibility option avoids differences in the economic burdens from the implementation of certain emissions targets but leads to higher abatement costs for the total mitigation target.

Figure 2 Schematic representation of the equal burden approach for target sharing, without flexibility by emissions trading



Source: authors' calculations.

Figure 3 Schematic representation of the equal burden approach for target sharing, with flexibility by emissions trading



Source: Authors' calculations.

However, with the introduction of a flexible mechanism the main shortfall of the above-outlined equal burden approach could be compensated.

For the equal burden approach with flexibilisation we assume an initial target sharing between the two parties and the additional option to trade emissions allowances.

Figure 3 shows the general function of this model. If perfect information was available and there were no significant uncertainties, both parties would implement mitigation measures at costs lower than the optimal abatement costs C_{opt}. The target sharing would be designed in a way that an equal burden results for both parties, considering firstly the abatement costs for the measures which are implemented and the costs and the benefits from the transfer of allowances. For the example shown in Figure 3 the following mechanisms must be considered. For both party 1 and party 2 all mitigation measures with costs lower than C_{opt} would be implemented. The total costs for party 1 would be higher than for party 2, as occurs in the economic efficiency approach (Figure 1). However, if the target sharing is set for $T_{EB\text{-}ET}$, party 2 would need to purchase an amount of allowances from party 1 which is equivalent to the difference between T_{opt} and $T_{EB\text{-}ET}$. If the marginal abatement option is available for the specific costs of C_{opt}, the price for the allowances should be equivalent to this cost level. The total costs for the purchase of allowances for party 2 are represented by the areas B_1' and B_2' in Figure 3. In contrast, for party 1 all costs would occur which are related to the implementation of mitigation measures for which the costs are less or equal C_{opt}. However, the sale of allowances to party 2 would generate a revenue which is equivalent to the total area of B_1' and B_2' in Figure 3. As a result, the measures for meeting the overall mitigation target would be available at least cost and no differences would arise for the net burden from implementation of abatement measures and allowance trading. However, the costs for purchases and sales of allowances in this approach cannot be assessed in isolation from the abatement costs which must be implemented by the parties and those more expensive measures which can be avoided by the introduction of flexible mechanisms. However, as clearly can be seen from Figure 3, the distributional effects of trading can lead to significant shifts of the pattern of target sharing.

In summary it can be concluded that the twin target of least cost emissions abatement and the prevention of unequal burdens to the parties of the target sharing exercise can be met if flexible mechanisms are introduced and the transfers between the parties are taken into account.

However, the main barrier for such an approach results from the issue of modelling, parametrisation and uncertainties:

- The parties of the burden sharing would have to agree on a model which reflects the full set of mitigation measures and in which the modelling of both allowances trades and the allowance flows is adequately implemented.
- A set of transparent, robust consistent and acceptable data is needed for all factors which determine the abatement cost curves and the baseline emission trends.

- Due to the nature of every projection, a comprehensive and transparent uncertainty analysis for the abatement cost curves as well the baseline scenarios should be undertaken to identify robust trends and results.

These three preconditions have not been met at the recent stage of modelling within the EU-27. There is no comprehensive model available in which the methodological approach as well as the parametrisation is extremely transparent. There are significant uncertainties for the medium-term trends for parameters which are key determinants for both the baseline trends and the abatement curves (economic growth rates, energy prices, etc.). Furthermore, the necessary modelling should also reflect the efforts which were already undertaken by certain targets in the past. If these past efforts for reducing greenhouse gas emissions were related with costs, a modelling approach which only considers future action and futures costs would not be appropriate. Although this could be done in principle, the ex-post modelling of past efforts is extremely complicated in terms of models and its parameters.

Against this background, two consequences can be drawn. First, the efforts for building a consistent and extremely transparent modelling toolbox as well as for the development of comprehensive and well-founded data should be strengthened. Secondly, the approaches based on costs and burdens should at least be complemented by structural approaches, which could also more or less completely replace the above-described economic approaches.

2.3 Structural approaches

We define structural approaches as approaches in which target sharing is not based on the economic analysis but on emission patterns and the structures of the underlying drivers (population, economic growth and structures, etc.).

1. Simple structural approaches address the structure of emissions only. Two key assumptions and implications should be mentioned regarding this approach:
    - The underlying assumption is that comparable sectoral structures in emissions reflect comparable structures of mitigation potentials and costs.
    - The general implication regarding the consideration of future growth and so on is that for the same source categories the same growth factors should be assumed. However, some additional differentiation based on growth assumptions can also be implemented by means of minor modifications within this approach.
2. Complex structural approaches do not focus on the structure of emissions but rather on the underlying determinants, i.e. the driving forces (population, level and structure of gross domestic product, etc.), market structures (i.e. competiveness aspects) and emission intensities. This approach is mainly based on the following assumptions and implications:

- The underlying assumption is that certain emission intensities can be used as proxies for mitigation potentials and costs.
- (Different) growth trends are reflected explicitly by the development of the driving forces parameters.

The main advantage of structural approaches results from the transparency and the potential robustness of approaches. Even if there are significant uncertainties for key drivers of future developments and emission trends, the most structural approaches are easy to understand and a wide range of uncertainty and sensitivity analyses can be undertaken.

As a general rule, data used for structural approaches is more robust and the more comparable for simpler the structural approaches. In contrast, the underlying assumption of comparable structures mentioned above must not necessarily prove to be robust in every case.

Although complex structural approaches are extensively used in the debates on target setting and sharing (e.g. the Triptych Approach or other multi-stage approaches) we rely on a simple structural approach in the following analysis, mainly because of the resource restrictions for the analysis presented in this paper.

Furthermore, we do not include projections in the structural analysis. On the one hand this is a shortfall because the efforts for emission targets should be assessed against the counterfactual trends in principle. However, the reliance on counterfactual trends must reflect the robustness of the underlying assumptions on the one hand and the consistency of these assumptions on the other hand. Although the EU Member States present projection reports on a regular basis, recent analysis indicates that consistent comparison is possible at the moment because of the significant differences in the design of projections (e.g. regarding driving forces like fuel and CO_2 allowance prices, consideration of policies and measures and their goals) and regardless the questions that must be raised on the robustness on key assumptions (e.g. economic growth patterns).

An alternative, consistent and robust set of modelling results without these shortfalls was not available for the analysis presented in this paper. However, for some sensitivity analysis, aspects like different growth rates were reflected in the design of our simple structural analysis.

Against this background, our analysis should be seen as a complementary one to many other possible approaches. However, the main advantages of the approach undertaken here is a reliable and detailed database that is consistent to the data structure constituting the basis for future commitments as well as the sectoral and country differentiation which is appropriate for the EU emission target sharing.

2.4 Geographical and sectoral differentiation

The analysis presented in this paper is focussed on the 27 Member States of the European Union as of 2007. Although the results for all 27 Member States are presented and the differences between the Member States are a key result of the analysis, the methodologies and their parameters for the different approaches were not differentiated for the individual Member States. The only differentiation for some approaches is that different methodologies or parameters were applied for the group of the EU-15 Member States on the one hand and for the EU-12 Member States on the other hand.

The motivation for this differentiation was the fact that special circumstances must be reflected in the target sharing especially for the EU-12 Member States, given their transition process to a market economy which results in three trends of special importance:

- the significant emission reductions in the last decade;
- the strong process of economic growth during the last years, even if this was related to a major structural change; and
- the significant mitigation potentials and opportunities which result from the mostly inefficient capital stock from the past and the fast modernisation process during the last and the next years.

Some of these special circumstances could have been considered (at a lower magnitude) even for some EU-15 Member States; also, these circumstances are not of the same importance for all EU-12 Member States. However, such detailed and differentiated analysis would have gone significantly beyond the scope of the analysis presented in this paper.

In summary, the results for the specific Member States from the data analysis for the different options are based on at least three different inputs:

- the different structures of emission sources for the Member States;
- the different methodologies which were applied for the EU-15 and the EU-12 Member States for some options;
- the different parametrisation of certain methodologies for the EU-15 and the EU-12 Member States.

A key challenge for the definition of future emission targets for the EU Member States is the interaction between the targets for the total greenhouse gas emissions of a certain Member State and the caps which must be defined in the framework of the European Union Emissions Trading Scheme (EU ETS).

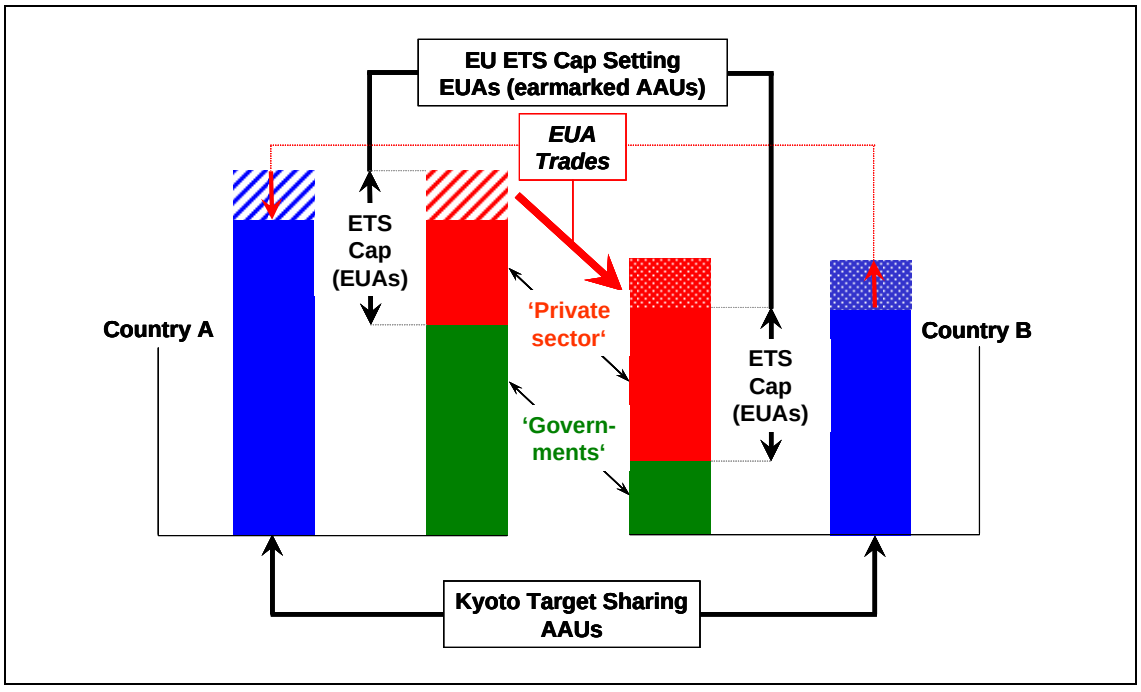
Figure 4 indicates these interactions. If the emission targets for the Member States in an international regime (or even within the EU) are defined by issuing Assigned Amount Units (AAUs) and these AAUs are consistently used for the EU ETS as earmarked AAUs or EU Allowances (EUA), EUA trade then has a significant implication for the compliance status of a specific Member State. The allocation of EUAs to private

entities (either free of charge or through an auction) is equivalent to a transfer off AAUs to the Member State when the EUA is used for compliance under the EU ETS.

In other words: If the cap under the EU ETS is fixed, the Member States have no opportunity to change their compliance status within the international regime by measures which change the emission levels from installations subject to the EU ETS. The transfer of EUAs (and the related AAUs) and their availability for compliance is completely in the hands of the private entities which operate installations under the EU ETS.

For the simple case presented in Figure 4 this means that if the Member State A transfers an AAU as an EUA to an operator under the EU ETS and an operator uses this EUA (after trading) in Member State B for compliance under EU ETS, the related AAU is available to Member State B for its compliance in the framework of the international climate regime. The Member State A has no means to influence these transfers.

Figure 4 *Interactions between emission targets, ETS caps, and the effects of allowance trading*



Source: *Authors' design.*

As a consequence, the installations under the EU ETS as a whole constitute an 'additional Member State' for which the emission target is set by the cap and compliance is ensured by the amount of allowances or credit units (from JI and CDM) available to the operators.

Against this background, the question arises as to whether the emission targets should address the total emissions from a Member State or only the emissions from those sources which are not subject to the EU ETS. In this model the emissions from the EU ETS would be treated completely separately as the 'additional Member State'. The gov-

ernments of the Member States would have to prove compliance only for the emissions from sources which are not covered by the EU ETS.

There is only one reason which would *necessarily* require the formal split of an EU-wide cap and the assignment to the Member State. If the architecture of the international regime does not allow for the split of responsibilities for compliance within a certain country into the 'government sector' and the 'private sector' which is part of the 'additional Member State', the cap of the EU ETS must be formally split and be assigned to the Member States to allow them to prove their compliance for all emissions from this country within the international regime. However, this formal assignment would not change the situation that the allowances within the EU ETS are not under the control of this Member State.

There are some other reasons which *could* make the formal assignment of the EU ETS cap to the Member States meaningful:

- If significant amounts of allowances will be auctioned under the EU ETS, the sharing of revenues constitutes a challenge. If the revenues from auctions shall not form an income for EU institutions, a revenue sharing agreement must be negotiated. This revenue sharing agreement is directly or indirectly an agreement on the assignment of the allowances from the EU ETS cap (either on the sharing of the allowances itself or on the monetary revenues from the auctions). In the case that there is no full auction, a more complex setting will arise.
- In the case that an EU-wide cap constituted a emission target for the ETS sectors for the EU as a whole and the Member States would have the possibility of tightening the 'national' cap, for instance sticking to national emission targets which go beyond the EU targets, the allowances from the EU ETS cap must be assigned to the Member States.

Since these structural aspects of the future architecture of the EU and international climate regime were not foreseeable at the time of the analysis, we present all results from the target sharing analysis:

- for the total emissions of the Member States,
- for the emissions from the ETS segment, and
- for the emissions from the non-ETS segment.

As a consequence, a differentiation between the ETS and the non-ETS emissions sources is necessary as a minimum. Beyond this minimum requirement we analyse all emissions data:

- for the different source categories of the EU ETS (power, other combustion, refineries, coke ovens, metal ore, iron & steel, cement & lime, glass, ceramics, pulp & paper, opt-in installations and additional installations to be covered in phase 2 of the EU ETS);

- for CO_2 from non-ETS industry sectors, the transport sector (without international bunkers), the other sectors and the total for the non-CO_2 greenhouse gases.

The sources for the emissions data (as well as the target data for 2008-2012 which are used for some options) are described in chapter 3.

3 Data Sources

3.1 Preliminary remarks

The main data sources for the burden sharing calculations presented in this paper are:

- the 2007 national greenhouse gas inventory submissions of Member States;
- the community independent transaction log (CITL) of 5 July 2007; and
- Commission Decisions on the second national allocation plans under the EU emissions trading scheme.

3.2 National greenhouse gas inventory reports

The inventory submissions used are those which were uploaded to the CIRCA interest group *Climate Change Committee*[1] on 7 August 2007. The data shows some discrepancies compared to the information contained in the draft EEA report *Greenhouse gas emission trends and projections in Europe 2007.* These differences are potentially due to resubmissions, gap filling applied by the EEA for incomplete inventories and differences between base year emissions reported in the national GHG inventories and the initial reports under the Kyoto Protocol. All Member States for which these differences were larger than 1% either for the base year or 2005 estimates are listed in Table 1. In absolute terms only the Hungarian base year estimate shows a large discrepancy; the relative difference exceeds 5% in Cyprus and Malta in 2005 and in Hungary in the base year.

Of the countries for which the absolute difference is larger than 1 Mt CO_2-e in the base year or 2005, the figures for Portugal, Slovakia, Hungary used in this report are consistent with the latest data published on the UNFCCC website[2]; only for Bulgaria the 2005 data used here is 2.3 Mt CO_2-e higher than the latest data which was submitted to the UNFCCC secretariat on 15 January 2008. The data for Bulgaria have not been updated due to the late submission of the most recent inventory update.

1 http://forum.europa.eu.int/Members/irc/env/ccc/home

2 http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/3929.php on 21 January 2008

Table 1: Differences between base year and 2005 emission estimates in the draft EEA GHG trends and projections 2007 report and this report

	base year		2005	
	Mt CO_2	%	Mt CO_2	%
Bulgaria	0.5	0.4%	2.6	3.5%
Cyprus	0.0	0.1%	-0.9	-10.5%
Estonia	-0.4	-0.9%	0.3	1.3%
Hungary	-7.4	-6.4%	-0.3	-0.4%
Latvia	0.5	2.1%	0.0	0.0%
Malta	0.0	0.1%	-0.2	-6.1%
Portugal	-1.0	-1.7%	0.0	0.0%
Slovakia	-1.4	-2.0%	-0.8	-1.7%
Sum	**-9.1**		**0.5**	

Source: EEA GHG trends & projections report 2007; Member State GHG inventory submissions

3.3 Second national allocation plans

Some of the options considered require the cap for 2008-12 under the EU ETS and the share of the different sectors within the trading scheme. All Commission Decisions on the second national allocation plans taken by 29 November 2007 have been taken into account; only the Decision of 7 December 2007 adjusting the total cap for Slovakia by 1.7 Mt CO_2–e to 32.6 Mt CO_2–e was taken after all calculations in this analysis had been performed.

3.4 Base year and Kyoto target

For the calculation of some options, information on the Kyoto target and/or base year emissions under the Kyoto Protocol is needed. Cyprus and Malta are non-Annex I Parties under the Kyoto Protocol and have no base year or quantified emission target. For these two countries 1990 emissions were used as the base year. Taking into account that non-Annex I Parties have no emission limitation obligations, projections for 2010 were used as a substitute for the Kyoto target. Cyprus prepared projections of 2010 emissions which were used as reported by the country. Malta has not published any recent projections of emissions for all six Kyoto greenhouse gases for 2010. A linear extrapolation of the trend 1990-2005 has been used for the 2010 estimate instead. The base year emissions calculated in this way are 6.0 Mt CO_2-e for Cyprus and 2.2 Mt CO_2-e for Malta. The substitute 2008-12 target is 12.2 Mt CO_2-e for Cyprus and 3.8 Mt CO_2-e for Malta.

In calculations requiring the Kyoto target, it has been assumed that all Member States will reach their target; no differentiation has been made to take the use of flexible mechanisms by government or over delivery into account. This approach is consistent with the accounting principle under the Kyoto Protocol: Parties need to surrender sufficient units (AAU, ERU, CER and RMU) to equal their emissions during the commitment period; the actual magnitude of emissions or type of unit is not relevant in the target assessment. For those options requiring a sectoral differentiation of the 2010 emissions, the shares reported in the latest inventory submission were applied to 2010.

3.5 Sectoral coverage

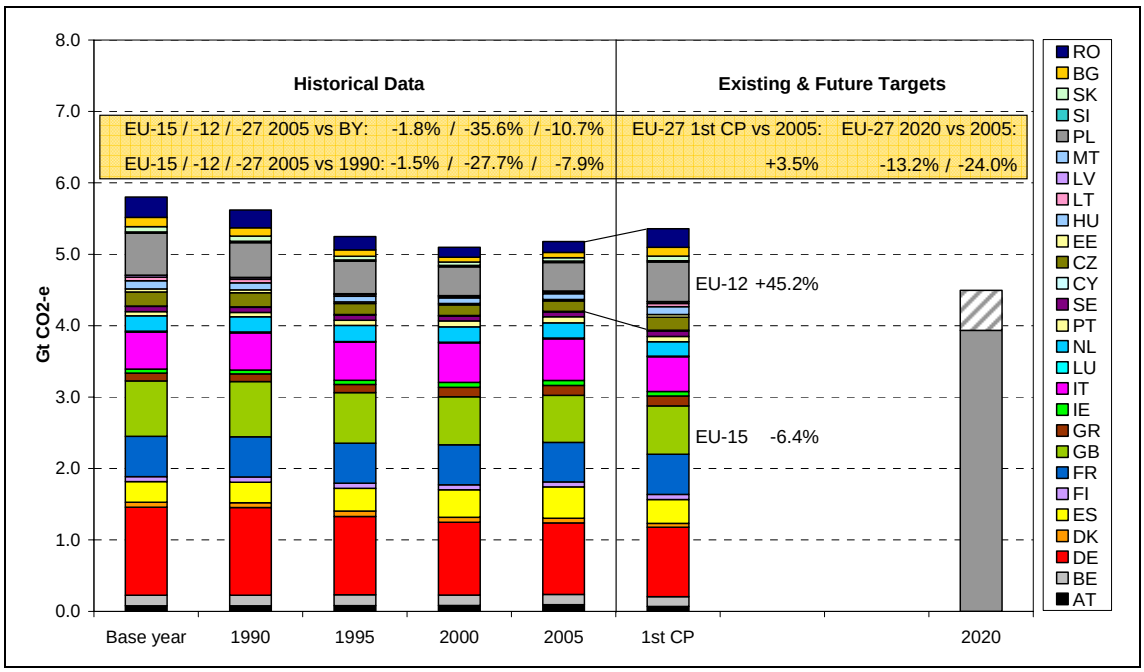
Emissions from international aviation and maritime transport (Bunker Fuels) have not been included in the assessment. Currently it is very unclear whether and how these emissions might be included in a post-2012 regime. The proposal by the European Commission for an emissions trading scheme in the aviation sector is more compatible to a sectoral approach than to the inclusion in national inventories. In a sectoral approach emissions are not distributed to individual countries but the sector as a whole has its own quantified emission reduction target. If such an approach were agreed upon in a post-2012 regime it would exist in parallel to national obligations and would not be affected by an EU burden sharing agreement. Emissions from bunker fuels based on fuel sales in EU-27 Member States were 174.8 Mt CO_2-e in the Kyoto base year and 287.8 Mt CO_2-e in 2005. Using the current growth rates as a rough basis for calculating emissions from these sectors for 2020 shows that they might rise to approximately 500 Mt CO_2-e. To model the effect of the inclusion of these emissions in national totals, assumptions would be needed on the mode of allocation to Parties and the base year for bunker fuels.

Likewise, emissions and removals from land-use, land-use change and forestry (LULUCF) were not included in the calculations. Estimates for this sector as reported in the national inventories are not consistent with the accounting under the Kyoto Protocol and cannot be used. It is unclear whether the current accounting system with obligatory and voluntary activities will remain as it is in a post-2012 regime. Due to the lack of reliable and consistent data this sector is not considered in this study.

4 Historic Emission Trends, Patterns and EU Targets

The analysis of greenhouse gas emissions trends for the European Union Member States indicates significant differences for the period since 1990. The total emissions for the EU-27 decreased about 10.7% from the base year of the Kyoto Protocol[3] and the year 2005. However, this aggregate emissions reduction results mainly from the EU-12 for which emissions dropped about 35.6% in this period. In the EU-15 emissions decreased only by about 1.8%. If the analysis refers to the year 1990 instead of the Kyoto base year, the respective emission reduction is slightly less, amounting to 1.5% for the EU-15, 27.7% for the EU-12 and -7.9% for the EU-27 (Figure 5).

Figure 5 Historical greenhouse gas emission trends and future targets, 1990-2020



Source: National Inventories, authors' calculations.

Compared to the 2005 emission levels the aggregate commitments from the Kyoto Protocol exceed the recent emissions by about 3.5%. In other words, if the EU-27 ultimately made use of the different flexible mechanisms of the Kyoto Protocol, full compliance would be ensured. However, if only the EU bubble of the EU-15 is considered, the gap to the aggregate Kyoto compliance still amounts to 6.4% of the recent emission levels. In contrast, the EU-12 Member could increase their emissions by about 45.2%

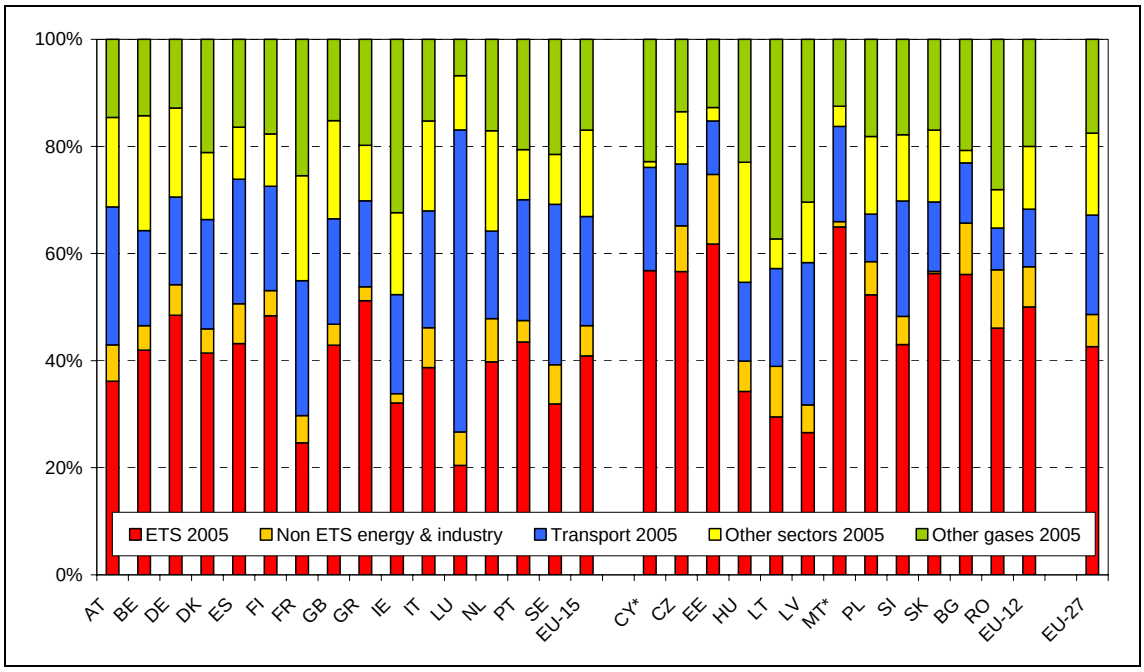
[3] Many EU Member States use the year 2005 for the emissions of HFCs, PFCs and SF6. Furthermore, some of the EU-12 Member States used the flexibility provided by the Kyoto Protocol for the countries with Economies in Transition (EIT) and chose earlier years than 1990 as a base year for their commitments.

or make alternative use of the respective assigned amount units without facing compliance problems under the Kyoto Protocol for the first Commitment Period of the Protocol.

The analysis of the source categories for the EU-27 Member States indicates some significant characteristics:

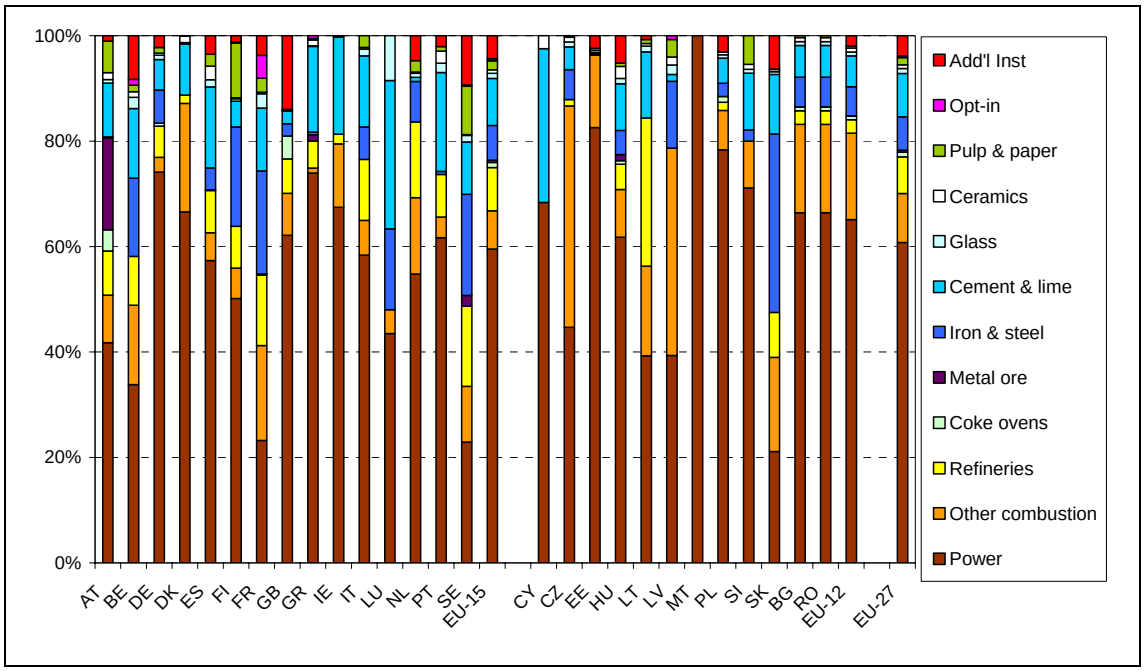
- The share of CO_2 emissions is about 80% for the majority of the EU Member States. The only exceptions are Ireland, Lithuania, Latvia and Romania.
- The installations covered by the EU ETS represent a wide range of emission shares in the total emissions. However, the range is narrower in the EU-15 than in the EU-12. However, in only a few Member States the ETS represents less than 40% of the overall emissions.
- With the exception of Luxembourg the transport sector covers a share of about 20% of the total emissions in the EU-15 Member States. In contrast, the share of emissions from transport is about 10% in most of the EU-12 Member States. The significant exceptions among the EU-12 are Lithuania, Latvia and to some extent Romania.
- The range of shares for the other sectors (residential and commercial, i.e. mainly the building sector) lies between 10% and 20% for most Member States, bringing about an average of 15% for the EU-27. However, in some EU-12 Member States the share of the other sectors is significantly lower (Cyprus, Malta, Estonia, Bulgaria).

Figure 6 Sectoral breakdown of greenhouse gas emissions for the EU-27, 2005



Source: National Inventories, authors' calculations.

Figure 7 Sectoral breakdown of greenhouse gas emissions from installations under the EU ETS for the EU-27, 2005



Source: CITL, authors' calculations.

Given the special importance of the share of emissions which is covered by the EU ETS, a more in-depth analysis for these sectors leads to the following conclusions:

- The emissions from power generation represent the main share of total emissions controlled by the ETS for the majority of Member States. The average share of emissions from the power sector is about 60% for the EU-15, slightly higher for the EU-12 and also about 60% for the EU-27. In only a few Member States less than 40% of the total emissions come from power generation.
- The share of emissions from combustion installations which cannot be assigned to the power sector is significantly lower than the share of emissions from power plants. In a few Member States only (France, the Czech Republic, Latvia, Slovakia) the share of emissions from other combustion installations is comparable with those for the power sector.
- The emission contributions from other installations or sectors indicate a significant spread.

As a result of the sectoral analysis of the different greenhouse gas emission source categories, three main findings can be derived:

- The structural differences of emission sources between the Member States come mainly from the ETS sectors. The range of emission shares from the other sectors (and gases) is much narrower for each sector for the majority of the EU-27 Member States.

- Within the ETS sector the emissions from the power sectors dominate for the majority of the Member States. In only a few Member States the emissions from other combustion installations or sectors reach a comparable importance.

These findings on the greenhouse emission patterns could constitute an interesting starting point for the sharing of emission reduction targets among the Member States.

However, the key starting point is the overall emission ceiling for the EU-27. The European Council on 8/9 March 2007 endorsed 'an EU objective of a 30 % reduction in greenhouse gas emissions by 2020 compared to 1990 as its contribution to a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and economically more advanced developing countries to contributing adequately according to their responsibilities and respective capabilities.' In addition the EU committed itself to a unilateral reduction of 20% compared to 1990 in the case that no comprehensive international post-2012 agreement will be reached.

With regard to the EU-27 emission levels in 1990 and 2005 these commitment options translate into the following emission targets:

- A (unilateral) 20% emission reduction based on 1990 levels is equivalent to an emission ceiling of 4,496 Mt CO_2-e for the year 2020. Compared with the 2005 levels an additional aggregate emission reduction of about 682 Mt CO_2-e would be necessary to meet this commitment by domestic action. This equals an emissions reduction of 13.2% compared to 2005 or a ceiling which is 16.1% lower than the aggregate commitment for the first commitment period of the Kyoto Protocol.
- The more ambitious target of a 30% emissions reduction results in an emissions ceiling of 3,934 Mt CO_2-e which is 1,244 Mt CO_2-e less than the 2005 levels. This would require a further emission reduction of 24% compared to the recent (2005) levels and would go 26.6% beyond the recent aggregate EU-27 commitment within the framework of the Kyoto Protocol.

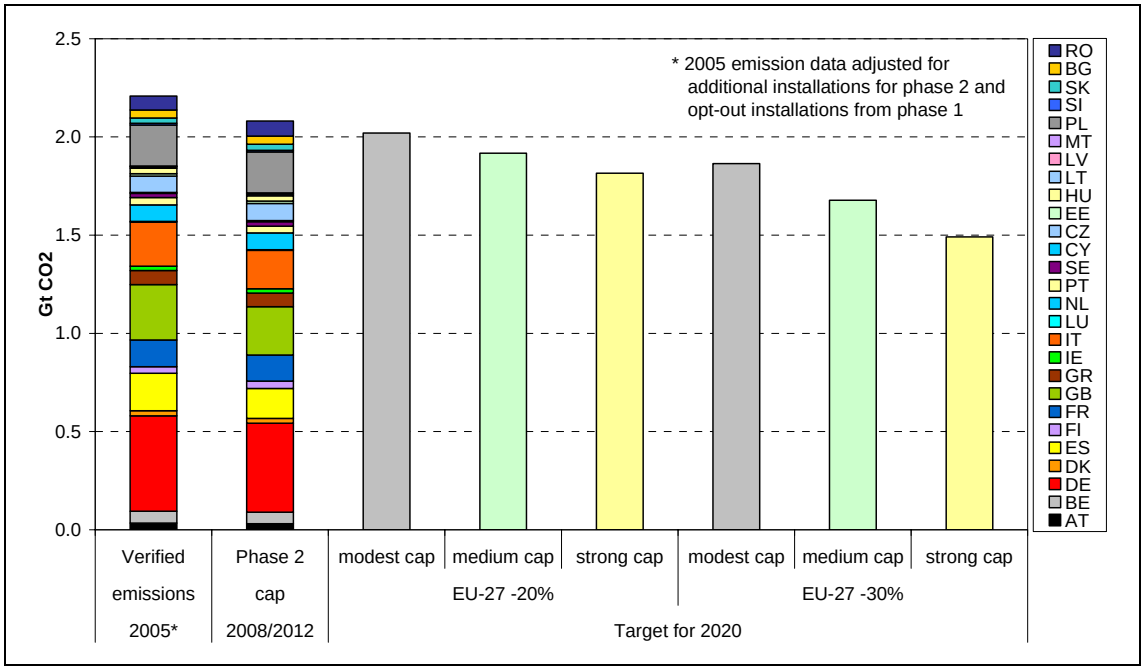
For the analysis presented in this paper all options for a future burden sharing have been calculated for the 20% (the '20% scenario') as well as the 30% target (the '30% scenario').

The European Union Emissions Trading Scheme plays a special role in the framework of future commitments. The general design of the scheme is based on allocation and trade of earmarked international emission allowances (assigned amount units). When the ETS cap is fixed, the only option for the Member States for further improvement of their compliance status is to induce emission reductions from those sources which are not covered by the ETS. Therefore the ETS caps are of crucial importance for the future commitments. This is even more relevant if the EU Member States are to decide on an EU-wide cap. This would mean that commitments of the Member States would cover the non-ETS sectors only and the installations covered by the EU ETS would constitute an additional 'Member State' for which the emission ceiling is equivalent to

the cap and the compliance is ensured by the compliance mechanisms of the scheme, including the options for the use of other flexible mechanisms (CDM, JI).

Against this background a special focus was set on the EU ETS caps for the period beyond 2012.

Figure 8 Emissions from installations under the EU ETS and future EU ETS caps, 2005-2020



Source: CITL, National Allocation Plans, Commission decisions, authors' calculations.

Figure 8 indicates the 2005 verified emissions from the installations covered by the EU ETS as well as the cap for the second phase of the scheme from 2008 to 2012.[4] According to this analysis the cap for 2008-2012 requires an emission reduction of about 127 Mt CO_2-e.

Given the special importance of the EU ETS caps three different options were considered in the analysis:

4. The base case ('medium cap') marks an approach where the contribution of the EU ETS to gap closure is equivalent to the share of the (adjusted) emissions from installations under the EU ETS in the total greenhouse gas emissions in 2005 (42.6%). As a result the medium cap ceiling is about 1,917 Mt CO_2–e in the 20% scenario for 2020 and 1,678 Mt CO_2–e in the 30% scenario. This

[4] To ensure the consistency of the time series the 2005 verified emissions were adjusted for the emissions which are additionally included in the EU ETS from 2008 onwards and for the emissions from installations which were temporarily opted out from the scheme for the first period of 2005-2007.

equals an emissions reduction of about 291 Mt CO_2–e in the 20% scenario and an emissions reduction of about 530 Mt CO_2–e by 2020, compared to (adjusted) 2005 levels.

5. In a first variation ('modest cap') this share was reduced by 15 percentage points. This equals a modest cap of about 2,020 Mt CO_2–e in the 20% scenario or an emissions reduction of about 188 Mt CO_2–e by 2020, compared to 2005 levels. For the 30% scenario the modest cap is 1,864 Mt CO_2–e which is 344 Mt CO_2–e less than the 2005 emission level.

6. In a second variation ('strong cap') the share of the EU ETS in gap closure for the overall commitment was increased by 15 percentage points. In the 20% scenario this results in a strong cap ceiling of about 1,815 Mt CO_2–e for 2020 which is 393 Mt CO_2–e lower compared to 2005 emissions levels. The respective ceiling for the strong cap in the 30% scenario is 1,491 Mt CO_2–e in 2005, corresponding to a reduction of 717 Mt CO_2–e compared to 2005 emissions levels.

Figure 8 illustrates these approaches for the 2020 targets. It must be pointed out that these targets are not necessarily equivalent to the caps for future trading periods. These cap levels depend for example on the length of the trading periods and must be derived from this. For example, the effective cap for a third EU ETS phase of 8 years (2013-2020) could be calculated from the average of the mean annual cap from the second phase trading and the 2020 target. For this reason, the 2020 target levels are shown as well as the illustrative cap for a 2013-2020 trading phase in the following analysis. However, this illustration should not necessarily be understood as an unconditional recommendation for a longer (eight-year) trading phase from 2013 onwards.

5 Scenario Analysis

5.1 Overview

Three different groups of options for a future burden sharing have been carried out for the illustrative purposes of this study:

- Option 1: Simple top-down approaches
  Emissions for a given year are scaled down to the 2020 target. Member States' targets are proportional to the emission or commitment patterns for the given year or period. This means that the share in total EU-27 emissions by a certain Member State is held constant compared to the relevant reference year or period.
- Option 2: Top-down approaches with an EU-wide cap for the EU ETS beyond 2012
  Member States are only responsible for the emissions of non-trading sectors; the cap for sectors included in the EU ETS is set at the EU level. The burden sharing only covers emissions not included in the EU ETS. However, the EU ETS cap is distributed among the different Member States for illustrative purposes and comparison. For the analysis of these approaches the mean, the modest as well as the strong cap options were considered.
- Option 3: Bottom-up approaches
  Sectoral targets for trading and non- trading sectors are used to calculate the burden sharing agreement. Since the option of an EU-wide ETS cap can also be applied for these approaches, the Member States' commitments either would address the total national emissions or the non-ETS sectors only. The analysis of the approaches was carried out only for the mean cap cases.

All options were furthermore differentiated by additional variants and the two different EU 2020 targets (20% and 30%). Detailed results for all options and variants are given for all variants. The following results are presented for the different approaches and variants, if applicable:

- the Member States' targets for the overall emissions for the year 2020 compared to 1990 emissions levels, this allows for the comparison with the existing commitments under the Kyoto Protocol;
- the Member States' targets for the overall emissions for the year 2020 compared to 2005 emissions levels, this allows for assessment of the necessary efforts to be undertaken from today's emission levels;
- the Member States' targets for the emissions from the sources covered by the EU ETS for the year 2020 compared to 2005 emissions levels, this enables assessment of the necessary efforts to be undertaken from the ETS sector from today's emission levels – even in the case that an EU-wide cap would apply;

- the Member States' targets for the emissions from the sources not covered by the EU ETS for the year 2020 compared to 2005 emissions levels, this allows for assessment of the necessary efforts to be undertaken by the non-ETS sector from today's emission levels;
- the Member States' illustrative caps for a potential 2013-2020 ETS phase compared to 2005 emissions levels, this allows for the necessary efforts to be undertaken by the non-ETS sector to be illustrated from today's emission levels – even in the case that an EU-wide cap would apply;
- the Member States' illustrative caps for a potential 2013-2020 ETS phase compared to the caps for the 2008-2012 phase, this enables indication of the level of ambition compared to the second phase of the EU ETS – even in the case that an EU-wide cap would apply.

The Member States' illustrative caps for the potential 2013-2020 ETS phase were calculated as the mean from the ETS cap for the phase 2 (2008-2012) and the ETS sector target for 2020. In other words: The average annual cap for the 2013-2020 ETS phase is equivalent to the 2016/2017 emission level if we assume a linear trend between the average annual phase 2 caps and the ETS sector target for 2020.

Again, the analysis was undertaken to obtain some quantitative insights from the main interrelations of quite different approaches. In order to ensure the transparency and to reduce some of the complexity of the results, the only variations which were added to those described above is the different treatment of EU-15 and EU-12 Member States in some of the bottom-up approaches to reflect the special circumstances of the Member States with economies in transitions also for the time horizon beyond 2012.

5.2 Option 1: Simple top-down approach

5.2.1 Overview

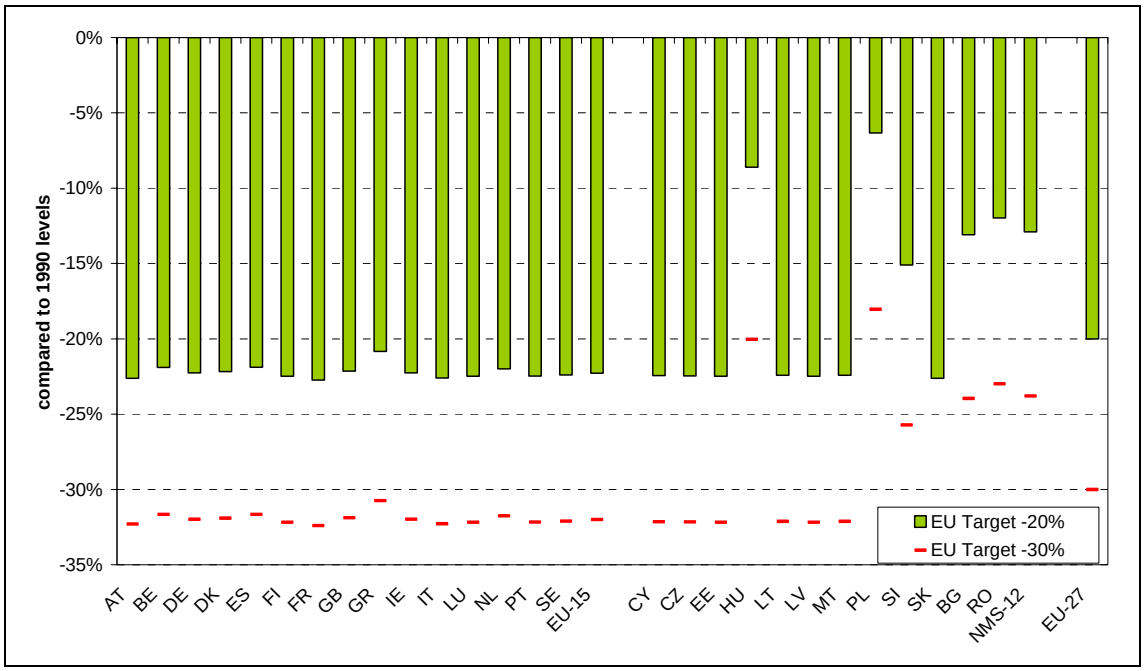
The four variants using a simple top-down approach are all calculated by proportionally reducing Member State emissions by a uniform percentage to reach the 2020 target in the 20% and the 30% scenario.

The four variants only differ in terms of the reference years or periods for the uniform reduction rates.

5.2.2 Option 1.1: 2020 target proportional to base year emissions

In this variant base year emissions are reduced by 20% and 30% for all Member States to calculate the 2020 targets. Member States' shares of EU-27 base year emissions are kept constant for the target year. This option takes into account the special rules for Member States with economies in transition under the Kyoto Protocol but does not reflect the existing target sharing among the EU Member States for the 2008-2012 period. It does not differentiate between different levels of responsibility, economic conditions or mitigation options in Member States which could be assumed for the existing commitments within the EU or in the framework of the Kyoto Protocol.

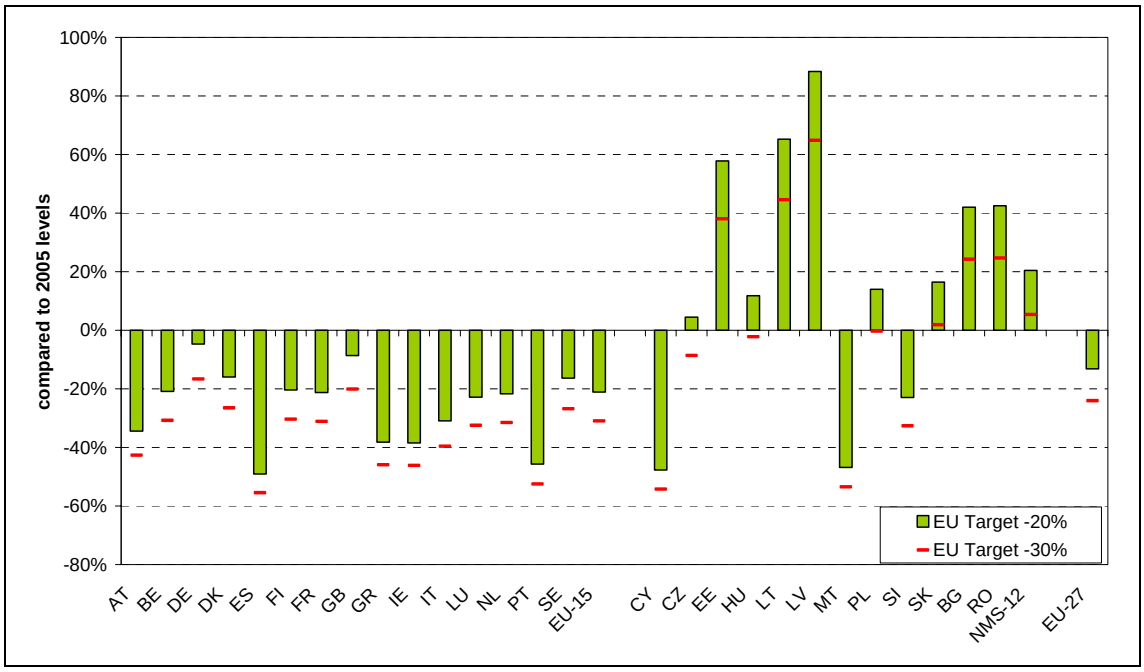
Figure 9 *Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on Kyoto Protocol base year emission levels, 2020 compared to 1990 emission levels*



Source: *National Inventories, authors' calculations.*

The different emission reduction needs compared to the 1990 emissions levels as indicated in Figure 9 result only from base year effects. These effects are of less importance for the exceptional base years for HFCs, PFCs and SF_6 which cause the variations for many EU-15 Member States but underline strongly the emission reductions which were achieved in some of the EU-12 Member States before 1990.

Figure 10 *Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on Kyoto Protocol base year emission levels, 2020 compared to 2005 emission levels*



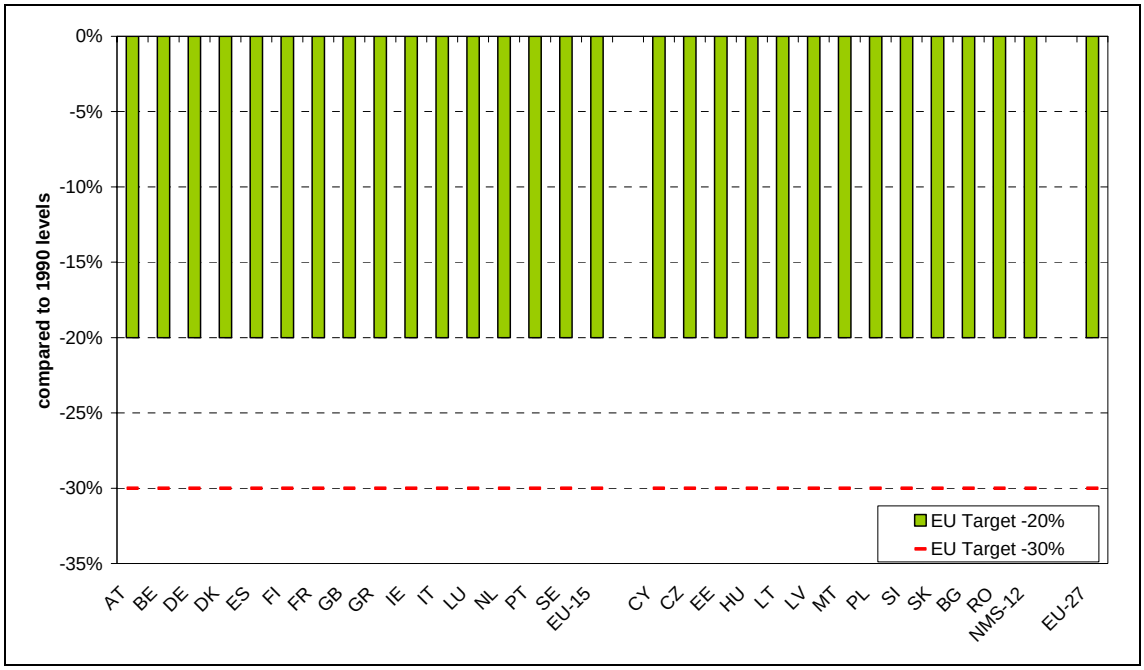
Source: *National Inventories, authors' calculations.*

With the exception of the EU-12 Member States with increasing emissions trends (Cyprus, Malta, Slovenia) since 1990, this approach would allow significant emission increases for the EU-12 especially for those Member States for which emissions have dropped dramatically since 1990 (Baltic countries, Romania, Bulgaria).

5.2.3 Option 1.2: 2020 target proportional to 1990 emissions

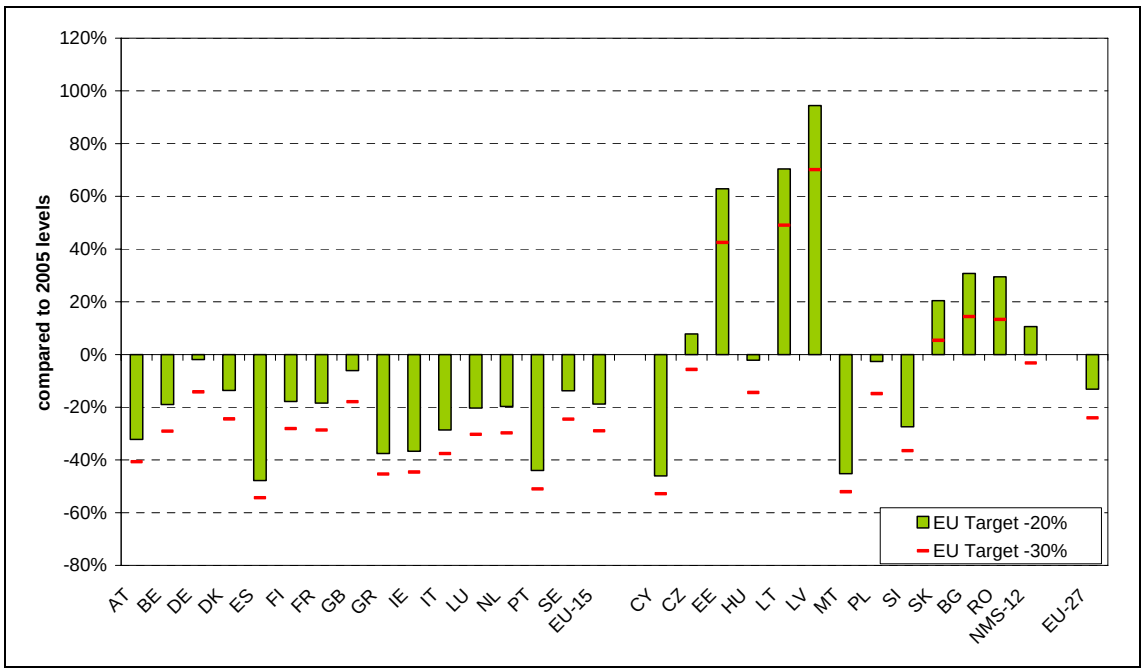
In this variant 1990 emissions are reduced proportionally for all Member States to calculate the 2020 targets. Member States' shares of EU-27 1990 emissions are kept constant (Figure 11). The only difference to the above variant is the use of 1990 instead of the Kyoto base year which favours the EU-15 Member States to some extent. EU-15 countries would be able to emit annually about 100 Mt CO_2-e more for this option than for option 1.2. In the 20% scenario this equals a redistribution of about 14% of the total emission reduction efforts, and of about 7% in the 30% scenario.

Figure 11 *Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on 1990 emission levels, 2020 compared to 1990 emission levels*



Source: *National Inventories, authors' calculations.*

Figure 12 *Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on 1990 emission levels, 2020 compared to 2005 emission levels*



Source: *National Inventories, authors' calculations.*

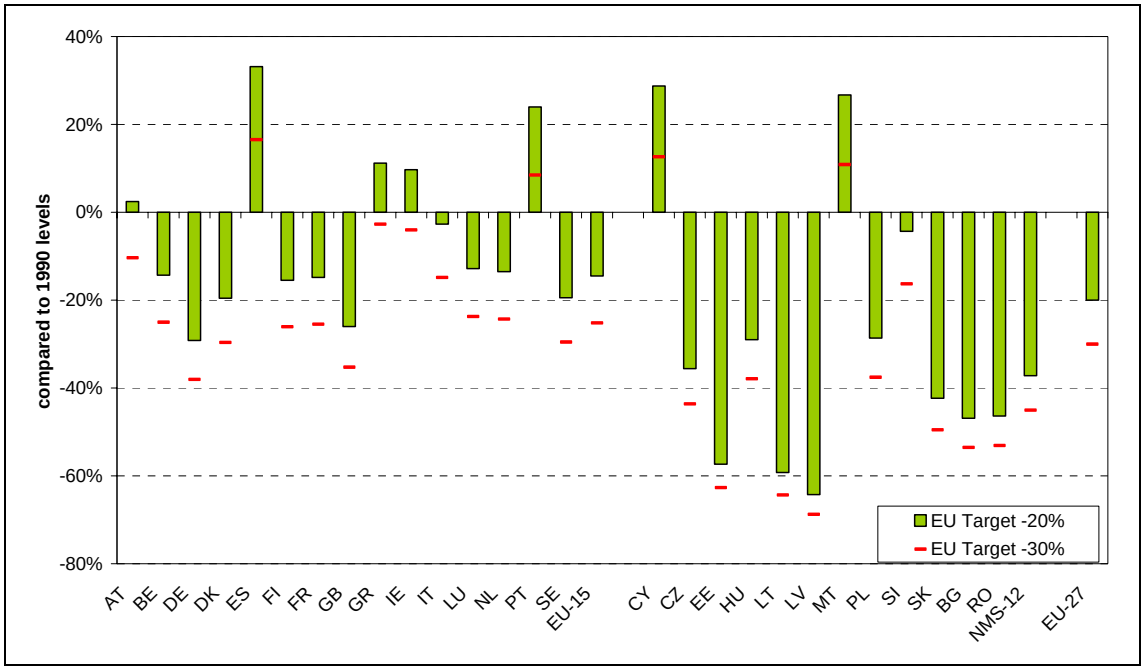
However, this option also does not reflect the existing commitments as well as the different emission levels which can be observed for the most recent years (Figure 12).

5.2.4 Option 1.3: 2020 target proportional to 2005 emissions

In this variant 2005 emissions are reduced by 13.2% in the 20% scenario and by 24% in the 30% scenario for all Member States in order to calculate the 2020 targets. Member States' shares of EU-27 emissions in 2005 are kept constant. Member States with high current emissions, for example due to less ambitious efforts or a strong reliance on flexible mechanisms, are favoured in this option. Member States which have reduced emissions early, for instance by more ambitious domestic actions or through the transition to a market economy, would be penalised.

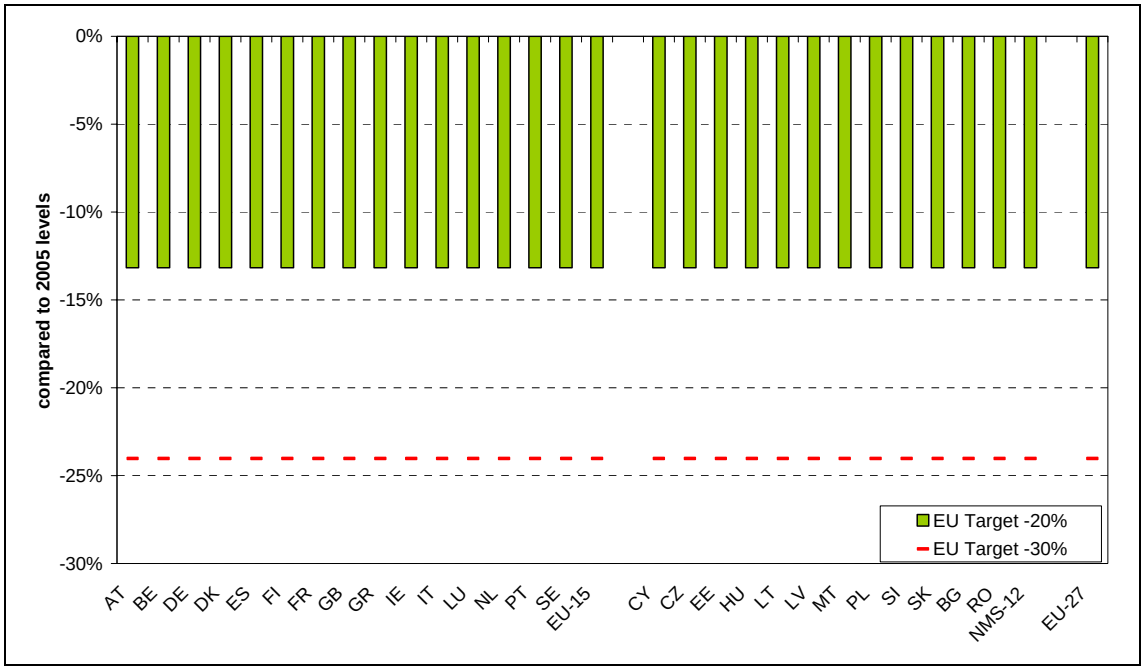
This marks the most complicated signal from this option: Neither early action nor climate benefits from difficult economic transition processes are rewarded. Even if a complete new set-up could be seen as an attractive option especially in the international climate policy framework, the collateral damages within a climate regime which allows the extensive use of flexible mechanisms would be significant.

Figure 13 Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on 2005 emission levels, 2020 compared to 1990 emission levels



Source: National Inventories, authors' calculations.

Figure 14 Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on 2005 emission levels, 2020 compared to 2005 emission levels



Source: National Inventories, authors' calculations.

Compared to 1990 levels the aggregate emissions from the EU-12 Member States would have to be reduced by about 34% (20% scenario) and 42% (30% scenario) whereas the emissions ceilings would amount to 14% and 25% for the EU-15. However, Figure 13 highlights the fact that the reliance on recent reference periods does not only create significant distributional effects between the EU-15 and the EU-12 Member States but also within the two groups.

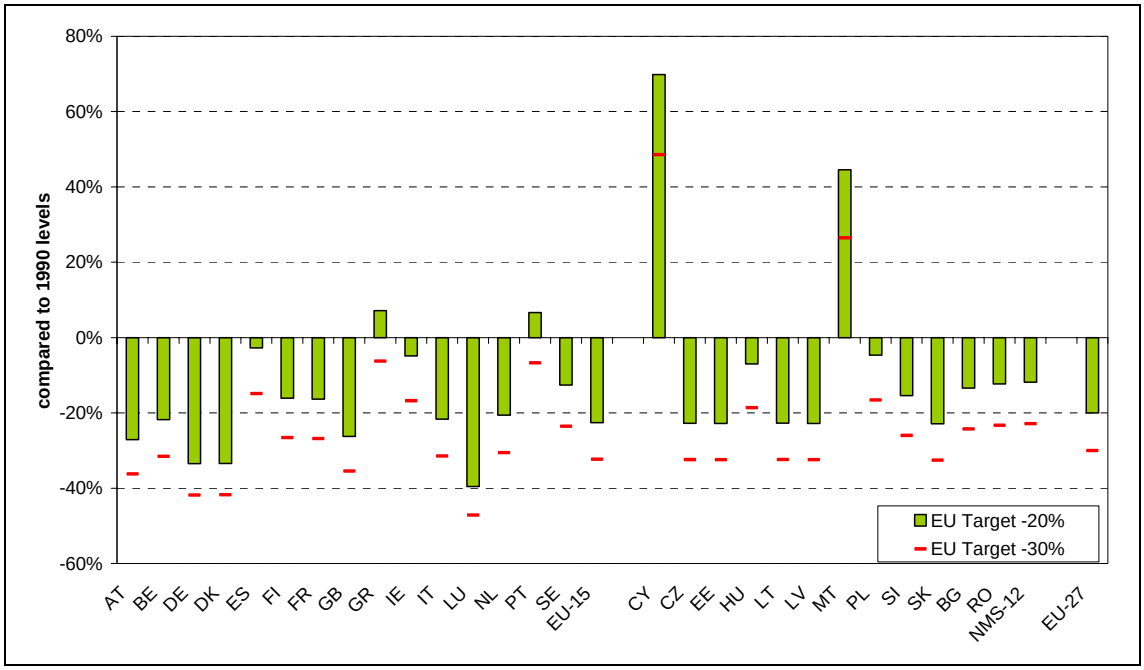
Among the simple top-down approaches this (updating) option is probably the most complicated and the least preferable one.

5.2.5 Option 1.4: 2020 target proportional to Kyoto target

In this variant the Kyoto target of all Member States is reduced proportionally to calculate the 2020 targets. Member States' shares of EU-27 2008-12 assigned amounts under the Kyoto Protocol remain constant.

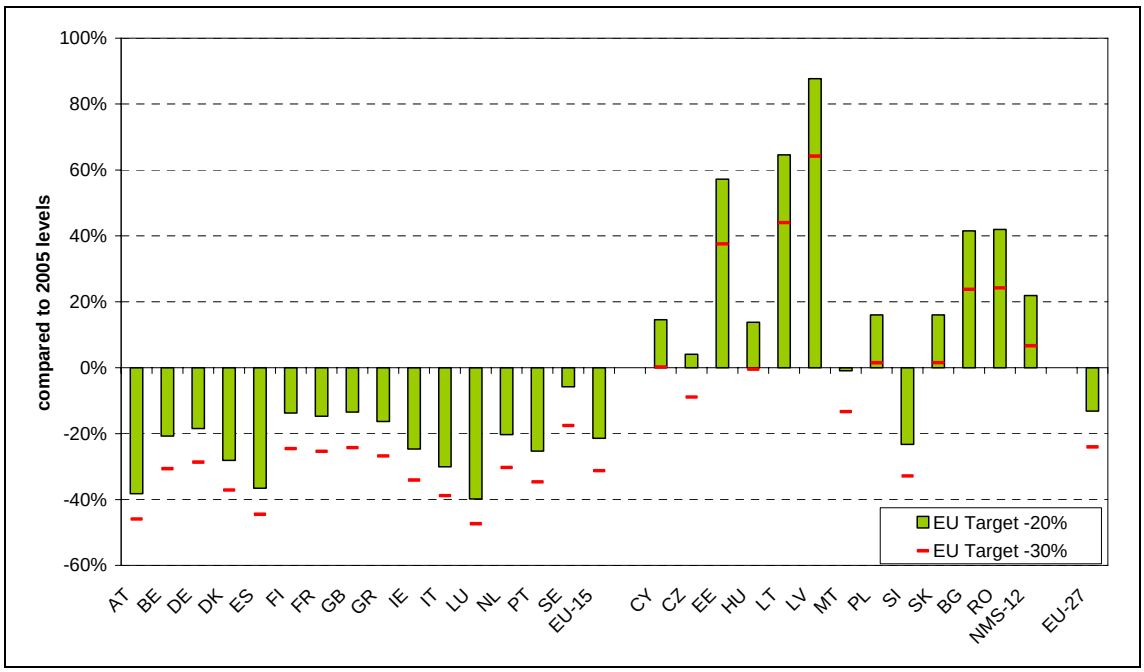
This option reflects the existing burden agreement for EU-15 Member States as well as the special circumstances of the new Member States from the EU-12. Those Member States which had the possibility of increasing emissions under the current burden sharing agreement have to reduce less compared to the base year than others.

Figure 15 Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on Kyoto Commitments for 2008/2012, 2020 compared to 1990 emission levels



Source: National Inventories, authors' calculations.

Figure 16 Total greenhouse gas emission targets for the EU-27 Member States, uniform reduction based on Kyoto Commitments for 2008/2012, 2020 compared to 2005 emission levels



Source: National Inventories, authors' calculations.

For example in the 20% scenario EU target variant, Spain's 2020 emissions would return to nearly the 1990 levels while Germany would need to reduce emissions by 33% compared to 1990. However, in the 30% scenario all EU-15 Member States would have to reduce their emissions below the 1990 levels by the year 2020.

The twelve new Member States would still be able to increase their emissions by 22% compared to 2005 levels in the 20% scenario despite a reduction of 16.1% compared to the 2008-12 target. Even in the 30% scenario the EU-12 Member States would have space left for 5% additional emissions in 2020 compared to 2005.

In other words, this approach is based on the assumption that the national circumstances are sufficiently reflected in the burden sharing for the 2008-2012 period and a level playing field with no special provisions for certain Member States is necessary. Since the 2008-2012 burden sharing is not seen as appropriate for reflecting the national circumstances and efforts, this option will not prove to be a widely accepted one.

5.3 Option 2: Top-down Approaches with an EU-wide ETS Cap

5.3.1 Overview

If the Member States decide on an EU-wide cap for the EU ETS, a methodology must be found to define it. It is an open question as to whether this EU-wide cap should then be assigned to the different Member States or remain as a stand-alone "28th Member State". However, if a significant share of allowances is to be auctioned within the EU ETS the distribution of the auction revenues originates as a new challenge. Although there are many options for distributing the revenues, the problem could also be seen as the problem of assigning the allowances from the EU-wide cap to the Member States.

Against this background and to ensure the comparison of the results, we analyse different options in this chapter for assigning the allowances from the EU-wide cap to the Member States, to derive additional approaches to define the emission targets for the non-ETS sectors and to calculate emission targets for the overall emissions of a certain Member State which can be compared to the results presented in the other sections of this study.

In addition to the 20% scenario and the 30% scenario we analyse three different options for the EU-wide cap within the EU ETS:

1. a medium cap based on a 1,917 Mt CO_2–e emissions target for the ETS sectors in 2020 in the 20% scenario (-13.2% compared to 2005 emission levels) and 1,678 Mt CO_2–e in the 30% scenario (-14.0% compared to 2005);
2. a modest cap based on a 2,020 Mt CO_2–e emissions target for the ETS sectors in 2020 in the 20% scenario (-8,5% compared to 2005) and 1,864 Mt CO_2–e for the 30% scenario (-15.6% compared to 2005);
3. a strong cap based on a 1,815 Mt CO_2–e emissions target for the ETS sectors in 2020 in the 20% scenario (-17.8% compared to 2005) and 1,491 Mt CO_2–e for the 30% scenario (-32.5% compared to 2005).

If an eight-year trading phase is assumed, the average annual cap for the 2013-2020 period could be calculated as the average of the 2008-2012 cap and the 2020 targets mentioned above. The medium cap for the third phase would then be 1.999 Mt CO_2–e for the 20% scenario and 1879 Mt CO_2–e for the 30% scenario. For the modest variant the cap would amount to 2,050 Mt CO_2–e for the 20% scenario and 1,973 Mt CO_2–e for the 30% scenario. For the strong cap in the 20% scenario a level of 1,948 Mt CO_2–e would result, and of 1,786 Mt CO_2–e for the 30% scenario.

A different specification of the trading phases for the time horizon beyond 2012 would result in other average annual caps on the track to the 2020 emissions targets for the ETS sector as specified above. However, the presentation of these average annual caps could facilitate the comparison with today's emission levels and the caps for the second phase of the EU ETS.

5.3.2 Options 2.1 - 2.3: Top-down with EU-wide caps for the EU ETS

In these variants the caps from the second trading phase are reduced by a fixed percentage to calculate the phase 3 caps. This means that the phase 3 caps are proportional to the phase 2 caps. The share of the ETS cap of one Member State in relation to the EU-27 ETS totals remains constant from 2008-12 to 2020.

The remaining emissions of the non-trading sectors are calculated as the difference between the overall EU-27 emissions target in 2020 and the EU-wide phase 3 cap. These emissions are distributed to Member States according to the share of the emission targets for the non-ETS emissions in 2010. This emission target is expressed by the difference between the overall commitment for the first commitment period under the Kyoto Protocol and the sum of the Member States' caps within the second phase of the EU ETS. Although all other options for reference years or periods for the definition of the non-ETS emission targets could have been chosen for this exercise, the approach taken for the options 2.1 to 2.3 is based on the following assessments:

- A reference period before 2005 would face the problem that no ETS data are available for the years before 2005. This would create additional uncertainties and potential for confusion.
- The reference to the 2005 emissions would create the updating problem with its perverse signals. The 2008-2012 commitments therefore combine the advantages of being consistent with the ETS data and caps on the one hand and of being reasonable in the framework of early action and economic transformation processes.

The difference between the 2.1 to 2.3 variants is the ambition of the EU-wide caps as described in chapter 5.3.1. In variant 2.1 the relative reduction effort of the ETS is lower than the overall reduction, equal in variant 2.2 and higher in variant 2.3.

Figure 17 to Figure 22 indicate the results for the overall emission targets, assuming that the EU ETS cap is assigned to the Member States. Compared with the 1990 emission levels as well as the 2005 emission levels, the three different cap variants do not lead to significant differences in the assignment of the Member States' emission targets. As a result, the distribution of the emission targets among the Member States is dominated by a model which is used for the non-ETS sectors if the definition of the ETS caps is based on a flat rate cut of the caps for the second phase.

- The *EU-15 Member States* would have to decrease their aggregate emission levels by 21.3% (medium cap), 21.4% (strong cap) or 21.2% (modest cap) in the 20% scenario, compared to 2005 emission levels. In the 30% scenario the respective emission reduction is 31.1%, 31.3%, and 31.0%.
- The aggregate emission target for the *EU-12 Member States* would amount to 21.3% (medium cap), 21.9% (strong cap) or 20.9% (modest cap) below the 2005 emission levels in the 20% scenario. In the 30% scenario the respective emission targets are +6.1%, +6.8%, and +5.5%, compared to the 2005 emission levels.

- The overall emission targets for *Germany* are -17.5% (medium cap), -18.1% (strong cap) and -16.9% for the 20% scenario, compared with 2005 emission levels. In the 30% scenario the respective emission reduction starting from the 2005 emission levels amounts to -17.8%, -28.9%, and 26.7%.

For all EU-15 Member States this option would result in emission targets significantly below the 2005 emission levels in the 20% scenario as well as in the 30% scenario. For the EU-12 Member States the patterns are more diverse. In the 20% scenario the emission targets for 2020 are significantly higher than the 2005 levels, the only exception is Slovenia. In contrast, some other EU-12 Member States (the Czech Republic, Hungary, Malta) would have to target emission levels which are more or less significantly below those of the year 2005 (Figure 20 to Figure 22).

For the non-ETS sectors, for which compliance definitely will continue to fall under the responsibility of the Member States, extreme differences occur between the EU-15 and the EU-12 (Figure 26 to Figure 28). The convergence of the phase 2 caps and the wide spread between recent emission levels and the Kyoto commitments of the most EU-12 Member States leads to very high emission reduction targets for the non-ETS sectors of the EU-15, which are for the majority of the EU-15 in the range of 30% and 50% compared to 2005 emission levels for the 20% scenario and even higher in the 30% scenario. In contrast, many of the EU-12 Member States could increase their non-ETS sector emissions by about 40% or more, in extreme cases more than 150%.

In contrast to these extreme spreads the range of targets for the ETS sectors in the year 2020 is much narrower. If the EU-wide cap for phase 3 is assigned to the Member States, the emission targets for the ETS sectors in most of the EU-15 Member States are about 10% to 20% below the 2005 emission levels in the 20% scenario for the medium and strong cap variant, and for many EU-12 Member States in the range of 5% and 15% below the 2005 levels. In the modest cap variant for the 20% scenario, the emission targets for the ETS sectors in most EU-15 Member States are in the range of 5 and 10% below the 2005 levels; some of the EU-12 Member States could increase their emissions from the ETS segment, other EU-12 Member States would face emission reductions for this segment which are around 5% below the 2005 levels. In the 30% scenario the caps are tightened by 9 to 18 percentage points (Figure 26 and Figure 28).

If these emission targets are translated into an annual average cap for a hypothetical ETS phase 2013-2020, Figure 29 to Figure 31 indicate the total cap numbers for the EU-27 and for the Member States if the cap is assigned to the Member States on the basis of a flat rate reduction of the phase 2 caps.

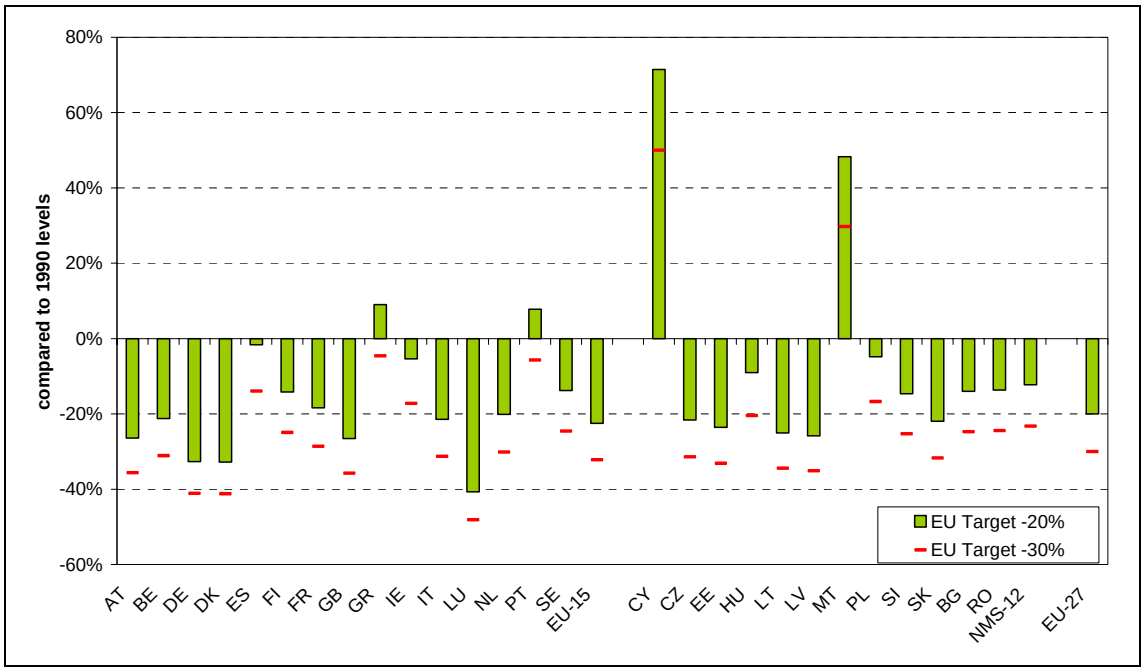
In summary, it can be concluded that:

- The definition of future ETS targets on the basis of phase 2 caps leads to caps which are much more closed to the recent emission levels than the resulting targets for the non-ETS sectors if these are based on the non-ETS targets for 2008-2012.

- Due to these imbalances an enormous spread results between the non-ETS targets for the EU-15 Member States and the EU-12 Member States for 2020.
- The ambition of the caps as well as the overall target for the greenhouse as emissions causes only minor changes in this spread.

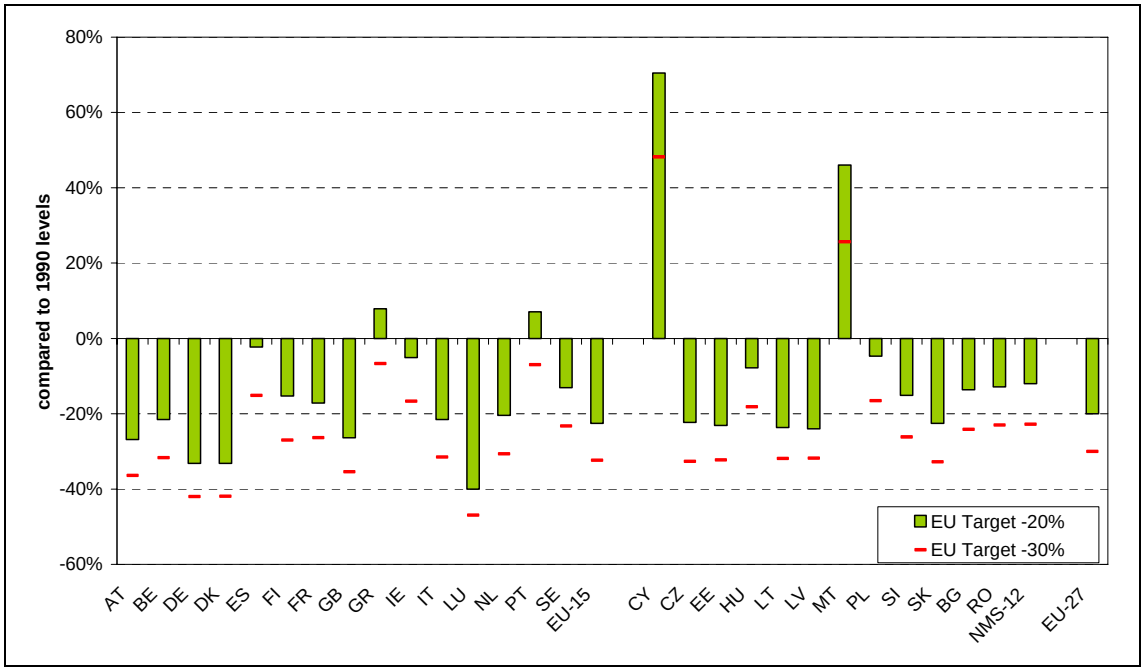
If the target sharing approach leads to reduction targets of 30% to 50% or more for the non-ETS sectors in the EU-15 by 2020 on the one hand and offers the option to increase the emissions from these sectors in the EU-12 sectors in the range of 30% to 100% on the other hand, it can hardly be seen as a very promising model if significant trading of assigned amount units among the Member States is not seen as a primary goal.

Figure 17 Total greenhouse gas emission targets for the EU-27 Member States, medium ETS cap reduction, 2020 compared to 1990 emission levels



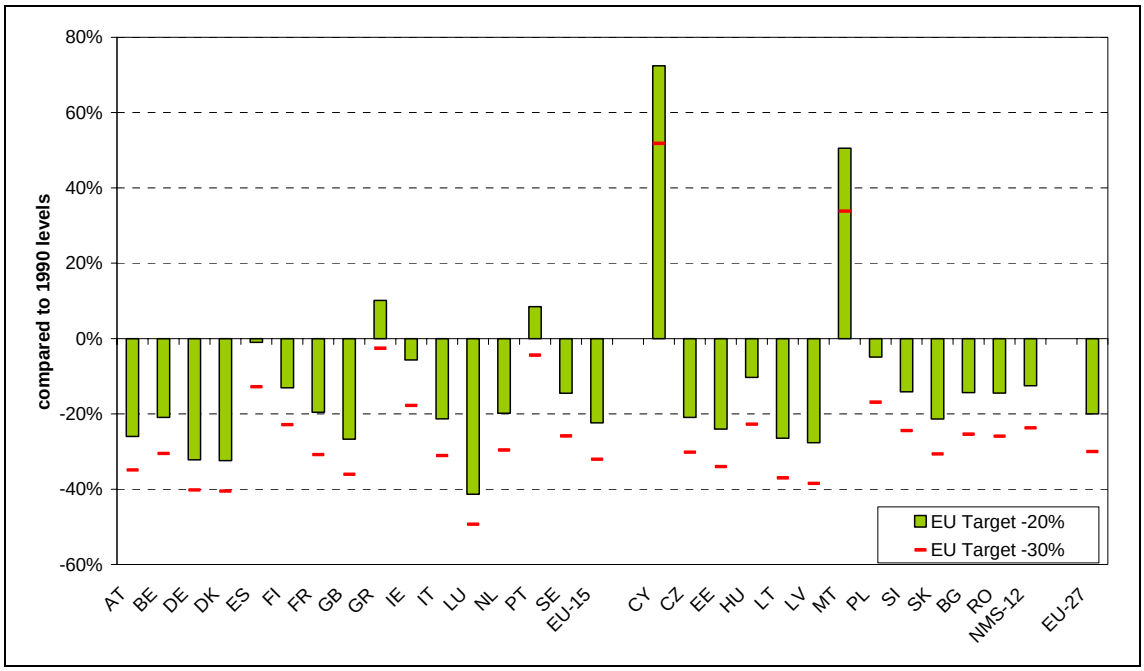
Source: National Inventories, authors' calculations.

Figure 18 Total greenhouse gas emission targets for the EU-27 Member States, strong ETS cap reduction, 2020 compared to 1990 emission levels



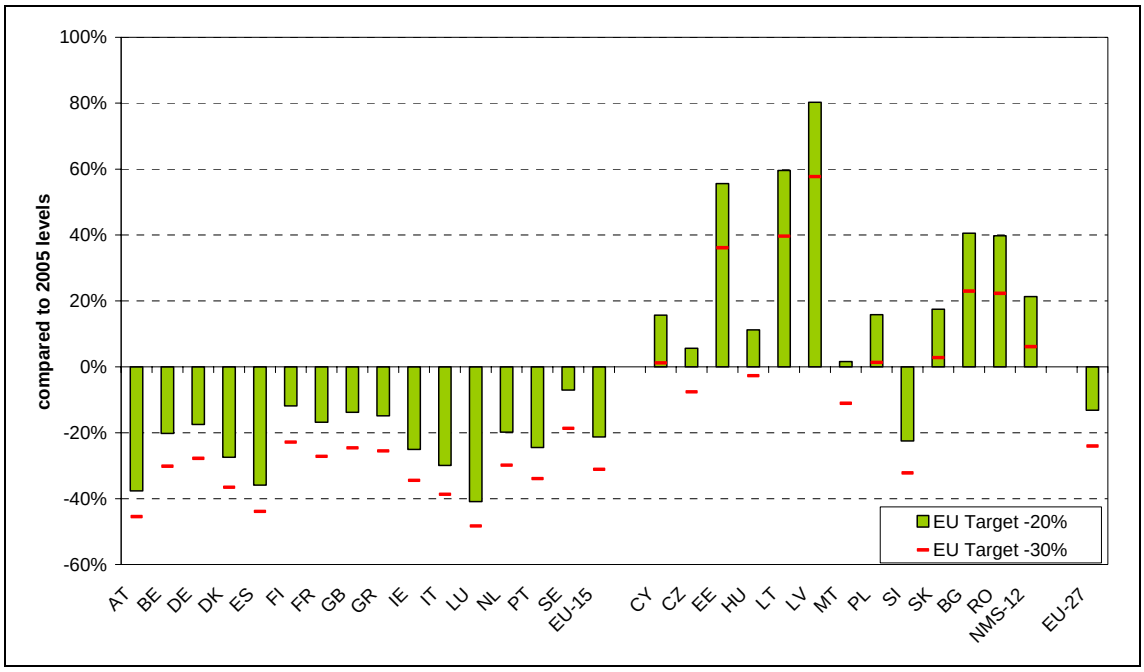
Source: National Inventories, authors' calculations.

Figure 19 Total greenhouse gas emission targets for the EU-27 Member States, modest ETS cap reduction, 2020 compared to 1990 emission levels



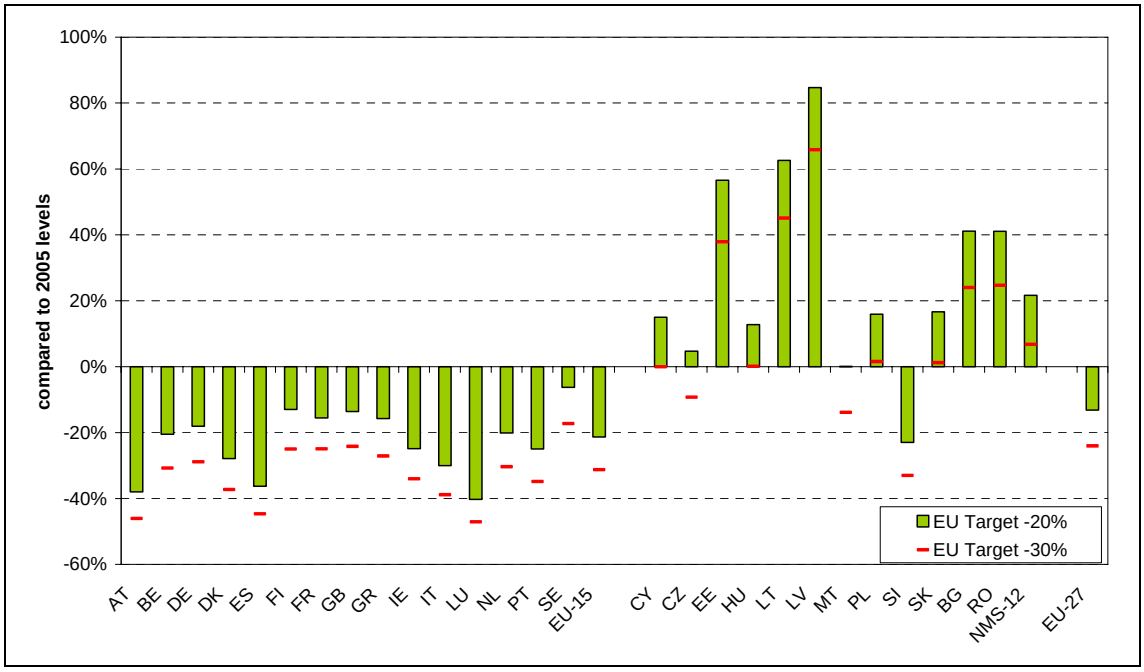
Source: National Inventories, authors' calculations.

Figure 20 Total greenhouse gas emission targets for the EU-27 Member States, medium ETS cap reduction, 2020 compared to 2005 emission levels



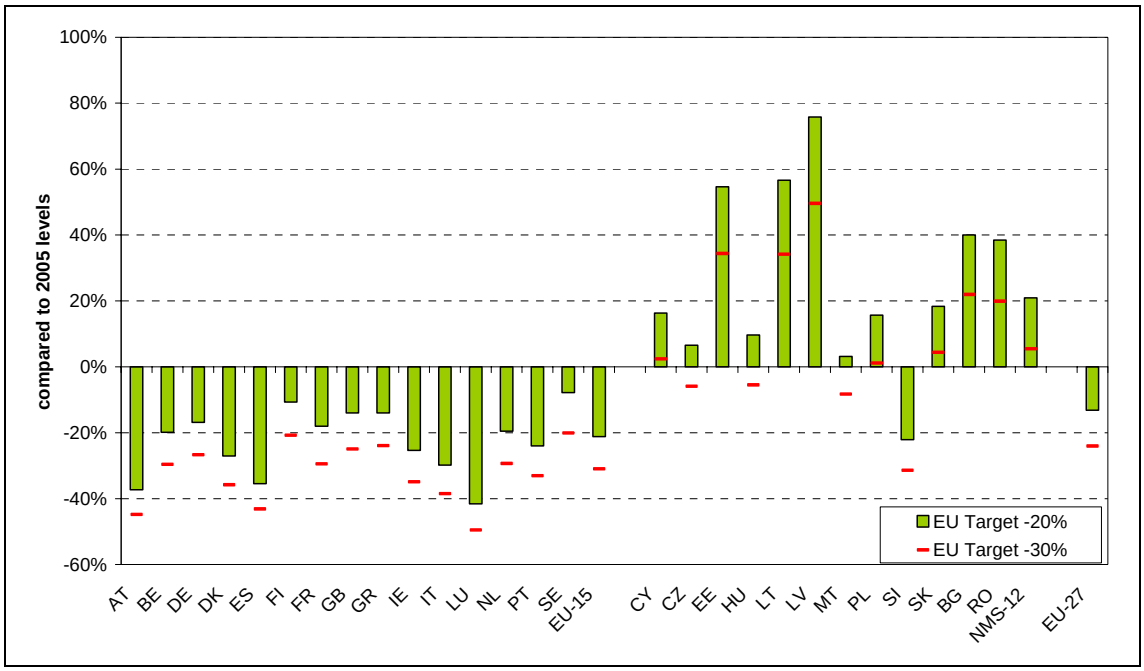
Source: National Inventories, authors' calculations.

Figure 21 Total greenhouse gas emission targets for the EU-27 Member States, strong ETS cap reduction, 2020 compared to 2005 emission levels



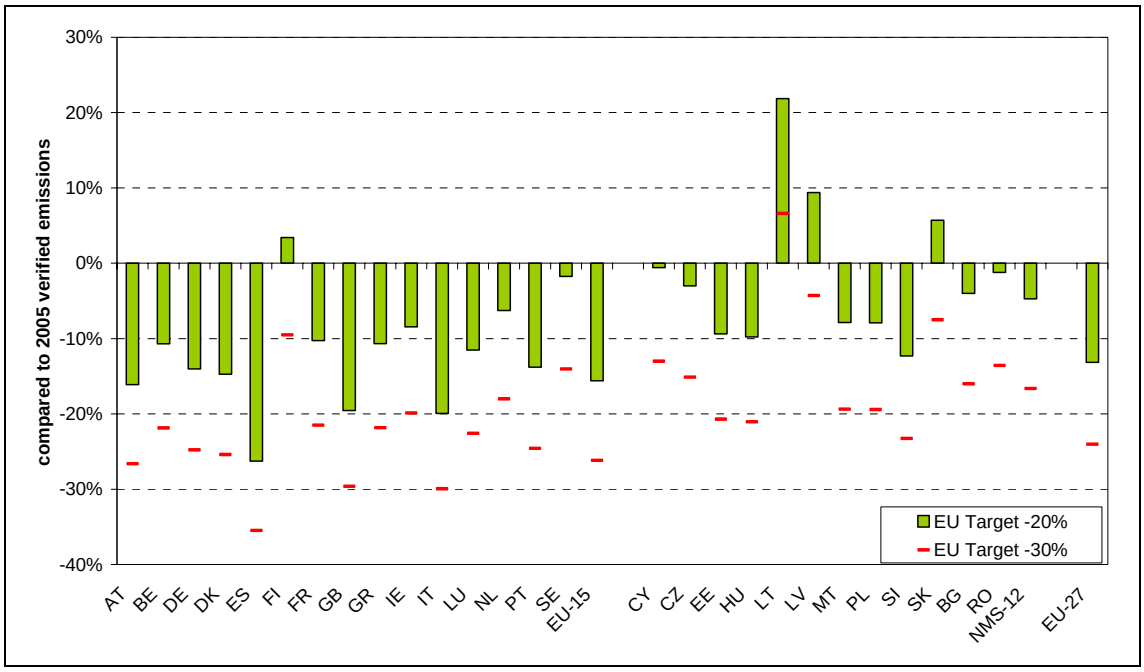
Source: National Inventories, authors' calculations.

Figure 22 Total greenhouse gas emission targets for the EU-27 Member States, modest ETS cap reduction, 2020 compared to 2005 emission levels



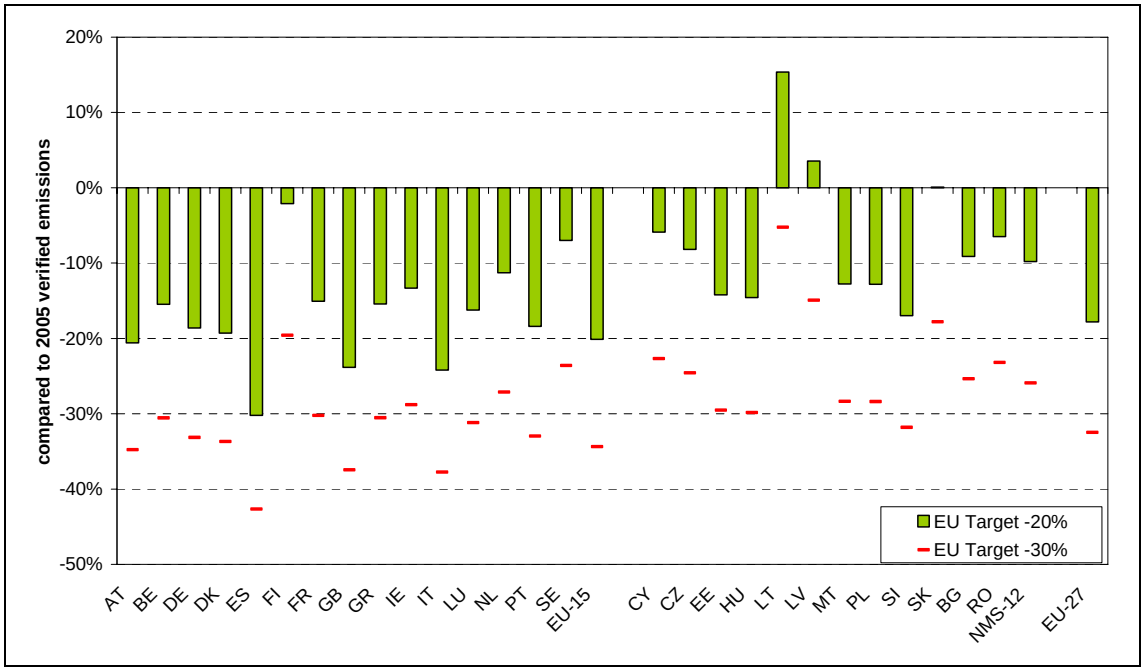
Source: National Inventories, authors' calculations.

Figure 23 2020 targets for phase 3 of the EU ETS for the EU-27 Member States, medium ETS cap reduction, 2020 compared to 2005 emission levels



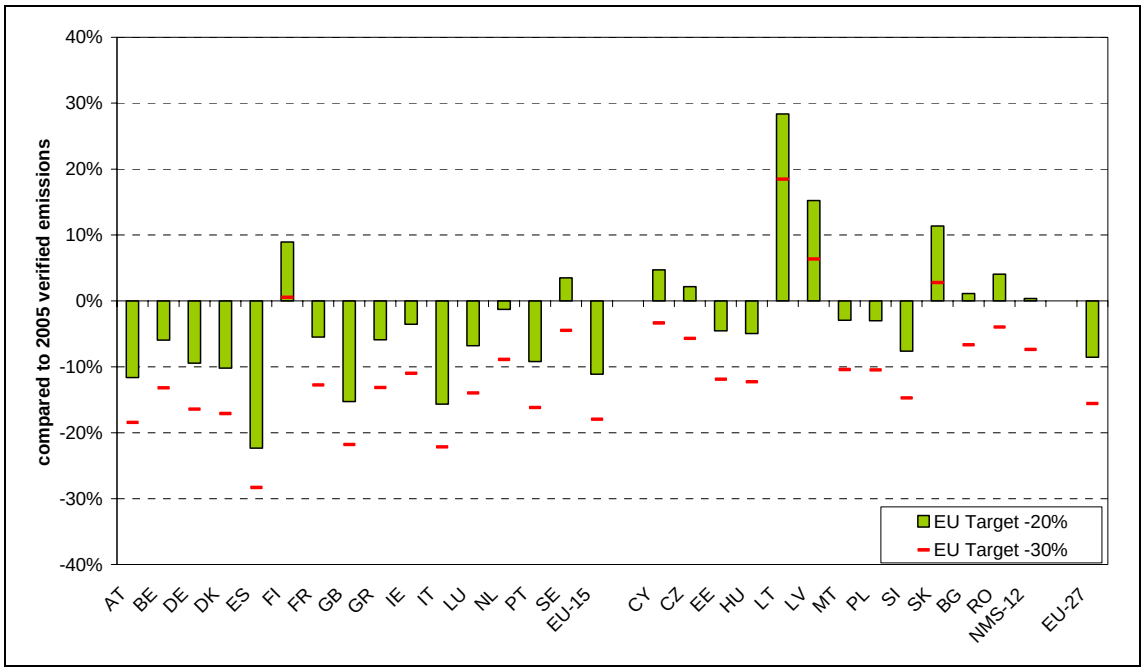
Source: National Inventories, authors' calculations.

Figure 24 2020 targets for phase 3 of the EU ETS for the EU-27 Member States, strong ETS cap reduction, 2020 compared to 2005 emission levels



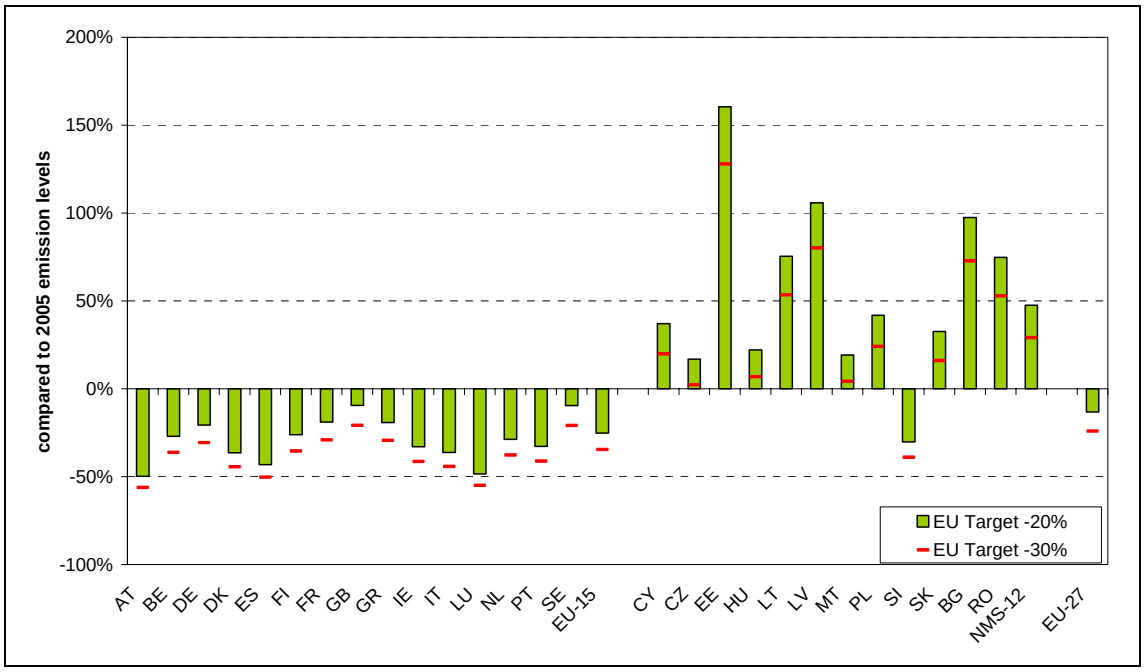
Source: National Inventories, authors' calculations.

Figure 25 2020 targets for phase 3 of the EU ETS for the EU-27 Member States, modest ETS cap reduction, 2020 compared to 2005 emission levels



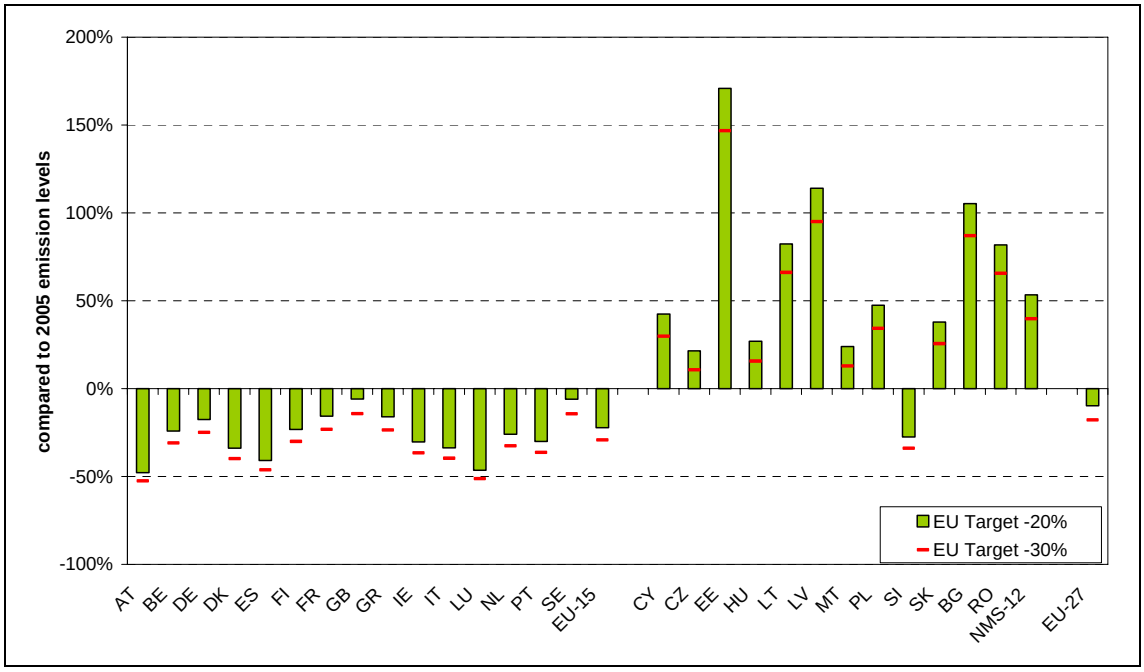
Source: National Inventories, authors' calculations.

Figure 26 2020 targets for the non-ETS sectors for the EU-27 Member States, medium ETS cap reduction, 2020 compared to 2005 emission levels



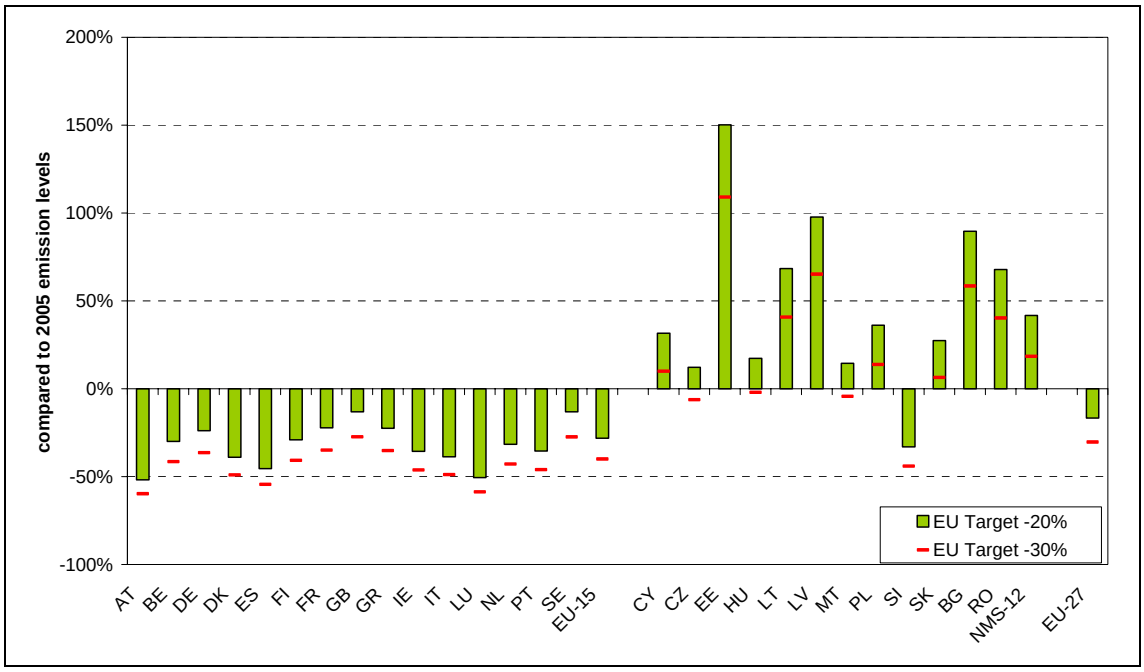
Source: National Inventories, authors' calculations.

Figure 27 2020 targets for the non-ETS sectors for the EU-27 Member States, strong ETS cap reduction, 2020 compared to 2005 emission levels



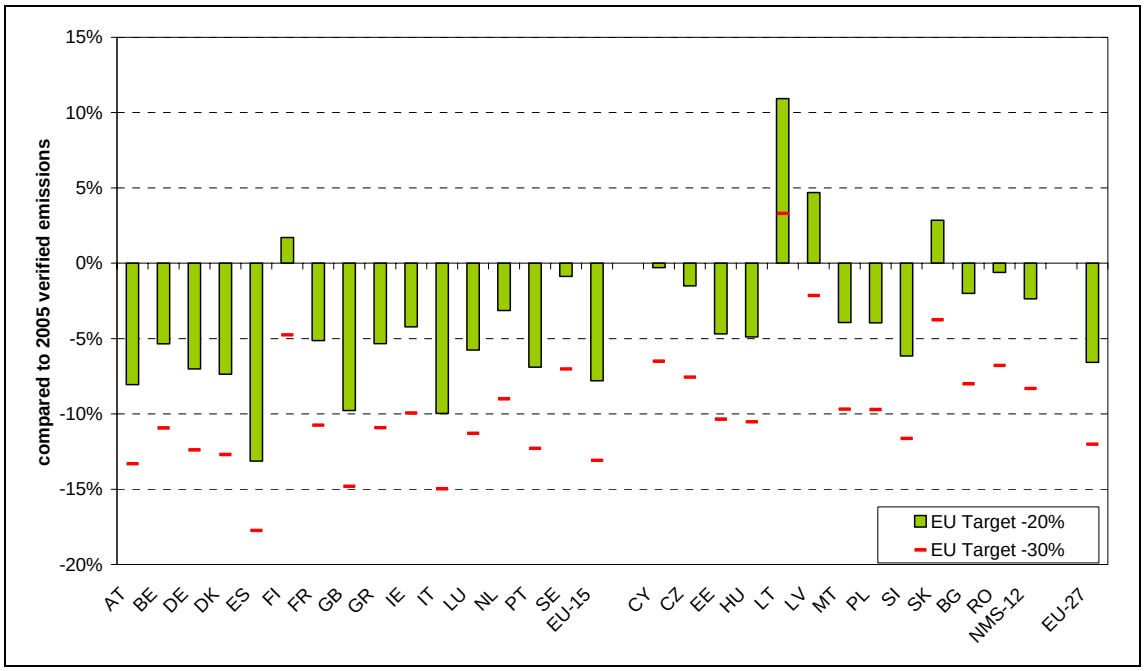
Source: National Inventories, authors' calculations.

Figure 28 2020 targets for the non-ETS sectors for the EU-27 Member States, modest ETS cap reduction, 2020 compared to 2005 emission levels



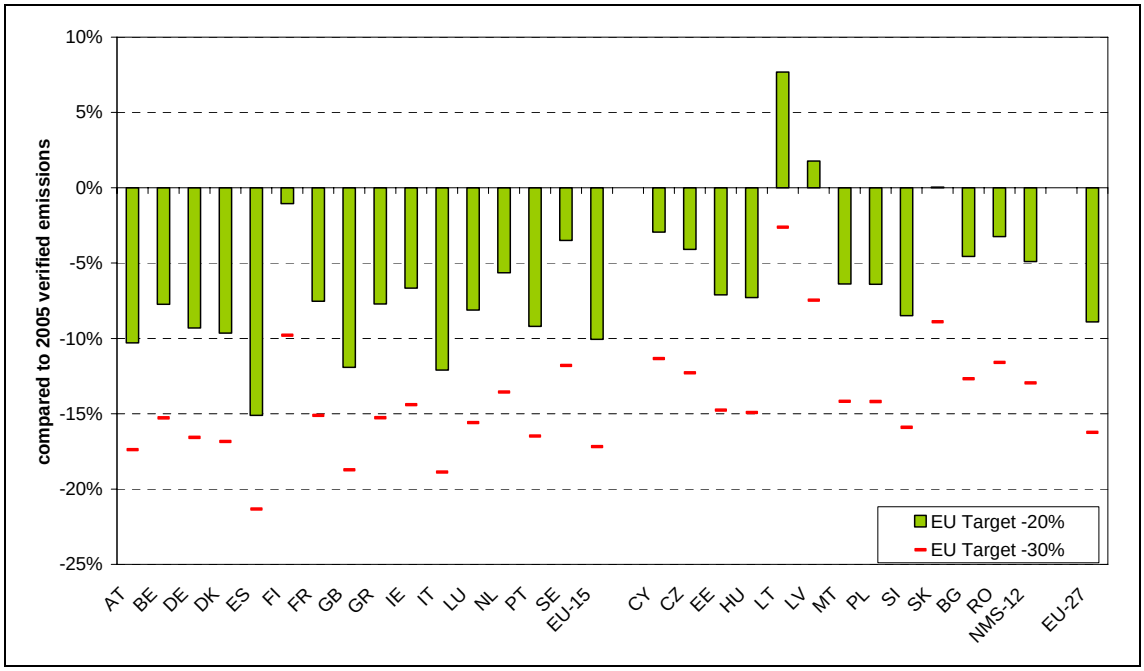
Source: National Inventories, authors' calculations.

Figure 29 EU ETS phase 3 cap for the EU-27 Member States, medium ETS cap reduction, 2013/2020 cap compared to 2005 emission levels



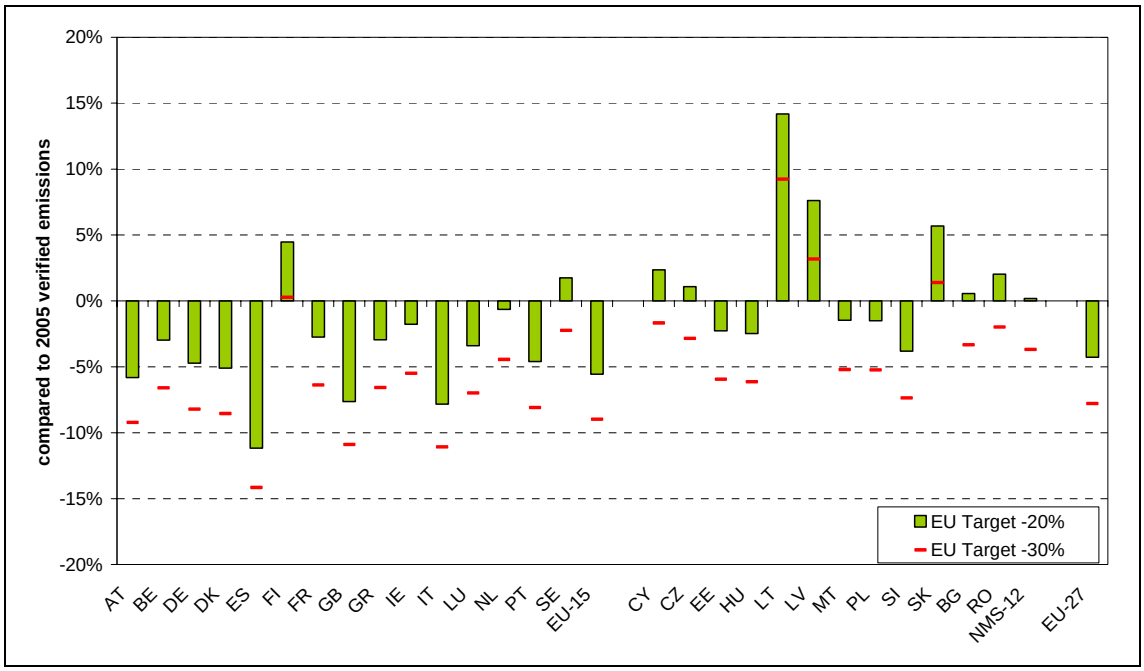
Source: National Inventories, authors' calculations.

Figure 30 EU ETS phase 3 cap for the EU-27 Member States, strong ETS cap reduction, 2013/2020 cap compared to 2005 emission levels



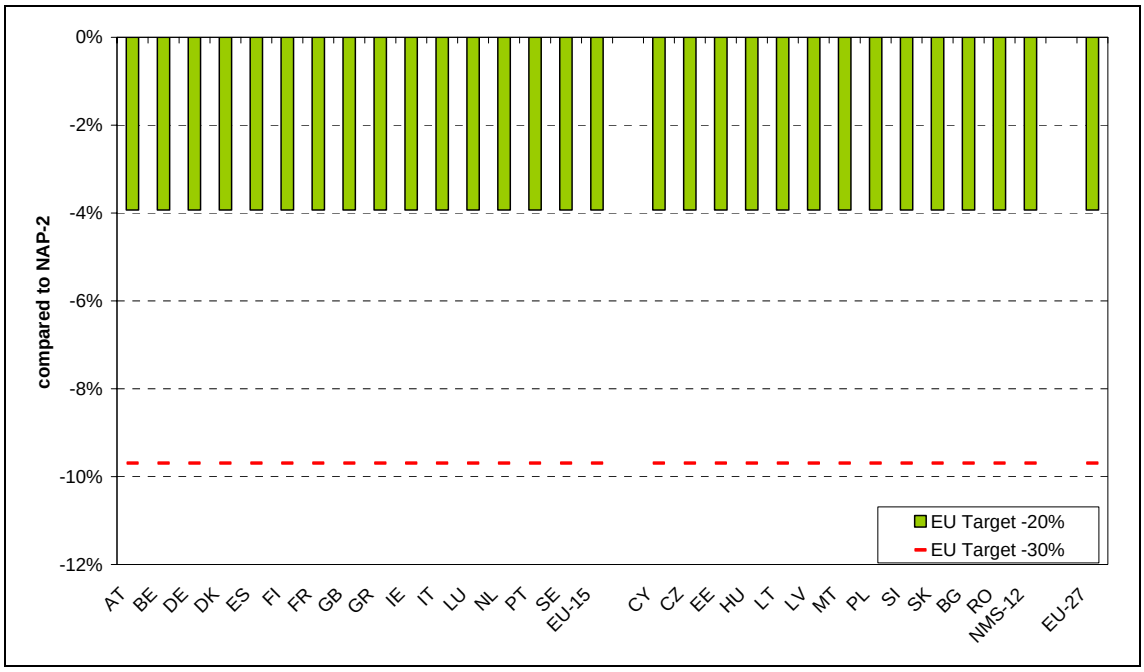
Source: National Inventories, authors' calculations.

Figure 31 EU ETS phase 3 cap for the EU-27 Member States, modest ETS cap reduction, 2013/2020 cap compared to 2005 emission levels



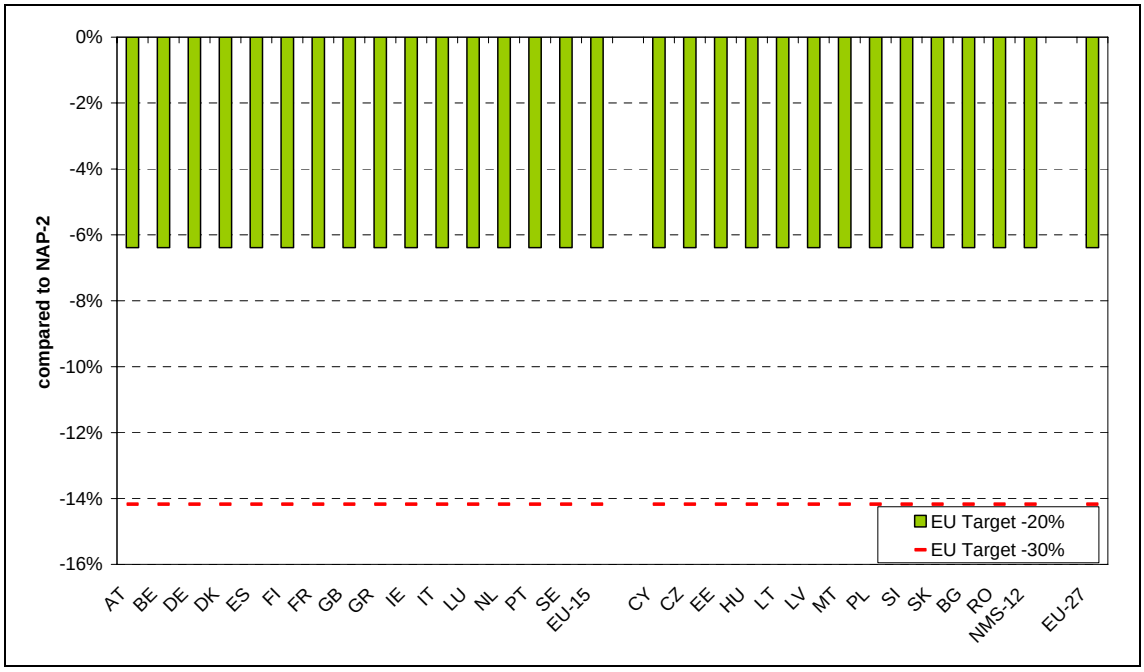
Source: National Inventories, authors' calculations.

Figure 32 EU ETS phase 3 cap for the EU-27 Member States, medium ETS cap reduction, 2013/2020 cap compared to phase 2 caps



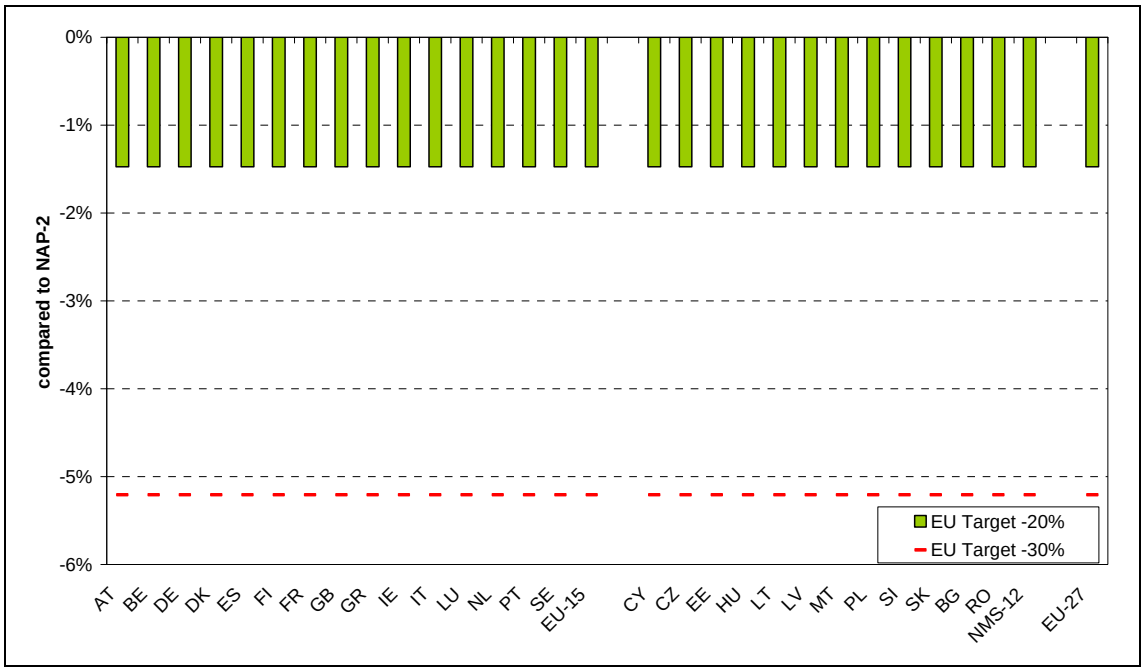
Source: National Inventories, authors' calculations.

Figure 33 EU ETS phase 3 cap for the EU-27 Member States, strong ETS cap reduction, 2013/2020 cap compared to phase 2 caps



Source: National Inventories, authors' calculations.

Figure 34 EU ETS phase 3 cap for the EU-27 Member States, modest ETS cap reduction, 2013/2020 cap compared to phase 2 caps



Source: National Inventories, authors' calculations.

5.4 Option 3: Bottom-up model based on sectoral reduction targets

5.4.1 Overview

In this section we analyse greenhouse gas emission targets which are based partly or fully on sector-specific parameters.

The rationale behind these approaches is that similarities between certain sectors in the different Member States could be more significant than the differences between certain Member States which result from different structures in terms of sector emissions. However, these similarities could be in terms of sector growth, emission reduction potentials or regarding the mitigation costs. In addition, the issue of competition distortions within certain industries could be addressed with this approach because similar industries are not treated differently and no advantages arise from the location of a certain industry.

In this study we do not analyse these aspects for the different sectors; the sectoral structure of emissions is used as a proxy on an aggregate level. Without a doubt, this is a very approximate approach but could make transparent some of its merits and shortfalls, which allows for assessment of the potential of such approaches for the further debate. Two main steps are analysed regarding sectoral approaches

- In a first analysis we apply the sectoral approach to the ETS sectors only, whereby the different sectors are treated equally between the EU-15 on the one hand and the EU-12 Member States on the other hand. In another analysis we differentiate between the sectors in the EU-15 and the EU-12 to reflect differing growth rates, etc.
- In a second group of calculations we apply sectoral emission targets for the ETS sectors as well as the non-ETS sectors.

The basis for the sectoral targets for the ETS sectors is based on the medium cap variant which was derived in chapter 5.3.1.

5.4.2 Option 3.1: Sectoral cuts for ETS, proportional cuts for non-ETS based on Kyoto commitments

In this variant we assume an EU-wide cap for the installations which are covered by the EU ETS. The total EU-wide cap is defined as top-down in a first step. In a second step this cap is substantiated by sectoral reduction targets which result in their combination in the total emission target for the ETS in the EU-27 as a whole. A very rough differentiation was applied for this analysis:

- In the 20% the emission target is about 82% for the power sector and 5% for the other combustion installations and the other sectors covered by the EU ETS, based on the 2005 emission levels.

- In the 30% scenario the emission target is 68% for the power sector, 80% for the other combustion installations and 90% for the other installations under the EU ETS.

The background for these definitions is the assumption that the emission reduction potential and costs in the power sector are more attractive than for the other combustion installations as well as the other industrial installations under the EU ETS. However, the orders of magnitude mentioned above should be understood as illustrative ones only.

The total EU ETS cap is assigned to the Member States based on sectoral emissions targets for the different installations under the EU ETS and the emission contributions of the different ETS sectors of the Member States in 2005. In other words, the structure of emissions sources of a certain Member States defines the part of the EU-wide cap which is assigned to this Member States.

For illustration purposes the breakdown of the cap was calculated on a 27% emission reduction for power plants, 20% for other combustion installations and 10% for all other installations covered by the EU ETS in the 30% reduction case. In the 20% reduction case the breakdown of the EU-wide cap is based on a 13% emission reduction requirement for power plants and 5% for all other installations covered by the EU ETS. Depending on the structure of installations and their emissions under the EU ETS national caps were defined for each Member State.

Figure 37 indicates the emission targets for the ETS sectors for the Member States. Not surprisingly there are no large-scale differences between the Member States. The existing differences result from the different structure of the source categories under the EU ETS. Member States with a higher share of power sector in the 2005 ETS emissions face lower caps and Member States with a higher proportion of non-combustion installations are confronted with more modest caps. For illustration purposes these caps for the Member States were also translated into average annual caps for a hypothetical 2013-2020 ETS phase. Figure 39 and Figure 40 indicate these caps compared to the 2005 emissions levels as well as the caps for phase 2 of the EU ETS. Especially the comparison with the phase 2 caps underlines that this approach puts higher burdens on the EU-12 Member States.

The necessary emission reduction from the non-ETS sectors is calculated as the difference between the total emission reduction for the EU-27 (given by the 20% or 30% reduction target) and the emission reduction provided by the EU ETS which is allocated to the Member States proportional to their targets for 2008/2012 under the Kyoto Protocol. The results for the non-ETS sectors are shown in Figure 38.

Figure 35 and Figure 36 indicate the total emission ceilings if the ETS caps were assigned to the Member States as described above:

- The *EU-15 Member States* would have to decrease their aggregate emission levels by 20.2% in the 20% scenario, compared to 2005 emission levels. In the 30% scenario the respective emission reduction is 30.0%.

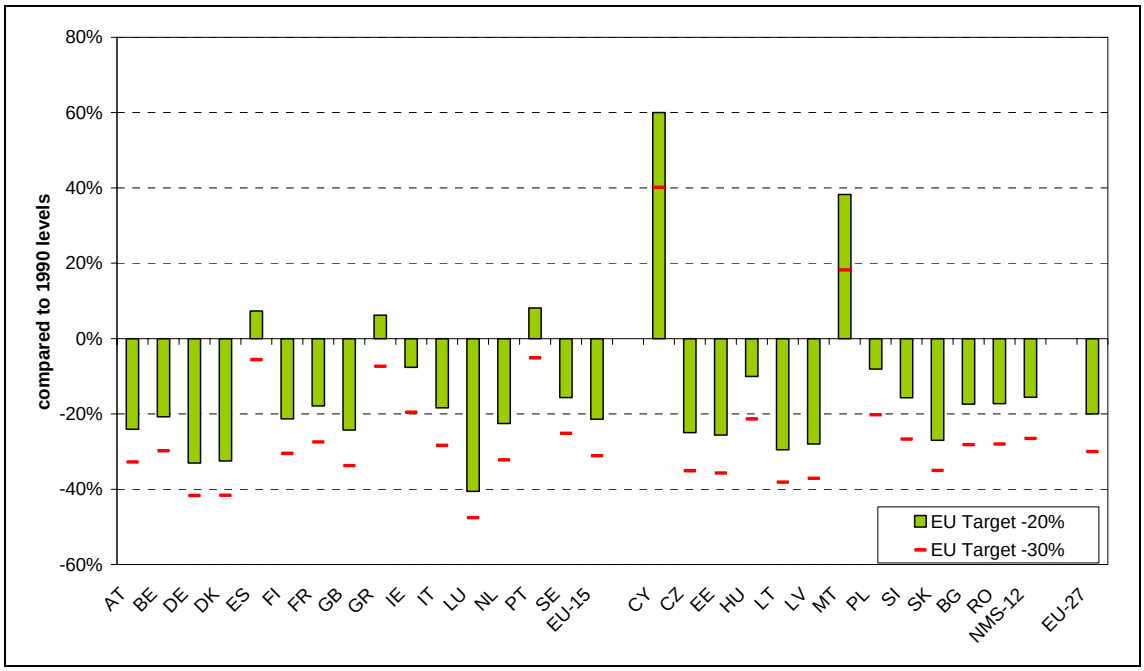
- The aggregate emission target for the *EU-12 Member States* would amount to 16.7% above the 2005 emission levels in the 20% scenario. In the 30% scenario the respective emission targets are +1.6% compared to the 2005 emission levels.
- The overall emission targets for *Germany* are -17.9% for the 20% scenario, compared with 2005 emission levels. In the 30% scenario the respective emission reduction starting from the 2005 emission levels amounts to -28.5%.

In summary, it can be concluded that:

- less competition distortions can be presumed between the EU-15 and the EU-12 Member States industries if comparable growth rates as well as reduction potentials and costs are assumed;
- the emission targets for the ETS sectors based on a pure sectoral approach put a special burden on many of the EU-12 Member States because the share of the power sector is comparatively high;
- strong emission reduction needs will arise for the non-ETS sectors in the EU-15 and significant potentials exist for increasing emissions from these sectors in the EU-12;
- the gains from the emission reductions in the transformation process in the EU-12 will be allocated to these Member States.

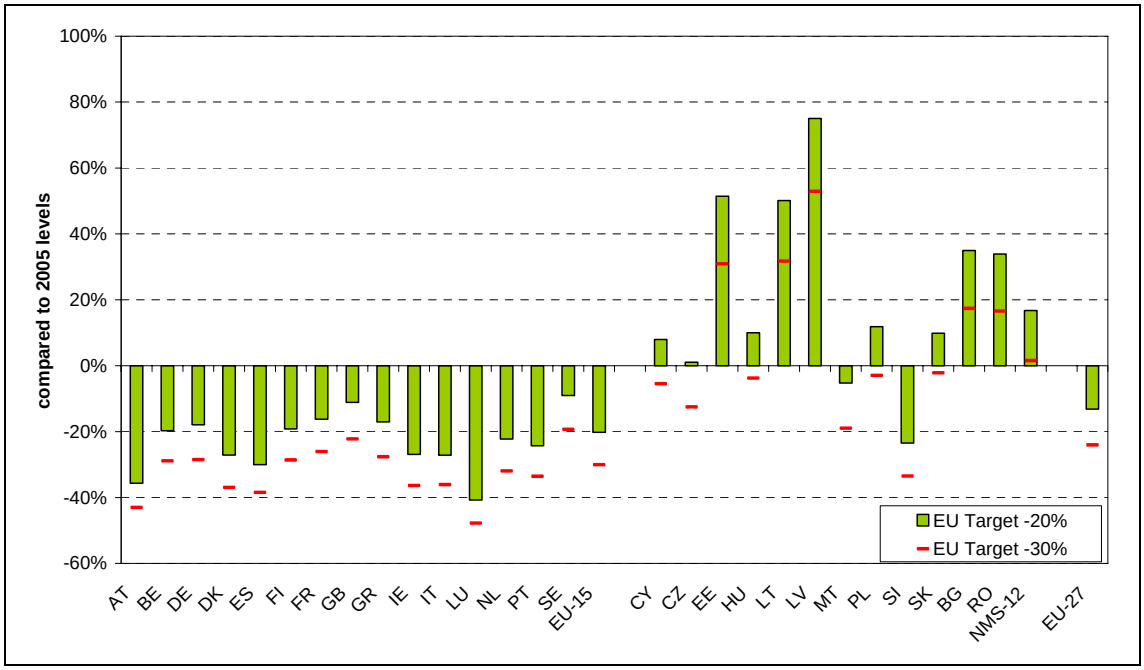
With the sectoral approach for the ETS sectors (whether the EU-wide ETS cap is assigned to the Member States or not) the level of ambition for the competing industries between the Member States could converge more than in the flat rate approaches for the ETS sectors. However, huge spreads between the non-ETS sector commitments between the EU-15 and EU-12 Member States must be taken into account. Again, this effect is caused by the major spread between the 2008-2012 commitments and the recent emission levels of the non-ETS sectors in most of the EU-12 Member States and is enforced by the strong convergence of the emission targets for the ETS sectors.

Figure 35 *Total greenhouse gas emission targets for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2020 compared to 1990 emission levels*



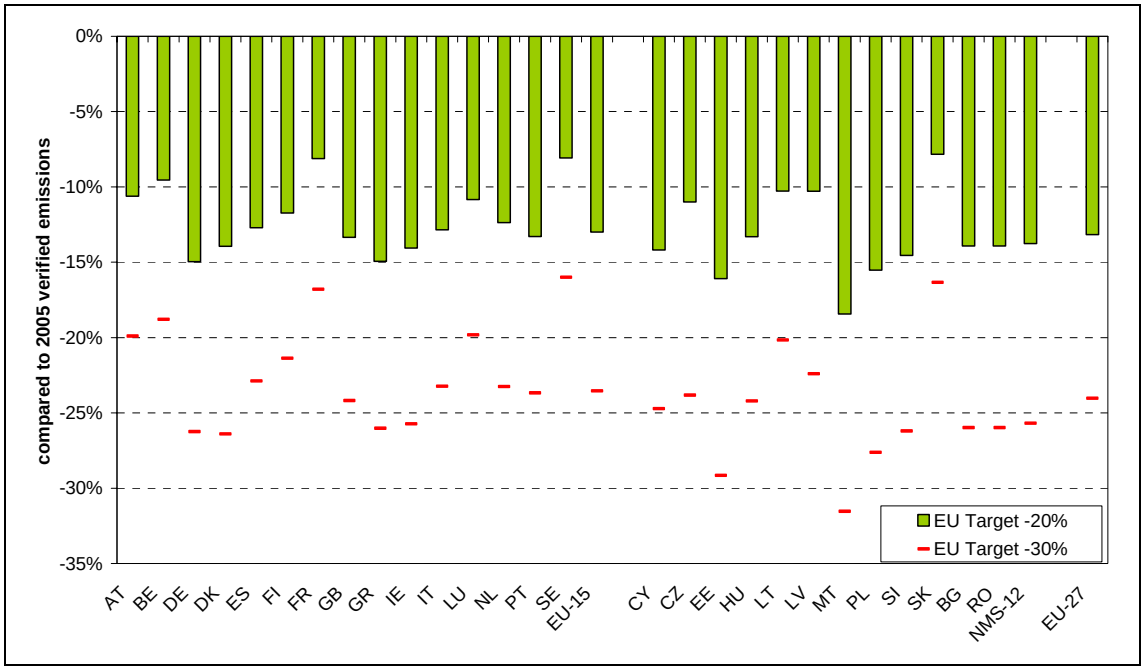
Source: *National Inventories, authors' calculations.*

Figure 36 *Total greenhouse gas emission targets for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2020 compared to 2005 emission levels*



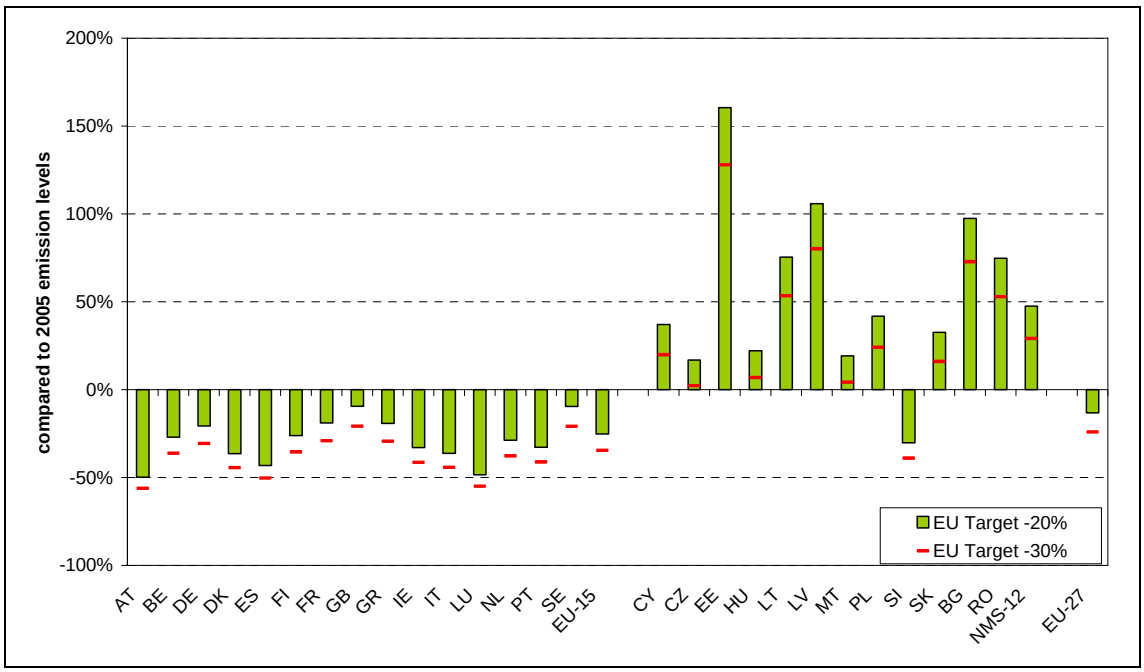
Source: *National Inventories, authors' calculations.*

Figure 37 *2020 targets for phase 3 of the EU ETS for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2020 compared to 2005 emission levels*



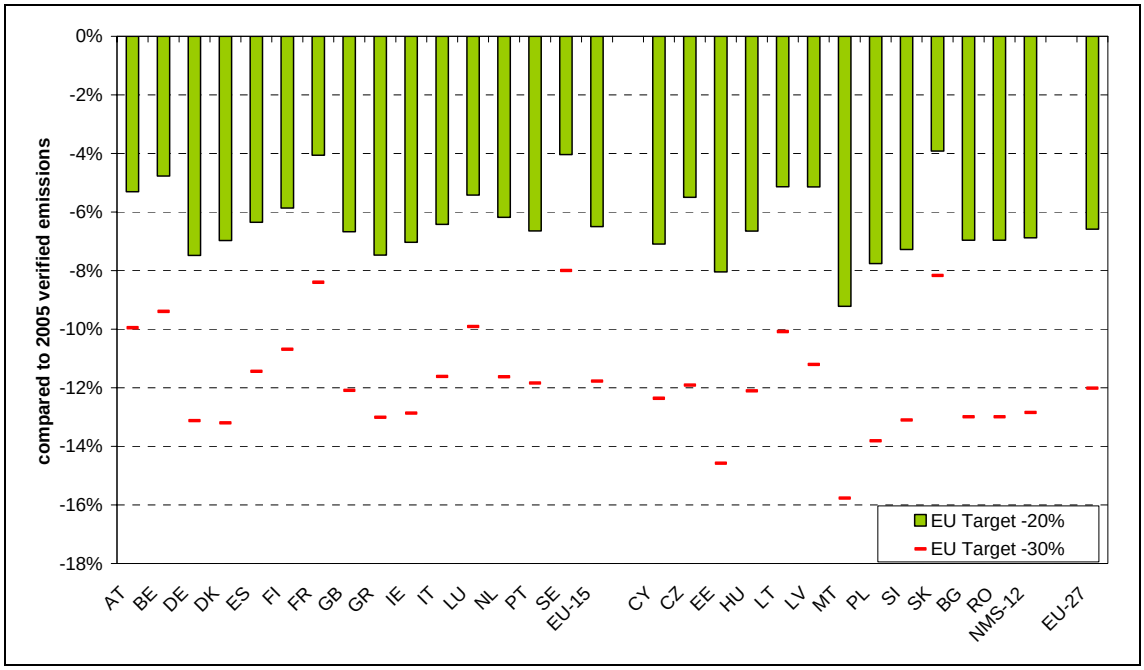
Source: *National Inventories, authors' calculations.*

Figure 38 *2020 targets for the non-ETS sectors for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2020 compared to 2005 emission levels*



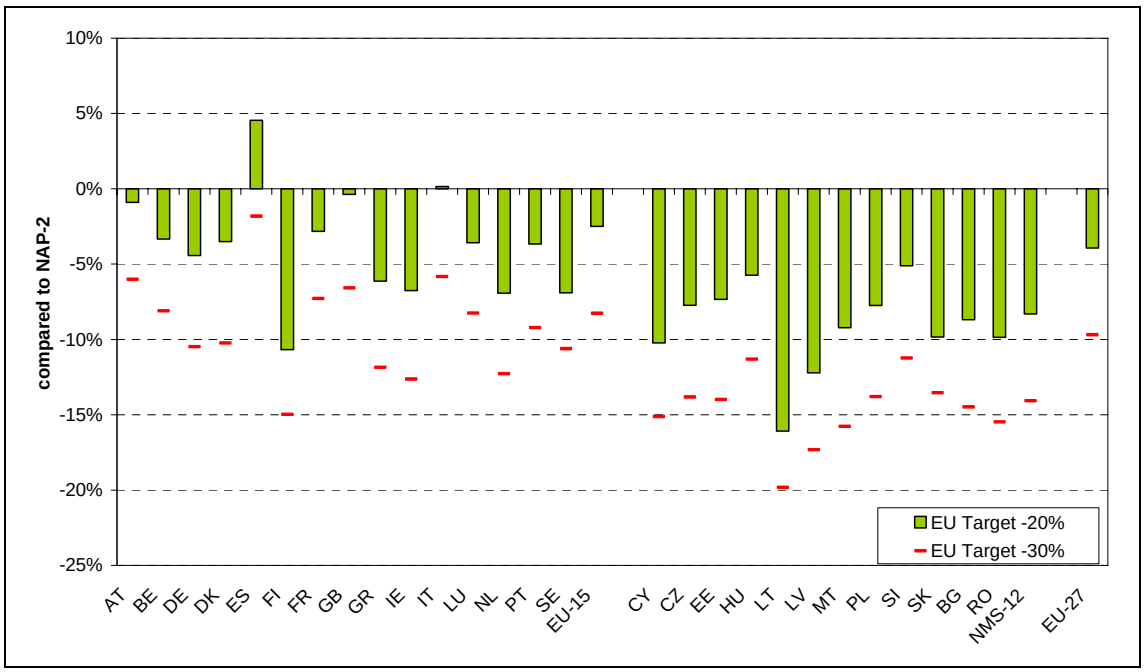
Source: *National Inventories, authors' calculations.*

Figure 39 *EU ETS phase 3 cap for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2013/2020 cap compared to 2005 emission levels*



Source: *National Inventories, authors' calculations.*

Figure 40 *EU ETS phase 3 cap for the EU-27 Member States, sectoral ETS cap reduction and proportional non-ETS reduction targets, 2013/2020 cap compared to phase 2 caps*



Source: *National Inventories, authors' calculations.*

5.4.3 Option 3.2: 2020 target based on sectoral cuts for EU-15 ETS caps, constant ETS caps for EU-12, and proportional cuts for non-ETS based on 2005 emission levels

One of the main problems of option 3.1 is the treatment of the industry installations in the EU-12 which are covered by the EU ETS. If we assume that higher growth rates of these industries will outweigh potentially higher emission reduction potentials this would require another approach for the ETS sector in the EU-12.

In contrast to option 3.1 we assume for the EU-12 phase 3 caps which are equivalent to the phase 2 of the EU ETS. The caps for the EU-15 Member States are tightened to reach the medium EU-27 ETS target in 2020. The related target rates were defined as follows:

- In the 20% scenario the emission target is about 73% for the power sector and 95% for the other combustion installations and the other sectors covered by the EU ETS, based on the 2005 emission levels.
- In the 30% scenario the emission target is 54% for the power sector, 80% for the other combustion installations and 90% for the other installations under the EU ETS.

The fact that the EU-12 Member States are attributed a more modest emission target for the ETS sector is contrasted in this option with the approach for the non-ETS sectors. Regarding the non-ETS sectors we assume a definition of the Member States' targets based on 2005 emission levels. As a result the EU-12 Member States lose their benefits from the economic transition to a large extent.

Figure 41 and Figure 42 show the total emission targets in the case that the ETS caps are assigned to the Member States as described above:

- The *EU-15 Member States* would have to decrease their aggregate emission levels by 15.1% in the 20% scenario, compared to 2005 emission levels. In the 30% scenario the respective emission reduction is 27.3%.
- The aggregate emission target for the *EU-12 Member States* would amount to 4.8% below the 2005 emission levels in the 20% scenario. In the 30% scenario the respective emission targets are -10.2% compared to the 2005 emission levels.
- The overall emission targets for *Germany* are -17.0% for the 20% scenario, compared with 2005 emission levels. In the 30% scenario the respective emission reduction starting from the 2005 emission levels amounts to -30.2%.

Regarding the different sectors the following key findings result from the detailed analysis:

- The aggregate ETS cap for the EU-15 is significantly tighter than in option 3.1. The emission target for the EU-15 ETS sectors is -18% in the 20% scenario and –32.0% in the 30% scenario, compared with 2005 emission levels.

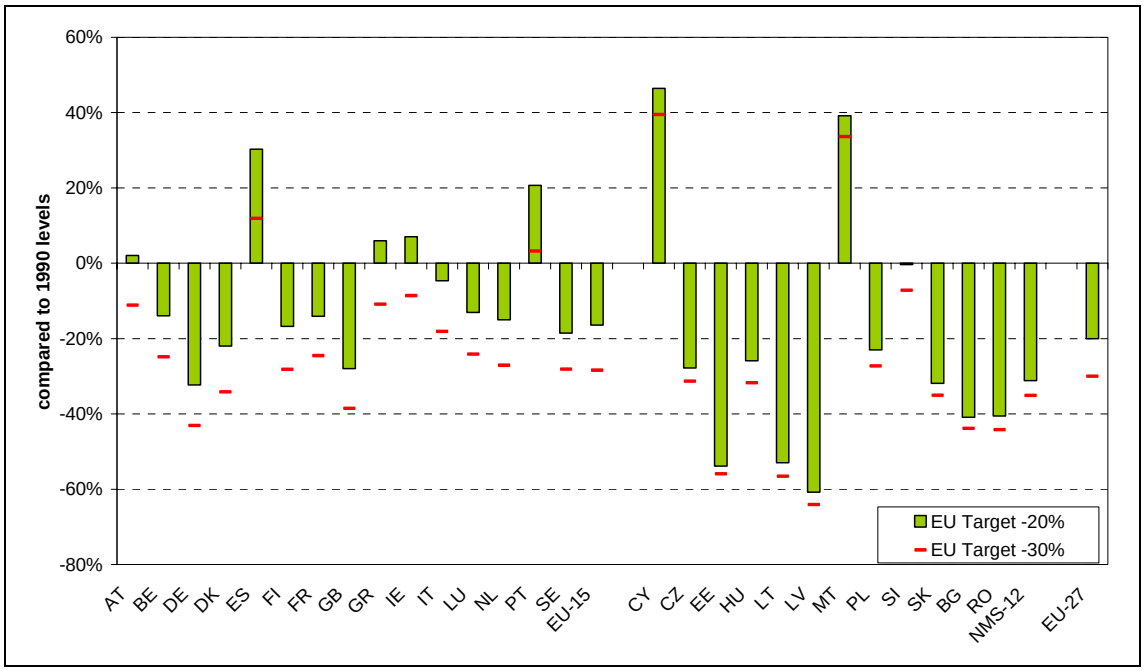
- The total of all ETS caps assigned to the EU-12 Member States is 3.4% above the 2005 emission levels in the 20% and the 30% scenario.
- For Germany the 2020 target for the ETS sectors is 21.1% below the 2005 emission levels in the 20% scenario and 36.7% below the 2005 levels in the 30% scenario.

According to the definition of this option and the parametrisation of the caps the emission target for all Member States is -13.2% below the 2005 emission levels in the 20% scenario and 24% below the 2005 levels in the 30% scenario.

In summary, it can be concluded that:

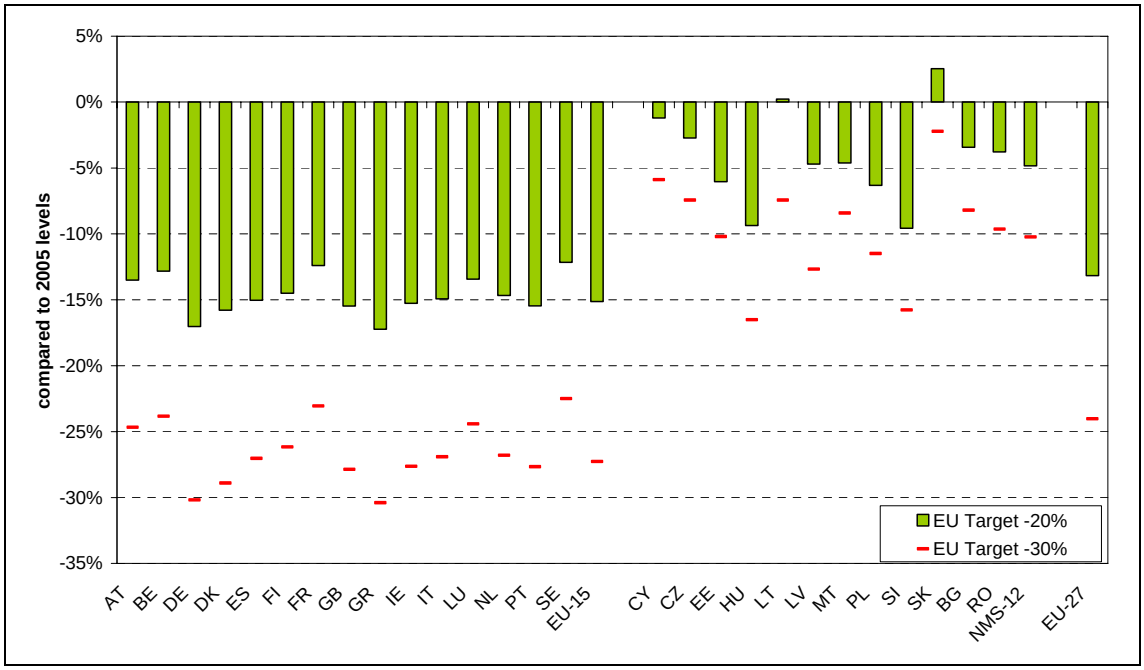
- a low level of competition distortions could be presumed between the EU-15 and the EU-12 Member States industries if more ambitious growth rates can be proved for the ETS sectors in the EU-12 in general;
- the emission targets for the ETS sectors based on a pure sectoral approach for the EU-15 only and frozen ETS caps from the phase 2 for the EU-12 leads to a wide spread between tight emissions targets for the EU-15 and more or less no additional emission reduction targets for the EU-12;
- strong emission reduction needs will arise for the non-ETS sectors in all EU-27 Member States;
- the gains from the emission reductions in the transformation process in the EU-12 will be reflected to a certain extent in the ETS sectors only. This leads to the overall result that the largest share of the transitions gains in terms of emission reductions will be redistributed among all Member States.

Figure 41 Total emission targets for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2020 compared to 1990 emission levels



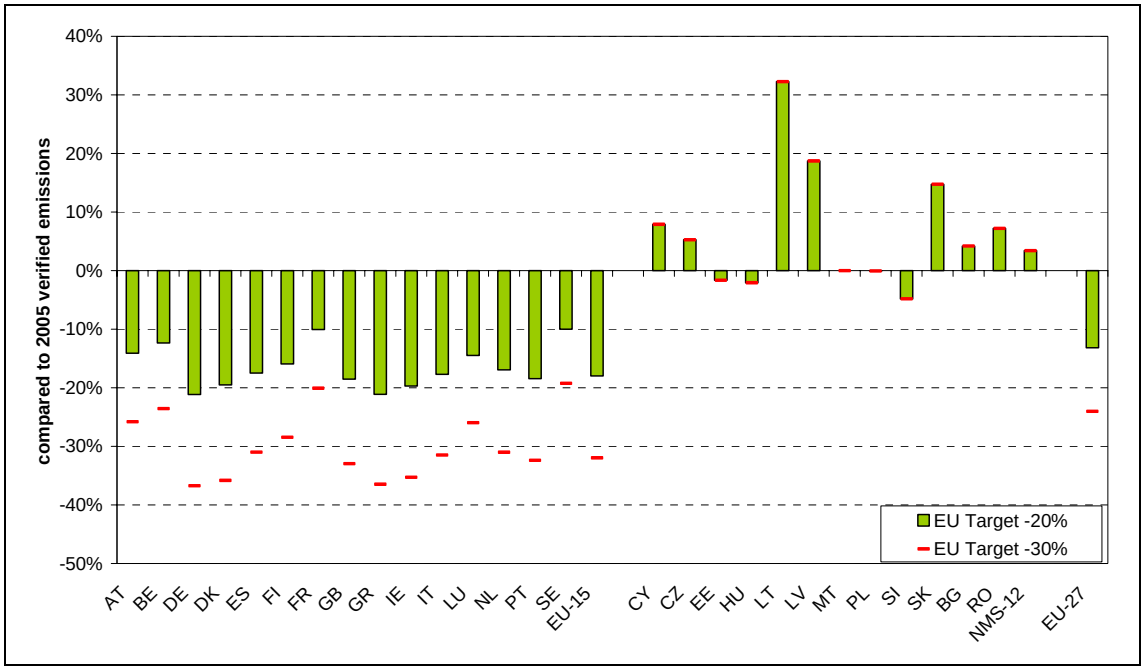
Source: National Inventories, authors' calculations.

Figure 42 Total emission targets for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels



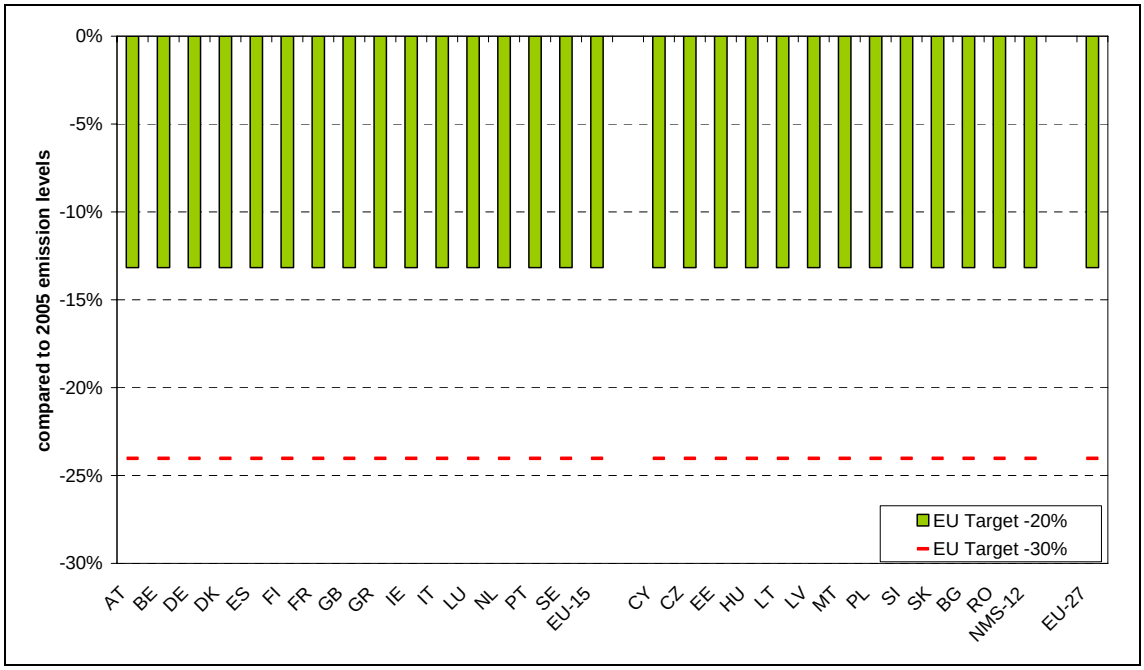
Source: National Inventories, authors' calculations.

Figure 43 *2020 targets for EU ETS phase 3 for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels*



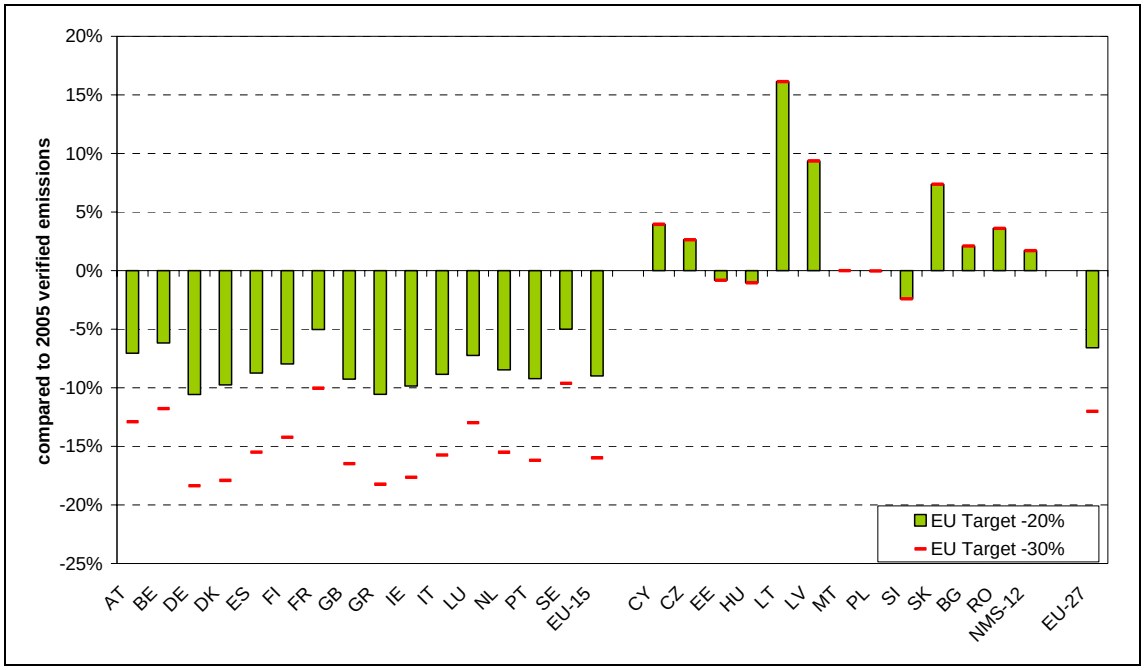
Source: *National Inventories, authors' calculations.*

Figure 44 *2020 targets for the non-ETS sectors for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels*



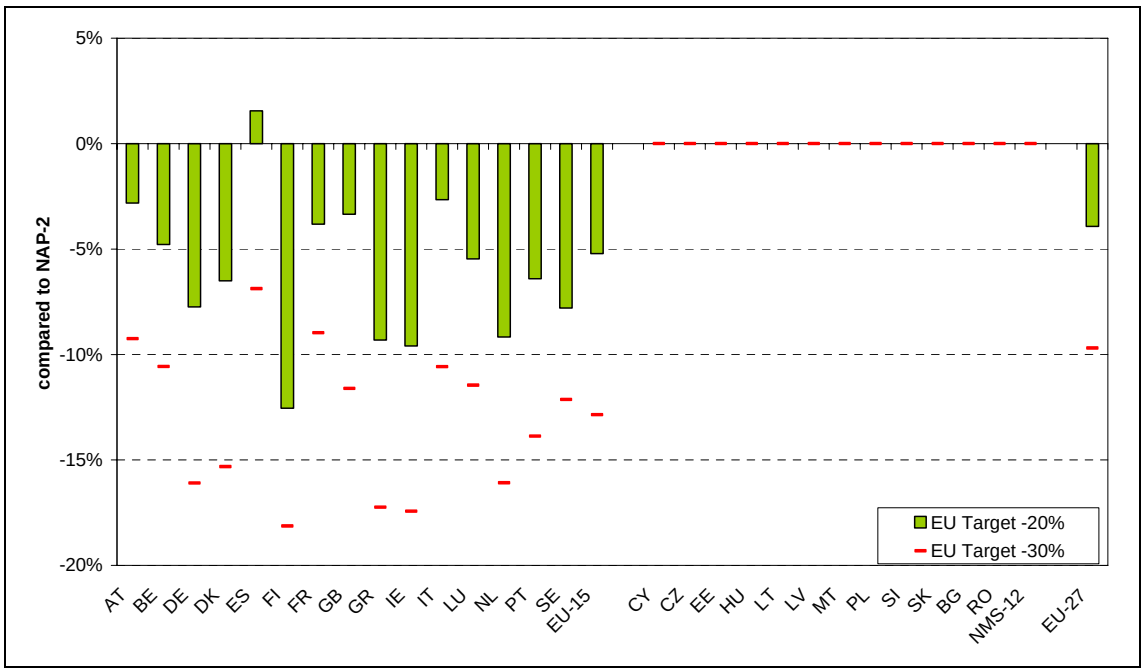
Source: *National Inventories, authors' calculations.*

Figure 45 EU ETS phase 3 cap for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2013/2020 cap compared to 2005 emission levels



Source: National Inventories, authors' calculations.

Figure 46 EU ETS phase 3 cap for the EU-27 Member States, sectoral ETS cap reduction for EU-15, constant caps for EU-12, and proportional non-ETS targets, 2013/2020 cap compared to phase 2 caps



Source: National Inventories, authors' calculations.

5.4.4 Option 3.3: 2020 target based on sectoral cuts for ETS for EU-15, modest sectoral cuts for ETS caps for EU-12, and proportional cuts for non-ETS based on the average of 2005 emission levels and the Kyoto target

In this option we analyse an approach which reflects some elements from option 3.1 and option 3.2.

If we assume a higher growth rate for the industries under the ETS for the EU-12 Member States, this could lead to more modest emission targets for these industries. However, we do not assume that the higher growth rates will completely compensate the necessary contribution of these industries to an absolute emission reduction. We assume the EU-27 medium ETS target for 2020; the related targets for the ETS sectors in the different Member States are derived as follows:

- In the 20% scenario the emission target is about 79% of the 2005 emissions levels for the power sector in the EU-15 Member States and half of this (about 89%) for the EU-12 Member States. For all other sectors under the ETS the target is 95% for the EU-15 and 98% for the EU-12.
- In the 30% scenario we assume an emission target of 63% for the power sector in the EU-15, 80% for the other combustion installations and 90% for the other TS sectors. For the EU-12 Member States the emission targets reflect only half of the absolute reduction targets of the EU-15; this equals 82% for the power sector, 90% for the other combustion installations and 95% for the other ETS sectors.

Since the special circumstances of the EU-12 Member States are reflected in a different way, the approach for the non-ETS sectors follows a methodology which is consistent to the general underlying idea of this option. The distribution of emission targets for the non-ETS sectors is based on the average of the implicit Kyoto target for the non-ETS sectors and the 2005 emission levels if the non-ETS sectors.

The results for the total emission targets are shown in Figure 47 and Figure 48. The approaches for the assignment of ETS and non-ETS emission targets to the Member States lead to the following targets:

- The EU-15 Member States face a target for the total greenhouse gas emissions which is 17.5% below the 2005 levels in the 20% scenario. For the 30% scenario this target level is -28.4%.
- The aggregate emission target for the EU-12 is +5.2% higher than the 2005 emission level in the 20% scenario. The respective target for the 30% scenario is -5.4%.
- The total emission target for Germany is -17% for the 20% scenario and -28.8% for the 30% scenario, compared to 2005 emission levels.

The more detailed analysis for the ETS and the non-ETS sectors leads to the following key findings:

- Not surprisingly the ETS target for the EU-15 is less tight than in option 3.2 but at -14.6% (compared to 2005 the emissions) still slightly tighter than in option 3.1 in the 20% scenario. In the 30% scenario the ETS target is -26.7% lower than the 2005 emission levels.
- The aggregate ETS target for the EU-12 is, at -8.1% in the 20% scenario, significantly tighter than in option 3.2. The respective target in the 30% scenario is at 14.6% much stronger than in option 3.2.
- For Germany the 2020 target for the ETS sectors is -17% below the 2005 emission levels for the 20% scenario, and -30.2% in the 30% scenario.

According to the definition of this option the emission targets for the non-ETS sectors differ between the Member States:

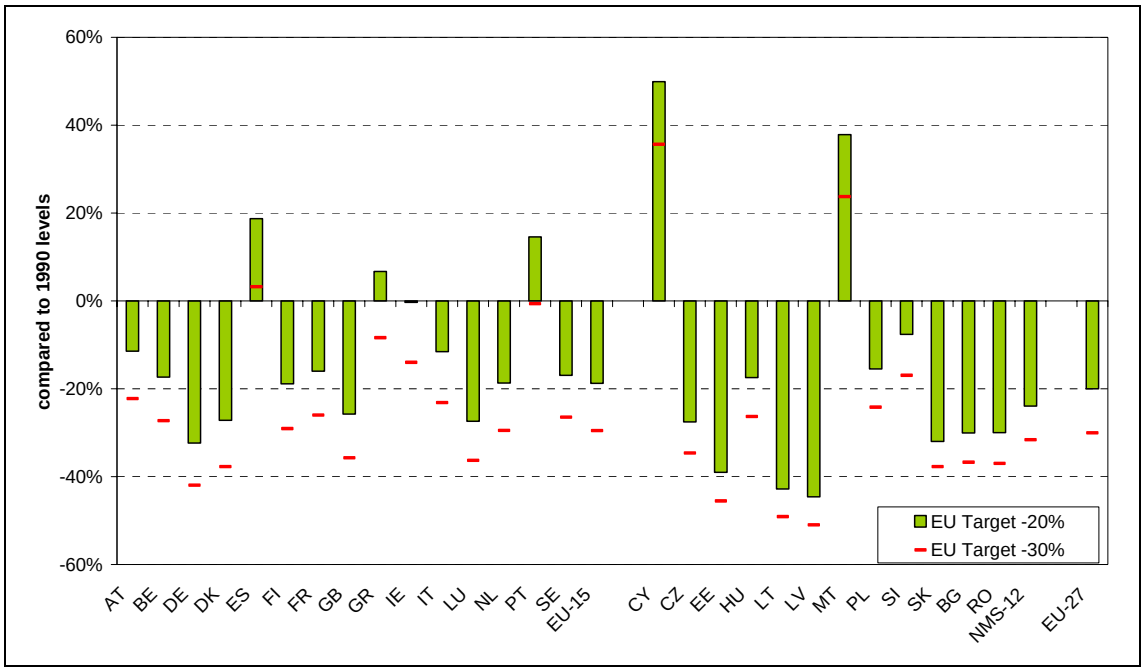
- For the EU-15 Member States the target for the non-ETS sectors is -19.5% below the 2005 levels in the 20% scenario and -29.5% in the 30% scenario.
- The 2020 target for the non-ETS sectors in the EU-12 Member States is +18.7% in the 20% scenario, compared to the 2005 emission levels. The respective target for the 30% scenario is +3.8%.
- For Germany the non-ETS sector target is -17.1% for the 20% scenario and -27.5% in the 30% scenario.

In summary, it can be concluded that:

- the more equal treatment of the ETS sectors in the EU-15 and the EU-12 (which implicitly assume growth rates in the ETS sectors which are twice as much than those in the EU-15) leads to small changes for the EU-15 ETS targets and more significant changes for the EU-12 which is purely an effect of the large share of ETS emissions from the EU-15 Member States;
- strong emission reductions must be targeted in many EU-15 non-ETS sectors (in the range of 20% to 30% below 2005 emission levels in the 20% scenario and in the range of 30% to 40% in the 30% scenario) whereas significant emission growth will be possible for the non-ETS sectors in many of the EU-12 Member States (between 10% and 50% in the 20% scenario and between 0% and 30% in the 30% scenario),
- the gains from the transition process will be mainly allocated to the non-ETS sectors of the EU-12 and only a small part will be redistributed amongst all EU-27 Member States.

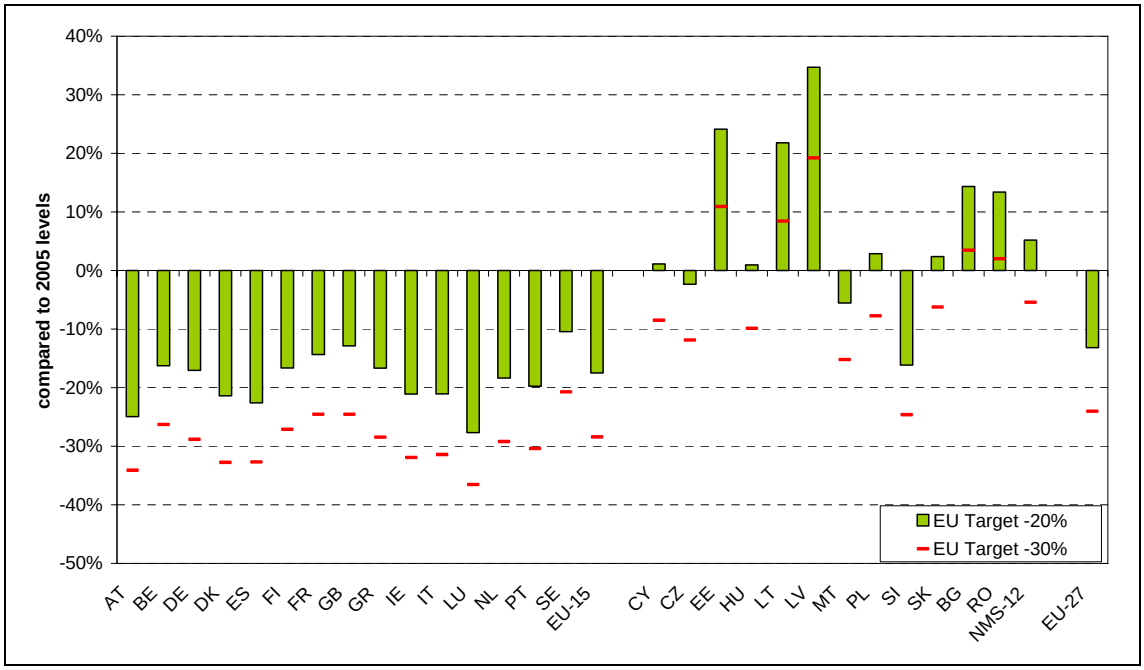
Even if the 2005 emission levels will be reflected to some extent, the total emission targets change only slightly for the EU-15 Member States from those which were calculated in option 3.2. The convergence of targets in the ETS sectors between EU-15 and EU-12 does not outweigh the dominating distributional effects caused by the consideration of (implicit) non-ETS Kyoto commitment levels for the non-ETS targets.

Figure 47 *Total emission targets for the EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2020 compared to 1990 emission levels*



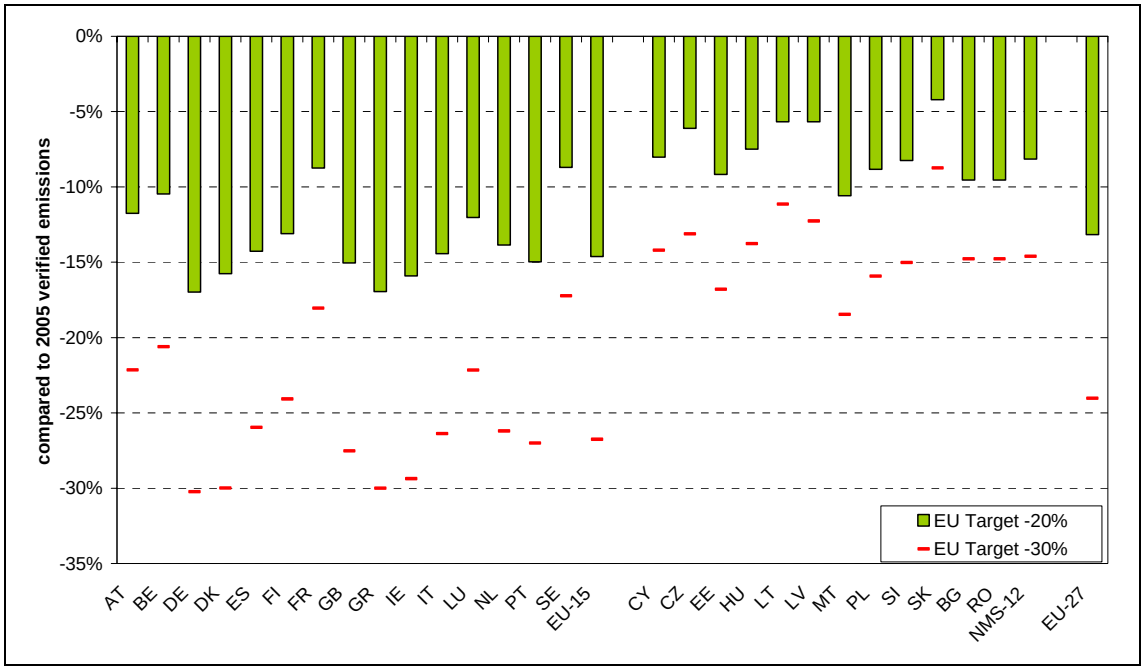
Source: *National Inventories, authors' calculations.*

Figure 48 *Total emission targets for the EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels*



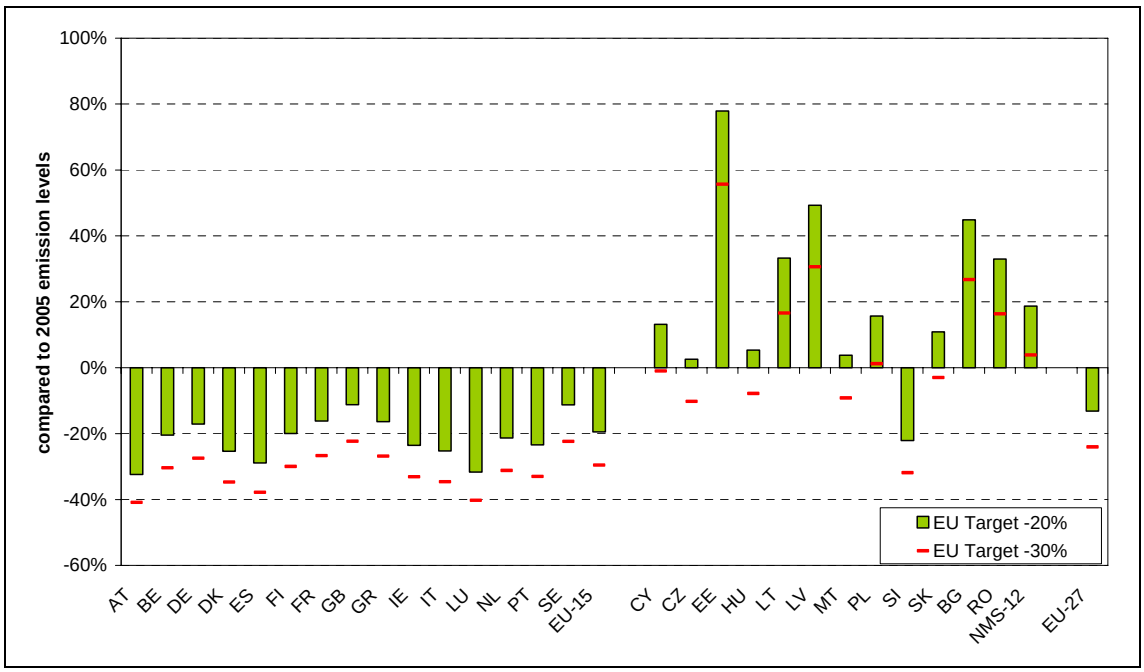
Source: *National Inventories, authors' calculations.*

Figure 49 *2020 targets for EU ETS phase 3 for the EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels*



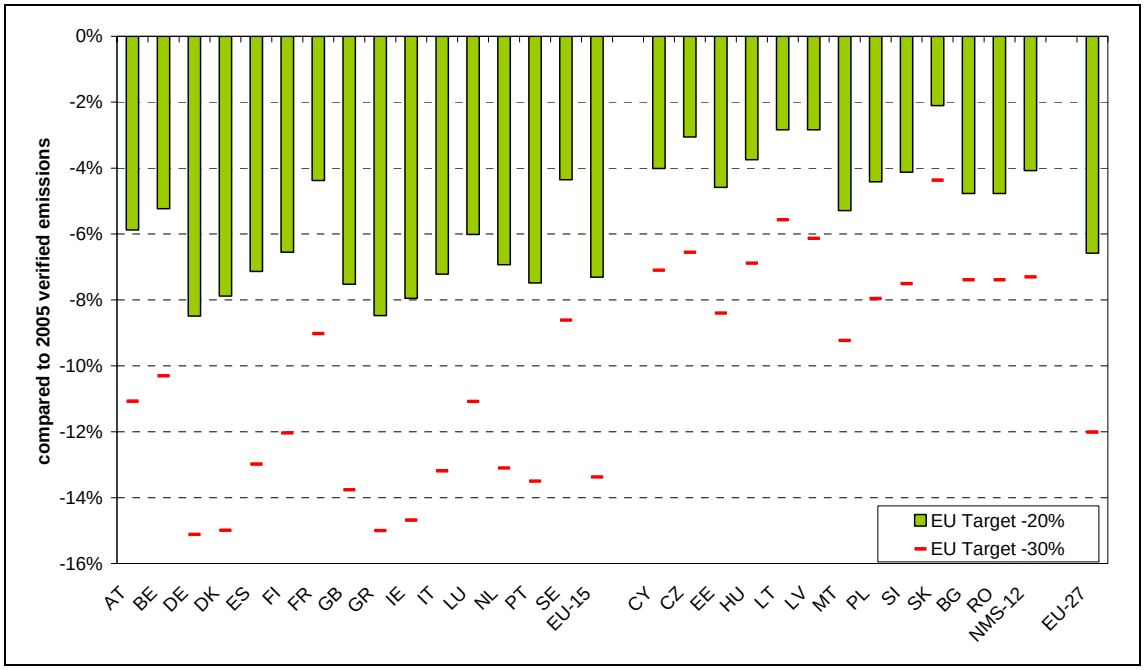
Source: *National Inventories, authors' calculations.*

Figure 50 *2020 targets for non-ETS sectors for EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2020 compared to 2005 emission levels*



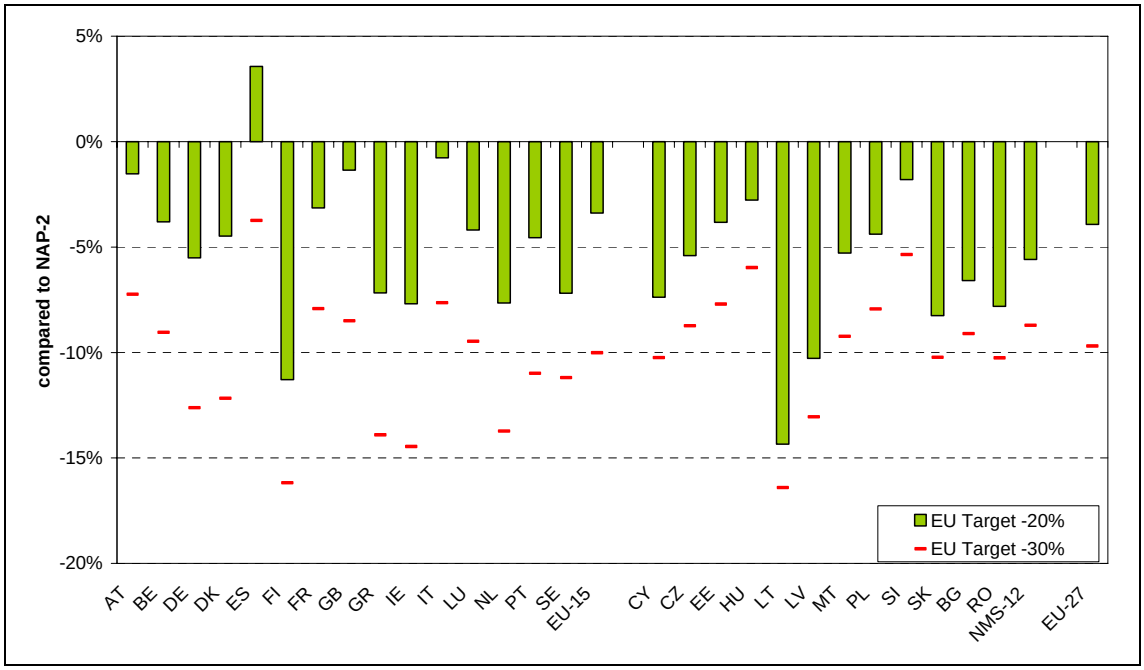
Source: *National Inventories, authors' calculations.*

Figure 51 *EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2013/2020 cap compared to 2005 emission levels*



Source: *National Inventories, authors' calculations.*

Figure 52 *EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap reduction for EU-15, modest sectoral ETS cap reduction for EU-12, and proportional non-ETS targets, 2013/2020 cap compared to phase 2 caps*



Source: *National Inventories, authors' calculations.*

5.4.5 Option 3.4: Sectoral cuts for ETS caps and non-ETS emissions

In this variant we use sectoral targets for ETS as well as the non-trading sectors to calculate the target sharing. The results are not proportional to any specific year but depend on the sectoral distribution of emissions of each Member State.

For the ETS targets we use the same approach and the same parameters as for option 3.1 (uniform sectoral reduction targets for the ETS sectors for the EU-27, i.e. 27% reduction for power plants, 20% for other combustion installations in the 30% scenario, etc.).

In addition, the distribution of the emission reduction requirements from the non-ETS sectors and installations are based on uniform emission reduction cuts for certain sources:

- in the 20% scenario the reduction target for non-ETS sources from energy and industry sectors is 10%, for transport 15%, for residential and tertiary sectors 17% and 10% for all other sectors and gases;
- in the 30% scenario the CO_2 emission reduction target for non-ETS sources from energy and industry sectors is 10%, for transport 34%, for residential and tertiary sectors 34% and 10% for all other sectors and gases.

The underlying assumption for this approach is that the differences in abatement potentials and costs as well as the growth of the driving forces for the non-ETS sectors are not significant for the single sectors. This assumes a wide convergence of the sectors between the Member States.

All emission reduction targets for the ETS and the non-ETS sectors refer to the 2005 emission levels.

Figure 53 and Figure 54 indicate the targets for the total greenhouse gas emissions compared to the 1990 and the 2005 emission levels:

- The EU-15 Member States would have to decrease their emissions by 14.7% by 2020 in the 20% scenario and by 24.2% in the 30% scenario, compared to the 2005 emission levels.
- The aggregate emission target for the EU-12 in 2020 amounts to -13.1% in the 20% scenario, compared to 2005 emission levels. The respective target for the 30% scenario is -23.2%.
- For Germany the emission target is -14.2% in the 20% scenario and -25.8% in the 30% scenario.
- Compared to 2005 emission levels, only comparatively small differences occur between the EU-15 as well as the EU-12 Member States. However, compared to the 1990 emission levels a wide diversity results between the different Member States.

The 2020 emission targets for the installations covered by the EU ETS are shown in Figure 55:

- The average target for the EU-15 Member States is a 13.0% reduction compared to 2005 in the 20% scenario and a 23.5% reduction for the 30% scenario.
- For the EU-12 Member States the 2020 target is 13.8% below the 2005 emission levels of the ETS sectors in the 20% scenario. The respective target for the 30% scenario is -25.7%.
- The ETS sector target for Germany in 2020 is -15% compared to the 2005 emission levels in the 20% scenario and 26.2% in the 30% scenario.

The total target for the EU-27 for the non-ETS sectors results from the aggregate EU target and the ETS cap (in this option the medium cap variant). The comparison shown in Figure 56 indicates the following trends:

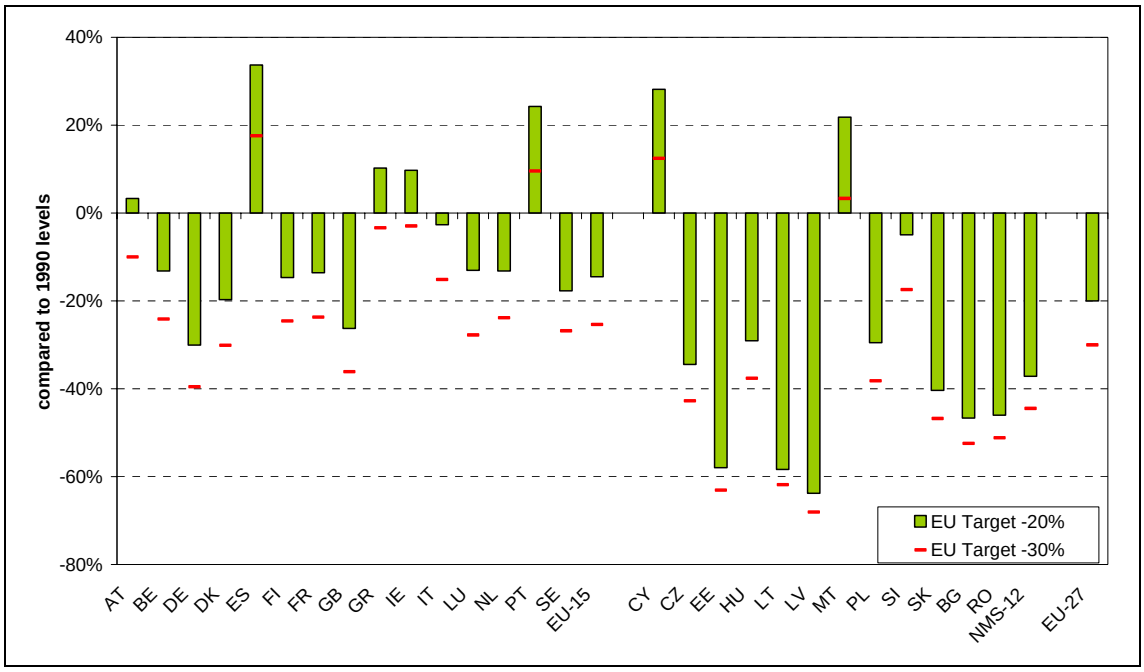
- For the non-ETS sectors of the EU-15 the target level for 2020 is 13.3% below the 2005 levels in the 20% scenario. In the 30% scenario the respective target is -24.7%.
- For the EU-15 the 2020 target is -12.5% compared the non-ETS emissions in 2005 for the 20% scenario, and -20.7% for the 30% scenario.
- The target for the non-ETS sectors in Germany is -13.6% for the 20% scenario and -25.5% for the 30% scenario.

In summary, it can be concluded that:

- the sectoral approach in the ETS sectors (based on a strong convergence assumption and largely motivated by concerns on competition distortions) as well as in the non-ETS (based on a strong convergence assumption) lead only to small differences in the additional efforts to reach the 2020 targets;
- the gains from the transition process and from other early emission reductions in the period before 2005 are redistributed between the Member States;
- this would limit the distributional effects between the EU Member States for the time horizon beyond 2005 but could create a perverse signal if this approach would also apply in future (updating problem).

As clearly can be seen from the comparison of Figure 54, Figure 55 and Figure 56, this approach creates differences in the targets for the total emission mainly because of the structural differences of the emissions covered by the EU ETS.

Figure 53 Total emission targets for the EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2020 compared to 1990 emission levels

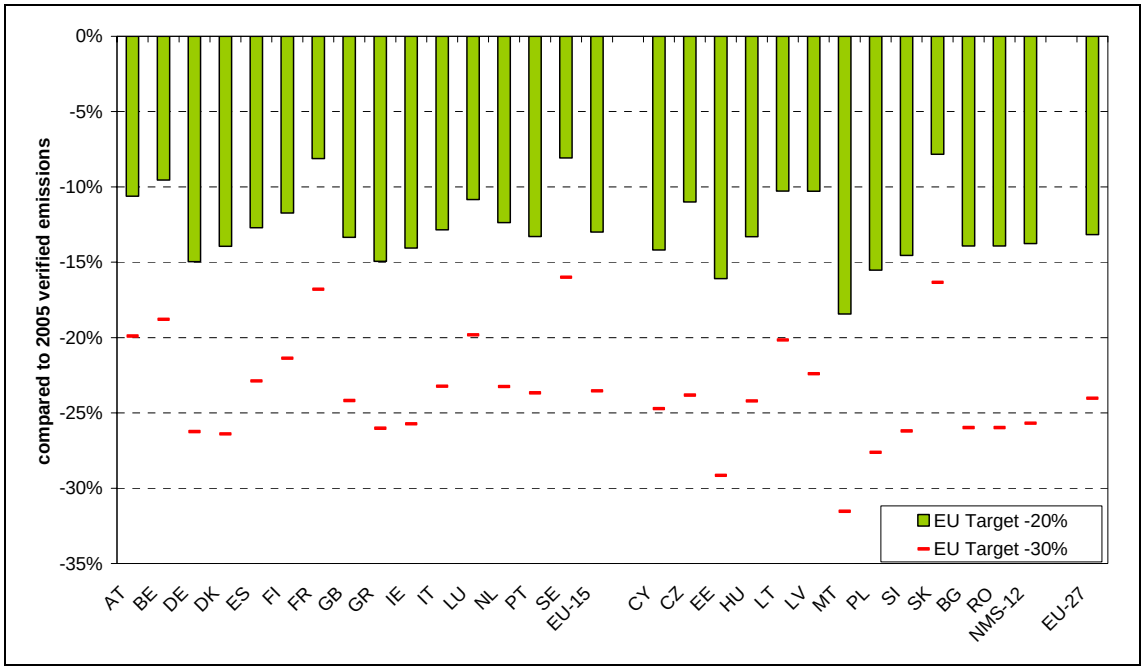


Source: National Inventories, authors' calculations.

Figure 54 Total emission targets for the EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2020 compared to 2005 emission levels

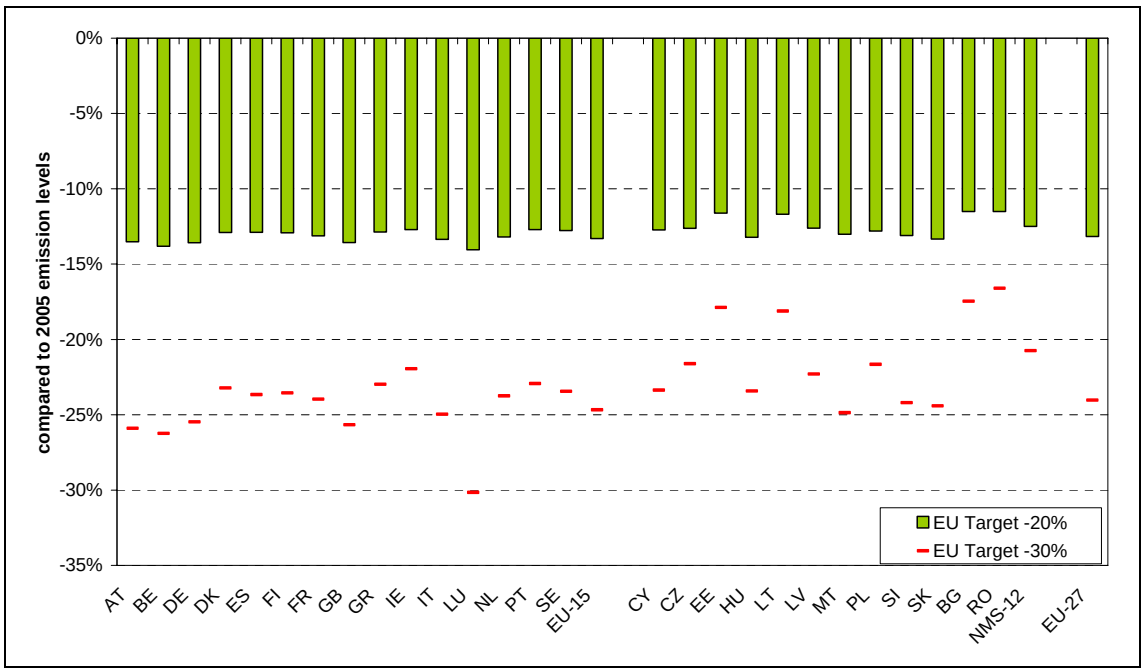
Source: National Inventories, authors' calculations.

Figure 55 *2020 targets for EU ETS phase 3 for the EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2020 compared to 2005 emission levels*



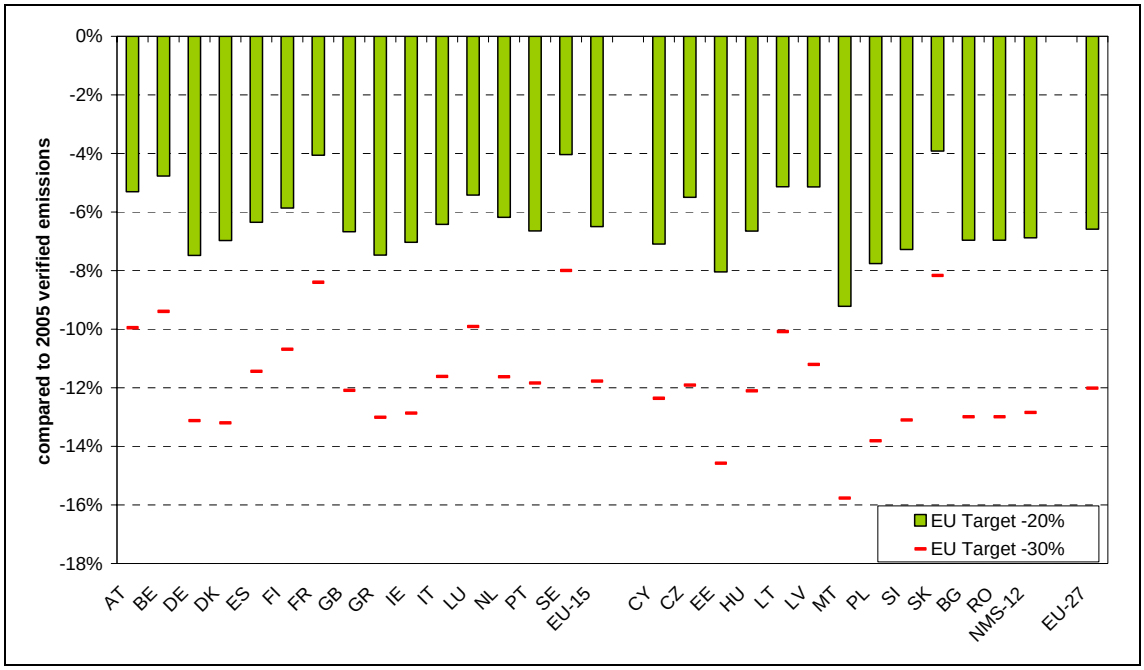
Source: *National Inventories, authors' calculations.*

Figure 56 *2020 targets for non-ETS sectors for EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2020 compared to 2005 emission levels*



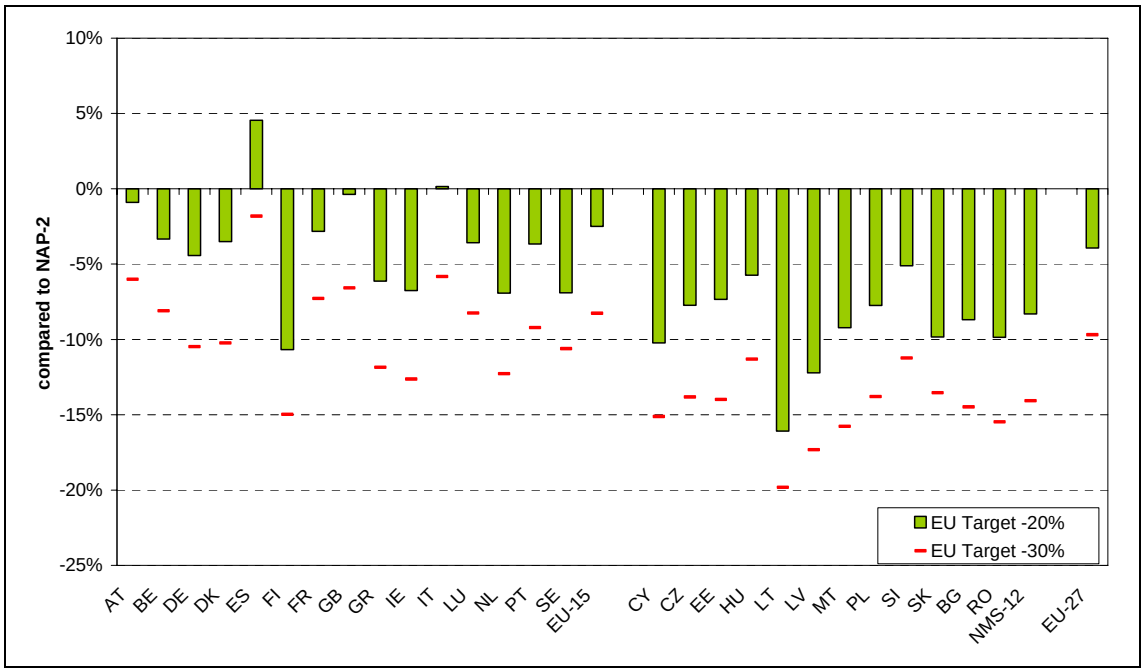
Source: *National Inventories, authors' calculations.*

Figure 57 EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2013/2020 cap compared to 2005 emission levels



Source: National Inventories, authors' calculations.

Figure 58 EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap reduction and sectoral non-ETS targets, 2013/2020 cap compared to phase 2 caps



Source: National Inventories, authors' calculations.

5.4.6 Option 3.5: Sectoral cuts based on EU wide policies and measures effects

In this option we also base the calculation of targets on a sectoral analysis. However, for the analysis of this option we use sectoral abatement potentials which could be assigned to several EU Several Directives and council conclusions.

The estimates for the effects have been taken from documents and publications of the European Commission:

- the estimates for renewables, CHP, fuel switch, other abatement options as well as biofuels and fuel quality has been taken from the Commission Discussion paper on GHG emissions 2020;
- the estimate for the Landfill Directive has been taken from the 2nd ECCP report[5];
- the estimates for the 20% energy efficiency targets have been taken from the EU action plan for energy efficiency[6]

The total effect was split between the trading sectors and the non–trading sectors to calculate the reduction by sector. Table 2 provides an overview of the EU wide policies and measures which were included in the calculations.

Table 2: Effect of EU wide policies and measures

EU wide policies and measures	Effect	Share ETS	Share non-ETS
Renewables	240 Mt CO2 eq	95%	5%
CHP, fuel switch, other abatement options	160 Mt CO2 eq	95%	5%
Biofuels & fuel quality	70 Mt CO2 eq	0%	100%
Landfill Directive (Waste)	28 Mt CO2 eq	0%	100%
20% EnEff Residential	201 Mt CO2 eq	70%	30%
20% EnEff Commercial buildings	139 Mt CO2 eq	70%	30%
20% EnEff Transport	231 Mt CO2 eq	0%	100%
20% EnEff Manufacturing Industry	209 Mt CO2 eq	80%	20%
Total	**1 278 Mt CO2 eq**	**61%**	**39%**

Sources: European Commission

The total of an addition of all listed EU PAMs is larger than the gap between 2005 emissions and the 30% reduction target for 2020. To avoid double counting effects and other inconsistencies we take into account 50% of the potentials that are listed in Table 2. For the 30% scenario which requires further reductions, the approach used in option 3.1 has been applied.

The sectoral emission reduction targets based on EU CCPM and additional national policies and measures (for the 30% scenario) lead to the following main sectoral targets:

[5] http://europa.eu.int/comm/environment/climat/pdf/second_eccp_report.pdf

[6] http://ec.europa.eu/energy/action_plan_energy_efficiency/index_en.htm

- a 20% reduction for the power sector for the 20% scenario and a 36% reduction for the 30% scenario (compared to 2005 emission levels);
- a 20% reduction for other combustion installations in the 20% scenario and a 31% reduction in the 30% scenario;
- a stabilisation of emissions at the 2005 levels for refineries and coke ovens in the 20% scenario and a 5% reduction in the 30% scenario;
- a 16% emission reduction for the other ETS sectors in the 20% scenario and a 20% reduction target for these sectors in the 30% scenario;
- a 20% emission reduction for the transport sector in the 20% scenario and a 28% reduction in the 30% scenario;
- a 6% emission reduction for the residential sector in the 20% scenario and a 20% reduction in the 30% scenario;
- an 11% emission reduction compared to 2005 for the commercial sectors for the 20% scenario and a 24% reduction for the 30% scenario;
- for CH_4 emissions the target is 3% in the 20% scenario and 13% in the 30% scenario;
- the 2020 target for N_2O emissions is an stabilisation on 2005 levels for the 20% scenario and a 10% reduction in the 30% scenario;
- for HFCs, PFCs and SF_6 the target for the 20% scenario is a stabilisation at 2005 levels, and a 5% reduction in the 30% scenario.

The pattern of results is to some extent comparable with the structure of targets in option 3.4.

Figure 59 and Figure 60 indicate the targets for the total emissions:

- For the EU-15 the aggregate target is a 13.1% reduction compared to 2005 in the 20% scenario, and a 23.7% reduction in the 30% scenario.
- For the EU-12 the target for the total greenhouse gas emissions in 2020 is -13.6 for the 20% scenario, and -25.1% in the 30% scenario.

The 2020 target for the ETS sectors is, at 1.836 Mt CO_2–e for the 20% scenario, more in the range of the strong cap variant and at 1.568 Mt CO_2–e for the 30% scenario between the medium and the strong cap variant (see chapter 5.3.2). Figure 61 indicates the targets for the ETS sectors:

- The aggregate target for the ETS sectors in the EU-15 is 16.4% below 2005 emission levels in the 20% scenario and -28.2% in the 30% scenario.
- The ETS target for the EU-12 is -18.4% for the 20% scenario and -31.5% in the 30% scenario.
- For Germany the ETS 2020 target is -17.6% in the 20% scenario and -30.9% in the 30% scenario.

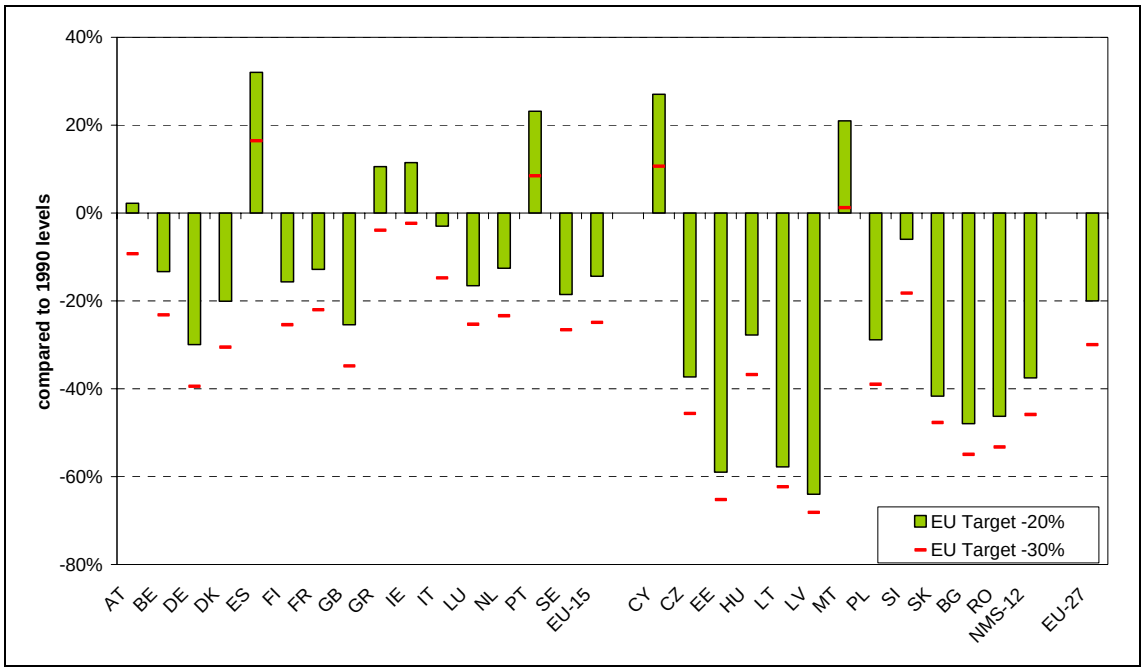
Regarding the non-ETS sector, slightly more modest emission targets result from the CCPM approach (Figure 62):

- For the EU-15 the 2020 target for the non-ETS sectors is -10.8% compared to 2005 in the 20% scenario and -20.6% in the 30% scenario.
- For the EU-12 the target is -8.7% for the 20% scenario in 2020, compared to 2005 emission levels and -18.7% in the 30% scenario.

In summary, it can be concluded that:

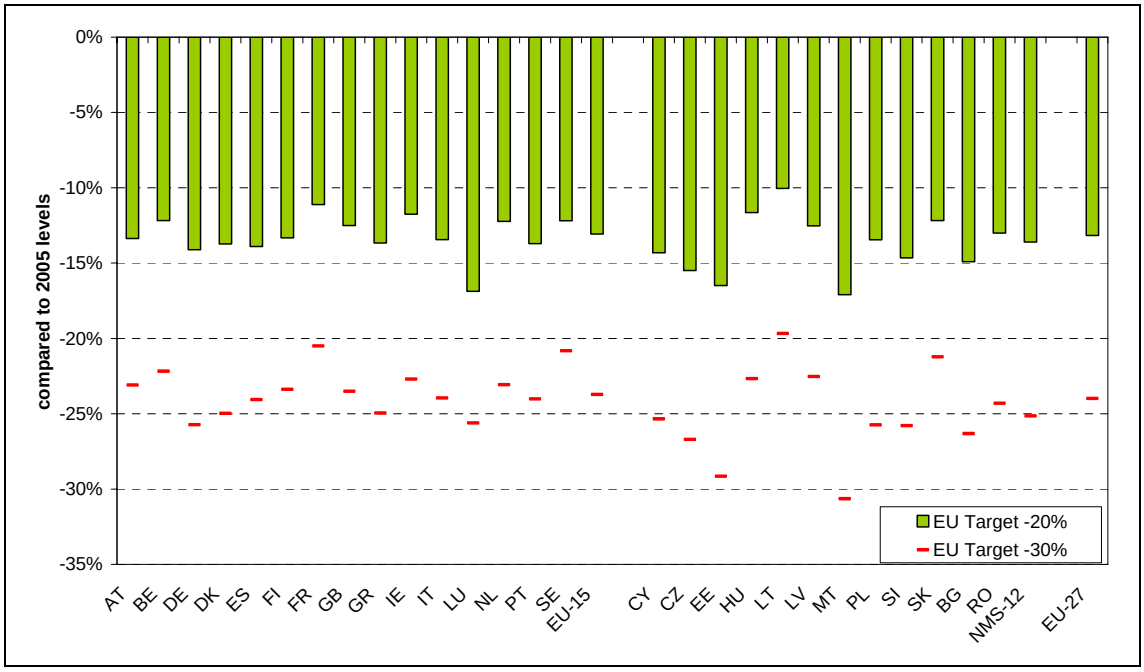
- the general pattern of results is comparable to those from option 3.4;
- the sectoral bottom-up approach leads to tighter emission targets for the ETS segment (more in the range of the strong cap targets);
- the spread between the different Member States is wider than in option 3.4;
- the wider spread for the emission totals is mainly an effect of the stronger targets for the ETS sectors which show much more significant differences between the Member States than those which can be observed for the non-ETS sectors.

Figure 59 Total emission targets for the EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2020 compared to 1990 emission levels



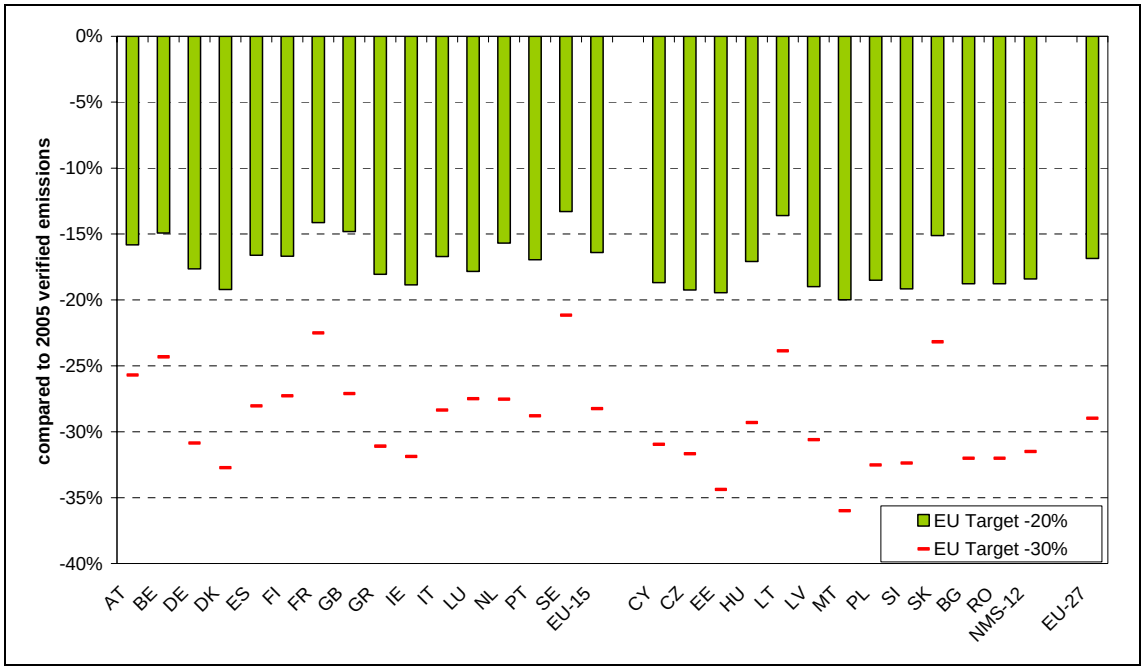
Source: National Inventories, authors' calculations.

Figure 60 Total emission targets for the EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2020 compared to 2005 emission levels



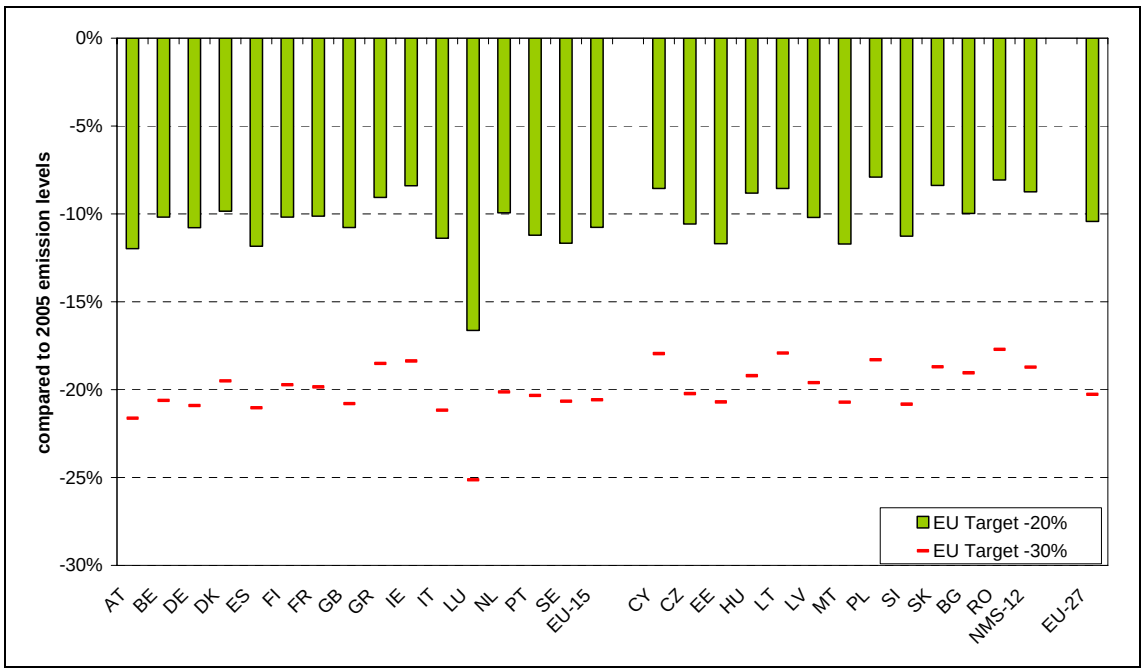
Source: National Inventories, authors' calculations.

Figure 61 *2020 targets for EU ETS phase 3 for the EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2020 compared to 2005 emission levels*



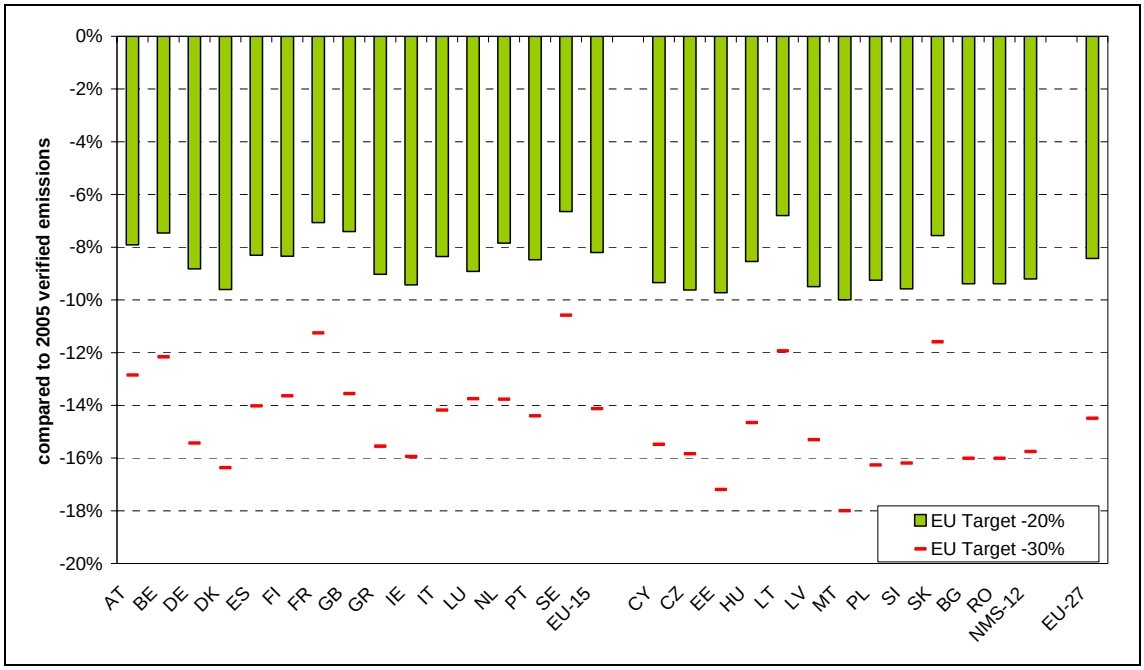
Source: *National Inventories, authors' calculations.*

Figure 62 *2020 targets for non-ETS sectors for EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2020 compared to 2005 emission levels*



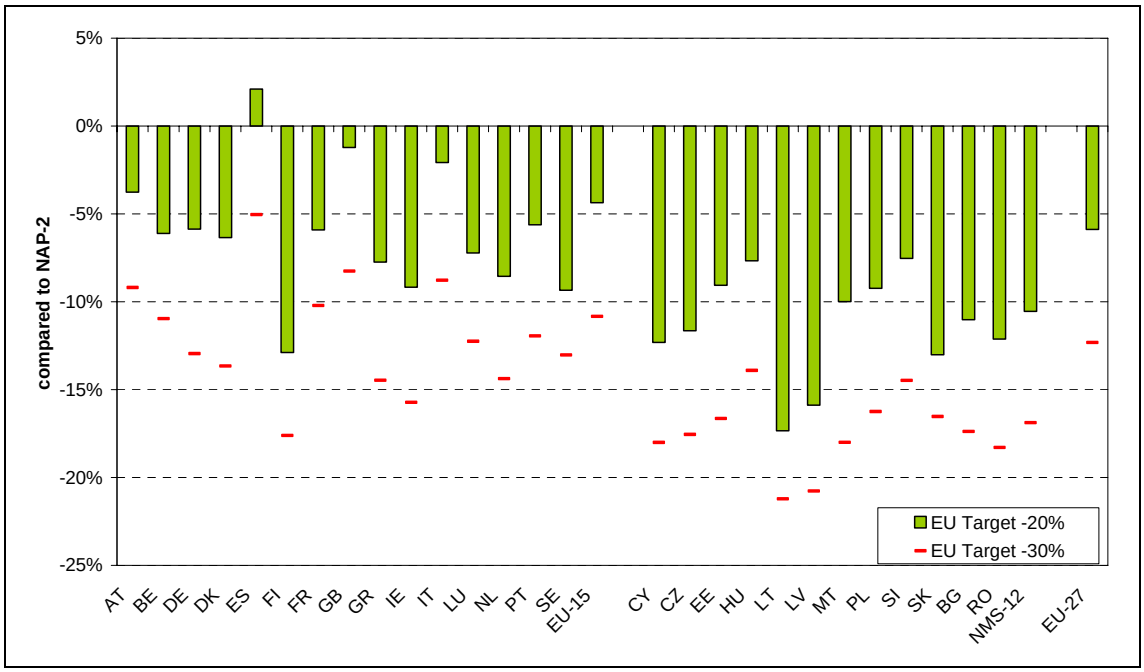
Source: *National Inventories, authors' calculations.*

Figure 63 EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2013/2020 cap compared to 2005 emission levels



Source: National Inventories, authors' calculations.

Figure 64 EU ETS phase 3 cap for the EU-27 MS, sectoral ETS cap sectoral non-ETS targets based on CCPM, 2013/2020 cap compared to phase 2 caps



Source: National Inventories, authors' calculations.

If the Member States are able to trade surplus allowances such spreads lead to:

- emission reduction gains from the transition
- levels from recent years provide (1) benefits to the countries which rely on Flex Mechs for Kyoto compliance and (2) removes the benefits from ‘hot air’ for the New Member States

Burden Sharing based on Kyoto commitments for 2008/2012 (1) does not honour the use of Flex Mechs in the first commitment period for the subsequent periods and (2) does extend the benefits from ‘hot air’ for the New Member States.

Role of ETS:

- EU-wide cap definition should be assumed;
- distribution of the EU-wide ETS cap among the Member States is decisive for the commitments regarding the emissions from non-ETS sectors;
- EU ETS caps relying on emission shares in 2005 lead to sharp emission reduction requirements either for transport or for the residential and commercial sectors;
- transparent and robust methodology for the cap sharing is urgently needed; sector-based approach could deliver robust results.

6 Complementary Analysis: Interaction between GHG and renewables targets

The interactions between the target sharing for total greenhouse as emissions and the cap setting for the trading phase beyond 2012 are not the only links which must be reflected in the analysis. In the framework of the comprehensive energy and climate policy package, the binding targets for the use of renewable energies play a crucial role.

By the year 2020 the EU-27 has set a binding target to increase the use of renewable energies to 20% of the total final energy consumption. If a significant share of this increase will be induced by additional policies in sectors which are covered by the EU ETS in general, this additional emissions mitigation will change the supply curve of mitigations and as a consequence the allowance price significantly. A weak allowance price could result from a combination of weak targets (caps) for the EU ETS and strong targets for renewable energies especially in the power sector. Such erosion of the EU ETS carbon price signal by additional political intervention could then lead to counterproductive effects.

Against this background, we undertook a rough analysis of these interactions between ETS caps and targets for renewable energies. This analysis is not based on economic modelling but on conclusions by analogy that reflect the market results we see from the first and the second phase of the EU ETS. Again, this rough assessment should not be seen as a substitute for more comprehensive economic modelling and is more of a complementary nature in order to derive some basic findings.

The methodological approach for the analysis is based on the following assumptions:

1. The buy-in of additional mitigation options into the EU ETS induced by complementary political measures (e.g. support schemes for renewable energies) represents the availability of free mitigation options. This could be seen as a relief of the cap if it was not reflected when the cap was defined. The allowance price will decrease as a result. However, costs will occur for the complementary measures but not within the ETS.
2. Although there are only assumptions on the counterfactual development, we can in some way link the observed allowance prices for the second phase of the EU ETS with the cap for phase 2 of the EU ETS.
3. If we consider that some of the significant mitigation options will be available in accordance to the rolling investment cycle, some mitigations which are reflected in the foreseeable allowance prices could also be available for comparable prices for the subsequent phases. Some other mitigation options are of a first order nature (e.g. merit order effects) and as such are not available additionally for future periods. Furthermore, all mitigation options depend on the framework of prices, etc. and the supply of external credits form the Clean Development Mechanism or Joint implementation. However, for a rough analysis we assume that additional mitigation efforts in the same magnitude as in the second phase

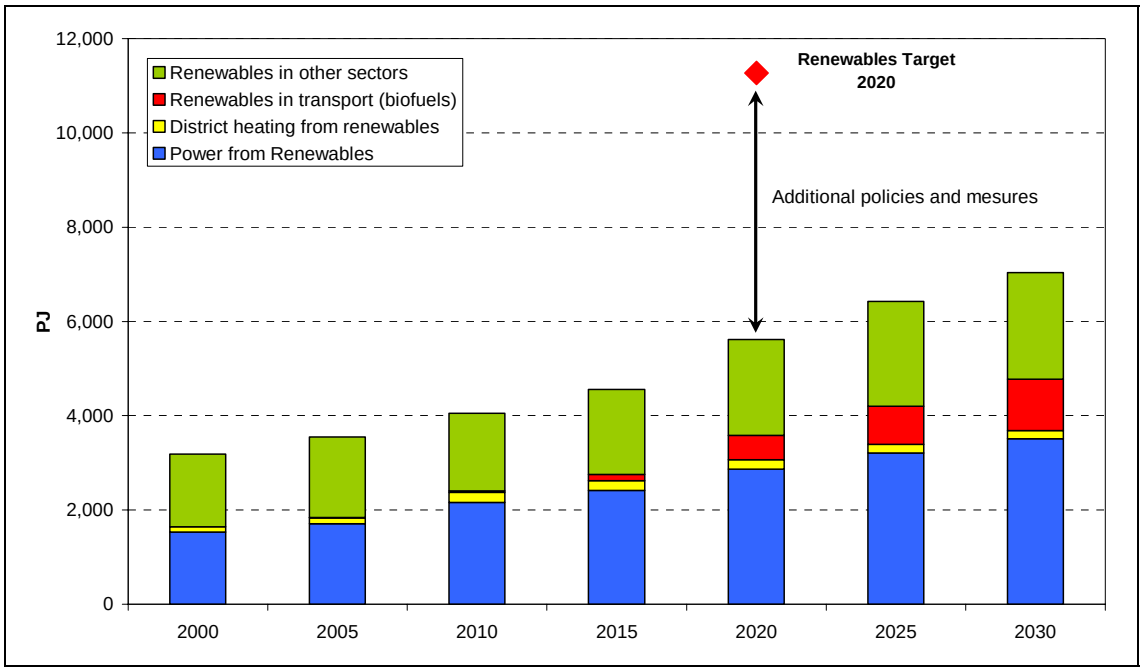
could lead to comparable (probably slightly higher) efforts being needed to reach the targets and as such to comparable allowance prices.

Based on these assumptions and starting points we analyse the following questions:

1. What is the order of magnitude for the additional CO_2 abatement delivered by renewable energies incentivised from complementary political measures?
2. What are the implicit cap reliefs for the EU ETS (as an expression for additional free of charge mitigation options for the scheme)?
3. How do these implicit cap reliefs relate to the emissions targets for the EU ETS in phase 2 and what conclusions could be drawn from this?

As the counterfactual development could be of crucial importance, we use the Primes Baseline Scenario (version 3 of the 2007 baseline runs, dated from 28 August 2007) as the baseline. The analysis was carried out in full for the EU-27 because the interactions mentioned above result only from the aggregate levels of caps and buy-in of renewable energies.

Figure 65 Final energy deliveries from renewables according to the Primes baselines, and the EU-27 renewables targets, 2000-2030.



Source: Primes, authors' calculations.

The Primes baseline is characterised by the following trends, indicated also by Figure 65:

- The total final energy demand grows from 48.7 EJ in 2005 to 51.6 PJ in 2010 and 56.4 EJ in 2020.

- The baseline includes a growth of total final energy from renewable energy sources from 3.6 EJ in 2005 to 4.0 EJ in 2010 and 5.6 EJ in 2020.[7] The major growth comes from additional power production from renewables. However, the contribution of biofuels grows from 0.008 EJ in 2005 to 0.026 EJ in 2010 and 0.515 EJ in 2020. The ratio between the final energy from renewables and the total final energy consumptions grows from about 7.3% in 2005 to 7.8% in 2010 and 10.0% in 2020.
- The total CO_2 emissions from those sectors which are covered by the EU ETS decreases slightly from 2005 to 2010 by about 33 Mt CO_2–e but increases from 2005 to 2020 by about 128 Mt CO_2-e.

From these key data we can derive the counterfactual trend as well as the efforts which have to be undertaken to reach the renewable energy targets by 2020.

- The baseline trend leads to an emissions increase for the ETS sectors of about 128 Mt CO_2–e by 2020 compared to 2005 levels.
- Regarding the 20% target for all renewable energies, an additional 5.7 EJ final energy from renewable energy sources must be supplied. If we consider the separate target of 10% motor fuels from biofuels, 0.8 EJ of the additional renewable energy must come from biofuels. As a result, about 4.8 EJ must be delivered for other sectors or in addition to the 10% transport sector target.
- We assume that on average the additional renewable energies will deliver a CO_2 abatement of 74 t/TJ for transport as well as heating and cooling and 155 t CO_2/TJ for power generation.[8]

For the analysis we use the three cap variants we defined in chapter 5.3.2 on the one hand and three different variants for the implementation of the renewable energy targets regarding the sectors:

- In a first variant we assume that three quarters of the additional deliveries from renewable energies (beyond the share which is necessary to meet the biofuels target) come from the power sector. As a result, an additional CO_2 emission mitigation of 562 Mt CO_2–e will be available for the EU ETS compared to the baseline. This is equivalent to a 434 Mt CO_2-e reduction compared to the 2005 emissions.

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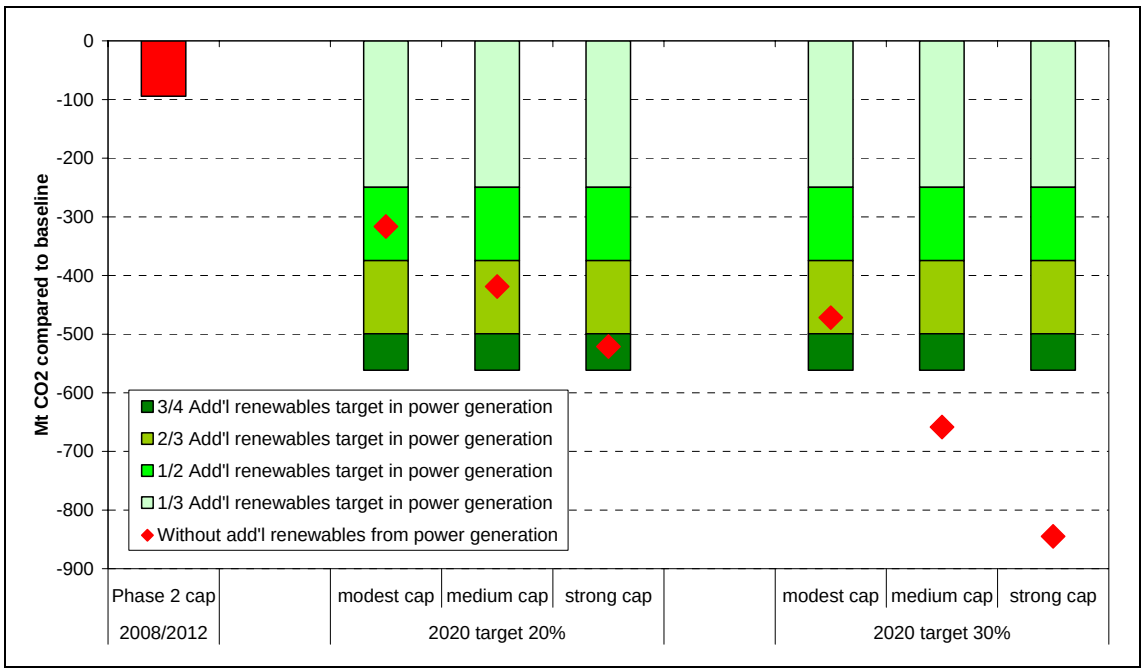
[7] To ensure consistency with the EU target which is based on final energy, we defined electricity and heat produced from renewable energies as final energy from renewable energies. Furthermore, the available statistical data do not allow for a differentiation of biomass and waste.

[8] This is a rough assumption for a power mix from 50% hard coal based power generation and 50% natural gas based power generation (new power plants). However, in some Member States additional power generation from renewables will substitute higher emitting sources (lignite) on the one hand. On the other hand in some Member States the replacement faces more gas-fired power generation. On average the substation rate we use seems to us to be a good one and a sufficiently conservative approximation of the general effects in the EU-27.

- In a second variant we assume that two thirds of the additional deliveries will come from additional power generation from renewables. This is an equivalent of a 499 Mt CO_2–e emission reduction compared to the baseline and an emissions reduction of 371 Mt CO_2–e compared to 2005.
- In a third variant we define the share of additional deliveries from renewable power as 50% which leads to an additional emission reduction of 374 Mt CO_2–e compared to the baseline and 246 Mt CO_2–e compared to the 2005 emission levels.
- In a fourth variant we assume a share of one third for the additional deliveries from renewable power generation. This equals an emissions reduction of 250 Mt CO_2–e versus the baseline and of 122 Mt CO_2–e compared to 2005.

Figure 66 Implicit reduction efforts within the EU ETS as a function of additional renewable energy supplies from power generation



Source: Primes, authors' calculations.

Figure 66 provides an overview of the implicit reduction effort of the different variants. The implicit reduction effort equals the net effects from the additional gratis mitigation potentials from additional renewable energy supplies and the growing baseline, based on the cap variant (modest, medium and strong for the 20% and the 30% target) expressed as reduction target compared with baseline emissions.

- The implicit reduction effort for the 2008-2012 phase is about 95 Mt CO_2-e resulting from a cap that is 127 Mt CO_2–e below the 2005 emissions and the baseline for 2010 which is 33 Mt CO_2–e below the 2005 emission levels for the sectors covered by the ETS.

- In the 20% scenario the implicit reduction effort for 2020 would be less than zero in case of the modest cap and the case the 50% variant for the additional deliveries from renewable power generation. For the medium cap and the 2/3 variant for additional power generation from renewables the implicit cap is about 44 Mt CO_2–e. However, this an increase of emissions compared with the reduction effort for the phase 2 target for 2008-2012. In case of the strong cap the implicit cap is only more tight than the phase 2 cap if the additional power generation from renewables is less than 2/3 of the total need for the expansion of final energy supplies from renewables.
- The other extreme is the strong cap in the 30% scenario for the variant that only one third of the additional final energy supplies from renewable energies which are necessary to meet the EU target would come from the power sectors. The implicit reduction effort for 2020 is at a level of 595 Mt CO_2–e in this case.
- Without additional power generation from renewables the implicit reduction effort would be in the range of 317 and 845 Mt CO_2–e compared to the baseline.

The three-quarters and the two-thirds variant for all cap variants in the 20% scenario and the three-quarters and the two-thirds variant of the modest cap in the 30% scenario represent implicit reduction efforts in which the additional efforts from 2010 to 2020 are lower than the reduction effort for the phase 2, compared with the baseline emissions.

For all other variants and especially the strong cap variants and the caps within the framework of the 30% scenario, the efforts within the ETS to reach the 2020 targets will significantly exceed those levels which can be assumed for the second phase of the EU ETS.

The reduction efforts could exceed the efforts to reach the phase 2 caps by a factor of up to 5 (strong cap variant in the 30% scenario with an additional contribution of power generation from renewables of 50% to the total renewables target). Especially in the medium and strong cap variant of the 30% scenario a significant share of power generation from renewable energies incentivised by complementing policies and measures could be essential to limit the necessary efforts and allowance prices to reach the 2020 targets.

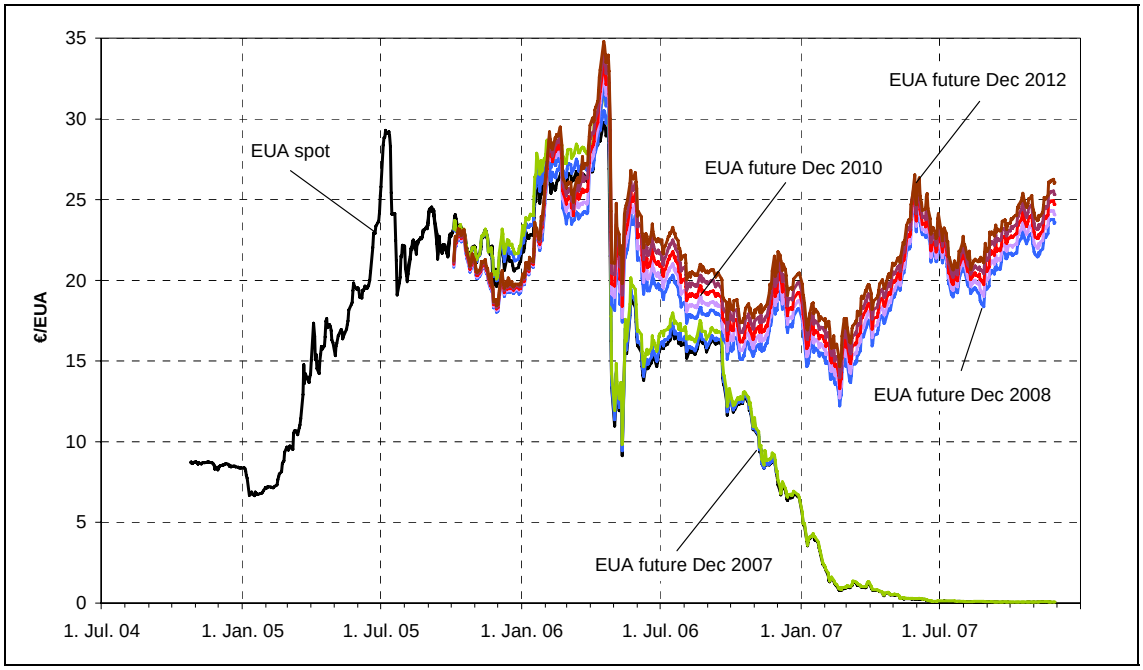
The reference to the implicit reduction effort allows us to compare future reduction efforts with the efforts which were already priced by the allowance market. Figure 67 shows the price trends in the spot market as well as the futures market for the first and the second phase of the EU ETS. Especially the different patterns for the first and the second phase highlight the fundamental difference between the two phases:

- After the publication of the 2005 verified emission data it became clear that the number of available allowances significantly exceeds the total emissions covered by the EU ETS in the pilot phase. As a result the allowance price has crashed to much less than 1 € since spring 2007.

- The very strict approach of the European Commission in the approval of the National Allocation Plans of the EU-27 Member States lead, among other factors, to significant levels of allowance prices which indicate a price level between 20 € and 25 € per EUA for recent months.

In other words, an implicit reduction effort of about 100 Mt CO_2–e was mirrored by the allowance market with allowance prices of about 20 € to 25 €/EUA.

Figure 67 Spot and future EU allowances prices, 2004-2007



Source: EEX.

Ceteris paribus, comparable reduction efforts for the phases after 2012 could lead to a comparable range of allowance prices. If the supply of project credits for significantly lower prices were to increase, it would lead to lower prices; certain energy market trends (higher gas prices, etc.) would lead to higher allowance prices. The consideration of first order effects in contrast to the rolling window of investment opportunities in sectors with a long living capital stock could lead to somewhat higher allowance prices.

Such rough conclusions of analogy clearly have strong limitations and cannot substitute economic modelling. However, some robust trends should be highlighted:

- In the case of the 20% scenario, probably only the strong cap variant (for the lower and medium variants for additional power generation from renewable energies) would maintain a level of allowance prices that is comparable somehow to the EU ETS phase 2 market results.
- For the 30% scenario especially for the medium and strong cap option the variants with strong contribution from renewable power generation (i.e. the three-

quarters and the two-thirds variant) could limit the necessary efforts within the EU ETS and as such the allowance price increases – if this is a major concern.

In summary it can be concluded that the interactions between ETS and renewable energy targets must be seriously considered in the definition phase for caps and targets, but there are sufficient options (tighter caps, assignment of targets to renewable power generation) for avoiding counterproductive effects for both the EU ETS, and the renewables targets.

7 Conclusions

The target sharing for the total greenhouse gas emission targets for 2020, the cap setting for the EU ETS for the periods beyond 2012 and the target sharing for the renewable energies commitments are complex and interlinked issues.

There are different options which could constitute the general approach to identify target sharing models. The short analysis on the different approaches (economic approaches focussing efficiency, equal burdens, with or without flexibilisation on the one hand, complex and simple structural approaches on the other hand) shows that many advantages and deficits must be stated for every approach. However, the robustness and transparency of the different approaches is of key importance for the target sharing exercise. The simple structural analysis was identified as a robust and transparent approach which can provide interesting insights, eventually possibly as a complementary analysis to other analytical approaches.

The comparison of the different scenario analyses based on the simple structural approach leads to some general principles:

- Target sharing approaches which are based on emission levels and structures from recent years at the whole or partly (ETS or non-ETS segment) lead to the need for relatively more efforts for countries which have decreased their emission in the past significantly. Other countries which ensure their compliance to the existing commitments with purchases of emission credits will relatively benefit from such approaches.
- The emission reduction gains from the transition process of the EU-10 (EU-12 without Cyprus and Malta) will be redistributed among the Member States if the target sharing is based on data from more recent years.
- If the target sharing is fully or partly based on 1990 emission levels and structures or the existing burden sharing commitments for 2008-2012, very strong emission reduction targets occur for many of the EU-15 Member States; significant emission increases for most of the EU-12 would still fit in with their 2020 targets.

However, a wide spread of targets for 2020 (compared to the recent emission levels) must not necessarily be seen as a prohibitive approach but will lead to major distributional effects if the Member States must trade significant amounts of allowances. The key question is to what extent emission reduction gains from the past should be redistributed among all Member States in the framework of more or less strong future commitments of the EU-27 as a whole.

The definition of the cap for the EU ETS plays a crucial role in the framework of the target sharing. Whether the cap is set EU-wide and then assigned to the Member States or the installations covered by the EU ETS are defined as an ‘additional Member State’, a separate analysis of the ETS and the non-ETS is inevitable for the target sharing analysis. Setting the size of the EU-wide ETS cap is a crucial staring point for the

analysis. Against the background of the uncertainties related to the unilateral and the multilateral commitments of the EU the following points on the cap setting should be highlighted:

- If the cap is defined on a medium or modest level in the framework of the 20% scenario than the potential adjustment of the total share would require additional efforts in the non-ETS sectors which will probably lead to a major reliance on non-domestic emission reductions, in other words: major emission reduction credit purchases. Only a strong cap variant in the 20% scenario could also fit somehow in the framework of the 30% scenario. As an alternative, the length of future trading phases should be defined in a way which allows for cap adjustments before the year 2020.
- Furthermore, the analysis of the interactions between the EU ETS and the renewables targets shows that a major erosion of the allowance price could occur if the renewables targets are implemented in the power sector to a large extent (more than 50% of the necessary expansion of total final energy from renewable energies) and the cap would be based on the modest or medium variant within the 20% scenario (significantly less than an 18% reduction compared to 2005 emission levels from the ETS sectors).
- The definition of the ETS sector target and a possible assignment to the Member States dominates the outcome of the target sharing for the total emissions in many cases. Also against this background, the cap setting within the EU ETS is the key exercise of the target sharing.

If the EU-wide cap should be assigned to the Member States (because of auctioning revenues or the architecture of the future international regime) the following findings should be highlighted:

- If the assignment to the Member States is based on flat rate approaches, significant competition distortions can occur because of the strong differences in the structure of branches which are covered by the EU ETS in the different Member States.
- Sectoral differentiation could constitute a suitable and robust approach to reflect the different structures of the EU Member States. Even if different growth rates will be assumed for some sectors between the Member States (which is relevant especially for the EU-12 Member States) this could be integrated into sectoral differentiation approaches without major complications. The significant differences between the total emissions covered by the EU ETS in the EU-15 and the EU-12 Member States lead to limited changes for the EU-15 even if significant adjustments are assumed for the EU-12 Member States.
- With the cap setting for the first and the second phase of the EU ETS a clear pathway is defined for future cap setting and its breakdown to sectors and/or Member States: The caps will refer to more recent emission levels, the emission reduction gains from the transition process will not materialise within the

EU ETS. In the context of potential competition distortions among the industries in the EU-27 this is an important starting point.

Whatever the approach for the EU ETS is, the Member States will definitely remain in charge of the 2020 commitments for the emissions from the non-ETS sectors.

- All approaches which rely on early base years or the non-ETS shares in the 2008-2012 commitments (if these are expressed as the difference between the total commitments and the ETS cap) will lead to significant emission reduction targets for the EU-15 and a strong potential for emissions growth or allowance sales for most EU-12 Member States. Even for approaches which combine more recent reference years and the existing commitment structures, the emission reduction gains from the transition period dominate the outcome.
- The divergence between the real emission trends and the commitments under the EU burden sharing in the framework of the Kyoto Protocol from 1997 are so significant that a pure reference to these 'historical commitments' will probably not constitute a reliable basis for the 2020 target sharing because of the order of magnitude of the distributional effects (e.g. if non-ETS should target 30% to 50% emission reductions in the EU-15 and the non-ETS sectors in the EU-12 could increase emissions about 50% as in option 3.1). However, the use of more recent reference periods will create the updating problem with its perverse incentive signal (Member States could benefit from delayed efforts).
- If the targets for the non-ETS sectors are based on recent emission levels and structures the emission reduction gains from the transition period for most of the EU-12 Member States will be redistributed among all EU-27 Member States.
- Approaches based on sectoral emission structures which are adjusted for major differences in growth rates in certain sectors could constitute an appropriate starting point for the target sharing regarding non-ETS sector emission targets. Neither flat rate approaches for the non-ETS sector emissions nor simple sectoral differentiation approaches will be able to soften major distributional effects of target sharing for the non-ETS sector emissions.

Last but not least, the analysis presented in this paper has set a strong focus on sectoral analysis and a differentiation between the EU-15 as one group and the EU-12 as another one. The more detailed analysis shows that within both of the groups there are Member States which in some way fit better into the characteristics of the other group (Cyprus, Malta and Slovenia regarding the EU-15, Germany to some extent regarding the EU-12). The further analysis should focus on such additional differentiations in a much more in-depth fashion than was possible in this study.