The environmental effectiveness and economic efficiency of the European Union Emissions Trading Scheme:

Structural aspects of allocation

A report to WWF

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Öko-Institut led the analysis, defined the methodology and the roster of analysis, analysed the country-specific information on Germany and was ultimately responsible for delivering this report. The other partners provided more general comments on the approach and the findings.

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EXECUTIVE SUMMARY

Environmental effectiveness and economic efficiency of the EU Emissions Trading Scheme

Market-based policy tools are increasingly regarded as an effective and reliable means of environmental policy, especially in climate policy. They are attractive options for environmental policy because of the combination of environmental effectiveness and economic efficiency.

Among the different market-based environmental policy tools, cap-and-trade emissions trading schemes received special attention after the inclusion of international emissions trading in the Kyoto Protocol to the UN Framework Convention on Climate Change. Within this framework, and given that the European Union (EU) is, in addition to its Member States, a party to the Kyoto Protocol, the EU decided to implement a community-wide Emissions Trading Scheme (EU ETS) for greenhouse gas emissions.

In a perfect emission trading scheme, the environmental effectiveness of the scheme is given by the cap and the efficient allocation of resources is guaranteed by the information exchange among the trading entities via prices and market mechanisms.

The allocation of allowances to sectors and installations was for a long time seen as a pure distributional problem in the academic and political debate. However, initial experiences with regard to the effective implementation of the EU ETS show that some key provisions were implemented in some Member States that could have significant negative impacts on the economic efficiency of the scheme and could create fairness problems which will have significant effects on the environmental effectiveness of the scheme in the medium and long term. If the costs of emission abatement increase, the definition of the necessary caps to combat global warming will face much more resistance in the future and could obstruct an effective contribution of the ETS to climate policy. Against this background, strong ties should be seen between the economic efficiency and the environmental effectiveness of an ETS if this scheme is meant to play an important role in medium and long term climate policy.

Purpose and scope of the report

WWF has commissioned Öko-Institut together with a consortium of co-operation partners from across Europe – AVANZI (Italy), EcoSolutionsConsulting (Poland), ILEX (UK) and ILEX Iberia (Spain) – to evaluate the allocation provisions from the National Allocation Plans for the pilot phase of the European Union Emissions Trading Scheme (EU ETS) with regard to their impacts on environmental effectiveness and economic efficiency.

The purpose of this report is to provide an independent analysis of the National Allocation Plans in six Member States - Germany, Spain, Italy, the Netherlands, Poland, Spain und the UK – in terms of environmental effectiveness and economic efficiency.

- We compare and contrast the different ways in which six Member States of the European Union have chosen to allocate the European Union Allowances (EUA) to the installations and analyse these allocation approaches in their NAPs for the pilot phase (Phase 1).
- This analysis includes the principles and provisions surrounding allocation of allowances to existing installations in the scheme, to new entrants, how plant closures are treated, their interactions, and plans for the use of credits from the Clean Development Mechanism (CDM) and Joint Implementation (JI) at the level of installations.
- Based on the lessons learnt from the Phase 1 of the EU ETS, different options for allocation approaches in future phases of the EU ETS are analysed and conclusions are drawn for the Phase II and for the time horizon beyond 2012, including some key harmonisation needs.

The assessment of allocation approaches is partly based on a qualitative analysis and in some dimensions derived from a detailed quantitative examination of allocation provisions in order to assess the impact of different provisions on the incentive structures, efficiency and environmental effectiveness, which are critical to the successful implementation of the scheme. Definitions are provided in Chapter 1.3 and methodologies are detailed in Chapter 2.

Focus of the study

The structural analysis of allocation provisions in this report focuses on the power sector. This is chiefly because:

- the power sector plays an outstanding role in terms of its share in the total greenhouse gas emissions of the six EU Member States analyzed in this report as well as in the European Union;
- the emission trends in the power sectors of the six countries were the major driver for the emission increase of the sectors covered by the EU ETS for the last five years;
- the capital stock in the power sector is characterised by long-living assets; the allocation provisions for the power sector will set the course for future greenhouse gas emissions trends in the EU;
- the power sector has proved to be very influential in the NAP process in many Member States and if key improvements of allocation provisions for the power sector could be achieved, it would constitute a strategic direction for the allocation approach in the framework of the EU ETS.

Criteria for the assessment of allocation provisions

In this study we refer to the four key criteria for the assessment of key allocation provisions for the power sector in terms of environmental effectiveness;

- **economic efficiency:** the overall costs of meeting a given target (the cap) should be minimized;
- **fairness:** the allocation to installations should not distribute burdens and benefits between the installations and operators in a way that major market distortions could result;
- **transparency:** the methodology for the allocation should be clearly documented and traceable for operators, other market agents and the stakeholders; the uncertainties on the outcome of the allocation process should be minimized for both the operators of installations and other market agents or observers;
- **simplicity:** the allocation provisions should be streamlined to ensure the lowest administrative and transactional costs and to avoid unintended and adverse side effects of interacting provisions.

Analysis of the Phase 1 NAP allocation provisions

The general intention of the pilot phase of the EU ETS was to gather experiences to improve the EU ETS for following periods. Member States had a significant flexibility in the implementation of their National Allocation Plans (NAPs) in terms of various principles, approaches and provisions for the allocation of allowances to installations, both existing installations and new entrants.

The allocation rules are clearly documented and traceable for all Member States except Spain. However, very different uncertainties existed on the outcome of the allocation process because the final allocation resulted from complex interactions between the different allocation provisions in some countries. The more special provisions applied by the Member States, the lower the transparency on the allocation outcome was. Consequently, important interactions result between the simplicity and transparency of the allocation approach. As a result, the assessment of the transparency and simplicity of the provisions in the NAPs is differentiated and shows a wide range.

The assessment of economic efficiency and fairness is to a large extent based on a quantitative analysis of the allocation provisions to installations in the power sector. The main findings and general considerations of the analysis are outlined below.

Allocation to existing installations

The incentives to reduce emissions from existing plants - either by change of merit order or different technical improvements – do not depend on the real costs for purchasing allowances. The incentives provided by the ETS in a certain period amount to the full costs of carbon, including the real costs for purchasing allowances as well as the opportunity costs of allowances allocated for free to the installations. In this case, the different allocation provisions do not change any incentives to decrease emissions in existing plants. The only exception is when ex-post adjustments apply, as is intended in Germany. Ex-post adjustments were intended to avoid certain windfall profits but as a secondary effect ex-post adjustments eliminate carbon pricing in the framework of the ETS for the installations to which these provisions apply.

Allocation to new entrants

Investment decisions on new plants could be significantly influenced by the allocation provision in the NAPs. All six Member States decided to allocate allowances to new entrants for free based on emission benchmarks for power plants or comparable requirements (best available technology). The allocation provisions in most Member States (except the UK) eliminate the price signals from the EU ETS (and therefore the incentive structure to invest in low-carbon plants) to a large extent.

The economic incentives from the allocation to new installations in most countries do not reflect the different emission levels of new plants. Furthermore, the complex and highly differentiated allocation provisions for new entrants in some Member States (e.g. Italy) can even create significant perverse incentives to invest in more emitting technologies.

A critical review of the provisions for new entrants is key for the future improvement of the EU ETS. The counterproductive allocation to new entrants depending on the fuel used or the technology applied should be removed to ensure that operators are given the right price signal which is the key mechanism of the ETS. The allocation to new entrants based on product-specific benchmarks is the favoured approach to achieve this.

Treatment of Combined Heat and Power (CHP)

All countries except the UK have introduced special provisions for CHP installations because this technology faces special problems under an ETS which does not include all emission sources (e.g. heat boilers with a thermal input capacity of less than 20 MW). The allocation to new entrants is the most important issue in this field. Most countries have set up appropriate allocation provisions to reward the high energy efficiency of parallel production of heat and power in new CHP installations.

New entrants reserve

If there is a free allocation to new entrants, a new entrants reserve (NER) will be necessary. The size of the NER differs significantly between countries. In some countries (e.g. Germany and Spain) the NER was significantly reduced in the bargaining process of the cap.

Most countries (the UK, Spain, the Netherlands and Poland) apply a ‘first-come, first-served’ approach, whereas Germany and Italy guarantee free allocation - if the demand exceeds the reserve, the government will replenish the reserve.

The most appropriate way to ensure availability and fair access is the Dutch approach which differentiates between the NER for ‘known new entrants’ and ‘unknown new entrants’. If the NER for both segments is subject to a transparent process of public participation, an appropriate size of NER could be ensured and the ‘first-come, first-served’ approach will not lead to fairness problems.

Plant closure

The provisions on plant closure face different challenges. If allowances are allocated for free to existing and to new installations and operators may retain the allowances allocated to plants that were shut down, the problems of windfall profits and leakage could arise. In spite of this distributional or fairness problem, plant closure provisions can significantly incentivise the closure and (early) replacement of old plants. Furthermore, stopping operators from bypassing plant closure provisions is far from simple because in many cases there is no reliable way to identify effective plant closures, if the operator himself does not notify the authority of a plant closure.

Apart from the Netherlands, all Member States analysed in this study do not continue the issue of allocated allowances in the case of plant closure. Some countries require the operators to give back allowances no longer needed for an installation which was shut down (Italy and Poland). Restrictive plant closure provisions can, however, remove intended incentives from the EU ETS (e.g. regarding early replacement of old plants) and lead to further problems regarding the efficiency of the scheme.

Interactions between allocation provisions for existing and new installations

The analysis showed strong and significant interactions between the allocation to existing installations, the allocation to new entrants, the provisions on plant closure and the allocation in subsequent periods. This highlights that the isolated assessment of single provisions could lead to counterproductive effects in the scheme as a whole.

If existing installations receive a generous allocation (as is the case in most countries, except the UK) and new installations do not, the incentives for operators to extend the lifetime of the existing installations for as long as possible would be significant, and would lead to reduced incentives to invest in cleaner plants. Less generous allocation to existing installations is a crucial issue for many other provisions in terms of environmental effectiveness, ranging from the effects from updating to better incentives for the (early) replacement of existing installations by less emitting plants. In particular, the more restrictive allocation provisions for existing installations in the UK NAP for the pilot phase (power plants receive an allocation of 72% of base period emissions in the UK whereas this ratio is 92.6% in Germany) provide a good example in this respect.

Use of credits from Clean Development Mechanism (CDM) and Joint Implementation (JI)

The use of credits from CDM and JI (beyond 2007) delivers several advantages for the EU ETS (e.g. flexibility in meeting reductions especially for the pilot phase, economic efficiency, etc.). They do, however, also raise questions about to what extent domestic action in EU Member States will be seen as taking priority over the use of overseas credits. Given the lack of empirical evidence on the amount of credits available for use by the trading entities under the EU ETS, the use of these credits should be more subject to observation than regulation for Phase 2 of the EU ETS. The efforts of the Member States should focus more on ensuring the quality of CDM and JI projects. Additional regulations could be added for the subsequent phases after there is empirical evidence on how the use of credits affected domestic actions to comply with the Kyoto-Protocol.

Costs of the ETS and the electricity prices

Although the main share of the allowances was allocated free of charge to the installations, the price of electricity will be set by the marginal power generation unit including almost the full costs of carbon in a liberalized and competitive power market. According to theory, this effect should be applicable for all markets. However, in some countries the electricity prices are still subject to regulation and the operators cannot (yet) pass through the opportunity costs to the wholesale market and in some countries the competitive electricity markets are not fully matured (Italy, Poland, Spain). In other countries (Germany, the Netherlands, and the UK) the costs of carbon already showed significant impacts on the power prices.

The distributional and fairness problems (significant differences in windfall profits) arising from such asymmetries are significantly higher than most of the fairness problems related to certain allocation provisions.

Integrated assessment of Phase 1 NAPs

No country managed to design their national allocation rules to picture the real cost of carbon, as an emission trading scheme based on complete auctioning would have done. An allocation scheme with a substantial amount of allowances allocated for free may easily lead to an erosion of the economic efficiency of the scheme. The challenge to ensure economic efficiency seems much greater than the question of fairness.

Still some countries managed better than others to implement provisions that mirror the carbon intensity. The more transparent and simple the provisions are the better are the economic incentives to reduce emissions caused by the ETS. A complex set of provisions using diverse allocation methods and exceptions faces significant problems when it comes to the interaction of the rules. In conclusion, the simpler and more transparent the provisions are, the better the ETS can represent the cost of carbon and lead to a reduction of emissions. Transparency and simplicity enable stakeholder participation, which in turn is key in ensuring a fair and environmentally effective ETS.

The ratings for NAPs in Table 1 are to be understood as comparative values. If a country is rated as ‘good’, this does not imply that there is no better option; ‘good’ as well as ‘weak’ are to be seen in comparison to the other countries assessed. All ratings are related to the current phase of the ETS. In a multi-phased ETS the same provisions may develop other effects. For more detailed analysis and elaborated conclusions, see Chapter 3.

Tabelle 1 – Integrated assessment of national allocation provisions (summary)

	Transparency	
	Existing installations	**New entrants**
Germany	average	average
Spain	weak	weak
Italy	good	average
Netherlands	good	good
Poland	average	good
UK	average	good

	Simplicity	
	Existing installations	**New entrants**
Germany	good	average
Spain	weak	weak
Italy	good	average
Netherlands	good	good
Poland	average	average
UK	good	good

	Economic Efficiency		
	Existing installations	**New entrants**	**Interaction**
Germany	weak	average	average
Spain	good	-	-
Italy	good	weak	weak
Netherlands	good	average	average
Poland	good	average	average
UK	good	good	good

	Fairness	
	Allocation to new entrants	**Access to NER**
Germany	average	average
Spain	good	average
Italy	good	average
Netherlands	good	average
Poland	average	weak
UK	good	good

Note:
More details on the ratings are given in the respective chapters of this report.

Source Öko-Institut

Lessons learnt and recommendations from Phase 1 NAPs analysis for the power sector

The following key lessons can be drawn from the quantitative and qualitative analysis of the NAPs for the pilot phase as well as from the qualitative and quantitative analysis of future options.

1. Auctioning remains the most efficient allocation approach. All approaches based on free allocation of allowances to existing or new installations will face major problems in ensuring comprehensive and non-distorting incentive structures of the ETS (i.e. the full and comprehensive pricing of carbon). No Member State was successful in sufficiently balancing all different incentives (for existing installations, new entrants, plant closure and replacement) against each other, although some (e.g. the UK) did much better than others.

2. In liberalized and competitive electricity markets, the operators will increasingly be able to pass through the full costs of carbon to the wholesale electricity prices, including the opportunity costs for the allowances allocated for free. The consequent windfall profits will be less significant if the allocation to existing and new installations is less generous.

3. The criterion of economic efficiency should be seen as the most important especially with regard to existing installations in the power sector. Fairness problems mostly arise for the allocation to new entrants.

4. There are strong interactions between the allocation to existing installations, the allocation to new entrants, the provisions on plant closure and the allocation in subsequent periods. The isolated assessment of single provisions could lead to counterproductive effects in the scheme as a whole. An integrated assessment should be undertaken for every provision.

5. Less generous allocation to existing installations is a crucial issue for many other provisions (from the effects from updating up to the incentives for the (early) replacement of existing installations by less emitting plants). The UK NAP constitutes the only good example in this respect from the NAPs analysed in this study.

6. The full costs of carbon create the key incentive for the operation of existing power plants and the implementation of emission abatement measures in existing plants. Ex-post adjustments eliminate these incentives (see the German example).

7. Updating is not a preferable option for future allocations in general. However, different motivations could lead to the application of updating (plant closure, avoiding a surfeit of special provisions for fast growing sectors, etc.). The problem of fixed vs. updated base periods is of less importance if the differentiation between ‘old’ existing (‘pre-2005’) installations und ‘new’ existing (‘post-2005’) installations can be maintained in subsequent periods and new installations will receive allocation based on benchmarks.

8. Under an updating scheme, the incentive for 'gaming' (i.e. increase emissions to receive a higher allocation in future phases) will remain and the incentive structure of the ETS (in other words, the economic efficiency of the ETS) will be eroded to some extent. However, the potential for 'gaming' could be limited and the incentive structures could be ensured by transition to a benchmark approach for the allocation in subsequent periods. Ideally this benchmark scheme would be based on product benchmarks but also a scheme of fuel-specific or technology-specific benchmarks for existing installations could ensure key incentives under an updating approach. A streamlining of the allocation scheme for existing installations will be of significant importance if the transition to an updating scheme is planned.

9. Any benchmark scheme for allocation should be designed as a provisional approach to maintain the phase-in of auctioning. However, complex benchmark schemes can create major distortions with respect to emission abatement measures in existing plants under an updating approach (see the example of Italy). The simpler the benchmark scheme is (e.g. product-specific benchmarks), the more minor the problem of carbon price distortions will be.

10. The benchmark approach can only provide the intended incentives if installations with low emissions (lower than the benchmark value) also receive the full benchmark allocation. Limiting the allocation by benchmarks to the level of historical or planned emission levels will eliminate important incentives under the ETS (see the Dutch example).

11. The incentive structure from the ETS for new entrants should be seen as the most important one in the medium and long term. Compared to the incentives for existing plants, investment decisions for new installations will to a large extent rely on the real costs from the ETS.

12. The allocation provisions for new entrants should be carefully balanced against the allocation provisions for existing installations. Less generous allocation to existing installations should lead to less generous allocation provisions for new entrants and vice versa.

13. Not allowing free allocation to new entrants could ensure a comprehensive and non-distorted carbon price signal to the investment decisions. However, in the framework of a generous allocation to existing installations, significant incentives will arise to invest in the lifetime extension of old plants if no allowances are provided for free to new plants. This could be partly compensated by generous provisions on plant closure but this will create additional benefits for the incumbents, resulting in strong barriers for newcomers and fairness problems.

14. The free allocation to new entrants based on product benchmarks creates carbon price signals equivalent to the case of auctioning or no free allocation to new entrants. It will require the setting aside of a new entrants reserve.

15. The allocation to new entrants based on fuel-specific benchmarks will to a large extent eliminate the intended incentive structures of the ETS. Consequently, this is not an appropriate allocation approach to new entrants. If this is the only alternative, transfer provisions could constitute an appropriate approach. However, some fairness problems have to be considered which will arise from the implementation of the transfer rule.
16. If there is free allocation to new entrants, the allocation should be based on production data which is defined by load factor (capacity utilization) benchmarks rather than on plant-specific projections (see the provisions in the UK and Italy as good examples). This is a simpler and more transparent approach which could avoid the problem of windfall profits arising from exaggerated installation-specific projections under the latter approach.
17. Generous plant closure provisions could ensure incentives for (early) plant replacement on the one hand. On the other hand, leakage effects could arise from generous plant closure provisions (if the shut down of plants is incentivised and production is shifted to more emitting plants outside the EU ETS). Additionally, the incumbents will receive the major benefit from generous plant closure provisions, which is seen as a fairness problem in some debates. However, fairness problems will arise in every case from the impossibility of identifying all plant closures (mothballing, 'cold reserve'). If the plant closure issue is to be addressed (probably mainly for political reasons), the transition to an updating scheme represents the only appropriate and comprehensive approach.
18. If there is a free allocation to new entrants, a new entrants reserve (NER) will be necessary. The most appropriate way of ensuring availability and fair access is to differentiate between 'known new entrants' and 'unknown new entrants' in the NER. If the NER for both segments undergoes the common procedures for the allocation lists and the allocation plans, an appropriate level of availability and fairness should be assumed. A NER sized in such framework should provide allowances under a 'first-come, first-served' approach.
19. Transparency and simplicity of the full set of allocation provisions constitute a crucial precondition for public participation as well as for the approval of allocation plans. Transparency and simplicity are cross-cutting issues to be reflected as much as possible in the allocation provisions. Public participation will be a major tool in ensuring the fairness of the allocation scheme laid down in future allocation plans.
20. The use of credits from CDM and JI deliver several advantages for the EU ETS. Given the lack of empirical evidence on the amount of credits available for use by the trading entities under the EU ETS, the use of credits from CDM and JI should be more subject to observation than regulation for Phase 2. Additional regulations could be added for the subsequent phases after empirical evidence arises on effective supplementary problems under the Kyoto-Protocol. Neverthe-

less, measures to ensure the quality and the environmental integrity of CDM and JI projects are important, especially in the first years of the EU ETS.

The lessons learnt focus on the power sector. For some other sectors (cement, steel) other priorities could arise from an in-depth analysis. However, the power sector as the most important emissions source under the EU ETS will shape the allocation scheme significantly. Eventually, a separate treatment of the power sector could constitute an appropriate approach for future allocation plans.

Best practice proposals for Phase 2 allocation provisions

The recent EU ETS Directive offers limited possibilities for a general revision of the allocation scheme (e.g. regarding the share of auctioning). However, we recommend the following general changes and priorities for the design of the NAPs in Phase 2 in order to improve the environmental effectiveness of the scheme. These recommendations are derived from the analysis of Phase 1 NAPs and further quantitative analysis of different provisions for Phase 2.

Allocations to existing installations

Particularly for the power sector, the auctioning of 10% of the total amount of allowances should be implemented in the Phase 2 NAPs.

Supplementary to a 10% share of auctioning, the allocation provisions for existing installations should be based on the following list of priorities:

1. allocation based on product-specific benchmarks and historical activities;
2. allocation based on fuel-specific benchmarks and historical activities;
3. allocation on historical emissions and an ambitious (low) compliance factor.

Ex-post adjustments

No ex-post provisions should be allowed for Phase 2 of the EU Emissions Trading Scheme.

Updating

Updating of base periods used for the pilot phase could deliver additional flexibility and could ensure the transparency and simplicity of the allocation provisions. However, the base period for the second phase should exclude the year 2005 in order to exclude gains from ‘gaming’ under the EU ETS (increase emissions to receive a higher allocation in future).

Allocations to new entrants

The allocation to new entrants should be built on the following list of priorities, reflecting economic efficiency also from an inter-temporal perspective, and the issue of fairness:

1. new entrants should receive a free allocation based on load factor benchmarks and product-specific benchmarks;
2. no free allocation to new entrants could constitute an appropriate approach if the first option cannot be implemented and if the plant closure provision is comparatively generous (retain allocated allowances for the duration of the period);
3. if the first two approaches are not accepted for political reasons, a transfer provision should apply;
4. free allocation to new entrants based on fuel-specific benchmarks for emissions should not be seen as an appropriate approach because the intended incentive structure will be largely eliminated.

As a starting point, less ambitious product benchmarks (higher than BAT for the least carbon-intensive fuels) are more acceptable for incentivising new investments if fuel-specific benchmarks can be avoided and the allocation to existing plants is comparatively generous. However, the allocation according to benchmarks for new installations should be continuously decreased over time as it should be for existing installations (i.e. phase in of auctioning).

For NAPs in Phase 2, those installations allocated under a new entrants provision during the pilot phase should be continuously allocated on the new entrant provision of the pilot phase. According to this approach, the new entrants from the pilot phase and from the second phase would be treated differently from the ‘old’ existing (‘pre-2005’) installations in NAPs for future phases of the EU ETS.

Plant closure

Bearing in mind that the effective and comprehensive identification of plant closures will not be possible (mothballing, ‘cold reserve’, etc.) and that generous plant closure provisions incentivise (early) replacements of old plants, the operators should retain the allowances allocated for the duration of the phase.

Country-specific improvements for Phase 2 NAPs

For all countries analysed in this report, substantial improvements could be achieved in the NAPs for Phase 2 beyond the general issues mentioned above. At least for the power sector the following key improvements should be focussed upon (see Chapter 5.3):

- Germany: the option to auction 10% should be used at least for the power sector; ex-post adjustments and the options provision should be removed; benchmarking should also be used for incumbent installations; the allocation to existing CHP plants should rely on a ‘double benchmark’ (separate allocation for heat and electricity) as already used for the allocation to new entrants in Phase 1; the allocation to new entrants should be changed to product-specific emission benchmarks and load factor benchmarks and – if this change applies – the transfer provision could be removed; if allocation to new entrants does not change in this way, then the transfer provision should remain; benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector); the long-lasting allocation commitments should be shortened; the size of the NER should be identified in a more transparent way and should differentiate between ‘known new entrants’ and ‘unknown new entrants’ and the replenishment approach should be changed to a ‘first-come, first served’ approach; the operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.
- Spain: the option to auction 10% should be used at least for the power sector; much more transparency and documentation of allocation provisions should be ensured; the differentiation of allocation provisions (e.g. by fuels or regions) should undergo a critical revision; benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector); the allocation to existing CHP plants should rely on a ‘double benchmark’ (separate allocation for heat and electricity); the allocation to new entrants should be maintained with product-specific emission benchmarks; the size of the NER should be identified in a transparent way and should differentiate between ‘known new entrants’ and ‘unknown new entrants,’ as already partly applied for Phase 1 NAP; the operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.
- Italy: the option to auction 10% should be used at least for the power sector; the complex system of benchmarks (for emission benchmarks and capacity utilisation benchmarks) should be significantly simplified for the allocation to existing and new installations; the allocation to new entrants should be changed to product-specific emission benchmarks; and should differentiate between ‘known new entrants’ and ‘unknown new entrants’, the replenishment approach for the NER should be changed to a ‘first-come, first served’ approach; the operators should

retain the allowances allocated for the duration of the current phase even in the case of plant closure.

- The Netherlands: the option to auction 10% should be used at least for the power sector; the benchmarking approach should remain with the following modifications: the allocation to new entrants should be changed to product-specific emission benchmarks and load factor benchmarks; new entrant benchmarks should be set at a fixed level per unit output, regardless of the expected emissions from an individual installation; the operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.
- Poland: the option to auction 10% should be used at least for the power sector; the allocation to new entrants should be changed to product-specific emission benchmarks and load factor benchmarks and – if this change applies – the transfer provision could be removed; if allocation to new entrants does not change in this way, then the transfer provision should remain; benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector); the allocation to existing and new entrant CHP plants should rely on a 'double benchmark'(separate allocation for heat and electricity); the size of the NER should be identified in a transparent way and should differentiate between 'known new entrants' and 'unknown new entrants'; the operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.
- United Kingdom: the option to auction 10% should be used at least for the power sector; the differentiation of load factors differentiated by technologies should undergo a critical revision; the benchmarking approach for new entrants should remain; benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector); the allocation to existing and new entrant CHP plants should rely on a 'double benchmark'(separate allocation for heat and electricity); the new entrants reserve should differentiate between 'known new entrants' and 'unknown new entrants' for the purpose of its quantification during the preparation and in the public participation process also in Phase 2; the operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.

Options for harmonisation

In the EU level under the existing EU ETS Directive, no strong legal basis exists for the further harmonisation of the allocation provisions. Nevertheless, the following issues of harmonisation should be targeted on the EU level on a formal or informal basis by Member States:

1. Regarding the provisions for existing installations, more harmonisation on the following issues could be necessary and useful: a harmonised share of auctioning (10%), at least for the power sector; the differentiated treatment of 'old' ('pre-2005) and 'new' ('post-2005') existing installations in subsequent trading periods; a harmonisation of (generous) plant closure provisions; a strict ban on ex-post adjustments.
2. Regarding the provisions for new entrants, the following issues should be seen as high priorities for the EU-wide harmonisation: harmonized provisions for free allocation to new installations (ideally product-specific), especially harmonized benchmarks for allocation to new installations; an allocation exceeding the recent or planned emission should be allowed if the allocation is based on appropriate benchmarks; replenishment approaches for the NER should be banned and more harmonised and transparent approaches to identify the necessary size should be developed.
3. Regarding transparency and procedures, the following issues should be subject to further harmonisation between the Member States: the transparency and the documentation of allocation methodologies in harmonised formats should be strengthened; for all allocation provisions an assessment of incentives should be presented with a transparent and traceable approach and in a harmonised format; the NER should be documented in a harmonised format; the size of the NER and the underlying set of planned installations and other assumptions should be subject to public participation.

The European Commissions should *recommend* the following for the development of the NAPs for Phase 2:

- the introduction of 10% auctioning, at least for the power sector; the introduction of a benchmark approach for the allocation to existing installations; to plan a transition to an updating scheme only if the allocation scheme for existing installations is based on a benchmark approach at the same time; to treat the new entrants from the pilot phase separately from the 'pre-2005' installations in the allocation plan for the second phase and to continue doing so for the subsequent periods; to allocate allowances for free to new entrants, only if the incentive structure of the ETS can be maintained; to hold the NER for 'known new entrants' separately from the NER for the 'unknown new entrants' for the purpose of its quantification during the preparation and in the public participation process.

The Commission should *demand* the following for the notification of Phase 2 NAPs:

- a clear documentation of the allocation provisions for individual installations in a harmonised format; the demonstration of incentives for the different allocation provisions and their interactions for existing and new entrants (probably an exercise with a standardised set of installations and a standardised set of case studies would help to present these incentive structures); to demonstrate that the size of a NER (if applicable) is appropriate for the foreseen demand; that the quantification of the NER and the assumptions and methodologies used to calculate the size of the NER was subject to the public participation process.

The Commission should *consider* the following for the approval of NAPs in Phase 2:

- that all activities under the ETS (operation of existing plants, investment in new plants, etc.) need to receive a price signal depending on their carbon intensity to ensure economic efficiency of the ETS. This is critical in order to outweigh the administrative and transactional costs associated with the ETS and to ensure the legitimation of the ETS in the medium to long term;
- that an allocation exceeding the recent or projected emissions of an installation should be allowed if the allocation is based on an ambitious benchmark scheme (e.g. if CHP plants are allocated with ‘double benchmarks’ according to the separate power and heat production) or receives allowances in the framework of a transfer provision.

To reduce uncertainty to operators on the future development of the EU ETS, the Member States as well as the Commission should state clearly that the further development and improvements of the EU ETS beyond the time horizon of 2012 will focus more stringently on the intended incentive structures of the ETS.

Recommendations for post-2012

Whereas the design of the EU ETS is restricted by the legal provisions of the EU ETS Directive, for the periods beyond 2012 much more flexibility is given than for the pilot and the second phase.

The political framework will play an important role in the future development of the scheme. This is particularly relevant post-2012, given possible future regimes for the second commitment period of the Kyoto Protocol, and if there are strong links to the international climate regime. The development of the global climate regime could significantly influence the development of the EU ETS.

Having discussed different options for the future development of the EU ETS, the research presented in this report leads to some key recommendations:

An auctioning scheme should be introduced immediately for the third phase of the EU ETS. If a full auctioning system (which is still the preferable option) is not accepted, we recommend a two-track approach:

- all allowances to the power sector should be allocated by full auctioning beginning from 2012;
- the allocation to the other sectors should rely on a phase-in of partial auctioning, e.g. 20% for the third phase (2013-2018), 30% for the forth phase (2019-2024), etc.

An important issue regarding the future of the EU ETS is the future coverage of the scheme. The inclusion of other sectors and additional greenhouse gases must be assessed against their advantages and disadvantages.

Bearing in mind that the administrative costs have led to an intensive debate on the exclusion of some sources, the extension of the scheme should be handled with care. As a general rule, the EU ETS should be mainly focussed on larger installations and large emission sources. Given the limited experiences with the existing coverage of the ETS and the related effects, much more in-depth analysis and experience is needed to enable a proper assessment of an extension of the EU ETS beyond some short-term measures to straighten the recent coverage according to the existing inconsistencies.

Against this background, the extension of the EU ETS should target those sectors that were already under discussion during the negotiation process regarding the recent EU ETS Directive (chemical industry, aluminium production). All other extensions to other gases and sectors require a more profound assessment and the careful examination of experiences accrued in the coming years.

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ABBREVIATIONS

a	annum (year)
AAU	Assigned Amount Unit
BAT	Best available technology
BAU	Business as usual
BM	Benchmark
CCGT	Combined cycle gas turbine
CDM	Clean Development Mechanism
CER	Certified Emission Reduction Unit
CF	compliance factor
CHP	Combined heat and power production
CO_2	Carbon dioxide
ERU	Emission Reduction Unit
ETS	Emission Trading Scheme
EU	European Union
EU-15	Member States of the European Union before May 2004
EU-25	Member States of the European Union including the New Member States of the EU as of May 2004
EUA	European Union Allowances
GWh	Gigawatt hour (million kilowatt hours)
GWh_{el}	Gigawatt hours (electric)
GWh_{th}	Gigawatt hours (thermal)
h	hour
HFC	Hydro fluorocarbon
IEA	International Energy Agency
JI	Joint Implementation
kW	Kilowatt
LHV	Lower heating value
MW	Megawatt
MWh	Megawatt hours (1,000 kilowatt hours)
N_2O	Nitrous oxide
NAP	National Allocation Plan

n/a	not available
NER	New entrants reserve
NPV	Net present value
PP	Power plant
ProMechG	Projekt Mechanismen Gesetz
SF_6	Sulphur hexafluoride
SO_2	Sulphur dioxide
t	metric ton
TJ	Terra Joule
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UK	United Kingdom
U.S.	United States of America
/w	with
w/o	without

1 Introduction and background

1.1 Introduction

Market-based policy tools are increasingly regarded as effective and reliable means of environmental policy, especially in climate policy. They are attractive options for environmental policy because of the combination of environmental effectiveness and economic efficiency.[1]

Among the different market-based environmental policy tools, cap-and-trade emissions trading schemes received special attention after the inclusion of international emissions trading in the Kyoto Protocol to the UN Framework Convention on Climate Change.[2] Within this framework, and given that the European Union (EU) is, in addition to its Member States, a party to the Kyoto Protocol, the EU decided to implement a community-wide emissions trading scheme (EU ETS) for greenhouse gas emissions.

In a perfect textbook-style emissions trading scheme, the environmental effectiveness of the scheme is given by the cap and the efficient allocation of capital is guaranteed by the information exchange via prices and market mechanisms. In this framework the allocation of allowances does not influence the environmental effectiveness or the economic efficiency of the trading scheme. The allocation should only create distributional effects between the trading entities.[3]

Setting a cap on greenhouse gas emissions, distribution of the related amount of emission allowances among the trading entities and allowing free trading of allowances between the market agents should create a price of carbon which should affect the economic appraisal of the trading entities either to undertake emission reduction measures or to buy allowances from those entities which have access to cheaper emission abatement options. The set of measures undertaken by the trading entities would only depend on the price of carbon.

Within the framework of perfect competition and without erosion of price signals, this set of abatement measures should represent the lowest cost solution to meet the emission target given by the cap. Although the overall result of abatement measures and the associated costs should not depend on the way the emission allowances are allocated to the trading entities, the allocation provisions will significantly influence the economic burdens to the different trading entities. Consequently the allocation will create distributional effects. In theory, the fixed cap and the clear split between the efficiency of the scheme and the distributional effects by allocation represents the most attractive characteristics of emissions trading schemes for climate policy.

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1 See OTA (1995) for a comprehensive discussion and assessment.

2 See OECD (2002 + 2004), Butzengeiger et al. (2001).

3 For definitions of the most relevant economical and technical terms used in this report, see Chapter 1.3.

However, the EU ETS as it was implemented by the Member States in 2005 does not fit fully into the framework of a perfect emissions trading scheme.

- First, the EU ETS is organised as a multi-phase emissions trading scheme where the definition of caps as well as the allocation of allowances to the trading entities and their installations can be subject to change in certain phases (five years beginning from the second trading phase).
- Second, certain allocation provisions (e.g. some provisions for free allocation to new entrants or ex-post adjustments) could lead to an erosion of the price signals created by the ETS which will lead to a less efficient allocation of resources for certain emission abatement options.
- Third, complicated allocation provision could increase administrative and transactional costs of the scheme which could compensate the efficiency gains of the ETS full or partly.
- Fourth, imperfect information is a crucial issue for the trading entities. If the allocations are decided late and if there is no understanding of the provisions for future phases, the efficiency of the scheme will decrease.

From a dynamic point of view the increase of costs for meeting certain emission targets will create significant interactions with future cap definitions. If the costs of emissions abatement and the price of allowances increase significantly, the definition of adequate and ambitious caps for future trading phases will face major resistance in the climate policy arena. In other words, the most efficient allocation of capital for emission abatement constitutes a key precondition for achieving the adequate environmental effectiveness of the ETS in future. If the fact is considered that for many abatement options certain windows of opportunity exist when the emissions abatement is available for low costs (e.g. replacement of plants after the end of their technical and economical lifespan), an adequate and non-distorted price signal for carbon emissions is of special importance for early investments in low carbon technologies. In this study we will demonstrate that in some EU Member States allocation provisions were implemented which instead will lead to distorting effects.

Furthermore, experience from the first allocation process shows that in many Member States it was impossible to maintain a clear split between cap definition and determination of the provisions for the allocation of allowances to the trading entities. When particular trading entities demanded changes in the allocation rules which lead to a higher demand of allowances in total, it often did not lead to a more restrictive allocation to other trading entities but to an increase of the cap. In this way pure distributional aspects significantly influenced the environmental effectiveness of the ETS. It has to be assumed that such mechanisms will be much more influential in the next allocation process if no adequate countermeasures are to be taken.

1.2 Scope of the report

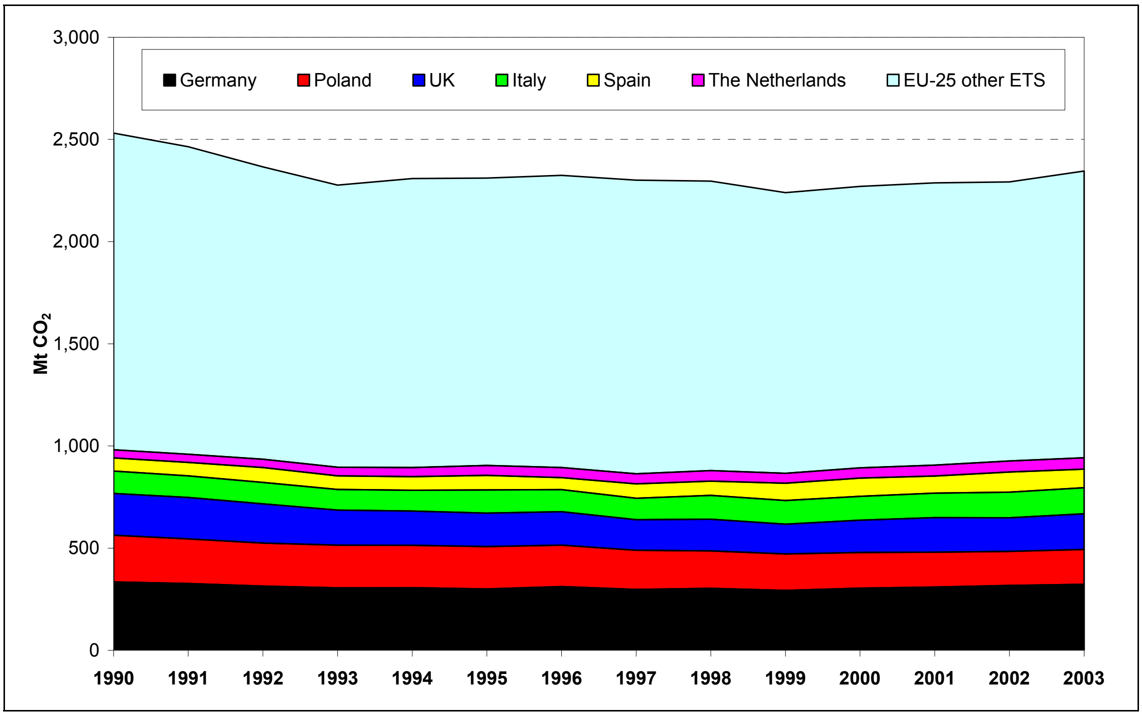
In this report, we compare and contrast different ways that six Member States of the European Union have chosen to allocate the European Union Allowances (EUA) to the installations and analyse these allocation approaches in their National Allocation Plans (NAPs) for Phase 1 (Chapter 3).

The structural analysis covers both the principles and provisions of setting caps for certain activities and sectors and the allocation of allowances to existing installations and new entrants. This analysis includes the rules surrounding allocation of allowances to existing installations in the scheme, those that are new, how plant closures are treated, and how the use of CDM/JI credits is planned at the level of installations.

Based on the lessons learnt from the Phase 1 of the EU ETS different options for allocation approaches in future phases of the EU ETS are analysed and conclusions are drawn for the Phase 2 (Chapter 5) and for the time horizon beyond 2012 (Chapter 6) including some key harmonisation needs (Chapter 5.4).

The assessment of allocation approaches is partly based on a qualitative analysis and in some dimensions derived from a quantitative examination of allocation provisions (Chapter 3).

Figure 1 – Total CO_2 emissions of EU-25 covered by the EU ETS and CO_2 emissions from public power production in Germany, Italy, the Netherlands, Poland, Spain and the UK

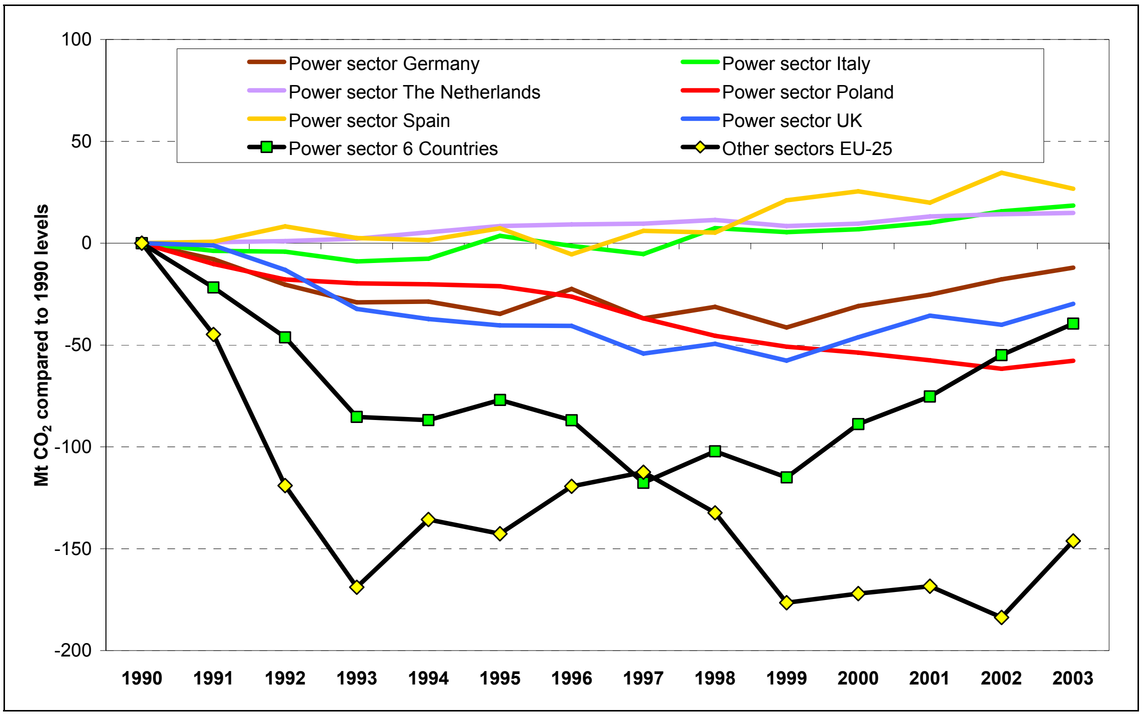


Sources UNFCCC, Öko-Institut calculations

The structural analysis of allocation provisions in this report focuses on the power sector only. This selective approach is based on five major reasons:

- The power sector plays an outstanding role in terms of its share in the total greenhouse gas emissions of the six EU Member States analyzed in this report as well as in the European Union (Figure 1).
- The emission trends in the power sectors of the six countries were the major driver for the emission increase of the sectors covered by the EU ETS for the last five years (Figure 2).

Figure 2 – CO_2 emission trends in the power sector of the six Member States and for the total emissions covered by the ETS in the EU-25



Sources UNFCCC, IEA, Öko-Institut calculations

- The capital stock in the power sector is characterised by long-living assets. Bearing in mind that the power sector is approaching a major reinvestment cycle in the next 20 to 30 years in the EU-25, the allocation provisions for the power sector will set the course for future greenhouse gas emissions trends in the EU.
- The power sector has proved to be very influential in the NAP process in many Member States and if key improvements of allocation provisions for the power sector could be achieved, it would amount to a strategic direction for the allocation approach in the framework of the EU ETS.
- Power generation activities are comparatively homogenous and enable comparative approaches for analysis and assessment of allocation approaches. For other

industrial sectors in some Member States, the analysis must reflect the national circumstances in much more detail than was possible in the scope of this report.

Last but not least, the analysis and assessments in this report are focussed on the substance of allocation provisions. In some Member States, single allocation provisions originate from legal regulations or from the legal nature of NAPs.[4] These dimensions were not subject to the research presented in this report.

4 In some Member States certain hardship clauses are required under constitutional law. In some Member States the allocation provisions depend on the fact that the final data enquiries are legally linked to the application for allocation and the allocation decision.

1.3 Definitions

According to the EU ETS Directive the following definitions are used regarding the structural analysis of the NAP:

- ‘installation’ means a stationary technical unit where one or more activities listed in Annex I of the EU ETS Directive are carried out and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution;
- ‘operator’ means any person (or company) who operates or controls an installation or, where this is provided for in national legislation, to whom decisive economic power over the technical functioning of the installation has been delegated;
- ‘new entrant’ means any installation carrying out one or more of the activities indicated in Annex I of the EU ETS Directive, which has obtained a greenhouse gas emissions permit or an update of its greenhouse gas emissions permit because of a change in the nature or functioning or an extension of the installation (including taking into operation a new installations), subsequent to the notification to the Commission of the national allocation plan[5];
- ‘permit’ means a document issued by a competent authority, granting authorisation to emit greenhouse gases from all or part of an installation if the operator is capable of monitoring and reporting emissions.

In the framework of the structural NAP analysis presented in this report the following additional definitions are used:

- ’economic efficiency’ means that the overall costs of meeting a given target (cap) are minimized, including compliance costs (e.g. for investments, fuels, etc.), administrative costs (e.g. for monitoring, verification, allocation, etc.) and transactional costs (e.g. for trading);
- ‘fairness’ is the ability to make allocation decisions free from discrimination and arbitrariness, not leading to unjustified burdens or other distortions;
- ‘allowance’ is the permission to emit one tonne of CO_2 equivalent – the metrics of allowances under the EU ETS are in European Union Allowances (EUA), under the Kyoto Protocol in Assigned Amount Unit (AAU);
- ‘initial allocation’ is the allocation of emissions allowances for existing installations laid down in the NAP;

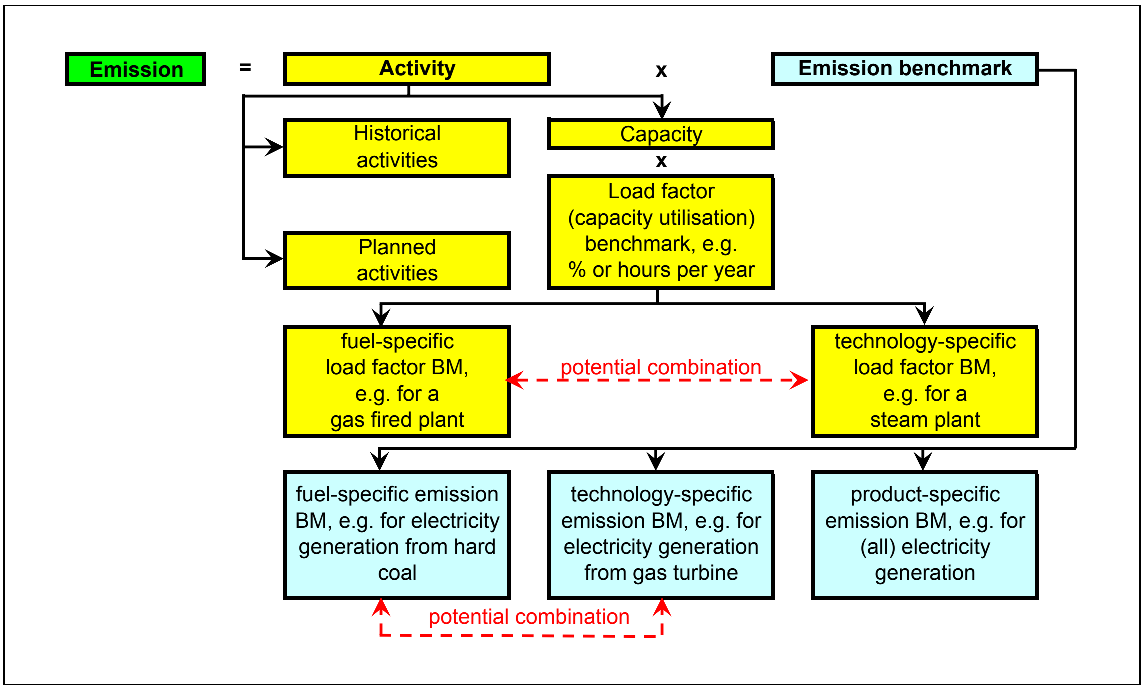
[5] Some Member States use slightly different definitions when transposing the EU ETS Directive into national legislation (e.g. in the UK a new entrant is every new installation that commences commercial operation in 2004 or later).

- ‘auctioning’ is an allocation method in which allowances are sold in an auction, rather than being handed out for free; the allowances sold at an auction must be held back in a reserve and are not available for a free allocation to installations;
- ‘no free allocation’ means that the allowances must be purchased from an auction or on the market,;
- ‘grandfathering’ is an allocation method in which allowances are allocated for free based on historical emissions or on historical activities (in the framework of a benchmark allocation);
- ‘benchmark allocation’ is an allocation method in which allowances are allocated free of charge based on benchmarks, such as emissions per unit of output (activity);
- ‘base period’ is the period where the allocation is based on historical emissions or production in a chosen period, either one reference year or the average over several years;
- ‘updating’ is an allocation method in which allowances are allocated free of charge based on historical emissions or on historical activities (in the framework of a benchmark allocation) in a base period which changes with time (‘rolling’) for subsequent trading phases;
- ‘trading entity’ is an entity obliged to surrender allowances for emissions generated;
- ‘ex-ante allocation’ means an allocation of allowances to the trading entities at a fixed deadline before the trading phase starts;
- ‘ex-post adjustment’ is the adjustment of an allocation decision after the fixed deadline for the allocation decision;
- ’incumbents’ are trading entities who operate installations under the ETS which were commissioned before the ETS started;
- ’best available technology’ (BAT) is the most effective, economically-achievable, and state-of-the-art technology that reduces negative impacts on the environment;
- ‘new entrants reserve’ (NER) is the amount of allowances set aside in the NAP for the allocation to new entrants;
- ‘compliance factor’ means the ratio between the amount of allowances allocated to a certain installation and the level of emissions or activities the allocation is based on – a low compliance factor indicates a low allocation compared to (historical) emissions;
- ‘load factor’ is the electricity produced by a generating set expressed as a percentage of the electricity which it could produce if it operates at its full net output capacity over a fixed period of one year;

- 'merit order' is the ranking of available power generation units from those with the lowest short-run marginal costs (the change in total cost resulting from a one-unit increase or decrease in the output of an existing production facility) to those with the highest;
- 'mothballing' is the temporary closure of a power station;
- 'opportunity costs' are the net revenue that is forgone by not allocating resources to the other best alternative use (e.g. selling allowances on the market instead of surrendering the allowances for emissions generated);
- 'distributional effect' means the impact of allocation or other activities (e.g. passing through opportunity costs to the prices) on the distribution of costs and benefits among various entities.

In the framework of a benchmark allocation the calculation of relevant emissions will be based on the multiplication of certain activities and benchmarks. The same approach could apply to certain approaches for the free allocation to new entrants.

Figure 3 – Schematic overview on the terms used in relation to benchmarks



Source Öko-Institut

Regarding the calculation of emissions or allocations that are based on benchmarks the following definitions are used in this report (see Figure 3):

- 'activity' means the amount of production of a certain commodity;
- 'load factor benchmark' (capacity utilisation benchmark) is a predefined value for the load factor (regarding power production) or the utilization of the installed capacity, the activities results from a multiplication of the installed capacity and

the load factor benchmark, load factors could be differentiated by fuels or technologies or a combination;

- ‘emission benchmark’ is a predefined value for the specific emissions based on a certain activity, the emission benchmarks could be differentiated by products, fuel, technologies or a combination;
- ‘fuel-specific benchmarks’ means an emission benchmark where the activities the benchmark is related to is differentiated by fuels (e.g. tons of CO_2 per gigawatt hour electricity production from hard coal, tons of CO_2 per gigawatt hour electricity production from natural gas);
- ‘technology-specific benchmarks’ means an emission benchmark where the activities the benchmark is related to, is differentiated by technologies (e.g. tons of CO_2 per gigawatt hour electricity production from a supercritical steam plant, tons of CO_2 per gigawatt hour electricity production from a combined cycle gas turbine);
- ‘product-specific benchmark’ is an emission benchmark where the activities the benchmark is applied to, is not subject to further differentiation than specific product (e.g. tons of CO_2 per gigawatt hour electricity production independent from the fuel or the technology used for power production).

The term ‘emission benchmark’ and its specifications (fuel-specific, technology-specific or product-specific) also can be used related to allocation (e.g. EUA per gigawatt hour electricity produced instead of tons of CO_2 per gigawatt hour electricity produced).

1.4 Criteria

1.4.1 Criteria from the EU ETS Directive and guidance of the Commission

A first set of criteria for the analysis and the assessment of allocation provisions are laid down in the EU ETS Directive[6] and a related guidance document published by the European Commission (COM 2004e).

The EU ETS Directive defines a set of 11 criteria that should be used for the development of the NAPs. Five of the criteria are relevant for the definition of the caps, four criteria are relevant for the potential definition of caps for certain sectors or activities and at least five criteria are relevant for the allocation of allowances to the installations.

The Commission also published a guidance document to assist Member States in the implementation of these criteria. In this non-legally binding document the Commission presents its opinion on whether the criteria are mandatory or optional and gives recommendations on how to consider the criteria in the NAPs.

Table 1 – Criteria for the allocation of allowances to installations

No.	Criterion	Activity/ Sector	Installation level
		Mandatory (M)/ Optional (O)	
3	Potential to reduce emissions	O	
4	Consistency with other legislation	M/O[a]	
5	Non-discrimination between companies or sectors	M	M
6	New entrants		O
7	Early action		O
8	Clean technology		O
11	Competition from outside the European Union	O	

Note:
[a] The mandatory part of criterion (4) is related to the consistency with other EU legislative and policy instruments. Taking into consideration emission increase resulting from new EU legislation is optional.

Source EU ETS Directive, European Commission Guidance Paper

The list of criteria relevant for the allocation to installations covers criteria which could be used to design and assess allocation provisions on the one hand and criteria for the process of NAP design and implementation on the other hand. The following references will only look at the criteria which are relevant for the design and assessment of the allocation to sectors, activities and installations (see Table 1). So in summary, most of these criteria were only an optional requirement aside from criterion (5) which means that the specification of allowance allocation provisions in the NAPs was widely a matter of discretion apart from the obligation for non-discriminatory allocation rules.

6 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275/32).

The *economic or technical potential* to reduce greenhouse gas emissions (Criterion 3) could be considered on an optional basis. According to the guidance from the Commission this could be implemented if caps for certain sectors or activities are set in addition to the total cap defined in the NAP. According to this criterion differentiated allocations to installations in certain sectors or activities are enabled if based on a transparent and reliable basis. The Member States should describe the methodology it has used to assess the potential to reduce emissions. Considering the significant potential to reduce emissions this criterion could be of special importance for the power sector.

The *overall EU environmental policy* is based on a broad policy mix which to some extent creates interactions between climate policy and other fields of environmental policy.[7] The purpose of criterion (4) is to ensure that the allocation approach does not contravene the provisions of other legislation (e.g. in the framework of clean air policies). If one considers the recommendation of the Commission to take this into account only if the Community legislation or policy instruments are expected to result in a substantial increase or decrease of emissions this criterion should not be of crucial importance for the power sector.

The *non-discrimination between companies or sectors* (Criterion 5) must be seen in the framework of the normal state aid rules according to the view of the European Commission. Discrimination between companies or sectors in such a way as to unduly favour certain undertakings or activities is prohibited in accordance with the common requirements concerning state aid.[8]

In the NAP Guidance document the Commission presents three options for dealing with *new entrants* on the market (Criterion 6).

- First, the new entrants on the market would have to buy all allowances on the market.
- Second, the allowances for new entrants to the market could be provided by auctioning.
- Third, allowances for new entrants could be provided free of charge out of a reserve.

The Commission points out in its Guidance document that the methodology for allocation to new entrants should as far as possible be the same as the one used for incumbents if there are no justified reasons for a change. The creation of dedicated reserves for specific activities, technologies or purposes is not recommended. Last but not least,

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7 e.g., certain standards for fuel quality create significant higher energy consumption in refineries and result in higher emissions from these installations. There is no EU legislation or other EU policy instrument which could create comparable effects for the power sector.

8 see Articles 87 and 88 of the Treaty establishing the European Union (http://europa.eu.int/eur-lex/en/treaties/selected/livre219.html) and the more detailed explanations on State Aid Rules by the Commission (http://europa.eu.int/comm/competition/state_aid/overview/). Considering the mandatory nature of this criterion the compliance to this criterion must be seen as given by the approval of the NAP by the Commission.

the Member States have to present a transparent methodology if allocation to new entrants is provided for free from a new entrant reserve and the reserve set aside for the phase is already exhausted.

The optional consideration of *early action* (Criterion 7) should be taken into account on the level of individual installations. Those installations that already reduced greenhouse gas emissions in the absence of or beyond legal mandates should not be disadvantaged vis-à-vis other installations that have not undertaken such efforts. The Commission recommends a benchmarking approach to reflect early actions adequately.

Allocation provisions for *clean technologies* (Criterion 8) should reflect only energy efficient technologies approved under the state aid rules for environmental protection.[9] The main field for application of provisions under this criterion is high efficient combined heat and power production (CHP) and district heating. Both technologies are of special importance for the power sector. The Commissions states in addition that either early action provisions or special provisions for clean technologies should be applied.

The consideration of *competition from outside the European Union* (Criterion 11) should be taken into account only for the distribution of allowances for certain sectors. According to the view of the European Commission, the total cap as well as the allocation to individual installations should not reflect this criterion. Given the special situation of the power sector with no or low competition from outside the EU-25, the application of these criterion could lead to a lower allocation of allowances to the power sector if for other sectors a higher demand of allowances can be demonstrated because of their exposure to international competition from outside the EU-25.

1.4.2 Key criteria for environmental effectiveness

The criteria given by the EU ETS Directive and the legally non-binding NAP Guidance document by the Commission are on a very aggregate level. The compliance to these criteria is given formally by the approval of the NAPs by the Commission. Nevertheless, for a wider assessment of the NAP provisions some more criteria should be applied to reflect additional dimensions which are of crucial importance for the implementation of the EU ETS from a structural point of view.

In this study we use four additional criteria for the assessment of key allocation provisions for the power sector:

- economic efficiency,
- fairness,

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9 It should be mentioned that the criterion on clean technology was included in the directive against the background of the debate on effects of the EU ETS on combined heat and power production (CHP) plants. However, the Commission and the Council resisted mentioning a special technology in the EU ETS directive and the more abstract term of 'clean technologies' was used in the language of the directive.

- transparency,
- simplicity.

Economic efficiency

Economic efficiency means that the overall costs of meeting a given target (the cap) are minimized, including compliance costs (e.g. for investments, fuels, etc.), administrative costs (e.g. for monitoring, verification, allocation, etc.) and transactional costs (e.g. for trading).

From a theoretical perspective and with respect to a textbook-style ETS, the *economic efficiency* of the EU ETS should not depend on the allocation provisions for individual installations in a single phase ETS model without differentiated allocation provision for new entrants and with ex-post adjustments. The economic efficiency of the ETS will result from information provided to all trading entities or other market agents by a uniform carbon price signal. If there are allocation provisions in NAPs in the current EU ETS which lead to an erosion of this carbon price signal, the efficiency of the scheme will decrease. In a multi-phase ETS with differentiated allocation provisions for new entrants and ex-post adjustments, some provisions could distort the uniform carbon price signal, e.g.

- if a free allocation is provided to new entrants which depends on the emission level of the installation;
- if a decrease of emissions of an installation leads to a situation, where the trading entity must return allowances to the authority because of this change in emissions (ex-post adjustment).

A key dimension of the analysis of the structural allocation provisions in the NAPs will be provided by exploring how far a uniform carbon price signal will be not eroded by certain allocation provisions.[10]

Fairness

In the framework of allocation of allowances to installations *fairness* should be assessed mainly in terms of competition distortions. To be ‘fair’, the allocation to installations should not distribute burdens and benefits between the installations and operators in a way that major market distortions could be created apart from the uniform carbon price. Identical activities to increase or lower emissions, undertaken by different operators (e.g. incumbents or newcomers on the market) should not lead to significant differences in gains or burdens from the ETS in the framework of ‘fairness’.

Transparency

In order to support environmentally effective objectives, lower the overall costs of the emissions trading scheme (including the administrative and transactional costs), maintain a liquid allowance market and to build a reliable basis for decision making in the

[10] To see how the price signals are assessed in the research presented in this report, see Chapter 2.

traded sectors, the allocation provisions should be as *transparent* as possible. This includes:

- the methodology for the allocation of allowances to installations should be transparent, clearly documented and traceable for operators, other market agents and the stakeholders;
- the uncertainties on the outcome of the allocation process should be minimized for both the operators of installations and other market agents or observers by setting up a clear methodology with clear rules, formulas and parameters.

Furthermore, the criterion of transparency also plays a key role in ensuring the fairness of allocation provisions. The comprehensive and complicated assessment of fairness must be ensured by adequate democratic processes where transparency constitutes an indispensable foundation. According to the provisions of the EU ETS directive the NAPs must undergo a mandatory public participation process. Without having an extremely transparent NAP, the public participation process will lose its meaning.

Transparency is also important in ensuring the effectiveness and efficiency of the market as well as the fairness of the scheme. Only with transparent provisions and procedures it will be ensured that powerful market players do not receive unjustifiable advantages from asymmetric information.

Simplicity

Last but not least, the allocation provisions should be as *simple* as possible to ensure the lowest administrative and transactional costs and to maintain the ability to adjust the allocation provisions for future phases of the scheme. Very complex allocation provisions tend to create unintended adverse effects in the whole allocation system if adjustments or changes of certain elements are to apply. A certain degree of simplicity is furthermore a precondition for transparency which could be undermined by very complex allocation provisions.

2 Methodological approach

The methodology for the assessment of the allocation provisions for sectors, activities and individual installations for NAPs in Phase 1 as well as the analysis of options for future NAPs is based on a differentiated approach.

- In a qualitative analysis we describe key allocation provisions for the power sector, explore how each of the 6 Member States applied key allocation provisions in their NAPs for Phase 1 and draw qualitative conclusions from a cross-country comparison of the relevant provision. Transparency and simplicity can be assessed in the framework of this analysis.
- In a quantitative analysis we analyse key allocation provisions from a comparative analysis based on a standardized set of existing power plants and new entrants in the power sector. For this exercise the partners taking part in this study simulated the allocation to a pre-defined set of standardized installations based on the provisions laid down in the NAPs.[11] From this exercise, quantitative indications for the criteria of efficiency and fairness can be drawn.

The comparative quantitative analysis was limited to the basic allocation provisions for power plants and the allocation provisions for combined heat and power (CHP) plants. Other special provisions (e.g. for early action, if not reflected in the common allocation rules or regarding location of the plants) were not taken into account.

For the quantitative analysis a set of standardized installations of the power sector was selected that enables the cross-country comparison:

- an existing hard coal-fired power station;
- a new entrant hard coal-fired power station;
- an existing gas-fired power station;
- a new entrant gas-fired power station (combined cycle gas turbine – CCGT);
- an existing gas-fired combined heat and power plant (CHP);
- a new entrant gas-fired CHP plant (CCGT technology).

Against the background of the special importance of lignite-fired power generation for Spain, Poland and Germany additional benchmark installations were analysed:

- an existing lignite-fired power station;
- a new entrant lignite-fired power station.

[11] The allocation exercise for the UK and the Netherlands was carried out by ILEX, for Spain by ILIX Iberia, for Italy by AVANZI, for Poland by ESC and for Germany by Öko-Institut.

Table 2 – Characteristics of the installations included in the allocation exercise

No.	Power plant	Fuel	Net Capacity	Capacity utilization	Net electric efficiency[a]	Power-to-heat ratio
			MW	h/a		
1	Existing power plant	Hard coal	200	5,000	33.0%	-
2	New power plant	Hard coal	500	5,000	43.0%	-
3	Power plant replaced	Hard coal	500/400/200[b]	5,000	33.0%	
4	Existing power plant	Natural gas	200	5,000	33.0%	-
5	New power plant	Natural gas	400	5,000	55.0%	-
6	Power plant replaced	Natural gas	400/200[b]	5,000	33.0%	
7	Existing CHP plant	Natural gas	100	5,000	27.0%	0.5
8	New CHP plant	Natural gas	200	5,000	42.5%	1.0
9	CHP plant replaced	Natural gas	200	5,000	26.7%	0.5
10[c]	Existing power plant	Lignite	600	6,500	36.0%	-
11[c]	New power plant	Lignite	900	7,000	41.0%	-
12[c]	Power plant replaced	Lignite	900/400/200[b]	7,000	32.0%	

Notes:
[a] based on lower heating value (LHV) of the fuel used. - [b] plant capacity depending on the replacement scenario; more details can be gathered from Annex D. - [c] Spain, Poland and Germany only.

Source Öko-Institut

Table 3 – CO_2 emission factors for different countries

	Natural Gas	Hard Coal	Lignite
		t CO_2/TJ (LHV)	
Germany	56	94	113
Italy	56	95	-
The Netherlands	56	95	
Poland	56	95	111
Spain	56	100	117
United Kingdom	56	93	-
Non country-specific	56	94	113

Sources UNFCCC, ILEX, ILEX Iberia, AVANZI, ESC, Öko-Institut

Table 2 shows the key parameter used for the allocation exercise. The plant data indicate average characteristics which can be seen as typical for the European Union as a whole. Not every plant shown in the table is necessarily typical for the respective power generation segment in the particular country. The representation of the power plants for the power sector of the different countries is typically better for new installations than for existing plants. Nevertheless, for a cross-country comparison the definition of a standardized set of installations constitute the necessary basis for comparison. To reflect the national circumstances, an additional sensitivity analysis regarding the basic assumptions was undertaken for the countries and installations when this was necessary and relevant for the interpretation of the results.

The full set of data is shown in Annex D; Table 3 provides the CO_2 emission factors used in the analysis.

For the quantitative analysis of the different NAP provisions we calculate the ETS price signal for the operator or investor of a power plant. The ETS price signal marks the difference the ETS creates compared to decision making in absence of the EU ETS (the business-as-usual case). It should be noted that the EU ETS only adds an additional dimension to the economic appraisal of an operator or investor of an installation. The final decision of an operator will depend upon plenty of other parameters influencing the economic assessment of an investment or change in operation (e.g. costs for fuel, operation and maintenance, capital etc.).[12]

While the ETS price signal will not directly fix any economic decision, it does show the difference that the EU ETS creates to the conventional economic assessment and therefore the kind and level of incentive which exists to influence activities. This is important in understanding where provisions are helping to drive investment and behaviour towards low-carbon technologies or activities, which underpins the environmental effectiveness of the scheme. The price signal from the ETS is calculated as follows:

- If real and opportunity costs of allowances are the relevant parameter for the decision, the price signal is equivalent to the full costs of carbon equivalent for the installation independent from the allocation provided for free to the installation.[13]
- In the case of auctioning the price signal will equal the CO_2 emissions of the installation.
- In all other cases the ETS price signal arises from the shortfall or surplus of allowances provided for free to the installation compared to the emissions of this installation.

The price signal from the EU ETS will influence the economic assessment of different activities for reducing emissions. In the quantitative analysis we take into account four key areas of action:

1a) changes in the merit order (optimal level of production under CO_2 constraints);

1b) taking technical measures to reduce emissions from existing plants (e.g. retrofits or fuel switch);

2) building new low emitting plants;

3) replacing existing plants by new and less emitting plants.

In order to compare the ETS price signals generated by the EU ETS with a perfect and non-partial[14] emissions trading scheme the results of the allocation benchmarking exercise will be compared with the ETS price signals in the framework of an ETS based on

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12 see IEA (2003).

13 Annex A provides an introduction to the issue of opportunity costs in the framework of this report.

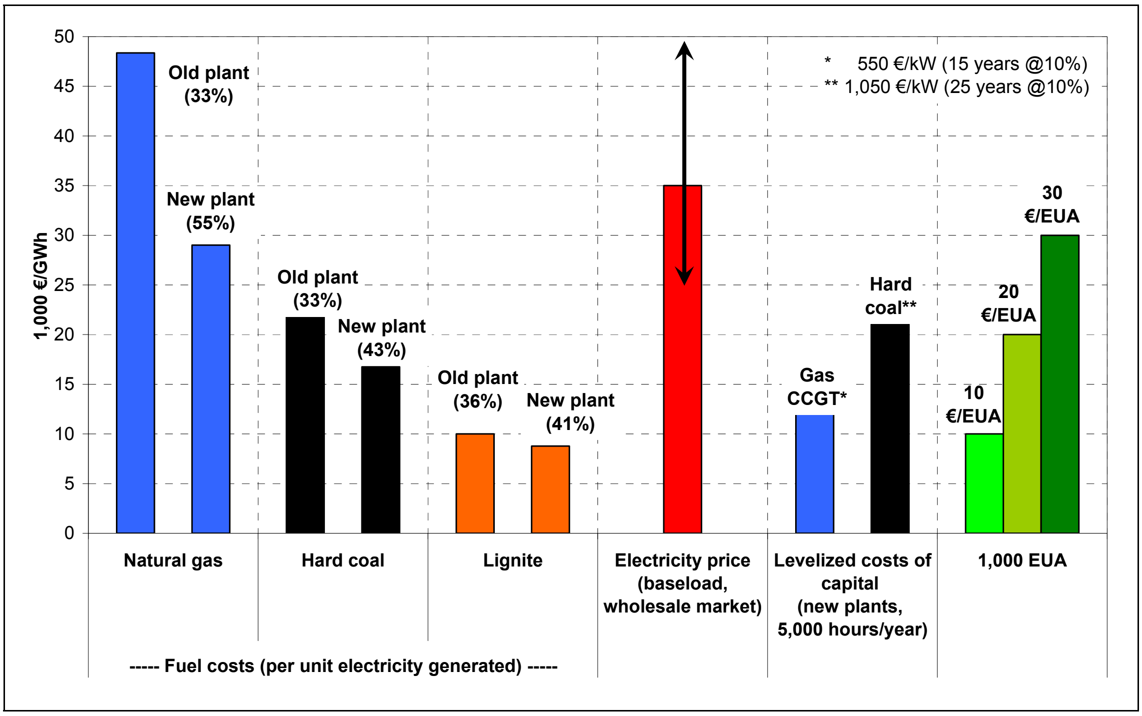
14 The EU ETS covers only a part of CO_2 emitting plants in certain sector. e.g., sectors like transportation or private households as well as combustion installations with a thermal capacity of less than 20 MW are not engaged in the EU ETS. In this sense the EU ETS is characterised as a partial ETS. The partial nature of the EU ETS can create problems at the boundary of the scheme (e.g. CHP – see Annex B).

full auctioning of the allowances. In such a scheme the ETS price signal will follow directly the CO_2 emissions, representing the full price of carbon.

If the basic concept of an ETS is seen as a market based approach of carbon pricing, an ETS price signal which is lower than the price signal that would arise from an auctioning approach the respective allocation provision would be seen as eroding the carbon price signals of the ETS and therefore undermining the economic efficiency and the environmental effectiveness of the scheme.

The metrics of the ETS price signal used in this study are in emissions allowances (EUA) per GWh electric power generation. These standard metrics allow a comparison independent from allowance price levels or differences in the plant parameters used in the comparative analysis (e.g. for capacity, load factor). For more detailed explanations on the treatment of CHP within this approach see Annex B.

Figure 4 – Comparison of allowance prices with costs of capital and fuel



Source Öko-Institut

The comparison in Figure 4 shows the value of EU allowances (EUA) in different price scenarios compared to other costs and prices at current levels.[15]

One thousand EU allowances at a price of 10 €/EUA equal the fuel price for the generation of one gigawatt hour in an old lignite-fired power plant or is slightly lower than the

[15] The data shown in Figure 4 illustrate approximate levels. The costs, prices and parameters for the valuation (e.g. discount rates) may differ from country to country, from company to company, from project to project and from plant to plant.

costs of capital that should be covered for a new gas-fired combined cycle gas turbine power plant. One thousand EUAs at a price of 20 €/EUA represent the same value as the costs of hard coal for the production of one gigawatt hour in an old power plant or the cost of capital that should be covered by the sale of one gigawatt hour in a new hard coal-fired plant. One thousand EUAs at a price of 30 €/EUA mark a value slightly higher than the fuel costs for the generation of one gigawatt hour in a high efficient natural gas-fired power plant.

This rough comparison underlines that the incentives and benefits from the ETS in metrics of EUA/GWh must reach a certain magnitude to significantly influence the economics of power production and the allowance price should have reached significant levels for this. The comparison with the level of electricity prices also shows that passing the full costs of carbon to the electricity prices (see Annex A) may have significant impacts on the price of electricity.

3 Review and analysis of Phase 1 NAP

3.1 Introduction

In the framework of the EU ETS, the Member States have implemented the allocation rules to sectors, activities and individual installations sector quite differently.

In this chapter we describe the different approaches the Member States chose to allocate allowances to existing and new installations and how other key issues (e.g. plant closures, design of new entrant reserves) are treated in the different NAPs.

A main challenge for the documentation as well as for the comparison and the assessment of the provisions in the different NAPs is that many provisions cannot be understood and should not be assessed in isolation from the allocation scheme as a whole. Significant interactions must be reflected between different allocation provisions in order to answer to key questions of NAP assessment:

- Will the different NAP provisions provide incentives for operators and investors to reflect the costs of carbon in their decision making?
- Will certain provisions create serious fairness problems that could offset the benefits of certain provisions?
- Are the different provisions themselves and the complex interactions transparent and simple or will complexity and intransparency affect the way decisions will be made and the way in which the market for allowances functions?

Although the structure of NAPs is quite different among the Member States, we joined the description and analysis to the following issues which are of special importance in the assessment of NAPs;

- general principles and effective provisions which apply for the allocation to existing installations in the power sector;
- general principles and effective provisions which apply to new entrants in the power sector (operated by incumbents or newcomers on the market), including the provisions on the design of new entrant reserves and the access to new entrant reserves;
- general principles and effective provisions which apply for plant closures in the power sector.

The analysis on these issues was carried out on a detailed level for three reasons:

- First, in some cases favourable principles from a very general point of view could be implemented in a way that results in unintended effects. The more detailed the analysis, the more such effects can be identified.
- Second, significant interactions could arise between different provisions that also lead to unintended side effects.

- Third, the economic effects caused by different provisions can differ in magnitude and also in their incentive directions. Consequently some effects could strengthen each other whilst other effects could neutralise or pervert each other. The only way to deal with this challenge is to complement the description and qualitative assessment with a quantitative analysis.

In this chapter we start with a compact description of the provisions which the Member States decided to use in the NAPs for the pilot phase (Phase 1) of the EU ETS (Chapter 3.2). As far as possible we draw initial conclusions and undertake an assessment on the transparency and simplicity of the different provisions.

Due to the complexity and the interactions between different allocation provisions, our assessments on the issues of efficiency and fairness are based on a wide range of quantitative analyses described and presented in Chapter 3.3. To enable such analyses we base the calculations on a set of standardized installations to which the different allocation provisions were applied (see Chapter 2).

In the analysis presented in this report we do not address some other provisions that received significant attention in some or all of the Member States. For example, we do not analyse systematically the way early action was rewarded in the different Member States or how special problems are treated in the allocation scheme (e.g. the issue of process emissions or the use of blast furnace gas or biomass in power stations). In addition we do not deal with the definition of installations, opt-in and opt-out of certain installations or other complicated issues that are nevertheless also important for the EU ETS and its future streamlining and improvement.

Finally, we underline that the analysis in this chapter was limited to the power sector for the reasons given in Chapter 1. This is worth mentioning again because some Member States implemented an allocation scheme for the power sector that is significantly different from the provisions applied to other sectors or activities.

3.2 Qualitative analysis

3.2.1 Scope of the analysis

The main scope of the analysis presented in this chapter is to describe in more detail the general principles and approaches that the different Member States chose to use in the Phase 1 NAPs of the EU ETS as well as key provisions:

- for the allocation to existing installations (see Chapter 3.2.2);
- for the allocation to new entrants (see Chapter 3.2.3);
- for the treatment of plant closure (see Chapter 3.2.3.4).

We systemise the different provision in a common pattern and compare the particular provisions between the Member States.

With regard to transparency and simplicity we draw initial conclusions from the analysis and comparison on the different provisions and undertake a qualitative assessment under a comparative approach.

3.2.2 Allocation to existing installations

The general principles and the effective provisions for the allocation to existing plants were at the centre of the debate on the preparation process for the Phase 1 NAPs. In Chapter 3.3 we will show that the incentives from the ETS for plant operation do not depend on the shortfall or surplus of allowances of an installation compared to its emissions. However, we describe the allocation provisions in much detail here because the effective allocation provisions play a role in the incentives in the framework of plant replacement (see Chapter 3.3.5), with regard to the inter-temporal effects in subsequent phases of the ETS (see Chapter 4) and for the assessment of fairness (see Chapter 3.4).

The key allocation provisions for existing installations in the power sector for all countries are shown in detail below in Table 4 to Table 9.

In all countries analysed in this study the *initial allocation* to existing installations in the power sector is based on a grandfathering approach. Allocation is provided for free in most Member States based on historic emissions or historic production data combined with emission benchmarks. No country uses the possibility of auctioning (except for the surplus of the new entrant reserve – see Chapter 3.2.3.2).

Member States use two general approaches for the allocation to existing installations:

- The first approach is to use historic emissions or to calculate base emissions from historic activities and certain benchmarks. The historic or base emissions are multiplied with a compliance factor and eventually with sector specific growth factors. The harmonization between the total cap and the total allocation to installations is assured via a compliance factor. Germany, the Netherlands and

Poland chose this approach. In the Dutch NAP the base emission is calculated from fuel-specific emission benchmarks.

- The second approach is to define a sectoral cap first and to distribute these emission allowances to the installations belonging to the sector in proportion to their share of the base emissions, which can be historic emissions. UK, Spain[16] and Italy (for the heat sector) chose this approach. CHP plants in Italy receive their share of the sectoral allocation according to their share of historic production of the sector.

In this general framework two countries use a benchmark approach (Italy and the Netherlands). However, the benchmark schemes are designed very differently in these two countries. In the Netherlands the allocation for power plants is based on historic activities in a base period and simple production yields defining a standard efficiency for the power plants differentiated by fuels. In contrast, in the Italian Phase 1 NAP a benchmark approach is used for existing power plants which relies on load factor benchmarks specified according to fuel *and* the technology employed. As a result the allocation depends on the installed capacity of a plant; for different technologies and fuels predefined emission factors and load factors are given.

Germany, Spain and the UK base the allocation to existing installations on historic emissions in certain base periods.

The duration of the *base period* ranges from one year (Poland) up to six years (UK). The UK as well as Italy (heat sector and CHP) implemented some flexibility by excluding the year with the minimum value. The earliest year taken into account for the calculation of base emissions was 1998 (UK) and the most recent was 2004 (Poland). For the Italian electricity sector no base period is necessary because of the specific benchmark approach.

Sectoral *projections* were taken into account for the allocation to existing installations as growth factors in the allocation formulas in the Netherlands, Poland and Spain (for CHP only). In the UK, growth factors played a crucial role in determining the sectoral cap and consequently for the total amount of allowances allocated to the sector. Projected emissions are used in two countries to determine the allocation to installations with no historic emissions in Spain, and the allocation to installations that were commissioned in 2003 or 2004 in Germany. For the operators who chose the options rule in Germany; production growth was taken into account for the allocation (see Table 4). In most countries the use of projections did not influence the cap. Only in the UK was the cap (and therefore the compliance factor) changed when the growth rates were revised.

Special provisions to existing *combined heat and power (CHP)* installations applied in Spain (inclusion of a growth factor) and Germany (special allocation to CHP). In the Netherlands and in Italy CHP installations receive allowances for both electricity and heat production respectively.

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[16] The detailed Spanish allocation provisions were not laid out clearly in the National Allocation Plan. Nevertheless, the allocation to installations generally followed this approach.

In Germany and Poland a transfer of allowances from a closed installation to an existing installation is possible. In Poland a take-over of heat production from non-ETS plants is additionally granted with added allowances. Such additional required allowances are provided for in the new entrants reserve. In Germany the operator may retain the allowances of a closed plant if the production of the closed plant is taken over by comparable installations of the same operator.

Germany is the only country planning to apply *ex-post adjustments*. This mechanism is still subject to a legal dispute between Germany and the European Commission. Italy also planned to introduce an ex-post adjustment but this was rejected by the Commission and the Italian NAP was changed in this regard.

Table 4 to Table 9 show in more detail the most relevant allocation provisions for existing installations in the power sectors for all countries.

Table 4 – Description of key provisions for the initial allocation to existing installations in the power sector in the German Phase 1 NAP

Country	Germany
Basis for the initial allocation to existing installations	The initial allocation in Germany is based on historic emissions. The formula for allocation to existing installations which started production before 2002 is: *Average annual historic emission * compliance factor (0,9709) * cap adjustment factor (0,9538)* The cap adjustment factor serves for the harmonization of the defined cap and the total allocation to individual installations. Its magnitude was unknown to the operators in the phase of application for allocation. Special provisions for existing installations in the German Phase 1 NAP: 1. In cases of hardship (if less than 75% of the needed emission allowances are allocated to an installation and this would imply a significant economic disadvantage for the operator) the operator can apply for an allocation on the basis of projected emissions. 2. The operator can choose to receive allocation based on the allocation provisions for new entrants ('options rule'). The allocation to new entrants (see Chapter 3.2.3) is based on projected activities and fuel-specific benchmarks based on best available technology (BAT). Thus production growth was taken into account. In the two latter cases no compliance factor and only the cap adjustment factor is applied. 3. To installations with process emissions that cause a minimum of 10% of total emissions of the installation no compliance factor applies to the share of process emissions. 4. An early action rule was adopted where no compliance factor is applied for 12 years if certain requirements are met. In the latter two cases no cap adjustment factor is also applied.
Base year/period	In Germany for installations that started operation before the end of 1999, the base period was 2000-2002, for installations starting operation in 2000, the base period was 2001-2003 and for installations starting operation in 2001 the base period was 2001-2003 as well, but including an extrapolation of the 2001 emissions to make it a full year; for installation starting operation in 2002, the base period was 2002-2003 including extrapolation for the year 2002.

Table 4 – continued

Projections used in addition to historic emissions or activities	Existing installations that started production in 2003 or 2004 receive allowances according to projections. The allocation formula is *Capacity of the plant * capacity utilization * specific emission factor* The capacity *utilization* follows the planned data supplied by the operator and the specific emission factor is based on the planned emissions. No compliance factor will apply to the installations commissioned in 2003/2004 for the first 12 years of operation and no cap adjustment factor either. Installations treated according to the 'options rule' receive allowances according to projections. The allocation formula is *Capacity of the plant * capacity utilization * benchmark * cap adjustment factor* The capacity *utilization* follows the planned data supplied by the operator and the fuel-specific benchmark is based on best available technology (BAT) as defined in the German NAP. No compliance factor will apply to the installations allocated under the 'options rule' for Phase 1; the cap adjustment factor was applied. In both cases an ex-post adjustment shall apply if the real capacity utilisation is lower than planned.
Projections or other flexibility options affecting the cap	There is a proportionate cut by the cap adjustment factor in order to avoid an increase of the cap. After the preliminary allocation to all installations was calculated according to the rules, it was identified to what extent the allocation exceeded the cap and the allocation was reduced by a cap adjustment factor for those installations for which the cap adjustment factor was applicable. As a result, the cap adjustment factor was 0.9538 and had a greater impact on the final allocation than the regular compliance factor (0.9709).
Use of benchmarks for the initial allocation	For those installations treated according to the 'options rule' fuel-specific BAT benchmarks were applied (see above and Table 13).
Compliance factor	In theory a uniform compliance factor was applied but the various special provisions and the cap adjustment factor lead effectively to different compliance factors.
Special provisions for CHP	CHP plants receive an extra allocation of 27 EUAs/GWh electricity produced from the CHP process. If the real net electricity production from CHP is lower, the extra allocation will be reduced by 5% for every percentage point the electricity production from the CHP process is decreased (ex-post adjustment). This rule is intended to prevent a reduction of electricity and heat-production from the CHP process.
Transfer provisions	The operator of a closed plant may retain the allocated allowances if the production of the closed plant is taken over by a comparable installation of the same operator. If only part of the production is taken over, the allocation will be recalculated accordingly (ex-post adjustment). A transfer rule also applies for the replacement of plants (see Chapter 3.2.3).

Table 4 – continued

Other significant provisions	There are three cases of ex-post adjustment in Germany: • If projections are higher than real capacity utilisation for the installations is allocated on the basis of planned production (see above). • If CHP plants reduce their electricity production from the CHP process (see above). • If emissions of an installation that received allowances according to historic emissions drop due to lowered production lower than 60% of the average historic emission in the base period, then the allocated allowances shall be reduced proportionally to the drop of CO_2-emissions. For the phase 2005–2007 the closure of the nuclear power stations at Stade and Obrigheim is to be compensated by an annual total of 1.5 million EUA. This compensation is a transitional rule confined to the first trading phase.

Table 5 – Description of key provisions for the initial allocation to existing installations in the power sector in the Italian Phase 1 NAP

Country	**Italy**
Basis for the initial allocation to existing installations	In Italy sector-specific caps are defined and the allowances distributed between the installations of this sector. For heat production the share of every installation is calculated according to the share of total historic emissions of the sector. In the sector of CHP, distribution depends on the share of historic production. For the electricity sector a new formula is applied, which has not yet been notified by the Government, to calculate the allocation to plant n for the year t: $A(n,t) = (\alpha(k,t)^* h(t)^* Ps(k))/1000$ where: *A (n,t)* = Allocation to plant n for the year t *α (k,t)* = reference emission coefficient specific for category k, for the year t in (g CO_2/kWh) to be used within the main component; *h (k,t)* = number of hours of conventional operation of plants belonging to category k, relating to year t; *Ps(k)* = gross efficient capacity (in MW) of unit s(k), belonging to category k.
Base year/period	The base period 2000-2003 was selected. The historic activity level is computed as the yearly average over the historical reference phase with the exclusion of the minimum value. This exclusion is aimed at taking into account exceptional circumstances that may have affected the plant's activity.
Projections used in addition to historic emissions or activities	No.
Projections or other flexibility options affecting the cap	No.
Use of benchmarks for the initial allocation	The reference emission coefficient (*α*) is a fuel-specific emission benchmark. The load factor (*h*) is in fact a load factor benchmark.
Compliance factor	No compliance factor was used, but for heat production and CHP a sector-specific compliance factor is implicitly defined by the sector specific caps.
Special provisions for CHP	CHP plants get an allocation both for the share of electricity and for the share of heat multiplied with a sector-specific compliance factor of 0.95: $A(n,t) = [\alpha(k,t) * QE + \lambda(t) * QW] *$ *sector-specific compliance factor* where: *λ (t)*= benchmark for heat production of 350 g/kWh *QE* and *QW* = historic production of electricity and heat. CHP plants characterised within the historical reference phase by a thermal limit smaller than 15%, will receive an allocation based on the same criteria used for plants producing electricity only.
Transfer provisions	No.
Other significant provisions	Ex-post adjustments were planned but refused by the European Commission.

Table 6 – Description of key provisions for the initial allocation to existing installations in the power sector in the Dutch Phase 1 NAP

Country	**Netherlands**
Basis for the initial allocation to existing installations	The Dutch allocation is based on a combination of historic emissions and projected production. The allocation formula for power stations is given below. *Allocation = base emissions * production growth factor (1.071) * compliance factor (0.97)* The base emissions were calculated based on historic energy and heat production [t CO_2/year]. *base emissions = ζE x QE x 3.6 /ηE + ζW x QW /ηW* where: ζE = Emission factor for the used fuel [t CO_2/TJ] QE = Electricity production in million [kWh] averaged over 2001 and 2002 ηE = Production yield (as factor) for the generation of electricity ζW = Emission factor for the used fuel [t CO_2/TJ] QW = Heat production in [TJ] averaged over 2001 and 2002 ηW = Production yield (as factor) for the generation of heat
Base year/period	The average of 2001 and 2002, no flexibility was offered.
Projections used in addition to historic emissions or activities	A production growth factor of 1.071 as factor for the years 2003 to 2006 [relative index] is used for the power sector.
Projections or other flexibility options affecting the cap	No.
Use of benchmarks for the initial allocation	Power and heat have their own benchmark values. A world's best reference was used for production yields. The production yield depends on the fuels used in the installation. For hard coal the production yield factor (efficiency) is 0.39 and for gas 0.5.
Compliance factor	A compliance factor of 0.97 was used to make the sum of allocated allowances per company equal to the available total amount of CO_2.
Special provisions for CHP	The allocation to CHP was calculated by using the same formula as for power production. The allowances were allocated separately for power and heat.
Transfer provisions	No.
Other significant provisions	No.

Table 7 – Description of key provisions for the initial allocation to existing installations in the power sector in the Polish Phase 1 NAP

Country	**Poland**
Basis for the initial allocation to existing installations	The initial allocation in Poland is based on historic emissions. The formula for power plants is: *Historic emissions * sector-specific growth factor for public power production (electricity 1.03, heat 1.01, CHP 1.206)* fuel-specific compliance factor*
Base year/period	For CHP plants and heat production the base period was 2001 to 2004, for electricity production the (higher) emission value from 2003 or 2004.
Projections used in addition to historic emissions or activities	The annual growth of production was anticipated in line with 'Poland's Energy Policy until 2025', implying electricity production growth of 3% annually and heat production growth of 1% annually. So for the electricity production an annual growth factor of 1.03 is used and for heat production 1.01. For CHP the annual growth factor lies between these two factors (1.0206). When the total of forecasted production levels for the power sector thus calculated differed from the official forecast based on 'Poland's Energy Policy until 2025', the Ministry of Environment of Poland envisaged a compliance factor to match that forecast. The adjusted production levels for individual installations were then multiplied by emission factors.
Projections or other flexibility options affecting the cap	No.
Use of benchmarks for the initial allocation	No.
Compliance factor	The final cap of 239.1 Mt CO_2 annually for the trading system in 2005-2007 was calculated by the EU Commission and published in the Commission Decision on 8 March 2005. The subsequent Polish NAP I versions (versions from 2 to 4, as well as version 6 to 7) attempted to redistribute the allocations among sectors and installations, correcting allocations of the initial version (overall 286.2 Mt CO_2). The present version of draft NAP[a] has introduced a new category: all combustion installations including power sector and combustion installations from chemistry and food production, including sugar. For electricity installations fuel-specific compliance factors were applied (coal: 0.95, gas: 0.97, lignite: 0.95).
Special provisions for CHP	CHP and heat production were treated in the same way. For CHP a compliance factor of 1 was applied.
Transfer provisions	In the case of an ETS-heat plant taking over the production from a closed non-ETS plant, a special allowances reserve is used for additional allocation. A transfer rule also applies for the replacement of plants (see Chapter 3.2.3).
Other significant provisions	No.

Note:
[a] Version 7, if we also count a separate NAP for the power sector, or version 6, if we consider NAP for the power sector to be an intermediary solution.

Table 8 – Description of key provisions for the initial allocation to existing installations in the power sector in the Spanish Phase 1 NAP

Country	**Spain**
Basis for the initial allocation to existing installations	Allocation was calculated on the basis of historic emissions as well as geographical and technological criteria[a], with a view to achieving the ceiling of 86.4 Mt CO_2 as an annual average. There is no formula or more specific information documented in the NAP. The allocation method might be based on the historical average emissions and then scaled to the total amount of allowances for the sector.
Base year/period	The average emissions of the years 2000-2002.
Projections used in addition to historic emissions or activities	For installations without reference emissions it was necessary to reconstruct the 'historical emissions' by the specific emission factors of similar installations, production capacity and average load factor for the sector in question. For CHP (and process emissions) a factor representing the evolution of emissions from the reference phase up to 2006 was used.
Projections or other flexibility options affecting the cap	No.
Use of benchmarks for the initial allocation	No.
Compliance factor	No compliance factor was used, but a sector-specific compliance factor is implicitly defined by the sector-specific caps[b].
Special provisions for CHP	The allocation was based on the historic emissions 2000-2002 multiplied with a factor representing the evolution of emissions from the reference phase up to 2006. The equation provides a 'sufficient' allocation to co-generation sources, since they are granted as many allowances as their forecast emissions.
Transfer provisions	No.
Other significant provisions	No.

Notes:

[a] Geographical: until the Balearic Islands have a natural gas supply and the Canary Islands a liquid natural gas supply, allowances will be allocated on the basis of the total quantity of actual emissions produced by the generating equipment available in each of these autonomous communities and the autonomous cities of Ceuta and Melilla, irrespective of the fuel used. In addition, renewable-generation technologies will be upgraded, as will the technology exhibiting the highest energy efficiency, in order to enable the increase in demand in the phase 2005-2007 to be covered. There could be unexpected increases in demand that would have to be appropriately taken into consideration.
Technological: It is felt that the following will experience less-intensive involvement in covering demand in the phase 2005-2007: Installations envisaging progressive cessation of generation with fuel oil; thermal power stations that, at more than 25-30 years of age, are nearing the end of their service life; power stations that, because other environmental and/or operational determinants apply, do not envisage, owing to financial constraints, any investment in incorporating pollutant-reducing technology; reduction in production at less efficient thermal power stations (30%-34% depending on type of coals used), linked to a progressive decrease in coal availability.

[b] As there was no formula published and therefore no official compliance factors available to the authors, ILEX constructed compliance factors using the available data for the purpose of this study: hard coal power plant: 0.92; natural gas power plant: 0.64; natural gas CHP: 0.975; lignite power plant: 0.5.

Table 9 – Description of key provisions for the initial allocation to existing installations in the power sector in the UK Phase 1 NAP

Country	**UK**
Basis for the initial allocation to existing installations	The allocation to existing installations is based on a two-stage approach: 1. The total number of allowances to allocate the power stations sector was initially calculated by subtracting a fixed amount from projected power sector emissions. The final calculation, though, was based on the difference between the total UK cap and the sum of the sector caps for all other sectors. 2. Then these allowances are shared out between all the installations in the sector. Each installation's share is on the basis of its 'relevant emissions'. The formula for the allocation to power plants can be expressed as: *Allocation = base emissions * compliance factor* where the compliance factor is the difference between the sector cap and the sum of the relevant emission of all installations in the sector.
Base year/period	The base period was1998-2003 with the exception of the year with the lowest emission. In addition, power stations that were commissioned during the baseline period were allowed to eliminate those years' emissions from their relevant emissions calculation. Installations that changed significantly during the period (e.g. where CHP was added) were allowed to disaggregate their historic emissions to calculate the relevant emissions amount. Where production was rationalised between sites during this period (through the closure of one or more installations), the relevant emissions calculation was adjusted to reflect this.
Projections used in addition to historic emissions or activities	Subsectoral output/gross value added projections were used for a majority of sectors. These are based on the UK Department of Trade and Industry's Updated Energy Projections Model. These were applied to 2002 emissions to calculate the sector growth rates. Climate change agreement targets were also applied. For other sectors, emissions growth rates from the same model were applied to historic emissions. For a small number of sectors including power stations, the emissions projections were used directly from the model. The baseline data (i.e. historic emissions data) was verified for each installation using independent verifiers.
Projections or other flexibility options affecting the cap	Each time the projections (and therefore the growth rates) were revised the cap was changed. This occurred twice during the course of 2004.
Use of benchmarks for the initial allocation	Benchmarks were only used for installations that commenced commercial operations in 2003 (and new entrants). Technology-specific benchmarks (BAT) were developed that use standardized load and emission factors to calculate an annual emissions rate per unit capacity. The benchmarked allocations assume that the fuel used for power generation is natural gas.
Compliance factor	A compliance factor was applied only to the power sector. Allocations to all sectors except the power sector were in line with business as usual (BAU) emissions. That means, that only the power sector cap reflects an allocation below BAU.
Special provisions for CHP	No.
Transfer provisions	No.
Other significant provisions	No.

3.2.2.1 Evaluation of the transparency and simplicity of the initial allocation

Transparency

In order to assess the transparency on a qualitative basis regarding the allocation of allowances to existing installations, we consider the accessible documentation of allocation specified in the national allocation plans of the Member States and evaluate the clearness of it. Furthermore we assess the uncertainty of the outcome of the allocation process for the participants of the ETS. For both criteria it is important that any operator or stakeholder is able to retrace the allocation rules and calculate the amount allocated to a plant in Phase 1 provided that the person knows the relevant data of the individual plant.

First we consider transparency according to *documentation*. The following conclusions can be drawn from the comparison:

- For all countries except Spain the allocation to individual installations is based on a clearly documented methodology and is traceable for the operators as well as for other market agents and stakeholders. However, the methodologies used for Poland and Italy have not yet been officially approved.

Second we analysed the transparency criterion according to *uncertainty*:

- In the Netherlands' NAP, the uncertainty of the outcome of the allocation process is minimal because of the transparent rules and formulas to compute the allocation.
- In the German NAP, the complicated adjustment approach led to a situation with high uncertainties regarding the outcome of the allocation procedure. The adjustment factor (0.9538) was calculated and announced after the application procedure for the free allocation was finished. It was significantly higher than the compliance factor (0.9709). Furthermore it was not clearly documented to which installations the cap adjustment factor would apply.
- In a less significant range than in the German NAP, the adjustments in the Polish NAP faced the same problems. The high number of versions of the NAP goes along with changes that also induced much uncertainty.
- In Italy there are no uncertainties on the outcome of the allocation for the electricity sector because of the comprehensive benchmark approach. Some uncertainty arises for the other power sectors as a result of the exclusion of the minimum value of historic emission (heat sector) or of production (CHP sector).
- The same problem applies to a larger extend for the UK; where the year with the lowest emissions was excluded from the average. In the UK the use of projections to calculate the sector-specific cap lead to additional uncertainty, as the revisions and adjustments of the projections changed the cap and with it the amount of allowances allocated to every individual installation in the sector.

- The allocation methodology for individual installations in Spain is not clear. There are no transparent rules or formulas given in the NAP to compute the individual amount of the allocation. So the uncertainty is very high.

Against this background the NAPs for Italy and the Netherlands can be rated as 'good' in terms of transparency. The allocation in these NAPs is based on a clear documented methodology and the uncertainties of the outcome of the allocation are low.

The NAPs for Germany, Poland and the UK are rated as 'average' in this regard because the allocation is more or less clearly documented but the uncertainty regarding the outcome of the allocation process was rather high.

The Spanish NAP is rated as 'weak' regarding transparency because of the missing transparency on the allocation methodology for installations and thus the high uncertainty of the allocation outcome resulting from this. Table 10 gives an overview of the evaluation of transparency.

Simplicity

In order to assess the simplicity of the allocation provisions to existing installations on a qualitative basis, we consider the complexity of the allocation provisions. If there is a general allocation rule applying to all installations with only few parameters, the allocation provisions are judged as simple. If the way that the allocation is computed varies according to the installations characteristics and there are many exceptions and special provisions, the allocation is considered as complex. The more complexly the system is, the higher the administrational and transactional costs are expected to be.

Considering the *simplicity* of the allocation provisions for existing installations the following conclusions can be drawn for the power sector

- In Germany the general allocation formula is quite simple as the historic emission is multiplied with a uniform compliance factor and a uniform cap adjustment factor but due to several special provisions[17] and the possibility of choice between different provisions ('options rule') the system has become complex. Furthermore, the variety of the different allocation provisions led to high administrative costs.
- In the UK, allocation to existing installations is straightforward. The allocation to existing installations equals the relevant historic emissions multiplied by a uniform compliance factor for the whole power sector. Some flexibility was offered at the installation level when determining the relevant historic emission for allocation.
- In Poland the allocation provisions to existing installations are easy to calculate once the growth factors and the compliance factors have been defined. The

[17] The German NAP includes special provisions for existing installations in case of hardship, to reward early action, for process emissions, for the operators of nuclear power plants affected by the German scheme for nuclear phase-out, and several ex-post adjustments. Furthermore, a special provision exists on plant closure if the production is taken over by another installation of the same operator.

growth factors are sector-specific and the compliance factors fuel-specific, but the number of possible combinations is limited.[18]

- The allocation methodology for electricity production in Italy is more complex because the load factor benchmarks and the emission factors are fuel- and technology-specific. This leads to a high number of combinations and therefore many different benchmark parameters. However, since the allocation is based on benchmark no historic data is necessary and it is especially the historic data which is difficult to obtain. CHP receive allocation according to historic production of electricity and heat multiplied by an emission factor depending on technology and fuel.
- The allocation methodology for Spain is not documented in detail but the variety of parameters influencing the allocations to installations (e.g. geographical and technological ones) points to a rather complex set of allocation provisions, thus leading to high administrative costs.
- The allocation methodology for the Netherlands is quite simple with clear rules applying to condensation and CHP plants alike. The emission factors and the production yields (efficiencies) are both fuel-specific; the production growth factor and the compliance factor are uniform for the whole sector. With the historic production data and knowing the fuel used, the outcome of the allocation is easily computable. This leads to low administrative costs.

Against this background the NAP for the Netherlands, the UK and Poland can be seen as ’good‘ with regards to its simplicity.

The NAPs for Germany and Italy are rated as ’average‘ in terms of simplicity because of the high number of special provisions and the complex benchmark scheme respectively.

The lack of available information in the Spanish NAP leads to a rating as ‘weak’ because the indications in the Spanish NAP about geographical and technological criteria influencing the allocation point to rather complex allocation provisions.

[18] In the power sector, there are three growth factors (for electricity, for CHP and for heat) and four compliance factors (for coal, for gas, for lignite and one for CHP).

Table 10 – Qualitative evaluation of transparency and simplicity of the initial allocation to existing installations

	Transparency	Simplicity
Germany	average	average
Spain	weak	weak
Italy	good	average
Netherlands	good	good
Poland	average	good
UK	average	good

Notes:
Transparency: 'good' – documentation of allocation provisions is clear and the uncertainty on the outcome is low; 'average' - documentation of allocation provisions is clear, but the uncertainty on the outcome is significant; 'weak' – no clear documentation of allocation provisions.
Simplicity: 'good' – the allocation provision is a simple calculation exercise with few different parameters, this leads to minimal administrative costs; 'average' – the allocation provision is based on complex parameters depending on multi-dimensional characteristics of the individual installation; 'weak' – very complex or intransparent allocation provisions

Source Öko-Institut

3.2.3 Allocation to new entrants, new entrants reserve and plant closure

3.2.3.1 Allocation to new entrants in the power sector

In addition to the environmental optimisation of the operation of existing plants under the ETS, the decisions on new investments should also reflect the price of carbon provided by the ETS. Considering the long technical and economical lifetime of plants in the power sector, the allocation provisions to new entrants will significantly determine future emission levels. Against this background, the provisions for the allocation to new installations are of special importance for climate policy in the medium and long-run.

In the text of the EU Directive, new entrants refer to any newly-built plant, irrespective of whether the plant operator is an incumbent or a newcomer on the market. However, in some Member States different provisions for new entrants apply depending on whether the investor is either an incumbent replacing an old plant or a newcomer on the market or will extend his production capacities. In Table 13 to Table 18 we describe the allocation provisions to new entrants in detail.

In principle new entrants in the power sector receive their allocation for free in all six countries from a new entrants reserve. However major differences can be found between the six Member States analysed in this study regarding the parameters, on which allocation is based, the amount of allowances allocated for free and the access to the new entrants reserve.

Most countries allocate allowances to new entrants (newcomers) in the power sector based on Best Available Technology (BAT) emission benchmarks (in the case of Poland BAT standard). Nevertheless, the definition of BAT differs widely between the different countries.

The allocation to new entrants is based on planned production data in the German, Polish and Dutch NAP. The problem of installation-based projections is that the operators, when in doubt about how their production will develop, may want to choose a higher load factor to ensure a generous allocation. To avoid this effect, Germany has introduced an ex-post provision, so that the allocated amount of allowances will be adjusted if the real production is lower than the projected one.[19] With the same intention the Netherlands have introduced a maximum load factor that is equal to the capacity utilisation at similar plants. In addition the allocation to a new power plant in the Netherlands may never be ‘higher than the planned, realistic, annual CO_2 emission’ (NOVEM 2004, p. 17) based on the production forecast So if an installation is more efficient than the benchmark parameters used for allocation assume, the allocation will be reduced to avoid the operator receiving more allowances than he would need for the plant.

Some countries like the UK and Italy avoid installation-specific projections and use load factor benchmarks instead. To calculate the production, the capacity of a plant is

[19] This provision is – like all ex-post adjustments in the German Phase 1 NAP – still subject to a legal dispute between Germany and the European Commission.

multiplied with the benchmarked load factor. In the UK the load factors are differentiated by technology. In Italy, moreover, the benchmark is also fuel-specific. Table 11 gives an overview of the load factor benchmarks applied in Italy and the UK.

Table 11 – Load factor benchmarks used for allocation to new power plants in Italy and the UK

	Italy		UK	
	h/a	**% of year**	**h/a**	**% of year**
Steam turbine	900 (natural gas)	10	3,618	41
	7,100 (solid fuel)	81		
CCGT	6,700 (natural gas)	71	6,325	72
CHP (combined cycle)	no load factor benchmark for CHP	-	6,745	77

Source AVANZI, ILEX

Table 11 shows that the load factor for steam turbine power plants applied in the UK is half of the value of the Italian load factor for solid fuels.[20] For natural gas the load factor benchmark used in Italy would be three times less than the load factor benchmark applied in the UK provisions. However, the load factor benchmarks for new CCGTs (which will be the most relevant new gas-fired power plants) are at a similar level. CHP plants (based on CCGT technology) will be allocated with a slightly higher load factor in the UK. The higher the load factor benchmark is, the higher the number of allowances allocated for free will be.

Spain uses a standardized load factor benchmark combined with an emission benchmark.[21] No new hard coal or lignite power plants are expected in Spain.

Germany, Poland and the Netherlands provide allocation for free depending on the fuel used in new installations. In Germany and the Netherlands fuel-specific emission benchmarks are applied. Table 12 gives an overview of the benchmarks used in Germany and the Netherlands for hard coal and gas power plants as well as for CCGTs and steam turbine power plants in Italy and the UK.

In all countries except the UK[22] power plants using hard coal, a fuel with high emissions, will receive a much more generous allocation than installations fired with the more environmental-friendly natural gas. For both fuels the German benchmark is more

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[20] A quantitative analysis of the resulting effects is carried out in Chapter 3.3.

[21] There are some uncertainties regarding the allocation methodology to new entrants in Spain. Therefore the information is to be considered under reserve.

[22] The allocation to new entrants is planned only for natural gas in the UK. However, there are no known plans to build new coal power stations in the UK at the moment.

ambitious than the Dutch one[23] and the Dutch benchmark for hard coal is more ambitious than the Italian benchmark.

The technology-specific benchmarks for the UK (where only natural gas can be taken into account) differ significantly, whereas the fuel-specific benchmark in the Dutch NAP and in the Italian NAP is within the British range.

The range of emissions benchmarks shown in Table 12 already indicates problems in regard to the economic efficiency of new entrants provisions based on fuel or technology differentiation (see Chapter 3.3.4) and the need for harmonisation between the Member States as well.

Table 12 – Fuel-specific and technology-specific emission benchmarks used for different new power plants in Germany, the Netherlands, Italy, and the UK

	Germany	**The Netherlands**
	t CO_2/GWh	
Natural Gas	365	403
Hard Coal	750	877
	Italy	**UK**
	t CO_2/GWh	
CCGT	396 (natural gas)	376 (natural gas)
Steam turbine	913 (solid fuels)	595 (natural gas)
Note: For allocation purposes the emission benchmarks apply in combination with growth factors, complinace factors and/or other adjustment factors.		

Sources AVANZI, ILEX, Öko-Institut

In Poland installations will receive free allocation to cover their emissions, provided that BAT standards are fulfilled. This implies that the amount allocated to hard coal and lignite-fired power plants will be higher than the amount allocated to natural gas power plants. This effect is reduced slightly by fuel-specific compliance factors; the compliance factor for hard coal and lignite is 0.95 and the compliance factor for natural gas is 1.0.[24]

Germany and Poland provide the possibility of transferring allowances from closed plants to new plants. This offers incumbents the opportunity to choose between receiving allocation according to the new entrants provisions applying to newcomers or to receive allocation according to the transfer provision. In the case of the transfer provi-

[23] However in the Netherlands a compliance factor of 0.97 is applied on top of the emission benchmark whereas in Germany no compliance factor applies to new entrants for a period of 14 years. The benchmark used for lignite in Germany is the same one as for hard coal.

[24] A compliance factor of 1 has the same effect as if no compliance factor was applied.

sions the new entrant will receive the same number of allowances as the closed plant would have received for a given number of years (Germany) or the allowances transferred to the new installation are granted till the end of the given trading phase (Poland). There is the possibility in Poland to move unused allowances to the next trading phase but only in case of permission given by the authority. See Table 13 and Table 16 for more details.

All countries set aside a new entrants reserve (NER). If the size of the NER turns out to be too small, the Netherlands, Spain, Poland[25] and the UK apply a 'first-come, first-served' approach. By contrast, the government in Germany and Italy guarantees that all new entrants will receive allocation for free and government authorities will purchase the allowances to refill the NER, if needed. If the size of the NER turns out to be too large, Italy, Poland and the UK will sell the surplus allowances left, whereas Germany will not do so. In Chapter 3.2.3.2 we analyse the NERs in more detail. In Chapter 3.2.3.3 we evaluate the transparency and simplicity of allocation to new entrants.

[25] In Poland the system administrator may use emission rights not used in the non-traded sector to replenish the new entrants reserve.

Table 13 – Description of key provisions for the allocation to new entrants in the power sector in Germany in the Phase 1 NAP

Country	**Germany**
Basis for the allocation to new entrants	Additional new installations receive free allocation out of a new entrants reserve. The allocation depends on the expected production and the technology used. No compliance factor will apply. The formula is: *Plant capacity * projected capacity utilization * specific emissions factor* For CHP allowances will be allocated separately for electricity and heat production. The formula is: *Net power production * specific emissions factor + net useful heat production * specific emission factor + CHP bonus of 27 EUA/GWh (electric)* The allocation based on these formulas will be granted for a period of 14 years after the year the installation was commissioned. Alternatively, a transfer provision exists (see below).
The allocation is based on	The BAT emission factor for the power sector is fuel-specific: For power plants the emission factor is fuel-specific and ranges from 365 up to 750 t CO_2/GWh. For CHP the specific emission factor for electricity production is the same one as for condensation plants and the specific emission factor for heat production is 215 t CO_2/GWh warm water produced and 225 t CO_2/GWh steam produced.
Deficit or surplus of the new entrants reserve	The government guarantees that there will be enough allowances even if the demand exceeds the reserve and will, if needed, buy allowances on the market and allocate them for free.
Transfer provisions	In the case of plant closure and replacement by a new plant, the allowances of the closed plant can be transferred to the new one, which will receive the same number of allowances as the closed plant for four years. There is no change in the way the allowances are calculated. After the four years the new entrant will receive allowances according to historical emissions for a further 14 years. The new entrant needs not to be owned by the same operator, it can be owned by the legal successor or even a different operator, if so agreed by contract.
Other significant provisions	If the real production is lower than the projected one, the allocated amount of allowances will be adjusted accordingly. This ex-post mechanism is disputed between German government and European Commission.

Table 14 – Description of key provisions for the allocation to new entrants in the power sector in Italy in the Phase 1 NAP

Country	**Italy**
Basis for the allocation to new entrants	The allocation to new entrants is from a sector-wide new entrant reserve: • The allocation to condensation power plants is based on a load factor benchmark combined with a fuel- and technology-specific emission benchmark. • For CHP the allocation is based on planned production of electricity and heat. • The allocation rules follow the same approaches as the allocation to existing installations (see Table 5).
The allocation is based on	The load factor benchmark is based on the average load factor of the existing installations in the electricity sector depending on technologies and fuels. The emission coefficients are fuel-specific.
Deficit or surplus of the new entrants reserve	Should the reserve be insufficient, the competent authority will purchase the missing allowances on the market. At the end of the phase, allowances which may be left in the reserve may be sold by the competent authority to the extent necessary to recover the financial resources previously required to replenish the new entrant reserve.
Transfer provisions	No transfer provisions to new power installations.
Other significant provisions	No.

Table 15 – Description of key provisions for the allocation to new entrants in the power sector in the Netherlands in the Phase 1 NAP

Country	**The Netherlands**
Basis for the allocation to new entrants	In establishing the CO2 emission allowances of the ‘known new entrant’, the following calculation rules are applied consecutively in the order given: 1. the date on which the ‘known new entrant’ produces the planned capacity and specification is the start date for the allowances; 2. no CO2 emission allowances are allocated for any test phase that may proceed this; 3. for all installations it is the case that the allowances that may be allocated is never higher than the planned, realistic, annual CO2 emission; 4. for electricity-production installations and CHP plants a maximum load factor applies that is equal to the capacity used at similar plants; 5. if new entrants have started up within the reference period 2001/2002, account is taken pro rata of the duration and the production volume; 6. the factor for production growth is set at 1.0 for the phase preceding 31 December 2007; 7. the compliance factor is also applicable to the ‘known new entrant’.
The allocation is based on	The benchmark is a fuel-specific emission benchmark using a fuel-specific emission factor and a fuel-specific production yield. A maximum load factor applies that is equal to the capacity used at similar plants.
Deficit or surplus of the new entrants reserve	The ‘first-come, first-served’ principle applies: Allocations from the reserve can be made for free as long as it still contains allowances. After that the new entrant probably has to buy the allowances on the market.
Transfer provisions	No.
Other significant provisions	No.

Table 16 – Description of key provisions for the allocation to new entrants in the power sector in Poland in the Phase 1 NAP

Country	**Poland**
Basis for the allocation to new entrants	New installations will be allocated enough allowances to cover their emissions needs for free, defined on the basis of verifiable production plans, provided BAT standards are fulfilled. The allowance allocation covers the period from the issue of the allocation decision to the end of the first ETS phase. New CHP plants will be allocated according to their planned emission level. In the case of an extension of the installation or a change in its character, allowances are allocated to cover the emission increase caused by the action taken. For hard coal and lignite power plants a compliance factor of 0.95 will be applied.
The allocation is based on	New installations will be allocated sufficient allowances, provided BAT standards are fulfilled.
Deficit or surplus of the new entrants reserve	Allowances will be allocated from the new entrant reserve on a 'first-come, first-served' basis. In case there are not enough allowances in the new entrant reserve, the system Administrator may use the non-ETS emissions reserve to allocate emissions to new installations if such a reserve exists in the non-ETS sector. The allowances from the new entrant reserve which are not allocated by 30 September 2006 may be auctioned. The system administrator may use the remaining allowances to cover the growth of emissions in the non-ETS sectors in order to meet the national emission cap, if the emission balance requires it.
Transfer provisions	In the case of plant closure and replacement by a new plant within 3 months, the emission allowances can be transferred to the new installation (new operator) and are granted till the end of a given trading phase. If the operator has at the end of trading phase a number of unused allowances left, he may apply to the national authority issuing the allowances for a permission to move all or part of the unused allowances to the next trading phase.
Other significant provisions	An ex-post adjustment was planned but refused by the EU Commission.

Table 17 – Description of key provisions for the allocation to new entrants in the power sector in Spain in the Phase 1 NAP

Country	**Spain**
Basis for the allocation to new entrants	Allocation to new entrants will be calculated: • On the basis of CO_2 emission projections and best available technologies (BATs) and the same compliance factor as in the initial NAP allocation. The allowances allocated to new entrants will not be proportionally greater than those allocated to installations already existing within the same sector; • Taking into account the installations' production capacity, the average production capacity of installations already existing in the sector, BATs and the reduction burden complied with by the sector.
The allocation is based on	The allocation benchmark is based on BAT technology.
Deficit or surplus of the new entrants reserve	Distribution will be on a 'first-come, first-served' basis. Allowances from the new entrants reserve not allocated before 30 June 2007 may be transferred in accordance with the provisions of Law 33/2003 on the Assets of the Public Agencies.
Transfer provisions	No.
Other significant provisions	No.

Table 18 – Description of key provisions for the allocation to new entrants in the power sector in the UK in the Phase I NAP

Country	**UK**
Basis for the allocation to new entrants	New entrants receive allocation free of charge from a new entrant reserve based on a benchmark approach. A compliance factor of approximately 0.85 will be applied to the power sector.
The allocation is based on	Technology-specific benchmarks were developed. They use standardized assumptions regarding efficiency, load factor and emissions to calculate a set the amount of allowances per year per unit of capacity for each technology type. The benchmarked allocation assumes that the fuel used for power production is natural gas.
Deficit or surplus of the new entrants reserve	The 'first-come, first-served' principle applies. New entrant good quality (high efficiency) CHP plants have preferential access to a ring-fence portion of the new entrant reserve. The surplus of the NER will be auctioned.
Transfer provisions	No.
Other significant provisions	No.

3.2.3.2 Determination of the new entrants reserve

All six Member States analysed have chosen to provide free allocation to new entrants.[26] To provide free allocation it is necessary to set aside a new entrants reserve. Table 19 gives an overview of the approaches regarding the new entrants reserves. Note that the new entrants reserves are not specific for the power sector but are for the whole emission trading sector.

Table 19 – Overview of the different approaches to the determination of the NER

Country	Determination of NER
Germany	In Germany the size of the NER was derived from a compilation of known projects and a projection for unknown projects. The size of NER decreased from 5 million EUA annually in the first NAP draft to 3 million EUA in the final version.
Spain	In Spain a free reserve of 3.5% over and above reference-scenario emissions was established. However, the reserve was then reduced from 5.420 million EUA to 2.994 million EUA annually in order to increase the allowances distributed to existing coal plants.
Italy	In Italy the sector reserves initially contain a number of allowances subtracted from sector level allocations and based on the expected role of new entrants in the sector. The reserves also receive residual allowances allocated to closed plants (see Table 22). The initial sizes of the reserves have been set by stabilising to 2005 the number of allowances allocated to existing plants and introducing in the reserve the allowances introduced to accommodate the growth of each sector in the periods 2005-2006 and 2006-2007.
Netherlands	In the Netherlands there are two separate reserves for 'known' and 'unknown' new entrants which are based on sectoral growth percentages presented in NAP. From this reserve allowances can be made to new entrants and to honour any appeals made to the administrative tribunal that lead to the allocation of extra allowances.
Poland	In Poland the 'National Reserve' for the period 2005-2007 covers: new entrants, increase in production levels for the installations covered by the EU ETS, and for those installations which take over production from facilities which are not covered by the EU ETS as far as this would lead to an increase of emissions.
UK	In the UK the size of the new entrants reserve was determined by calculating the level of expected new entry in each sector, plus allowances for new CHP plants. Allowances which are not issued to installations because of closure will be added to the new entrants' reserve (see Table 22).

The new entrants reserve forms part of the cap of the traded sector. Increasing the share of the new entrants reserve should result in a decreasing the allocation to existing installations. Therefore all Member States should have aimed at a new entrants reserve big

[26] The commission provides three approaches for the treatment of new market participants in the Guidance Document; the purchase of the certificates on the market; auctioning as well as the building of a reserve for the allocation free of charge for new entrants (COM 2004e).

enough to cover the expected demand of new entrants but which would not exceed the demand.

However, the NER was also subject to the overall bargaining process on caps and allocation provisions in several countries. For example, in Germany the size of NER decreased from 5 million EUA annually in the first draft of the NAP to 3 million EUA in the final version. In Spain the size of NER dropped from 5.42 million EUA to 2.994 million EUA during the NAP process.

Major differences can be found between the six Member States regarding the amount of allowances in the reserve. The proportional share of the reserves range from 0.6% in Germany to 9.3% in Italy, calculated as the share of the total amount of allowances. Table 20 gives an overview of the different sizes of NERs in the six countries.

Table 20 – Overview of the of the NER size in the six countries analysed

Country	Total number of allowances[a]	Size of the NER	Share of NER of total
	Million EUA/a	million EUA/a	%
Germany	499	3.0	0.6
Italy	232.5	21.7[b]	9.3
Netherlands	95.5	2.5[c] For unknown new entrants: 2.5 For known new entrants: not yet defined	2.6[c] 2.6 -
Poland	239.1	0.94	0.4
Spain	174.4	2.9[d]	1.7
UK	245.3	15.1[e]	6.2

Notes:

[a] Figures do not take into account any opt-ins and opt-outs of installations in accordance with art

[b] Italy: For the energy sector the reserve is 20.33 million EUA/year.

[c] Netherlands: only for ‘unknown new entrants’, the reserve for ‘known new entrants’ has not yet been conclusively defined.

[d] Spain: 1.0 million EUA/year is earmarked for the electricity sector and is already included in the 86.4 million EUA/year allocation established for the sector. The remaining 1.994 million EUAs/year are allocated to industrial sectors (pool) and 0.364 is for cogeneration activities associated with sectors not listed in Annex I to the Directive.

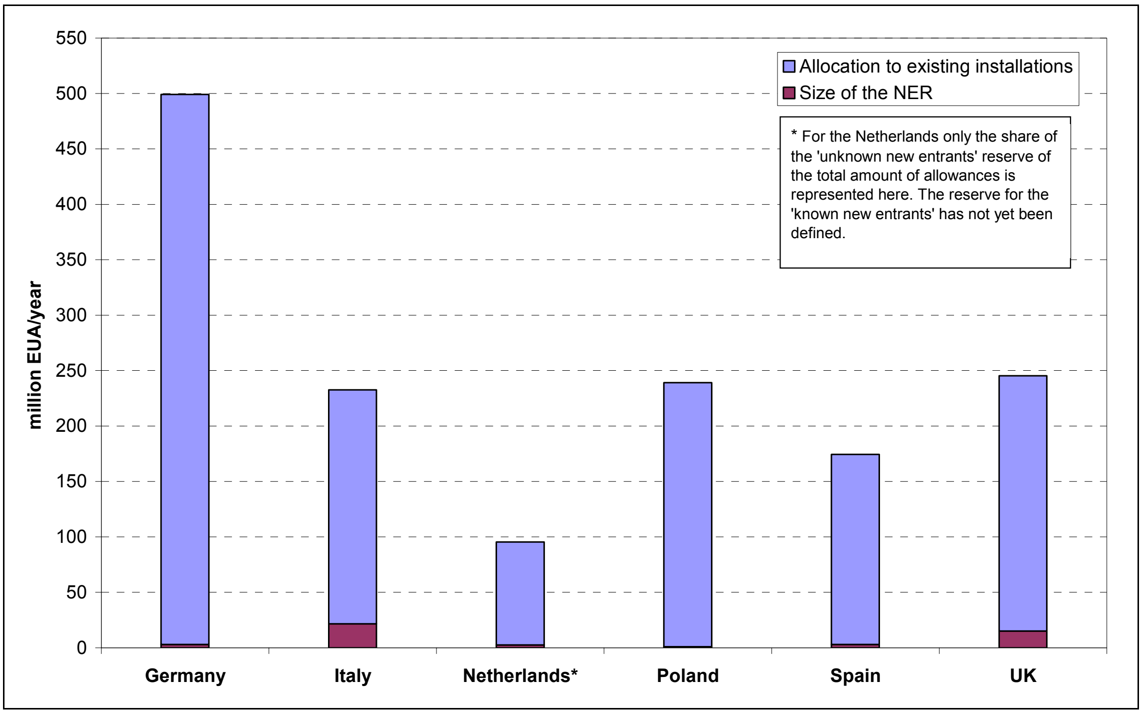
[e] UK: 4.63 million allowances are set aside for good quality CHP and the remainder is open to all new entrants (including CHP if their reserve runs out). A further 0.5 millions allowances are set aside for incumbent installations that are identified late.

Sources AVANZI, ILEX, ILEX Iberia, ESC, Öko-Institut

Table 20 indicates that the share of the NER of the total amount of allowances is quite different in the six countries. Italy provides the greatest reserve for the new entrants in comparison to the other. The reserve of the UK seems at first to have approximately the same magnitude as in Italy, but it must be taken into account that the UK reserve applies to all sectors, whereas in Italy almost the complete reserve is reserved for new entrants in the power sector. Furthermore in the case of an insufficient reserve in Italy the authority will purchase the missing allowances on the market (replenishment approach), unlike the 'first-come, first-served' principle which applies in the UK. The replenishment approach reduces uncertainty for the operators but increases the uncertainty for the government (and ultimately for the taxpayer). The NER in Germany seems small, but here the replenishment approach as well as the transfer provision (which lead to less demands for the NER) should be taken into account. The transfer provisions should also be reflected in the assessment of the Polish NER.

The reserve for the new entrants in the Netherlands is split in two different reserves, one for 'known new entrants' and one for 'unknown new entrants'. The UK also followed a similar approach to calculate the size but put it all into the same reserve for allocation. A 'queue' on regulator's website is published in the UK which shows the amount of allowances left in the reserve and the plants which are in line for allowances. In Spain some of the new CCGT projects were included in the NAP list. These approaches can help to reduce the uncertainty for both, the government and also for the operators, even though a 'first-come, first- served principle' applies.

Figure 5 – Share of the NERs on the total amount of allocation in the six Member States analysed



Sources Öko-Institut calculations based on data provided by AVANZI, ESC and ILEX, ILEX Iberia

3.2.3.3 Evaluation of the transparency and simplicity of the allocation provisions to new entrants

Transparency

In the section above we have seen the allocation provisions for new entrants in six Member States. The transparency of those provisions can be assessed regarding the documentation of the rules and the uncertainty operators and stakeholders face to determine the amount a given plant will receive as allocation.

There are two important dimensions to the *documentation* of the allocation provisions for new entrants: first if the allocation provisions are clearly enough documented that the amount of allowances a given plant could be calculated easily;[27] and second whether the trading entities and the stakeholders can retrace the determination of the NER and whether its size is documented.

- For all countries except Spain the allocation to new installations is based on a clearly documented methodology. The allocation provisions to new entrants in the UK are published as a calculation tool on the internet.[28]
- The size of the national NERs is stated in the national allocation plans. The reserves were determined according to different projection methodologies, but at least in Poland, Spain and Italy the NER was changed due to the decision on their NAPs by the European Commission (e.g. reduction of the cap for the traded sector). In Germany the NER was subject to the bargaining process and was deceased significantly.

There are two dimensions to the *uncertainty* of allocation to new entrants: first the uncertainty for operators and other stakeholders inherent in allocation provisions and second the uncertainty resulting from the size and approach of the NER.

- In all countries except Spain there is a clear allocation methodology with specified rules. Thus the result of the outcome of the allocation procedure is clear. In contrast to the allocation to existing installations the compliance factors and growth factors used are predefined; therefore the uncertainty is lower. This is especially true for operators. In Germany, Italy (for CHP only), Poland and the Netherlands projections at the installation level are used in the form of planned production data or capacity utilization data; this brings uncertainty for all stakeholders not being the operator of a given plant, as they do not possess this information.
- For all countries in which the 'first-come, first-served' principle is used, however, the uncertainty for the operator to build a new plant is high, since he cannot assume that certificates are still available in the reserve. This applies to Spain, Poland and the UK in general. From the view of the national government,

27 Provided the entities would know the respective plant specific data.

28 See http://www.dti.gov.uk/energy/sepn/calculating_allocations.xls.

a NER with a pre-defined size has the advantage of a low uncertainty for the state.

- UK and Spain aimed at reducing uncertainty by introducing a 'queuing' system (UK) or by including some known new entrants in the installations list (Spain).
- In contrast, in Germany and Italy there is much less uncertainty for the operator because the state will make additional purchases if needed and thus the allocation is guaranteed (replenishment approach). Furthermore the allocation is granted for a period of 14 years in Germany. However, the replenishment approach implies a significant uncertainty for the government, also in financial terms.[29]
- In the Netherlands, the NER is divided in two parts: one for 'known new entrants' and one for 'unknown new entrants'. Even though a 'first-come, first-served' principle applies the uncertainty is lower for most operators because all installations being 'known new entrants' have certainty that they will receive the allowances. Only the operators whose plans to build new installations are not part of the 'known new entrants' face an uncertainty whether they will receive allocation.
- In Germany and Poland a transfer provision is enabled. Operators can transfer allowances from closed installations to new ones taking over the production. In the German case the new installations will receive the allocation that the closed installations would have received for four years; as the amount is clear this rule causes no uncertainty.

Against this background the NAPs for Germany, Italy, the UK and the Netherlands are rated as 'good' in terms of transparency regarding documentation and minimizing uncertainty. The new entrants provisions for Poland is rated as 'average' in terms of transparency. Once again the transparency of the Spanish allocation methodology for the new entrants leads to a rating as 'weak' (see Table 21 for the underlying criteria).

Simplicity

Considering the simplicity of the allocation provisions for new entrants we assess the complexity of the allocation rules, whether there is a high number of different rules and whether the rules for new entrants are different to the ones for existing installations.

- In Italy the allocation provisions for electricity production in condensation plants are the same for existing and for new installations. Also for CHP the same principle applies for new installations as for existing ones, only replacing the historic production data with planned production data. Therefore the rating of simplicity of the allocation provisions is the same as for existing installations.

[29] The replenishment approach does also matter with regard to the fairness criterion. See Chapter 3.4.4 for more discussion on this issue.

- In the Netherlands allocation provisions for new installations are also similar to the ones for existing installations; historic production is replaced by planned production (a maximum load factor applies). Additionally the allocation may never exceed the 'planned realistic' CO_2 emissions (NOVEM 2004).
- In the UK allocation to new entrants is based on a technology-specific benchmark approach. Allocation depends on the capacity of the new installation and its technology and can be computed easily.
- In Germany and Poland there are two possibilities to get allowances allocated to a new plant. On the one hand there are the rules to new entrants (newcomers); on the other hand a transfer rule could be applied. Allocation to newcomers depends in both countries on installation-specific production plans in the case of Germany combined with ex-post adjustment provisions. So the system to an operator appears to be complex. The different allocation provisions lead to high administrative costs.
- No detailed description of the allocation provisions is given for Spain. The NAP only specifies a number of criteria that will be taken into account.

Against the criterion of simplicity the allocation provisions to new entrants for the Netherlands and the UK can be seen as 'good' in terms of simplicity. Italy is rated as 'average' for the complex allocation method depending on several fuel- and technology-specific parameters. Germany and Poland can be seen as 'average', too, for their possibility of choice between different allocation provisions. The Spanish allocation provisions remain unclear and are therefore assessed as 'weak'.

Table 21 – Evaluation of transparency and simplicity of new entrant provisions

	Transparency	Simplicity
Germany	good	average
Spain	weak	weak
Italy	good	average
Netherlands	good	good
Poland	average	average
UK	good	good

Notes:
Transparency: 'good' – documentation of allocation provisions and NER is clear and the uncertainty on the outcome is low; 'average' - documentation of allocation provisions and NER is clear, but the uncertainty on the outcome is significant; 'weak' – no clear documentation of allocation provisions and NER.
Simplicity: 'good' – the allocation provision is a simple calculation exercise with few different parameters, this leads to minimal administrative costs; 'average' – the allocation provision is based on complex parameters depending on multi-dimensional characteristics of the individual installation; 'weak' – very complex or intransparent allocation provisions

Source Öko-Institut

3.2.3.4 Treatment of plant closures

The treatment of plant closure is addressed from very different perspectives in the public and academic debate. A key argument in the political debate states that if allowances were allocated for free, the operators should not gain a profit if they shut down a plant. Although even this could be an intended incentive within the EU ETS, more serious questions must be raised on potential leakage problems. If operators get an incentive to shut down old plants under the EU ETS and they have the option of building new plants outside the EU this could create counterproductive effects also from the environmental point of view. However, especially in the power sector this should not be possible to a large extent. Nevertheless, the incentive to shut down old plants and replace them by modern ones is one of the key CO_2 abatement options. With regard to this plant closure provisions can play a crucial role (see Chapter 3.3.5).

In all Member States except the Netherlands, explicit plant closure provisions are implemented. The main challenge is a robust and consistent definition of plant closures. The majority of Member States have not yet presented such definitions in the NAP documents. Plant closure is only defined in Italy[30] and the UK[31]. Whatever the main motivation for the implementation of a plant closure provision, the Member States developed a variety of approaches to deal with it. These are described in Table 22 .

- The Netherlands does not have an explicit plant closure provision. All allowances allocated to a certain installation will be issued to the operator of this installation in the present emissions trading phase regardless of whether the plant ceases operation.
- Installations that are shut down are allowed to maintain the allowances for the remaining year in the UK and in Germany (if they do not make use of a transfer provision). Those allowances which are no longer issued will be added to the reserve in the two countries.
- In Italy only half of the allowances no longer used for the installation can be kept by the operator. In the year following the closure of an installation, allow-

[30] In Italy a plant is considered closed under the following circumstances:
a) Permanent suspension of services – the plant discontinues its activity on a permanent basis; in such a case, following the annual surrender of allowances, the permit is revoked;
b) Temporary suspension services – the plant discontinues its activity on a temporary basis for more than 1 year;
c) Significant change – the plant undergoes significant changes to the extent of requiring a permit update.

[31] In the UK a plant is considered closed under the following circumstances (from Appendix C of the approved NAP):
a) the Schedule I activity at the installation has ceased operating; or
b) the capacity of the Schedule I activity at the installation has dropped below the thresholds contained in Schedule I.
The energy activities defined in Schedule I are: activities of combustion installations with a rated thermal input exceeding 20 megawatts (excluding hazardous or municipal waste installations); activities of mineral oil refineries and activities of coke ovens. Research, development or testing of new products or processes do not fall under the activities defined.

ances will no longer be issued (the additional allowances will be added to the reserve).

- In Poland and Spain the allowances issued to a closed installation (disregarding transfer provisions) must be given back to the authority. In Spain these allowances will be transferred to the new entrants reserve.

Table 22 – Plant closure treatment in the Phase 1 NAP

Country	Rules on plant closure
Germany	If the allowances of closed plants are not transferred to an existing installation or to a new entrant (see Table 4 and Table 13), no further allowances will be issued in the next year. The allowances not issued to the operator are transferred to the new entrants reserve.
Spain	Plant closure will result in the loss of allowances for that installation.[a]
Italy	At the time of annual surrender, the operator of the closed plant has to surrender a number of allowances equal to emissions produced before halting.[b] If there are allowances not used in the year of closure, half of them will be reclaimed by the authority and be added to the reserve of the relevant activity. A definition for plant closure is given in the Italian NAP.
Netherlands	No plant closure rule is specified. Plants may keep all allowances allocated for the whole trading phase irrespective of whether they are operating or not.
Poland	If no new plant within 3 months would overtake its production (see Table 16) the allowances issued to the installation for the year the plant is closed will be reclaimed by the authority and cancelled.
UK	An installation that closes is allowed to keep the allowances that it was allocated for the year of closure but loses its entitlement to allocations in future years. Any allowances that are not issued to installations because of plant closure will be added to the NER. There is a definition of plant closure given in the NAP.

Notes:
[a] No further information is given in the relevant law (Law 1/2005, published 9th March 2005).
[b] The residual allowances can – in some sectors – be transferred to new entrants but not in the power sector.

The main challenge regarding plant closure is to identify that a plant is closed, apart from when the operator informs the authority about plant closure and gives the permit back. It may well be that a plant is only operated when demand is very high or that a plant is operated only a few hours a year in order not to lose the permit (‘cold reserve’).

Germany implemented an ex-post adjustment provision to avoid the pseudo-operation of plants. If emission drops about 40% below the base period levels because of production decrease, the allocation will be reduced according to the drop in emission. From a fairness point of view this rule is very sensible but in terms of economic efficiency it may create adverse effects (see Chapter 3.4). This provision is disputed between the European Commission and the German government.

The easiest way of treating plant closure is shown by the Netherlands. Since the operator may retain all allowances allocated, a plant closure definition and checking up on the operation of plants are not necessary, which may well increase administrative costs. Also there is no uncertainty about the amount allocated to any given plant, either for the operator or for other stakeholders.

Another way of dealing with plant closure is the use of transfer provisions. Germany and Poland implemented the possibility of transferring allowances of a closed plant to a new entrant and, under certain conditions, to existing installations.[32] Transfer provisions can set a strong incentive to inform the authority about plant closure in order to be able to transfer the allocation of an old plant to new facilities. However, if a generous alternative exists to the transfer provisions (e.g. non-ambitious emission benchmarks for the allocation to new entrants) even the transfer provision would no longer help in avoiding the plant closure problem.

We do not rate transparency and simplicity here because they are not the decisive criteria to evaluate plant closure definitions. We will take up the issue of plant closure in Chapter 3.3, Chapter 3.4 and in Chapter 4.

[32] Italy also implemented a transfer provision but not for the power sector.

3.3 Quantitative analysis

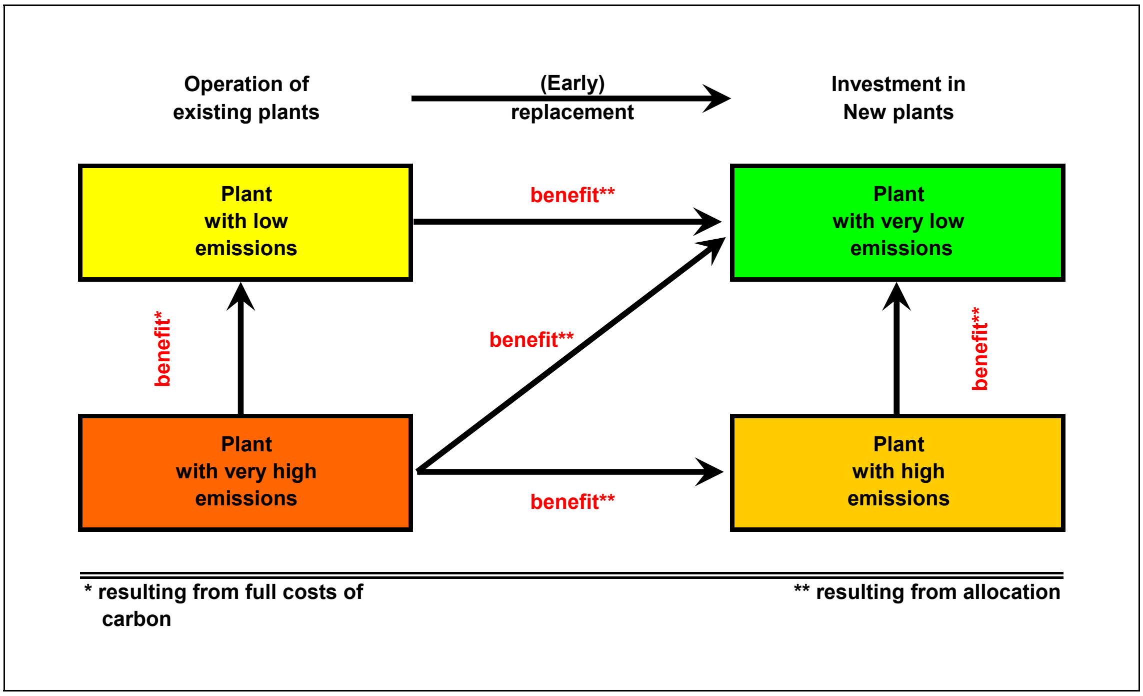
3.3.1 Scope of the analysis and introduction

In the previous chapter we assessed the transparency and simplicity of the allocation rules for the power sector in a qualitative way. In the following part we will quantitatively assess the economic efficiency of the allocation rules for the sector.

Our aim is to compare the incentives which the national allocation provisions are likely to develop. Therefore, we calculated the allocation to a standardized set of power plants and compared the allocation between countries and between technologies.

In a perfect emissions trading scheme, the trading entities would take decisions (e.g. on the operation of plants or new investments) considering the price of carbon provided by the market. Such scheme would provide comprehensive and non-distorted incentives for the economic appraisal of the trading entities.

Figure 6 – Comprehensive incentive structures to be provided by the ETS



Source Öko-Institut

However, it must be assumed that the situation under the EU ETS is more complicated because it is based on free allocation for existing and new plants and the allocation rules might be subject to change in subsequent phases. The question arises of whether and how the Member States were able to manage the various interactions between the allocation provisions (Figure 6)

- to ensure appropriate incentives for an optimal operation of existing plants under CO_2 constraints;

- to ensure appropriate incentives for the optimal investment in new low carbon technologies;
- to ensure appropriate incentives for the optimal (early) replacement of old plants by new installations.

Figure 6 indicates the different mechanisms that would arise if every ton of CO_2 would have a price. The operator of a plant with low emissions would gain a profit from the ETS compared with an operator who operates a plant with higher emissions. An operator who decides to replace an old plant by a new one with lower emissions would have an advantage from the ETS compared to when he would decide not to do so. An investor who decides for a less polluting plant would bring about a benefit from the ETS compared to the case where he would invest in a more polluting plant.

Using the magnitudes of benefits in a perfect ETS based on auctioning as a yardstick, we can analyse whether and to what extent the Member States were successful in implementing a consistent allocation scheme.

- in Chapter 3.3.3 we analyse the incentive structures regarding existing installations – depending mainly on the full costs of carbon;
- in Chapter 3.3.4 we assess the case of new investments from an incumbent's point of view and from a newcomer's perspective – depending on the real costs arising from particular allocation provisions;
- in Chapter 3.3.3 and 3.3.5 we examine the incentives to replace old plants by new installations – depending on the differences in real costs created by the different allocation provisions.

Last but not least, it should be noted that the analysis of incentive structures is even more complex from an inter-temporal perspective which also takes into account future allocations. We address that issue in Chapter 4.

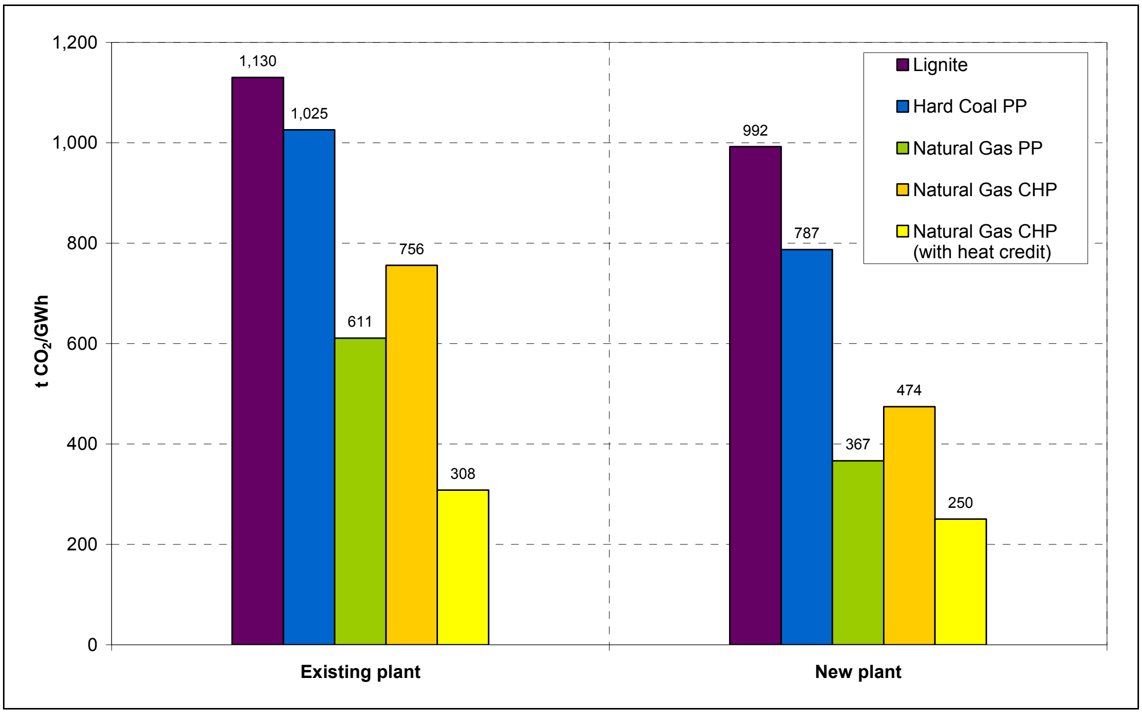
The criterion of fairness is analysed in Chapter 3.4 with regard to the relation between the real costs for the trading entities and their ability to pass through the costs of carbon to the electricity prices, as well as the different options for allocation to new entrants and the access to the new entrants reserve (NER).

3.3.2 Yardstick for comparison: an emission trading scheme based on complete auctioning

In an ideal emissions trading scheme, different levels of emissions would create costs (or benefits) proportional to the differences in emissions. Under an auctioning approach, a trading entity which operates an installation with emissions of one million tons of CO_2 less than a competing installation should gain a benefit (from lower costs) of one million allowances. If an investor implements a measure to lower the CO_2 emissions by about one million tons he should raise a profit of one million allowances.

Since the situation in a multi-phase ETS based on grandfathering and with certain special provisions (free allocation for new entrants, plant closure provisions, etc.) is much more complex, we use the auctioning scheme as a reference case for the comparison of particular provisions and their interactions. The more the pattern of costs and benefits of a certain provision resembles the effects of an auctioning scheme, the better these provisions meet the incentive structures intended by the general concept of an ETS.

Figure 7 – Emission per GWh electricity production in typical power plants



Source Öko-Institut

The emission of a plant depends on the technology and fuel the power plant uses. Natural gas causes lower emissions than hard coal; a new, efficient gas plant will emit less than an old gas plant; an efficient hard coal plant less than an old, inefficient one. Based on those assumptions, we chose a standardized set of power plants with typical parameters[33] to compare the economic incentives which the emissions trading system could provide and provides currently in the six countries analysed.

In Figure 7 we see the emissions of our standardized set of power plants. The highest emissions are caused by lignite-fired power plants (1,130 t CO_2/GWh) and the lowest emission by natural gas-fired plants.[34] The difference between the emission of an existing power plant (i.e. hard coal with 1,025 t CO_2/GWh) and the emission of a new power plant (787 t CO_2/GWh) is due to the better efficiencies of new plants.

The emission per unit electricity production of a natural gas-fired CHP is higher than for a natural gas-fired power plant (756 compared to 611 t CO_2/GWh for existing installations) even though the overall efficiency of CHP plants is much higher than the one of (condensation) power plants. This is due to the fact that CHP produce electricity and heat at the same time and the electrical efficiency is lower than in a condensation power plant that only produces electricity. If a bonus for the heat produced is taken into account, the total emissions of our standardized CHP plant are significantly lower (308 t CO_2/GWh electricity produced – see Annex B for more details and explanations). In an ideal ETS, the total efficiency of CHP would be reflected.

The emissions of our standardized set of plants are roughly the same in all countries. The emissions of hard coal and lignite vary slightly because of the different compositions of coal from different providences.[35]

In an ideal ETS based on auctioning, the operator would have to buy an amount of allowances which is equal to the emissions of the plants. In the EU ETS the great majority of allowances are not auctioned but are allocated for free.[36] To present this method of comparison we contrast below the emissions of the standardized set of plants to the number of allowances allocated to an operator according to the allocation rules of a specific country.[37]

We can observe in Figure 8 that the allocation to the existing installations with the standardized parameters could be lower than the emissions of these installations; i.e. a hard coal power plant emits 1,025 t CO_2/GWh h and the allocation is at 730 t CO_2/GWh. By contrast, a new efficient natural gas power plant and a new efficient natural gas CHP

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33 For the parameters see Table 2.

34 In order to make the emissions of plants of different sizes comparable, we present the emissions in tons CO_2 per gigawatt hour electricity production and the allocation in EUA per GWh. The emission data shown in Figure 7 refer to the 'non country-specific' emission factors for the different fuels shown in Table 3.

35 For the full set of emission factors see Table 3 in Chapter 2.

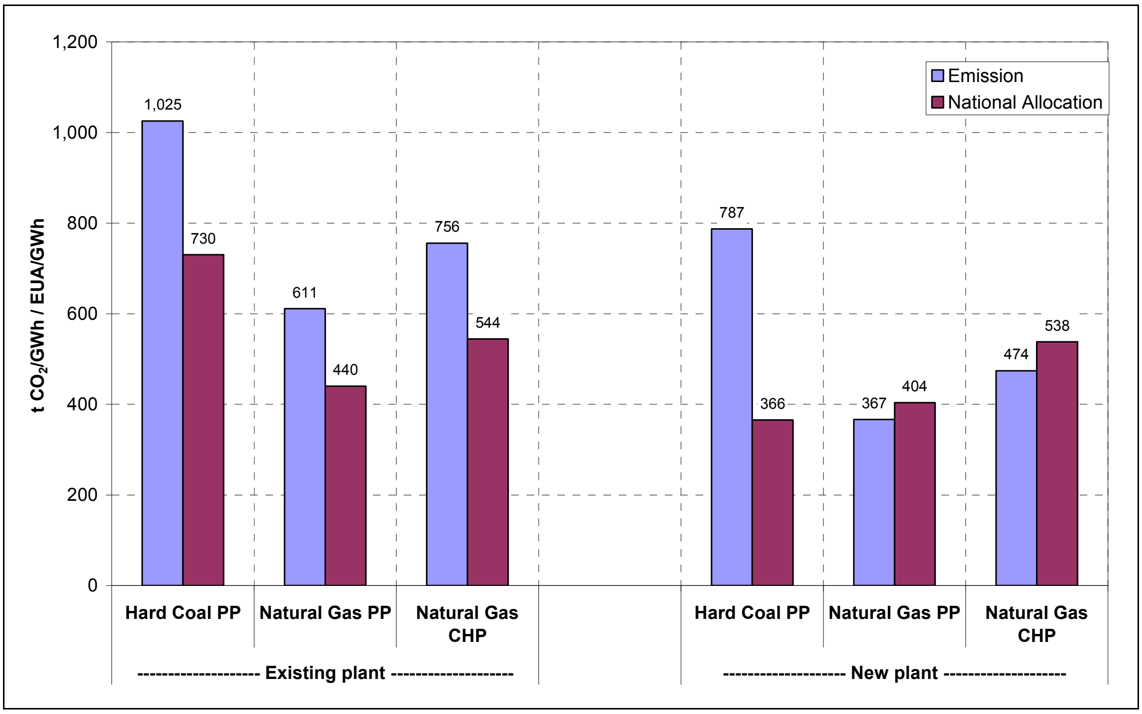
36 The EU Directive 2003/87/EU specifies that in the first trading period (2005 to 2007) at least 95% of the allowances should be allocated for free and at least 90% in the second trading period (2008 to 2012).

37 In this introduction, we use the emissions from the non country-specific plants and the allocation data from UK because the methodology we used can be illustrated very clearly with this set of data. The explanations in this chapter do not reflect any analysis of the UK allocation approach; this is carried out in chapter 3.3.3.

could receive more allowances for free than they would need for operation in our exemplary set of data.

The differences between the emissions (and so the required amount of allowances to operate the plant under the compliance regime of the ETS) and the number of allowances allocated indicate the shortfall or surplus of allowances represented in Figure 9. For example, the shortfall of allowances of the existing hard coal power plant amounts to 295 EUA/GWh[38] (see also Figure 9). The shortfall of allowances would always be greater in the auctioning reference case because no free allocation would be granted in such scheme (1,025 EUA/GWh).

Figure 8 – Comparison of emissions to allocation to different plants in a specific country



Source Öko-Institut

In the case of auctioning, the shortfall of allowances for all condensation power plants is equal to the specific emissions of this plant. As explained above and elaborated in Annex B, we assume a shortfall of allowances in the case of CHP in an ideal auctioning equal to the net emission effects in the whole system (i.e. we apply a heat bonus).

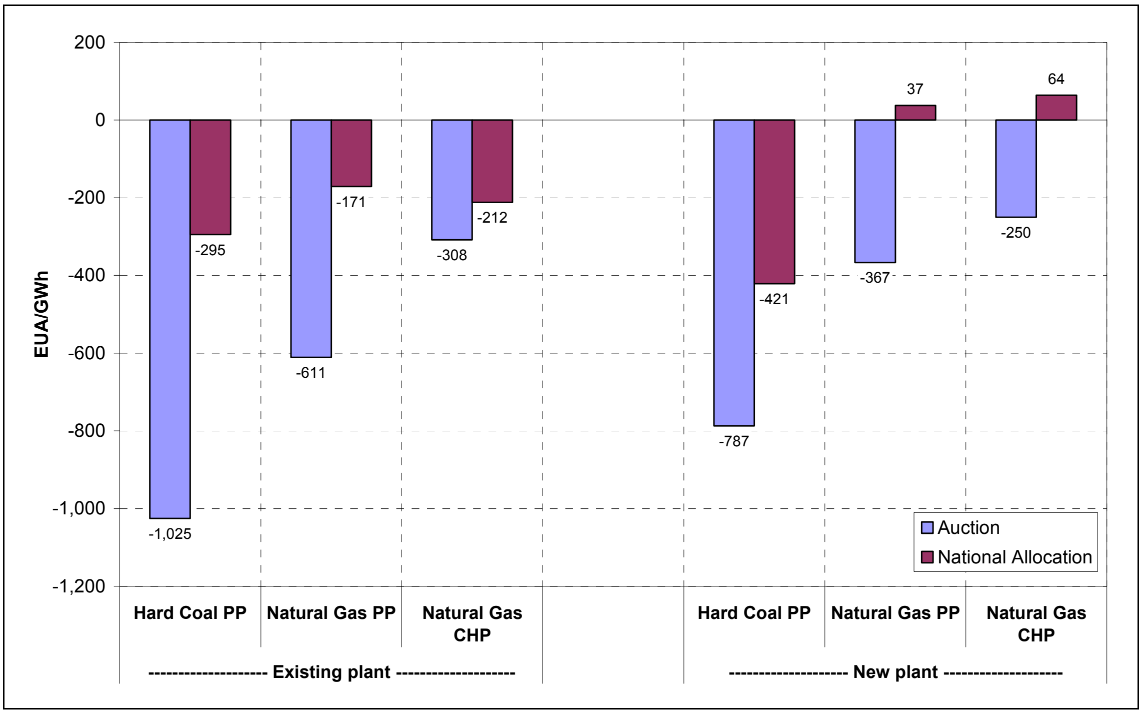
The shortfall of allowances needed to operate a plant indicate the real cost for which the emission trading scheme accounts. We see that the real costs are significantly lower in an ETS where a part of the allowances are allocated for free than in an ETS where all

[38] The emission of a hard coal power plant is of 1,025 t CO_2/GWh and the allocation is of 730 EUA/GWh. Therefore, the resulting shortfall of allowances is of 295 EUA/GWh (1,025 – 730 = 295 EUA/GWh).

allowances have to be purchased. For highly efficient plants the free allocation can lead to a surplus of allowances which can be sold by the operator.

The differences between the levels of these costs can matter as much as the level of the real cost itself. For example, the difference between the shortfall of allowances of a new hard coal power plant and a new natural gas power plant in our example is 458 EUA/GWh.[39] This is a significant difference and of a comparable level to the difference of 420 EUA/GWh in the auctioning case.[40]

Figure 9 – Shortfall or surplus of allowances allocated compared to emissions of different plant types in a specific country



Source Öko-Institut

The higher the differences between real costs from the ETS for plants using different fuels are, the greater the role played by the level of emissions, e.g. for investment decisions.[41]

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39 This results from the difference between a shortfall of 421 EUA/GWh for the new hard coal power plant and the surplus of 37 EUA/GWh for the new natural gas-fired power plant (Figure 9).

40 In this case, the benefit for the new natural gas fired power plant would result from the difference between the shortfall of 787 EUA/GWh for the hard coal-fired power plant and the shortfall of 367 EUA/GWh for the new natural gas-fired power plant (Figure 9).

41 Obviously investment decisions will depend on more factors than simply the price to emissions. However, we focus on the price and incentive difference which the ETS can cause in this report.

If the real costs caused by the ETS are more or less of the same level for all new power plant options irrespective of the emission intensity, then the ETS will not encourage the investment in low emitting plants.

However, in some cases the real costs resulting from the allocation will not determine the incentives from the ETS but rather the full costs of carbon. This will be analysed in the following chapters.

3.3.3 Allocation to existing installations

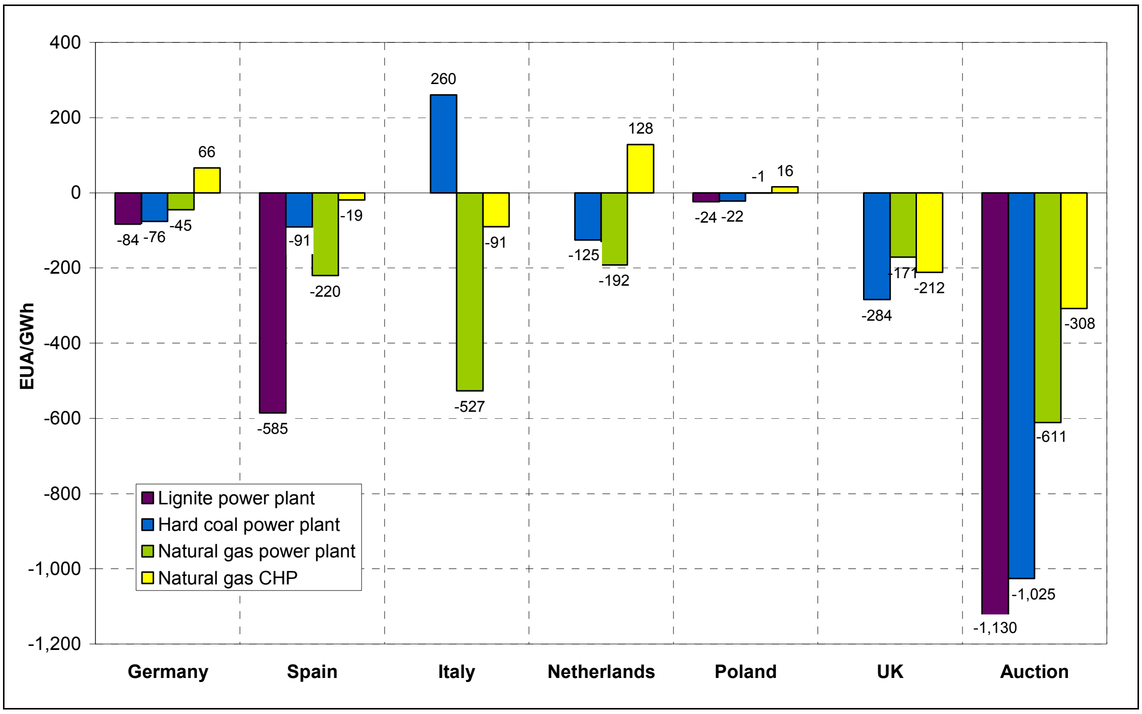
3.3.3.1 Allocation to existing installations and real cost from the ETS

When the EU ETS was being introduced, very heated debates were conducted in the political arena about the appropriate level of free allocation of allowances.

However, the incentives to reduce emissions in existing installations depend purely on the full cost of carbon which is equal to the magnitude of emission (as we will show in the next chapters). The free allocation influences only the real cost from the ETS, which is decisive for the incentive to new entrants and to the replacement of plants.

Nevertheless, we start with a documentation of the allocation effects in the following section. We analyse the real costs of the ETS for existing installations, and we will refer to these data when we continue with the analysis of interactions between the allocation to existing and to new installations (see Chapter 3.3.5).

Figure 10 – *Shortfall or surplus of allowances allocated to existing installations compared to their emissions*



Source *Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia*

All countries allocate a substantial part of the needed allowances for free to existing installations. As emissions of the reference installations are practically the same for all countries,[42] we skip the intermediate step to show the allocated allowances compared to emissions for each country and present immediately the shortfall or surplus of allow-

[42] See Figure 7.

ances allocated compared to emissions in Figure 10. The shortfall or surplus of allowances represents the real costs the ETS is causing the operators per gigawatt hour power generated. If the operator has a surplus of allowances he can sell these allowances on the market and raise a profit. If he is short of allowances, he has to purchase the missing allowances on the market and faces extra costs (or has to reduce the emissions of his plants).

Figure 10 shows that in all countries the pattern of shortfall or surplus of allowances differs significantly from the auction reference case. This is due to the high amount of allowances allocated for free based on a grandfathering approach.[43] Although the allocation is generous in general, some mentionable differences arise from the comparison between countries and power plants.

The upper extreme of generous allocation is Poland with an allocation of allowances which is very near to the emissions; i.e. in the case of the hard coal power plant there is a shortfall of only 22 EUA/GWh while there would be a shortfall of 1,025 EUA/GWh in the auction reference case. The only country with a significant shortfall of allowances for all plant types analysed is the UK.[44]

In three countries (Germany, the Netherlands, and Poland) there is a surplus of allowances for electricity production in existing CHP plants. This is due to an allocation of additional EUAs for CHP exceeding the emissions of these CHP plants. All countries except the UK implemented special allocation provisions for existing CHP to foster this low emitting technology.

Focussing on the relative differences between technologies, we see in the auction reference case that the plants with the highest emissions also have to face the highest shortfall of allowances.

Only for Germany and Poland with relatively simple allocation approaches (based on historic emissions) combined with an extra allocation for CHP does the same ranking result in general; even though at a very low level. The approach in the UK is even simpler and works well for condensation power plants but not for CHP. For all other approaches for free allocation the order is changed due to the more complex allocation provision differentiated by technologies or fuels (benchmarking, different treatment of condensation power plants and CHP or according to fuels – see Chapter 3.2).

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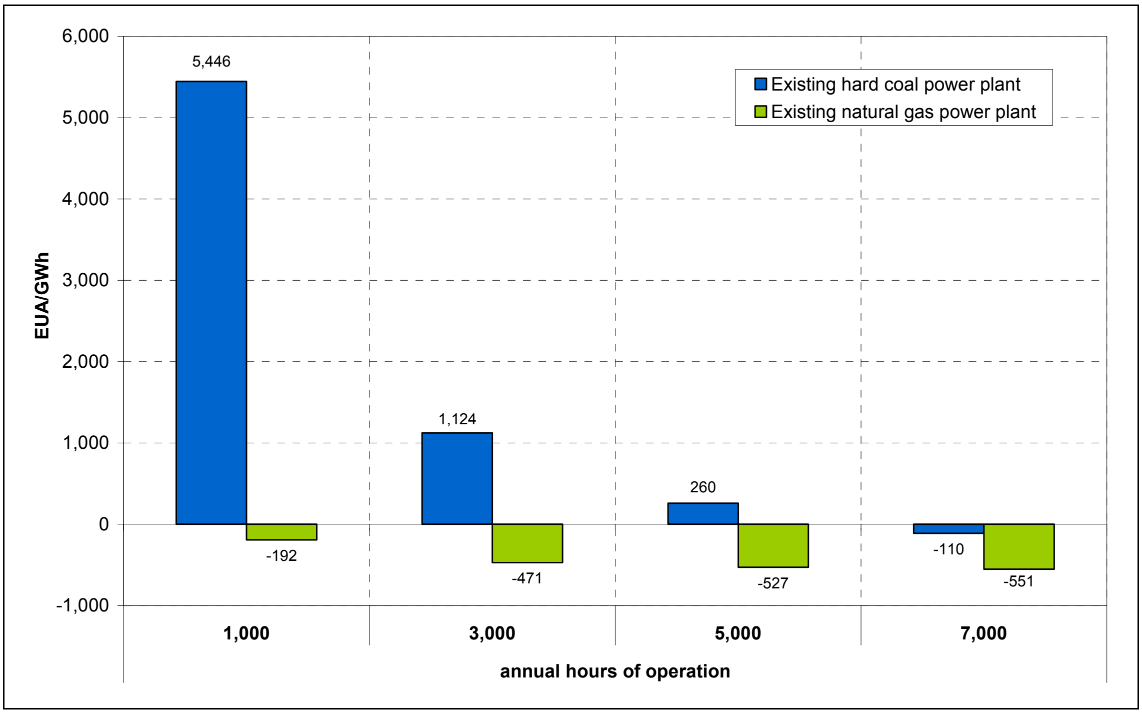
[43] For example, a German hard coal power plant with the standardized parameters creates an emission of 1,025 t CO_2/GWh. According to German allocation provisions the power plant gets 950 EUA/GWh for free, therefore the shortfall of allowances for a German hard coal power plant is 76 EUA/GWh. The differences are due to the rounding of the numbers.

[44] This is due to the relatively ambitious compliance factor of 0.72. For more details on the allocation to existing installations in the UK power sector in the Phase 1 NAP see Table 9.

In Spain[45] we can observe a heavy burden on lignite. This is in line with the high emissions lignite power plants produce. However, in Spain, as well as in the Netherlands, the real cost incurred by operators producing electricity in natural gas power plants is higher than for production in hard coal power plants, even though the emission of electricity produced in hard coal power plants is nearly twice the emission for the same amount of electricity produced in natural gas power plants (611 t CO_2/GWh for natural gas compared to 1,025 t CO_2/GWh for hard coal). This should be seen contrary to the general intention of an ETS to represent the cost of carbon.

Figure 11 – Shortfall or surplus of allocation to existing condensation power plants in Italy; sensitivity analysis



Source Öko-Institut calculations based on data provided by AVANZI

In the case of Italy we observe in Figure 11 an extremely high surplus of allowances for hard coal power plants. When assessing the Italian numbers, we need to take into account that national allocation provisions for existing condensation power plants are based on a load factor benchmark depending on technology and fuel (see Chapter 3.2). If we alter the load factors in the standardized set of installations used for the analysis, we see the sensitivity of shortfall or surplus of allowances per GWh electricity production, depending on the load factor used.

45 The Spanish figures have to be read with caution. The government did not publish an allocation formula and it remains unclear how the allocation was calculated in the end. All Spanish figures should be regarded as approximation only; they are the best estimate ILEX could make with the data given. The Spanish NAP does not differentiate between lignite and hard coal; they both fall in the category of 'coal'.

In Figure 11 we show the results of such a sensitivity analysis. The surplus of allowances is highest, when the number of hours of operation (and therefore the load factor) is closer to the load factor benchmark. In the standardized set of power plants we set a load factor of 5,000 hours annually (57% of the year), so that the surplus for electricity produced with hard coal is 260 EUA/GWh and the shortfall for natural gas 527 EUA/GWh.

If we would have assumed the Italian benchmark load factors[46] when calculating the allocation to the standardized set of power plants, there would have been a shortfall of 123 EUA/GWh in the case of a hard coal power plant and a shortfall of 145 EUA/GWh for a natural gas power plant. The sensitivity analysis for load factors shows that hard coal-fired power plants always receive a more generous allocation compared to gas-fired power plants in Italy in terms of real costs arising from the ETS. The difference in allocation increases steeply, if the load factor for a particular gas-fired power plant is significantly higher than the (low) load factor benchmark for gas-fired steam turbine power plants in Italy.[47]

3.3.3.2 Incentives to change the merit order of existing power plants

In the last section we examined the shortfall or surplus of allowances resulting from different allocation provisions. The real costs (or benefits) arising from shortfall does not necessarily provide the incentives for plant operation reflecting the cost of carbon or abatement measures at existing plants.

In this section and the following ones, we analyse the incentive which the ETS provides to reduce the emission by changing the operation of existing installations. One way to reduce emissions is to change the merit order.

If the power production of a plant is decreased and the electricity output of another plant is increased instead, the merit order of power production is changed.[48] We picture in the following graph the incentive to reduce the electricity production of an emission-intensive power plant (a hard coal power plant) and increase the electricity production of a low emitting power plant (a natural gas-fired power plant or natural gas-fired CHP) instead. If the electricity production in a hard coal power plant is reduced by one unit, then the emission of the hard coal power plant is reduced by the specific emission of one unit power production in this plant.

If we analyse the incentives for a change of merit order, we see in Figure 12 that the incentives to change the merit order of existing power plants range from 404 EUA/GWh

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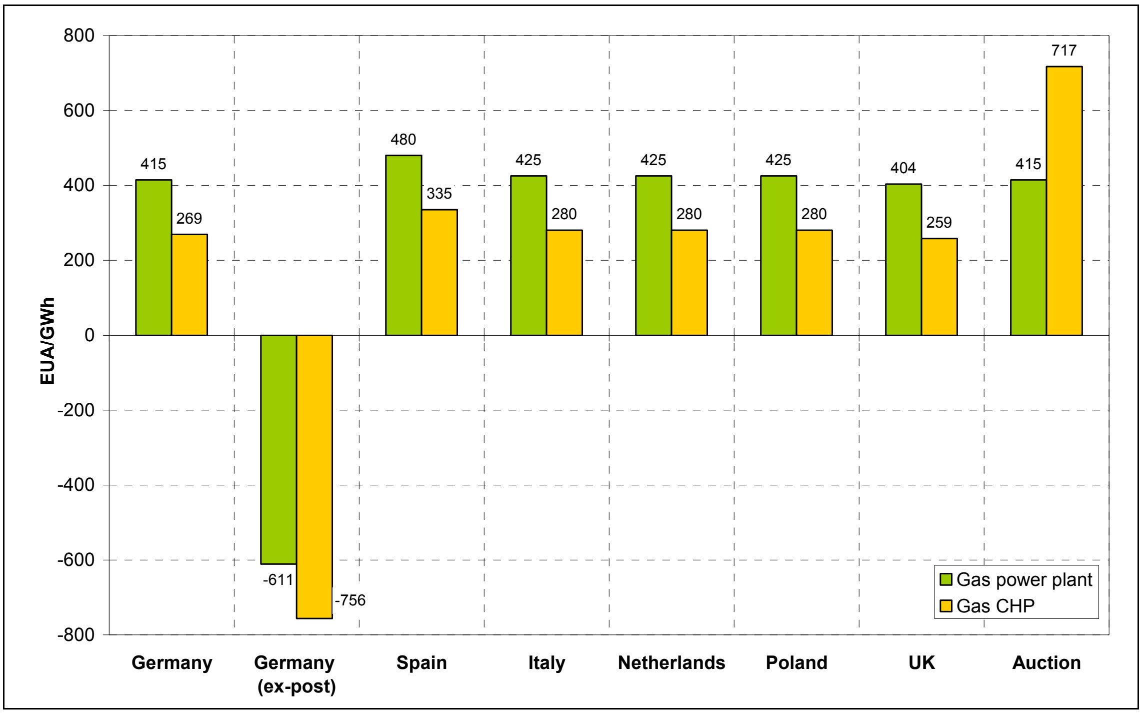
[46] The Italian load factor for an existing hard coal-fired steam turbine power plant is 7,100 hours/year and the capacity utilization for an existing gas fired steam turbine power plant is 900 hours/year.

[47] For a more in-depth analysis of the sensitivity of load factor benchmarks see Annex C.

[48] The way in which operating a plant might influence the allocation in future allocation phases and thereby induce strategic behaviour of the operator is not taken into account at this point. This is analysed later in Chapter 4.2.2.

(UK) to 480 EUA/GWh (Spain). If we consider the country-specific emission factors, these incentives exactly equal the differences of emissions from power generation. The quite different allocation provisions do not influence the structure of incentives.[49]

Figure 12 – Incentives to substitute electricity production from existing hard coal power plants by electricity production from existing natural gas-fired power plants or existing natural gas-fired CHP



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

The same result can be shown for the substitution of hard coal-based power production by power from a CHP plant which amounts to a range between 259 EUA/GWh (UK) and 335 EUA/GWh (Spain). The differences between the Member States only depend on the differences in emission factors for hard coal which differ significantly between the countries (see Table 3).

The magnitude of the incentives to replace electricity produced in a hard coal power plant by a gas power plant is equivalent to the auctioning approach and is of a significant level for all countries. The incentive to replace electricity produced by hard coal

[49] This result could be explained as follows, taking Spain as the example. The hard coal power plant in Spain has specific emissions of 1,091 t CO_2/GWh and receives a free allocation of 1,000 EUA/GWh. The operator needs to purchase 91 EUA/GWh to operate the plant. For the extension of power production of an existing natural gas power plant the additional costs amount to 611 EUA/GWh (see also Annex A). The benefit from a substitution of hard coal-based power production by a gas-fired plant amounts to 480 EUA/GWh (1,000 + 91 – 611 = 480 EUA/GWh) which is equal to the different emissions (1,091 – 611 = 480 t CO_2/GWh).

with electricity produced by natural gas in a CHP is lower in all countries than in the auction reference case for the reasons described in more detail in Annex B.

The only outlier is due to an ex-post adjustment provision in the German NAP.[50] The ex-post provisions in the German NAP were introduced mainly to avoid windfall profits of plants receiving allocation on the basis of planned production data or in the case of plant closure.[51]

The most crucial provision for ex-post adjustments in the German NAP is the one to treat unidentified plant closures. If the emission of a plant decreases by more than 40% compared to the base period emissions due to production decrease, the allocated allowances will be reduced proportionally to the emissions reduction and the operator would have to give those allowances back to the authority. As a result, the incentive to reduce emissions and production in a certain plant with high emissions and to extend the production in a cleaner plant would be completely eliminated if the ex-post adjustment applies.

Ex-post adjustments of this sort constitute a strong disincentive to changes in the merit order; ex-post adjustments reduce the incentive structure of the ETS significantly.

[50] The ex-post adjustment provisions in the German NAP are disputed between the German government and the European Commission.

[51] It should be underlined that the ex-post provisions in the German NAP shall only apply to reduce the allocation, never to increase it.

3.3.3.3 Incentives to reduce emissions in existing power plants

In the next case study we highlight the incentives the emission trading scheme provides to reduce the emissions of an existing plant by implementing technical measures for emission reduction.[52]

Basically two ways of reducing the emissions of an existing plant exist. The first option is to enhance the efficiency and the second to undergo a fuel switch.[53]

- To illustrate the incentives, in our exercise we assume for the first option that the efficiency of an existing hard coal-fired power plant is improved by four percentage points (from 33% net efficiency to 37%). This is a range of efficiency enhancement which can be realistically reached by some investments such as retrofitting or replacing an old turbine in existing power plants.
- For the second option we assume that a power plant was fired with hard coal and after technical adjustments will switch to natural gas.

An increase in efficiency leads to a decrease of emissions. The hard coal power plant in the standardized set of power plants has an efficiency of 33% and an emission of 1,025 t CO_2/GWh. The same plant with an efficiency of 37% would only emit 915 t CO_2/GWh. The incentive to enhance the efficiency equals the difference between the two emissions levels because the demand for allowances decreases by about the same value. In our case study, a value of 111 EUA/GWh would result.[54]

Apart from the efficiency, the emission of the plant also depends on the fuel used. The specific emission of the hard coal power plant amounts to 1,025 t CO_2, whereas the emission of the same plant with the same efficiency but fired with natural gas is only 611 t CO_2/GWh. The incentive to undergo such fuel switch under the ETS results from different emission levels and is 415 EUA/GWh in this case study.[55]

We observe in Figure 13 that the incentives to reduce the emissions of existing installations are roughly the same in all countries and equal the emission reduction caused by the efficiency improvement or by the fuel switch. The differences are caused by the different emission factors for hard coal in the different countries. As we have seen in the previous section, the UK is the country with the lowest emission factor for hard coal and therefore with the lowest incentive and Spain is the country with the highest.

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52 That the reduction of emissions of a plant might influence the allocation in future allocation phases and thereby induce strategic behaviour of the operator is not taken into account at this point. This is analysed later in Chapter 4.2.2.

53 The technical feasibility of such a fuel switch or an efficiency enhancement will obviously depend on the individual installation. The example is of an illustrative character in order to clarify the economic effect.

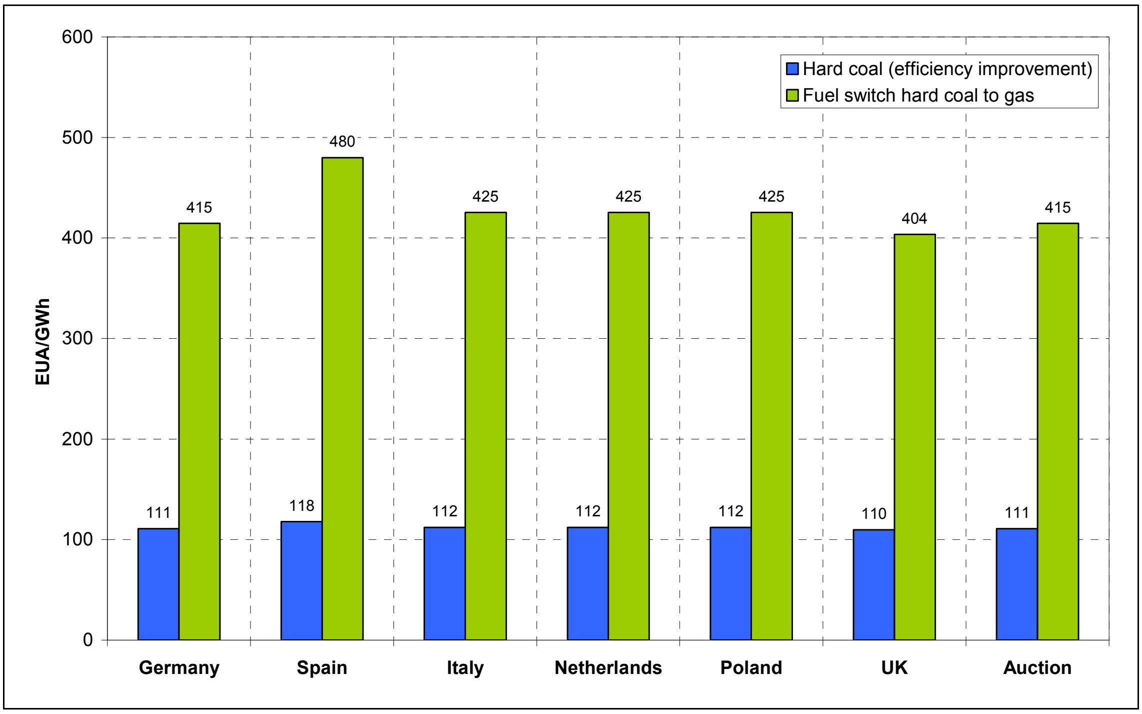
54 The difference between 1,025 and 915 t EUA/GWh is 111 EUA/GWh due to rounding effects.

55 The difference in emission intensity (1,025 – 611 t CO_2/GWh) is 415 t CO_2/GWh due to rounding effects (or 415 EUA/GWh if expressed in terms of incentives).

In our case study, the incentive to undergo a fuel switch is about four times higher than the incentive to improve the efficiency (i.e. 425 EUA/GWh for fuel switch and 112 EUA/GWh for efficiency improvements in the case of Italy). However, both the potential for a complete fuel switch or for significant efficiency improvements in existing power stations must also be seen in the light of the resulting necessary investments and fuel costs (see Figure 4 in Chapter 2).

For both options assessed in this case study the magnitude of incentives from the ETS does not depend on the national allocation rules but rather purely on the emissions reduction achieved; the incentives reflect the full costs of carbon.

Figure 13 – Incentives for efficiency improvements in existing hard coal-fired power plants and fuel switch from hard coal to gas in existing power plants



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

The incentive follows the same direction as the auctioning approach and is of a significant level for all countries. The German ex-post adjustment does not apply for fuel switch or efficiency improvements. Therefore we find no outlier caused by this ex-post adjustment provision in this case study.

3.3.3.4 Evaluation of economic efficiency of the allocation to existing power plants

In this chapter we analyse the real costs and incentives caused by the emission trading scheme when operating existing installations. Even though the real costs do not influence the incentives from the ETS for the operation of existing power plants, we will discuss the real costs because there is an influence on the economic efficiency regarding the replacement of old plants (see Chapter 3.3.5) and the allocation provisions in subsequent phases of the ETS (see Chapter 4).

However, the real costs for the operators of installations will not influence the rating of the economic efficiency of the allocation to existing power plants in this chapter.

The real cost induced by an emission trading scheme depends on the shortfall or surplus of allowances allocated in comparison to the realistic emissions of a given plant. We can summarize the findings in regard to the real cost as follows:

- In Germany and Poland the real costs of operating existing plants follow the same order as in the auction case, which is positive. However, the shortfall or surplus is of a very low level.
- Italy and the Netherlands both have allocation rules that lead to a greater shortfall of allowances for natural gas power plants than for the more emission-intensive hard coal power plants.[56] The Netherlands, however, foster the power production in CHP with significant surpluses of allowances allocated to existing CHP compared to emissions because CHP receive an allocation for electricity and heat separately. In contrast, in Italy existing natural gas CHP face a shortfall of allowances.
- The Spanish allocation provisions place a heavy burden on the emission intensive fuel lignite. However the real cost for electricity production in a hard coal power plant is lower than for electricity production in a natural gas power plant. CHP are favoured with a relatively generous allocation.
- Among all of the countries, the UK places the strongest shortfall of allowances on the hard coal power plants. The shortfall of allowances for natural gas power plants is lower because the emissions are lower as well. However, the real cost of each gigawatt hour electricity produced in a CHP plant is higher than the real cost in a natural gas power plant even though the overall efficiency of CHP is higher than in a condensation power plant.

The incentives to reduce emission of power production by existing installations do not depend on the real costs but on the cost of carbon. Evaluating the incentives to change the merit order or to reduce emissions by technical measures we come to the following conclusion:

[56] This is true for Italy, also when controlling for sensitivity using the Italian benchmark load factors for both power plants.

- Allocation provisions do no alter the incentives to reduce emission by change of merit order or technical improvements. The only exception is the German ex-post adjustment provision. The magnitude of the incentive is in general equal to the auction reference case; the incentive to change the merit order by producing more energy in CHP is lower than in the auction case but still significant. Therefore all countries except Germany are rated as ‘good’.
- Germany is the only country assessed that applies an ex-post adjustment provisions. Especially the provision of ex-post adjustments in the case of an emission decrease of over 40% due to production decrease could lead to massive incentive erosion concerning the change of merit order. Although the motivation for the introduction of ex-post adjustments is understandable, Germany is rated as ‘weak’ with regard to economic efficiency.

Table 23 summarises the ratings of economic efficiency of the allocation provisions to existing installations per country.

Table 23 – Evaluation of economic effiency of the allocation to existing installations

Economic Efficiency	Evaluation of allocation to existing installations
Germany	weak
Spain	good
Italy	good
Netherlands	good
Poland	good
UK	good

Notes:

'good' – the provisions provide full incentives to reduce emissions in existing plants; the overall incentives are comparable to the incentives in the reference case of auction; ‘average’ – some provisions counteract the incentives which should be generated by an emissions trading scheme to reduce emissions in existing plants; ‘weak’ – significant provisions counteract the incentives which should be generated by an emissions trading scheme to reduce emissions in existing plants.

Source Öko-Institut

3.3.3.5 Lessons learnt: Allocation to existing installations

In all countries a major part of the allowances needed to operate a given plant is allocated for free. Against the very different approaches chosen in the Member States the following conclusions can be drawn:

1. The *real cost* of the emission trading scheme for electricity production depends on the emission intensity of the production and the free allocation. The more allowances allocated for free, the lower the difference is between emissions and allocation and the lower the real costs are for the operators.

   In general the real costs arising for the installations from the ETS are far below the costs for the full purchase of allowances under an auctioning scheme. Only in some Member States and for some power plants (e.g. hard coal and gas plants in the UK, lignite power plants in Spain) are the real costs not minor compared with the auctioning case.

The allocation to particular installations is very generous in some of the Member States (e.g. Germany and Poland) and is much less generous in other Member States (e.g. the UK). In some cases of the standardized set of installations analysed here the allowances allocated may even exceed the emission; in this case the operator may sell this surplus. Such surplus could indicate windfall or bargaining profits for the operators on the one hand or was planned as ex-post benefit for early action or the operation of a CHP plant on the other hand.

However, the *proportion* of allowances allocated for free of the respective emission level is quite different between the Member States. In some countries (Germany, Poland) the free allocation is more or less proportional to the emissions; high emissions go along with a higher shortfall of allowances in absolute terms and lower emissions with a lesser shortfall. In some countries (Spain, Italy and the Netherlands) shortfall or surplus of allowances show no evident link to the level of emissions. In the UK the different emission levels follow the patterns of emission only for some condensation power plants (hard coal and natural gas). Even if some bias could result from the definition of the standardized set of installations used in the analysis (e.g. for Italy), a sensitivity analysis shows that significant distortions remain regarding the level of emissions and the shortfall or surplus of allowances. Some countries (Germany, Italy, Poland, and the UK) implemented allocation provisions for CHP that do not sufficiently reflect the emissions abatement effects of CHP plants.

2. In contrast to the real costs, the *incentives* created by the ETS for emission reduction in existing installations do *not* depend on the allocation approach. If operators decrease emissions – either by changing the merit order (to meet the optimal level of production) or by reducing emissions by technical improvements or fuel switching – they will benefit from the ETS equivalent to the emission reduction.

   The benefit (or burden) from the ETS (given in allowances) is as high as the amount of reduced or increased emissions (given in tons of CO_2). So the full cost of carbon – including the real costs for the purchase of allowances and the opportunity costs of the allowances allocated for free – creates a clear and non-distorted price signal from the ETS. As these incentives from the ETS do not depend on the allocation, national allocation rules have *no influence* on the magnitude of the incentives for *existing* installations created by the ETS within a certain trading phase. There are no differences in the benefits from emissions reductions in existing installations regardless of whether the Member States selected a benchmarking approach (Italy and the Netherlands) or based the allocation on historical emissions (Germany, Poland, Spain and the UK).

3. The only exception is in the case of *ex-post adjustment*. If ex-post adjustments apply, the benefits from the ETS in the case of emission reductions in existing installations will be deleted.

   German ex-post adjustments were intended to avoid windfall profits from the allocation based on planned production and from plant closure out of fairness considerations but as secondary effect ex-post adjustments eliminate carbon pricing in the framework of the ETS for the installations to which these provisions apply. Therefore ex-post adjustments need to be avoided to ensure the economic efficiency of the scheme.

However, the allocation provisions for existing installations for subsequent phases in a multi-phase ETS could change the situation where the incentives from the ETS do not depend on allocation (see Chapter 4). Furthermore, the discrepancies between real costs and incentives should be reflected in the framework of fairness considerations (see Chapter 3.4). Last but not least, the share of allowances allocated for free and the magnitude of real costs constitutes an important parameter for the incentives for an early replacement of old plants (see Chapter 3.3.5).

3.3.4 Allocation to new power plants

3.3.4.1 Introduction

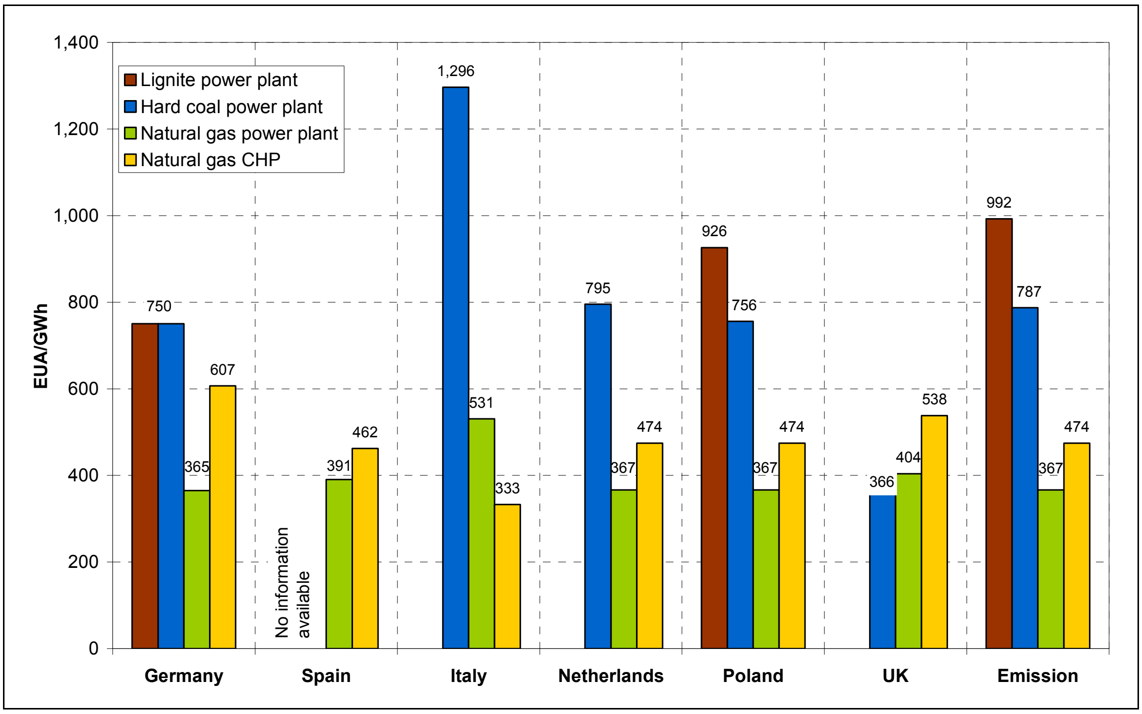
An investor in the power market will calculate the expected costs and gains of electricity production in different plants when deciding which kind of power plant to build. With the emission trading scheme the shortfall or surplus of allowances can play a critical role in an investment decision. In contrast to the allocation to existing installation where the full cost of carbon is decisive, the real costs matter most for new investment. The real cost is the difference between the emission of a plant and the amount of allowances allocated for free. Therefore we need to assess whether the shortfall or surplus of allowances reflects the emission intensity of the plants assessed here. First, we analyse the allocation to new installations (new entrants) built by newcomers (e.g. an independent power producer). In some countries transfer provisions for incumbents exist; those cases will be analysed in the next step.

3.3.4.2 Incentives to invest in low emitting new power plants

All six Member States analysed provide free allocation to new entrants out of a new entrants reserve, even though the EU ETS Directive allows for no free allocation. In an ETS based on complete auctioning there would be no free allocation and the real costs would equal the full cost of carbon for each plant. In this case the real cost for power production in a plant with high emissions would be higher than the real cost for power production in a plant with low emissions. The resulting incentive is to invest in low emitting new plants. Free allocation influences the real costs. When designing allocation provisions, national governments should aim at ensuring the appropriate incentives to invest in low emitting technology.

Below we compare the allocation to different newly-built power plants across countries.[57] We analyse the amount of allowances allocated for free to our standardized set of new plants.[58] The amount of allocation calculated is on the assumption that the investor is a newcomer and cannot profit from any transfer rule (see Chapter 3.2). First we examine the number of allowances allocated to the different plants in different countries (Figure 14). Afterwards we compare the shortfall and surplus of allowances as we did for the existing installations because this determines the real cost (Figure 15).

Figure 14 – Allocation to new entrant power plants compared to emissions



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

Figure 14 pictures the free allocation to the standardized power plants. The highest amount of allowances is allocated to electricity produced in hard coal power plants in Italy (1,296 EUA/GWh).[59] We can observe that in all countries except the UK[60] new

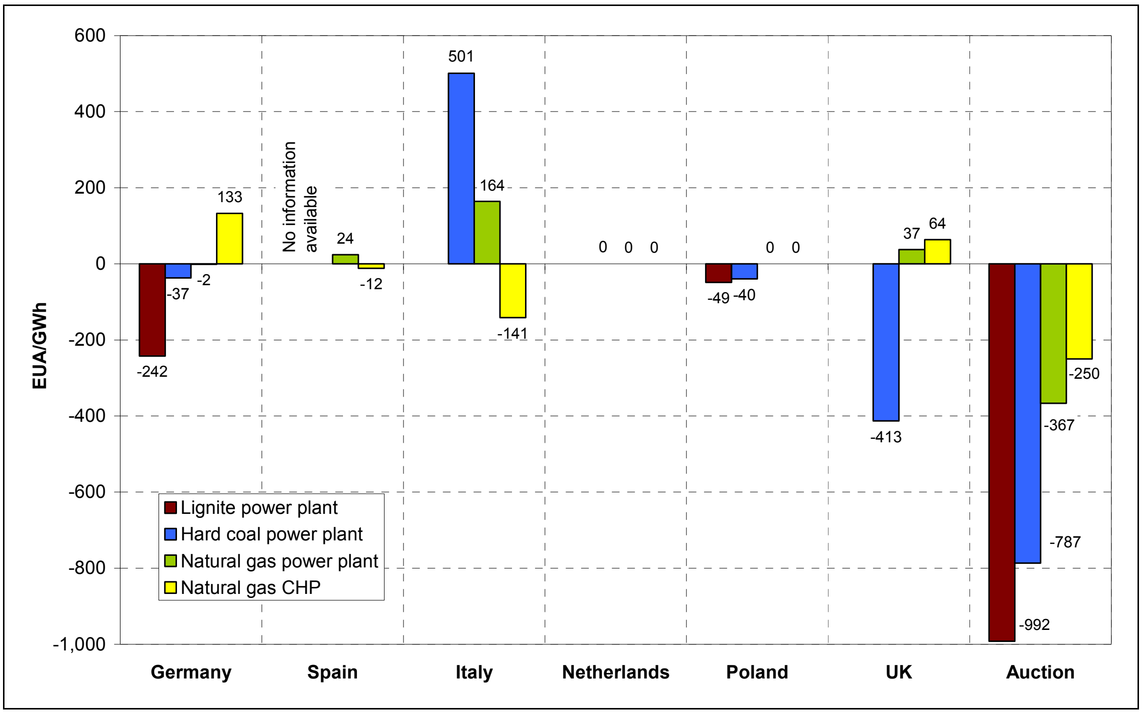
[57] At this point we do not take into account that allocation rules in future trading phases might induce strategic behaviour of the operator (see Chapter 4).

[58] The properties of the standardized set of new plants are specified in Table 2.

[59] When analysing the sensitivity (using the Italian benchmark load factor of 7,100 hours/year instead of the load factor in the standardized parameters of analysis; 5,000 hours/year) the allocation would account for 913 EUA/GWh which would still be the highest allocation per gigawatt hour in a hard coal power plant. The allocation to the natural gas power plant would be higher (396 EUA/GWh), but still

hard coal-fired power plants (blue bars) receive considerably higher allocation per planned unit electricity production than natural gas-fired power plants (green bars). For example in the Netherlands the allocation to hard coal power plants amounts to 795 EUA/GWh while the allocation to a natural gas-fired power plant is of 367 EUA/GWh. This difference is due to the use of fuel-specific emission benchmarks[61] in many countries, which lead to a levelling between the differences in shortage or surplus of allowances (see also Figure 15).

Figure 15 – Shortfall or surplus of allowances allocated to new power plants built by newcomers compared to emissions



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

When we compare the allocation to the emission of electricity production in the different plant types, we can assess the shortfall or surplus of allowances allocated compared

lower than the allocation to a hard coal power plant. For a more detailed sensitivity analysis see Annex C.

60 The allocation to new entrants in the UK is based on load factor benchmarks as in Italy too. Using the load factor benchmark for UK, the allocation to the hard coal power plant (steam turbine) would be 505 EUA/GWh and the allocation to a natural gas power plant (CCGT) 319 EUA/GWh. For more details see Annex C.

61 A fuel-specific emission benchmark implies that depending on the fuel used, plants will receive different amounts of carbon credits for free. See also section 1.3.

to emissions which equals the real cost. Figure 15 shows that the shortfall of allowances is in all countries significantly smaller than in the auction reference case.[62]

The shortfall or surplus is only for few plants in few countries of a relevant level. There is a significant shortfall of allowances for hard coal in the UK (413 EUA/GWh)[63] and for lignite in Germany (242 EUA/GWh) if no transfer provision can apply (see Chapter 3.2).

In Spain there are no plans to build new hard coal or lignite power plants. Therefore, the NAP does not specify allocation provisions for new power plants fired by other fuel than natural gas.

A significant surplus results for CHP in Germany (133 EUA/GWh electricity produced). In Italy a CHP faces a significant shortfall of allowances compared to emissions, even though CHP installations are a very efficient and environmental friendly way of producing electricity and heat.

The very similar level of shortfall or surplus of allowances for different technologies with very different emission levels is due to the use of fuel-specific allocation. If there are only minor differences between the real costs for emissions of new installations (as much between countries as between technologies), the emission trading scheme is not likely to play a critical role in investment decisions.

There is absolutely no difference in real costs from the emission trading scheme occurring to the set of new standardized plants in the Netherlands; for all plants the allocation equals their planned emissions. This effect is caused by a rule in the Dutch NAP to allocate according to a fuel-specific benchmark based on a production yield; combined with the rule that the amount of allowances allocated may never be higher than the 'planned, realistic annual CO_2 emissions of the plant'.[64] To picture the effect of this rule, we compare the emissions of and the allocation to hard coal power plants with different efficiencies.

However, Figure 16 indicates the effect of the Dutch allocation rule mentioned above. If a plant with a relatively low efficiency is built, then the benchmark in the form of the production yield works as intended. For example, a hard coal power plant with an efficiency of 38% would have an emission of 900 t CO_2/GWh but only receives 851 EUA/GWh, so it would be short of 49 EUA/GWh. When the shortfall of allowances allocated for free is greater than the emission, the efficiency is lower. However, if the efficiency is higher than the benchmark requires, then the investment in more efficiency is not rewarded. So a plant with 41% efficiency will receive an amount of allowances equal to the emission of the plant (834 EUA/GWh) and a plant with 43% efficiency will

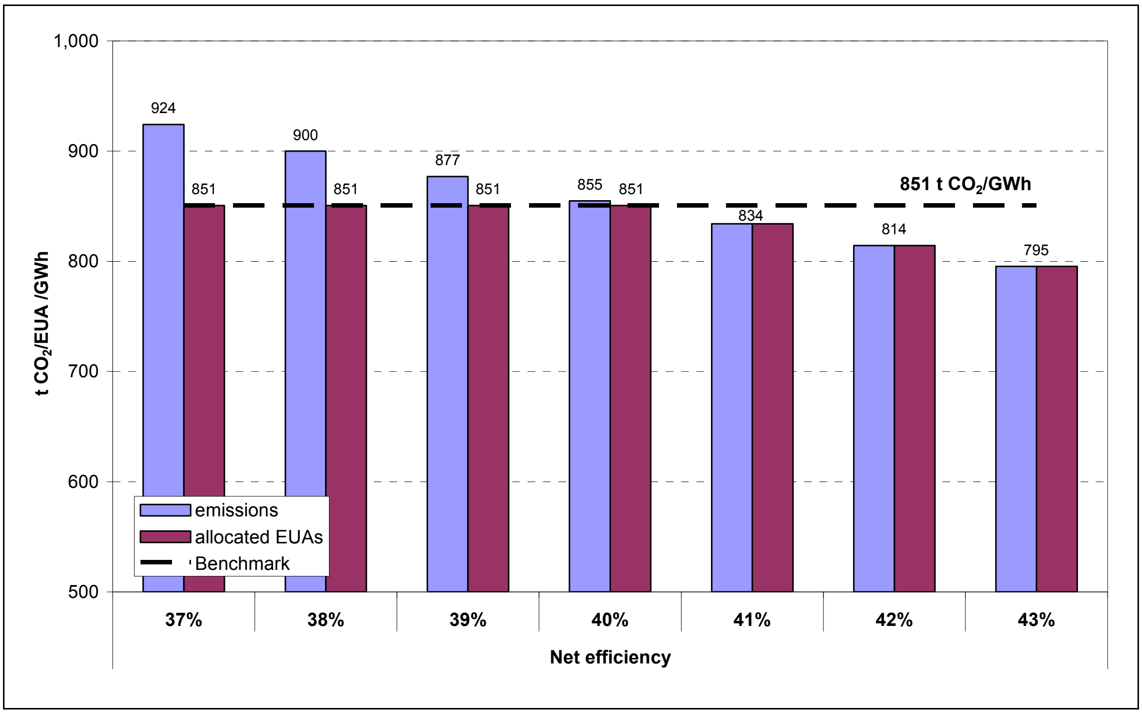
[62] For example the real cost of the power production in a hard coal plant would be under an auctioning scheme equal to the emission (so for hard coal 787 EUA/GWh). However, in Germany, for example, the real cost is only 37 EUA/GWh because 750 EUA/GWh are allocated for free to a new hard coal power plant.

[63] There are no known plans to build a hard coal power plant in the UK for the time being.

[64] The Dutch allocation provision for new entrants can be found in Chapter 3.2.

receive less allowances (795 EUA/GWh) because it emits less. The rule that the allocation may never exceed the planned emissions leads to a reduction of the allocated amount of allowances to plants which are more efficient that the benchmark and therefore discourages investments which exceed those levels of efficiencies. This is counterproductive even from the viewpoint of innovation incentives.

Figure 16 – Efficiency cut in the Dutch NAP; comparison of emissions and allocation to hard coal power plants with different efficiencies



Source Öko-Institut calculations based on data provided by ILEX

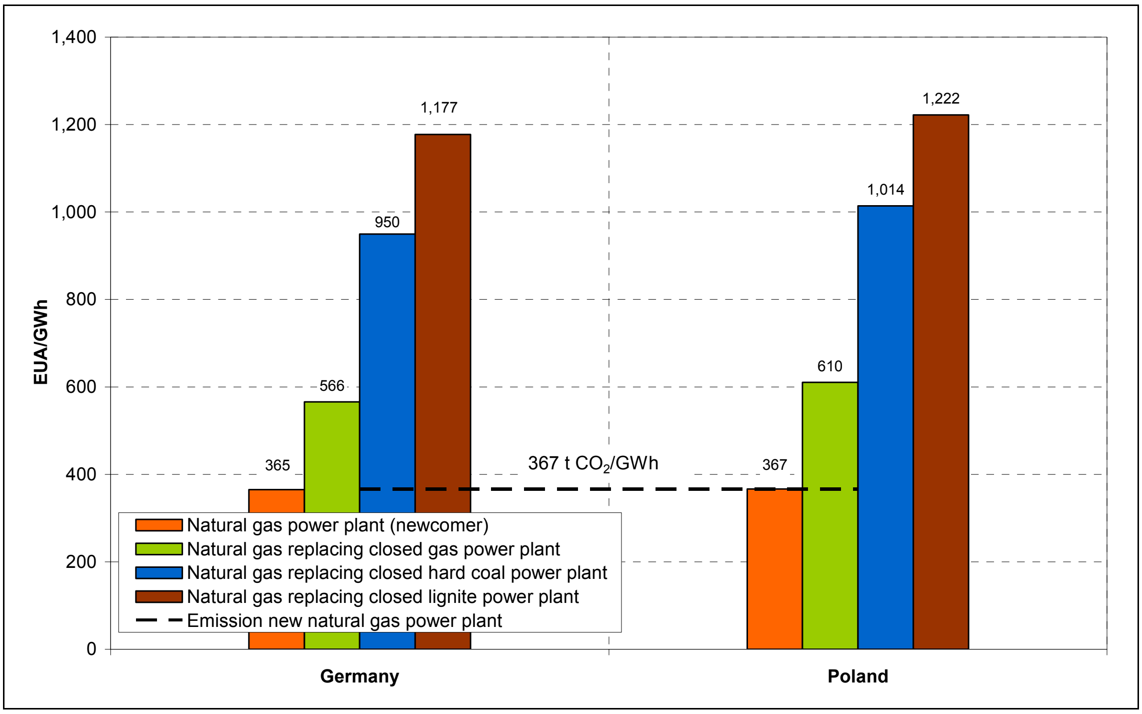
However, the magnitude of the counterproductive effect of this rule depends on how ambitious the benchmark is. If the benchmark efficiency is very high, then there will be only few cases where plant operators consider investing in even more efficient technologies. However, if the benchmarks are not very ambitious, then this provision will lead to an erosion of the incentive to invest in efficient energy technologies. Therefore the allocation should not be cut, even though this might lead to a surplus of allowances for some plants because only in this way there is an incentive to invest in technology that is more efficient than the benchmark. This problem will already arise in the short-term, especially for CHP installations where the allocation to modern plants based on benchmarks for heat and power (‘double benchmark’ – see Chapter 3.2) will often lead – well-founded by the general concept of ETS – to an allocation higher than the planned emission levels.

3.3.4.3 Incentives to build low emitting new power plants (with transfer provisions)

In most countries, independent investors and incumbents investing are treated in the same way and their installations receive a number of allowances allocated for free according to the rules specified in the qualitative section of this report and the real cost for these plants will be as analysed in the section above.

In contrast, in some countries like Germany and Poland the national allocation plan includes the possibility of transferring allowances to a new entrant from a closed installation. In Germany the new installation will receive the amount which the closed installation would receive for four years; in Poland it is possible to transfer the remaining allowances of the closed plant of the current trading phase. Below we analyse the amount of EUAs a new power plant will receive according to the transfer provisions depending on the closed plant it replaces.[65]

Figure 17 – Allocation to a new natural gas power plant with and without a transfer provision (Germany and Poland)



Source Öko-Institut calculations based on data provided by ESC

Figure 17 shows the amount the standardized new natural gas plant will receive as a newcomer (first bar; 365 EUA/GWh in Germany and 367 EUA/GWh in Poland) and if benefiting from a transfer rule (bars two to four). In both countries the amount trans-

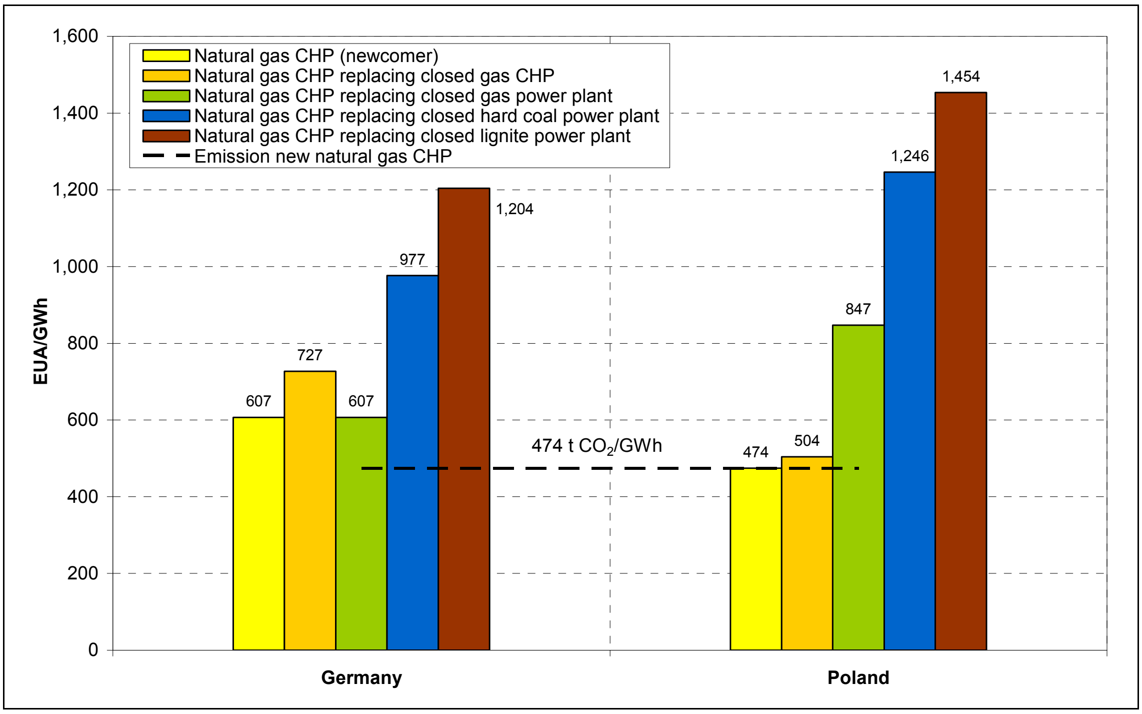
[65] Here we analyse allocation solely for the actual period and do not take allocation for subsequent phases into account (see Chapter 3.4).

ferred equals the amount of EUAs allocated to the closed plant. The higher the amount allocated to the closed plant, the higher the amount that is transferred. As the allocation to existing installations in both Poland and Germany is carried out according to historic emissions and is very generous in both countries, a new natural gas power plant replacing a closed lignite power plant receives the highest allocation (1,177 EUA/GWh in Germany and 1,222 EUA/GWh in Poland).

The difference between the real emissions of the new gas power plant (dotted line) and the amount allocated shows the surplus of allowances that could be sold by the operator to raise an additional profit. This benefit is significant, especially for the replacement of a hard coal or a lignite power plant. On the other hand the transfer rules in both countries only apply for a rather short time period. Investors tend to orient themselves to a longer time period than the duration of these transfer provisions because power plants imply a huge investment and run for decades.

If we look at a new natural gas CHP benefiting from a transfer rule (Figure 18) we see a very similar picture but also with some important differences.

Figure 18 – Allocation to a new natural gas CHP with and without a transfer provision (Germany and Poland)



Source Öko-Institut calculations based on data provided by ESC

We see in Figure 18 that the amount of allowances transferred is again the highest for lignite (1,204 EUA/GWh electricity production in Germany and 1,454 EUA/GWh in Poland). The values shown in Figure 18 differ from the allocations shown for the gas-fired condensation power plant (Figure 17) for the following reasons:

- In Germany for the allocation under the transfer rule to a CHP in addition to the allocation to the closed installation, the CHP bonus will be applied (see Chapter 3.2). Consequently, the allocation is 27 EUA/GWh higher for the CHP plant.
- The 'double benchmark' in the German allocation provisions for CHP (see Chapter 3.2) is as attractive for the investor as the transfer rule related to an old gas-fired condensation power plant. Thus the allocation to the newcomer will be equivalent to the allocation to a CHP plant built by an incumbent.
- The special provisions for CHP plants in the Polish NAP (see Chapter 3.2) also lead to a more generous allocation to CHP plants even under the transfer provision.

Transfer rules imply that not all new installations will be treated in the same way. Mainly incumbents will profit from transfer rules, whereas independent power producers or those companies which plan to extend their capacities cannot benefit from these rules. This could raise the question of fairness.

3.3.4.4 Evaluation of the economic efficiency of the allocation to new entrants

In this chapter we have analysed the economic efficiency of the allocation rules applying to new entrants. We examined two different cases: the allocation to newcomers (e.g. independent power producer) and the allocation to incumbents who may benefit from a transfer rule. The main criteria for the evaluation of these rules is the real cost power plant operators will have to face; it is then compared to the real cost they would face in an emission trading scheme based on auctioning.

Assessing the allocation to new entrants (newcomers) we can rate the countries as following:

- Regarding their real cost, the UK follows the ranking of the auction reference case. Furthermore, the shortfall of allowances for hard coal is of a significant magnitude and the distance to the surplus for natural gas-fired power plants is also comparable to the auction reference case. This is because benchmarks are not fuel-specific. The allocation to new entrants in the UK can be rated as 'good' with regard to economic efficiency.
- In Germany there is a noticeable shortfall of allowances for lignite, taking into account the high emission lignite causes. However, the very generous allocation to hard coal due to fuel-specific benchmarks leads to a shortfall very close to the one of natural gas, which is not the case in the auction reference case. There is a clear positive incentive for CHP. In total, Germany can be rated as 'average'.
- In Poland there is no significant shortfall or a surplus of allowances. Due to the very small differences in real costs the emission trading scheme is not likely to develop a substantial impact on investments in Poland. However, in principle the ranking of allocation mirrors the auctioning case (despite relatively small

differences in real costs); Poland can be rated as 'average' with regard to economic efficiency.

- The Netherlands is also rated as 'average' due to the efficiency cut in the allocation provisions. The allocation to CHP considers both heat and power which is positive. The Dutch benchmarks are fuel-specific; therefore the overall rating is 'average'.
- In Italy there is a very generous allocation to hard coal making the use of this fuel more attractive than natural gas and a very scarce allocation to natural gas CHP. There is some sensitivity about the allocation to condensation plants but when choosing an equal load factor as well as when choosing the Italian benchmark load factors hard coal is favoured in most cases over the options with significantly lower emissions. Therefore Italy is rated as 'weak'.
- For Spain it is not possible to draw conclusions on the economic efficiency of the allocation rules for new installations. There are no new hard coal- or lignite-fired power plants planned, therefore there are no figures available. The allocation formula for natural gas power plants and natural gas CHP has not been published and the approximation made for the purpose of the study prevents us from analysing differences in allocation as small as in the Spanish case between natural gas power plant and natural gas CHP.

The only two countries among the Member States analysed in this report which make use of a transfer provision are Germany and Poland.

- Transfer provisions provide strong incentives for emission reduction in both countries because the magnitude of the incentive is very high. On the other hand, the impact is reduced by the rather short time of duration of the transfer provisions. Therefore both countries are overall rated as 'average'.

Table 24 – Evaluation of the economic efficiency of the allocation rules to new installations

Economic Efficiency	Evaluation of allocation to new entrants
Germany	average
Spain	-
Italy	weak
Netherlands	average
Poland	average
UK	good

Notes:

'good' – the provisions provide full incentives to reduce emissions of new plants; the overall incentives are comparable to the incentives in the reference case of auction; 'average' – some provisions counteract the incentives which should be generated by an emissions trading scheme to reduce emissions of new plants; 'weak' – significant provisions counteract the incentives which should be generated by an emissions trading scheme to reduce emissions of new plants.

Source Öko-Institut

3.3.4.5 Lessons learnt: Allocation to new installations

In all countries new installations receive free allocation out of a new entrants' reserve, even though the EU ETS Directive would allow for non-free allocation. The free allocation reduces the real cost that the emission trading scheme significantly places on investors in all countries. In all countries the real costs for new entrants are far from the magnitude that would arise from an auctioning scheme in absolute terms. This would not create a problem in general if the relative costs between the different plants would reflect the differences of emission levels.

The more detailed and quantitative analysis of NAPs leads to the following conclusions on their incentive structures:

1. For new investments the *real cost* from the ETS is the decisive parameter for investment decisions. The real costs from the ETS depend on the national allocation provisions and are significantly lower than the full cost of carbon for all countries.

2. Allocation based on *standardized benchmarks* is more environmentally effective and economic efficient than allocation based on *installation-specific information*.

   If the allocation is based on installation-specific parameters, the allocation will strongly depend on the emission level of the particular installation. Therefore, installations with high emissions will receive a higher allocation than installations with lower emissions. This will not create appropriate price signals from the ETS.

3. *Fuel-specific benchmarks* for new installations almost eliminate the economic benefits from investments in low emitting plants.

   Most countries allocate allowances to new entrants according to fuel-specific benchmarks. The exceptions are the UK and Spain; in both countries there are no known plans to build power plants using fossil fuels other than natural gas.

   The result of fuel-specific benchmarks is that power plants fired by fuels with high emissions receive a higher allocation than power plants fired by fuels with low emissions. Fuel-specific benchmarks reduce the differences in real costs between fuels with high and with low emissions and can even turn this relationship upside down and create remarkable perverse incentives. This allocation approach no longer reflects the general approach of carbon pricing.

4. If emission benchmarks are used for the allocation to new entrants and the *allocation is limited to the planned emissions*, the incentive to build highly efficient plants is removed.

   In the Dutch NAP the allocation provisions for new installations foresee a fuel-specific benchmark combined with a provision that allocation may never exceed the planned realistic annual CO_2 emissions. This provision was intended to avoid windfall profits. However, as a secondary effect this provision discourages the investment in plants with lower emissions than the benchmark allocation defines. It cuts the benefits provided by the ETS to a more efficient plant if a certain threshold for efficiency is exceeded.

5. The Member States chose different approaches to deal with the uncertainties on future production of new installations. *Load factor benchmarks* are the most robust approach to define the production level on which the allocation is based.

   For the allocation to new plants the question arises as to what production data the allocation should be based on. Some countries foresee the allocation on projected activities for each specific installation; other countries introduced predefined load factor (capacity utilization) benchmarks. With the use of load factor benchmarks (as applied in Italy and the UK) a simple and transparent approach was implemented where windfall profits arising from exaggerated installation-specific projections or the need for additional provisions (e.g. ex-post adjustments) could be avoided.

6. *Transfer provisions* can significantly encourage the investment in low emitting technologies because they are almost in line with the difference in cost of carbon. The impact will depend not only on the absolute number of allowances allocated but also on the period of validity.

   Germany and Poland offer new entrants a second option besides the allocation from a new entrants' reserve. In the case of plant closure, the allocation to the plant can be transferred to a new entrant for a defined time span. Transfer provisions can significantly encourage early replacement of existing plants and the investment in new plants with low emissions because the magnitude of the incentive created by transfer provisions is almost in line with the difference in cost of carbon. The impact of transfer provisions is reduced by their comparable short validity.

   However, transfer provisions will create additional benefits for the incumbents compared to newcomers in the market and fairness problems will arise.

A critical review of the provisions for new entrants is a key for the future improvement of the EU ETS (see Chapter 4). The counterproductive allocation to new entrants depending on the fuel used or the technology applied (in other words, depending on the emissions of the new installation) must be removed to ensure the key mechanism of the ETS: a comprehensive carbon price signal from the ETS for all activities leading to emissions reduction (benefit from the ETS) or increase (burden from the ETS) and not the other way round.

Furthermore, the interaction between the allocation to existing installations and new entrants could raise additional problems for the complex incentive structures in an ETS based on free allocation of allowances (see Chapter 4).

Last but not least, the treatment of new entrants in the ETS phases subsequent to the phase the plant was put into operation could significantly change the incentive structures (see Chapter 3.4).

3.3.5 Interaction of allocation provisions to existing and new plants

3.3.5.1 Introduction

Plant replacement plays a crucial role when it comes to long-term emission reduction. Especially in mature power markets the question of plant replacement is key to changing the emission intensity of electricity production, as new installations are – generally speaking – more efficient and therefore cause lower emissions. The emission trading scheme can either set the incentives to foster early plant replacement or encourage investment in plant lifetime extension.

So far we have analysed the economic incentives of the allocation provisions for existing and new plants separately. When looking at plant replacement, we have to view the allocation provisions to existing and new plants together. We want to assess whether the ETS with its current NAP provisions provides an incentive to replace existing plants with new plants with lower emissions or whether it encourages the lifetime expansion of old plants.

If the allocation provisions are designed in a way that represents the emission intensity of the plants (and therefore the full cost of carbon), then there should always be an incentive for replacement in the standardized set of plants if the new power plant has lower emissions than the old one (see Figure 7 in Chapter 3.3).

In the following, we begin by comparing the economic incentive to replace old plants by a new hard coal-fired power plant, a new natural gas-fired power plant and a new natural gas CHP. For each plant type we first compare the shortfall or surplus of allowances existing plants would face with the allocation a new entrant would get. In a second step we compare the incentives to replace different existing plants.

3.3.5.2 Incentives to replace existing plants by new hard coal-fired power plants

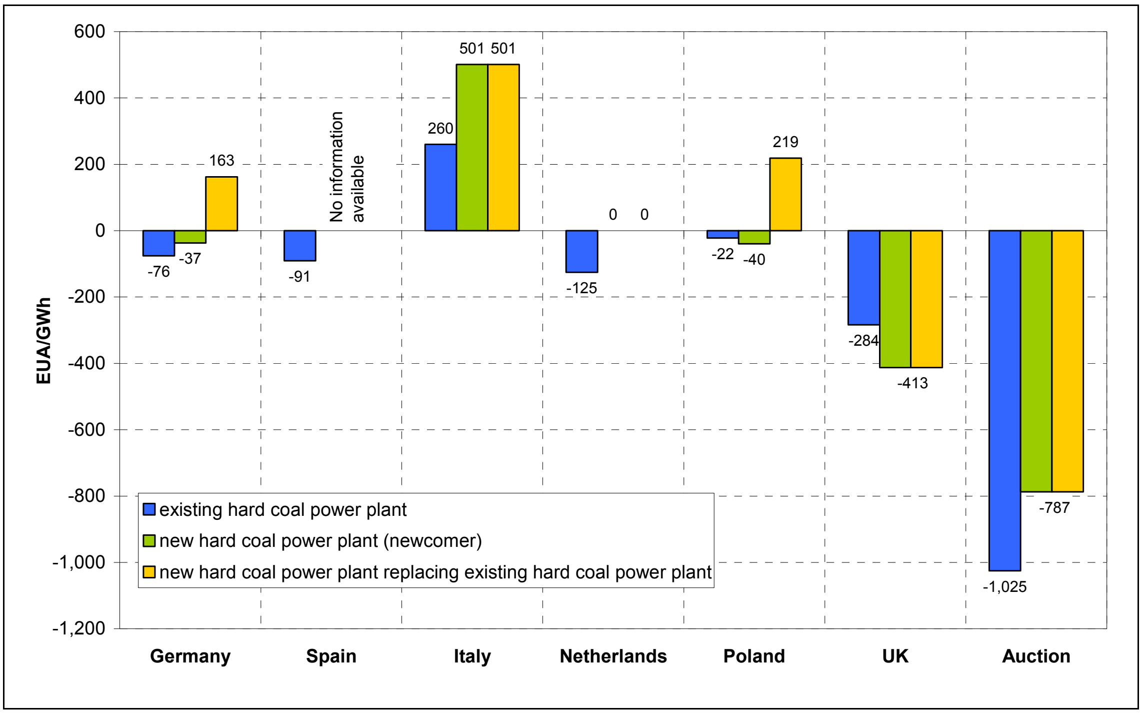
When an operator considers replacing the electricity production of an existing plant with the electricity production of a new plant, he will compare the real costs because real costs are the decisive dimension for investment decisions. Therefore we compare below the shortfall or surplus of allowances allocated to a new plant compared to the shortfall of allowances allocated to an existing plant. The shortfall or surplus of allowances is equal to the difference between the emissions and the allowances allocated for free. We start by examining hard coal power plants.[66]

Figure 19 shows that all existing hard coal installations (blue bars) except those in Italy need to buy allowances to cover their emissions. For example, a German operator of an

[66] That the allocation to subsequent phases might lead to strategic behaviour of the plant operator is not taken into account. We assume here that the allocation rules are also valid for the following phases.

existing hard coal power plant faces a shortfall of 76 EUA/GWh[67] For new installations (newcomers) (yellow bars) there is equally a shortfall of allowances for all countries except Italy.[68] To stay with the German example, a new hard coal power plant (newcomer) is of 37 EUA/GWh short of allowances.[69]

Figure 19 – Shortfall or surplus of allowances for existing and new hard coal power plants compared to emissions



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

While in most countries the shortage or surplus for new power plants is the same irrespective of whether they are a newcomer or an incumbent, there is a difference in Poland and Germany due to their transfer provisions. So a new hard coal power plant replacing an old hard coal power plant and making use of the transfer provision receives a surplus of 163 EUA/GWh (green bar) in Germany. We have seen in the previous sec-

67 An existing German hard coal power plant with the standardized parameters causes an emission of 1,025 t CO_2/GWh and receives a free allocation of 950 EUA/GWh. Therefore a German hard coal power plant is short of 76 EUA/GWh (1,025 – 950 = 75 EUA/GWh; differences are due to rounding effects).

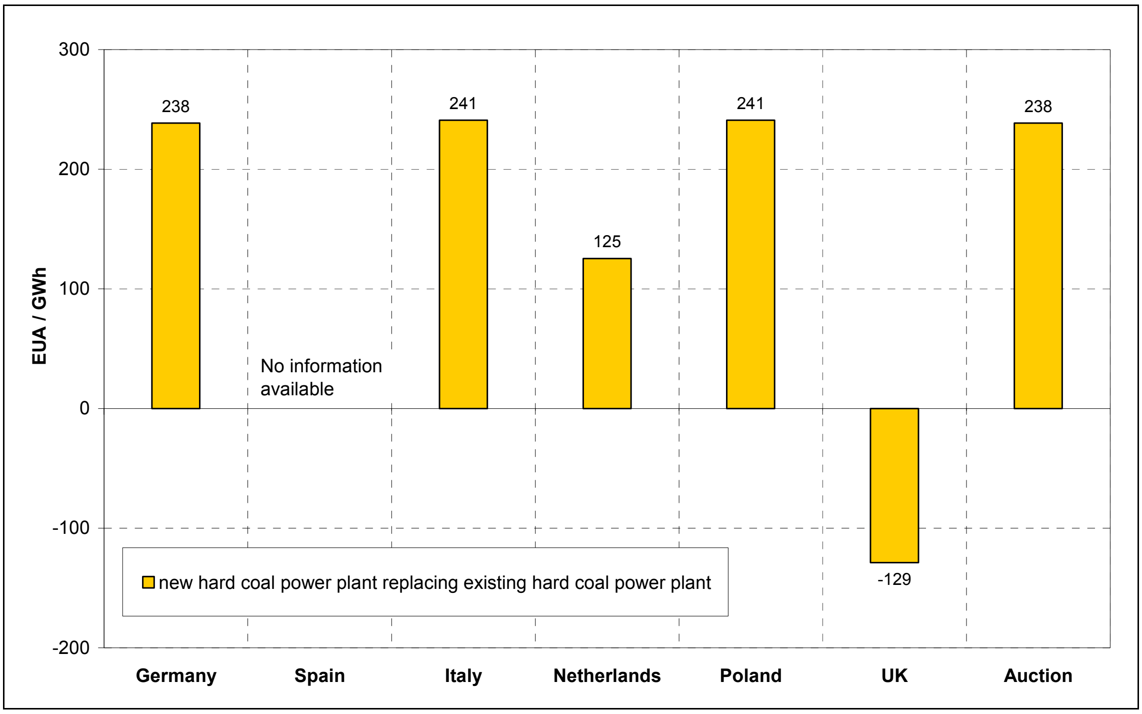
68 There are no new hard coal-fired power plants planned in Spain. Therefore we could not calculate the emissions.

69 A newly built hard coal power plant in Germany with the standardized parameters causes an emission of 787 t CO_2/GWh and receives a free allocation of 750 EUA/GWh. Therefore a new hard coal power plant (newcomer) is short of 37 EUA/GWh electricity production (787 – 750 = 37 EUA/GWh).

tion that the amount of allowances allocated to a new plant profiting of a transfer provision depends on the allocation which the replaced plant received.[70]

In order to be able to compare the incentive caused by the emission trading scheme to replace an existing hard coal power plant with a new hard coal power plant we compare the differences between shortfall of allowances for an existing power plant to the shortfall or surplus of allowances for the new installations.[71] The incentives for replacement for all countries are pictured in Figure 20.

Figure 20 – Incentive to replace an existing hard coal-fired power plant with a new hard coal power plant



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

Figure 20 shows that in all countries except the UK there is a positive incentive to replace an existing hard coal power plant by a new one. In Italy, the magnitude of the incentives for replacement is of a comparable level to the incentive in the auction refer-

70 The free allocation to an existing hard coal power plant in Germany is of 950 EUA/GWh. The emission of a new hard coal power plant is of 787 t CO_2/GWh, due to its higher efficiency. Therefore the surplus of a new hard coal power plant in Germany profiting from a transfer provision is of 163 EUA/GWh (950 – 787 = 163 EUA/GWh).

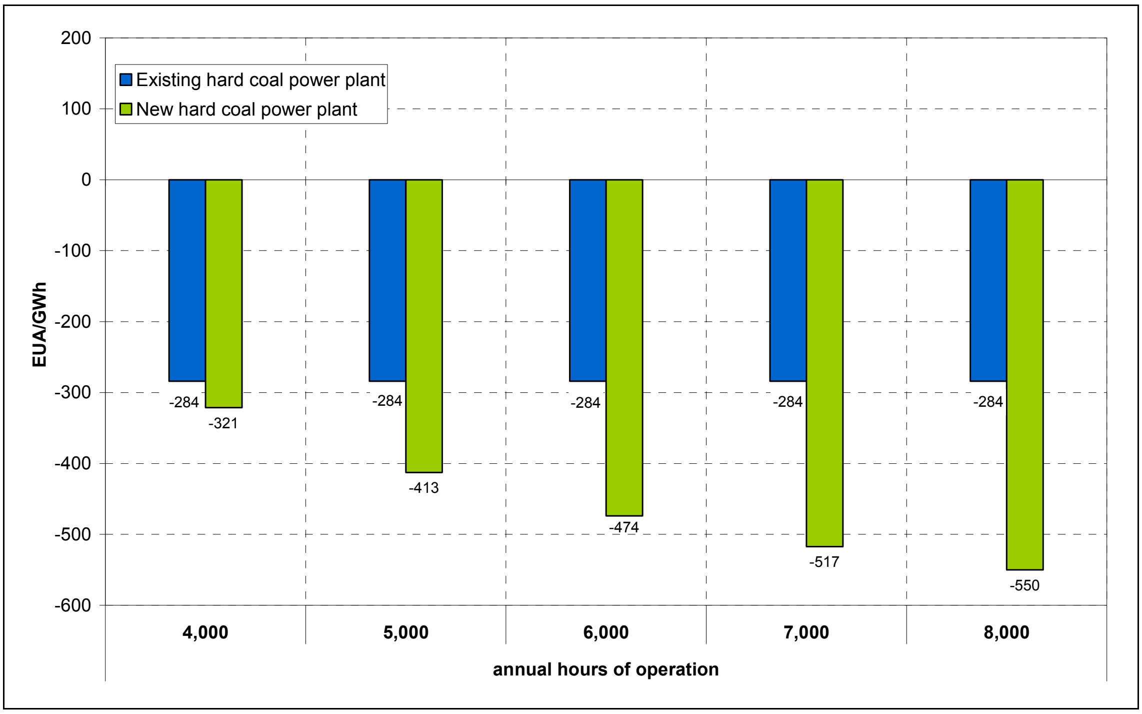
71 For example, in Germany the incentive from the ETS to replace an existing hard coal power plant by a new one is the sum of the avoided costs for not running the existing power plant (76 EUA/GWh) and the benefit of the surplus in allocation a new plant gets (163 EUA/GWh), the incentive is therefore 238 EUA/GWh (76 + 163 = 239 EUA/GWh; differences are due to rounding effects).

ence case. This is also true for the power plants profiting from the transfer provision in Poland and Germany but only as long as the transfer provision applies.[72]

There is a significant negative incentive to invest in new hard coal-fired power plants in the UK (a shortfall of 129 EUA/GWh). In this case it pays for the operator to run the existing hard coal power plant for as long as possible or even to invest in retrofitting or lifetime extension. Even though a new hard coal power plant emits more than a new natural gas power plant, the emissions of a new hard coal power plant are lower than the ones of an old hard coal power plant and consequently there should be a positive incentive. Therefore the allocation provisions for existing installations must be carefully balanced with the allocation provisions for new installations to ensure incentives for plant replacement.

However, for the UK the magnitude of the incentive is sensitive to the load factor chosen in our standardized set of plants. If we vary the load factor the magnitude of the incentive will change accordingly. To compare the different real costs of a new hard coal power plant, see Figure 21.

Figure 21 – Sensitivity analysis; shortfall or surplus of existing and new hard coal power plants in the UK compared to emissions



Source Öko-Institut calculations based on data provided by ILEX

In Figure 21 we can observe that the shortfall of allowances for *existing* installations in the UK does not depend on the load factor chosen for analysis. The amount always re-

[72] The German transfer provision applies for four years. The duration of the Polish transfer provision depends on the point of time the transfer is made within the allocation period, see Chapter 3.2.

mains at 284 EUA/GWh. In contrast, the shortfall of allowances of a *new* hard coal power plant does depend on the load factor. This is due to the load factor benchmark for new power plants in the UK.[73] So the shortfall of allowances for a plant operated only 4,000 hours annually (this is about 47% of the year) is 321 EUA/GWh and for a plant operated 8,000 hours annually (91% of the year) the shortfall amounts to 550 EUA/GWh.

The difference between the shortfall for an existing power plant and the shortfall of a new power plant equals the incentive or disincentive for investment. So we can conclude that there is a negative incentive for replacement of an old hard coal power plant by a new hard coal power plant in the UK if the planned load factor is of 4,000 hours of operation or more. When choosing the benchmark load factor for steam turbines in the UK (41.3% of the year; 3,618 hours annually) the incentive would be slightly positive.[74]

There is no sensitivity in this case for Italy as long as we assume the same load factor for the existing and the new hard coal power plant because the allocation to existing and to new hard coal power plants both depends on the same capacity benchmark. The magnitude of the incentive for replacement (241 EUA/GWh; see Figure 20) equals the difference in emissions between an existing hard coal power plant in Italy and a new hard coal power plant; the emission reduction is due to the higher efficiency of a new plant. Consequently, there is a positive incentive for such replacement in Italy.

All in all, the allocation provisions in the majority of NAPs analysed (except the Netherlands and the UK) provide incentives for early replacement of old hard coal power plants by new hard coal plants which are comparable with the magnitude of incentives which would arise from an auctioning scheme. With respect to the Dutch NAP it should be mentioned that the generous plant closure provision (see Chapter 3.2.3.4) will compensate the lower level of incentives mentioned above.[75]

3.3.5.3 Incentives to replace old plants by new natural gas-fired power plants

In the last section we have seen the incentives to replace an old hard coal-fired power plant by a new power plant. A new hard coal power plant emits less than an existing hard coal power plant; therefore, the incentive should have been positive. However, a new natural gas power plant has even lower emissions; therefore the incentive to re-

[73] For a sensitivity analysis of the load factor benchmarks see Annex C.

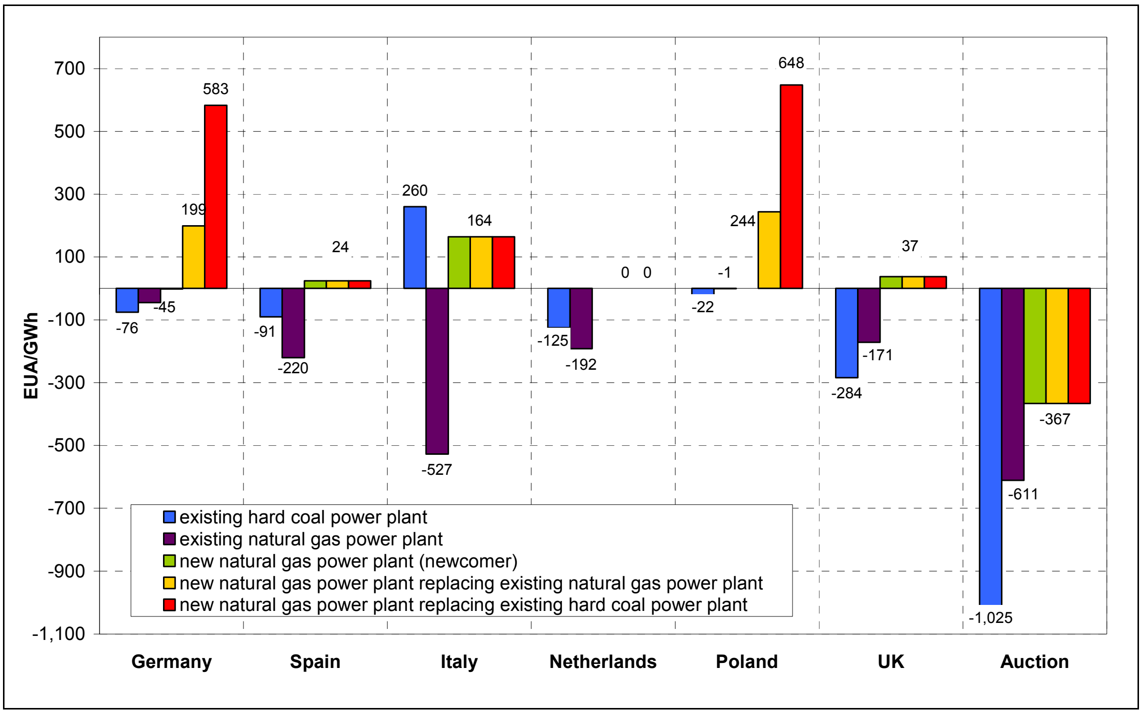
[74] The allocation to a new hard coal power plant assuming the benchmark load factor is of 505 EUA/GWh. The emission is of 779 t CO_2/GWh; the shortfall is therefore of 273 EUA/GWh. The shortfall of an existing hard coal power plant in the UK is of 284 EUA/GWh, therefore the incentive for replacement assuming benchmark load factors is of 11 EUA/GWh (284 – 273 = 11 EUA/GWh).

[75] If we assume that the operator could retain the total amount of allowances for only one additional year in a certain trading phase the benefit from this for a hard coal plant (1,036 t CO_2/GWh) would compensate the lower incentive for replacement shown in Figure 20 for about 9 years.

place an existing hard coal power plant by a new natural gas power plant should be even higher. Additionally, there should be some incentive to replace an existing natural gas power plant by a new one.

In the following section, we extend the analysis to replacement of power production of existing power plants (be it hard coal-fired or natural gas-fired) by new natural gas power plants. For the assessment we look first at the shortfall or surplus of allowances (compared with the emissions) for existing and new power plants. We differentiate three different circumstances for a new natural gas power plant: a new natural gas power plant built by a newcomer, a plant built by an incumbent which replaces a natural gas power plant, as well as a plant built by an incumbent which replaces a hard coal power plant.[76]

Figure 22 – Shortfall or surplus of allowances to existing hard coal and natural gas power plants and to new natural gas power plants



Source Öko-Institut calculations based on data provided by AVANZI, ESC and ILEX, ILEX Iberia

We see in Figure 22 that the shortfall or surplus of allowances for existing hard coal power plants (blue bars) are the same ones as in Figure 19. All existing natural gas power plants (violet bars) face a shortfall of allowances; this means for the operation of their existing natural gas installations the operator has to buy allowances. For example in the Netherlands an operator is 192 EUA/GWh short for the operation of an existing

[76] The allocation to subsequent allocation phases is not taken into account at this point (see Chapter 4.2.2).

gas power plant.[77] For new natural gas-fired CCGTs (green bars) in all countries there is no relevant shortfall of allowances. In the Netherlands, the allocation to new natural gas power plants equals the emission so the shortfall or surplus is zero. This is due to the Dutch rule never to allocate more allowances than the planned realistic emissions of the plant. In contrast, in Italy for example, there is a surplus of 164 EUA/GWh for a new natural gas-fired power plant.[78]

In countries using a transfer provision (Germany and Poland) the surplus of allowances depends highly on the allocation the replaced plant received. So a new natural gas power plant replacing a hard coal power plant will receive, in Poland for example, a surplus of 648 EUA/GWh, whereas a new natural gas power plant replacing a closed natural gas power plant will receive a surplus of 244 EUA/GWh.[79]

To compare the incentives to produce electricity in a new natural gas power plant rather than in an existing natural gas or hard coal power plant, we compare the differences of shortfall or surplus of allowances for new plants to the shortage of allowances of existing plants in Figure 23.

We see from this comparison that there is a positive incentive for all countries to replace an existing natural gas power plant with a new natural gas power plant (yellow bars). For example the incentive in the Netherlands is of 192 EUA/GWh.[80] The incentive is highest in Italy because of the significant shortfall of allowances which existing natural gas power plants face. For the UK as well as Italy, it has to be kept in mind that the figures are sensitive to the load factor chosen in our standardized set of installations.[81]

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77 The emission of an existing natural gas power plant is of 611 t CO_2/GWh and an existing natural gas power plant receives an allocation of 419 EUA/GWh in the Netherlands. Therefore, an existing natural gas power plant in the Netherlands faces a shortfall of 192 EUA/GWh (611 – 419 = 192 EUA/GWh).

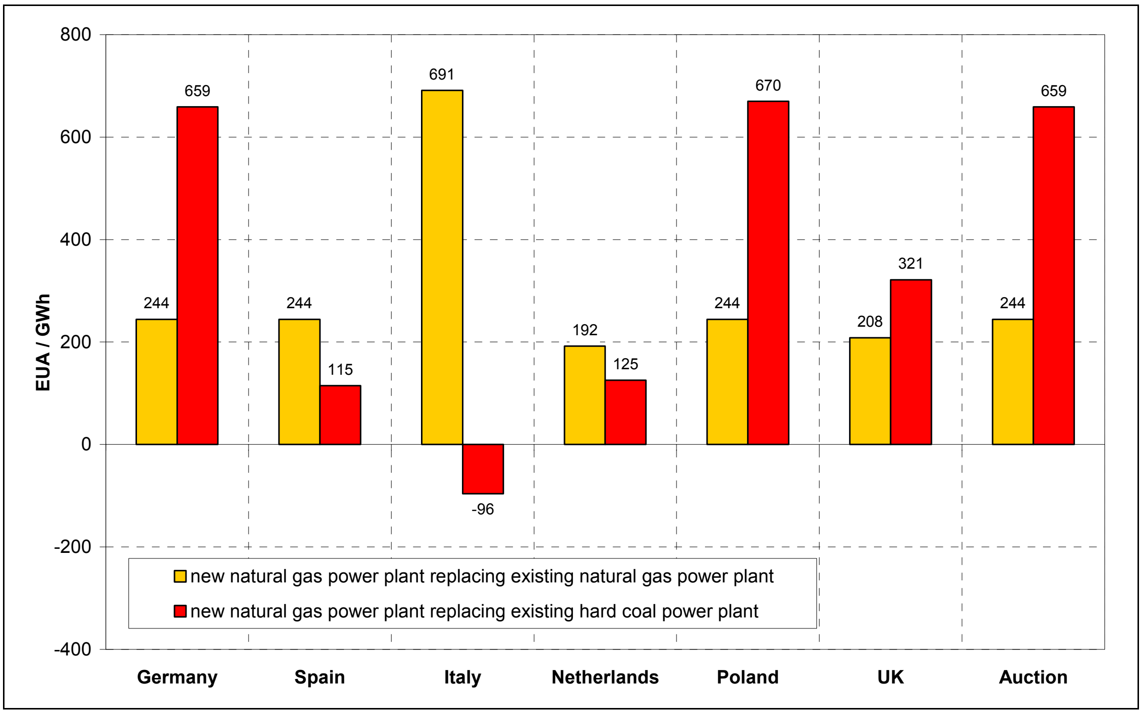
78 The allocation to new natural gas power plants in Italy is based on a load factor benchmark and is therefore sensitive to the load factor chosen in the standardized set of installations used for analysis. If the Italian benchmark load factor is assumed (6,700 hours annually) then the surplus would decrease to 29 EUA/GWh (see also Annex C).

79 The allocation to an existing hard coal power plant in Poland is of 1,014 EUA/GWh and the emission of a new natural gas power plant is of 367t CO_2/GWh. Therefore the surplus of a new natural gas power plant profiting from the transfer rule is of 648 EUA/GWh (1,014 – 367 = 647 EUA/GWh, differences are due to rounding effects). The allocation to an existing natural gas power plant in Poland is of 610 EUA/GWh and the emission of a new natural gas power plant is of 367 t CO_2/GWh, therefore the surplus of a new natural gas power plant profiting from the transfer rule is of 244 EUA/GWh (610 – 367 = 243 EUA/GWh, differences are due to rounding effects).

80 The shortfall of an existing natural gas power plant in the Netherlands is of 192 EUA/GWh, the shortfall or surplus of a Dutch new built natural gas power plant is zero, so the incentive for replacement of an existing natural gas power plant by a new one is of 192 EUA/GWh (192 + 0 = 192 EUA/GWh).

81 There is sensitivity to these numbers arising from the load factor benchmark concepts and the parameters defined within this scheme. In Italy the incentive would be of 174 EUA/GWh to replace an existing natural gas power plant with a new natural gas power plant and of 152 EUA/GWh to replace an existing hard coal with a new natural gas power plant if the analysis would be based on installations with load factors according to the benchmarks in Italy. Even in this case the incentive to replace

Figure 23 – Incentive to replace existing power plants with a new natural gas power plant



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

The incentives to replace an existing hard coal power plant by a new natural gas power plant (red bars) are significant for the two countries with transfer provisions: Germany and Poland. The incentives to incumbents to replace existing installations are comparable to the incentive in the case of auctioning but only for the time in which the transfer provision applies.

In the case of Spain and the Netherlands, the incentive to replace an existing hard coal power plant by a new natural gas power plant is lower than the incentive to replace an existing natural gas power plant. In Italy the incentive to replace existing hard coal is even negative. This is due to the very generous allocation which existing hard coal power plants receive in the three countries, even though hard coal power plants have high emissions. The very generous allocation to existing hard coal power plants causes this problem because the allocation to plants with lower emissions should be even more generous in order for the incentives to work. However, if allocation to all plants is very generous this might exceed the cap of the traded sector. Therefore less generous allocation to existing installations turns out to be essential to ensure plant replacement incentives.

gas would be higher than the incentive to replace the more emission-intensive hard coal power plant. In the UK when using the load factor benchmarks the incentive to replace an existing natural gas power plant by a new natural gas power plant would be of 123 EUA/GWh and the incentive to replace an existing hard coal power plant of 236 EUA/GWh. The incentive to replace hard coal is higher in this case.

Nevertheless, the incentive structures created by the German and Polish NAP provisions are comparable to the reference case of auctioning. The incentive in the UK to replace existing natural gas with new natural gas is comparable to the reference case of auctioning. This is due to the rather ambitious compliance factor applying to existing installations. However, the incentive to replace an old hard coal plant by a new gas plant in the UK is only half of the magnitude in the auctioning case.

For Spain, the Netherlands and Italy the incentive to replace gas-fired plants is much more significant than the replacement of coal plant by less emitting natural gas-fired CCGTs. However, for the Dutch case it should be mentioned that the generous plant closure provision will partly compensate the incentive pattern in favour of early plant replacements.[82]

3.3.5.4 Incentives to replace old plants by new natural gas-fired CHP

So far we have assessed the incentives to replace old plants with new condensation plants fired by hard coal or natural gas. We finished the analysis of the incentives for replacement by looking at natural gas CHP. We analysed the shortfall or surplus of allowances allocated compared to emissions to existing and new natural gas CHP below. This time, we will look, in addition to the existing hard coal and natural gas power plants, at existing CHP and in the case of the new CHP at four different cases: CHPs built by a newcomer and CHPs built by an incumbent replacing either an existing CHP or an existing natural gas power plant or an existing hard coal power plant.[83]

Figure 24 and Figure 25 illustrate that new CHPs from a newcomer (green bars) receive an allocation higher than their emissions in Germany and in the UK. In the Netherlands the allocation to new natural gas CHP equals exactly the realistic emission, therefore the surplus is zero. This is due to the Dutch rule that allocation to new entrants may never exceed ‘their planned realistic annual emissions’. In Italy new CHP face a shortfall of allowances; allocation to new CHP plants in Italy is based on projected production and is much lower than the allocation to new natural gas or new hard coal power plants which is based on load factor benchmarks.[84] In Spain new CHP receive allocation that equates more or less the emissions. [85]

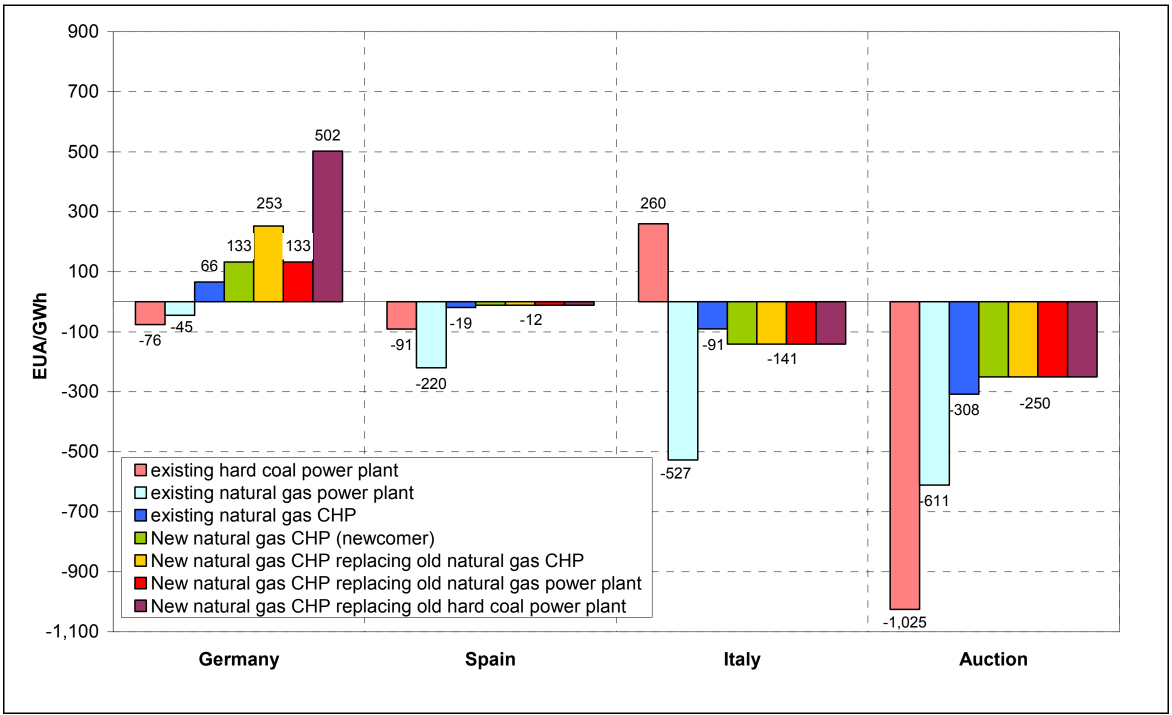
[82] If we assume that the operator could retain the total allowances for one additional year in a certain period the benefit from this for a hard coal plant (1,036 t CO_2/GWh) would compensate the lower incentive for replacement of coal plants shown in Figure 23 for about 2 years.

[83] Allocation to subsequent phases is not taken into account at this point (see Chapter 4).

[84] This effect might be an unintended side effect of the European Commission’s refusal to accept ex-post adjustments.

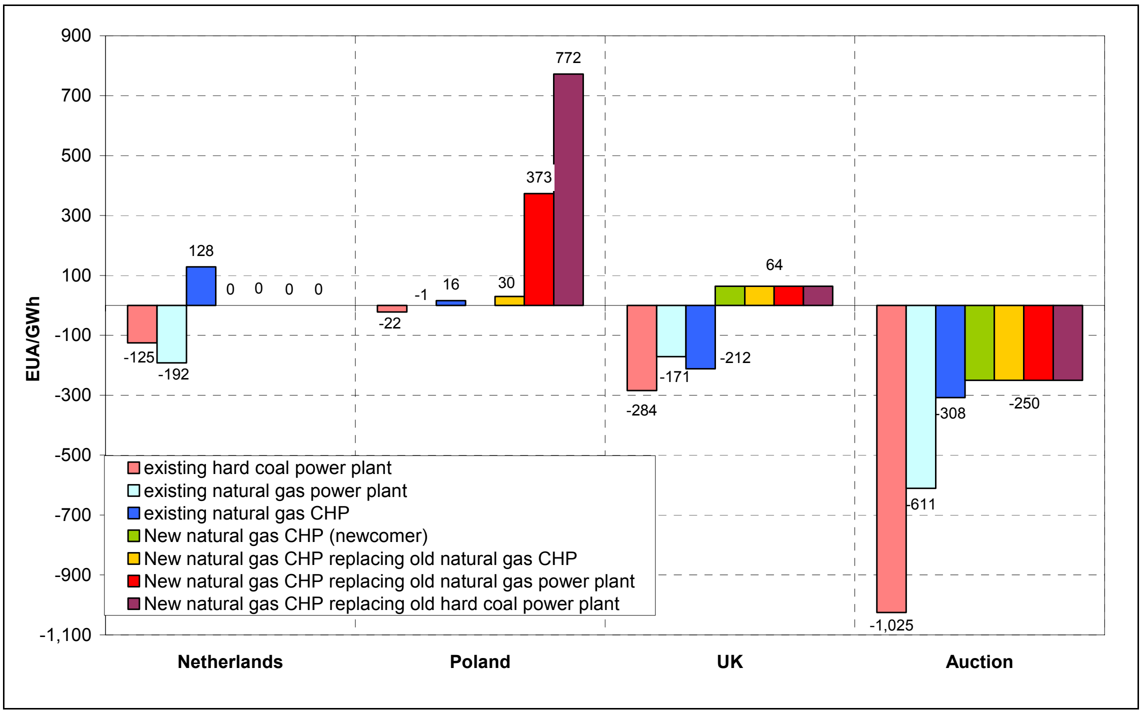
[85] The Spanish number should be read with caution as there was no allocation formula published and the figures used here are a best estimate made by ILEX for the purpose of the report. It is stated in the NAP that allocation to new entrants may not be proportionally greater than allocation to existing installations. Therefore, ILEX assumed the same compliance factor as for existing CHP, even though the NAP also states the aim to allocate allowances to CHP according to their emission needs (the emissions forecasted).

Figure 24 – Shortfall or surplus of allowances compared to emissions for existing plants and newly-built natural gas CHP (Germany, Spain, Italy)



Source Öko-Institut calculations based on data provided by AVANZI, ILEX and ILEX Iberia

Figure 25 – Shortfall or surplus of allowances compared to emissions for existing plants and newly-built natural gas CHP (Netherlands, Poland, UK)

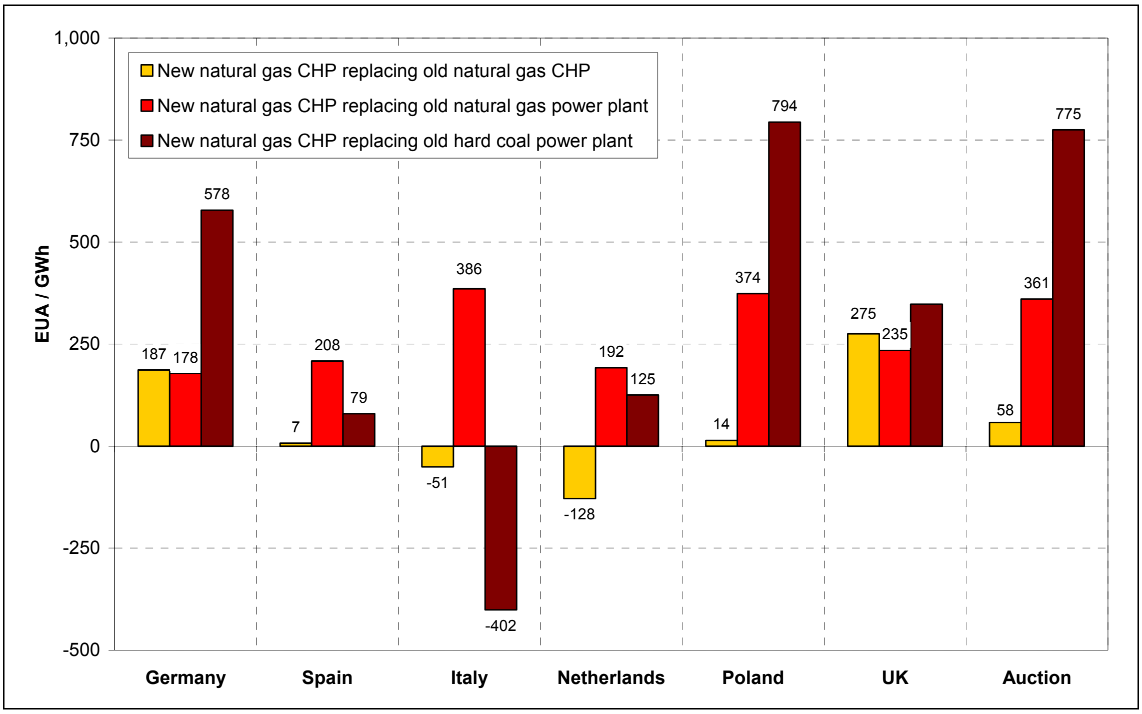


Source Öko-Institut calculations based on data provided by ESC and ILEX

We see again that the allocation to new entrants being newcomers and new entrants replacing old plants differs only for Poland and Germany which are the countries using a transfer provision. The higher the allocation to the replaced plant is, the higher is the transferred amount.

To assess the incentive created by the emission trading scheme for replacement of plants by a new natural gas CHP, we compare the differences of shortage or surplus of a new gas CHP with an existing natural gas CHP in Figure 26.

Figure 26 – Incentive to replace existing plants by a newly-built natural gas CHP



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

We see clearly in Figure 26 that in most cases the Emission Trading Scheme gives rise to a positive incentive for replacement of old plants by new CHP power plants. For example in Germany there is an incentive of 187 EUA/GWh to replace an existing natural gas CHP with a new CHP. This incentive is even higher than in the auction reference case due to the CHP bonus applied.[86] Due to the transfer provisions combined with the CHP bonus provisions the replacement of an existing CHP by a new CHP is slightly favoured over the replacement of an existing natural gas power plant.

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[86] In Germany a new natural gas CHP replacing an old plant and making use of a transfer provision will receive the amount allocated to the closed installation (without any CHP bonus allocated to the old installation) plus a CHP bonus. If a new CHP plant under the transfer provision (replacing an old CHP plant) will receive a surplus of 253 EUA/GWh (see Figure 18; 727 – 474 = 253 EUA/GWh) and the old CHP plant was provided with a surplus of 66 EUA/GWh (Figure 24) a net incentive of 187 EUA/GWh (253 – 66 = 187 EUA/GWh) for an early plant replacement will arise from the ETS.

In the case of Poland, we observe that the incentive follows the same ranking as in the auction reference approach; the incentive is highest when the emissions of the replaced plant are highest. This is due to the transfer provision and therefore only for the time in which the transfer provision applies.

In Spain there is a positive incentive to replace existing natural gas power plants and also existing hard coal power plants. Due to the relatively generous allocation to existing hard coal power plants (compared to existing natural gas power plants) the incentive to replace the more emission-intensive hard coal plants is lower.[87]

In the Netherlands there is a negative incentive to replace an existing CHP by a new CHP with lower emission due to the more generous allocation that existing CHP receive. However, the generous plant closure provisions should be considered again.

A more counterproductive incentive structure must be recognised for Italy. The huge negative incentive in the case of Italy is due to the very generous allocation to existing hard coal power plants and the rather scarce allocation for new CHP, leading to a remarkable perverse incentive. Even a sensitivity analysis for the load factor benchmarks used in the Italian provisions does not change this assessment.[88]

In the UK there is a very high incentive to replace existing CHP plants with new CHP installations because of the scant allocation to existing CHP plants.

As a result the case study underlines that the allocation to existing and new installation needs to be more carefully balanced and especially the very generous allocation to existing installations, as well as the asymmetric allocation provisions for new entrants, should be carefully reconsidered to ensure incentives for early plant replacement.

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[87] Regarding the difficulty of determining the allocation to new CHP compared to existing CHP, we do not assess the small incentive here, as it may well be even smaller. As stated above, the Spanish number should be read with caution.

[88] Due to the load factor benchmark used in the Italian allocation, there is a sensitivity of 383 EUA/GWh. However, even when using the benchmark load factor, the incentive for replacement of an existing hard coal power plant by a new natural gas CHP would be negative. See also Annex C.

3.3.5.5 Evaluation of the economic incentives to replace existing power plants by new ones

In the previous section we compared the shortfall and surplus of different existing and new power plants and assessed the incentive to replace old power plants with new power plants with lower emissions. From the analysis we can make the following ratings;

- For the UK there is a significant positive incentive for replacement by new natural gas power plants and natural gas CHP. This is due to a rather ambitious allocation to existing installations (the compliance factor for existing installations being 0.72) and a more generous allocation to new entrants using natural gas. There is a negative incentive to replace an old hard coal power plant with a new hard coal power plant.[89] This is not in line with the cost of carbon but in spite of this and given that there are no new hard coal power plants planned in the UK, we rate the UK as 'good'.
- In Germany there is a positive incentive for replacement for all three cases. The incentive is only of a low level, if no transfer provision applies. With a transfer provision, the incentives are significant and sometimes even higher than in the auction reference case. As the duration of the transfer provision is rather short, Germany can be judged as 'average'.
- In the Netherlands, there are positive incentives for replacement with new condensation plants both fired by hard coal and fired by natural gas. Compared to other countries and to the reference case of auctioning, the incentives are lower and sometimes asymmetric. In addition, there is a significant negative incentive to replace existing CHP with new CHP. However, we demonstrated that the generous plant closure provision in the Dutch NAP could compensate some deficiencies. All in all, the Netherlands are rated as 'average'.
- In Poland the positive incentives for replacement are significant if a transfer provision applies. As the transfer provisions' duration is comparably short, Poland is rated as 'average'.
- The very generous allocation to existing and new hard coal power plants in Italy is contrary to the cost of carbon and even leads to perverse incentives in several cases. We rate Italy as 'weak' regarding the incentives for plant replacement.
- In Spain the basis for analysis makes it difficult to assess the incentives for replacement. Figures suggest that there is a positive incentive for replacement for both natural gas power plants and natural gas CHP, even though the Spanish NAP states with regard to new installations that 'the allowances allocated to new entrants will not be proportionally greater than those allocated to installations already existing within the same sector'. Therefore we refrain from giving Spain a rating.

[89] There is some sensitivity to this analysis, see Annex C for more details.

The ratings of the economic efficiency of the interaction of national allocation rules for existing and new installations favouring replacement are summarized in Table 25 below.

Table 25 – Evaluation of the economic efficiency of the interaction between allocation rules for existing and new plants

Economic Efficiency	Evaluation of the interaction of allocation to existing and new
Germany	average
Spain	-
Italy	weak
Netherlands	average
Poland	average
UK	good

Notes

'good' – the provisions provide full incentives for (early) replacement of old plants; the overall incentives are comparable to the incentives in the reference case of auction; 'average' – some provisions counteract the incentives which should be generated by an emissions trading scheme to incentivise (early) plant replacement; 'weak' – significant provisions counteract the incentives which should be generated by an emissions trading scheme to incentivise (early) plant replacement.

Source Öko-Institut

3.3.5.6 Lessons learnt: Interaction of allocation provisions for existing and new plants

In most Member States the allocation to existing installations and to new entrants is based on different approaches. In most Member States the allocation to existing installations is based on a grandfathering approach and the allocation to new installations on an emission benchmark. Only in the case of Italy (electricity generation only) and the Netherlands is the allocation to existing installations also based on a benchmark scheme.

The analysis showed strong and significant interactions between the allocation to existing installations and the allocation to new entrants. Furthermore the provisions on plant closure and the allocation in subsequent phases must be taken into consideration.

Therefore the provisions for existing installations, new entrants and plant closure must be carefully balanced. The isolated assessment of single provisions could lead to counterproductive effects in the scheme as a whole. The following lessons can be learnt from the analysis:

1. The provisions for existing installations and new entrants must be *carefully balanced*. If the allocation to existing installations is generous and restrictive plant closure provisions apply, the allocation to new installations should be more generous as well to ensure early plant replacement (e.g. the UK as a good example). A generous allocation to existing installations and no free allocation to new en-

trants would foster the effort to keep existing installations running for additional years or to undertake investments for further lifetime extension.

However, this approach should not lead to an increase of the total number of allowances. Furthermore, this problem is more significant in countries with matured and stagnating markets (e.g. the UK, Germany) than in markets with high growth rates where extension of capacities is needed anyway.

2. The magnitude and the structure of the *incentives for replacement* differ widely between countries and fuel technologies.

   Not all countries were successful in balancing the different allocation provisions in a way to reach the intended carbon pricing. In some countries the incentive structure is asymmetric to the emission reduction achievable with replacement of old installations and creates perverse incentives (e.g. the provisions from the Italian NAP create a higher incentive to switch from an old gas plant to a new coal plant than for the replacement of an old coal or gas plant by a new gas plant).

   For the incumbents a transfer provision ensures auctioning equivalent incentives but also creates additional benefits compared with new market entrants. This raises again questions on the 'fairness' of transfer provisions. However, the incentives from the transfer rules incentive as well as potential fairness problems are limited by their rather short duration of validity in two countries that implemented this provision (Germany and Poland).

   The provisions on *plant closure* can also contribute to the incentive structure for plant replacements. If the operators may also retain the allowances in the case of plant closure this contributes to an earlier replacement of plants. In contrast, very restrictive plant closure provisions incentivise the continued operation of old plants even at a minimum level.

3. The more *complicated* the different rules for existing installations, new entrants and plant closure are, the more unintended side effects arise that could create perverse incentives.

   This is especially evident for the allocation to new CHP installations in the set of standardized installations used in the analysis. In most countries the incentives to replace an existing power plant with a new natural gas-fired CHP plant is lower than to replace it with a new natural gas-fired condensing power plant.

Less generous allocation to existing installations is a crucial issue in the avoidance of perverse incentive structures and for some other provisions, from the effects from updating up to the incentives for the (early) replacement of existing installations by less emitting plants. Furthermore, the effects from plant closure provisions should be taken into account (see Chapter 4).

3.4 Assessment of fairness for the allocation provisions

3.4.1 Introduction

In the foregoing sections we assessed the national allocation provisions against the criterions of transparency and simplicity on the one hand and against the criterion of economic efficiency on the other hand. For the purpose of the analysis we have defined a fourth criterion of assessment: the fairness.

A national allocation plan can be judged as 'fair' if it allows allocation decisions to be taken free from discrimination and arbitrariness and in a manner that does not lead to unjustified burdens or market distortions. The first part of the definition – to allow allocation free from discrimination and arbitrariness – greatly depends on transparency and simplicity. Therefore we will focus in this section mainly on the second part of the definition: the avoidance of market distortion apart from a uniform carbon price.

Following this definition it is 'fair' that plants with higher emissions face a higher carbon cost than plants with low emissions. Moreover, there would be no economic incentives of the emission trading scheme at all, if the inclusion of the cost of carbon were considered unfair.[90]

In order to assess the fairness of the allocation provisions we first analyse the allocation provisions for existing installations and then compare the provisions for new entrants (newcomers on the market) with the provisions for new plants of incumbent operators.

3.4.2 Allocation to existing installations

A major point of discussion, when introducing the EU ETS, was that allocation provisions may favour some plants over others. If we compare the allocation to existing installations we do find that an identical existing plant with identical emissions will face different shortfall or surplus and therefore different real costs in different countries (see Chapter 3.3.3).

Differences in real costs from the ETS do not necessarily constitute a market distortion. A market distortion would arise if a major imbalance on the market were observed.

The shortfall of allocated EUAs is equal to the amount of EUAs that an operator has to purchase on the market for the operation of his plant. This time we will picture this shortfall as real cost (so positive, not negative as in Figure 27). The surplus of allowances allocated can be sold on the market and represents a benefit[91] to the operator.

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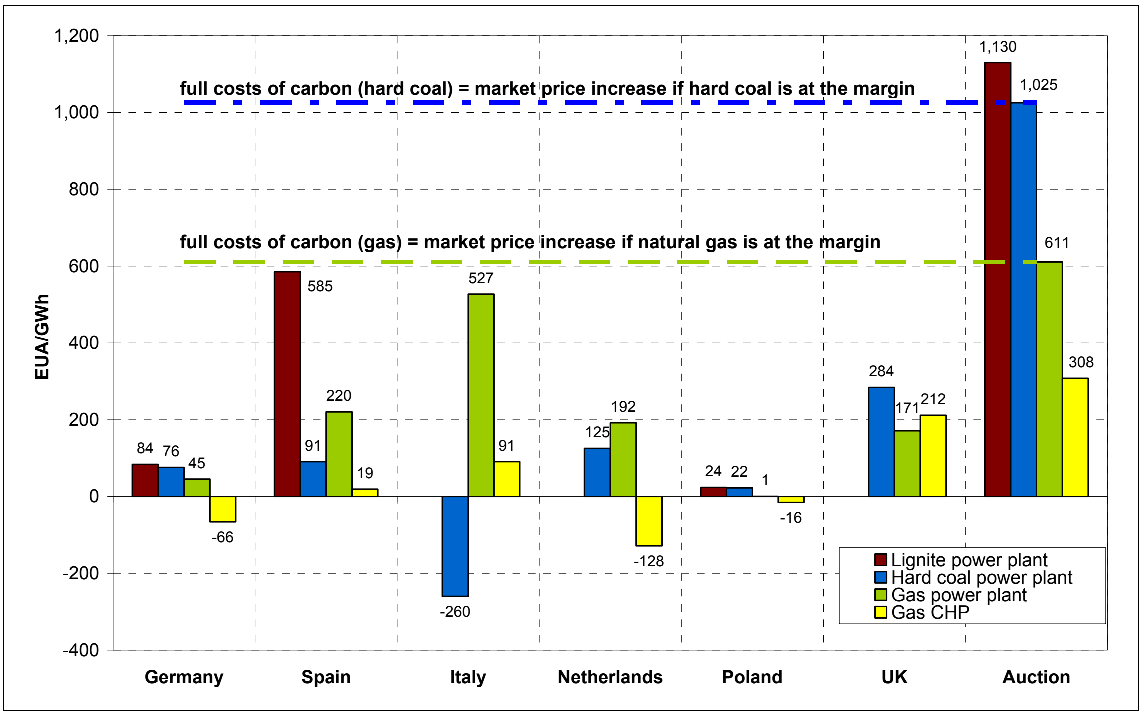
[90] In this part we will not assess how the allocation provisions reflect the carbon intensity of the electricity production in different plants because this would lead to exactly the same results as the economic efficiency assessment conducted in Chapter 3.3 .

[91] In Figure 27 the benefit is displayed as a negative cost.

Figure 27 – Real costs for allowance acquisitions or benefit from sales depending on NAPs (existing installations)



Source Öko-Institut calculations based on data provided by AVANZI, ESC, ILEX and ILEX Iberia

In Figure 27 the bars represent the real cost the emission trading scheme places on an existing plant of the standardized set of plants used in this analysis. For example, the real cost for a natural gas-fired power plant in Spain amounts to 220 EUA/GWh[92] while the real cost for an identical plant in Germany would only amount to 45 EUA/GWh.

However, the economic burden for a generator on the electricity is not equal to the real costs from the ETS. In liberalised markets the prices will be set by the short-term marginal costs of the last generation unit operated to meet the demand. Referring to Annex A the generators should be able to pass the full cost of carbon through to the wholesale market prices. For all generation units operated with lower short-term marginal costs a contribution to the fixed costs or the profits will be created. An additional profit arises from the opportunity costs of the allowances allocated for free.

There is not enough empirical evidence at the moment on the extent to which the power generators are able to pass the full cost of opportunity costs to the market prices.[93] However, the price developments in the UK, as well as in Germany and on the Dutch

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92 The emission of an existing natural gas power plant with the standardized parameters is of 611 t CO_2/GWh electricity production. The Spanish allocation is of 391 EUA/GWh, the difference of 220 EUA/GWh equals the real cost. In Germany the emission is of the same, but the allocation is higher (566 EUA/GWh), therefore the real cost in Germany is lower (611 – 566 = 45 EUA/GWh).

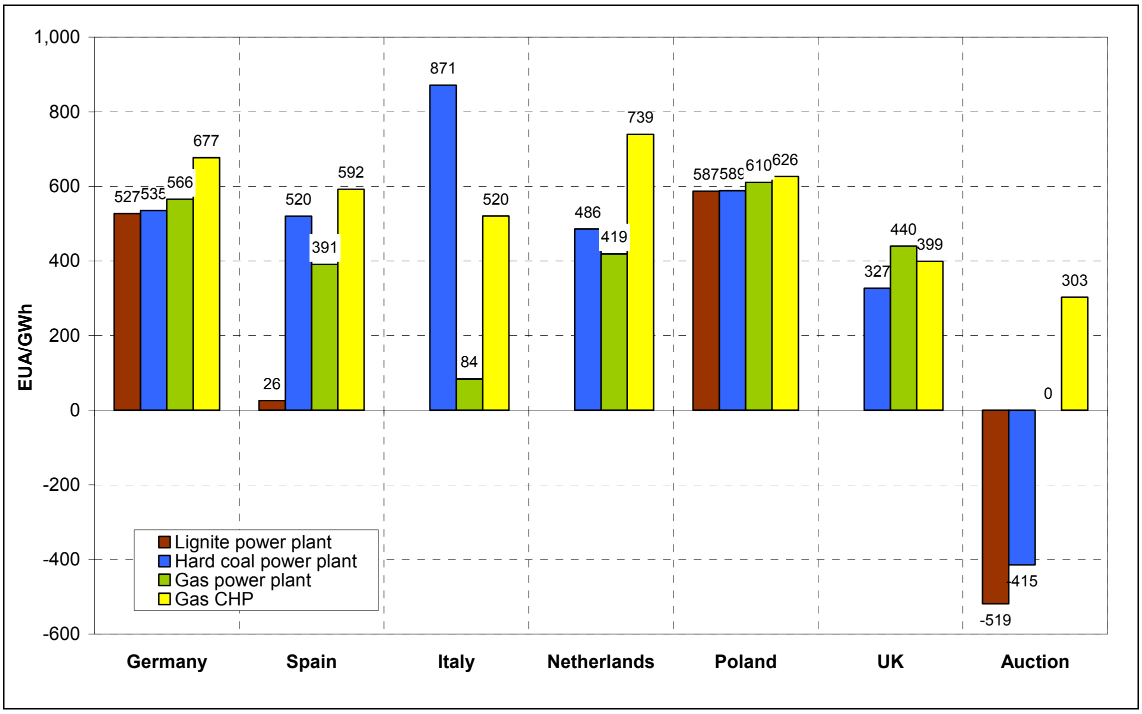
93 However, the issue is discussed intensively in the literature; see ILEX (2004), Sijm et al. (2004+2005), Mannaerts/Mulder (2003) and Oxera (2004).

power market show very clearly that some price trends are clearly influenced by the price trends for EU allowances. In the electricity markets in Spain or in Poland no such trends can be observed at the moment. Considering the market structures and the regulatory framework in these two countries the costs of carbon should be reflected in the electricity prices only to a lesser extend. Significant uncertainties still exist on the question whether the electricity prices in Italy reflect already the price of carbon or not. With regard to the market structures one could question that. However, the electricity prices in Italy are well above the level that can be explained by short-run marginal costs of electricity generation.

As a conservative and preliminary approach we assume for those countries were it is likely to happen (Germany, Netherlands, and the UK), that the generators will be able to pass the full cost of carbon of an existing plant to the market prices. The dotted green line in Figure 27 indicates the approximate level of price increases caused by the ETS in a competitive power market.

The comparison between the additional revenues and the real costs from the ETS underlines that the vast majority of power generators in Germany, the Netherlands and the UK will benefit more from the ETS than the ETS will place burdens on them, if they are able to shift the full costs of carbon of the marginal generation unit to the prices.

Figure 28 – Net profits for operators resulting from a shift of the full cost of carbon to electricity prices (natural gas case)



Source Öko-Institut calculations based on data provided by AVANZI, ESC,IILEX and ILEX Iberia

In Figure 28 we compared the real costs arising from the different allocation provisions with an exemplary increase of power prices according to the full costs of carbon of an older gas-fired power plant. Most of the plants analysed would gain an additional benefit in the range of 400 to 600 EUA/GWh. In the case of EU ETS being based on an auctioning scheme such net benefits would only arise for gas-fired CHP plants with a high efficiency.

If we would assume a competitive market also in Spain, for the case of the lignite-fired power plant in Spain the net benefit would be much less.[94] If we would assume a different plant as being the marginal generation unit (e.g., in Germany a hard coal-fired power plant should be seen as the marginal generation unit) the profits would be even higher.

However, the degree of market opening and the intensity of competition are still very different on the relevant European markets. In Spain some prices are still regulated and the wholesale market for electricity in Poland is far from being a very liquid one and also Italy is not yet a competitive market. For these countries it could be asked whether the power generators were able to pass the full price of carbon to the power prices. In this case, the operators must carry the burden of the real costs from the ETS.

In conclusion we can see that in all countries operators could reap high net profits if they are able to shift the full costs of carbon to the electricity prices. These benefits are high due to free allocation of allowances. Those net profits are significantly higher than the real costs from emission trading. Against this background minor differences in allocation to comparable plants in one country or across countries lose importance. The problem of competition distortion because of different allocation provisions is therefore probably much lower than often assumed. Much more important for the competitive position or the profitability of the utilities is whether the full cost of carbon can be shifted to the electricity prices or not. If competition intensity is low or the market is not liberalized, then prices of electricity tend not to fully reflect the price of carbon. However, this problem cannot be changed by adjustments in the allocation provisions and is no original problem of the ETS. It indicates in fact the need for additional efforts to open the European power markets and create a competitive environment.

Against this background, no significant problems in terms of fairness arise from the different allocation provisions to existing plants in the different Member States. In some countries the power producers will gain higher revenues but this should be seen more as a problem of market configuration than as a fairness problem created by the ETS.

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[94] We underline the special uncertainties related to the data and methodologies for Spain.

3.4.3 Allocation to new entrants

3.4.3.1 Allocation from a new entrants reserve (NER)

All six Member States have decided to provide free allocation to new entrants out of a new entrants reserve. From a fairness perspective the access to the new entrants reserve is an issue to consider, especially if the demand exceeds the new entrants reserve.

The size of the new entrants reserve (NER) is fixed with the approval of the NAP by the Commission. As we have seen in Chapter 3.2.3 the size of the NER differs widely among the Member States in absolute as well as in relative terms. If the demand is higher than the amount of allowances in the new entrants reserve there are two approaches; some countries (the Netherlands, the UK, Poland and Spain) apply a ‘first-come, first-served’ principle while others (Germany and Italy) guarantee free allocation to all new entrants via government purchases (‘replenishment approach’).

The ‘first-come, first-served’ principle could lead to a fairness problem between the operators. Whilst one operator would receive a substantial amount of allowances for free, another operator with an identical power plant would have to pay for all allowances he would need if the NER is exhausted.

In contrast to this fairness problem between the operators the fairness problem in the other model (‘replenishment approach’) arises from the shift of burden between the operators and the state budget. If the demand exceeds the new entrants reserve then the government would have to buy allowances to be able to hand them out free to the new entrants, this could lead to significant public expenditures. In this sense, the government purchase principle could also be seen as a problem in terms of fairness.[95]

The Netherlands tackled the problem by dividing the new entrants reserve into two parts. One part is reserved to ’known new entrants‘ while the second part is for ’unknown new entrants‘. In this way it is assured that all ’known new entrants‘ will receive allocation and therefore the operators do not face the uncertainty as to whether they will receive allowances for free or not and only few operators (the ’unknown new entrants‘) face an uncertainty problem. As investments in the power sector are not of a short-term nature, the number of operators that face this uncertainty problem will be low. At the same time this system offers the possibility of planning for the government as well and of conducting a public participation when deciding about the size of the new entrants reserve.

Additionally, the UK and Spain aimed at reducing uncertainty about the access to their new entrants reserve. The UK publishes a ‘queue’ on the regulator’s website which shows the installations which are in line for allowances and also the amount of allowances left in the reserve. This enhances the transparency for all stakeholders and the

[95] In order not to achieve the national emission reduction target the emission reduction has to be achieved either by other participants in the emission trading sector, in the non-traded sector or via CERs.

planning reliability for operators. The Spanish NAP includes allocation for some new power plants which will be commissioned during Phase 1 to provide certainty.

Reflecting the size of NERs (see Chapter 3.2.3.2) we rate the provisions on the access to NER against the fairness criterion as follows:

- The NER in the UK has a reasonable size and a transparent approach was implemented with the ‘queue’. We rate this as ‘good’.
- In Germany as well as Spain, the NER was subject to the bargaining process and was deceased significantly without a well-founded explanation being given. However, in Germany the ‘replenishment approach’ was implemented which removes uncertainties for the investors. In Spain the list of CCGT projects in the NAP list also decreased the fairness problems. We rate both countries as ‘average’.
- The Netherlands implemented an approach which is interesting in general and appropriate, at least for the purpose of figuring out the size of the NER (nevertheless we would question the concept of differentiated NER for different purposes). However, if we consider the fact that the size of the NER for ‘known new entrants’ is not yet defined, this leads to a rating as ‘average’.
- The process in Italy was not very transparent and the ‘first-come, first-served’ approach could raise problems. However, because the NER is of reasonable size, we rate Italy as ‘average’.
- The NER in Poland is rather small, even when the option of the transfer provision is taken into account. The combination with the ‘first-come, first-served’ approach led to a rating as ‘weak’.

Especially for the NER, the rating on fairness is of a preliminary and more theoretical nature. The experiences from the pilot phase of the EU ETS will help to substantially improve the scheme with respect to fairness.

3.4.3.2 Allocation under a transfer provision and plant closure

From the six countries analysed, two countries have a transfer provision: Germany and Poland. Under a transfer provision the amount of allowances allocated to a plant can be transferred to a new entrant if the existing plant is closed. A new entrant profiting from a transfer provision will normally receive a higher amount of allowances than when an identical new entrant is a newcomer (see Chapter 3.2.3). Inherently, the transfer provision generates advantages for incumbents. This could be particularly problematic in highly-concentrated power generation markets, where the market dominance of the incumbents is already very high.

However, countries without transfer provision also face fairness problems related to plant closure. Comparable advantages for operators can also arise from the rules on plant closure. In the Dutch NAP the operator may keep all allowances allocated for the current emission trading phase even if the plant is shut down.

In the other three countries (Spain, Italy and the UK) the operator will not receive any allowances in the year following to the plant closure or would even have to hand back part of the allowances already received.

The interaction of the plant closure provision with other provisions are so strong that we do not rate the Member States on this issue separately but together with the general allocation provisions for new entrants.

- For the countries that implemented a transfer provisions we assume a fairness problem between incumbents and newcomers. However, the short duration of the transfer provision in both countries (see Chapter 3.2) should be taken into account.
- For all countries with uniform allocation provisions for all new entrants we would state no fairness problem (apart from the fact that major efficiency problem could arise from such provisions).

Against this background we rate Germany and Poland with regard to the new entrants provisions as ‘average’ and all other Member States analysed in this report as ‘good’.

3.4.4 Evaluation of the fairness criterion

In the section above we analysed the national allocation provisions from a fairness point of view. We did not address the issues of avoidance of discrimination and arbitrariness because the assessment would have been almost identical to the assessment of transparency and fairness in the Chapter 3.2.

We have analysed the fairness regarding absence of market distortion. Market distortion could arise with allocation provision that strongly favour some operators and strongly disfavour others. One indicator as to whether there is a danger of market distortion may be a comparison of the net benefits that the operator receives as a result of the emission trading scheme with the real costs the emission trading scheme imposes on them. It is difficult to assess this question properly for all countries which have power markets with very different characteristics or even no (liberalised) market at all; therefore we will abstain from rating on this issue.

The second dimension of analysis was to check whether comparable plants owned by different operators are treated in the same way. We identified the transfer as a potential fairness problem in this respect. The third perspective is the fair access to the NER if there is a free allocation to new entrants. In summary the fairness issues can be rated as shown in Table 26.

Table 26 – Evaluation of fairness of the national allocation provisons

	Access to NER	Allocation to new entrants
Germany	average	average
Spain	average	good
Italy	average	good
Netherlands	average	good
Poland	weak	average
UK	good	good

Notes:
Allocation to new entrants: 'good' – equal treatment of all new entrants; 'average' - limited advantages for incumbents, but also free allocation for newcomers; 'weak' – clear and long lasting advantages for incumbents.
Access to NER: 'good' – size of NER was set out by a clear and transparent process with public participation; the size is appropriate; 'average' – access to the NER either under a 'first-come, first-served approach' and the size is appropriate or the NER is based on a 'replenisment approach'; 'weak' – access to the NER under a 'first-come, first-served approach' and the size of NER seems to be rather small.

Source Öko-Institut

3.4.4.1 Lessons learnt

Although the main share of the allowances was allocated free of charge to the installations, the price will be set by the marginal power generation unit including almost the full costs of carbon in a liberalized and competitive power sector. The full cost of carbon covers the real costs for purchasing allowances and the opportunity costs of the allowances allocated for free. According to theory this effect should be assumed for all markets. Nevertheless, in some countries (e.g. Spain) the electricity prices are still subject to regulation and the operators cannot (yet) pass through the opportunity costs to the wholesale market and in some countries the competitive electricity markets are not fully matured (e.g. Poland). The ability to pass through the full costs of carbon dominates the net economic effects arising from the ETS (higher electricity prices vs. real costs) for the power sector and will significantly determine the fairness issue. Nevertheless, some key issues on fairness can be raised.

1. The *windfall profits* from passing through the full costs of carbon to the electricity prices are mostly higher than the real cost of the emission trading scheme. Against this background the different structures of the electricity markets in different Member States will greatly determine the net economic effects for the power sector.

   The distributional and potential fairness problems (significant differences in windfall profits) arising from such asymmetries in market opening etc. between different countries are more significant than most of the fairness problems caused by certain allocation provisions leading to different real costs.

   In many cases the more stringent liberalization of electricity markets and the development of stronger competition on the power markets will create more important benefits in terms of fairness than any change of allocation provisions.

   However, if the real costs from the ETS converge more to the full costs of carbon by a much less generous allocation to existing allocations (e.g. auctioning in a perfect system), the differences in windfall profits will also be removed.

2. The different approaches to free *allocation to new entrants* could also raise fairness problems. The potential fairness problems range from the very generous allocation for new entrants in some Member States to access problems to the new entrants reserve in other Member States.

   If new entrants receive free allocation, a new entrants' reserve (NER) will be necessary. Most countries apply a 'first-come, first-served' approach, whereas Germany and Italy guarantee free allocation; if the demand exceeds the reserve the government will replenish the reserve. Meanwhile the 'first-come, first-served' approach could create a fairness problem between installations with different schedules for commissioning; the replenishment approach causes a fairness problem between countries.

   An appropriate way of ensuring availability and fair access is the Dutch approach of differentiating between the NER for 'known new entrants' and 'unknown new entrants.' If the NER for both segments undergoes the common procedures for the allocation list and the allocation plans, an appropriate level of availability and fairness should be assumed. Although the uncertainties will not be removed completely within this approach, it is much easier to assess the appropriate size of the new entrants reserve. A NER sized in such framework should guarantee a fair allocation under a 'first-come, first-served' approach for new entrants. The UK and Spain have implemented alternative provisions that could be seen as equivalent.

3. A *transfer provision* for new entrants can lead to unequal treatment of identical new installations.

   Transfer provisions allow the transfer of allowances from closed installations to new entrants. From an incentive point of view the transfer provision can be seen as beneficial, as it ensures auctioning equivalent incentives for incumbents. However, a transfer provision also creates additional benefits for incumbents compared with new market entrants and creates serious concerns from the fairness perspective.

All in all, the fairness problems created by different allocation provisions are by no means as fundamental as the distortions stemming from the incentive structures. However, some problems need to be solved with policies and measures beyond the EU ETS. If almost all operators in countries with liberalised and highly competitive markets benefit from the ETS by passing through the full costs of carbon and operators in another country cannot because of the market structures, it should be addressed with measures concerning market liberalisation and competition policy. Other fairness problems (e.g. regarding the allocation to new entrants) can be solved by greater harmonisation of these provisions between the Member States (see Chapter 5.4).

3.5 Use of CERs for compliance in the EU ETS

According to the Linking Directive, credits (CER - certified emission reduction units) from projects of the Clean Development Mechanism (CDM) can be used for compliance within the EU ETS in the pilot phase 2005-2007. Beginning from 2008 also credits (ERU – emission reduction units) from Joint Implementation projects (JI) can be used in the compliance regime of the EU ETS.[96]

The use of CER is of special importance for the EU ETS against the background of two main issues:

- On the one hand the use of CER could provide an inexpensive compliance option if there is a sufficient supply. On the other hand, the use of CER within the EU ETS will decrease the share of domestic action to comply with the Kyoto targets. If the Member States plan to use significant amounts of credits from CDM and JI to comply with the Kyoto emission ceilings, the supplementarity of the contributions of the flexible Kyoto mechanisms will lose importance, which is inconsistent with the EU's position in the UNFCCC process.
- CERs can be used within the EU ETS in the pilot phase 2005-2007 as well as in the subsequent Kyoto phase. Considering the fact that banking from the pilot phase 2005-2007 to the Kyoto phase 2008-2012 will not be allowed by the majority of the Member States the acquisition of CERs is the only way to provide inter-temporal flexibility between the two phases.

Against this background, the Member States may allow the use of CER from project activities within the EU ETS for the pilot phase 2005-2007. From 2008 the use of ERU may also be allowed. According to the Linking Directive, the Member States can limit the use of CER or ERU to a certain percentage of the allocation of allowances to each installation.

Not all Member States have already transposed the Linking Directive into national legislation. According to the information provided in the NAPs and additional information, the use of CER was treated as follows:

- According to the Italian NAP the operators can use credits from CDM projects in the compliance regime of the EU ETS.
- According to the transposition of the Linking Directive into German legislation (ProMechG) the use of CER is enabled within the framework of the EU ETS. For future phases the amount of credits from JI and CDM used in the compliance regime of the EU ETS can be limited to a certain percentage.

[96] Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms (OJ L 338/18). For the provisions on CDM and JI under the Kyoto Protocol see UNFCCC (1997+2001). See also Blyth/Bosi (2004), Bygrave/Bosi (2004) and Baron/Bygrave (2002).

- According to the Greenhouse Gas Emissions Allowance Trading Law (dated 22 December 2004), the use of CER in the EU ETS for Poland is foreseen only from 1 January 2008 onwards.

In the other Member States the Linking Directive was not yet transposed into national legislation at the time that the research for this report was carried out.

Given the fact that only some Member States have already established the provisions for using CERs in the EU ETS and the empirical evidence on how much credits will be available on the market during the coming years, an evaluation was neither possible nor reasonable. Nevertheless, some qualitative issues on the use of CERs and ERUs in the EU ETS should be noted:

- If some Member States where large emission volumes are covered by the EU ETS allow the use of CERs (and ERUs from 2008 onwards) and credits from the project-based mechanisms of the Kyoto Protocol, and if CERs will be available in significant market volumes and for attractive prices, the economic efficiency of the EU ETS will be improved and the allowance price will decrease even in the case of some Member States not allowing the use of CERs and ERUs. Furthermore, prohibiting the use of CERs and ERUs in the EU ETS in only some Member States will emerge as a symbolic policy because of the free cross-border flow of EUAs which are fully fungible with CERs and ERUs in the compliance regime of the EU ETS.
- If the use of CERs and ERUs will be allowed in some Member States and will not be in other Member States, it could create distortions and fairness problems between the different operators in different Member States. However, the relevance of this argument remains speculative because it is neither clear how much cheaper CERs and ERUs really will be compared to EUAs[97] nor how many CERs and ERUs will be available for purchase by individual operators under the EU ETS.
- The limitation of CER and ERU use in the EU ETS to a certain percentage of the allocation to an individual installation will not be effective because CERs and ERUs are fully fungible with EUAs. If there is a sufficient supply of CERs and ERUs the limitation will only result in a secondary market for the use of CERs and ERUs.[98] As long as the amount of CERs and ERUs used in the EU

[97] On the one hand it could be argued that CERs should be more expensive than EUAs until the end of 2007 because CERs can be banked to the second phase of the EU ETS which is not possible for EUAs. On the other hand, the acquisition of CERs is related to some additional risks (project performance and delivery) which lead for the time being to markdowns.

[98] If an operator uses CERs (and ERUs in future) for compliance and this would exceed the limit for the use of CERs as defined by the respective regulation he would look for other trading entities which did not exceed their limits and offer these ‘capacities’. Probably this would not be free of charge and would increase transactional costs which should be limited in general to ensure the economic efficiency of the scheme.

ETS will not obviously counteract the supplementary criterion, no limitation should be introduced so as to keep the ETS as simple as possible.

- Some Member States plan to establish certain criteria to ensure the environmental integrity of CDM and JI projects. On the one hand this leads to higher administrative costs and more complex regulations. On the other hand this would help to create high project standards. An assessment of this type of regulation can only be made if there is a lot more empirical evidence on the development of the CDM und JI markets.

Considering the manifold uncertainties and the fact that the supply of CERs will be limited until the end of 2007, the interactions between the CDM market and the EU ETS should be more subject to observation than regulation at the moment. At the moment the efforts of the Member States should be more focussed to ensure the quality of CDM and JI projects than the quantities used by the trading entities.

3.6 Conclusions

The EU Emission Trading Scheme (ETS) is based on free allocation of at least 95% of the allowances for the first trading phase. When transposing the EU ETS Directive into national law and designing the national allocation plans (NAPs), the Member States chose different approaches to define the free allocation for specific installations. All Member States have chosen to allocate allowances to new as well as to existing installations for free. However, approaches differ in transparency and simplicity and develop different effects regarding economic efficiency and fairness as well. These four criteria, it has transpired, mostly complement each other but in some cases they turned out to represent conflicting goals. The same is true for the allocation provisions, which showed to have some interactions with unintended adverse effects.

Allocation based on historic activity (grandfathering)

For the allocation to existing installations in the power sector, most countries apply a grandfathering approach based on *historic emissions*. The allocation to a specific installation is based on the historic emission of the installations multiplied by a compliance factor (and sometimes a growth factor) or by predefining a sectoral cap and sharing out the allowances according to the installations share of the historic emission. This approach was chosen by Germany, Poland, the UK, Spain and Italy (heat sector only).

A similar approach is to base the allocation on *historic production* rather than historic emission. Following the same logic, installations receive allocation based on historic production data multiplied with a certain emission benchmark (see below also) or their allocation is calculated as their share of a sectoral cap depending on the installations share of historic production. The Netherlands and Italy (CHP only) chose this approach.

Any allocation based on historic data needs to specify a time span to which the historic data refers, a base period. If the historic emissions or activities are not quantified very accurately before the allocation procedure, there will be some uncertainty as to the outcome of allocation to specific installations. This is because the overall cap of the traded sector and the individual allocation applications have to be matched. The greater the uncertainty, the more flexibility that is offered i.e. by dropping a year when calculating the relevant historic emissions, inclusion of growth factors or introducing exceptions to the general rule. For example, Germany has a high number of special provisions, thus increasing the complexity of the allocation significantly. A high transparency on the allocation provisions combined with a low uncertainty of the allocation outcome should be a goal for governments when designing the allocation rules because it offers all stakeholders the possibility of retracing the allocation, to control for a fair allocation as well as environmental effectiveness and provides the operators with planning reliability.

Allocation according to projected activity (emission benchmarks)

For the allocation to new entrants the grandfathering approach cannot be used, because there is neither a historic emission nor a historic production. A way of calculating a reference emission is to project the future production of a specific installation and multiply this value with an emission benchmark (and eventually a compliance factor and a growth factor). Germany, Italy (CHP only), the Netherlands and Spain have chosen this approach for allocation to new installations. In Poland the allocation is not based on benchmarks but on BAT standards, with a similar effect.

The difficulty of this approach lies in defining the future production. If the allocation depends on the planned production, then operators will have an incentive to project very high production data to receive a high allocation. Several countries have therefore implemented additional provisions to impede this effect (i.e. in the Netherlands a maximum load factor applies; in Germany an ex-post adjustment was implemented), thus enhancing not only the complexity of the system (which is very likely to increase also transactional and administrative costs) but also with negative side effects for the structure of economic incentives.

Allocation according to load factor benchmarks

A means of avoiding installation-specific projections is to apply a load factor benchmark approach. This approach reduces the amount of uncertain factors significantly and makes allocation calculation more transparent for all stakeholders because the allocation is based on the plant capacity multiplied with a load factor benchmark (and eventually compliance and growth factors). So the only installation-specific parameter is the plant capacity, a value which is easy to control and rarely changes. It is a simple and transparent approach with low transactional costs, as long as not too many specifications are included in the benchmarks. Italy was the only country to choose allocation based on load factor benchmarks to existing as well as to new installations (electricity sector only) and the UK based the allocation to new entrants on this concept.

Special provisions to combined heat and power installations (CHP)

If the allocation is based on electricity production data (be it historic or projected) electricity production in CHP installations faces a disadvantage. As in CHP installations electricity and heat is produced together, the overall efficiency is higher but the emission per gigawatt hour electricity production is higher, if the heat production is not taken into account. All Member States have implemented extra provisions of some sort to foster CHP. One way is to base allocation to CHP on a ‘double benchmark’, which means to allocate allowances to electricity and heat separately. This approach was chosen by the Netherlands, Germany (new entrant CHP) and Italy. In Poland CHP installations do not need to reduce their emissions (their compliance factor is of 1.0).

Economic incentives to reduce emissions in existing power plants

There is an economic incentive for emission reduction in existing installations created by the ETS independently from national allocation provisions. The magnitude of the incentive depends purely on the cost of carbon, so purely on the magnitude of emission reduction achieved. If the operators can pass through the cost of carbon to the electricity prices, free allocation will only result in extra benefits for the electricity companies. However, there is one sort of national allocation provisions that may eliminate the incentive to change the way that existing plants operate: ex-post adjustments as introduced in Germany. Therefore ex-post adjustments, even though they may be reasonable from a fairness perspective, need to be avoided to ensure the economic efficiency.

Economic incentives to invest in low carbon power plants

Investments in new power plants play a crucial role in the development of the emissions caused by the power sector in future, especially in growing power markets. The economic incentive which the ETS brings about for investors to build new installations with low emissions depends on the national allocation provisions. For investment decisions, the real costs matter the most and they are reduced significantly by free allocation.[99] When allocating for free, the allocation provisions should be shaped in a way that the real costs reflect the carbon intensity. In other words, the real costs for the production with installations with high emissions should be high and for installations with low emissions low. Fuel-specific allocation provisions can easily lead to an erosion of these differences in real costs (Germany, the Netherlands and Poland) or may even create perverse incentives to invest in emission intensive installations (Italy). All countries except the UK and Spain have implemented fuel-specific allocation procedures to new entrants which lead to an erosion of the incentive to invest in new power plants with low emissions.[100] A transfer provision can ensure the incentive to build low carbon plants, if they replace an existing installation. Germany and Poland implemented transfer provisions.

If new entrants receive free allocation, a new entrants reserve is needed. The size of, and the access to, the new entrants reserve raise fairness issues. A 'first-come, first-served' approach may lead to a fairness problem because one plant may receive free allocation, while an identical plant may not receive any allocation at all, if the reserve is used up. A 'replenishment approach' on the other hand means that the government will purchase the missing allowances if the demand exceeds the new entrants reserve. This approach, chosen by Italy and Germany, offers certainty to operators but may in turn lead to fairness problems between countries and could imply substantial public expenditures. Among the countries using the 'first-come, first-served' approach (the Netherlands, the UK, Spain, and Poland), several implemented extra rules to reduce uncertainty (a public 'queuing list' in the UK, inclusion of planned installations in the installation list in Spain and in the Netherlands).

Economic incentives for (early) replacement of existing installations

The emission intensity of power production will depend on whether existing installations with high emissions are replaced by new plants with lower emissions. This is especially true for mature markets. To ensure incentives for (early) replacement of power plants, the free allocation to existing and to new installations has to be carefully balanced to reflect the carbon intensity of existing and new power plants alike. If existing installations receive a generous free allocation and new installations do not, the operator would receive the incentive to expand the lifetime of the existing installations as long as

99 The real cost from the ETS equals the cost of carbon (emission) minus the free allocation.

100 There are no known plans to build power plants fired by hard coal or lignite in both countries.

possible and to invest in lifetime expansion. An option for ensuring the incentive for replacement would be to give new installations an even more generous free allocation. This might, however, conflict with the goal of overall emission reduction and the cap on emissions of the emission trading sector. The more generous the allocation to existing installations is, the more difficult it is to achieve this balance without increasing the cap. Therefore less generous allocation to existing installations is crucial to ensure the incentive for (early) plant replacement.

Under a transfer provision the allowances allocated to an existing installation can be transferred to a new installation if the new plant replaces the existing one. Transfer provisions can significantly encourage the investment in new plants with low emissions and for early replacement, because the magnitude of the incentive created by transfer provisions is almost in line with the difference in cost of carbon. The impact of transfer provisions is reduced by their comparably short validity. Transfer provisions imply that identical new installations may receive different allocation depending on whether the operator is an incumbent or a newcomer. This is problematic from the viewpoint of fairness.

A generous plant closure provision can also contribute to the incentive for plant replacement. If operators have to give back all unused allowances in the case of plant closure, they receive no incentive from the ETS to close a plant and no incentive to notify if a plant ceases operation either. In contrast, a provision as in the Netherlands' NAP – that an operator will receive the allocated allowances no matter whether operating or not – does constitute an incentive to close existing installations with high emissions and to use the allocated allowances for other power plants owned by the operator or sell them. This provision has similar effects as a transfer provision.

Rating of NAPs against the criteria of transparency, simplicity, economic efficiency and fairness

The analysis of the NAPs of the six Member States conducted in this chapter was completed by an assessment of the different national provisions against the four criteria of transparency, simplicity, economic efficiency and fairness.

The criterion of transparency was assessed against the question of whether any stakeholder and plant operator could retrace the allocation to specific installations, provided the installation-specific parameters are known. Transparency was rated as 'good' when the allocation provisions were clearly documented and uncertainty to the outcome was low; as 'average' when the allocation provisions were documented but the uncertainty of the allocation outcome was high; and as 'weak' when documentation was poor and the uncertainty was consequently high.

The criterion of simplicity was assessed so that the administrative and transactional costs which the ETS is likely to develop could be judged. Simplicity was rated as 'good' when the allocation provisions were simple calculation exercises with only a few different parameters; as 'average' when the allocation provisions were based on complex parameters depending on multi-dimensional characteristics of the individual installation; and as ‘weak’ when the allocation provisions were very complex or intransparent.

The criterion of economic efficiency was assessed comparing the economic incentives to reduce emissions that an ETS based on complete auctioning would cause with the incentives the ETS is causing with the current allocation provisions using a standardized set of installations for comparison purposes. The economic efficiency was rated as ‘good’ when the provisions implemented provided comparable incentives to the ones in the auction reference case; as ‘average’ when the provisions implemented counteracted the incentives which should be generated in an ETS; as ‘weak’ when significant provisions counteracted the incentives which should be generated in an ETS.

The criterion of fairness related to the question of whether the implemented provisions allow allocation free from discrimination and arbitrariness and do not lead to market distortion (apart from a uniform price signal). To guarantee an allocation free from discrimination and arbitrariness, transparent and simple provisions are key. As transparency and simplicity are assessed separately, we rated fairness according to equal treatment and absence of market distortion. The fairness was rated as ‘good’ when identical installations are treated equally and have equal access to the NER; as ‘average’ when some operators (i.e. incumbents) have limited advantages over other operators and the NER is likely to provide sufficient allocation for all; as ‘weak’ when incumbents have clear and long lasting advantages and a rather small NER combined with a ‘first-come first-served’ approach.

In Table 27 we summarize the ratings of the different national allocation provisions.

In the analysis, we found that no country managed to design their national allocation rules to picture the real cost of carbon, as an emission trading scheme based on complete auctioning would have done. The assessment showed that an ETS with a substantial amount of allowances allocated for free may easily lead to an erosion of the economic efficiency of the scheme. The challenge to ensure economic efficiency seems much greater than the question of fairness.

Nevertheless, some countries managed better than others in implementing provisions that mirror the carbon intensity. The more transparent and simple the provisions are, the better the economic incentives are to reduce emissions caused by the ETS. A complex set of provisions using diverse allocation methods and exceptions faced significant problems, it transpired, when it comes to the interaction of the rules. In conclusion, the simpler and more transparent the provisions are, the better the ETS can represent the cost of carbon and lead to a reduction of emissions. Transparency and simplicity enable stakeholder participation, which in turn is key to ensuring a fair and environmentally effective ETS.

The ratings in Table 27 are to be understood as comparative values. If a country is rated as ‘good’, this does not imply that there is no better option; ‘good’ as well as ‘weak’ are to be seen in comparison to the other countries assessed. All ratings are related to the current phase of the ETS. In a multi-phased ETS the same provisions may develop other effects. These are explored in greater detail in the next chapter.

Table 27 – Evaluation of national allocation provisions (summary)

	Transparency		
	Existing installations	**New entrants**	
Germany	average	average	
Spain	weak	weak	
Italy	good	average	
Netherlands	good	good	
Poland	average	good	
UK	average	good	
	Simplicity		
	Existing installations	**New entrants**	
Germany	good	average	
Spain	weak	weak	
Italy	good	average	
Netherlands	good	good	
Poland	average	average	
UK	good	good	
	Economic Efficiency		
	Existing installations	**New entrants**	**Interaction**
Germany	weak	average	average
Spain	good	-	-
Italy	good	weak	weak
Netherlands	good	average	average
Poland	good	average	average
UK	good	good	good
	Fairness		
	Allocation to new entrants	**Access to NER**	
Germany	average	average	
Spain	good	average	
Italy	good	average	
Netherlands	good	average	
Poland	average	weak	
UK	good	good	

Note:
More details on the ratings are given in the respective chapters of this report.

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4 Options for future allocation plans and best practice

4.1 Introduction and overview

Allocation plans constitute the central basis of the multi-phase EU ETS as it was established by the EU ETS Directive. Whatever the nature of future NAPs – either with strong national elements or much more harmonized – the quality of the NAPs will depend on the provisions and the interactions between some key areas:

- the treatment of existing plants;
- the treatment of new entrants;
- the treatment of plant closures.

Although there is a range of other areas which received special attention during the debate on the Phase 1 NAPs (early action, process emissions, CHP, etc.) the three provisions mentioned above will build the main pillars of future NAPs and the environmental effectiveness of the scheme. Nevertheless, some new questions will arise if the focus changes from the effects of a single NAP as was mainly the case in the NAP debates for the pilot phase 2005-2007 to a series of subsequent NAPs which at least make up the longer term perspective of the EU ETS.

The different options discussed below are of a generic nature.[101] They could be applied for all installations covered by the EU ETS. Nevertheless, the specification and more detailed assessment in the next chapters focus again on the power sector.

Whereas full flexibility exists for the design of NAPs for the time beyond 2012, the potential for fundamental revisions of NAPs for the second phase of the EU ETS (2008-2012) is limited by the provisions of the existing EU ETS Directive. The assumption that major revisions of the existing Directive will not take place for the phase 2008-2012 constitutes the basis for the analysis as far as it refers to the phase 2008-2012.

For the allocation to *existing installations* several options must be taken into account which could be differentiated by two dimensions. The first dimension concerns the general principle of allocation to new installations and the second dimension regards the underlying period of time:

1. The allocation provisions in future NAPs could be based on the *allocation of the pilot phase*. In a simple case, the average annual allocation to a particular installation in the pilot phase would be multiplied by a factor or a set of factors which represent the emission caps for the next phase and the number of years in the respective phase.

[101] The full range of possible allocation approaches is much wider than discussed here. The selection of those approaches discussed here covers approaches that are already subject to a more in-depth debate or could play a more important role in the improvement of the EU ETS. See Harrison/Radov (2002), Böhringer/Lange (2003), KPMG/Ecofys (2002), Matthes et al. (2003), PwC/ECN (2003) and DIW et al. (2003)..

2. The allocation could rely on *emissions in a certain base period*. The annual average emissions in an EU-wide harmonised or non-harmonised base period would be multiplied by a compliance factor and the number of years in the respective phase to calculate the allocation certain base period.
   a) The base period for such approach could be the *fixed base period* of the pilot phase of the EU ETS.
   b) The base period could be *updated* so as to include years closer to the respective trading phase.
   c) In theory the allocation also could rely on *future* years, i.e. planned emissions.
3. The free allocation of allowances could be based on a *benchmark* approach. The activities (production of electricity or other commodities) of a certain base period would be combined with emission benchmarks (e.g. tons of CO_2 per million kilowatt hours or tons of production) to calculate the reference emissions from which the allocation could be derived (using compliance factors, growth factors, etc.).
   a) The benchmarks could rely on the *output* of installations (output based or product-specific benchmarks – tons of CO_2 per million kilowatt hours or tons of production, etc.).
      i) The base period for the activity data used in such approach could be the fixed base period of the pilot phase of the EU ETS.
      ii) The base period could be updated to years closer to the respective trading phase.
      iii) In theory the allocation also could rely on future years, i.e. planned production.
      iv) The activities on which the benchmarking allocation is based could be defined independently from a certain base period and alternatively rely on the average use of capacities (activity benchmarks, e.g. average load factor benchmarks).
   b) The benchmarks could reflect more *differentiated technologies or fuel inputs* (fuel-specific or technology-specific benchmarks – tons of CO_2 per million kilowatt hours from a hard-coal-fired power plant, etc.).
      i) The base period for the activity data used in such approach could be the fixed base period of the pilot phase of the EU ETS.
      ii) The base period could be updated to years closer to the respective trading period.
      iii) In theory the allocation also could rely on a base period covering future years.

iv) The activities on which the benchmarking allocation is based could be defined independently from a certain base period and alternatively rely on the average use of capacities (activity benchmarks, e.g. average load factor benchmarks).

4. The allowance allocation to existing installations could be not *free of charge*. The operators would have to buy the allowances or a part of the allowances at an auction. The share of allowances allocated by auctioning is limited by the EU ETS Directive for Phase 2 to 10% of the total amount of allowances in a particular Member State.
5. Last but not least, the different approaches could be *combined* in various ways.

The advantages and disadvantages and the assessment of different approaches are discussed in more detail in Chapter 4.2.

The allocation to *new entrants* – either installations replacing old plants or additional installations – could be implemented with the following approaches:

1. *No free allocation* to new entrants
    - a) Operators of new entrants would have to purchase the allowances on the market.
    - b) Allowances for new entrants will be available from an auction fed from a new entrants reserve.
2. *Free allocation* from a new entrants reserve based on a benchmarking approach.
    - a) The allocation is based on product-specific emission benchmarks (e.g. tons of CO_2 per gigawatt hour of electricity generation or ton of product).
        - i) The allocation is based on planned activities for the particular installation.
        - ii) The allocation is based on average activity benchmarks (average load factors or average capacity utilization).
    - b) The allocation is based on fuel-specific or technology-specific emission benchmarks (e.g. tons of CO_2 per gigawatt hour of electricity generation in a hard coal-fired power plant, etc.).
        - i) The allocation is based on planned activities for the particular installation.
        - ii) The allocation is based on average activity benchmarks (average load factors or average capacity utilization).
3. Free allocation by *transfer* of the allowances from an old plant replaced by the new installation (transfer provision).
4. Free allocation based on installation-specific estimates of *future emissions*.

5. The different approaches for the allocation to new entrants could also be *combined* in various ways.

These options and their potential combinations are analysed and discussed in more detail in Chapter 4.3. The consequences and the different design options for new entrants reserves are analysed in Chapter 4.3.5.

Furthermore, for new entrants the problem arises as to which allocation approach the allocation should be based on for the phases *subsequent* to the period the plant is put into operation.[102]

1. The allocation could be based on the general provisions for existing installations. The allocation plans would also consist of two segments in future, the general allocation provisions for the installations included in the general list of existing installations and eventually a new entrants reserve.
2. The allocation could rely on the effective new entrant provision. Any allocation plan would consist of three segments, the list of existing installations commissioned before 2005 ('old' existing installations), the list of existing installations commissioned after 2005 ('new' existing installations) and the new entrants reserve.
    a) The (annual) allocation could be identical to the first allocation in the period the plant was taken into operation. The average annual allocation to a particular installation in the pilot phase could be multiplied by a factor or a set of factors which represent the emission ceilings for the next phase and the number of years in the respective phase.
    b) The (annual) allocation could be updated to the real activities of the plant for the first phase when empirical data of the plant are available for the preparation of the allocation plan.

The complex issue of allocation approaches for subsequent trading phases to plants commissioned during the pilot phase is discussed in Chapter 4.3.6.

Regarding the closure of installations, it must be underlined that the definition and identification of plant closures remains an unsolved problem in all Member States. On the one hand there is no problem if the operator notifies a plant closure and returns the permit for the installation. However, it must be considered that a wide range of activities exists, whereby the identification of plant closures is much more complicated. As a result, the mothballing of installations ('cold reserve') is usual practice especially in the power sector.

[102] Within the date regime of the recent EU ETS Directive this must be read as the period when the new entrant will be part of an allocation plan for the first time. Since the allocation plan for a certain period must be finalized 30 months before the begin of the next period, an installation which is put into operation after this point of time must be seen as a new entrant for the rest of the period as well as for the subsequent period.

Against this background different options and approaches exist to treat the issue of *plant closures*:

1. The allocation decision remains valid and all allowances allocated will be issued to the operator of the installation.
2. The issue of allowances allocated to an installation which was shut down is ceased within a certain time frame.
    a) Allowances which were issued to the operator will not be subject to an obligation of return.
    b) The allowances issued to the installation will be claimed back for a proportion that is equivalent to the time the installation was no longer operated.
3. The allowances allocated to a certain installation can be transferred to a new entrant.
4. The allocation of allowances will be subject to an ex-post adjustment according to production cuts.

Furthermore, it should be considered that some allocation provisions (transfer provision, updating approaches for the initial allocation, etc.) have major impacts on the allocation to installations which were shut down. These interactions and the full range of plant closure provisions are discussed in Chapter 4.3.

4.2 Allocation to existing installations in subsequent phases

4.2.1 Fixed base periods

If the allocation provisions in future NAPs rely on the *allocation of the pilot phase*, it would constitute the simplest approach and would be easy to implement. The average annual allocation of the pilot phase would be multiplied by a factor or a set of factors which represent the emission ceilings for the next phase and the number of years in the respective period. The inter-temporal incentives for emission reductions provided by the EU ETS would be equivalent to the full costs of carbon, which are equivalent to the incentives within a trading phase (see Chapter 3.3.3). The operator would maximise its profits in terms of the optimal level of production as well as considering potential measures for the decrease of emissions. The main advantage of this approach results from the certainty that it provides for operators. Furthermore, the amount of data collection would be reduced and such an approach should be easy to understand for every trading entity and market agent.

Nevertheless, some disadvantages result from an allocation not depending on production growth or emission changes after the base period on which the allocation for the pilot phase was based:

- For industries with a high exposure to international competition this allocation approach would hamper production growth and could create leakage effects. However, this is not the case for the electricity sector where the exposure to international competition is rather low.
- Any distributive imperfections and distortions created by the NAP for the pilot phase would be extended to future trading phases. There would be no chance to adjust the allocation rules according to the lessons learnt from the pilot phase.
- An EU-wide harmonization of allocation approaches, even with a stepwise approach would be precluded because of the significant differences in the allocation methodologies for the pilot phase (see Chapter 3.2). Distortions between the Member States would be reinforced.

The latter effect could be avoided only if the base period used for the allocation for the pilot phase remains unchanged. The respective historic data on emissions or activities could constitute the basis for improved allocation provisions.

Neither production growth nor changes in emissions after the respective base periods for the pilot phase would influence the allocation. The changes in allocation will only depend on the changes in the allocation provisions. The approaches range from allocation based on historic emissions (allocation results from emissions in the base period and the particular compliance factor) to different types of benchmark allocations (allocation results from the activities in the base period, different types of emissions benchmarks, supplemented eventually by growth or compliance factors). If the allocation approaches are developed in a more counterproductive way (see the case studies on hard-coal- and gas-fired power plants in Italy and Spain – Chapters 3.3.5 and 4.2.2), the losses in economic efficiency due to the adjustment of allocation provisions could offset the advantages of a fixed base period.

Given the fact that some Member States already implemented more advanced allocation approaches (e.g. benchmarking schemes) which eliminate some distortions (e.g. the early action problem) and other Member States face some problems with their allocation approaches (see Chapters 3.2 and 3.3) the allocation for subsequent trading phases based on the pilot phase allocation proves that it is not a recommendable option. Flexibility for improving the allocation approaches based on the lessons learnt from the pilot phase is a minimum requirement for the dynamic improvement of the EU ETS.

4.2.2 Updating of base periods

4.2.2.1 Overview and quantitative analysis

Base periods play an important role both for grandfathering which depends on historic emissions and benchmarking based on average activities in the base period.

From a theoretical perspective, the shift of base periods to more recent years for subsequent trading phases could have counterproductive effects regarding the efficiency of the scheme. The adjustment of base periods (‘updating’) could also create problems for the future which are comparable to the early action problem and erode the incentives to target the optimal production level.[103] So the base period should not be subject to change even in the case of the general allocation approach undergoing a general revision for the next trading phases. Furthermore, operators should not be given a chance to influence their allocation by ‘gaming’ (e.g. increase emissions or postpone emission reduction measures to receive higher allocation in future) from a general perspective.

However, the political pressure to update base periods will increase. Even the experience from the pilot phase suggests that the bigger the time gap between the base period and the respective trading phase, the more special provisions, and hardship clauses will be demanded. Against this background, the updating of base periods could help to maintain a simpler and transparent allocation scheme. Last but not least, the updating approach offers an interesting option in dealing with the issue of plant closure in an appropriate manner. If the production of a certain installations is phased out, the free allocation would decrease over time.

In order to assess the advantages and the disadvantages of updating approaches, a modelling exercise was carried out. Without any doubt, the updating approach diminishes the incentives to target the optimal level of production. However, if the incentives for measures to decrease emissions from existing installations are to be eroded to a non-acceptable extent, this fact should build a strong argument against updating.

[103] See Figure 31 for an illustrative overview on the key mechanisms of the updating approach.

We initially based the modelling exercise on the effects of updating on the following assumptions[104]:

- The fuel efficiency of an existing hard coal-fired power plant is improved by 4 points (the emissions drop e.g. for Poland from 1,036 t CO_2/GWh to 924 t CO_2/GWh). The measure is implemented on the first day of Phase 2 (i.e. 1 January 2008).
- Alternatively, for an existing hard coal-fired power plant a complete fuel switch to natural gas is assumed (the emissions decrease e.g. for the German case study from 1,025 t CO_2/GWh to 611 t CO_2/GWh).[105] This measure will also be taken on the first day of Phase 2.
- The allocation for subsequent phases is based on an updating approach. The first two years of the recent and the three years of the last phase constitute the base period for the subsequent trading phase.
- The allocation approaches for the six EU Member States do not change over time. If the allocation relies on benchmarks, these benchmarks do not change over time.

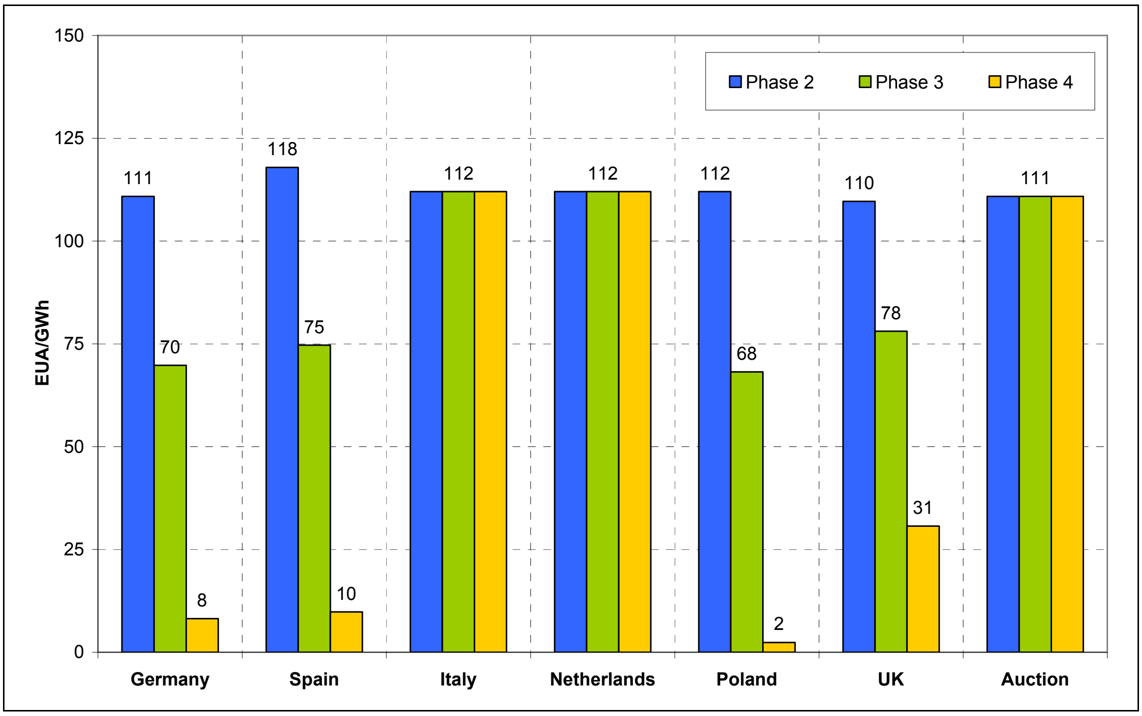
Figure 29 shows the results of the modelling exercise for the case of *efficiency improvements in an existing power plant*. The benefit from the ETS is calculated from the shortfall or surplus of allowances for the installation before the measure is taken and the shortfall or surplus off allowances after the abatement measure was implemented.[106] In the auctioning case the demand for allowances decreases from 1,025 EUA/GWh to 915 EUA/GWh, the measure would benefit with 111 EUA/GWh from the ETS (including rounding effects).

[104] More detailed data are given in Annex E.

[105] This option is not possible to implement in every hard coal-fired power plant. Nevertheless, it is a realistic option for some plants which illustrates the interactions very clearly.

[106] It must be pointed out that the analysis presented in this report is limited to the benefits arising from the ETS. These benefits must be compared against the additional costs (for investment, other fuels, etc.) for the trading entities. However, the main goal of the ETS is to create price signals which enable this comparison for the trading entities.

Figure 29 – Benefits from ETS from efficiency improvements in existing hard coal power plants under an updating approach



Source Öko-Institut calculations based on data provided by ILEX, ILEX Iberia, ESC and AVANZI

The benefit from the emission abatement measures will decrease significantly for those Member States where the allocation is based on historic emissions (Germany, Spain, Poland and the UK).

- In Phase 2 when the measure was implemented the installations will gain a benefit which is equivalent to the auctioning case.[107]
- In Phase 3 the benefit is between 29 and 39% less because the allocation will rely partly on the emission level reached after the efficiency improvement.[108] For Poland the surplus of allowances gained from the abatement measure decreases from 110 EUA/GWh to 78 EUA/GWh in the subsequent phase. The smaller decrease for the UK is caused by the much less generous allocation to existing installations which lead to a higher sensitivity on emission levels than in other countries.

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[107] The differences between the data for Italy, the Netherlands, Poland (112 EUA/GWh), Spain (118 EUA/GWh), the UK (110 EUA/GWh) and the auctioning case (111 EUA/GWh) result only from the different CO_2 emission factors used for the country-specific calculations (see Table 3).

[108] The range of erosion of benefits depends on the composition of the base period. If the 5 years base period for the subsequent period consists of two years of the recent period and three years of the last period ('two and three of five') the erosion of incentives will be in the range of 29 to 39% as shown in Figure 29. If the composition is 'one and two of three' the erosion amounts to 24 to 33%. In the case of a '1 and 3 of four' base period the benefit from a surplus of allowances amounts will cover the range of 18 to 24%.

- In Phase 4 the allocation only depends on the allocation provisions for existing installations. If it is less generous, the lower emission level will lead to more benefits for abatement measures analysed in this case (e.g. the UK compared with Poland, Germany or Spain).

The incentive for emission improvements is not subject to erosion in those countries where the allocation is based on a non installation-specific benchmarking approach (i.e. Italy and the Netherlands).[109] For all three phases the incentive is equal to the auctioning case representing the yardstick for efficiency of the provision.

The modelling exercise lead to the first set of lessons learnt from the updating approach. Regarding *energy efficiency measures* the transition to an updating approach

- will erode the price signals from the ETS if the allocation is based on grandfathering over time compared to the case of auctioning;
- this erosion is limited to a certain extent if the allocation to existing installations is less generous (e.g. for the UK);
- will not lead to an erosion of incentives if it is based on a non installation-specific benchmark scheme.

For the case study on *fuel switching in an existing power plant* the results differ significantly (Figure 30). For the countries where the allocation is based on historic emissions (Germany, Spain, Poland and the UK) a gradual erosion of incentives from the ETS arises.

- In Phase 2 when the measure was implemented the installations will gain a benefit which is again equivalent to the auctioning case.[110]
- In Phase 3 the benefit is between 29 and 38% less because the allocation will rely partly on the emission level reached after the efficiency improvement.[111] The loss of benefits from the ETS is again less if the allocation to existing installations is less generous (e.g. in the UK).
- In Phase 4 the incentive structures mirror the differences of allocation results for hard coal- and gas-fired power stations. In the case of the allocation to existing gas-fired plants being much less generous than for hard coal (e.g. Spain), there will a negative benefit for fuel switching in existing power plants from the beginning of the third phase.

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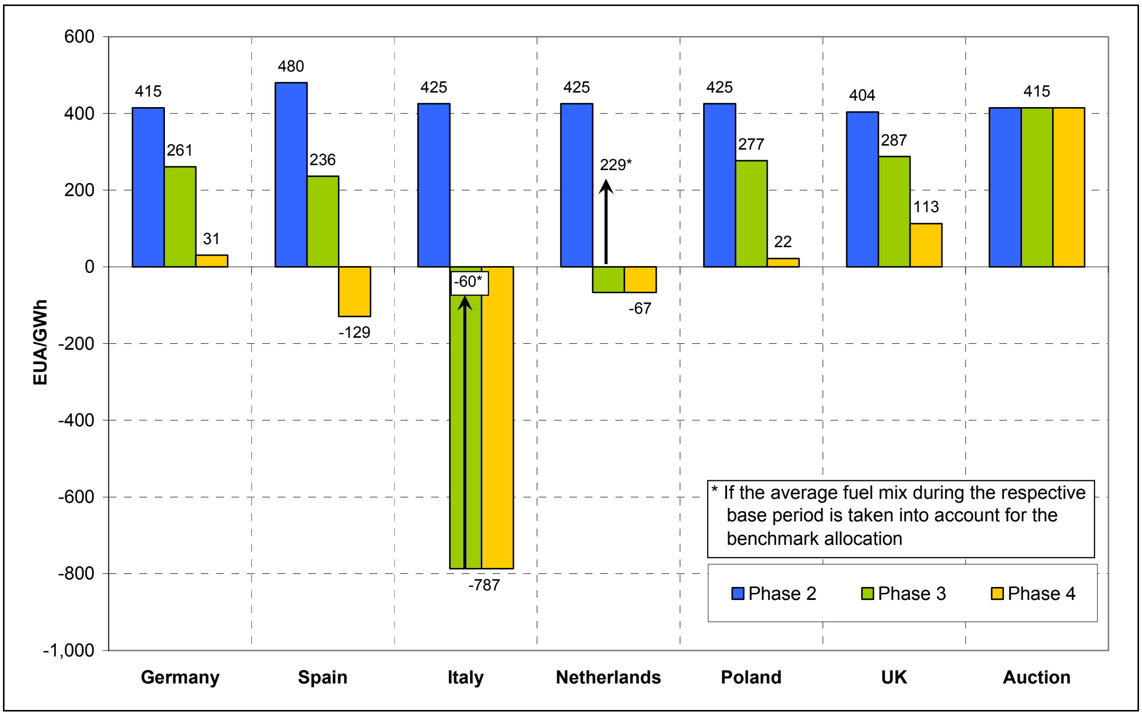
[109] If the benchmark would be subject to change over time, the benefit from the ETS would also be subject to change but only to the extent that the emission benchmark would decrease.

[110] The differences between the data for Italy, the Netherlands, Poland (425 EUA/GWh), Spain (480 EUA/GWh), the UK (404 EUA/GWh) and the auctioning case (415 EUA/GWh) result only from the different CO_2 emission factors used for the country-specific calculations (see Table 3).

[111] The exception is Spain where the allocation to existing hard coal-fired power stations is much more generous than for existing gas-fired power stations according to the data available for the research presented in this study. In this case the surplus of allowances drops approximately 53% in the second period. A sensitivity for analysis for the composition of base periods leads to sensitivities comparable to the case of efficiency improvements (see Footnote 108).

Figure 30 – Benefits from ETS from fuel switching in existing hard coal power plants under an updating approach



Sources Öko-Institut calculations based on data provided by ILEX, ILEX Iberia, ESC and AVANZI

A more complicated situation arises for the different allocation approaches relying on benchmarks (Italy and the Netherlands):

- In Phase 2 when the measure was implemented the installations also will gain a benefit from the ETS which is again equivalent to the auctioning case.[112]
- If the allocation by benchmarks relies on the fuel used in the most recent year for both the Netherlands and Italy, the benefits drop drastically.[113] In the case of Italy, a strong disincentive even arises for fuel switching already in the phase subsequent to the phase when the measure was implemented.[114]

[112] The differences between the data for Italy, the Netherlands, Poland (425 EUA/GWh), Spain (480 EUA/GWh), the UK (404 EUA/GWh) and the auctioning case (415 EUA/GWh) result only from the different CO_2 emission factors used for the country-specific calculations (see Table 3).

[113] In both countries the emission benchmarks depend on the fuel. If the fuel used in the most recent year constitutes the only basis for allocation, then the allocation will be comparatively low in the next period.

[114] In Italy the allocation to a steam condensation power plant would be based on a different emission benchmark for hard coal and natural gas on the one hand. On the other hand the allocation relies on benchmarks for load factors which are 81% for hard coal and only 10% for existing natural gas steam turbine power plants. Compared to the average load factor used in this case study (57%) a significant surplus of allowances results for the hard coal power plant and a significant shortfall for the gas-fired power plant. In total a string disincentive arises form the ETS for fuel switching from hard coal to gas.

- If for the allocation the average fuel mix in the base period builds the basis, the strong distortion in the second period could be lowered. For the Dutch allocation approach the benefit from the ETS in Phase 3 would arise that is comparable to the other countries where allocation is based on updated historic emissions (benefit of 229 EUA/GWh). Although the disincentive for fuel switching in Italy would be lowered significantly in this case, there would be no benefits for fuel switching in existing installations beginning from the phase subsequent to the phase in which the measure was taken.
- In Phase 4 the benefits for the switch to gas would only result from the allocation provisions for gas-fired power plants. For the Netherlands a small benefit would result and for Italy a strong burden.

For the case study on *fuel switching* the following lessons can be learnt on the transition to an updating approach:

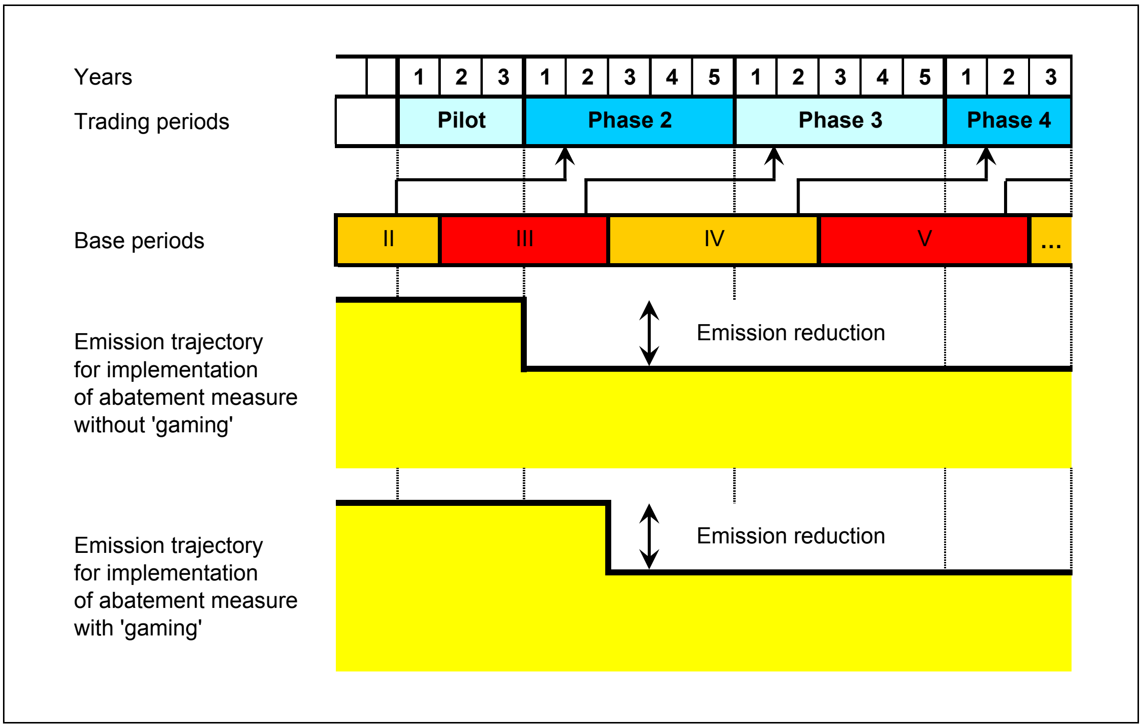
- The benefit from the ETS will erode significantly over time for those cases where the allocation is based on updated historical emissions (Germany, Spain, Poland, UK) as well as where the allocation relies on fuel-specific emission benchmarks (Italy and the Netherlands).
- This erosion is limited to a certain extent if the allocation to existing installations is less generous (e.g. in the UK).
- This erosion of incentives will be stronger if the allocation based on fuel-specific emission benchmarks for existing installations only refers to the fuel used in the most recent year. If the average fuel mix over the total base period constitutes the basis for allocation relying on fuel-specific emission benchmarks, this counterproductive effect could be avoided for one phase.
- Strong distortions from the allocation to existing installations with different fuels will create additional and strong incentive problems under an updating approach.
- If product-specific benchmarks were to be applied for existing installations (which no Member State carried out in Phase 1) the incentives should not erode over time.

While in this case the incentive problems arising from updating could be absorbed by certain allocation provisions (benchmarking, less generous allocation to existing installations in general), updating will open a window for 'gaming' by the operators. The operators definitely would optimize the plant operation according to their actual production and future allocation under an updating approach.[115] Consequently, the problem of gaming is inherent to the updating approach.

[115] If a higher emission in a certain year would lead to a significant higher allocation in future phases the operator could maximise profits by increasing the emissions in the respective year. The same would apply for postponing emissions reduction measures.

In order to outline this gaming potential, additional case studies were analysed in the framework of an updating approach. Different to the case studies on energy efficiency improvements and fuel switching in existing installations we varied the point of time for the implementation of the measure. If the operators were to know that the last three years of the previous trading phase and the first two years of the recent trading phase constitute the basis for the allocation for the subsequent trading phase, they could schedule the measure for the earliest date where the decrease of emissions would not be taken into account for the allocation of the next trading phase.

Figure 31 – Schematic overview on the modelling of 'gaming' under an updating approach



Source Öko-Institut

Figure 31 shows the key assumptions for the modelling exercise on 'gaming' under an updating approach. For the NAPs for the second phase of the EU ETS, one year of the pilot phase could potentially be taken into account.[116] For all subsequent phases the base period would cover years when the EU ETS was working. We assume that three years of the last phase and two years of the recent phase constitute the base period for the subsequent phase.[117]

[116] Considering the deadline for notification of the NAPs (30 June 2006) only the data for 2005 could be available for the base period for the phase from 2008-2012.

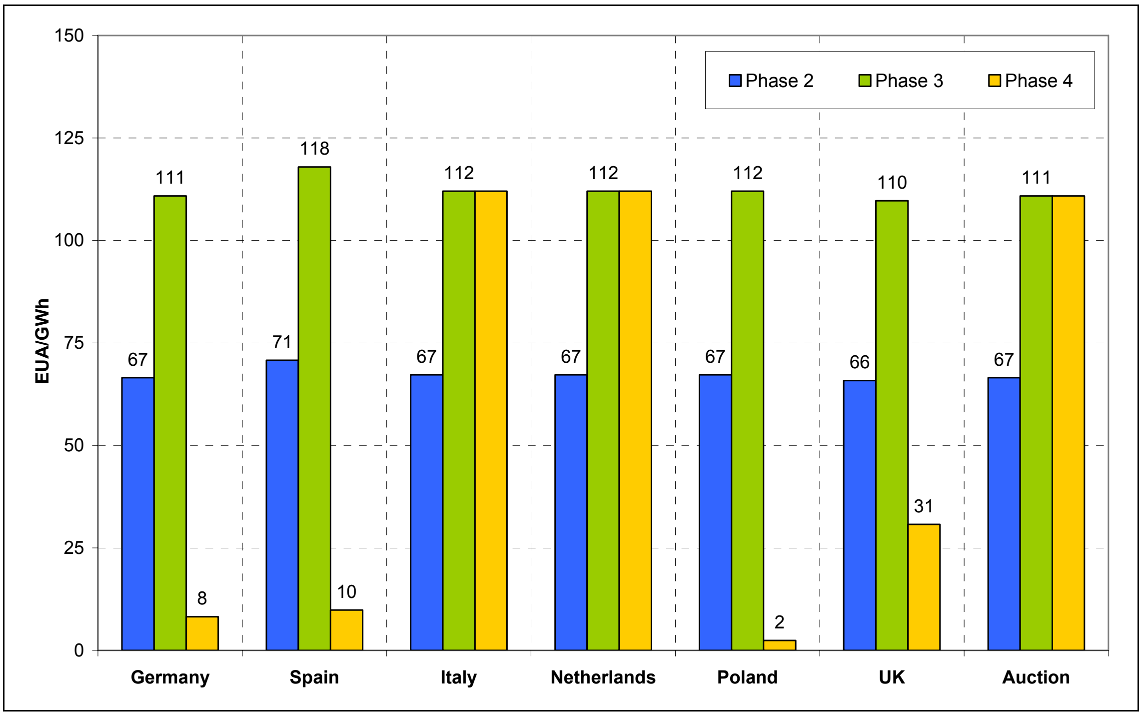
[117] The allocation for Phase 3 would rely on the Base Period III (last three years of the pilot phase, first two years of Phase 2), the allocation for Phase 4 would take into account the years of the Base Period IV (last three years of Phase 2 and first two years of Phase 3), etc.

In the case studies discussed above, the operator would decrease the emissions in the beginning of the first year of Phase 2. In the base period for Phase 3, three years with higher emissions and two years with lower emissions would be considered.

To receive a higher allocation for Phase 3, we assume that the operator postpones the reduction measure until the beginning of the third year of Phase 2. The emissions of the installation would remain high for the full base period for Phase 3.

However, under the EU ETS increasing emissions or not undertaking abatement measures would lead to additional costs for the purchase of allowances or lost opportunities to sell allowances in Phase 2. Consequently, the acquisition of additional allowances for future phases on the one hand must be compared to the higher costs in the phase in which the emissions will be increased or abatement measures will not be taken motivated by 'gaming' of the operators.

Figure 32 – Benefits from ETS for efficiency improvements in existing hard coal power plants with 'gaming' under an updating approach



Source: Öko-Institut calculations based on data provided by ILEX, ILEX Iberia, ESC and AVANZI

The results from this modelling for the energy efficiency improvement in an existing hard coal-fired power plant are shown in Figure 32. For those cases where allocation is based on updated historic emissions (Germany, Spain, Poland and UK), the following results can be drawn from the analysis:

- The operators could gain the full benefits equivalent to the auctioning case for Phase 3. For this phase the benefit from the ETS would be greater because of 'gaming' (i.e. higher emissions in the base period for Phase 3).[118]
- However, for Phase 2 the surplus is less because additional allowances were needed for compliance if the abatement measure was postponed for two years (i.e. higher emissions in the first two years of Phase 2).[119]
- In Phase 4 the benefit from the ETS is equivalent to the modelling exercise without taking into account 'gaming' of the operators (Figure 29).

For the cases where the allocation in subsequent phases is based on fuel-specific emission benchmarks and updated production data (Italy and the Netherlands), the following findings result from the modelling exercise on energy efficiency improvements:

- For all phases except the first one, benefits result from the EU ETS which are equal to the auctioning case.
- For Phase 2, the average benefit is lower because of the additional allowances needed for compliance under the EU ETS.
- In summary, for energy efficiency improvements in existing plants there is no incentive to postpone investments so as to receive a higher allocation in future phases under an updating approach.

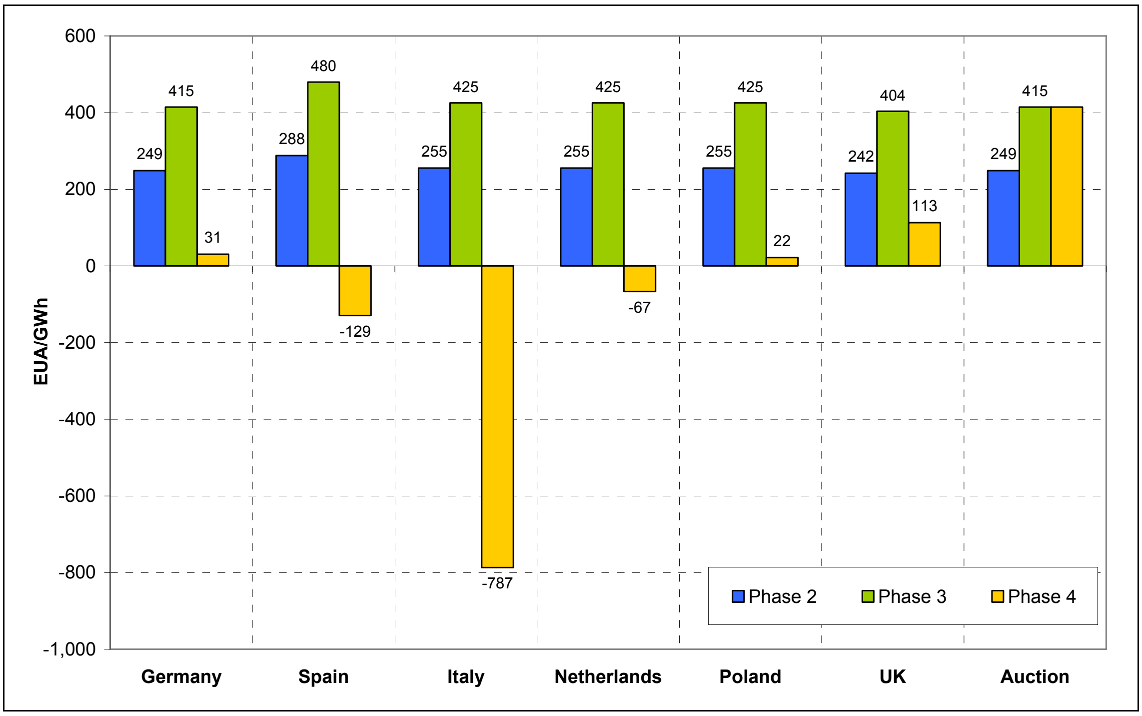
Figure 33 gives the results for the case study on fuel switching in existing hard coal-fired power plants. The general pattern is comparable with the results of the measure analysed above.

In Phase 3, all operators gain from a benefit provided by a surplus of allowances which is equivalent to the auctioning approach. For Phase 2 the additional demand for allowances caused by the strategically-motivated postponement of the abatement measure lowers the average surplus of allowances available for sale. In Phase 4 the benefits from the ETS have almost disappeared. For the Dutch and the Italian case, strategic behaviour could compensate the disadvantages arising from the fact that the allocation based on fuel-specific emission benchmarks could rely on the fuel used in the last recent year.

[118] The benefit of 112 EUA/GWh for Poland would result from an emission of 924 t CO_2/GWh and an allocation of 1,014 EUA/GWh based on the emission level before the measure was taken. This surplus of 90 EUA/GWh must be compared with the shortfall of 22 EUA/GWh before the measure was implemented (resulting from emissions of 1,036 t CO_2/GWh and an allocation of 1,014 EUA/GWh according to the Polish NAP provisions).

[119] The benefit of 67 EUA/GWh for Poland would result from an average emission of 969 t CO_2/gWh (1,036 t CO_2/GWh for 3 years and 924 t CO_2/GWh for two years) and an allocation of 1,014 EUA/GWh based on the emission level before the measure was taken. This surplus of 45 EUA/GWh must be compared with the shortfall of 22 EUA/GWh before the measure was implemented (resulting from emissions of 1,036 t CO_2/GWh and an allocation of 1,014 EUA/GWh according to the Polish NAP provisions).

Figure 33 – Benefits from ETS for fuel switching in existing hard coal power plants under an updating approach with 'gaming' under an updating approach



Sources Öko-Institut calculations based on data provided by ILEX, ILEX Iberia, ESC and AVANZI

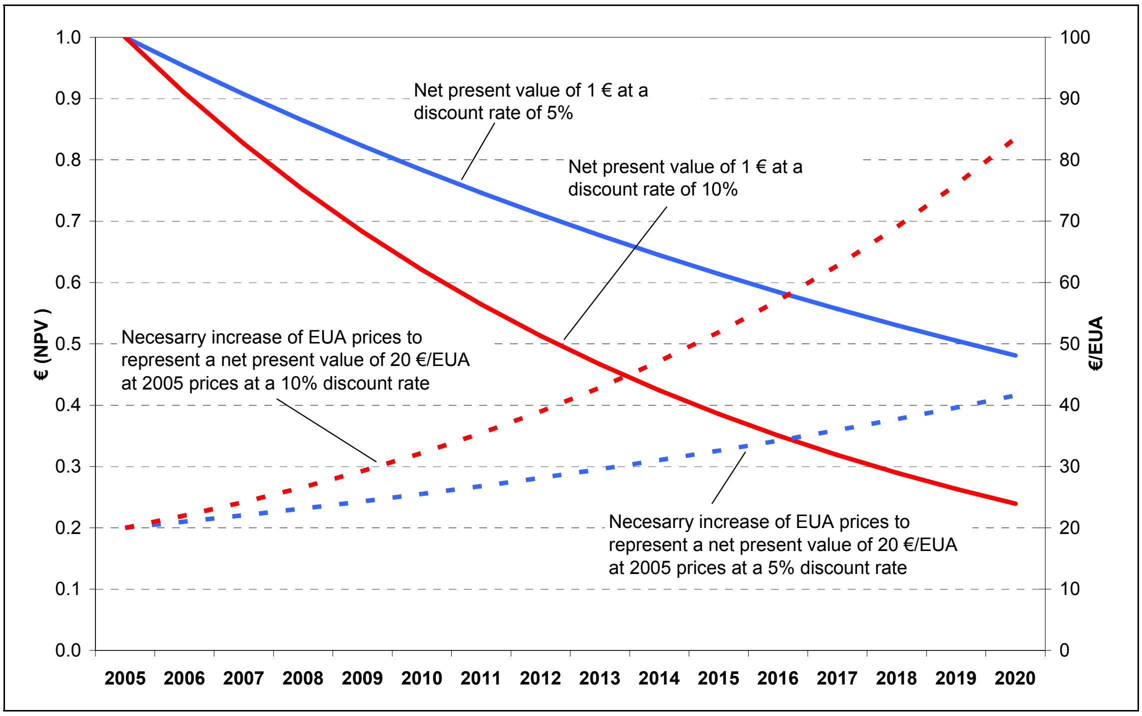
The following conclusions can be drawn for the modelling exercise on fuel switching and 'gaming':

- The operators will gain the benefit equivalent to the auctioning reference case in the phase subsequent to the one in which the measure was taken. In the first phase the benefit will be lower because of the higher emissions.
- The benefit from the ETS will erode significantly over time for those cases where the allocation is based on updated historical emissions (Germany, Spain, Poland, UK) as well as where the allocation relies on fuel-specific emission benchmarks (Italy and the Netherlands).
- This erosion is to a certain extent limited if the allocation to existing installations is less generous (e.g. in the UK).
- This erosion of incentives will be stronger if the allocation based on fuel-specific emission benchmarks for existing installations only refers to the fuel used in the most recent year. If the average fuel mix over the total base period constitutes the basis for allocation relying on fuel-specific emission benchmarks this counterproductive effect could be avoided for one phase (see the cases of the Netherlands and Italy in Figure 30).

- Strong distortions from the allocation to existing installations with different fuels will create additional and strong incentive problems under an updating approach.
- If product-specific benchmarks were to be applied for existing installations (which no Member State carried out in Phase 1) the incentives should not erode over time.
- In summary, for fuel switching in existing plants there is no significant incentive to postpone investments in order to receive a higher allocation in future phases under an updating approach.

Last but not least, the time preferences should be taken into account. Future benefits must be discounted at a certain discount rate to enable a consistent comparison with actual costs or lost opportunities for the sale of allowances.

Figure 34 – Net present value (NPV) at different discount rates



Source: Öko-Institut

Figure 34 underlines the significant impact of time preferences on the present value of future benefits. Discounted at a rate of 5% a certain benefit after ten years represents a net present value of 40% less in 2005 terms. At a more realistic discount rate of 10% the net present value of 1 € in 2015 is less than 40 ct in 2005 prices. On the other hand a potential price increase of allowances will be taken into account. If a future benefit of one EUA arises when one EUA is used for compliance under the EUA instead of selling it on the market the allowance price must be about 33 €/EUA after ten years at a discount rate of 5% and about 58 €/EUA after ten years at a discount rate of 10%. In other words, additional expenses for allowances at present time must create much higher benefits in future to be profitable.

4.2.2.2 Conclusions on updating

Considering the modelling results including those on some cases of 'gaming' the following lessons can be drawn on the use of updating approaches for the allocation:

- Updating is a non-preferable option from a general point of view. Over time updating could erode the intended incentive structures from the ETS to target an optimal level of production as well as to implement the cost efficient abatement measures. On an aggregated level updating will create a loss of dynamic efficiency of the ETS.
- Nevertheless, the erosion of benefits from the ETS for abatement measures could be compensated to some extent by an appropriate design of the initial allocation provisions. Allocation based on emission benchmarks could help to ensure the incentives from the ETS over time. Under an updating scheme, the allocation based on fuel-specific emission benchmarks could compensate the erosion of benefits for measures leading to energy efficiency improvements but not for fuel switching in existing plants. To ensure the appropriate benefits from fuel switching in existing installations, an allocation approach relying on non-fuel-specific benchmarks would be needed.
- Under an updating approach, existing distortions in the initial allocations could (as shown for Spain and Italy) create even stronger distortions and will impede the intended incentives structures of an ETS. Non-distorting allocation structures for the initial allocation can be seen as a crucial precondition for the introduction of an updating approach.
- Without any doubt, updating enables a window for 'gaming' by the operators and they will find possibilities for optimizing increased emissions or postponing abatement measures in order to achieve future benefits from the allocation. However, this creates additional costs in recent time.
- Considering the time preferences (discount rates) for recent and future benefits, the issue of 'gaming' could be assessed as less important if significant advantages arise from an updating scheme for other reasons. However, if future trading phases will be extended to more than 5 years and the transition to an updating scheme takes place, the potential and the incentives for 'gaming' could increase significantly.

Against the background of the issues raised above, updating should only be considered if there is a profound need. This could emerge from the following issues:

- The experience from the first NAPs shows that there is strong pressure to take into account developments in more recent years for the initial allocation for a certain phase (referring to the increase of natural gas prices, the economic cycles in some sectors of the manufacturing industry, etc.). If this would lead to a surfeit of special provisions to accommodate this, the updating approach could serve to avoid a lot of special provisions and maintain the allocation provisions under the EU ETS as simple and transparent as possible. The updating issue will probably arise more in those Member States which are experiencing very dynamic growth in production (e.g. electricity generation in Spain or Italy) than in those Member States where the markets are more or less stagnating (e.g. Germany).

- Updating could provide an option for addressing the plant closure problem. If the non-distorting treatment of plant closures (see Chapter 4.3.7) is assessed as an important criterion from the political point of view, the updating approach could contribute to solving the problem. If the production of particular installations is decreased over time, this would lead to a respective decrease of allocation. Therefore, a plant closure would lead to the loss of the free allocation of allowances after a certain time.

However, the problems identified in the analysis above lead to the necessity of flanking the updating approach with some other allocation provisions:

- So as to avoid the creation of a 'new' early action problem, the transition to an updating scheme should be linked to an allocation scheme based on benchmarks. In an updating scheme linked to emission benchmarks, the production data (activities) would be updated and the allocation would be calculated from the updated activities and the emission benchmarks.
- Preferably the benchmark scheme would be based on product-specific benchmarks. If the provisions for the initial allocation rely on fuel-specific emission benchmarks the incentives for energy efficiency improvements will be maintained but incentive erosion for fuel switching in existing installations cannot be avoided.
- The provisions for initial allocation must be designed more stringently if a transition is planned to an updating scheme. The distorting allocation provisions to existing installations (e.g. lower portion of free allocation to less emitting plants and higher share of free allocation to plants with higher emissions) should be removed in the framework of an updating scheme. For example, a less generous allocation to existing installations will help to minimise the incentive erosion from the EU ETS under the updating approach.
- The leverage effect of 'gaming' should be minimized. If updating approaches apply, the transition towards longer phases than 5 years should not take place.

Last but not least, it should be mentioned that for Phase 2 of the EU ETS a unique situation arises. Countries could update their base periods without using years covered by the ETS. However, this will not change the general assessment of updating carried out in this chapter.

4.2.3 Conclusions on base periods and allocation provisions to existing installations

In summary, it can be concluded that the definition of base periods or the basis for future allocations faces complex assessment problems.

Economic efficiency

In terms of the *economic efficiency* of the allocation for subsequent trading phases, the assessment leads to the following conclusions:

- The allocation based on the allocation results of the pilot phase could ensure economic efficiency in a comprehensive way.
- If the allocation for subsequent trading phases is based on the base period of the pilot phase, the net effects on economic efficiency of the scheme depend very much on the allocation provisions.
- The transition to an updating scheme will definitely create some losses in terms of economic efficiency. Nevertheless, appropriate allocation approaches (e.g. benchmarking) could compensate the efficiency losses to a large extent.

Distributional effects

The definition of base periods will generate *distributional* effects in different dimensions:

- Companies with negative growth will profit from fixed base periods or fixed allocations, while companies with fast growing production will profit more from updating approaches.
- Updating will create an incentive for 'gaming' of the operators. The opportunity for such 'gaming' is better for companies with plenty of installations than for those who operate only few installations. Whatever the real potential for 'gaming' is, some distributional effects will arise.
- Under certain circumstances distributional effects can emerge from plant closure and the ability to deal with this in the allocation scheme. Updating could help to ease some of the allocation problems related to plant closure.

Simplicity and transparency

The definition of base periods will have a major impact on the *simplicity* and *transparency* of the allocation scheme as a whole:

- Considering the fact that some Member States already implemented more advanced allocation approaches (e.g. benchmarking schemes) which eliminate some distortions (e.g. the early action problem) and other Member States face some problems with their complicated allocation approaches (see Chapters 3.2 and 3.3), the allocation for subsequent trading phases based on the pilot phase allocation proves to be an option that is not to be recommended. Flexibility for improving the allocation approaches based on the lessons learnt from the pilot phase is a minimum requirement for the dynamic improvement of the EU ETS.

- The fixation of allocations or base periods for the allocation could enforce the demand for special provisions in the allocation process in order to reflect the development in the most recent years. From the experiences gained in the allocation process for the pilot phase, it can be assumed that there will be a demand for a multitude of special provisions which will lead to major complications in terms of simplicity and transparency.
- If there is a strong motivation or strong political pressure to implement a plant closure provision, the updating approach could constitute an attractive alternative.

Last but not least, the transition towards an updating scheme could enforce the streamlining and the improvement of the existing allocation provision. All allocation provisions for existing installations have to be put to the test to evaluate their effects in the framework of an updating scheme.

Although there are only a few inherent arguments for updating, this approach could create advantages in the framework of the whole allocation scheme. If there is a move towards implementing an updating approach, this should urgently be linked to the streamlining of allocation provisions and especially the transition to a benchmarking scheme for the allocation to existing installations.

Preferentially the benchmarking scheme for existing installations would be based on product-specific benchmarks (e.g. tons of CO_2 per gigawatt hour electricity). Considering the problems related to product-specific benchmarks (strong political resistance in some Member States, significant distributional effects, etc.) for existing installations, a scheme based on process benchmarks (e.g. fuel-specific benchmarks) could also be acceptable if the amount of benchmarks is limited to an appropriate minimum (e.g. for different fuels, but not differentiated for other process parameters).

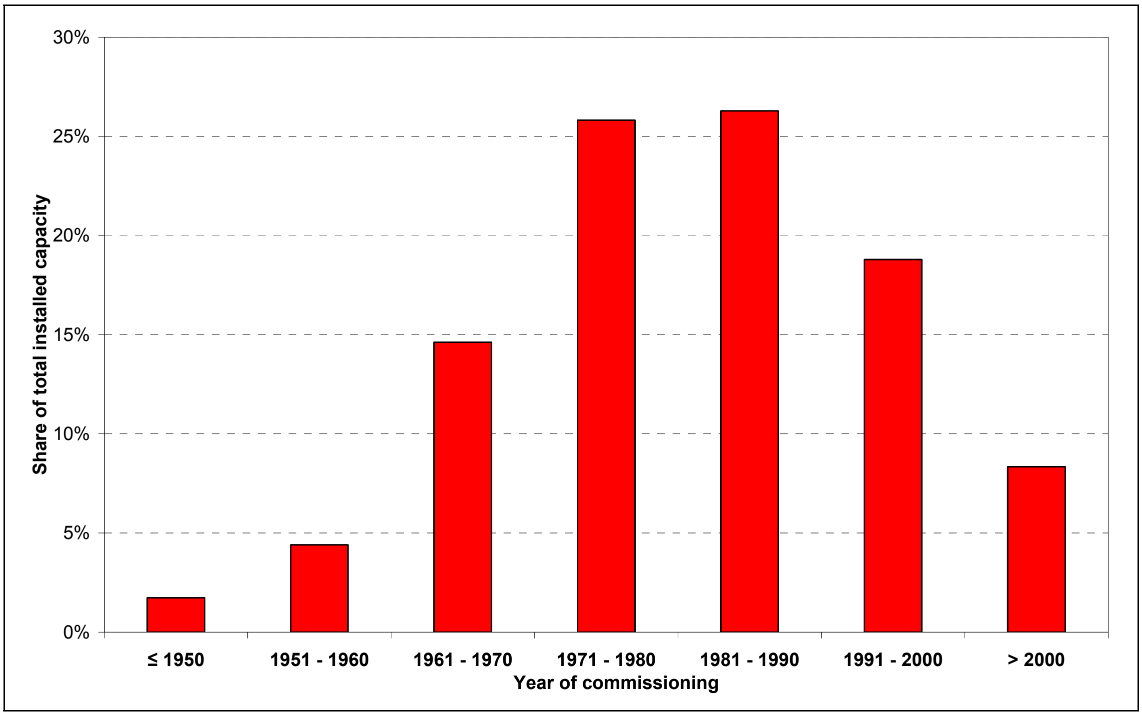
4.3 Allocation to new entrants and plant closure provisions

4.3.1 Introduction and overview

The analysis of the existing plants showed that certain allocation provisions will delete the intended incentives structure of the EU ETS (see Chapter 3.3.3) more or less completely from the economic appraisal of investments decisions. If the allocation to a new plant depends on the fuel type and principally on the emission level of the plant, there will be no carbon pricing at all. Whereas the full carbon price is taken into account for the operation of existing installations (see Chapter 3.3.3) in some Member States this price signal for new entrants is almost deleted. The investment resources are not allocated in the most efficient way, and the window of opportunity for the cost efficient implementation of low-carbon technologies is lost. This will increase future abatement costs as well as decrease the environmental effectiveness in the long run.

Particularly in the power sector there is a huge emission reduction potential from plant replacement in the next three decades. Figure 35 shows that more than 45% of the installed capacity in the EU-25 will reach an age of 30 years or more in 2010. Assuming a lifetime of about 40 years for power plants, significant investment decisions will be made in this decade which will markedly determine the emission levels in the EU-25 for the first half of the century. This special situation highlights the importance of the new entrants provisions in the framework of the EU ETS.

Figure 35 – Age structure of EU-25 power plants at the time of commissioning



Source Platts, Öko-Institut

In the different NAPs in the EU-25, different options were implemented for new entrants in the power sector. The key provisions from them are:

- no free allocation to new entrants;
- free allocation to new entrants based on fuel-specific benchmarks (sometimes additionally differentiated by other process parameters);
- free allocation to new entrants based on process-specific benchmarks other than fuel-specific ones;
- free allocation to new entrants based on product benchmarks;
- free allocation to new entrants based on transfer of allocation from closed plants.

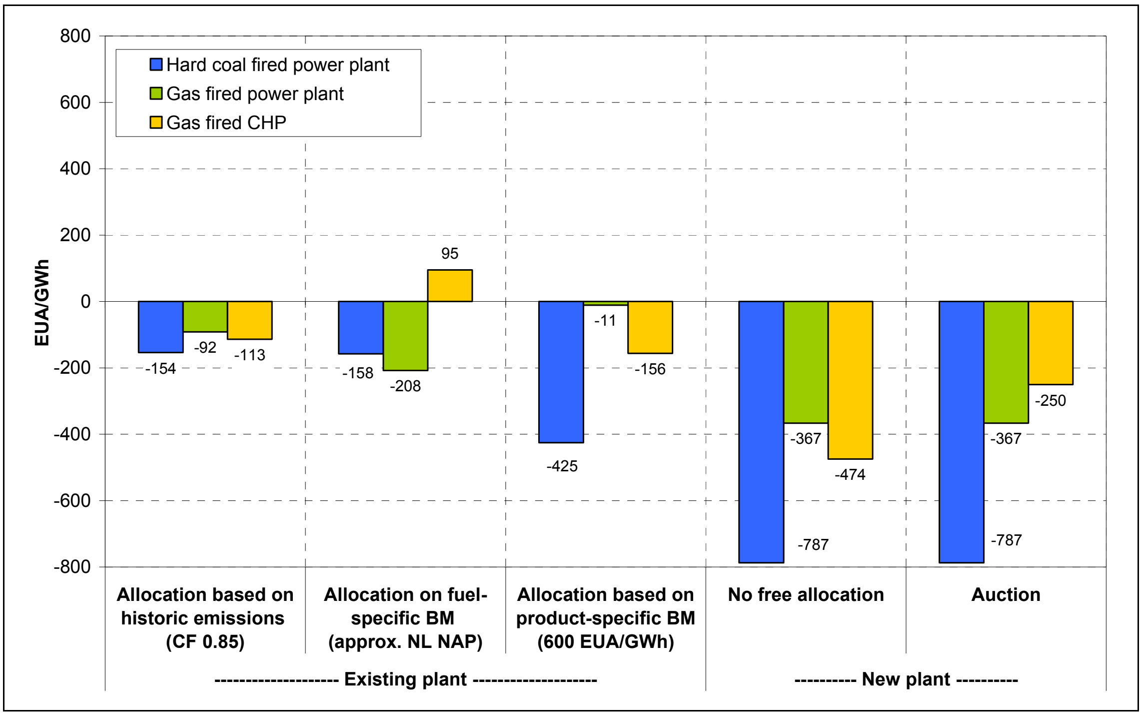
In the following analysis different approaches derived from these key options are analysed. In this framework the issue of plant closure must also be raised.

4.3.2 No free allocation to new installations

Often in the academic and the political debate, the position is put forward that not allowing a free allocation to new entrants would be an appropriate option in the framework of the ETS. This is based on the rationale that the need to purchase the allowances on the market would monetarize the full cost of carbon. Up to now, the incentive structure created by the ETS is equivalent to the auctioning case which sets the yardstick for the assessment in terms of economic efficiency.

Figure 36 underlines this finding with the exception of the CHP plant.[120] If we assume that in a perfect ETS all emission effects will be honoured, the energy efficiency yield of CHP will not necessarily raise a benefit within the framework of the partial EU ETS.[121]

Figure 36 – Shortfall or surplus of allowances for existing and new hard coal and gas-fired power plants



Source Öko-Institut

Apart from the special issue of CHP some serious aspects of the no free allocation approach should be taken into account.

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[120] This comparison is based on existing power plants with emissions of 1,025 t CO_2/GWh (hard coal), 611 t CO_2/GWh (natural gas) and 756 t CO_2/GWh (CHP, including emissions for 2 GWh useful heat per GWh electricity) and new power plants with emissions of 787 t CO_2/GWh (hard coal), 367 t CO_2/GWh and 474 t CO_2/GWh (CHP, including emissions for 1 GWh useful heat per GWh electricity). The bonus for useful heat is 224 t CO_2/GWh if applicable.

[121] For a more detailed discussion see Annex B.

The end of lifespan of a certain existing installation is also an economic decision, and hence closure provisions come into play. If the economic burden from a shortfall of allowances for an existing installation is comparatively low compared with the need for purchase of allowances for a new plant the incentive for measures for lifetime extension is significant. This is especially true if we are to assume that investments for lifetime extension will be comparatively low in many cases. The urgency of this analysis is highlighted by the fact that according to EU clean air regulations major decisions on retrofitting of power plants with flue gas treatment facilities have to be taken in the coming years. If it is more attractive to invest in retrofit and lifetime extension of (very) old plants because of the discrepancies between the allocation provisions for old and new installations, the economic efficiency of the EU ETS will face major problems.

The example shown in Figure 36 underlines the dimension of the replacement problem. We assumed the following parameters:

- In the first option for the existing plant, the allocation is based on historic emissions and a compliance factor of 0.85 is applied, the shortfall of allowances is 15%. This would indicate a less generous allocation compared to the results of the NAPs for the pilot phase.
- In the second option for the existing plants we assumed a fuel-specific benchmarking approach which is derived from the Dutch benchmarking scheme. Hard-coal-fired power plants receive a free allocation based on an efficiency of 39%, gas-fired condensation power plants are allocated on the basis of an efficiency of 50% and the CHP plant is allocated on the basis of an electric efficiency of 50% and an efficiency for heat production of 90%.
- In the third option the allocation to existing power plants is based on a product benchmark for power production of 600 t CO_2/GWh which is approximately the EU-15 average for thermal electricity generation from public power plants.

With the exception of the case of allocation relying on a product benchmark the allocation to the existing plants is very generous compared with the case of no free allocation to new installations. For the existing installation the shortfall of allowances ranges between 92 EUA/GWh and 208 EUA/GWh, the CHP plant under the fuel-specific benchmarking scheme benefits from a surplus of allowances arising from the double benchmark allocation for electricity and heat.

Even the low emitting new natural gas-fired CCGT plant would have to purchase 367 EUA/GWh if there is no free allocation. In other words, an operator would invest in lifetime extension if the existing plant would be competitive on the market (in terms of short-term marginal costs) and the annual costs of capital for the investment in lifetime extension would be less than the difference of shortfall in allowances for the existing and the new plant (see above). If this difference amounts to the range of 200 to 600 EUA/GWh, the probability that the investment for lifetime extension is more attractive is high. In the case of the much less generous allocation with a uniform benchmark of 600 EUA/GWh, the differences to the costs of an alternative investment for lifetime extension would only be low for the case of substitution of old hard coal plants by new gas-fired power plants. If gas-fired power plants were not attractive from the investment point of view the operator would also be attracted to lifetime extension in this case.

Lessons learnt

The main lesson learnt from this analysis is that the allocation provisions for new entrants should be carefully balanced against the allocation provisions for existing installations. This was previously highlighted in our analysis for the Pilot Phase (see Chapter 3.3). If the burden from purchasing allowances is very different between new entrants and existing installations, the problem of attentism for investment in new power plants could arise. If the allocation to existing installations is comparably generous, restrictive allocation approaches to new entrants could create problems which also have an impact on the emission trends.

This problem should be of different levels of importance in the different Member States. In countries like Spain or Italy where many new projects are brought into being because of the need for additional domestic generation capacities, the problem outlined above is much less significant than for other markets like the UK, Germany or Poland where a surplus of capacity still exists and the need for adding new capacity is much lower.

4.3.3 Free allocation to new installations based on benchmarks

Where allocation to new installations is free of charge, alternative options must be assessed. In general there are three main options under discussion:

- Free allocation based on the most efficient power plant for fossil fuels for the commercial fossil fuel with the lowest emissions (natural gas). A modern gas-fired CCGT plant with an annual average efficiency of 55% could be seen as such a plant (product benchmark of 365 EUA/GWh).[122]
- Free allocation based on the average emission of a certain power generation mix, e.g. the EU-15 average emissions from thermal power production in the public power sector (product benchmark of 600 EUA/GWh).
- Free allocation based on the most efficient power plant for the respective fossil fuel. Modern power plants with an annual average efficiency of 55% (natural gas) and 45% (hard coal) could be seen as such plants (product benchmark EUA/GWh for power production from natural gas and 750 EUA/GWh for power production from hard coal).[123]

For all allocation approaches the shortfall or surplus of allowances was calculated and compared with different allocation options for existing power plants as well as the reference case of auctioning for the new power plant.

[122] see Engelbert et al. (2004).

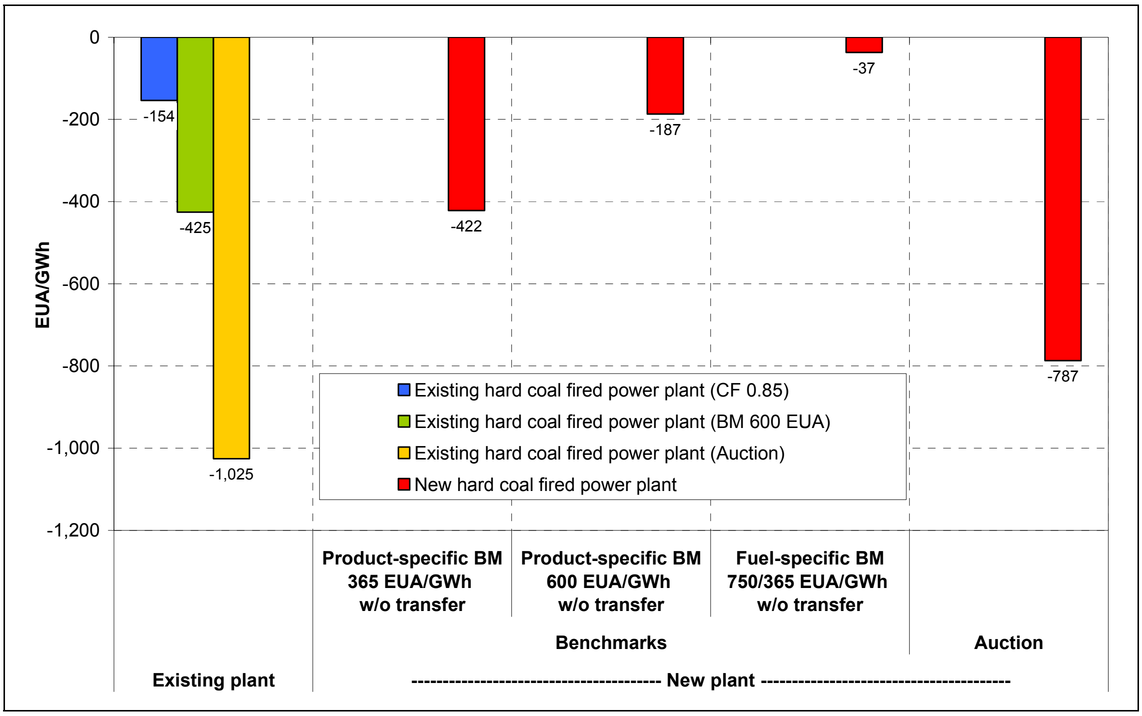
[123] see VBG PowerTech (2004).

Figure 37 gives an overview on the results. In the ideal case of auctioning, there should be an incentive of 238 EUA/GWh for the replacement of the old power plant by a new one.[124] If the allocation of the new plant is based on a benchmark of 365 EUA/GWh the burden is about the same (422 vs. 425 EUA/GWh) as for an existing installation which received allocation on the basis of a benchmark of 600 EUA/GWh.

If the allocation to the new installation is based on a product benchmark of 600 EUA/GWh, the burden on the new installation is slightly higher than the shortfall of allowances in the case of the existing installation allocated by historic emissions and a compliance factor of 0.85 (187 vs. 154 EUA/GWh).

The allocation to the new installation based on the fuel-specific emission benchmark of 750 EUA/GWh creates a bigger incentive for plant modernisation, even if this is still very much less than in the reference case set by auctioning.[125]

Figure 37 – Shortfall of allowances for existing and new hard coal-fired power plants under different allocation provisions



Source: Öko-Institut

The case studies show that the incentive for modernisation could be influenced in a dual fashion. On the one hand, the allocation to existing installations could be more restric-

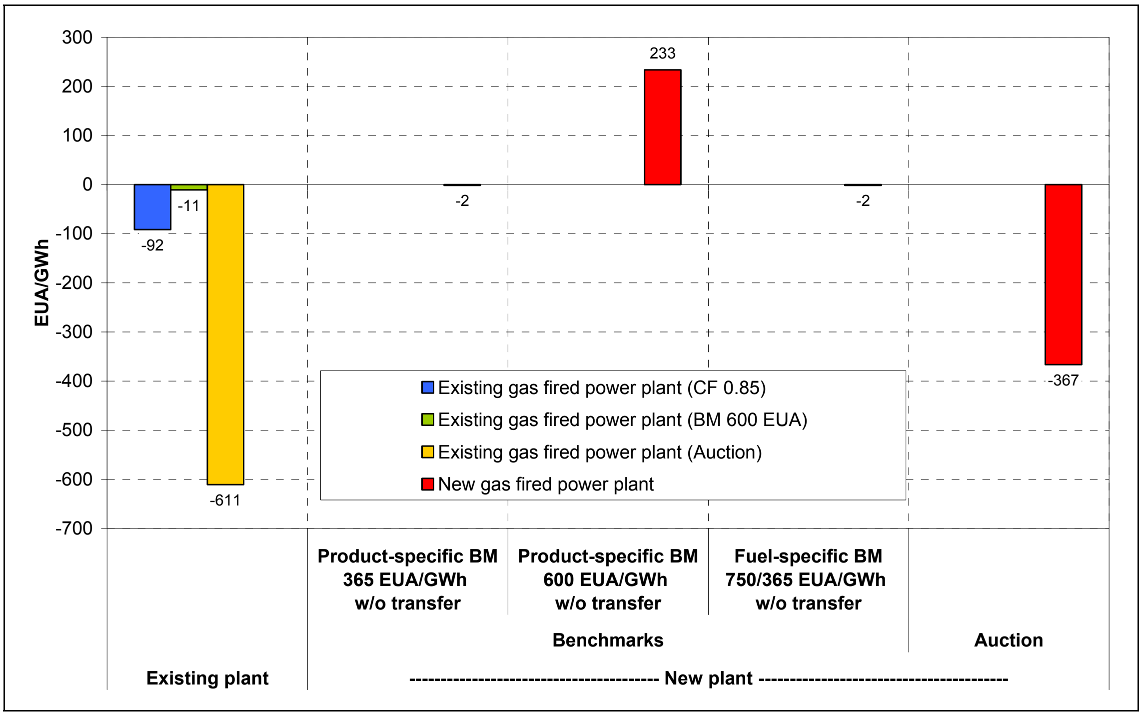
[124] This is the difference between the emissions of the old plant (1,025 t CO_2/GWh) and the new one (787 t CO_2/GWh), see Figure 37.

[125] The incentive for modernisation is 117 EUA/GWh (154 – 37 = 117 EUA/GWh) compared to an allocation to the existing plant with a compliance factor of 0.85. However, in the reference case of auctioning, the incentive would amount to 238 EUA/GWh (1,025 – 787 = 238 EUA/GWh).

tive (e.g. a compliance factor of less than 0.85). On the other hand the allocation could rely on more generous benchmarks for new installations (e.g. 600 EUA/GWh instead of 365 EUA/GWh).

The results of a similar analysis for existing and new gas-fired power plants are shown in Figure 38. In an ideal case the incentive from carbon pricing to replace an old power plant by a new one should amount to 244 EUA/GWh.[126]

Figure 38 – Shortfall or surplus of allowances for existing and new gas-fired power plants under different allocation provisions



Source Öko-Institut

The results for all options for the allocation to new entrants show that new investment is attracted; even if the incentives are lower than in the reference case of auctioning.

Impact on plant closure and transfer provisions

Compared to no free allocation to new entrants, the free allocation to new entrants could attract new investments instead of investments in lifetime extension of plants. However, it should be mentioned that the approach to plant closure provisions as well as the introduction of transfer provisions also could contribute to the attraction of new investments (see Chapters 4.3.4 and 4.3.7). In the case of a free allocation to new entrants based on benchmarks, the focus on very ambitious (low) benchmarks for new entrants (e.g. the BAT benchmark for gas-fired CCGTs as yardstick) could not compensate the incentives

126 This is the difference between the emissions of the old plant (611 t CO_2/GWh) and the new one (367 t CO_2/GWh), see Figure 38.

for investments in lifetime extension if the allocation to existing installations remains generous.

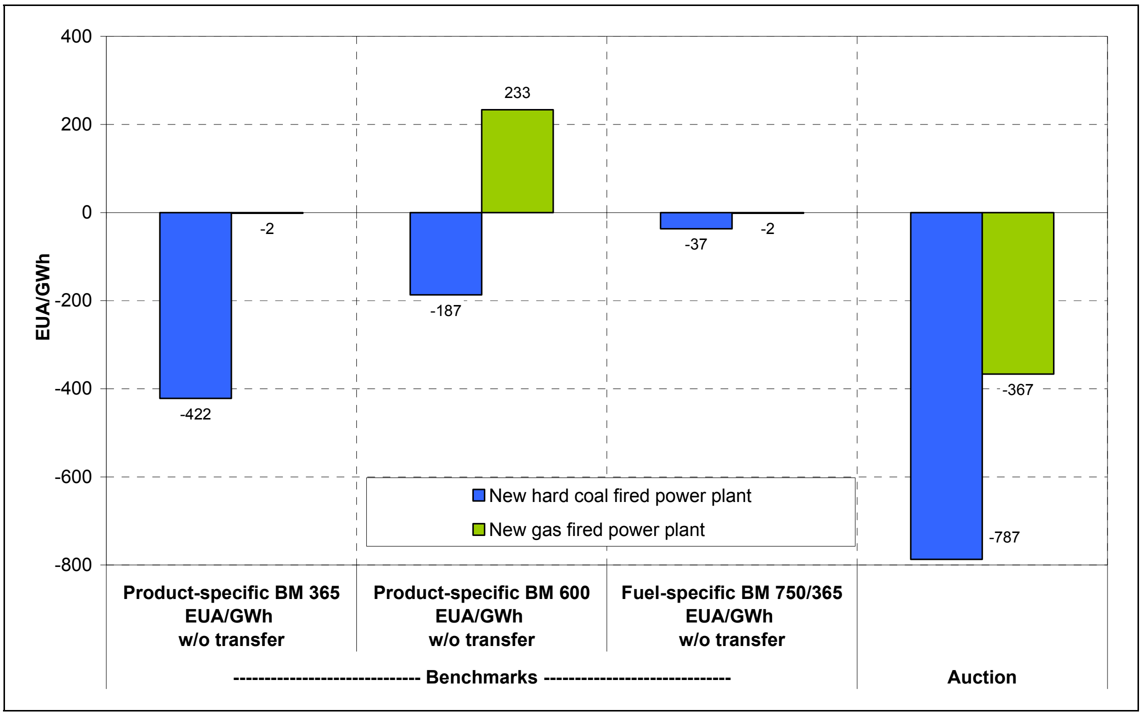
Impact relating to cost of carbon

Appropriate incentives for the replacement of old plants constitute one dimension of the assessment of new entrant provisions. However, the consideration of the costs of carbon in investment decisions is probably more important.

Figure 39 underlines the results from the NAP comparison (see Chapter 3.3). If the allocation to new entrants is based on product benchmarks and if there is no ban on allocation exceeding the projected demand, the incentives from the ETS will reflect the full price of carbon equivalent to the auctioning case. The structure of incentives will not depend on the level of the new entrants benchmark.[127]

Again, the use of fuel-specific benchmarks will level off the carbon pricing effect more or less completely, and therefore erode environmental efficiency.

Figure 39 – Shortfall or surplus of allowances for new hard coal and gas-fired power plants under different allocation provisions



Source *Öko-Institut*

[127] The difference between the power plants in terms of emissions is equivalent to the difference in allocation under the auctioning provision (787 - 367 = 420 EUA/GWh) as well as for the free allocation on the benchmark of 365 EUA/GWh (422 – 2 = 420 EUA/GWh) or of 600 EUA/GWh (187 + 233 = 420 EUA/GWh).

Use of benchmarks for new entrants

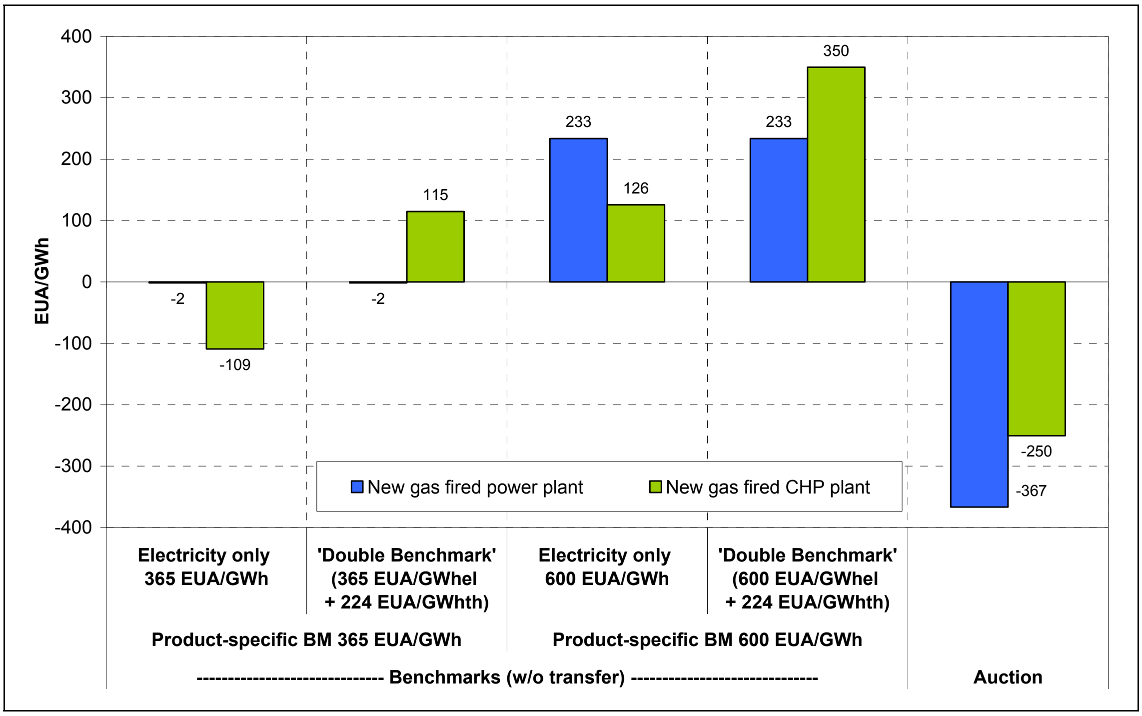
Against this background, the use of benchmarks for the allocation to new entrants should be limited to product benchmarks. For the level of the benchmarks pragmatic definitions (e.g. higher than BAT) could be applied, considering the fact that low benchmark levels could lower the attractiveness of plant replacement investments and create incentives for investments in lifetime extensions of existing plants.

The special case for CHP

A special problem arises for the allocation of new CHP plants. If the allocation to new power plants is only based on electricity benchmarks the incentives to build new condensation power plants will be higher than for CHP plants although the CHP plants create lower costs of carbon from a more comprehensive perspective (e.g. double benchmark), taken into account the emission reduction at the respective heat production sites. Because it cannot be assumed that the investor for a CHP plant necessarily benefits from the allowances surplus at the respective heat production plants (see Annex B) there could be a significant disincentive for the investments in CHP.

In a perfect trading scheme with auctioning, the CHP plant would receive an advantage of 116 EUA/GWh compared to a natural gas condensation power plant according to the net emission difference (Figure 40).

Figure 40 – Shortfall or surplus of allowances for new gas-fired condensation power and new gas-fired CHP plants under different allocation provisions



Source Öko-Institut

If the allocation to new entrants is only based on product benchmarks for electricity (365 or 600 EUA/GWh_{el}) the CHP plant would receive a disincentive of 107 EUA/GWh_{el}. This counterproductive effect could be compensated by a double benchmark approach. According to this approach the allocation to CHP plants would rely on a benchmark for the electricity produced (365 or 600 EUA/GWh_{el}) and an additional benchmark for the production of useful heat (e.g. 224 EUA/GWh_{th}).

As Figure 40 indicates the use of a double benchmark approach for CHP plants could ensure the appropriate carbon pricing also in the framework of the more complicated situation of CHP.

If the allocation to new entrants should rely on free allocation based on benchmarks, the related activities must be defined. The Member States used the following main approaches in the first NAPs:

- planned production data on installation level submitted by the operator, the production data are subject to ex-post adjustment if the real production does not reach the level submitted before;
- planned production data on installation level submitted by the operator, referring to data from comparable installations;
- common and predefined load factor benchmarks for certain technology clusters (e.g. load factor).

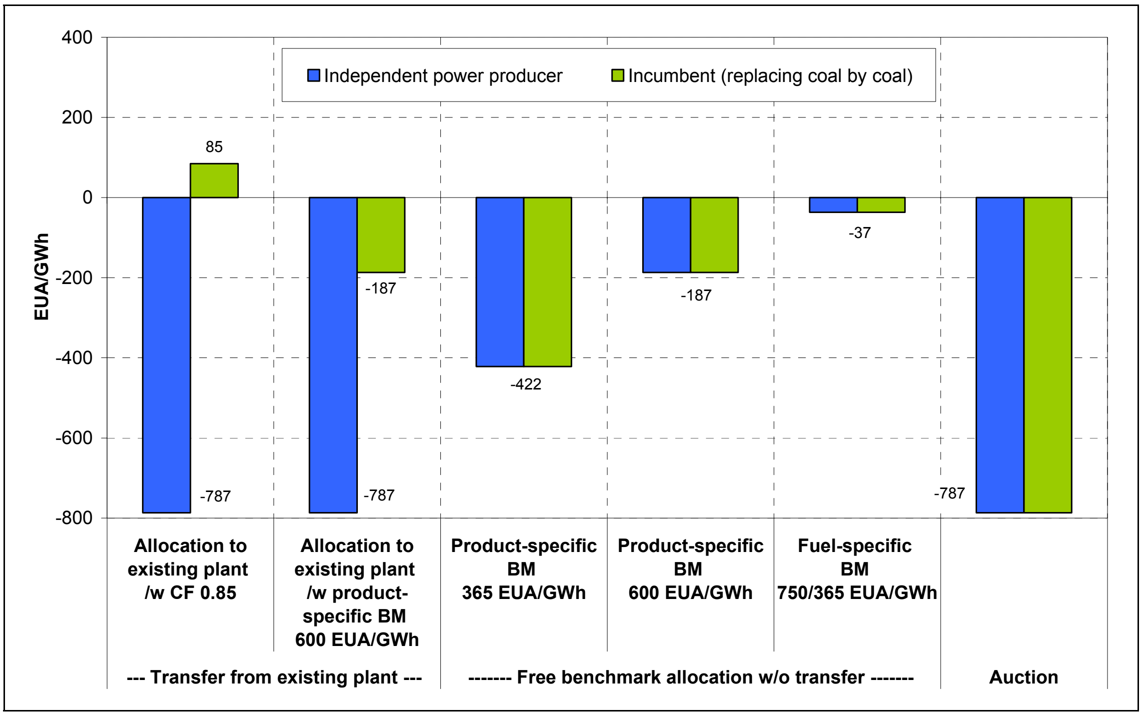
If ex-post adjustments are excluded for the reasons given in Chapter 3.3, the use of common and predefined load factor benchmarks (as used in Phase 1 NAP for the UK and Italy) should be see as a preferable option. The gains in transparency and simplicity as well as the much easier quantification of the necessary new entrants reserve lead to a much better assessment of capacity utilization benchmarks than for plant-specific projections.

4.3.4 Free allocation to new installations based on transfer provisions

If the allocation to new entrants is based on a transfer provision, the allocation to the new installation depends on whether the investor is an incumbent who can replace an old plant or the investor (newcomer) has no access to the transfer of allowances. New entrants to the market or operators who plan to extend their overall generation capacity would face a different burden from the EU ETS than incumbents.

Figure 41 indicates the different effects which could arise under a transfer provision or different options for free allocation to new entrants.

Figure 41 – Shortfall or surplus of allowances for new hard coal-fired power plants under allocation with and without transfer provision



Source Öko-Institut

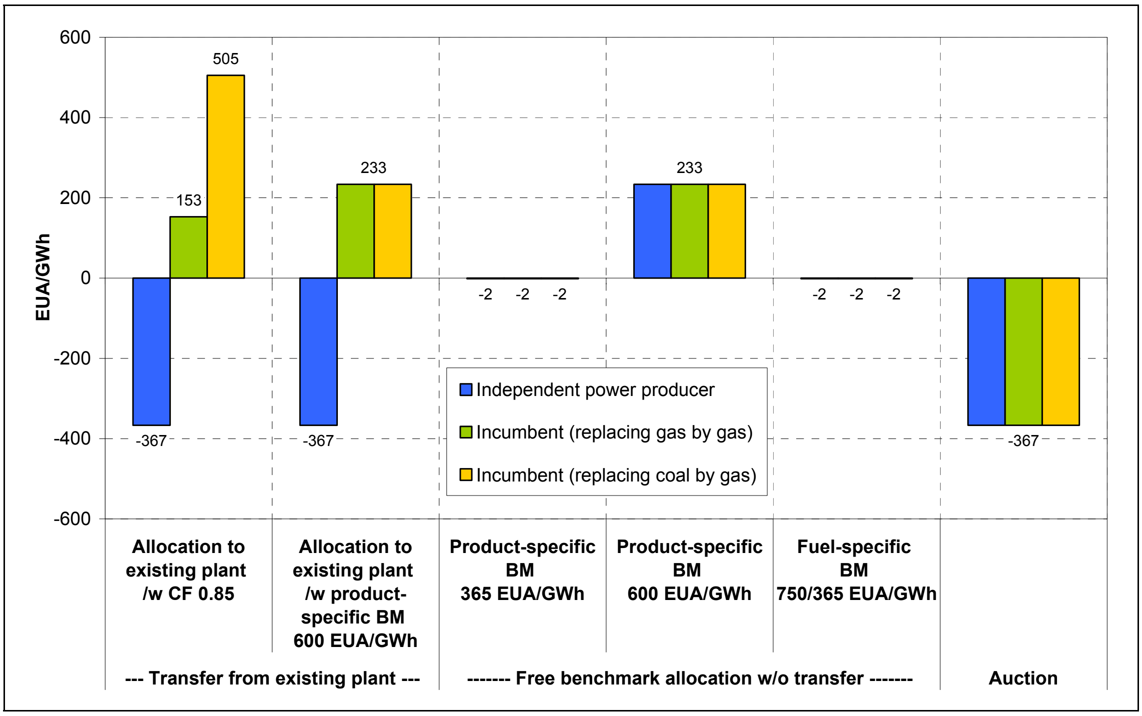
If the investor of a hard coal power plant is an incumbent who is able to transfer the allowances from an old hard coal-fired power plant allocated by historic emissions and a compliance factor of 0.85 the new plant will receive a surplus of 85 EUA/GWh for the time in which the transfer provision will apply. Compared with the same plant built by an independent power producer, the incumbent would gain an advantage of 872 EUA/GWh (787 + 85 EUA/GWh) which amounts to a significant competitive advantage. Even if the allocation to the old plant is much less generous (based on a product-specific benchmark of 600 EUA/GWh) the incumbent would gain a benefit of 600 EUA/GWh compared to the independent power producer (787 – 187 EUA/GWh).

Alternatively, the allocation relying on different benchmark approaches would result in an identical allocation to the new installations either replacing an old plant of an incumbent or being a project of an independent power producer. However, the incumbent could raise additional benefits from the shut down of the old plant if no plant closure provision applies or he is able to bypass the plant closure provision (see Chapter 4.3.7).

Consequently, incumbents will gain significant competitive advantages compared to independent power producers for new investments. However, these competitive advantages will be limited to the phase in which the transfer provision will apply.

The results for an analysis for a new gas-fired power plants show the same pattern. For an incumbent who replaces an old power plant, significant advantages will arise for the economic appraisal of the investment compared to an independent power producer (Figure 42). If the incumbent replaces an old hard coal power plant allocated on the basis of historic emissions and a compliance factor of 0.85 with a modern gas-fired plant the transfer provision will result in an comparative advantage for the investment of 872 EUA/GWh (367 + 505 = 872 EUA/GWh) for the duration of the transfer provision. If the allocation to the existing plant was much less generous (product-specific benchmark of 600 EUA/GWh) there will still be an advantage of 600 EUA/GWh (367 + 233 = 600 EUA/GWh) for the incumbent.

Figure 42 – Shortfall or surplus of allowances for new natural gas-fired power plants under allocation with and without transfer provision

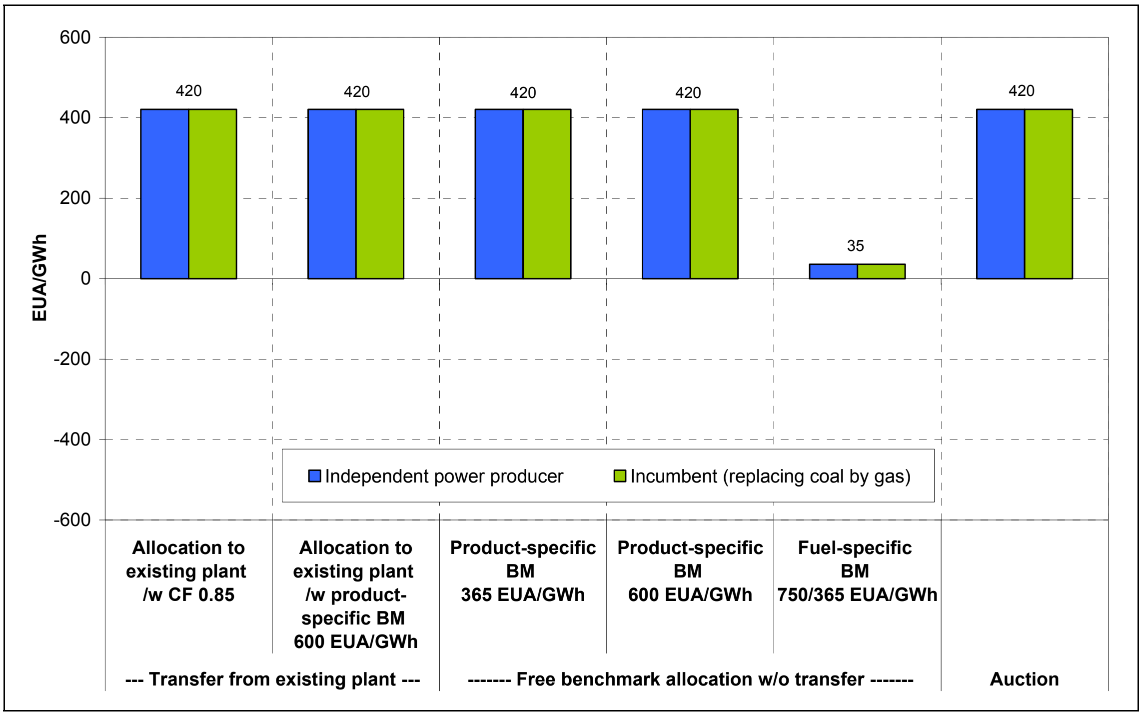


Source Öko-Institut

Against this background the transfer rule could be seen as a provision to gain additional benefits for the incumbents only. However, the transfer provision creates also the intended incentive from the ETS.

As Figure 43 indicates, the transfer provision creates a benefit for investment in a low carbon power plant that is equal to the reference case of auctioning. The transfer provision will also create the same carbon price signal for a new investment compared to the benchmark allocation approaches that are non fuel-specific.[128]

Figure 43 – Incentives from the ETS to build a new gas-fired power plant alternatively to a new hard coal power plant under allocation with and without transfer provision



Source Öko-Institut

Summary

The transfer provision can create an incentive which is equal to the magnitude of carbon prices in an ideal ETS based on auctioning. However, the same effect can be achieved under allocation schemes based on appropriate benchmark provisions. If it is possible to implement an allocation scheme for new entrants based on product benchmarks (i.e. non-fuel-specific benchmarks), the transfer provision would be unnecessary.

However, if the alternative is an allocation scheme for new entrants based on fuel-specific benchmarks that delete the intended incentives structure of the ETS, the trans-

[128] The incentive from the ETS presented in Figure 43 is calculated from the difference of surplus/shortfall of allowances resulting for the hard coal-fired power plant (Figure 41) and for the gas-fired power plant (Figure 42). For all options except the fuel-specific benchmark the incentive from the ETS to build a gas fired power plant instead of a hard coal-fired plant is 420 EUA/GWh. Only for the fuel-specific benchmark the incentive eroded to 35 EUA/GWh which is far from the carbon price signal that should arise from the ETS.

fer provision would constitute a compromise which ensures the appropriate carbon price signal for investments.

The transfer provision should not be seen as the first best solution. It is clearly a way of avoiding counterproductive incentive structures. The fairness problems that arise from the transfer provision would compromise the price for ensuring the basic incentive structures of the ETS for new investments.

4.3.5 Design of the new entrants reserve

If new entrants shall receive free allocation, the allowances for new entrants must be set aside in a new entrants reserve (NER). Regarding the quantification of the NER, many uncertainties are inherent (e.g. how many installations will enter into operation at what time). Whatever the approach for the quantification of the NER is, these uncertainties will remain and no options exist which would eliminate these uncertainties. The Member States dealt with these uncertainties in the pilot phase in different ways:

- The state guarantees the free allocation to new entrants from the NER. If the NER is exhausted and further free allocation to new entrants will be demanded, the state will purchase allowances from the market to replenish the NER ('replenishment approach').
- The NER will be available for the free allocation to new entrants on the 'first-come, first-served' basis. If the NER is exhausted, no free allocation to new entrants will be granted for the remaining phase.
- The NER will be differentiated for 'known new entrants' and 'unknown new entrants'. For 'known new entrants' the uncertainties for the quantification are significantly lower.

Needless to say, in the case of no free allocation to new entrants there will be no need for a new entrants reserve.

Some empirical evidence from the NAPs for the pilot phase shows that strong pressure exists to minimize the NER in order to lower the burden to the existing installations. In some Member States the size of the NER decreased significantly during the bargaining process.[129] This bargaining for the shift of burdens from existing installations to other entities essentially highlights an inherent fairness problem.

If the 'first-come, first-served' principle applies, the burden is shifted to the new entrants. If the 'replenishment approach' is to apply, the burden is shifted to the state budget and ultimately to the taxpayer.

Although there is no possibility of avoiding every uncertainty regarding the appropriate size of the NER; the following approach (taking the Dutch approach in Phase 1 NAP as a starting point) could constitute a robust and fair basis for the NER quantification:

- The NER is differentiated into two parts, the NER for 'known new entrants' and 'unknown new entrants'.
- The authority is notified of 'known new entrants' before the notification of the allocation plan. The allowances for the planed allocation to the 'known new entrants' will be presented in a list enclosed with the allocation list and must undergo the normal public participation and approval procedures.

[129] In the German NAP the NER was reduced from 5 to 3 million EUA in the bargaining process, in Spain the NER was initially planned at a size of 5.42 million EUA and ended with 2.994 million EUA.

- The size of the allowances for the ‘unknown new entrants’ must be justified in a separate chapter of the allocation plan.
- For the use of the allowances from the NER the ‘first-come, first-served’ principle should apply.

This approach should apply for the calculation of the size of the NER. For the purpose of allocation to new entrants, there should not be separate NERs for ‘known new entrants’ and ‘unknown new entrants’. The key issue of the procedure recommended above is to ensure full transparency and participation for the quantification of an appropriate NER.

4.3.6 Allocation to new entrants in subsequent phases

The analysis of options for the allocation to new entrants in the previous chapters was focussed on the phase when the new installation is put into operation. However, allocations to these new installations will change in subsequent phases, as they may no longer have the status of a new entrant after a certain phase of time, and may be defined as ‘existing installations’. If we assume a continuation of the EU ETS relying on five years phases and the deadlines given by the current EU ETS Directive, every ‘new’ installation will be subject to allocation as an existing installation after four to eight years.

If an installation is put into operation on the first day of the second year of a certain phase, it will be part of the allocation list to be notified 30 months before the start of the subsequent phase. For the phase beginning four years after the date of commissioning the installation will be treated as an existing installation. If an installation is put into operation after the deadline for notification of the NAP 30 months before the start of the subsequent phase, it will be treated as a new entrant for approximately eight years.

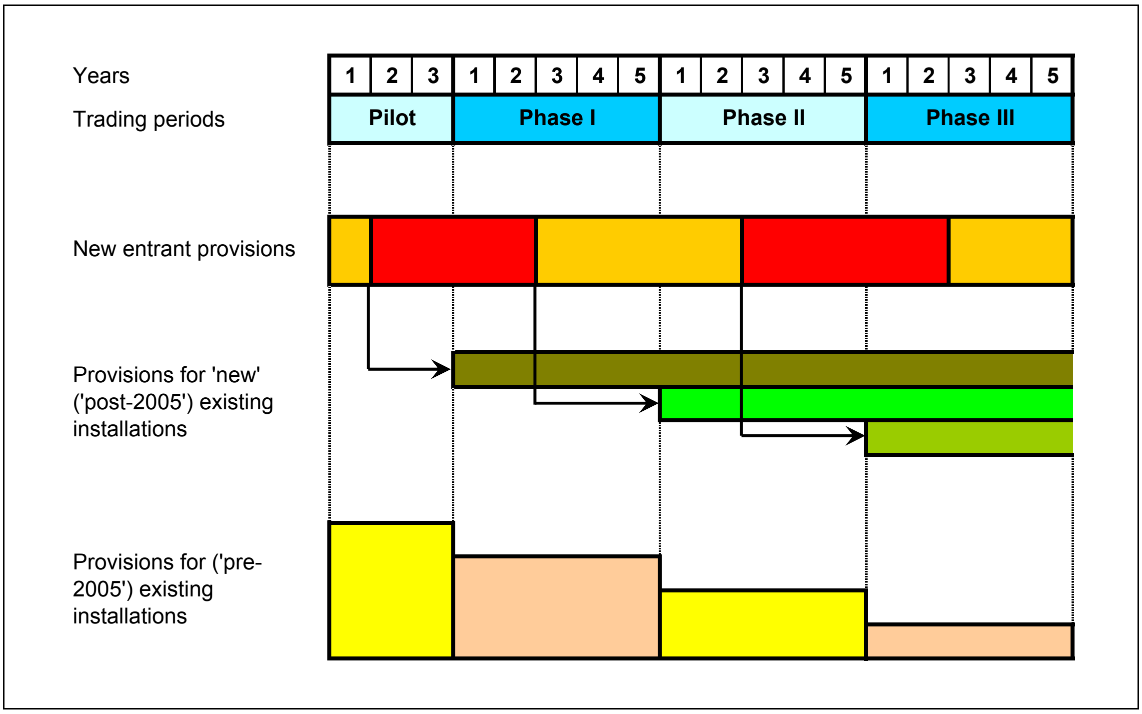
The question therefore arises of how an installation whose status as a new entrant has expired should be considered in the allocation plan. This is an issue for all installations commissioned since the beginning of 2005.

Two main approaches exist for the allocation approaches to new entrants in the first phase when these installations are considered as existing plants.

If the allocation to those installations relies on the same provisions as the existing plants put into operation before the start of the EU ETS, the incentive structures intended by the ETS could face serious problems. If we assume that the allocation provisions for existing installations will be significantly shaped by the concept of grandfathering the allocation provisions for existing installations will be more or less generous and differentiated (e.g. by fuels and major technology categories). If new entrants also receive an allocation motivated by grandfathering after a certain phase (four to eight years), the incentives set by the new entrant provisions (ranging from no free allocation to transfer provisions to ensure the incentive structure of the ETS) could largely be compensated by the newly-applied incumbent provisions for the new entrants. The treatment of new entrants based on the common provisions for existing installations in the subsequent phases could only be acceptable from the incentive point of view if the allocation provisions for existing installations would be highly incentivised in terms of carbon pricing. The allocation based on product-specific benchmarks (i.e. non fuel-specific benchmarks) would constitute a minimum requirement in this framework.

If we assume that this is not likely to happen, the new entrants ('post-2005 installations') should be allocated as a separate segment in the respective allocation plans. The allocation to these installations should rely on the same allocation scheme that was used for the allocation to new entrants in the previous phase. If there was no free allocation to new entrants, an allocation scheme comparable to a scheme for free allocation to new entrants must be set up for the subsequent trading phases. Regarding the issue of updating (for activities), the approach should match the approach for the existing installations ('pre-2005 installations'). If the existing installations are allocated under an updating approach, the base period for the activities used for the allocation to new entrants should be subject to updating for consistency reasons. If the allocation to the 'pre-2005 installations' is based on fixed base periods, the allocation to the 'post-2005 installations' should continue to rely on the activity level that was assumed for the first allocation to the new entrants.

Figure 44 – Schematic concept for the future treatment of allocation to new entrants after expiry of their new entrant status to ensure the incentive structure of the EU ETS



Source Öko-Institut

Figure 44 illustrates this concept. The common allocation provisions for existing installations ('pre-2005 installations') will be adjusted from phase to phase. The installations receiving an allocation as new entrants will form the existing ‘post-2005’ installations segment over time which is generally built on the respective new entrant provisions but could also be adjusted in the future. In a certain phase of time, the grandfathering-based allocation provisions will be phased out: The adjusted new entrant provisions will constitute the set of provisions for the ‘post-2005’ installations.

Such an approach could meet different targets: First, to ensure the intended incentive structure of the ETS (i.e. no new entrant will benefit from generous allocation to ‘pre-2005 installations’ which could significantly distort the incentive structure for new investments), second to maintain the planning reliability for investors and third, to phase out the grandfathering approach over time.

However, this kind of regulation for subsequent trading phases emerges only if the general concept of free allocation for a significant share of the allowances will remain in the longer term perspective. If other concepts are implemented after 2012 (e.g. auctioning – see Chapter 6), the issue raised here will be of less importance over time.

4.3.7 Plant closure

As previously mentioned, the issue of plant closure is often subject to heated debate. A more in-depth analysis of the problem shows several dimensions which should be differentiated carefully:

- If the operators can retain the allowances allocated to an installation that is shut down, this could be seen as a plant closure premium which is at least an intended incentive of an ETS. If the operators must return the allowances after plant closure, they will have an incentive to operate the installation longer than the optimal operation from the viewpoint of economic efficiency.
- In a partial emissions trading scheme (covering only the EU-25 and certain emissions sources), the shut down premium could cause leakage effects. Operators could shut down the installations, sell the retaining allowances und increase the operations in countries outside the EU-25 or in installations not covered by the ETS. Eventually the net emissions afterwards could be bigger than before the shut down. Nevertheless, there is not yet enough empirical evidence to prove such leakage effects will be of significant magnitude.
- If there is a free allocation to new installations, the operators of the old plants could gain additional benefits from retaining the allowances allocated to old installations und receiving some free allocation to the plants replacing the old installations. If the allocation scheme for new entrants is designed appropriately (see Chapter 4.3), efficiency problems should not arise, but some distributional and fairness problems would, from the additional burdens to other installations.
- Last but not least, there is a more moral attitude in the political arena that operators should not retain allowances allocated for free if there is no further 'need' for these allowances. One should not underestimate the dynamics of this political approach.

Furthermore, it should be pointed out that the definition of plant closure is not a trivial matter. Regarding plant closure provisions, there is no problem if the operator notifies a plant closure. However, in the real world the problem of plant closure is often much more complicated.

In many cases the old plants are not closed and are not demolished afterwards. A very common approach, especially in the power sector, is to mothball older power plants and shift them to the 'cold reserve'. There is some empirical evidence to show that it is attractive for operators to mothball power plants and to operate them for the minimum required to retain the respective licences.[130] If the operator does not notify the plant

[130] e.g., under the German clean air legislation, the licence of an installation expires if the installation has not been operated in the last three years. Some utilities operate plants from the 'cold reserve' for a couple of hours in every three year period in order to maintain the licences and assure future availability of the mothballed plants.

closure, the authorities will face major difficulties in differentiating between a real plant closure and the mothballing of plants for an unknown phase.

Some allocation provisions for existing and new installations could inherently address the plant closure problem:

- The transfer rule will incentivise the notification of plant closures and plant replacement in order to receive the permission for the transfer of allowances. Nevertheless, the transfer provision creates fairness problems and should be used with reasonable care (see Chapter 4.3.4).
- The allocation under an updating approach will gradually phase out the allocation to installations which are no longer operated. However, the updating approach is linked to other disadvantages (see Chapter 4.2.2).

In addition, the provisions for plant closure must be seen in the framework of incentives for the (early) replacement of old installations by modern plants. If the allocation to existing ('pre-2005') installations remains to be generous over time and the allocation to new entrants is more restrictive (see Chapters 4.3.2 and 4.3.3), the incentive for investments in lifetime extension could be lowered by a more generous plant closure provision.

Against this background, a combination of provisions could constitute a compromise, which should be seriously taken into account:

- The operators may retain the allowances allocated to an installation that is subject to closure for the recent trading phase. If they notify the plant closure, they will not receive an allocation for subsequent phases. This option should maintain the incentive for (early) reinvestments. If a transfer rule applies for whatever reason, this provision will probably not be applied very often.
- A transition towards an updating scheme could help in the handling of undiscovered plant closures; especially if it is also motivated by other issues (see Chapter 4.2.2.).
- If there is no strong pressure regarding a general transition to an updating scheme, the approach of selective updating with regards to the plant closure problem is worth noting as a non-preferable option compared to general updating. In this selective approach, installations that exceed a certain lifespan are subject to updating on a mandatory basis. The general incentive structure of this model is critical and must be taken into consideration. This model creates a general incentive to increase the production of older plants whereas the production of more efficient plants could be decreased. Besides the administrative costs of such a model (e.g. the precise definition of the lifespan in complex installations), its perverse incentive structures should lead to a more general updating approach.

A final option for dealing with plant closure is the use of ex-post adjustments. This should be generally excluded as a serious option because of the considerable problems ex-post adjustments create for an ETS which is generally based on ex-ante allocation as it is in the EU ETS.

If we assume that the introduction of updating will take place as a result of a few (political) reasons, we would recommend that operators retain the allowances for the respective trading phase for notified plant closures and that the issue of plant closure should be solved in a different fashion within the updating scheme.

5 Options and proposals for Phase 2 NAP

5.1 Key lessons learnt from the Phase 1 NAP analysis and the modelling exercises

The following key lessons can be drawn from the quantitative and qualitative analysis of the NAPs for the pilot phase as well as from the qualitative and quantitative analysis of future options.

1. Auctioning remains the most efficient allocation approach. All approaches based on free allocation of allowances to existing or new installations will face major problems in ensuring comprehensive and non-distorting incentive structures of the ETS (i.e. the full and comprehensive pricing of carbon). No Member State was successful in sufficiently balancing the different incentives (for existing installations, new entrants, plant closure and replacement) against each other, although some (e.g. the UK) did much better than others.
2. In liberalized and competitive electricity markets, the operators will increasingly be able to pass through the full costs of carbon to the wholesale prices, including the opportunity costs for the allowances allocated for free. The consequent windfall profits will be less significant if the allocation to existing and new installations is less generous.
3. The criterion of economic efficiency should be seen as the most important especially with regard to existing installations in the power sector. Fairness problems mostly arise for the allocation to new entrants.
4. There are strong interactions between the allocation to existing installations, the allocation to new entrants, the provisions on plant closure and the allocation in subsequent phases. The isolated assessment of single provisions could lead to counterproductive effects in the scheme as a whole. An integrated assessment should be undertaken for every provision.
5. Less generous allocation to existing installations is a crucial issue for many other provisions (from the effects from updating up to the incentives for the (early) replacement of existing installations by less emitting plants). The UK NAP constitutes the only good example in this respect under the NAPs analysed in this study.
6. The full costs of carbon create the key incentive for the operation of existing power plants and the implementation of emission abatement measures in existing plants. Ex-post adjustments eliminate these incentives (see the German example).
7. Updating is not a preferable option for future allocations in general. However, different motivations could lead to the application of updating (plant closure, avoiding a surfeit of special provisions for fast growing sectors, etc.). The problem of fixed vs. updated base periods is of less importance if the differentiation between ‘old’ existing (‘pre-2005’) installations und ‘new’ existing (‘post-

2005') installations can be maintained in subsequent phases and new installations will receive allocation based on benchmarks.

8. Under an updating scheme, the incentive for 'gaming' (i.e. increase emissions to receive a higher allocation in future phases) will remain and the incentive structure of the ETS (in other words, the economic efficiency of the ETS) will be eroded to some extent. However, the potential for 'gaming' could be limited and the incentive structures could be ensured by transition to a benchmark approach for the allocation in subsequent phases. Ideally this benchmark scheme would be based on product benchmarks but also a scheme of fuel-specific or technology-specific benchmarks for existing installations could ensure key incentives under an updating approach. A streamlining of the allocation scheme for existing installations will be of significant importance if the transition to an updating scheme is planned.

9. Any benchmark scheme for allocation should be designed as a provisional approach to maintain the phase-in of auctioning. However, complex benchmark schemes can create major distortions with respect to emission abatement measures in existing plants under an updating approach (see the example of Italy). The simpler the benchmark scheme is (e.g. product-specific benchmarks) the lower the problem of carbon price distortions will be.

10. The benchmark approach can only provide the intended incentives if the allocation by appropriate benchmarks can exceed the historic or planned emissions. Limiting the allocation by benchmarks to the level of historical or planned emission levels will eliminate important incentives under the ETS (see the Dutch example).

11. The incentive structure from the ETS for new entrants should be seen as the most important one in the medium and long-term. Compared to the incentives for existing plants, investment decisions for new installations will rely on the real costs from the ETS to a large extent.

12. The allocation provisions for new entrants should be carefully balanced against the allocation provisions for existing installations. Less generous allocation to existing installations should lead to less generous allocation provisions for new entrants and vice versa.

13. Not allowing free allocation to new entrants could ensure a comprehensive and non-distorted carbon price signal to the investment decisions. However, in the framework of a generous allocation to existing installations (as will occur in Phase 2 due to the limited auctioning allowed in this period), significant incentives will arise to invest in the lifetime extension of old plants if no allowances are provided for free to new plants. This could be partly compensated by generous provisions on plant closure, but this will create additional benefits for the incumbents, resulting in strong barriers for newcomers and fairness problems.

14. The free allocation to new entrants based on product benchmarks creates carbon price signals equivalent to the case of auctioning or no free allocation to new entrants. It will require the setting aside of a new entrants reserve.
15. The allocation to new entrants based on fuel-specific benchmarks will eliminate the intended incentive structures of the ETS to a large extent. Consequently this is not an appropriate allocation approach to new entrants. If this is the only alternative, a transfer provisions could constitute an appropriate approach. Some fairness problems will arise from the implementation of the transfer rule.
16. If there is free allocation to new entrants the allocation should be based on load factor (capacity utilisation) benchmarks rather than on plant-specific projections (see the provisions in the UK and Italy).
17. Generous plant closure provisions could ensure incentives for (early) plant replacement on the one hand. On the other hand, leakage effects could arise from generous plant closure provisions. Additionally, the incumbents will receive the major benefit from generous plant closure provisions which is seen as a fairness problem in some debates. However, fairness problems will arise in every case from the impossibility to identify all plant closures (mothballing, ‘cold reserve’). If the plant closure issue shall be addressed (probably mainly for political reasons) the transition towards an updating scheme represents the only appropriate and comprehensive approach.
18. If there is a free allocation to new entrants, a new entrants reserve (NER) will be necessary. The most appropriate way to ensure availability and fair access is to differentiate in the NER between ‘known new entrants’ and ‘unknown new entrants’. If the NER for both segments undergoes the common procedures for the allocation list and the allocation plans, an appropriate level of availability and fairness should be assumed. A NER sized in such framework should provide allowances under a ‘first-come, first-served’ approach.
19. Transparency and simplicity of the full set of allocation provisions constitute a crucial precondition for public participation as well as for the approval of allocation plans. Transparency and simplicity are cross-cutting issues to be reflected as much as possible in the allocation provisions. Public participation will be a major tool in ensuring the fairness of the allocation scheme laid down in future allocation plans.
20. The use of credits from CDM and JI deliver several advantages for the EU ETS. Given the lack of empirical evidence on the amount of credits available for use by the trading entities under the EU ETS, the use of CERs and ERUs should be more subject to observation than regulation for Phase 2. Additional regulations could be added for the subsequent phases after empirical evidence arises on effective supplementary problems under the Kyoto-Protocol. Nevertheless, measures to ensure the quality and the environmental integrity of CDM and JI projects are important, especially in the first years of the EU ETS.

It should be pointed out that these lessons learnt focus on the power sector. For some other sectors (cement, steel) other priorities could arise from an in-depth analysis. However, the power sector, as the most important emissions source under the EU ETS, will shape the allocation scheme significantly. Eventually a separate treatment of the power sector could build an appropriate approach for future allocation plans.

Last but not least, we analysed in the research presented in this report only the incentives the ETS adds to the conventional economic appraisal. The carbon pricing intended by the ETS only adds another dimension to the economic assessment undertaken by the respective entities. The results of distorted or non-distorted carbon pricing must be compared to the costs arising from emission abatement measures.

The experience from the first NAPs in some Member States underlines a key dilemma of the debate on NAPs. Often the debate is dominated by detailed estimations on the outcome of the ETS ("Does the power Plant ABC gain from the ETS?" or "If power plant XYZ can still be built under the EU ETS, the ETS does not work!"). However, the crucial issue for the further development and improvement of the EU ETS will be much more about ensuring non-distorted carbon pricing to all activities under the ETS. Incentives comparable to the reference case of auctioning constitute the yardstick for the economic efficiency of the ETS.

5.2 Best practice proposals for Phase 2 NAPs

The recent EU ETS Directive offers limited possibilities for a general revision of the allocation scheme (e.g. regarding the share of auctioning). However, we recommend the following general changes and priorities for the design of the Phase 2 NAPs.

1. Especially for the power sector auctioning of 10% of the total amount of allowances should be implemented in Phase 2 NAPs. If the power sector is able to pass through the full costs of carbon including the opportunity costs of the allowances allocated for free, the auctioning should compensate more distortions than create distortions.
2. Supplementary to a share of auctioning, the allocation provisions for existing installations should be based on the following priorities:
    a) allocation based on product-specific benchmarks and historical activities;
    b) allocation based on fuel-specific benchmarks and historical activities;
    c) allocation on historical emissions and an ambitious (low) compliance factor.
3. No ex-post provisions should be allowed, neither ex-post adjustments to the higher nor ex-post adjustments to the lower.
4. Updating of base periods used for the pilot phase could deliver additional flexibility. However, the base period for the second phase should exclude the year 2005 in order to exclude gains from 'gaming' under the EU ETS.
5. The allocation to new entrants should be built on the following priorities, reflecting economic efficiency from the dynamic perspective, and the issue of fairness:
    a) new entrants should receive a free allocation based on load factor benchmarks and product-specific benchmarks;
    b) no free allocation to new entrants could constitute an appropriate approach if the first option cannot be implemented and if the plant closure provision is comparatively generous (retain allocated allowances for the duration of the phase);
    c) if the first two approaches are not accepted for political reasons, a transfer provision should apply;
    d) free allocation to new entrants based on fuel-specific benchmarks for emissions should not be seen as an appropriate approach because the intended incentive structure will be largely eliminated.
6. At the starting point, less ambitious product benchmarks (higher than BAT for the least carbon-intensive fuels) are more acceptable for incentivising new investments if fuel-specific benchmarks can be avoided and the allocation to existing plants is comparatively generous. Nevertheless, the allocation according to

benchmarks for new installations should be continuously decreased over time as it should be for existing installations.

7. Those installations allocated under a new entrants provision during the pilot phase (Phase 1). The new entrants from the pilot phase and from the second phase should be treated differently from the ‘old’ existing (‘pre-2005’) installations in subsequent NAPs.
8. Bearing in mind that the comprehensive identification of plant closures will not be possible (mothballing, ‘cold reserve’, etc.) and that generous plant closure provisions incentivise (early) replacements of old plants, the operators should retain the allowances allocated for the duration of the phase.

In addition to these general recommendations, more country-specific recommendations are given in Chapter 5.3.

5.3 Country-specific recommendations

Summarising the analysis presented in this report and in addition to the general recommendations and the proposals for harmonisation and guidance, the following issues should be considered for the preparation of Phase 2 NAPs (at least for the power sector) in the six countries analysed in this report:

1. Germany
    - The option to auction 10% should be used for Phase 2, at least for the power sector.
    - All ex-post provisions should be removed from the different allocation provisions (see Chapter 3.3).
    - The options provision that enables operators to choose their allocation methodology should not be extended to the second phase (see Chapter 3.2).
    - The allocation to new entrants should be changed to product-specific benchmarks and load factor benchmarks.
    - Benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector).
    - The allocation to existing CHP plants should be equalised with those for equivalent separate power and heat generation (‘double benchmark’), as already used for the allocation to new entrants in Phase 1.
    - With a transition to product-specific benchmarks for the allocation to new entrants, the transfer provision could be removed. If not, the transfer provision should be maintained.
    - The long-lasting allocation commitments for new entrants without an application of compliance factors should be removed from the provisions for the Phase 2 (see Chapter 3.2).
    - The new entrants reserve should be differentiated for ‘known new entrants’ and ‘unknown new entrants’ for the purpose of its quantification during the preparation and in the public participation process. The replenishment approach should be substituted by the ‘first-come, first-served’ approach.
    - The operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.

2. Spain
    - The option to auction 10% should be used for Phase 2 at least for the power sector.
    - All allocation provisions should be documented in transparent a traceable manner.
    - The regional and technological differentiation of allocation should undergo a critical revision.
    - The allocation to new entrants should continue to rely on product-specific benchmarks.
    - Benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector).
    - The allocation to CHP plants (incumbents and new entrants) should be equalised with those for equivalent separate power and heat generation (‘double benchmark’).
    - As was already partly applied in the NAP for the pilot phase, the new entrants reserve should be differentiated for ‘known new entrants’ and ‘unknown new entrants’ for the purpose of its quantification during the preparation and in the public participation process.
    - The operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.
3. Italy
    - The option to auction 10% should be used for Phase 2, at least for the power sector.
    - Although the allocation to existing installations based on load factor benchmarks is an innovative option in general, the differentiation of load factors by fuels as well as technologies for the allocation to existing installations should undergo a critical revision. A decision should be made in favour of technology-specific load factor emission benchmarks and of removing the additional differentiation by fuels.
    - The allocation to new entrants should be changed to product-specific benchmarks and revised load factor benchmarks.
    - The new entrants reserve should be differentiated for ‘known new entrants’ and ‘unknown new entrants’ for the purpose of its quantification during the preparation and in the public participation process. The replenishment approach should be substituted by the ‘first-come, first-served’ approach.
    - The operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.

4. The Netherlands
    - The option to auction 10% should be used for Phase 2, at least for the power sector.
    - The benchmarking approach should be maintained for Phase 2 with some modifications (see below); the allocation to CHP plants should continue to rely on the allocation provisions for separate power and heat production ('double benchmark').
    - The allocation to new entrants should be changed to product-specific benchmarks and predefined load factor benchmarks.
    - New entrant benchmarks should be set at a fixed level per unit output, whatever the expected emissions from an individual installation.
    - The new entrants reserve should continue to be differentiated for 'known new entrants' and 'unknown new entrants' for the purpose of its quantification during the preparation and in the public participation process and continue to be based on a 'first-come, first-served' approach.
    - The operators should retain the allowances allocated for the duration of the phase also under the Phase 2 NAP provisions.
5. Poland
    - The option to auction 10% should be used for Phase 2, at least for the power sector.
    - The allocation to new entrants should be changed to product-specific benchmarks and load factor benchmarks.
    - Benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector).
    - With a transition towards product-specific benchmarks for the allocation to new entrants, the transfer provision could be removed. If not, the transfer provision should be maintained.
    - The allocation to CHP plants (incumbents and new entrants) should be equalised with those for equivalent power and heat generation ('double benchmark').
    - The new entrants reserve should be differentiated for 'known new entrants' and 'unknown new entrants' for the purpose of its quantification during the preparation and in the public participation process.
    - The operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.

6. United Kingdom
    - The option to auction 10% should be used for Phase 2, at least for the power sector.
    - Benchmarking based on product-specific emissions benchmarks and load factor benchmarks should be maintained for new entrants and 2003 installations in Phase 2.
    - Benchmarking should also be used for those incumbent installations where it is feasible to develop assumptions within the time frames for Phase 2 NAP (such as the power sector).
    - The differentiation of load factors differentiated by technologies should undergo a critical revision.
    - The allocation to CHP plants (incumbents and new entrants) should be equalised with those for equivalent separate power and heat generation (‘double benchmark’).
    - The new entrants reserve should be differentiated for ‘known new entrants’ and ‘unknown new entrants’ for the purpose of its quantification during the preparation and in the public participation process also in Phase 2.
    - The operators should retain the allowances allocated for the duration of the current phase even in the case of plant closure.

To some extent all recommendations mentioned above rely on the information available from the NAPs and other related documents. Furthermore, for some Member States the different provisions were not yet finally approved at the time of the research presented in this report. Much more transparency is needed in the NAPs, especially regarding the allocation provisions for Spain. Additional concerns and additional potentials for improvement could arise from more comprehensive information on the Spanish allocation provisions.

5.4 Harmonisation and guidance

In the EU level under the existing EU ETS Directive, no strong legal basis exists for the further harmonisation of the allocation provisions. Nevertheless, the following issues of harmonisation should be targeted on the EU level on a formal or informal basis by Member States:

1. Regarding the provisions for existing installations, more harmonisation on the following issues could be necessary and useful:
    a) a harmonised share of auctioning (10%), at least for the power sector;
    b) the differentiated treatment of ‘old’ (‘pre-2005) and ‘new’ (‘post-2005’) existing installations in subsequent trading phases;
    c) a harmonisation of (generous) plant closure provisions (see chapter 5.2);
    d) a strict ban on ex-post adjustments;
    e) while an EU-wide harmonisation of benchmarks for existing installations will not be a realistic option for comprehensive use in Phase 2, the harmonisation process should be started in order to prepare the allocation schemes for subsequent phases.
2. Regarding the provisions for new entrants, the following issues should be seen as high priorities for the EU-wide harmonisation:
    a) harmonized provisions for free allocation to new installations (product-specific ideally), especially harmonized benchmarks for allocation to new installations;
    b) an allocation exceeding the recent or planned demand should be allowed if the allocation is based on appropriate benchmarks;
    c) replenishment approaches for the NER should be banned and a common differentiation between ‘known new entrants’ and ‘unknown new entrants’ should be established for the purpose of its quantification during the preparation and in the public participation process; the list of planned allocations for the ‘known new entrants’ and the size of the NER for ‘unknown new entrants’ should be treated in a harmonized way under the public participation and approval procedures.
3. Regarding transparency and procedures, the following issues should be subject to further harmonisation between the Member States:
    a) the transparency and the documentation of allocation methodologies in harmonised formats should be strengthened;
    b) for all allocation provisions an assessment of incentives should be presented with a transparent and traceable approach and in a harmonised format;

c) the NER should be subject to harmonised documentation formats; the size of the NER and the underlying set of planned installations and other assumptions should be subject to the public participation and approval procedures.

The Commission will play a crucial role in the design and the approval of the NAPs in Phase 2 of the EU ETS. Although there is a restricted legal basis for interventions by the Commission, the following proposals should be taken into account.

The Commissions should *recommend* the following for the development of the NAPs for Phase 2:

- the introduction of a 10% auctioning, at least for the power sector;
- the introduction of a benchmark approach for the allocation to existing installations;
- to plan a transition to an updating scheme only if the allocation scheme for existing installations is based on a benchmark approach at the same time;
- to treat the new entrants from the pilot phase separately from the 'pre-2005' installations in the allocation plan for the second phase and to continue doing so for the subsequent phase;
- to allocate allowances for free to new entrants only, if the incentive structure of the ETS can be maintained;
- to hold the NER for 'known new entrants' separately from the NER for the 'unknown new entrants' for the purpose of its quantification during the preparation and in the public participation process.

The Commission should *demand* the following for the notification of Phase 2 NAPs:

- a clear documentation of the allocation provisions for individual installations in a harmonised format;
- the demonstration of incentives for the different allocation provisions and their interactions for existing and new entrants (probably an exercise with a standardized set of installations and a standardized set of case studies would help to present these incentive structures);
- to demonstrate that the size of a NER (if applicable) is appropriate for the foreseen demand;
- that the quantification of the NER and the assumptions and methodologies used to calculate the size of the NER was subject to the public participation process

The Commission should *consider* the following for the approval of NAPs in Phase 2:

- that only comprehensive incentives set by a non-distorted price of carbon for all activities under the ETS (operation of existing plants, investment in new plants, etc.) legitimate the administrative and transactional costs of an ETS in the medium and long-run;

- that an allocation exceeding the recent or projected demand at the level of certain installations or sub-sectors should be allowed if the allocation is based on an appropriate benchmark scheme (e.g. if CHP plants are allocated with 'double benchmarks' according to the separate power and heat production) or receives allowances in the framework of a transfer provision; however, this should not lead to an extension of the total cap;
- that ex-post adjustments should remain forbidden.

To reduce uncertainty to operators on the future development of the EU ETS, the Member States as well as the Commission should state clearly that the further development and improvements of the EU ETS beyond the time horizon of 2012 will focus more strongly the intended incentive structures of the ETS.

6 Options and recommendations for phases beyond 2012

Whereas the design of the EU ETS is restricted by the legal provisions of the EU ETS Directive, for the phases beyond 2012 much more flexibility is given than for the pilot and the second phase.[131] Three general options exist for the further development of the scheme:

- The scheme could be fundamentally renovated for allocations: the grandfathering approach could be transposed to an auctioning scheme immediately or with a transitional phase.
- The scheme could be improved on the basis of the provisions from the recent EU ETS Directive. The scheme could rely on partial auctioning and a share of continued free allocation. Probably the scheme would be streamlined and more harmonisation would take place.
- The general approach of the EU ETS could be left as is; however, instead of an allocation to installations, the allocation would be provided to the operators and no further adjustment would take place in future. The allowances allocated to the operators would be discounted in order to implement the cap development.

Since there is no in-depth evaluation from the experiences raised in the pilot and the second phase, it is too early to draft the future course that the EU ETS will take. However, some implications of the different options can be outlined for the structural aspects of the scheme.

The political framework will play an important role in the future development of the scheme. This is particularly relevant post-2012 given possible future regimes for the second commitment period of the Kyoto Protocol, and if there are strong links to the international climate regime. The development of the global climate regime could significantly influence the development of the EU ETS.

From the experience stemming from research in this report, it can be seen that the full set of allocation provisions under a grandfathering scheme leads to many distortions, inconsistencies and even some counterproductive effects. An auctioning scheme would inherently delete these problems and send out a uniform carbon price signal to all trading entities. However, distributional effects also arise under an auctioning scheme and the key question in the framework of an auctioning scheme revolves around the redistribution of the income from auctioning. Democratic societies have the means to deal with such distributional problems which arise from all taxation issues and other revenues of the state.

[131] See Ellerman et al. (2003), OECD (2002 + 2004), Stavins (2001), CCAP (2002) and Boemare/Quirion (2002) for more details.

If we assume the *transition to an auctioning scheme*, the following issues must be raised[132]:

- The auctioning scheme could be introduced immediately for the third phase of the EU ETS. Some sectors with a strong exposure to international competition will face competitive problems under a full auctioning scheme.
- Some sectors do not face such problems. In the light of the costs and feasibility concerns above, the next best approach would be to introduce auctioning gradually, starting with those sectors that are able to pass on costs, such as the power sector.
- Even the power sector will reclaim the issue of stranded assets (e.g. the impact of the ETS and allocation on the competitiveness of existing plants). Investments made before the start of the EU ETS could face economic problems. Nevertheless, if the market structure of the power sector is seriously taken into consideration, this issue should not constitute a reliable argument, even if it is to be extensively used in the political process. After a certain time, the issue of ‘old’ (‘pre-2005’) existing installations will be of less importance.

Regarding the case of an auctioning scheme, a certain transitional phase could be the only realistic approach. We recommend a two track approach:

- All allowances to the power sector should be allocated by full auctioning beginning from 2012.
- The allocation to the other sectors should rely on a phase-in of partial auctioning, e.g. 20% for the third phase (2013-2018), 30% for the forth phase (2019-2024), etc.

Without a doubt, the share of auctioning for the sectors other than the power sector will depend very much on the framework of global climate policy. If ETS is an essential part of future commitment structures, the overall phase-in of auctioning could be accelerated at a rapid rate.

It would be very speculative to lay out the structure of an auctioning scheme at the moment because of the limited experience under the recent scheme. However, the framework seems to be clear for some issues:

- If auctioning generates income for state authorities, the only place for auctioning is on the Member States level under the recent structure of the EU.
- If the revenue of auctioning goes into the state budget, the redistribution is consequently subject to the Member States which are free in their approaches on how to use the additional income. The legal EU framework on State Aid will avoid the use of measures which distort competition and create fairness problems.

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[132] See Reinaud (2003 + 2005), Oxera (2004), Mannerts/Mulder (2003) and Sijm et al. (2002) for further details.

- Decentralised auctioning at the level of Member States is also a preferable option from the viewpoint of administrative and transactional costs and transparency.
- Relying on the schedules of the recent EU ETS the auctioning could take place once a year, equivalent to the issue of allowances under the recent scheme to improve the liquidity of the market and avoid price peaks.

If some share of allowances is either allocated for free or the auctioning is located at the level of the Member States, there will also be a need for allocation plans in future; the amount of allowances available for the particular Member State will need to be established at least.

Last but not least, an auctioning approach requires elaborated provisions in order to ensure transparent and fair procedures. Without a doubt such provisions could be established in the time frame of several years. However, the introduction of auctioning under the same time pressure and with the same imperfections and delays as was the case for the pilot phase of the EU ETS, the scheme would have faced major problems in terms of transparency, non-discrimination and avoiding major distortions or price peaks.

If the introduction of auctioning is not possible or can only be implemented for certain sectors, a more *gradual evolution of the existing scheme* would move onto the agenda. Against the background of the experiences accrued up to now, some preliminary assessments and recommendations could be given:

- The continuation of an ETS which is to a significant extent reliant on grandfathering would implicitly require the transition to a benchmark scheme, if the incentive structure of the EU ETS is to be ensured.
- In the medium term, we would assume that updating will be unavoidable, given the heterogeneous structure of the sectors covered by the EU ETS. If updating is assumed, the future trading phases should not be extended to a time frame longer than 5 years in order to avoid the leverage effects of ‘gaming’.[133]
- The development of an EU-wide scheme of benchmarks would constitute a sound precondition for the continuation of a grandfathering scheme for all or part of the sectors covered by the EU ETS. A strong link between such a benchmarking scheme and the related caps would result from this. Against this background, much more harmonisation and convergence between the sector allocations between the Member States and also regarding the cap definitions would be needed in the framework of a more or less harmonised set of benchmarks for existing and new installations at the EU-level.
- All problems arising from the issues of allocation to new entrants and plant closures will remain. We refer to the analysis and the recommendations given in Chapter 5. Especially from a longer term perspective, the allocation provisions

[133] ‘Gaming’ for a few years could lead to major benefits for many years if we exclude very long base periods for practicability reasons.

for new entrants will be crucial. The future emissions will be defined by the new entrants of the coming years.

Transparency and public participation will be of special interest if the EU ETS is further developed on the grandfathering track. The only way to manage the increasing distributional conflicts in a grandfathering scheme is to ensure transparency in terms of structures, procedures and provisions as well as a full participation of all entities that have stakes in the scheme.

The implementation of the EU ETS constitutes a lock-in to a certain ETS style. Even if the probability of a very fundamental revision of the scheme is rather low for the time beyond 2012, the possibility of a transformation to other approaches should not be discarded.

The transition of the existing ETS based on allocation to installations and more short phases to an ETS of the U.S. SO_2 ETS type (allocation to operators, longer phases) is still an option for the longer term.

The last point regarding the future of the EU ETS is on the future coverage of the scheme. In this respect four dimensions should be differentiated between:

- Some adjustments of the coverage of the EU ETS should be done to streamline the recent coverage (e.g. the production of rock wool, some parts of the chemical industry).
- The exclusion of some sectors under the recent scheme is not consistent and has been already subject to political debates (e.g. the chemical and aluminium industry).
- The inclusion of additional sectors (e.g. transportation) would require a major revision of the scheme.
- The recent EU ETS is initially limited to CO_2 but also foresees the inclusion of other greenhouse gases.

The inclusion of other sectors and additional greenhouse gases must be seen against their advantages and disadvantages.

Regarding the advantages of a significant extension of the scheme, the following issues could be seen as significant[134]:

- The liquidity of the market and the number of options of emission abatement could increase from a theoretical perspective.
- Some emission sources would be kept for the first time under an instrument controlling greenhouse gas emissions (e.g. the aluminium industry, parts of the chemical industry).

[134] The extension of the scheme to sectors where the recent coverage of the ETS is obviously either inconsistent or leads to distortions (e.g. refineries, petrochemical industry) is not discussed in detail here.

However, some significant disadvantages arise in the light of the inclusion of other sectors and gases:

- The costs for monitoring, reporting and verification will increase significantly for some sectors and gases.
- The inclusion of sectors like transportation will require the combination of a downstream (control of emissions) approach with an upstream scheme (control of the carbon contents) which is theoretically possible but would not be free of problems.
- The scheme will be more complex and complicated, especially if it is not based on auctioning.
- For some point sources and some greenhouse gases (e.g. N_2O, HFCs), the leakage problem is much more significant than for CO_2 emissions from the sectors covered by the EU ETS at the moment.

Furthermore, other policies and measures and their effectiveness should be considered in comparison to the ETS. In some fields, other polices and measures exist to control greenhouse gas emissions more effectively (e.g. large point sources of N_2O, SF_6 and HFCs).

Bearing in mind that the administrative costs have lead to an intensive debate on the exclusion of some sources, the extension of the scheme should be handled with care. As a general rule the EU ETS should be mainly focussed on larger installations and large emission sources. Given the limited experiences with the existing coverage of the ETS and the related effects, much more in-depth analysis and experience is needed to enable a proper assessment of an extension of the EU ETS beyond some short time-term measures to straighten the recent coverage according to the existing inconsistencies.

Against this background the extension of the EU ETS should target those sectors that were already under discussion during the negotiation process regarding the recent EU ETS Directive (chemical industry, aluminium production).[135] All other extensions to other gases and sectors need a more profound assessment and the careful examination of experiences accrued in the coming years.

[135] see EP (2002a+b) and EP (2003a+b) for more details.

7 Conclusions

The implementation of the EU ETS is the largest experiment in environmental policy. Never before has such an environmental policy instrument been created that has a comparable coverage, both in geographical terms and with regard to the emissions.

The introduction of the scheme was determined by strong time pressure and was accompanied by manifold conflicts. Although the EU ETS is an EU-wide scheme, much flexibility was given for the implementation by the Member States.

This led to manifold implementation approaches where much stronger harmonisation and convergence will be needed in future.

The distribution of allowances to sectors and installations was seen as a pure distributional problem for a long time. However, the initial experiences of effective implementation show that some key provisions were implemented in some Member States that will decrease the economic efficiency and will create fairness problems which will have significant effects on the environmental effectiveness of the scheme in the medium and long term.

The first phase of the EU ETS was intentionally designed as a pilot phase. Indeed, in some of the NAPs, interesting approaches were developed which could be fruitful for the further improvement of the scheme. On the other hand some Member States implemented provisions which can thwart the basic principle of emissions trading, putting a price on carbon emissions based on market mechanisms.

The rating of the different provisions laid down in the NAPs of Germany, Spain, Italy, the Netherlands, Poland and the UK which we analysed in this report reveal a wide range. In general terms the rating shows comparatively diverse results. For most countries we found quite interesting and innovative approaches and for most countries we also identified more problematic ones. However, the transparency of the NAPs differs significantly. The exercise of analysing the NAPs, looking for the incentive structures of the allocation provisions in more detail and regarding their interactions, clearly shows how difficult the comparison and the assessment of the NAPs still is, apart from very general aspects (caps, obvious violation of the Directive, etc.).

The analysis against the criteria of economic efficiency, fairness, simplicity and transparency reveals that in some cases tensions exist between the different points assessed and that there will be no easy solutions (e.g. regarding the issue of transfer provisions).

From the comparative analysis carried out for the research presented in this report we can draw some main conclusions.

- Whilst an auctioning scheme will create a uniform and transparent price signal for the costs of carbon, the allocation based on grandfathering creates manifold distortions and inconsistencies. Especially for the investment in new plants in most of Member States, the incentive structure from the EU ETS was more or less eliminated.

- In the preparation process for the NAPs many provisions were discussed in isolation from one another. In some cases the net effect of different provisions led to rather surprising results and adverse effects in terms of economic efficiency and environmental effectiveness. This is especially true for Member States with a high number of different provisions and approaches. For the future development of NAPs much more attention should be paid to the interactions in the complex allocation system.
- Some interesting options were developed by the Member States which offer possibilities for streamlining of the ETS. In this regard allocation based on benchmarking could play an important role. Load factor benchmarks can help avoid installation-specific projections; allocation to CHP based on a double benchmark – for electricity and heat separately – is a way of taking into account the heat produced along with electricity.
- Although the analysis was limited to the power sector to a large extent some proposals can be drawn from the analysis of the NAPs, some more generic modelling exercises and a qualitative discussion of key provisions.
- If some provisions can be deleted from future NAPs (e.g. ex-post adjustments), the full price of carbon will incentivise the operation of existing plants. A very generous allocation to existing plants does not impede the economic incentives to change operation of existing plants but does tend to hinder the incentive for early replacement of existing installations.
- The key battleground for the Phase 2 NAP will be the design of new entrant provisions. If there is no major progress on streamlining the new entrants provisions along the carbon pricing approach (via product-specific benchmarking and auctioning), the incentive structure along with the integrity of a key part of the EU ETS will be lost. The legitimation of the ETS depends on a well-functioning incentive structure.
- Some issues are subject to more or less heated debates in the political arena, i.e. the issue of windfall profits from plant closure. A deeper analysis shows that even though generous plant closure provisions can create windfall profits, they will be more appropriate with regard to the problem of effective plant closures, thereby ensuring (early) replacement. When discussing plant closure provisions, the goal to ensure the economic and environmental effectiveness should play a greater role in comparison to the dominating assessment which mainly addresses fairness issues.
- The improvement of transparency and public participation could constitute an important corrective to the bargaining process which will, to a certain extent, also be unavoidable for future NAPs. The example of future procedures to define and verify the new entrants reserve (if applicable) is an interesting test of how effective transparency and public participation is.

- The simplicity of the allocation provisions must be of growing importance. The shortfall of many provisions in the different NAPs originates in an attitude of avoiding problems or tensions which result more from (to a greater or lesser extent) vague assumptions than from empirical evidence. Some issues (e.g. regarding the use of CERs and ERUs in the EU ETS) should be more subject to observation than to regulation, given our recent experience-based knowledge.

Outlook

The pilot phase of the EU ETS is the first step in a long way to establishing a comprehensive new approach in climate policy. We already gathered a lot of experiences from the pilot phase. However, the experiences will very much improve during the next two years. Although the second phase of the EU ETS marks an important milestone (the contribution of the ETS to the EU's compliance to the Kyoto commitments will undergo a reality check), many decisions on the design of allocation provisions will still be made in the second phase on the basis of comparably little practical experience with this policy instrument.

Against this background, the problems which were already clearly identified must be urgently addressed in the Phase 2 NAP. Furthermore, some of the key decisions must be taken for the third period of the EU ETS, starting in 2013. A lot of preparatory work is necessary already for this time horizon, even if the framework of the international climate regimes remains uncertain for the time being.

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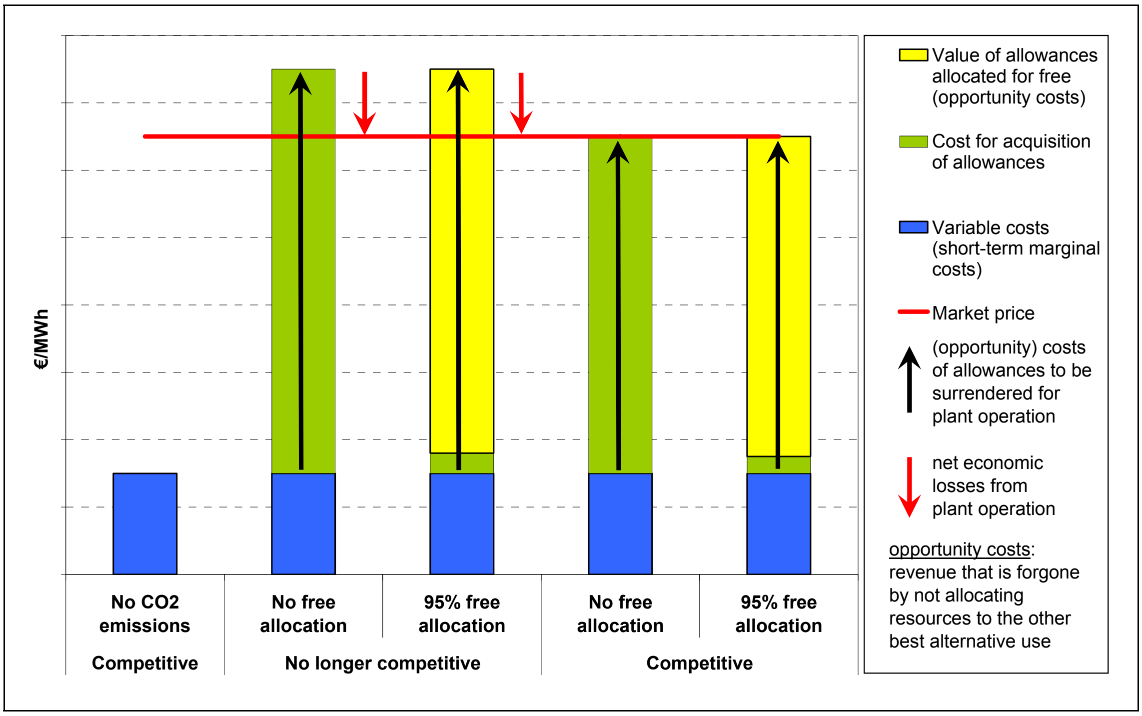
Annexes

Annex A – The role of opportunity costs

The operation of *existing* power plants depends on their short-term marginal costs. If the market price for the electricity produced is higher than the variable costs for fuel, operation and maintenance and so on, a contribution to cover the fixed costs and to create a profit will be created. Considering the fact that the fixed costs of a power plant have to be paid anyway, it is attractive to operate a plant as long as there is a contribution to the fixed costs or even to cover the sort-term marginal costs.

This general principle also applies for a power plant operated under an ETS. If no free allocation of allowances is available to the operator (e.g. in an auctioning scheme or because of production increase) the costs for the acquisition of emission allowances are part of the short-term marginal costs. If the short-marginal costs would be higher than the market price, the respective power generation would create losses and is no longer competitive. If the short-term marginal costs are less than the market price the plant would create a contribution to the fixed costs or profits and would be competitive.

Figure 45 – Competitiveness of power production and (opportunity) costs of emission allowances



Source Öko-Institut

The same situation also applies for the case in which the allowances are allocated for free. In this case the operator would have to decide to use the allowances allocated for free for the production or to generate no emissions and to sell the allowances on the market. Without a doubt, he would receive the actual market price for allowances allocated to his installation for free. Figure 46 shows an example. If 95% of the allowances are allocated for free (compliance factor 0.95) the operator would have to buy allowances on the market for 5% of the CO_2 emissions. If the sum of the short-term marginal costs (without the costs for the purchase of allowances) and the costs for the acquisition of 5% of the allowances is less than the market price, a contribution to the fixed costs or profits would be generated. However, if the difference between the market price and the short-term marginal costs (without costs for the purchase of allowances) and the costs for the acquisition of 5% of the allowances is less than the market value of the allowances allocated for free, it is more attractive for the operator to take the alternative. In this case, the production of the plant would be decreased and the allowances allocated for free could be sold on the market. The contribution to the fixed costs and profits would be higher in this case and this use of the allowances would be more attractive for the operator.

If the allowances allocated for free shall be used for the production of a plant, the revenue for the best alternative use (i.e. the sale of allowances on the market), the opportunity costs, must be examined. Consequently the opportunity costs of the allowances allocated for free must be fully taken into account as part of the short-term marginal costs defining the place of the power generation unit in the merit order.

As a result, decisions on the production of an existing plant or measures to decrease the emissions of an existing plant must be based on the full price of carbon (i.e. the sum of costs for purchase of allowances and opportunity costs of allowances allocated for free) in general. The share of allowances allocated for free does not influence this decision if no other allocation provisions (e.g. ex-post adjustments) thwart the general mechanism described above.

In contrast to decisions on the operation of existing plants for new investments, the real costs[136] for the purchase of allowances will primarily be taken into account. The fixed costs for investments cannot be seen as sunk costs as it is for existing installations only where the question arises as to what contribution to fixed costs can be obtained from the market. Opportunity costs of allowances allocated for free will play only a secondary role for new investment decisions. However, for the analysis of whether a new power plant will be competitive on the market, the opportunity costs also will be reflected.

Last but not least, if opportunity costs of allowances allocated for free are seen as part of the short-term marginal costs and price setting in competitive electricity markets depends on short-term marginal costs of electricity production the electricity prices will reflect the full costs of carbon regardless of the share of allowances allocated for free.

[136] In the case of a free allocation of 95% of the allowances, only the purchase of the missing 5% will cause the real cost.

Annex B – Treatment of combined heat and power production (CHP) plants

If the comparative analysis of CO_2 emissions of different power plants includes combined heat and power production (CHP) plants, the problem arises as to how to reflect the heat production from the CHP process. Although the total efficiency of a CHP plant is significantly higher (80 … 85 %) than the total efficiency of a condensation power plant (for gas-fired condensation power plants up to 55 %) the specific emissions of a CHP plant is significantly higher compared to those of a condensation power plant if the specific CO_2 emissions are calculated solely on the basis of electricity production.

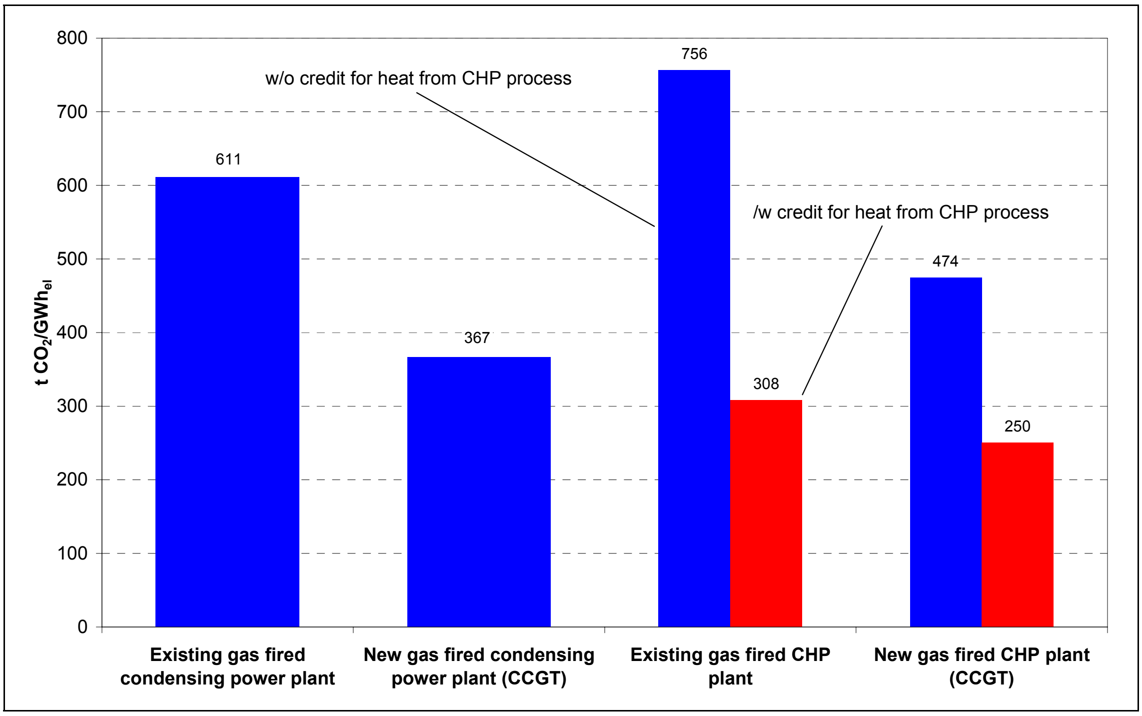
$$e_{A-i} = \frac{E_i}{A_i}$$

with

e_{A-i}	*specific emissions based on electricity production*
E_i	*emissions*
A_i	*electricity production*

Using the parameters for the gas-fired installations from the set of standardized power plants used in the research for this report (see Chapter 2) the calculation of specific CO_2 emissions leads to the results shown in Figure 46 (bars 'w/o credit for heat from CHP process').

Figure 46 – CO_2 emissions per gigawatt hour electricity production from gas-fired condensation power plants compared to CO_2 emissions from gas-fired CHP plants with and without credits for heat from the CHP process



Source *Öko-Institut*

The comparison underlines that this approach for the calculation of specific emissions is not appropriate to reflect the high efficiency of the CHP process. Against this background, the comparison of single installations should be extended to a comparison of supply systems providing the same amount of electricity and useful heat.

$$\begin{pmatrix} A_1 \\ Q_1 \end{pmatrix} = \ldots = \begin{pmatrix} A_i \\ Q_i \end{pmatrix} = \ldots = \begin{pmatrix} A_n \\ Q_n \end{pmatrix}$$

with

A_i *electricity production of the different supply systems*

Q_i *useful heat production of the different supply systems*

Considering the fact that condensation power plants supply no useful heat, it should be assumed that the respective amount of useful heat is produced by a heat boiler.

$$\begin{pmatrix} A_1 \\ k_1 \cdot Q_{ref} \end{pmatrix} = \ldots = \begin{pmatrix} A_{CHP1} \\ Q_{CHP1} + k_{CHP1} \cdot Q_{ref} \end{pmatrix} = \ldots = \begin{pmatrix} A_{CHP2} \\ Q_{CHP2} \end{pmatrix}$$

with

A_i *electricity production of supply systems 1 to n*

Q_i *useful heat production of supply systems 1 to n*

Q_{ref} *useful heat production from the heat boiler (reference installation)*

k_i *adjustment factor for the amount of useful heat supplied by the heat boiler*

and

$$k_{CHP1} = \frac{Q_{CHP2} - Q_{CHP1}}{Q_{ref}}$$

$$k_1 = \frac{Q_{CHP2}}{Q_{ref}}$$

for

$$A_1 = A_{CHP1} = A_{CHP2}$$

In this approach, it is implicitly assumed that the power production in the condensation power plant A_1 must be complemented by a heat production from a reference plant equivalent to the output of useful heat Q_{CHP2} from the CHP plant with the lowest power-to-heat ratio. If another CHP plant with a higher power-to-heat ratio is part of the comparison the useful heat production Q_{CHP1} of this plant must be complemented by heat production from the reference plant equal to the difference between the production of useful heat of the two CHP plants (Q_{CHP2} and Q_{CHP1}).

Based on this approach, the comparison of different power plants including CHP plants can be based on specific emissions related to electricity production and the use of a credit for useful heat production from the CHP process.

$$e_{A-i} = \begin{cases} \dfrac{E_i}{A_i} & for \quad \dfrac{1}{\sigma_{A-i}} = 0 \\ \dfrac{E_i}{A_i} - \dfrac{1}{\sigma_{A-i}} \cdot e_{ref-th} & for \quad \dfrac{1}{\sigma_{A-i}} > 0 \end{cases}$$

with

e_{A-i}	*specific emissions related to power production*
E_i	*emissions of the power plant*
e_{ref-th}	*specific emissions of the reference plant for heat production*
σ_{A-i}	*adjustment factor for the amount of useful heat supplied by the heat boiler*

If we assume a gas-fired heat boiler with a total efficiency of 90% as reference plant for the heat production (credit of 224 t CO_2/GWh_{th}), specific emissions for the CHP plants result which are shown in Figure 46 (bars '/w credit for heat from CHP process').

The environmental benefit of a modern CHP plant in the comparison shown in Figure 46 amounts to 58 (308-250) t CO_2/GWh_{el} compared with an old CHP plant, 117 (367-250) t CO_2/GWh_{el} compared with a new gas-fired condensation power plant (CCGT) and 361 (611-250) t CO_2/GWhel compared with an older gas-fired condensation power plant.

The specific CO_2 emissions of CHP plants using a credit for useful heat production from the CHP process can be seen as an appropriate approach to indicate the environmental benefits from the use of CHP plants.

Consequently, the CO_2 emissions from a CHP plant and the credit for useful heat production from the CHP process indicates the amount of allowances the operator of a CHP plant would have to acquire under a perfect ETS without free allocation of allowances (auctioning).

In the framework of a real-world ETS a different situation would arise for the operator of a CHP plant.

If the electricity production from a CHP plant is increased by one unit, the operator has to acquire additional allowances according to the total increase of emissions. If we assume a fixed power-to-heat ratio (e.g. in the case of a CHP plant with a backpressure turbine) the potential for the supply of additional useful heat must be guaranteed. If the additional useful heat production from the CHP plant substitutes heat production from a boiler owned by the same operator and if the boiler is also covered by the ETS the operator would benefit from the allowances no longer needed for the heat boiler. In this case, the operator of the CHP plant would receive a credit also in terms of emission allowances. If the additional useful heat from the CHP plant does not substitute heat production of a boiler owned by the same operator or if the boiler is not covered by the ETS, no credit in terms of allowances would arise.

Against this background in the research presented in this report we use the following specification:

- For the comparison with the auctioning case, we use a credit for the useful heat production from the CHP process amounting to 224 t CO_2/GWh_{th} to indicate the environmental benefit of the CHP process.
- If no other provision for CHP plants exists, we do not take into account allowance credits for the useful heat production from the CHP process which could arise from substitution of heat production in other installations.

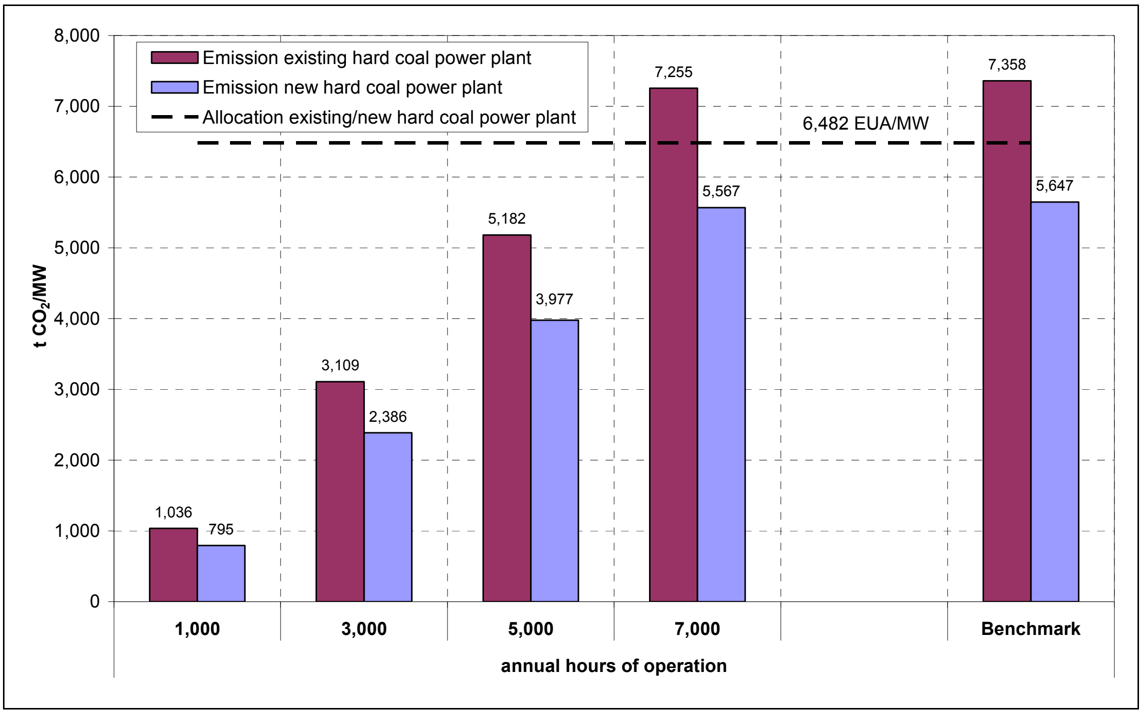
This specification is conservative but nevertheless realistic. In the case study shown in Figure 46 for a production increase of 1 GWh_{el} from the modern CHP plant the need for the additional acquisition of allowances would amount to an additional 474 EUA/GWh_{el} although the additional CO_2 emissions in the total system only amount to 250 t CO_2/GWh_{el}.

Annex C – Sensitivity analysis for allocation based on load factor benchmarks

The allocation to existing and new power plants in Italy and the allocation to new power plants in the UK are based on load factor benchmarks.[137] This means that allocation does not depend on the amount of electricity produced but on the capacity of the installation. Whether a plant is operated for the whole year round or just a few days does not alter the amount allocated. However, the hours of operation do matter when calculating the electricity production and therefore the emissions of a plant.

Thus, allocation provisions based on load factor benchmarks are especially sensitive to the parameters chosen in the standardized set of power plants. This section aims to illustrate this sensitivity. We start by looking at the allocation to Italian installations and then move on to the UK case.

Figure 47 – Allocation and emissions for different load factors for hard coal-fired power plants in Italy (related to capacity)



Source Öko-Institut calculations based on data provided by AVANZI

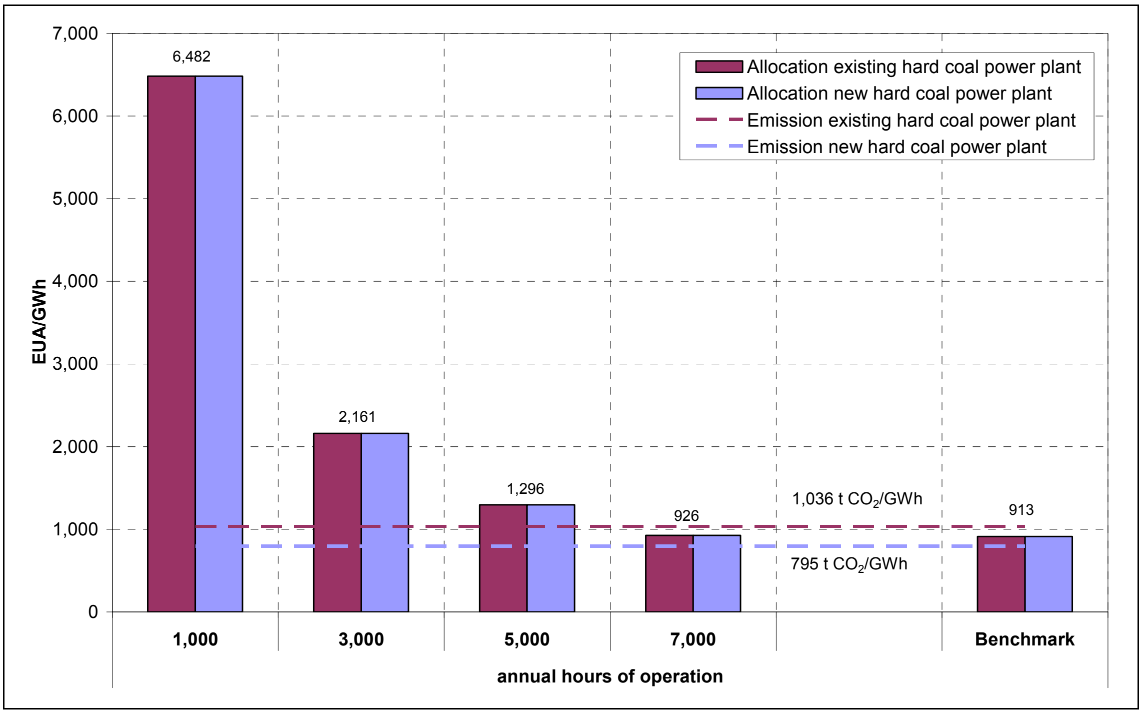
In Figure 47 we see that varying the hours of operation of a plant influences the emissions but not the allocation. The allocation per MW capacity which the standardised hard coal power plants would receive does not depend on the hours of operation (black line). In the Italian case the allocation is the same for existing and new power plants. In contrast, the emissions do rise with the increase of the hours of operation. The differ-

[137] For more details on the allocation rules based on load factor benchmarks see Chapter 3.2 for Italy as well as for the UK.

ences between the emissions of an existing hard coal power plant (red bars) and a new hard coal power plant (violet bars) is because of the higher efficiency of the new plant.

To make those figures comparable to the ones we have seen in the report so far in Figure 48 the allocation and emissions are related to the electricity production.

Figure 48 – Allocation and emissions for different load factors for hard coal-fired power plants in Italy (related to electricity production)



Source Öko-Institut

Figure 48 shows that the emissions per unit electricity produced do not depend on the hours of operation[138]; but the allocation per unit electricity does. The standardised set of plants assumes an annual operation of 5,000 hours. In contrast, the Italian benchmark value for hours of operation is set at 7,100 hours for hard coal power plants (right columns). We see that for 5,000 hours there is a surplus of allowances for both existing and new hard coal power plants.[139] Meanwhile for 7,100 hours of operation there is a sur-

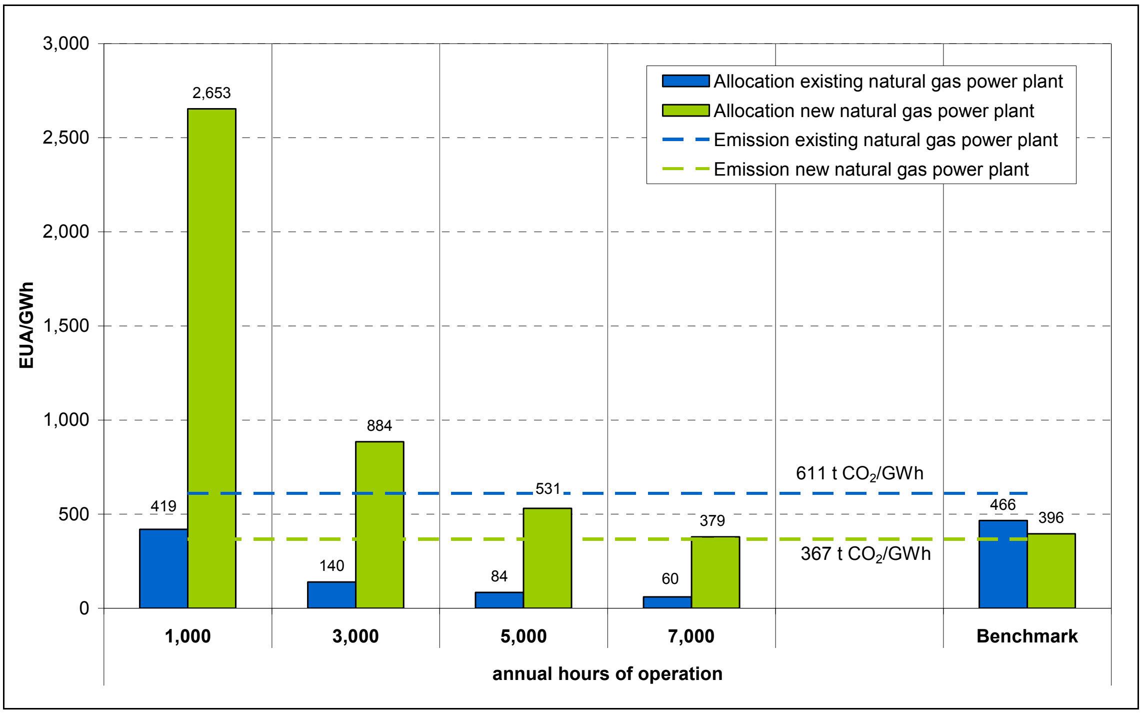
[138] The differences in the emission per gigawatt hour electricity produced between old and new hard coal power plants are due to different efficiencies assumed. For the parameters of our standardised set of power plants see Table 2.

[139] The surplus of allowances of an existing hard coal power plant with a load factor of 5,000 hours is of 260 EUA/GWh (1,296 – 1,036 = 260 EUA/GWh) and the surplus for a new hard coal power plant with a load factor of 5,000 hours is of 501 EUA/GWh (1,296 – 795 = 501 EUA/GWh).

plus only for new hard coal power plants and a shortfall for existing hard coal power plants.[140]

The amount of allowances allocated to an existing hard coal power plant for 5,000 hours of operation is of 1,296 EUA/GWh electricity production. Meanwhile the amount of allowances allocated when using the Italian benchmark load factor amounts to 913 EUA/GWh. So the difference in allowances allocated per GWh is quite significant (383 EUA/GWh) and the magnitude of this variation should be taken into account when assessing the comparative analysis of economic efficiency.

Figure 49 – Allocation and emissions for different load factors for natural gas-fired power plants in Italy



Source Öko-Institut

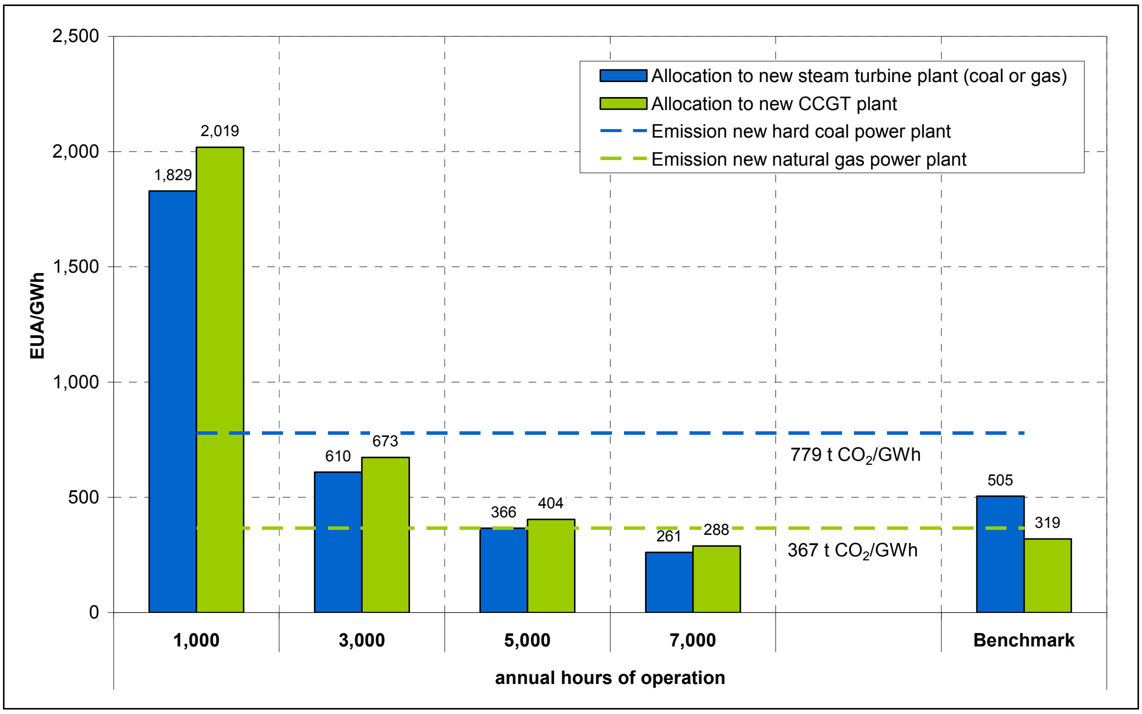
The same analysis for natural gas power plants in Italy (Figure 49) leads to similar results. In our standardised set of plants the capacity utilization is set at 5,000 hours annually while the Italian NAP assumes a capacity utilization of 6,700 hours for new gas CCGT and of 900 hours for existing gas-fired plants (steam turbine). A new natural gas power plant operated for 5,000 hours would receive an allocation of 531 EUA/GWh; whereas a natural gas CCGT operated for 6,700 hours annually (Italian benchmark) would receive only 396 EUA/GWh.

[140] The shortfall of allowances of an existing hard coal power plant with a load factor of 7,100 hours is of 123 EUA/GWh (913 – 1,036 = 123 EUA/GWh) and the surplus of allowances of a new hard coal power plant is of 118 EUA/GWh (913 – 795 = 118 EUA/GWh).

The difference is especially high for existing natural gas power plants because the benchmark load factor is very far from the load factor applied in the standardized set of plants. While an existing gas turbine with 5,000 hours of operation per year would receive an allocation of 84 EUA/GWh only, an existing gas turbine with 900 hours of operation (Italian benchmark load factor) would receive an allocation of 396 EUA/GWh, so the sensitivity to the allocation is higher than the value of the allocation itself. Instead of a significant shortfall of allowances when assuming and load factor of 5,000 hours/year, a gas-fired steam turbine would have even a slight surplus when operated only 900 hours a year.

The UK allocation is only for new installations and installations which commissioned in 2003 based on load factor benchmarks. In Figure 50 we compare the emissions and allocation per GWh for new hard coal and new natural gas power plants.

Figure 50 – Allocation and emissions for different load factors for new power plants in the UK (related to electricity production)



Source *Öko-Institut*

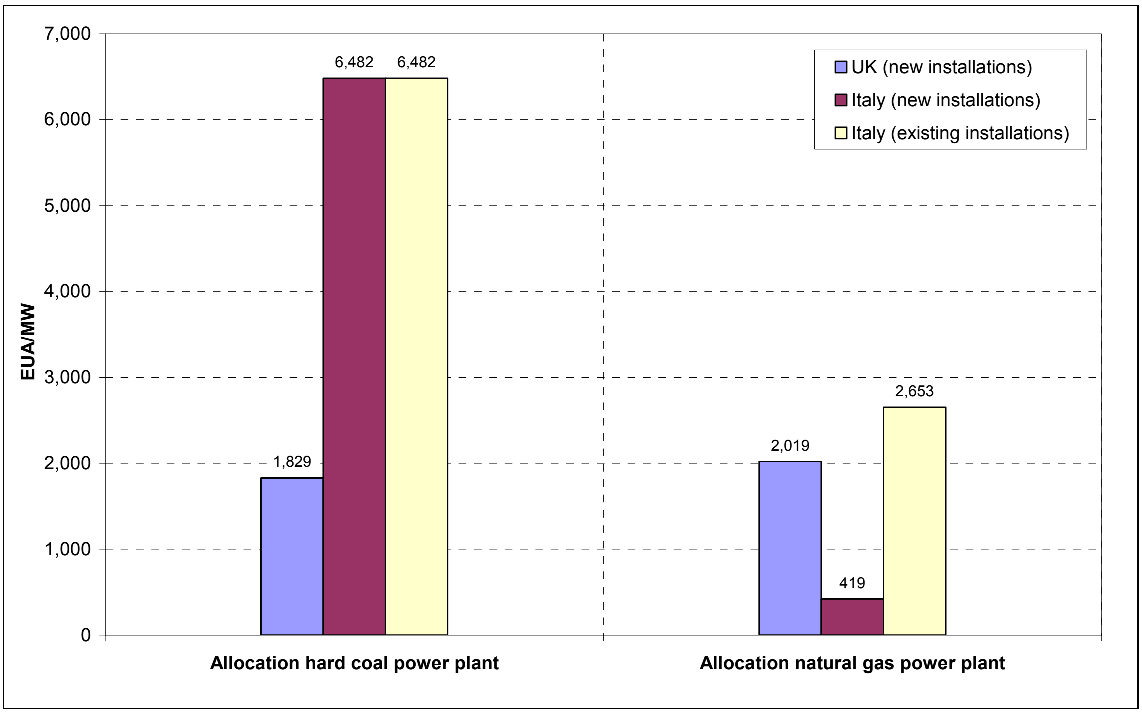
We observe in Figure 50 that there is a surplus of allowances for new natural gas power plants when operating them for 5,000 hours but a shortage when operating for 6,325 hours as assumed in the British allocation rules.[141] The allocation at 5,000 hours of operation is equal to 404 EUA/GWh; meanwhile, the allocation per gigawatt hour drops to 319 EUA if the plant is operated for 6,325 hours. For hard coal the allocation per giga-

[141] The British allocation provisions assume a capacity utilization of 72.2% of the year which corresponds to 6,325 hours.

watt hour is rather low as a capacity utilization of less than 4,000 hours is assumed;[142] this results in a shortage of allowances for all capacity utilization options over 2,500 hours.

The differences in load factor values between the two countries shape the differences in the benchmarks on a capacity basis, as we see in Figure 51.

Figure 51 – Allowances allocated to power plants per megawatt capacity in countries using load factor benchmarks



Source Öko-Institut

Figure 51 shows that the allocation per megawatt installed capacity differs hugely between Italy and the UK. The difference between the allocation to hard coal and to natural gas power plants are due to the combination of the load factor benchmark with technology-specific parameters in the UK and with technology and fuel-specific parameters in Italy. The difference between the allocation to existing and new natural gas power plants in Italy is caused by the different values of operating hours in the Italian allocation provisions[143].

In conclusion we see from the sensitivity analysis of allocation according to load factor benchmarks that the capacity utilization is a relevant parameter when assessing the shortage or surplus of allowances compared to emissions per gigawatt hour and there-

[142] The capacity utilization for steam turbines is set at 41.3% of the years which corresponds to 3,618 hours.

[143] The existing natural gas power plant in the standardized set of plants uses a steam turbine whereas the new natural gas power plant uses a CCGT.

fore also for the analysis of incentives conducted in this report. This sensitivity has to be kept in mind when using the findings of the report.

Annex D – Documentation of country-specific calculations

For the assessment of the allocation provisions we created a set of standardized installations of the power sector that enables a comparison across the countries. The methodological approach is described in Section 2.

In this Annex, we summarise the allocation data for the different installations provided by the consultancies and the date used for the quantitative analysis.

The country-specific data were provided by:

AVANZI	for Italy
ILEX	for the Netherlands and the UK
ILEX Iberia	for Spain
ESC	for Poland
Öko-Institut	for Germany

Table 28 – Allocation to the standardized set of plants in an emission trading scheme based on complete auction

Auction	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,025,455	0	0%	1,025	0	-1025
Power plant Hard Coal new entrant, newcomer independent power producer	1,967,442	0	0%	787	0	-787
Power plant Hard Coal new entrant, replacing an old hard coal power plant	1,967,442	0	0%	787	0	-787
Power plant Hard Coal new entrant, replacing an old lignite power plant	2,360,930	0	0%	787	0	-787
Power plant Natural Gas existing (initial allocation)	610,909	0	0%	611	0	-611
CCGT power plant Natural Gas new entrant, newcomer independent power producer	733,091	0	0%	367	0	-367
CCGT power plant Natural Gas new entrant, replacing an old gas power plant	733,091	0	0%	367	0	-367
CCGT power plant Natural Gas new entrant, replacing an old hard coal power plant	733,091	0	0%	367	0	-367
CHP Natural Gas existing (initial allocation)	224,000	378,000	59%	756	448	-308
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	224,000	47%	474	224	-250
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	224,000	47%	474	224	-250
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	224,000	47%	474	224	-250
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	224,000	47%	474	224	-250
Power plant Lignite existing (initial allocation)	4,407,000	0	0%	1,130	0	-1130
Power plant Lignite new entrant, newcomer independent power producer	6,250,829	0	0%	992	0	-992
Power plant Lignite new entrant, replacing an old lignite power plant	6,250,829	0	0%	992	0	-992

Table 29 – Allocation to the standardized set of plants according to German provisions

Germany	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,025,455	949,616	93%	1,025	950	-76
Power plant Hard Coal new entrant, newcomer independent power producer	1,967,442	1,875,000	95%	787	750	-37
Power plant Hard Coal new entrant, replacing an old hard coal power plant	1,967,442	2,374,041	121%	787	950	163
Power plant Hard Coal new entrant, replacing an old lignite power plant	2,360,930	3,531,702	150%	787	1,177	390
Power plant Natural Gas existing (initial allocation)	610,909	565,729	93%	611	566	-45
CCGT power plant Natural Gas new entrant, newcomer independent power producer	733,091	730,000	100%	367	365	-2
CCGT power plant Natural Gas new entrant, replacing an old gas power plant	733,091	1,131,458	154%	367	566	199
CCGT power plant Natural Gas new entrant, replacing an old hard coal power plant	733,091	1,899,233	259%	367	950	583
CHP Natural Gas existing (initial allocation)	411,000	378,000	109%	756	822	66
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	607,000	128%	474	607	133
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	727,090	153%	474	727	253
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	607,000	128%	474	607	133
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	976,616	206%	474	977	502
Power plant Lignite existing (initial allocation)	4,407,000	4,081,078	93%	1,130	1,046	-84
Power plant Lignite new entrant, newcomer independent power producer	6,250,829	4,725,000	76%	992	750	-242
Power plant Lignite new entrant, replacing an old lignite power plant	6,250,829	7,416,574	119%	992	1,177	185

Table 30 – Allocation to the standardized set of plants according to Spanish provisions

Spain	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91
Power plant Hard Coal new entrant, newcomer independent power producer	2,093,023	n/a	n/a	837	n/a	n/a
Power plant Hard Coal new entrant, replacing an old hard coal power plant	2,093,023	n/a	n/a	837	n/a	n/a
Power plant Hard Coal new entrant, replacing an old lignite power plant	2,511,628	n/a	n/a	837	n/a	n/a
Power plant Natural Gas existing (initial allocation)	610,909	390,600	64%	611	391	-220
CCGT power plant Natural Gas new entrant, newcomer independent power producer	733,091	781,200	107%	367	391	24
CCGT power plant Natural Gas new entrant, replacing an old gas power plant	733,091	781,200	107%	367	391	24
CCGT power plant Natural Gas new entrant, replacing an old hard coal power plant	733,091	781,200	107%	367	391	24
CHP Natural Gas existing (initial allocation)	368,550	378,000	98%	756	737	-19
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	462,494	98%	474	462	-12
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	462,494	98%	474	462	-12
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	462,494	98%	474	462	-12
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	462,494	98%	474	462	-12
Power plant Lignite existing (initial allocation)	4,563,000	2,280,000	50%	1,170	585	-585
Power plant Lignite new entrant, newcomer independent power producer	6,472,098	n/a	n/a	1,027	n/a	n/a
Power plant Lignite new entrant, replacing an old lignite power plant	6,472,098	n/a	n/a	1,027	n/a	n/a

Table 31 – Allocation to the standardized set of plants according to Italian provisions

Italy	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	$t\ CO_2/a$	EUA/a	%	$t\ CO_2/GWh$	EUA/GWh	EUA/GWh
Power plant Hard Coal[a] existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260
Power plant Hard Coal[b] new entrant, newcomer independent power producer	1,988,372	3,241,150	163%	795	1,296	501
Power plant Hard Coal[b] new entrant, replacing an old hard coal power plant	1,988,372	3,241,150	163%	795	1,296	501
Power plant Hard Coal[b] new entrant, replacing an old lignite power plant	n/a	n/a	n/a	n/a	n/a	n/a
Power plant Natural Gas[a] existing (initial allocation)	610,909	83,880	14%	611	84	-527
CCGT power plant Natural Gas[b] new entrant, newcomer independent power producer	733,091	1,061,280	145%	367	531	164
CCGT power plant Natural Gas[b] new entrant, replacing an old gas power plant	733,091	1,061,280	145%	367	531	164
CCGT power plant Natural Gas[b] new entrant, replacing an old hard coal power plant	733,091	1,061,280	145%	367	531	164
CHP Natural Gas existing (initial allocation)	332,721	378,000	88%	756	665	-91
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	332,876	70%	474	333	-141
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	332,876	70%	474	333	-141
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	332,876	70%	474	333	-141
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	332,876	70%	474	333	-141

[a] Load factors applied to existing installations in the Italian NAP: steam condensation (hard coal fired): 7,100h, steam condensation (natural gas fired): 900h

[b] Load factors applied to new entrants in the Italian NAP: steam condensation (hard coal fired): 7,100h, combined cycle (gas fired): 6,700 h

Table 32 – Allocation to the standardized set of plants according to Dutch provisions

Netherlands	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125
Power plant Hard Coal new entrant, newcomer independent power producer	1,988,372	1,988,372	100%	795	795	0
Power plant Hard Coal new entrant, replacing an old hard coal power plant	1,988,372	1,988,372	100%	795	795	0
Power plant Hard Coal new entrant, replacing an old lignite power plant	n/a	n/a	n/a	n/a	n/a	n/a
Power plant Natural Gas existing (initial allocation)	610,909	418,872	69%	611	419	-192
CCGT power plant Natural Gas new entrant, newcomer independent power producer	733,091	733,091	100%	367	367	0
CCGT power plant Natural Gas new entrant, replacing an old gas power plant	733,091	733,091	100%	367	367	0
CCGT power plant Natural Gas new entrant, replacing an old hard coal power plant	733,091	733,091	100%	367	367	0
CHP Natural Gas existing (initial allocation)	442,143	378,000	117%	756	884	128
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	474,353	100%	474	474	0
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	474,353	100%	474	474	0
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	474,353	100%	474	474	0
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	474,353	100%	474	474	0

Table 33 – Allocation to the standardized set of plants according to Polish provisions

Poland	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22
Power plant Hard Coal new entrant, newcomer independent power producer	1,988,372	1,888,953	95%	795	756	-40
Power plant Hard Coal new entrant, replacing an old hard coal power plant	1,988,372	2,535,205	128%	795	1,014	219
Power plant Hard Coal new entrant, replacing an old lignite power plant	2,386,047	3,665,706	154%	795	1,222	427
Power plant Natural Gas existing (initial allocation)	610,909	610,359	100%	611	610	-1
CCGT power plant Natural Gas new entrant, newcomer independent power producer	733,091	733,091	100%	367	367	0
CCGT power plant Natural Gas new entrant, replacing an old gas power plant	733,091	1,220,719	167%	367	610	244
CCGT power plant Natural Gas new entrant, replacing an old hard coal power plant	733,091	2,028,164	277%	367	1,014	648
CHP Natural Gas existing (initial allocation)	385,787	378,000	102%	756	772	16
CCGT CHP Natural Gas new entrant, newcomer independent power producer	474,353	474,353	100%	474	474	0
CCGT CHP Natural Gas new entrant, replacing an old gas CHP power plant	474,353	504,000	106%	474	504	30
CCGT CHP Natural Gas new entrant, replacing an old gas power plant	474,353	847,322	179%	474	847	373
CCGT CHP Natural Gas new entrant, replacing an old hard coal power plant	474,353	1,246,159	263%	474	1,246	772
Power plant Lignite existing (initial allocation)	4,329,000	4,235,927	98%	1,110	1,086	-24
Power plant Lignite new entrant, newcomer independent power producer	6,140,195	5,833,185	95%	975	926	-49
Power plant Lignite new entrant, replacing an old lignite power plant	6,140,195	7,697,982	125%	975	1,222	247

Table 34 – Allocation to the standardized set of plants according to UK provisions

UK	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surplus
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh
Power plant Hard Coal existing (initial allocation)	1,014,545	730,473	72%	1,015	730	-284
Power plant Hard Coal[a] new entrant, newcomer independent power producer	1,946,512	914,378	47%	779	366	-413
Power plant Hard Coal[a] new entrant, replacing an old hard coal power plant	1,946,512	914,378	47%	779	366	-413
Power plant Hard Coal new entrant, replacing an old lignite power plant	n/a	n/a	n/a	n/a	n/a	n/a
Power plant Natural Gas existing (initial allocation)	610,909	439,855	72%	611	440	-171
CCGT power plant Natural Gas[b] new entrant, newcomer independent power producer	733,091	807,784	110%	367	404	37
CCGT power plant Natural Gas[b] new entrant, replacing an old gas power plant	733,091	807,784	110%	367	404	37
CCGT power plant Natural Gas[b] new entrant, replacing an old hard coal power plant	733,091	807,784	110%	367	404	37
CHP Natural Gas existing (initial allocation)	272,160	378,000	72%	756	544	-212
CCGT CHP Natural Gas[c] new entrant, newcomer independent power producer	474,353	537,951	113%	474	538	64
CCGT CHP Natural Gas[c] new entrant, replacing an old gas CHP power plant	474,353	537,951	113%	474	538	64
CCGT CHP Natural Gas[c] new entrant, replacing an old gas power plant	474,353	537,951	113%	474	538	64
CCGT CHP Natural Gas[c] new entrant, replacing an old hard coal power plant	474,353	537,951	113%	474	538	64

[a] UK NAP benchmark assumptions for new steam turbine are: efficiency (net): 36%, load factor: 41%, emissions factor (tCO2/MWh fuel input): 0,21

[b] UK NAP benchmark assumptions for new CCGT: efficiency (net): 56%, load factor: 72%, emissions factor (tCO2/MWh fuel input): 0,21

[c] UK NAP benchmark assumptions for new CCGT CHP (>200MWe servicing mixed industrial load): efficiency (net): 45%, load factor: 77%, emissions factor (tCO2/MWh fuel input): 0,21

Table 35 – Characteristics of the replaced installtions included in the allocation exercise

	Fuel	Net Capacity	Capacity utilization	Net electric efficiency	Power-to-heat ratio
		MW	**h/a**		
New power plant replaces an:	Hard coal	500	5,000	43.0%	-
Old power plant	Hard coal	500	5,000	33.0%	-
New CCGT power plant replacing an: replaces an:	Natural gas	400	5,000	55.0%	-
Old power plant	Natural gas	400	5,000	33.0%	-
Old power plant	Hard coal	400	5,000	33.0%	-
Old power plant	Lignite	400		32.0%	-
New CHP power plant replacing an: replaces an:	Natural gas	200	5,000	42.5%	1.0
Old CHP plant	Natural gas	200	5,000	26.7%	0.5
Old power plant	Natural gas	200	5,000	33.0%	-
Old power plant	Hard coal	200	5,000	33.0%	-
Old power plant	Lignite	200	7,000	32.0%	-
New power plant replacing an: replaces an:	Lignite	900	7,000	41.0%	-
Old power plant	Lignite	900	7,000	32.0%	-

Annex E – Data of the modelling exercise on updating

Table 36 – Data for the modelling exercise on updating (efficiency improvement in an existing hard coal-fired power plant)

Efficiency improvement	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surpus	Incentive
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh	EUA/GWh
Germany							
Power plant Hard Coal existing (initial allocation)	1,025,455	949,616	93%	1,025	950	-76	
Fuel switch to gas							
Phase 2	914,595	949,616	104%	915	950	35	111
Phase 3	914,595	908,552	99%	915	909	-6	70
Phase 4	914,595	846,955	93%	915	847	-68	8
Spain							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	972,973	1,000,000	103%	973	1,000	27	118
Phase 3	972,973	956,757	98%	973	957	-16	75
Phase 4	972,973	891,892	92%	973	892	-81	10
Italy							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	924,324	1,296,460	140%	924	1,296	372	112
Phase 3	924,324	1,296,460	140%	924	1,296	372	112
Phase 4	924,324	1,296,460	140%	924	1,296	372	112
The Netherlands							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	924,324	911,009	99%	924	911	-13	112
Phase 3	924,324	911,009	99%	924	911	-13	112
Phase 4	924,324	911,009	99%	924	911	-13	112
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	924,324	1,014,082	110%	924	1,014	90	112
Phase 3	924,324	970,230	105%	924	970	46	68
Phase 4	924,324	904,451	98%	924	904	-20	2
UK							
Power plant Hard Coal existing (initial allocation)	1,014,545	730,473	72%	1,015	730	-284	
Fuel switch to gas							
Phase 2	904,865	730,473	81%	905	730	-174	110
Phase 3	904,865	698,885	77%	905	699	-206	78
Phase 4	904,865	651,503	72%	905	652	-253	31
Reference case (auction)							
Power plant Hard Coal existing (initial allocation)	1,025,455	0	0%	1,025	0	-1,025	
Fuel switch to gas							
Phase 2	914,595	0	0%	915	0	-915	111
Phase 3	914,595	0	0%	915	0	-915	111
Phase 4	914,595	0	0%	915	0	-915	111

Table 37 – Data for the modelling exercise on updating (postponed efficiency improvement in an existing hard coal-fired power plant)

Efficiency improvement (postponed)	Emission	Allocation	Allocation as share of emissions	Emission in relation to net power production	Allocation in relation to net power production	Shortfall/ Surpus	Incentive
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh	EUA/GWh
Germany							
Power plant Hard Coal existing (initial allocation)	1,025,455	949,616	93%	1,025	950	-76	
Fuel switch to gas							
Phase 2	958,939	949,616	99%	959	950	-9	67
Phase 3	914,595	949,616	104%	915	950	35	111
Phase 4	914,595	846,955	93%	915	847	-68	8
Spain							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	1,020,147	1,000,000	98%	1,020	1,000	-20	71
Phase 3	972,973	1,000,000	103%	973	1,000	27	118
Phase 4	972,973	891,892	92%	973	892	-81	10
Italy							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	969,140	1,296,460	134%	969	1,296	327	67
Phase 3	924,324	1,296,460	140%	924	1,296	372	112
Phase 4	924,324	1,296,460	140%	924	1,296	372	112
The Netherlands							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	969,140	911,009	94%	969	911	-58	67
Phase 3	924,324	911,009	99%	924	911	-13	112
Phase 4	924,324	911,009	99%	924	911	-13	112
Poland							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	969,140	1,014,082	105%	969	1,014	45	67
Phase 3	924,324	1,014,082	110%	924	1,014	90	112
Phase 4	924,324	904,451	98%	924	904	-20	2
UK							
Power plant Hard Coal existing (initial allocation)	1,014,545	730,473	72%	1,015	730	-284	
Fuel switch to gas							
Phase 2	948,737	730,473	77%	949	730	-218	66
Phase 3	904,865	730,473	81%	905	730	-174	110
Phase 4	904,865	651,503	72%	905	652	-253	31
Reference case (auction)							
Power plant Hard Coal existing (initial allocation)	1,025,455	0	0%	1,025	0	-1,025	
Fuel switch to gas							
Phase 2	958,939	0	0%	959	0	-959	67
Phase 3	914,595	0	0%	915	0	-915	111
Phase 4	914,595	0	0%	915	0	-915	111

Table 38 – Data for the modelling exercise on updating (fuel switch to gas in an existing hard coal-fired power plant)

Fuel switch to gas	**Emission**	**Allocation**	**Allocation as share of emissions**	**Emission in relation to net power production**	**Allocation in relation to net power production**	**Shortfall/ Surpus**	**Incentive**
	t CO_2/a	**EUA/a**	**%**	**t CO_2/GWh**	**EUA/GWh**	**EUA/GWh**	**EUA/GWh**
Germany							
Power plant Hard Coal existing (initial allocation)	1,025,455	949,616	93%	1,025	950	-76	
Fuel switch to gas							
Phase 2	610,909	949,616	155%	611	950	339	415
Phase 3	610,909	796,061	130%	611	796	185	261
Phase 4	610,909	565,729	93%	611	566	-45	31
Spain							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	610,909	1,000,000	164%	611	1,000	389	480
Phase 3	610,909	756,240	124%	611	756	145	236
Phase 4	610,909	390,600	64%	611	391	-220	-129
Spain (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	610,909	1,000,000	164%	611	1,000	389	480
Phase 3	610,909	574,740	94%	611	575	-36	55
Phase 4	610,909	390,600	64%	611	391	-220	-129
Italy							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	610,909	1,296,460	212%	611	1,296	686	425
Phase 3	610,909	83,880	14%	611	84	-527	-787
Phase 4	610,909	83,880	14%	611	84	-527	-787
Italy (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	610,909	1,296,460	212%	611	1,296	686	425
Phase 3	610,909	811,428	133%	611	811	201	-60
Phase 4	610,909	83,880	14%	611	84	-527	-787
The Netherlands							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	610,909	911,009	149%	611	911	300	425
Phase 3	610,909	418,872	69%	611	419	-192	-67
Phase 4	610,909	418,872	69%	611	419	-192	-67
The Netherlands (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	610,909	911,009	149%	611	911	300	425
Phase 3	610,909	714,154	117%	611	714	103	229
Phase 4	610,909	418,872	69%	611	419	-192	-67

Table 38 – continued

Fuel switch to gas	Emission	Allocation	Allocation as share of emissions	Emission	Allocation	Shortfall/ Surpus	Incentive
				in relation to net power production			
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh	EUA/GWh
Poland							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	610,909	1,014,082	166%	611	1,014	403	425
Phase 3	610,909	865,402	142%	611	865	254	277
Phase 4	610,909	610,359	100%	611	610	-1	22
Poland (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	610,909	1,014,082	166%	611	1,014	403	425
Phase 3	610,909	852,593	140%	611	853	242	264
Phase 4	610,909	610,359	100%	611	610	-1	22
UK							
Power plant Hard Coal existing (initial allocation)	1,014,545	730,473	72%	1,015	730	-284	
Fuel switch to gas							
Phase 2	610,909	730,473	120%	611	730	120	404
Phase 3	610,909	614,225	101%	611	614	3	287
Phase 4	610,909	439,855	72%	611	440	-171	113
Reference case (auction)							
Power plant Hard Coal existing (initial allocation)	1,025,455	0	0%	1,025	0	-1,025	
Fuel switch to gas							
Phase 2	610,909	0	0%	611	0	-611	415
Phase 3	610,909	0	0%	611	0	-611	415
Phase 4	610,909	0	0%	611	0	-611	415

Table 39 – Data for the modelling exercise on updating (postponed efficiency improvement in an existing hard coal-fired power plant)

Fuel switch to gas (postponed)	**Emission**	**Allocation**	**Allocation as share of emissions**	**Emission in relation to net power production**	**Allocation in relation to net power production**	**Shortfall/ Surpus**	**Incentive**
	t CO_2/a	**EUA/a**	**%**	**t CO_2/GWh**	**EUA/GWh**	**EUA/GWh**	**EUA/GWh**
Germany							
Power plant Hard Coal existing (initial allocation)	1,025,455	949,616	93%	1,025	950	-76	
Fuel switch to gas							
Phase 2	776,727	949,616	122%	777	950	173	249
Phase 3	610,909	949,616	155%	611	950	339	415
Phase 4	610,909	565,729	93%	611	566	-45	31
Spain							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	802,909	1,000,000	125%	803	1,000	197	288
Phase 3	610,909	1,000,000	164%	611	1,000	389	480
Phase 4	610,909	390,600	64%	611	391	-220	-129
Spain (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,090,909	1,000,000	92%	1,091	1,000	-91	
Fuel switch to gas							
Phase 2	802,909	1,000,000	125%	803	1,000	197	288
Phase 3	610,909	1,000,000	164%	611	1,000	389	480
Phase 4	610,909	390,600	64%	611	391	-220	-129
Italy							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	781,091	1,296,460	166%	781	1,296	515	255
Phase 3	610,909	1,296,460	212%	611	1,296	686	425
Phase 4	610,909	83,880	14%	611	84	-527	-787
Italy (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,296,460	125%	1,036	1,296	260	
Fuel switch to gas							
Phase 2	781,091	1,296,460	166%	781	1,296	515	255
Phase 3	610,909	1,296,460	212%	611	1,296	686	425
Phase 4	610,909	83,880	14%	611	84	-527	-787
The Netherlands							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	781,091	911,009	117%	781	911	130	255
Phase 3	610,909	911,009	149%	611	911	300	425
Phase 4	610,909	418,872	69%	611	419	-192	-67
The Netherlands (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	911,009	88%	1,036	911	-125	
Fuel switch to gas							
Phase 2	781,091	911,009	117%	781	911	130	255
Phase 3	610,909	911,009	149%	611	911	300	425
Phase 4	610,909	418,872	69%	611	419	-192	-67

Table 39 – continued

Fuel switch to gas (postponed)	Emission	Allocation	Allocation as share of emissions	Emission	Allocation	Shortfall/ Surpus	Incentive
				in relation to net power production			
	t CO_2/a	EUA/a	%	t CO_2/GWh	EUA/GWh	EUA/GWh	EUA/GWh
Poland							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	781,091	1,014,082	130%	781	1,014	233	255
Phase 3	610,909	1,014,082	166%	611	1,014	403	425
Phase 4	610,909	610,359	100%	611	610	-1	22
Poland (Variant - weighted allocation provisions for coal and gas)							
Power plant Hard Coal existing (initial allocation)	1,036,364	1,014,082	98%	1,036	1,014	-22	
Fuel switch to gas							
Phase 2	781,091	1,014,082	130%	781	1,014	233	255
Phase 3	610,909	1,014,082	166%	611	1,014	403	425
Phase 4	610,909	610,359	100%	611	610	-1	22
UK							
Power plant Hard Coal existing (initial allocation)	1,014,545	730,473	72%	1,015	730	-284	
Fuel switch to gas							
Phase 2	772,364	730,473	95%	772	730	-42	242
Phase 3	610,909	730,473	120%	611	730	120	404
Phase 4	610,909	439,855	72%	611	440	-171	113
Reference case (auction)							
Power plant Hard Coal existing (initial allocation)	1,025,455	0	0%	1,025	0	-1,025	
Fuel switch to gas							
Phase 2	776,727	0	0%	777	0	-777	249
Phase 3	610,909	0	0%	611	0	-611	415
Phase 4	610,909	0	0%	611	0	-611	415

Annex F – Questionnaire on structural analysis of NAPs

A Preliminary remarks

Please bear in mind that our analysis is focussed on the power sector. Nevertheless, if significant differences exist for the power sector and other industries' allocation, these aspects should be addressed.

B Initial allocation (for existing installations)

1. Initial allocation for existing installations is based on …
    a) … historic emissions, possibly other parameters as well *[please specify the general approach, formulas etc.]*
    b) … historic activities, possibly other parameters as well *[please specify the general approach, formulas etc.]*
    c) … partial auctioning *[please specify the approach, etc.]*
2. If a base period was used …
    a) … the base period (for historic emissions or activities) was: *[please specify]*
    b) … flexibility was offered …
        i) … by exception of one or more years
        ii) … by other mechanisms *[please specify]*
3. If projections were used in addition to historic emissions or activities …
    a) … installation-specific projections *[please specify methodology, parameters, verification, etc.]*
    b) … sector-specific projections *[please specify methodology, parameters, verification, etc.]*
    c) … other projections *[please specify methodology, parameters, verification, etc.]*
4. If projections were used or other flexibility options were enabled …
    a) … the increase of activities or emissions by the use of projections or other flexibility options increased the cap *[please specify]*
    b) … the increase of activities or emissions by the use of projections or other flexibility options did not increase the cap and was only used to calculate the share of a pre-defined cap *[please specify]*
5. If benchmarks were used for the initial allocation for existing installations …
    a) … the benchmark approach was *[please specify: BAT, average emissions, top runner]*

b) … the benchmarks used for the allocation …

   i) … were differentiated by products *[please specify]*

   ii) … were differentiated by processes *[i.e. fuels, please specify]*

   iii) … were differentiated by companies or installations *[please specify]*

6. If a compliance factor was used …

   a) … the compliance factor was sector-specific *[please specify]*

   b) … there was a uniform compliance factor *[please specify]*

   c) … other approaches *[please specify]*

7. If special provisions for the allocation to CHP installations applied:
   … *[please specify]*

8. If ex-post adjustments shall apply:
   … *[please specify the planned use of ex post adjustments for existing installations]*

9. If other significant provisions exist for the allocation to existing installations:
   … *[please specify]*

C Plant closure

10. If plant closure provisions shall apply …

    a) … a certain plant closure definition was used *[please specify]*

    b) … the issue of allowances will not be continued after plant closure *[please specify]*

    c) … the allowances issued to the installation for the year in which the plant was closed will be reclaimed by the authority *[please specify]*

    d) … other procedures *[please specify]*

11. If transfer of allocation is enabled from closed installations

    a) … to new entrants *[please specify the approach]*

    b) … to existing installations *[please specify the approach]*

12. If a plant closure provision will apply, how the backflow of allowances will be used?
    [please specify]

D Allocation to new entrants

13. Allocation to new entrants …
    a) … from a transfer provision (transfer from an allocation of an old installation)
    b) … is from a new entrants reserve
        i) … free of charge *[please specify]*
        ii) … by auction *[please specify]*
        iii) … other approaches *[please specify]*
    c) … is based on *[please specify the general approach, formulas etc.]*
    d) … no free allocation for new entrants
14. If benchmarks are used for the new entrants allocation …
    a) … the allocation is based on BAT benchmarks
        i) … differentiated by products *[please specify]*
        ii) … differentiated by processes *[i.e. fuels, please specify]*
        iii) … differentiated by companies or installations *[please specify]*
    b) … the allocation is based on other benchmark approaches
        i) … differentiated by products *[please specify]*
        ii) … differentiated by processes *[i.e. fuels, please specify]*
        iii) … differentiated by companies or installations *[please specify]*
15. If benchmarks are used for the new entrants allocation …
    a) … capacity use benchmarks are used *[please specify]*
    b) … installation or company-specific planning data for activity data are used *[please specify]*
16. If ex-post adjustments shall apply:
    … *[please specify the planned use of ex post adjustments for new entrants]*
17. If a new entrants reserve is used and the demand by new entrants exceeds the reserve
    a) … the 'first come, first served' principle applies
    b) … other procedures apply *[please specify]*

E 'Best practice'

The 'best practice' allocation provisions are not limited to the issues listed above.

18. *[Please specify the best provision No. 1 (from the incentive point of view)]*
19. *[Please specify the best provision No. 2 (from the incentive point of view)]*
20. *[Please specify the best provision No. 3 (from the incentive point of view)]*

F 'Worst practice'

The 'worst practice' allocation provisions are not limited to the issues listed above.

21. *[Please specify the worst provision No. 1 (from the incentive point of view)]*
22. *[Please specify the worst provision No. 2 (from the incentive point of view)]*
23. *[Please specify the worst provision No. 3 (from the incentive point of view)]*

G Allocation benchmarking

Please calculate a model allocation for the following installations (MS-Excel sheet).

The purpose of the exercise is (a) to compare allocation for incumbents across the countries and (b) to compare the allocation for new entrants compared with incumbents as well as across the countries. This analysis is not limited to installations that were allocated based on a benchmark approach! As far as possible the relevant allocation formulas should be applied to this installation. Data from the NAP allocation lists should only be used if capacity and production data are available.

24. Existing installations for all countries
    a) Hard coal-fired power plant [200 MW, 5000 h/a, 33% net efficiency]
    b) Natural gas-fired power plant [200 MW, 5000 h/a, 33% net efficiency]
    c) Natural gas-fired CHP plant [100 MW_{el}, 200 MW_{th}, 5000 h/a, 80% total efficiency]
25. Additional existing installations for Poland, Spain and Germany
    a) Lignite-fired power plant [600 MW, 6500 h/a, 36% net efficiency]
26. New entrants for all countries
    a) Hard coal-fired power plant [500 MW, 5000 h/a, 43% net efficiency] substituting a hard coal-fired power plant [500 MW, 5000 h/a, 33% net efficiency]
    b) Hard coal-fired power plant [500 MW, 5000 h/a, 43% net efficiency] owned and operated by a newcomer independent power producer on the market

c) Natural gas-fired combined cycle power plant [400 MW, 5000 h/a, 55% net efficiency] substituting a hard coal-fired power plant [400 MW, 5000 h/a, 33% net efficiency]

d) Natural gas-fired combined cycle power plant [400 MW, 5000 h/a, 55% net efficiency] substituting a natural gas-fired power plant [400 MW, 5000 h/a, 33% net efficiency]

e) Natural gas-fired combined cycle power plant [400 MW, 5000 h/a, 55% net efficiency] owned and operated by a newcomer independent power producer on the market

f) Natural gas-fired combined cycle cogeneration power plant [200 MW_{el}, 200 MW_{th}, 5000 h/a, 85% total efficiency] substituting a hard coal-fired power plant [200 MW, 5000 h/a, 33% net efficiency]

g) Natural gas-fired combined cycle cogeneration power plant [200 MW_{el}, 200 MW_{th}, 5000 h/a, 85% total efficiency] substituting a natural gas-fired power plant [200 MW, 5000 h/a, 33% net efficiency]

h) Natural gas-fired combined cycle cogeneration power plant [200 MW_{el}, 200 MW_{th}, 5000 h/a, 85% total efficiency] substituting a natural gas-fired CHP plant [200 MW_{el}, 400 MW_{th}, 5000 h/a, 80% total efficiency]

i) Natural gas-fired combined cycle cogeneration power plant [200 MW_{el}, 200 MW_{th}, 5000 h/a, 85% total efficiency] owned and operated by a newcomer independent power producer on the market

27. Additional new entrants for Poland, Spain and Germany

a) Lignite-fired power plant [900 MW, 7000 h/a, 41% net efficiency] substituting the equivalent capacity in a lignite-fired power plant [300 MW, 7000 h/a, 32% net efficiency]

b) Lignite-fired power plant [900 MW, 7000 h/a, 41% net efficiency] owned and operated by a newcomer independent power producer on the market

c) Hard coal-fired power plant [500 MW, 5000 h/a, 43% net efficiency] substituting the equivalent capacity in a lignite-fired power plant [300 MW, 7000 h/a, 32% net efficiency]

d) Natural gas-fired combined cycle power plant [400 MW, 5000 h/a, 55% net efficiency] substituting the equivalent capacity in a lignite-fired power plant [300 MW, 7000 h/a, 32% net efficiency]

e) Natural gas-fired combined cycle cogeneration power plant [200 MW_{el}, 200 MW_{th}, 5000 h/a, 85% total efficiency] substituting the equivalent capacity in a lignite-fired power plant [300 MW, 7000 h/a, 32% net efficiency]

28. Additional new entrants for Italy

a) Relevant oil-fired power plants

Table 40 – Spreadsheet for calculation of allocation

	Country		Existing power plant Fuel existing (initial allocation)	New entrant Fuel new entrant, newcomer independent power producer	New entrant Fuel new entrant, replacing an [fuel] power plant	New entrant Fuel new entrant, replacing an [fuel] power plant
	Variant No. (according to the guidelines)		option no.	option no.	option no.	option no.
Plant data	**Base data**					
	Capacity	MW	200	400	400	400
	Capacity usage					
	historic	h/a	5,000			
	projected average 2005/2007	h/a	5,000	5,000	5,000	5,000
	Net efficiency	%	33%	55%	55%	55%
	Power-to-heat ratio (CHP only)	%				
	Fuel		Fuel	Fuel	Fuel	Fuel
	CO2 emission factor	t CO2/TJ	56	56	56	56
	Historic production and CO2 emissions					
	Net power production	GWh	1,000			
	Net useful heat production (CHP only)	GWh				
	Net fuel consumtion	TJ	10,909			
	CO2 emissions	t	610,909			
		g CO2/kWh	611			
	Projected production and CO2 emissions					
	Net power production	GWh	1,000	2,000	2,000	2,000
	Net useful heat production (CHP only)	GWh				
	Net fuel consumtion	TJ	10,909	13,091	13,091	13,091
	CO2 emissions	t	610,909	733,091	733,091	733,091
		g CO2/kWh	611	367	367	367
Old plant data (if applicable)	**Base data**		Not applicable	Not applicable		
	Capacity	MW			400	400
	Capacity usage	h/a			5,000	5,000
	Net efficiency	%			33%	33%
	Power-to-heat ratio (CHP only)	%				
	Fuel				Fuel	Fuel
	CO2 emission factor	t CO2/TJ			56	94
	Historic production and CO2 emissions					
	Net power production	GWh			2,000	2,000
	Net useful heat production (CHP only)	GWh				
	Net fuel consumtion	TJ			21,818	21,818
	CO2 emissions	t			1,221,818	2,050,909
		g CO2/kWh			611	1,025
Plant allocation	**Allocation**					
	Allocation per year	EUA/a	565,728.95	730,000.00	1,131,457.91	1,899,232.92
	Short description of the calculation of allocation					
Interpretation	**Allocation as share of emissions**					
	Allocation as percentage of historic emissions	%	92.60%			
	Allocation as percentage of projected emissions	%	92.60%	99.58%	154.34%	259.07%
	Allocation in relation to net power production					
	CO2 emissions allocated (historic production)	g CO2/kWh	566			
	Deficit/Surplus of allowances (historic)	g CO2/kWh	-45			
	CO2 emissions allocated (projected production)	g CO2/kWh	566	365	566	950
	Deficit/Surplus of allowances (projected)	g CO2/kWh	-45	-2	199	583

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